80 U.S.

The Basic Computing Journal for the TRS-80

Vol. VI., No. 5 $3 per copy May, 1983

Special Peripherals Issue

Radio Shack's Model 100

- Model III I/O Ports
- Model I Eight-Channel A/D Converter
- ANOVA Program
- Astronomy on the Color Computer
- Plotters and Digitizers

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Authors: We constantly seek material from contributors. Send your material (double spaced, upper/lower case, please) and allow approximately 4 to 6 weeks for review. Programs must be supplied in machine readable form on diskette or tape, clearly marked as to model and operating system. Text files may be on diskette. Media will be returned if return postage is provided. Cartoons and photographs are welcome. Generous compensation will be made for non-trivial works which are accepted for publication. 80-U.S. Journal pays upon acceptance rather than on publication.

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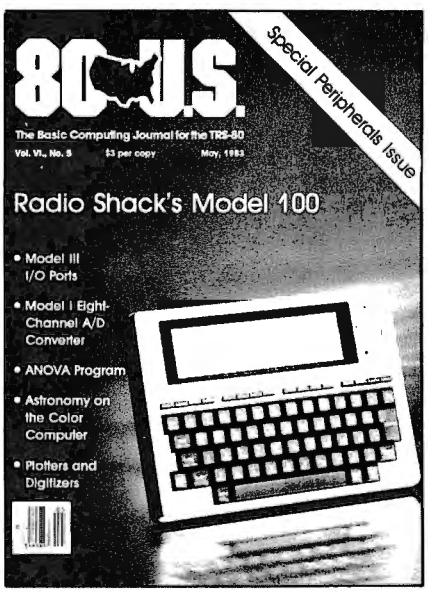

The Model 100 is the third new computer to be announced by Radio Shack this year. Photo courtesy of Radio Shack, a division of Tandy Corp., Fort Worth, Texas.

80-U.S.

The Basic Computing Journal for the TRS-80

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	PRODUCER	JR.	QUICKPRO	CREATOR
FEATURES OF THE FINISHED BASIC PROGRAM				
Full Screen Oriented Input of All Fields	YES	YES	NO	NO
Edit without Retyping with insert & delete	YES	YES	NO	NO
Restrict field Length automatically	YES	YES	YES	NO
Unlimited Restriction choice for each field	YES	YES	NO	NO
User defined Custom Prompts for each Field	YES	YES	NO	NO
Full Speed Typing in ALL Fields	YES	YES	NO	YES
Immediate Exit from Any Field to Menu	YES	YES	NO	YES
Enter Fields from last Record automatically	YES	YES	NO	NO
Fast BTREE File Structure (No Sort Needed)	YES	YES	NO	NO
Find Record with Part of a Key	YES	YES	NO	NO
Hi-Speed Global Search for ANY Field in a Record	YES	YES	NO	NO
Duplicate Keys and Multiple Keys Supported	YES	YES	limited	NO
Global Field Replacement Function	YES	YES	NO	NO
Run Predefined Reports from Finished Program	YES	YES	NO	NO
Select Reports from Menu in Finished Program	YES	YES	NO	NO
Sort (machine language) ANY Field-Free	YES	NO	NO	NO
Custom Mailing Labels Option (any Size)	YES	NO	NO	NO
Do Calculations on fields in Program	YES	NO	NO	NO
Sell Finished Program with No Royalty	YES	YES	YES	NO
PRODUCER CAPABILITIES & FEATURES				
Toll Free Question Line	YES	YES	NO	NO
Create PROFESSIONAL Finished Program	YES	YES	NO	NO
Modify Program without Starting Over	YES	YES	NO	NO
Ease of Use, including Complete TUTORIAL	YES	NO	NO	NO
Number of Calculations allowed per field	8	8	1	0
Use Field Names for Calculations	YES	NO	NO	NO
Use ALL Math Functions in Calculations	YES	NO	NO	NO
Generates a BASIC Program	YES	YES	YES	YES
Custom Design exact Screen YOU desire	YES	YES	NO	NO
Full Feature Screen Generator (graphics)	YES	NO	NO	NO
Easy Report Generation with Any Restrictions	YES	NO	NO	NO
Complete & Thorough DOCUMENTATION	YES	YES	limited	NO
Detailed Quick Reference Materials	YES	YES	NO	NO
Audio Cassette Tutorial Available	YES	NO	NO	NO
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For an independent product review of the PRODUCER see page 62 of March issue of 80 Micro

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Editorial

Robert Perez, Circulation Manager

Despite what some people may think, the title next to my name does not mean that I am the one whose job it is to send you junk mail, nor the one who is in charge of losing your monthly copy of your favorite magazine. I manage to do those in my spare time, but my main function is keeping subscribers happy. Besides replacing lost copies, handling address changes, or making sure you receive your renewal notice in time so you won't miss the second part of that important article, a circulation manager's hands are tied.

This special issue on peripherals provides a unique opportunity for me. Not many people in my place get the chance to offer advice to their customers on how to get more out of their magazine. If you have been a subscriber to *80-U.S.* for any length of time, you should have already realized that *80-U.S.* is the most important peripheral to your TRS-80 that you have ever purchased.

For an initial investment of $16, you have purchased a twelve-volume reference library, complete with monthly updates and a year-end index. Sure, most of you are using at least some of the programs in each issue. How many of you are incorporating the programming techniques of them into your own programs? Are you going back to the programming tutorials every month and brushing up or are you like the rest of us and assume that you don't need it? When you purchased your modem, did you consult the extensive modem and terminal comparisons in the November 1982 issue? We offer a free bulletin board service to our subscribers wherein they may list single or unusual items for sale or trade. Did you price a used printer before you bought that $2000 dot-matrix printer?

Ideally, every copy of *80-U.S.* should be sitting next to your computer. Perhaps you have gone to the trouble of pulling the indices to the hundreds of articles we have published over the past four years and posted them on the wall for quick reference. A system as simple as that is not only a very effective reference library; it is also an important consumer buying guide. I am sure that more than one person has saved some money simply by shopping around in *80-U.S.* Our "For Immediate Release" and "Review" sections are designed especially for the computer consumer.

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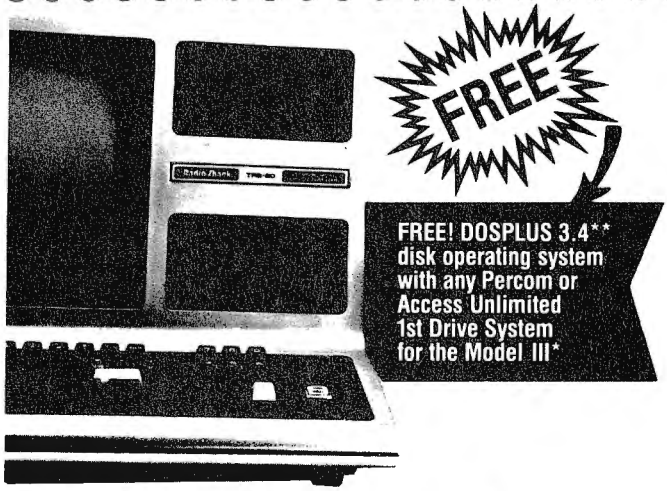

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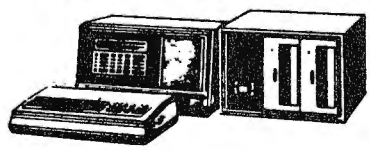

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Letters to the editor

Cameron C. Brown, Editor

Your February copy is so full of information that I had to use yellow, pink, and green hi-light pens all over the pages. You also left me with more questions. On page 17, who sells a copy of VisiCalc with "IF" for the Model I? Please give a comparison between Electric Notebook and dBase II. On page 48, how can a Pascal program on TRSDOS disk be read by an Apple under DOS 3.3? Where and how much is BASIC/S (page 62)?

Special thanks to James A. Conrad. How about more on DEF FN as strings and using it for input checking? Thanks to John Harding for the word Molimerx. Can we use it from now on? Being computer literate is one thing, but a Latin scholar?

Eddie Sung
Vancouver, B.C. Canada

The enhanced version of VisiCalc is sold by Radio Shack only for the Model III. Operating systems besides TRSDOS such as NEWDOS/80 from Apparat and LDOS from Logical Systems have patches to run enhanced VisiCalc on a Model I. The Electric Notebook relational database manager system from Allen Gelder Software was so different in structure from the others we discussed, we have chosen it for a complete evaluation. Our initial reports give it high praise. Look for the report soon. Mr. Renne was referring to language compatibility, not diskette compatibility. Telecommunication will get the program from your TRS-80 to an Apple. If the program uses a standard Pascal, it should run on both machines. More on DEF FN is in the works for Basically BASIC.

We dropped the ball on the BASIC/S report. It is from Powersoft, 11500 Stemmons Fwy, Dallas, TX 75229, and sells for $89.95. --Ed.

In Tom Quindry's excellent overview of the debugging process, Basic Bits March 1983, I noticed an instruction which might be a bit ambiguous. He stated, "The downarrow can be used quite effectively while programming. At the end of a subset of program lines defining a routine, enter the downarrow. This will provide you with an extra line between that line and the next. It only costs one byte each time you use it. You might use a colon preceding it if you want to LLIST it. This depends on your printer's characteristics."

Well, there might be a problem. If the subset involves a DATA statement, you should precede your downarrow with both a colon and a REM or ' sign. Else the DATA instruction will include a video

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screen linefeed where none is intended. I spent a lot of time with a word-play program that randomly selected words from DATA statements. Consequently, I'd get what almost appeared to be a random linefeed. It took considerable debugging until I noticed the pattern and protected my DATA statements from the downarrow instruction.

Ted Byne
South Hadley, MA

I contacted your magazine after finding out that the Model I drive 0 was no longer available through Radio Shack. One of the salesmen recommended that I contact your magazine to inquire where I might purchase a suitable substitute.

One of your staff explained that drive 0 had a resistor installed that is not used on the other drives. He also recommended several companies that I should contact. It was a pleasure talking to someone who speaks the "language", something that Radio Shack salesmen could be more proficient in.

Joseph B. McCarthy
Steilacoom, WA

We were lucky on this one. A few years ago we found out that running a drive 1 on the 0 position had no effect only because we didn't know that you shouldn't. The terminating resistor should be doing something, but we never had any problems. --Ed.

I recently bought the program Poltergeist for the Color Computer. It is the best game that I own. The only problem is when you lose a man, you are sent back to screen one, even if you died in screen two or three. This is very discouraging and the first screen gets quite boring. My brother Mike, an avid game player, discovered a simple way to combat this. While playing in screen one, hold down the fire button. This prevents the cars from coming out, thus allowing you to concentrate on the second and third screens. I hope this helps your readers.

Kari Hogan
Cedar Falls, IA

Thank you. --Ed.

I want to compliment Tim Chandler for his fine article and program, Crypto, in the February issue. Some quotation marks were left out at the ends of lines 860 and 870. Also, with Model III TRSDOS it is simple to print the directory. Remove lines 920 to 1090 inclusive. Add line 920 CMD "D:0". The directory for drive 0 will be listed on the screen.

A. Watson
Park Ridge, IL

I very much enjoyed the article, "Recipes for making pi" by Alan Mandell in the January issue. One of the beauties of a small microcomputer is that it can provide very graphic demonstrations of the difference between slowly and rapidly converging algorithms. Unfortunately, the demonstration is marred a bit since the program in listing 3 achieves an accuracy of only eight decimals. This is in spite of the use of double precision. Since the algorithm converges rapidly, it should be accurate.

The trouble is that the program uses the BASIC square root and exponentiation functions and these provide only single precision results...the listing below shows an alternative program based upon the same algorithm. In line 300, we use two stages of Newton's Method to refine the single precision square root. We compute powers of three by repeated multiplication within the loop at line 380...the routine reaches a steady state at step 29 and is accurate to one unit in the 15th decimal place.

```
240 LPRINT TAB(20);
260 LPRINT " K PI":PRINT
280 DEFDBL B,R,S
300 R3 = SQR(3): R3 = (R3+3/R3)/2:
R3 = (R3+3/R3)/2
320 K=0: A=1: B=1: S=1
340 Q=K/5: IF Q = INT(Q+.01)
THEN 440
360 PRINT K;TAB(5);S;TAB(30);
6*S/R3
380 A=A+2: B=-B*3: K=K+1:
S=S+1D0/(A*B)
400 A$=INKEY$: IF A$="" THEN
400
420 GOTO 340
440 LPRINT TAB(20);
460 LPRINT USING "###
###.################"; K, 6*S/R3
480 GOTO 360
```

Warren D. White
Northport, NY

I am fairly new to the computer world but have become addicted. I own a 16K TRS-80 Model III and LP VIII. I live in Switzerland and have bought my equipment here. I plan to update my computer to 48K with 2 disks and RS-232. I am an American and plan to return to the States at sometime. Can my equipment be modified, when I bring it to America, to run on 110 AC voltage (we have 220 AC)? What do the modifications cost?

Second, when I turn on the powerstrip the printer head traverses the length of the roller and back and then as soon as "Cass?" appears on the video screen an "E" is printed. If I turn on the printer first, and then the computer, three E's are printed. Is this normal or can it be prevented?

Is there a way to disconnect or

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suppress the out-of-paper switch to the printer? It is situated too far back and when using single sheets of 8.5 X 11 inch typing paper, the printer stops printing before the page is full.

Patrick R. Berry
Zurich, Switzerland

We have had other requests about 110 to 220 conversion and now yours about 220 back to 110. It is our understanding that the problem is in the cycling (60 cycle here, 50 cycle in Europe) and not the voltage. Only one article has come in on this problem, and it was mentioned only in passing. As soon as we hear from someone who has done it, we will print it.

The printer head movement on power-up is new to us. Our LP VIII behaves just fine, but we think the problem of the E's lies in your computer or cable and not the printer. You can easily default the paper-out signal by forcing down the micro-switch on the back left, behind the platen. But, be careful or else you may lose a print head by having it impact directly on the platen when you really are out of paper.

I use the ESF patched version of Scripsit and I find it very useful with my Exatron 64K keyboard mod. The only problem is that the print codes for the Epson cannot be sent out under Scripsit. Andrew Donald from the U.K. National TRS-80 users group wrote the following patch. It allows the codes to be sent out at the beginning of a line.

It modifies the error trap. Scripsit picks up the ">" symbol and expects to find a legal parameter to format the printout. If the command is not recognized, it jumps to an error routine. This patch intercepts the error and if it is one of the codes listed, it will send it to the printer.

On elaborate printouts, I find that certain codes need to be cancelled at the end of the text. The patch uses two types of code; "PP" which adds <ESC> and "PS" which does not. The modification to the error routine may cause it not to flag all the errors correctly, but apart from that, it has worked well.

ESF Scripsit Patch for Epson:

First load the ESF-80 monitor. Relocate it to F100H. Type 'Z' and return to BASIC. @LOAD the ESF patched Scripsit with one of the shift keys held down to prevent it from auto-starting. Type SYSTEM <ENTER> and /61696 to return to the ESF-80 monitor. Enter the patch using the 'M' command, starting at location 6CA6H (patches listed below). When complete, modify locations 66E1 and 66E2 to A6H and 6CH. Use the 'W' command to save the result as follows: W X,4300, 6CFC,53F2. (X = the file number).

The tape should now contain the patched version of Scripsit. The figures given for the relocation of the ESF-80 monitor apply to a 48K machine, the manual gives the figures for 16 and 32K machines. Here is the hex dump of the relocated patch:

```
6CA6    FE 53 28 05 FE 50 C2 2C 65
47 13 1A FE 3D 20 F6
6CB6    CD E0 6C 87 87 87 87 4F
CD E0 6C B1 4F 78 FE 53
6CC6    28 05 3E 1B CD D3 6C 79
CD D3 6C 13 C9 F5 3A E8
6CD6    37 CB 7F 20 F9 F1 32 E8 37
C9 13 1A FE 30 38 13
6CE6    EE 3A 30 03 E6 0F C9 FE
41 38 08 FE 47 30 04 DE
6CF6    06 18 F1 C3 2C 65
```

Type size affects positioning and it is good practice to cancel commands after their use. To use the patch, the codes are: emphasized PP=45, cancel emphasized PP=46, double-strike PP=47, cancel double-strike PP=48, wide PS=0E, cancel wide PS=12, condensed PS=0F, cancel condensed PS=12, condensed /wide PS=0E PS=0F, condensed double-strike PS=0F PP=47, cancel condensed double-strike PS=12 PP=48.

Derek Trayler
Hornchurch, Essex, England

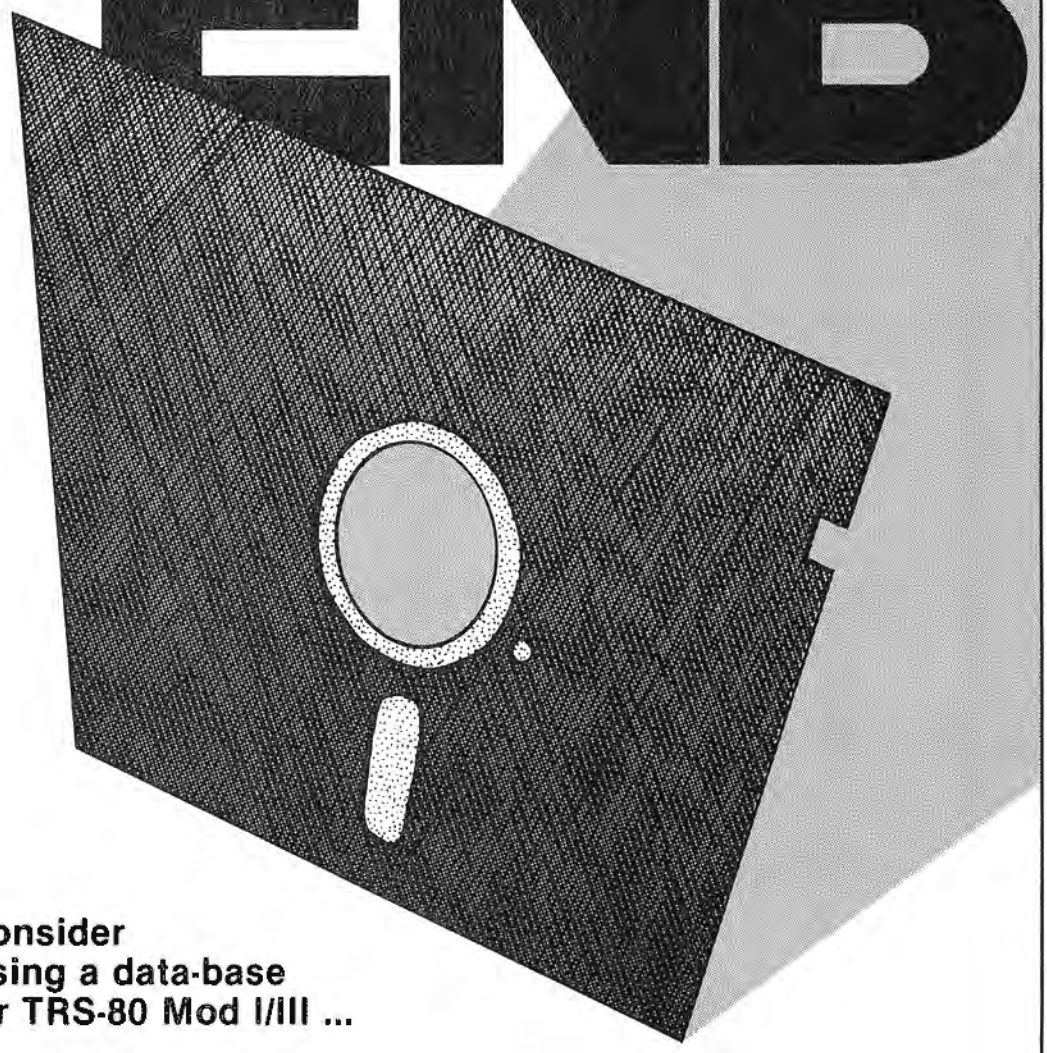
The February issue in color and a wrapper! Please note that this care (and expense) is appreciated. The magazine arrived in mint condition.

Now that you have a brown-paper wrapper, will you enter the "adult" publishing field? X-rated DOS patches? "Graphic" hardware modifications?

Lawrence Charters
Bremerton, WA

No comment. -Ed.

ENB



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Notes, etc.

Cameron C. Brown, Editor

The volume of correspondence has been overwhelming. It is clear that you are active computerists and do read *80-U.S. Journal* carefully. We appreciate the input, enjoy the praise, and love to pass on the tidbits you share with us.

Mr. Wayne King from New York, NY, responded to the article by Charles Edwards, *File copy utility*, January 1983, in which he asked if there was a way to CLEAR more than 32767 bytes for string space. According to Mr. King, he went through the same experience when he first upgraded to 48K. Since his Stringy Floppy operating system only used four bytes, he wanted to clear a large amount of string space for a BASIC word processing program. The following program will do it:

```
10 REM HOW TO CLEAR MORE THAN 32767 FOR
STRING SPACE
20 CLS: CLEAR 0: PRINT "AVAILABLE MEMORY
="MEM: INPUT "HOW MUCH STRING SPACE";X:
IF X>MEM-100 OR X<1 THEN 20
30 IF X<32767 THEN CLEAR X: GOTO 50
40 X = (PEEK(16561) + 256*PEEK(16562)) - X: POKE
16544,X AND 255: POKE 16545,X/256: CLEAR
50 PRINT: PRINT " STRING SPACE =" FRE(""):
PRINT "AVAILABLE MEMORY =" MEM: PRINT:
PRINT "PRESS KEY"
60 FOR X = 0 TO -1 STEP 0: X = (INKEY$ <> ""):
NEXT
70 GOTO 20
```

He also noted that Mr. Parrish's letter (Jan. 83) on restoring a NEWed program (POKE 17130,1: SYSTEM /11395) will allow for @SAVE to a Stringy Floppy wafer! When the program is reloaded it runs perfectly.

We were sent a sample of a rather extensive index to *80-U.S. Journal* that is being sold by Gary Diillio of COMP-AID, 1109 Madison Ave., Prospect Park, PA 19076. He is marketing the paper-bound index for $8.00 including shipping and handling. It is cross-referenced and does a better job than what we could include in our own annual index. For those of you looking for a quicker way to reference your *80-U.S. Journal* library, it should do the trick.

Corrections

Some readers have reported that the Color Computer Assembler/Disassembler program, September 1982, by Richard Tangeman would not work. Others have said it was fine. The command PCLEAR3 may not be possible on some Color Computer board versions. Our 32K Color Computer has a revised E board, and the program worked. If your Color Computer will not PCLEAR below its initial or default value (four), then the listing will give a syntax error in line 5; even though the program works. If you leave out the PCLEAR3 command, line 35 may result in a syntax error. Some Color Computer boards can be set to a lower PCLEAR value by sequentially performing, while in command mode, PCLEAR8: PCLEAR7: PCLEAR6: ... and so on, down to PCLEAR3.

The Color Computer Compiler program in the March 1983 issue has also drawn comment. The version we printed did work on our machine when it was 16K with a D board. Again, the problem may lie in the PCLEAR sequence. We can't seem to clarify the Color Computer problems. Please send us a letter if you have any firm information about board compatibility and program execution problems.

Basicmon, a Color Computer monitor program that we published in February 1983 could use a slight cosmetic change. In line 420, remove the TAB(7) so that the video output will correctly line up the hex and ASCII equivalents.

We incorrectly titled a table in the March 1983 article on Color Computer Conversions by Stephen Stone. Table 2 shows the special Model III characters, not Color Computer characters as it was labeled. For those of you who wondered why you never saw such characters on your Color Computer before it's because they don't exist.

Datex, March 1983, by Paul Emmons had some missing linefeeds in lines 10 and 915. Our attempt at typeset listings resulted in, as Mr. Emmons so kindly pointed out, the menus being reduced to mincemeat. A linefeed (downarrow) is represented by a "(LF)" in the code that follows. The correct lines are:

```
10 IF R THEN L=1:GOSUB 70:P=0:CLS:PRINT,"
Record selection(LF)
K Keep present group"," A use A11(LF)
F Find"," X no find(LF)
```

R Record no.",," C Complement":GOSUB 864 ELSE 870
and line 915 should be:
915 U=1:D(0)=CHR$(1):CLS:PRINT R " records full",LR-R" empty(LF)
(LF)
A Add",G(1)," L Load file(LF)
E Edit",G(2)," W Write file(LF)
D Display",G(3)," I Inform",G(9)"(LF)
P LPrint",G(4)," O Other(LF)
K Kill",," / Set option(LF)
S Sort",," Q Quit"

He went on note that there is an undocumented feature of the Edit command. A field can not only be (K)eyed or e(X)tended, but (E)dited by giving an old substring and a new one to replace it. Listing 5 may need some more explanation. It was a representative example of mergeable routines that a user might write for a special purpose. It finds duplicates in a field which should contain consecutive integers. It creates a selection group, like the search, accessible by responding to search with the "Keep" option. Readers with problems or questions on the Datex program can reach Mr. Emmons at the address given in line 1 of Listing 1 in his article.

Spencer Hall's Ram and Rom Monitor in our November 1982 issue (page 87) needs a correction to line 60000. Delete the reference to variable A in the DEFINT statement and let it be single precision, not an integer.

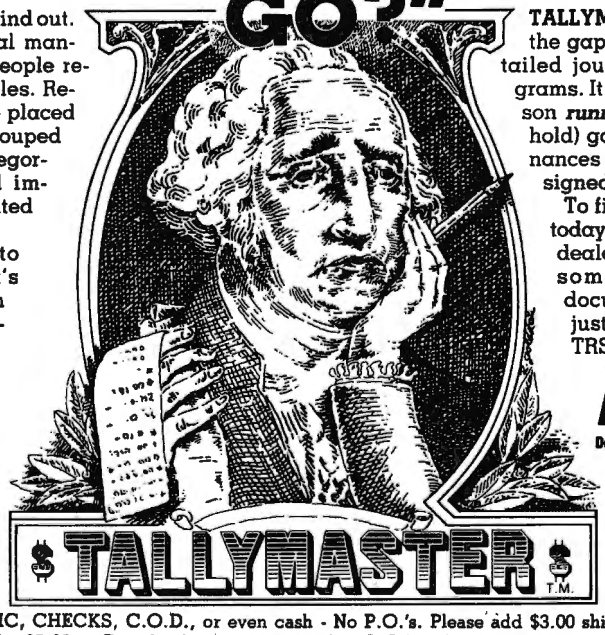
Two-byte Hex, the March program for In the Chips can be modified for one-byte operation as well. Delete the :IF statement at the end of line 150 and you can enter values below 255. Thanks to Daniel Armstrong of New Mexico for pointing out that it can be also called One-byte Hex.

Model III Passwords

J. Gaudeau of Malone, NY wrote to tell us how to backup a Model III TRSDOS disk after forgetting its password. BACKUP can be fooled into thinking that you know the password. Just follow these steps. Type BACKUP <ENTER> from TRSDOS ready. Find any TRSDOS disk with a known password and insert it in drive 0. Find another Model III disk (DOS or DATA) with DATA on it, insert it into drive 1 (DATA= programs or files). Enter source and destination drives with 0 and 1. Enter the password to the disk in drive 0. BACKUP compares the passwords and if they match, it will continue. BACKUP checks the destination disk for data. If data is present, it stops and queries you for a Y or N. *Do not enter anything just yet.* Remove the disks from both drives and set them aside. Insert the disk you want to copy into drive 0.(It is a good idea to write-protect it.) Insert the disk you want the copy on into drive 1 (it must not be write-protected). Answer the continue query with Y <ENTER>. Answer the format query with Y <ENTER>. BACKUP will proceed and make the copy. This method should work with most TRSDOS disks unless they have been zapped to prevent normal copying.

Or, it can be done this way. Put a TRSDOS diskette

"WHERE DID ALL THE MONEY GO?"



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with a known password in drive 0. Press the reset button and wait until it boots. Type PROT (PW) <ENTER> from TRSDOS. Answer the password query with the password to the disk in drive 0 and <ENTER>. Remove the disk from drive 0 after it stops spinning. Replace it with the disk that has the unknown password on it. Enter the new password and the PROT program will change it for you! You can do a normal backup or copy at this time. Using this technique of disk swapping, any TRSDOS command that asks for a password can be bypassed (e.g. PURGE).

Model III users should not forget the Model I audience. Using TRSDOS 1.3, and selecting CASS? low we are able to make tapes that will load on a Model I. We can think of many software producers that have mistakenly restricted their market to just Model III when they don't have to.

Puzzler

Wow! It is clear that we have to get tougher. The response to the March question on changing the numeric YYMMDD to MMDDYY form caused our mail room to work overtime. The solution we were looking for was to take X (YYMMDD) and the answer, Y (MMDDYY) can be obtained by Y deleting the first two digits of the integer portion of 100.0001 times X. The problem was first discussed in the December 1982 issue of *Small Systems World* by David Arbuckle of Albany, GA. The two submissions of INPUT"YY, MM, DD";YY,MM,DD: PRINT MM;DD;YY were short but not quite it. Our winner is David S. Rauscher of W. Barnstable, MA who submitted this code:

B% = X*.0001: Y = (X - B%*10000)*100 + B%

There is a problem with a leading zero being suppressed on the output and many readers caught it with a command PRINT USING "0#####";Y for the months of January through September. The vast majority of the submissions used INT and multiple statements requiring divisions by 10000 or other numbers to alter decimal points. Avoiding the INT command was the key concept we were after.

No winner selected yet for the January puzzler on GOTO or GOSUB XXX. We can't seem to get solutions to work on the Model I and III at the same time. No more submissions on this one please, our technical editor is overloaded now with ones to verify.

This month we are after something different. We have two questions and they are for specific models. First, how can you implement an AUTO command on the Color Computer? Right now, each line number has to be entered as you program. Second, how can one recover a BASIC program with all variables intact on a Model II after going to TRSDOS Ready? Assume that you are using TRSDOS 2.0a or 2.0b. Send us a card or letter with your answer or listing to either question c/o Puzzler, *80-U.S. Journal*, 3838 So. Warner, Tacoma, WA 98409. Due to the large response, we cannot return submitted items. Please do not send a tape or diskette. Earliest working or correct entry wins. Winners receive $10 and a free tour of our facilities.

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BAD PARAMETER(S)

or

FORMAT<ENTER>
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Name of diskette to be formatted (default "* DATA *")?
etc....

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Connect up to eight voltmeters or an audio digitizer to your system

Model I, 16K

Ray Bennett, Seattle, WA

How many times have you wished you had "just one more voltmeter" so that you could monitor two or more voltages at once? Or, having that extra voltmeter, have you had trouble keeping track of which one was monitoring which? Why not make your TRS-80 earn its keep? With this peripheral added to your system, you'll have not two, but eight "voltmeters." Not only that, since your computer is in control of the device, keeping track of which channel is which is as simple as adding labels. Also, scaling the measurement and adding units other than volts to indicate temperature, or whatever, is simple.

The jargon for the voltmeter is an "8-channel analog

Figure 1a — Inverting Amplifier

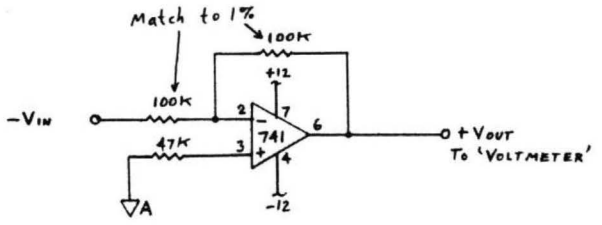


Figure 1b — Passive Attenuator

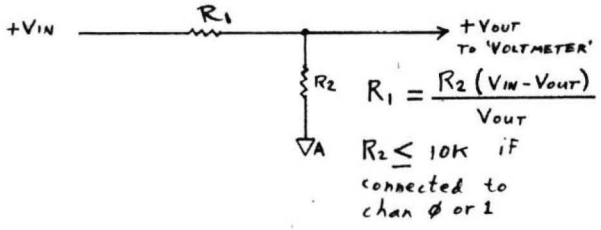
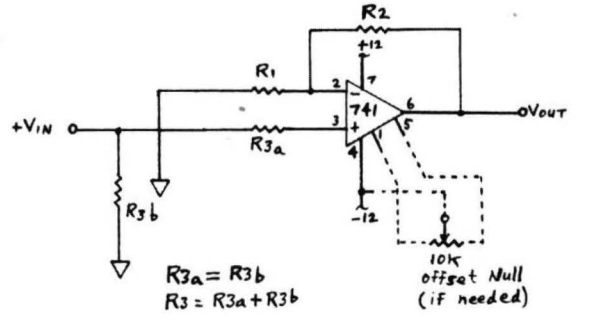


Figure 1c — Non-inverting Amplifier Gain =(R²/R¹)+1



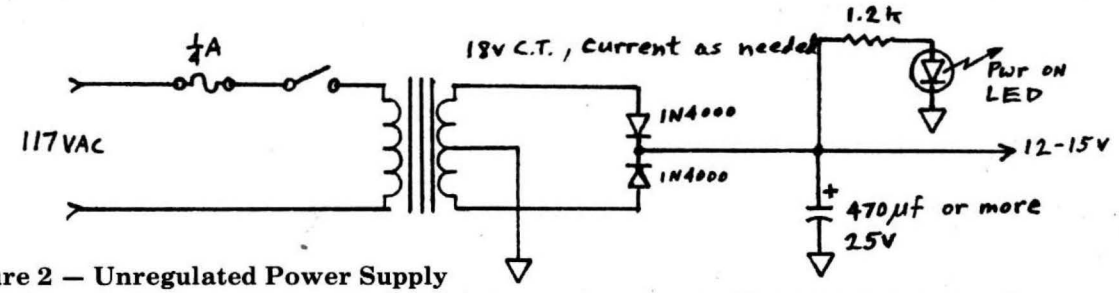
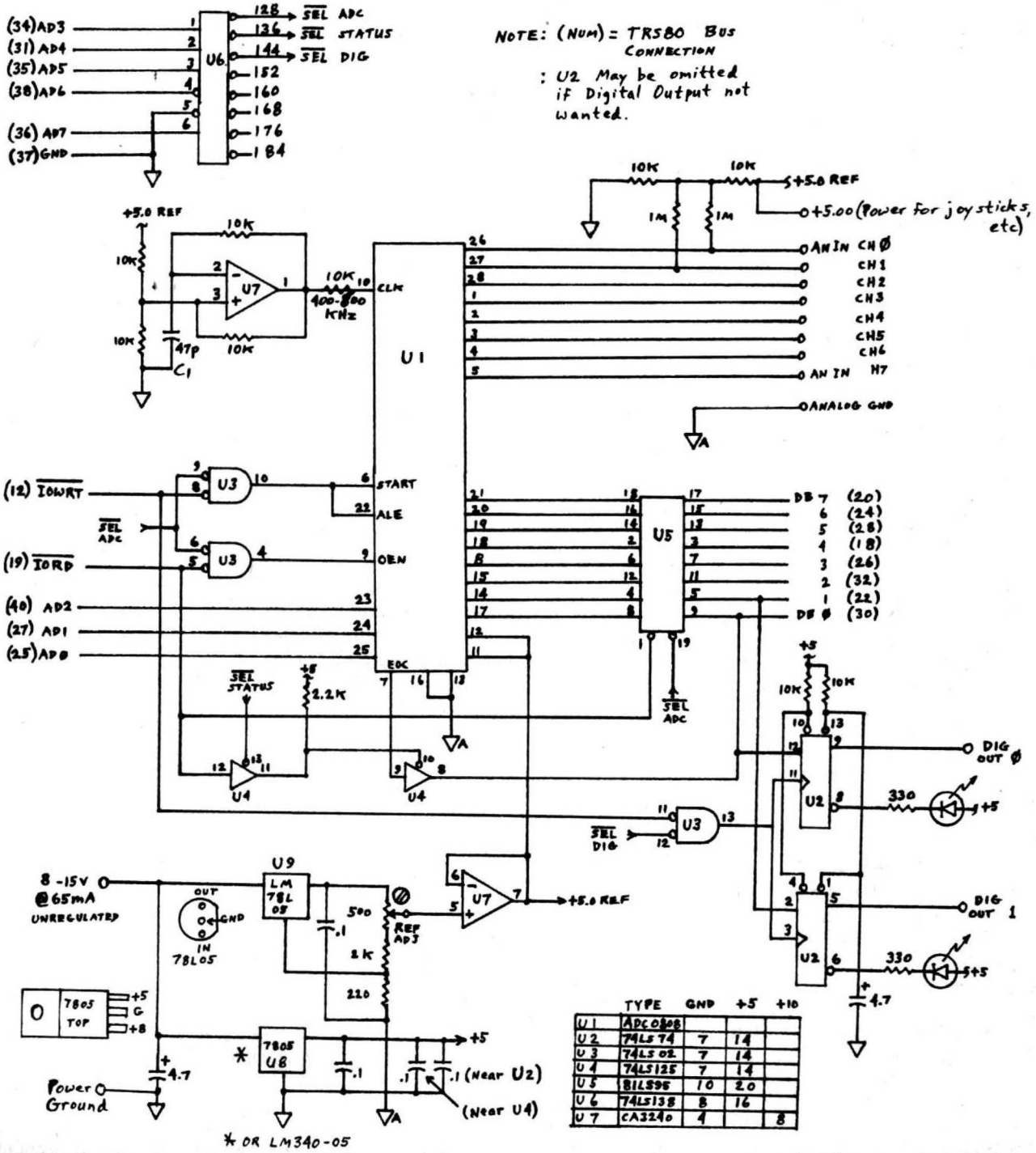


Figure 2 — Unregulated Power Supply
If used to supply more devices than the voltmeter, increase the filter capacitor to 2200uf.

Figure 3 — Schematic for 8-Channel Analog Input



	TYPE	GND	+5	+10
U1	ADC0808			
U2	74LS74	7	14	
U3	74LS02	7	14	
U4	74LS125	7	14	
U5	81LS95	10	20	
U6	74LS138	8	16	
U7	CA3240	4		8

to digital converter with computer interface." From that, we can see that it will convert an analog input into digital form, a process known as "digitizing." We can also see that it can do the conversion on eight channels of analog information. What doesn't show in the jargon is that it will do it fairly quickly, requiring approximately 100 microseconds to convert one sample.

That conversion time means that it can theoretically encode, or digitize, alternating voltages (such as audio) to an upper band width of 5 kiloHertz. That's not enough for hi-fi, but it is ample for voice. However, at that band width, you can only use one channel. If two were used, the band width would drop to 2.5kHz, and so on. Also, that kind of sampling really eats up memory, requiring 30K bytes of RAM for about three seconds of sampling. It's not so bad when you realize that a single word requires something like 0.1 to 0.5 seconds. It does lend itself to experiments in voice recognition. Using the device and a system of five band-pass filters, my TRS-80 was able to recognize my children's names and was able to tell which one said, "Hello." The accuracy wasn't too good, but it did show me that with some elaboration it could be done (and is, of course, being done by many others).

We've talked about some of the voltmeter's good points, now let's talk about its weaknesses. The first is that it is unipolar. That is, it can only measure positive voltages. Also, since the ground return for the analog inputs is tied to the computer ground, you can't make the measurement upside down (with the input of the voltmeter grounded and the measurement taken with the ground side of the voltmeter). If what you're measuring shares ground with your system, you'll load the voltage you're trying to measure. If that voltage has substantial current capability behind it, a puff of smoke will probably mock your folly. The problem can be partially cured with the circuit in Figure 1a. It is an inverting Op-amp with a gain of -1. The minus sign means only that it inverts. Minus in gives plus out. Whichever polarity you use, it must be consistent.

The second limitation is that the full-scale voltage is fixed at 5 volts (or very near there). If you want to measure higher voltages, the easiest way is with the voltage divider shown in Figure 1b. The input impedance is 1 megOhm on channels 0 and 1, and essentially infinite for channels 2 through 7. Therefore, the divider will be loaded only slightly. If you want to measure a voltage lower than 5 volts, but want to increase the resolution, just add the circuit in Figure 1c. It is a non-inverting Op-amp with its gain equal to R_2/R_1+1. R_3 should be equal to the parallel combination of R_2 and R_1 such that $R_3=(R_1*R_2)/(R_1+R_2)$. The actual value of R_3 isn't very critical. If high gains are used, the offset adjustment circuit will be necessary to compensate for input offset in the Op-amp. Normally, if the gain is less than 5 or so, the adjustment won't be necessary.

By now, someone has noticed an apparent discrepancy. I said that the device is unipolar and also mentioned digitizing audio with it. As you are probably aware, audio is AC, or "bipolar." But, for every problem, there is a solution (which Murphy claims creates several more problems). On channels zero and 1, I include a bias network so that, with no input, they are floating near mid-scale (2.5v). If you want to measure AC, or bipolar voltages, just capacitively couple the input with a 0.1 microFarad capacitor, or so. The input impedance on both channels is 1 megOhm. Be sure to limit the voltage excursion to 5 volts peak-to-peak. The other channels are open inputs and, as mentioned earlier, have a very high input impedance. Incidentally, the penalty for exceeding 5 volts on any input, or allowing any input to go negative, is that all of the other inputs will give erroneous readings. There is no indication which channel did it.

There are two program listings given. The first is a BASIC program to operate the device as an 8-channel voltmeter, complete with labels for each channel, and the ability to set high/low limits on any one channel. You can define how many channels you intend to use, which helps get rid of extraneous screen information. I don't provide for scaling the inputs, but that would be easy to add somewhere between lines 190 and 220. The program also allows you to have continuous updates (about two per second) or updates only on command. Upper and lower limits are indicated by the two LED's shown on the schematic. I made one red and the other green.

The second listing is more involved as it uses a supervisor written in BASIC, along with a routine in machine language. The machine language portion is contained in the DATA statements in lines 510 to 540. They are loaded into the appropriate memory locations by lines 30 and 36. The machine code is sum-checked in line 35 to make sure you enter it accurately, or that you get a good load from your tape cassette or disk.

Before loading this program, set MEM=31999, since the machine code resides above 32000 (all 311 bytes of it, including the data area). This program is used to digitize audio. The 256 bytes of data are stored starting at memory location 32055. A graph of the data will appear on the screen in two lines. A new sample is allowed by hitting any key (other than break or shift). The program waits for an input after a 26ms delay. The delay is to avoid picking up the noise of hitting the key if you're using a microphone (and a preamplifier) as your audio source. After the delay, it waits for a changing input to exceed an arbitrary level (approximately .5v if capacitor coupled on the input, 3v if connected straight in to the input). The purpose of the machine language routine (shown in a separate assembly language listing) is to allow the digitizing operation to run near maximum speed. A variable delay is provided to allow graphing slower data, if desired. That delay is set up in line 50 of the BASIC supervisor. The machine coded routine is called via a USR statement, two forms of which are shown, depending on whether you have a disk system or not. It is quite possible to digitize more than 256 samples, but the machine code will have to be modified, as will the BASIC program.

Construction of the voltmeter is not difficult, but does require some care in the grounding scheme. Care must be taken to be sure that ground currents in the digital circuitry are not included in the analog grounding. All of the grounds in the schematic with an "A" alongside are the analog grounds. They should all tie to each other and

then connect to one common point with the digital ground, preferably at power ground.

If you choose to build the wire wrap version, decide how you intend to connect the device to the TRS-80 bus. The model shown in the photo has ribbon cable permanently attached to the perf board, but some connector arrangement would be fine. I usually permanently attach ribbon cable to perf board just to avoid the cost of two connectors. The printed circuit board version shown mounted in the box has an edge-card connector to mate to a 40-pin ribbon cable.

Parts layout isn't critical. Just keep the analog section more or less separate from the digital. The layout shown in the photo is by no means the final word, but it does work well. External connections to the perf board aren't shown, as those will depend on whether or not you put it in a box (highly recommended that you do). I prefer to glue down the sockets with five-minute epoxy, but it isn't essential. If the ribbon cable is to be attached permanently, by all means glue it down with the epoxy or "super glue," or you'll be plagued by broken wires later.

First, connect all of the power and ground pins with 28-gauge (or larger) wire. This part may be soldered to the sockets, but do it close to the perf board so that you can still wrap to the socket pin. Next, hook up the ribbon cable, being careful to be accurate. Swapped wires here can be a real bear to find later. Don't be bashful about double checking this part of your work, along with the power wiring. Go ahead, when you've finished, and wrap up the rest of the device. As you wrap, don't pull the wires tight around the posts, or they may short later. Bring out the analog input leads in some fashion that is convenient for you.

If the unregulated input voltage is much more than the 8-15 volts called out, a heat sink on the power regulator (U8) may be necessary. The input could be as high as +35 volts, if that is more convenient, but U8 will tend to get quite warm. The other regulator (U9) is a small transistor-sized package but a larger one, like the power regulator (U8), will work just as well. If you're buying the parts, the smaller one is a bit cheaper and it takes up less space.

The IC labeled U2 is optional, having nothing to do with the analog convertor circuitry as such. The two LED's it controls are turned on or off by way of an OUT statement, and are addressed separately from the converter.

The reference-adjustment pot is set so that the +5.00 volt reference is correct. Some may prefer to set it to 5.12v. Then, the resolution (smallest voltage change measurable) is 0.02 volts, and each discrete step is 0.02v. This may well be a nicer value than the 0.0195v per step we get with a 5.00v reference. Take your pick, but don't go much higher than 5.12v or you'll have problems with input levels. As you can see, the ADC0808 (U1) is powered by the reference supply. That is the way the manufacturer recommends using it. Since it is a CMOS device, it requires very little supply current, so the scheme is valid.

The clock is provided by U7, a CA3240 dual Op-amp. If you wish to substitute another Op-amp, it should be fairly fast, such as one of the dual BiFET's. Normally, the pin-outs are standard in the 8-pin dip packages. The 10K resistor between the oscillator and the ADC0808 is necessary to protect the ADC from the higher voltage clock. By the way, the clock sets the conversion time of the converter with 640 kHz, giving 100 microseconds conversion. The data sheet indicates the clock may be as high as 1.28 mHz, but I haven't tried it that fast. If you need minimum conversion time, trim the clock frequency by changing the value of C1 (shown mounted in an IC socket on the wire-wrap model). The actual value will have to be arrived at experimentally, requiring a scope or a frequency counter to measure the frequency.

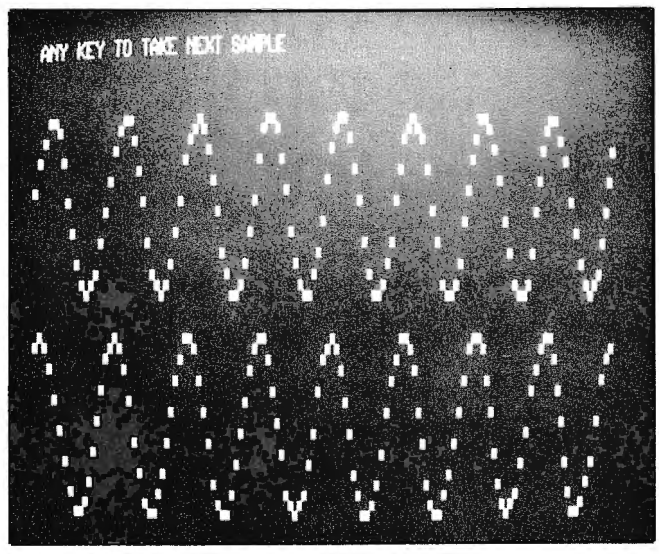
U6 is used to decode the addresses used in this device. As can be seen, five addresses are left unused. Any of these may be used for other devices. Be aware that each address-select line actually represents a block of eight addresses. That is necessary for the converter. Also, if any of the I/O addresses I've picked conflict with other peripherals, just use one of the other taps on U6 and change the program listing for the one (or more) function(s) changed.

Notice that the 8-15 volts power input doesn't need to be regulated. A power supply such as shown in Figure 2 should do fine. It need only supply about 65 mA.

One word of caution. If there is a chance that the analog inputs could be connected to a voltage higher than 5v, connect a 10K resistor in series with each input and change the 1 meg resistors on channels zero and 1 to 10 megOhms. That shouldn't affect the operation significantly.

Perform a power check on the board before plugging in any of the IC's (except U8-9). If +5v is present where it should be, turn power off, wait until 5v drops (could take quite a while with no load on the power supply), then plug in U7, the dual Op-amp. With power on, check to see that the clock is running. If you don't have a scope, use a logic probe that indicates pulses, or connect a voltmeter to pin 1 of U7. If the clock is running, it should show 1.5 to 3.5v. If all looks okay so far, remove power, plug in the

Photo 1 — Sample audio display. Digitized 300Hz, delay in Listing 2, line 50, set to 01.



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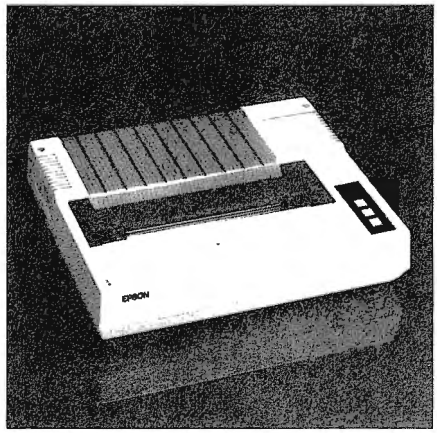

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Photo 2 — Wire wrapped version.

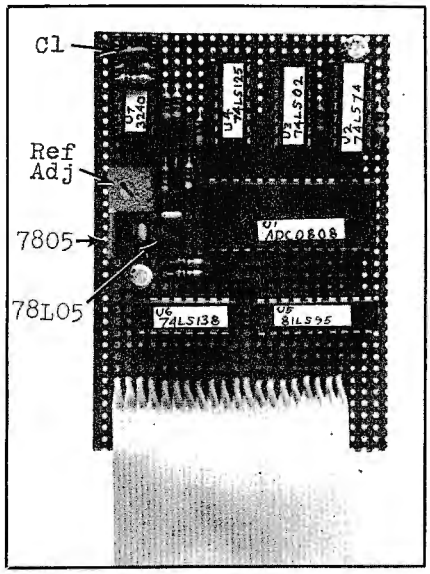


Photo 3 — Printed circuit mounted in box.

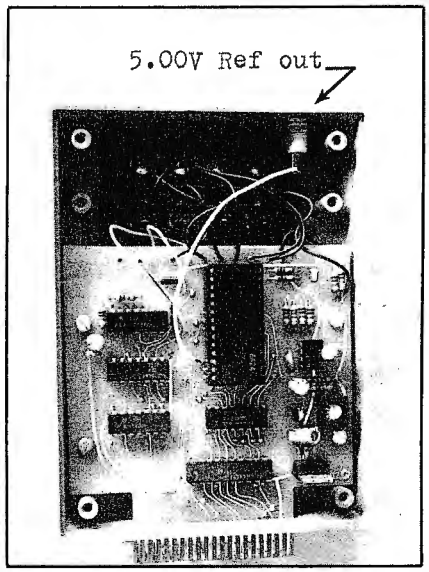
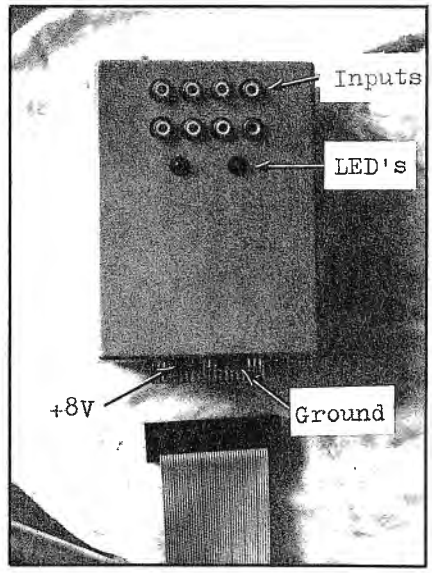


Photo 4 — Finished device mounted in a 4"x2"x5.25" unibox.



rest of the IC's (double check that they are in the correct way), and plug in the ribbon connector to the TRS-80.

Turn on the voltmeter and again check that +5v is present. If it's okay, turn on your computer in the usual fashion. If the computer won't come up properly, but the screen fills with junk and won't clear with the reset button, the bus connector is probably upside down. It won't hurt anything except your nerves. Turn the connecter over and plug it back in. In case you're wondering, it plugs into either the keyboard connector (where the interface adapter plugs in), or into the expansion port of the interface adapter.

If you have problems, check that the +5v is present and that the 5.00v reference voltage is close to its proper

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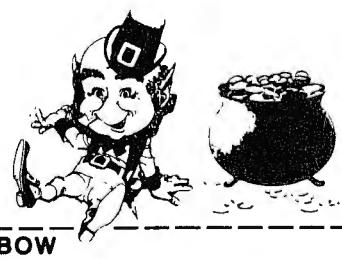

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voltage. Carefully recheck the connections to the TRS-80 bus. Depending on how much faith you have in your work, you can either replace the IC's one at a time, or check your wiring. Typing OUT144,1 should light one of the LED's (if you included them). OUT144,2 should light the other. If that works, just about everything except U1 has been tested.

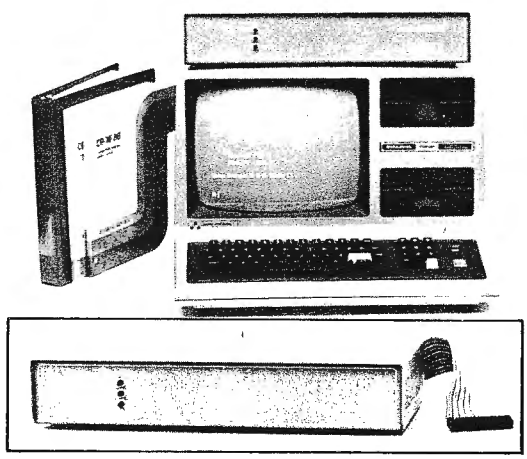
Operation of the voltmeter can be deduced from the program listings. However, a few notes here should make the operation more clear. To start a conversion, simply write to one of eight addresses beginning at 128 via an OUT statement. OUT128,0 will start channel zero, OUT129,0 will start channel 1, and so on, up to OUT135,0 (starting channel 7). The data written is ignored since only the address is used along with the IOWRT strobe.

To read the converted data, read the device via INP(128). Whichever channel you started the OUT statement with is the channel you'll have data for. In BASIC, the conversion time is shorter than the program access time, so it isn't necessary to test the status bit for end of conversion. However, when running the device via a machine language program, the status must be read to determine when the conversion is completed and the data is available. Just issue an I/O read to address 136 and loop back until bit zero is 1. Then, read I/O address 128 as in the BASIC program. Of course, in the programs provided, all of this is taken care of.

For those who would rather not tackle a wire wrap project, this peripheral is available in one of three forms: the bare PC board for $15, a full kit of parts for $50, or the finished board assembled and tested for $75 (fits in 4x5.25x2" unibox). Also, a cable 3 feet long with 40-pin edge-card connectors on each end is available for $25. Send inquiries to RB Enterprises, 15853 - 7th SW, Seattle, WA 98166.

Listing 1 — Eight Channel Voltmeter

```
10 '***  TRS80/8 VOLTMETER - BY RAY BENN
ETT
20 '      JUN '82
30 '
40 VM=128:'ADDRESS OF FIRST ADC CHANNEL
50 CLS
60 INPUT"HOW MANY CHANNELS";CH
70 IF CH<1 OR CH>8 PRINT"MUST USE BETWEE
N 1 AND 8 CHANNELS":GOTO60
80 INPUT"DO YOU WANT TO SET HI/LO LIMITS
";L$:L$=LEFT$(L$,1)
90 IF L$="Y" THEN INPUT"FOR WHICH CHAN";
CL:IF CL+1>CH THEN PRINT"CAN'T TEST UNDE
FINED CHANNEL":GOTO 80
100 IF L$="Y" INPUT"WHAT IS HIGH, LOW LI
MIT";HL,LL
110 FOR I=0TOCH-1
```

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A/D Converter

```
120 PRINT"LABEL FOR CHANNEL #";I:INPUT L
$(I)
130 NEXT I
140 INPUT"CONTINUOUS UPDATE (0) OR UPDAT
E ON COMMAND (1)";UD
150 CLS
160 PRINT @64,"":'SET STARTING PRINT LIN
E
170 FOR I=0TOCH-1
180 OUT VM+I,0:'START CONVERSION
190 X=INP(VM):X=X/51:'READ ADC, CONVERT
DIGITAL TO VOLTS
200 X=INT(X*100+.5)/100:'ROUND TO 3 PLAC
ES
210 IF L$="Y" AND CL=I:IF X>HL THEN OUT1
44,1 ELSE IF X<LL THEN OUT144,2 ELSE OUT
144,0:'LIGHT LIMIT LIGHTS IF NECESSARY
220 PRINT X;"V";:PRINT TAB(20) L$(I)
230 NEXT I
240 IF UD=0 THEN 160:'KEEP GOING IF UPDA
TES CONTINUOUS
250 PRINT "ANY KEY TO TAKE NEXT READING"
260 IF INKEY$="" THEN 260 ELSE GOTO 160
```

Listing 2 — Audio Digitizing

```
10 '*** AUDIO/BAS BY RAY BENNETT - JUN '
82
20 POKE16526,0:POKE16527,125:'SET UP MAC
H LANG CALL
25 'FOR DISK BASIC, REPLACE 20 WITH: DEF
USR0=32000
26 MM=32055
30 FOR I=0TO52:READ A:POKE(32000+I),A:B=
B+A:NEXT I
35 IF B<>6272 PRINT"***  ERROR IN MACHIN
E CODE ***":STOP
36 POKE 32053,55:POKE 32054,125
40 CLS
50 POKE 32051,01:'DELAY CONSTANT(1 GIVES
 .2MS PER STEP, 255
      GIVES 2.6MS)
60 '** WITH TD=20, DELAY IS APPROX 26 MS
 FROM DETECT TO
        START OF DATA COLLECTION
70 OUT144,1:'TURN ON GREEN LED
75 FOR TD=0TO20:NEXTTD:'DELAY TO PREVENT
 SOUND OF KEY PRESS FROM BEING PICKED UP
80 PRINT @0,"WAITING FOR INPUT
   ";
90 'NEXT TWO LINES CAUSE SAMPLE TO BE TA
KEN EACH TIME AT
     NEARLY THE SAME LEVEL ON THE SLOPE
100 OUT128,0:IF INP(128)>100 GOTO 100
110 OUT128,0:IF INP(128)>150 GOTO120 ELS
E 110:'WAIT FOR MIN LEVEL
120 PRINT@0,STRING$(32," ");
```

```
125 OUT144,2:'TURN ON RED LED
130 'FOR DISK BASIC:X=USRØ(Ø):'CALL MACH
INE LANG ROUTINE (TAKE SAMPLE)
135 X=USR(Y):'CALL MACH LANG ROUTINE - N
ON DISK BASIC
140 FOR I=Ø TO 127
150 Y=PEEK(MM+I)/10+4:'GET SAMPLE VALUE
160 SET(I,Y):'GRAPH SAMPLE(TOP OF SCREEN
)
170 NEXT I
180 FOR I=Ø TO 126
190 Y=PEEK(MM+128+I)/10+25
200 IF Y>47 Y=47
210 SET(I,Y):'GRAPH SAMPLE (BOTTOM OF SC
REEN)
220 NEXT I
230 PRINT@Ø,"ANY KEY TO TAKE NEXT SAMPLE
"
240 IF INKEY$="" THEN 240 ELSE CLS:GOTO7
Ø
250 'THE FOLLOWING TESTS THE VOLTMETER
260 OUT 128,Ø
270 PRINTINP(128)
280 GOTO260
500 'THE FOLLOWING IS THE MACHINE LANGUA
GE CODE
510 DATA213,197,229,42,53,125,17,Ø,1,14,
128,6,255,219,136,230
520 DATA1,40,250,211,128,58,51,125,50,52
,125,219,136,230,1,40
530 DATA250,58,52,125,61,194,36,125,237,
162,40,3,195
540 DATA19,125,225,193,209,201,55,125
```

Listing 3 — Assembly Language Listing of Machine Code Contained in Lines 510-540 of Listing 2

```
7D00            00100           ORG     32000
7D00 D5         00110           PUSH    DE
7D01 C5         00120           PUSH    BC
7D02 E5         00130           PUSH    HL
7D03 2A357D     00140           LD      HL,(DATAPT)
7D06 110001     00150           LD      DE,256
7D09 0E80       00160           LD      C,AAD   ;AN-IN ADDR
7D0B 06FF       00170           LD      B,0FFH
7D0D DB83       00210 AAH       IN      A,(AAE) ;READ ADC STATUS
7D0F E601       00220           AND     01      ;AND W/01
7D11 28FA       00230           JR      Z,AAH   ;JUMP IF BUSY
7D13 D380       00240 AAI       OUT     (AAD),A ;START AN-IN
7D15 3A337D     00250           LD      A,(DLY)
7D18 323479D    00260           LD      (TMP),A ;SET UP TIME DELAY
7D1B DB83       00270 AAJ       IN      A,(AAE)
7D1D E601       00280           AND     01
7D1F 28FA       00290           JR      Z,AAJ   ;WAIT FOR CONVER TO FINISH
7D21 3A347D     00300           LD      A,(TMP)
7D24 3D         00310 TIM       DEC     A       ;DECREMENT
7D25 C2247D     00320           JP      NZ,TIM
7D28 EDA2       00330           INI
7D2A 2803       00340           JR      Z,AAK
7D2C C3137D     00350           JP      AAI
7D2F E1         00360 AAK       POP     HL
7D30 C1         00370           POP     BC
7D31 D1         00380           POP     DE
7D32 C9         00390           RET
0001            00400 DLY       DEFS    1
0001            00410 THP       DEFS    1
7D35 377D       00420 DATAPT    DEFW    DATA
0000            00430 AAA       EQU     0000H
0010            00440 AAB       EQU     0010H
0098            00450 AAC       EQU     009BH
0080            00460 AAD       EQU     0080H
0083            00470 AAE       EQU     136
7D37 0001       00480 DATA      DEFW    256
0000            00490           END     AAA
00000 TOTAL ERRORS
00039  TEXT AREA BYTES LEFT
```


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Color Computer

Richard Giovanoni, Hagerstown, MD

The object of this article is to describe a program for constructing HR Diagrams used in many astronomical studies. Part of any science is the art of seeing patterns in the data that accumulates through observation and experimentation. In astronomy, one of the landmarks of pattern recognition is embodied in the HR Diagram, named for Ejnar Hertzsprung and Henry Norris Russell. This graphic plot of a star's absolute magnitude versus spectral class combined the work of many astronomers. Some had been busy for years compiling fundamental measurements that made it possible to talk about a true luminosity value for a star. Others had been classifying stellar spectra and were coming to understand the information contained in the series of bright and dark lines that stand out against the continuum of colors composing the little "rainbow" created from each star's image by the spectroscope.

The spark of insight ignited by the picture of this simple relationship of absolute magnitude (total luminosity) to spectral class (surface temperature) has provided a whole generation of astrophysical speculation with a base for modeling stars. Starting with only the star's mass at "birth," the "track" of its evolution can be projected on an HR Diagram. From proto-star to main sequence phase, up to giant and then back down to white dwarf or black hole.

It is not my purpose to go into all of the astronomy involved, but to show how I used my Color Computer to plot HR Diagrams. However, a few words about what is going on may be of help. There is a list of references at the end for those of you who want to find out more.

Once the data is plotted, certain groups emerge as shown in Figure 1 and Figure 2. Figure 1 represents a random sampling. An obvious major concentration falls along a diagonal. This is the main sequence, with giants and dwarfs on either side. Our sun, a 4.8 magnitude, class G2 star, is indicated by the large circle. Figure 2, on the other hand, shows the pattern of a single old cluster. The massive stars of the high end of the main sequence have long since spent most of their atomic energy, and are now giants or dwarfs. Only the much less massive stars remain on the main sequence. It is this ability to picture the age and composition of various groups that is so useful to astrophysicists.

My hobby is astronomy (mostly devoted to observing sunspots and the patterns involved in the solar cycle), but cosmology and the building of universes is also a great interest of mine. An understanding of the implications of HR plots is necessary in this study. Science teachers could find the program useful in class demonstrations or projects. It's a lot easier to plot several hundred stars this way than by hand, and much

Figure 1

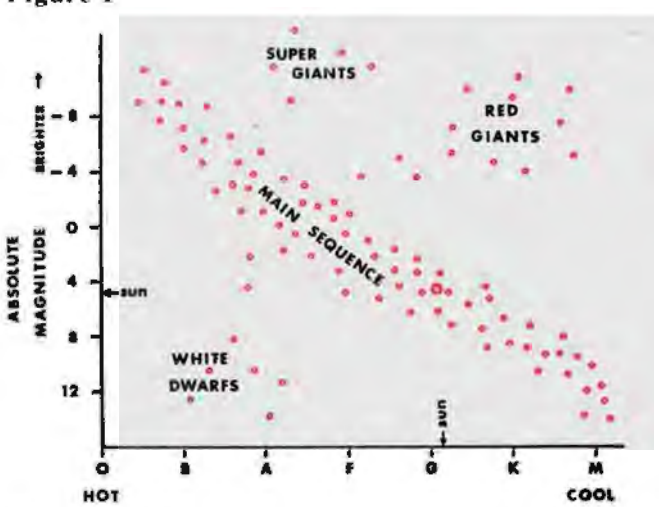
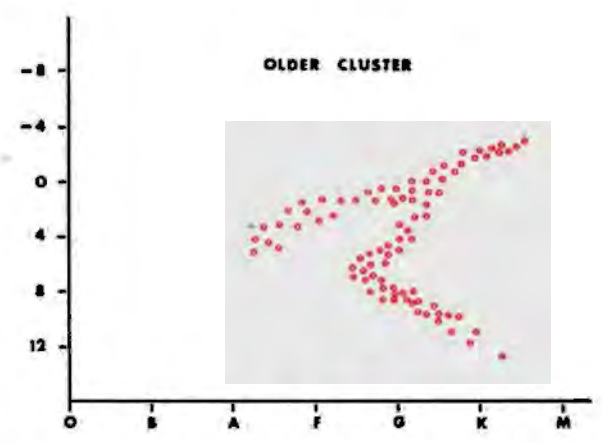


Figure 2



easier to make changes. With 16K memory, there is plenty of room for 500 stars.

On to the program. I have purposely left plenty of space in the program to make it easy to read. There are REM statements to mark each section and indicate what is going on.

The "Y" axis plots absolute magnitude. Because the system is over 2000 years old, it has a scale that may seem strange: the brighter the star, the smaller the value. This is similar to when we say first class is better than second class. A magnitude 1 star is 2.51 times brighter than a magnitude 2 star.

Over the years, it has also been necessary to extend the scale into the minus regions. The important thing to remember is that it is an absolute scale, which means we have a value that represents the relative brightness of the stars as if they were all lined up at a standard distance from us (approximately 32 light years). On this basis, our sun is only 4.8 magnitude — a very dim star compared to how we see it every day at -26. In our program, we cover the range from -20 to +12.

The "X" axis is in terms of spectral class designated by the letters O, B, A, F, G, K, M, which are indicative of surface temperatures. "O" stars are 35000°K, "M" stars 2500°K. The apparently out-of-sequence list of letters arises because the original classification systems were started simply as a means of bringing order to a mass of observations well in advance of the ability to understand the significance of the data. By the time the

Figure 3

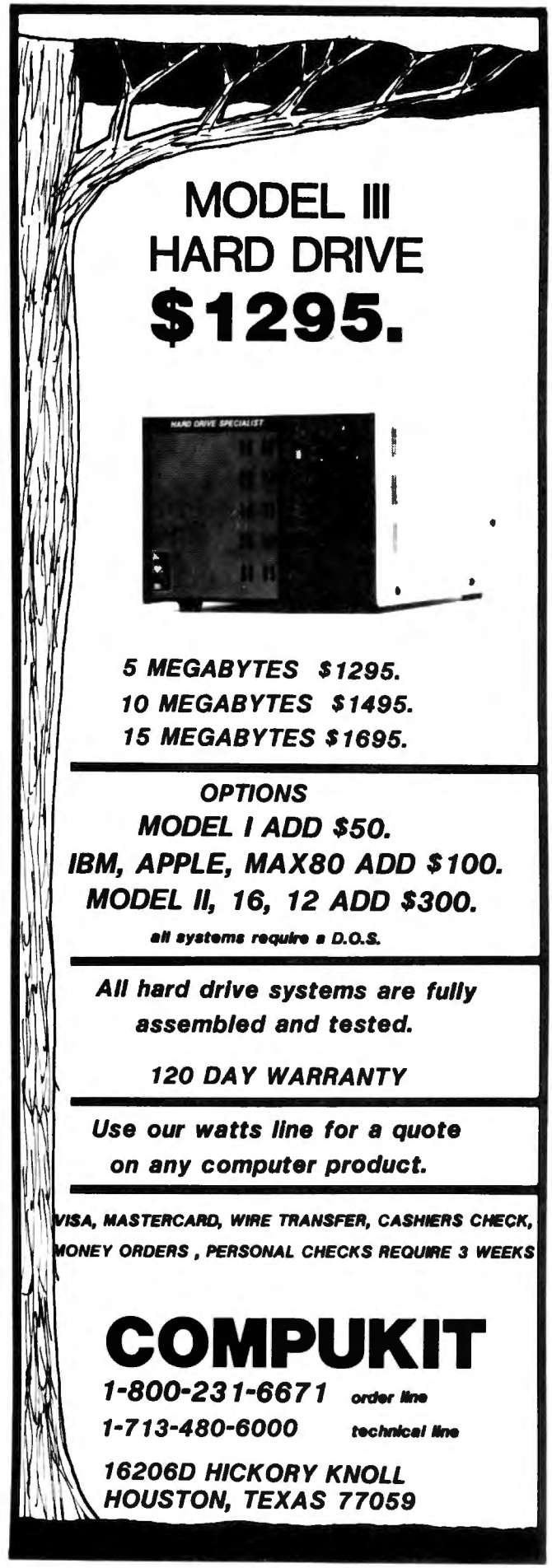
HR DIAGRAM
DATA SHEET

FOR: HR DEMO

SP = CLASS: O, B, A, F, G, K, M
S = CLASS DIVISION: 0 - 9
L = ABSOLUTE MAGNITUDE: 20 TO -12
DATE: 10-28-82

ITEM	SP	S	L	ITEM	SP	S	L	ITEM	SP	S	L	ITEM	SP	S	L	NOTES
1	G	2	4.8	26	M	5	13.7	51	K	5	7.5	76				
2	G	2	4.4	27	M	0	8.7	52	M	4	12.3	77				
3	K	4	5.7	28	M	0	10.8	53	M	5	11.6	78				
4	M	5	15.4	29	M	3	11.8	54	M	4	12.5	79				
5	M	5	13.2	30	M	4	13.3	55	A	0	11.2	80				WHITE
6	M	8	16.7	31	M	7	11.	56	A	0	14.	81				DWARFS
7	M	2	10.5	32	M	5	12.1	57	A	5	11.5	82				57-60
8	A	1	1.4	33	M	6	14.9	58	F	0	14.1	83				
9	M	5	15.3	34	M	6	15.2	59	F	0	14.2	84				
10	M	5	13.3	35	M	4	10.3	60	F	5	16.1	85				
11	M	6	14.8	36	K	7	8.2	61				86				
12	K	2	6.1	37	M	4	11.	62				87				
13	M	7	14.5	38	M	1	10.3	63				88				
14	M	5	13.4	39	M	5	12.8	64				89				
15	K	5	7.5	40	M	8	13.9	65				90				
16	K	7	8.3	41	M	4	10.	66				91				
17	K	8	7.	42	M	5	15.5	67				92				
18	F	5	2.4	43	M	4	10.7	68				93				
19	M	4	11.1	44	M	5	11.7	69				94				
20	M	5	11.9	45	K	1	5.9	70				95				
21	M	1	10.3	46	M	4	12.7	71				96				
22	M	6	13.2	47	M	4	10.9	72				97				
23	M	2	9.5	48	M	2	10.2	73				98				
24	G	8	5.6	49	A	7	2.2	74				99				
25	M	5	11.9	50	K	0	5.6	75				100				
			LINE 300				LINE 301				LINE 302					

R. GIOVANONI



temperature relation was correctly correlated, the nomenclature was "cast in concrete." However, the sequence is easily remembered by the famous mnemonic, "Oh Be A Fine Girl Kiss Me."

The simple letter grouping is now also divided into subdivisions, zero to 9. Thus, we can have classes like: B7, A2, G8 . . . Actually, even further divisions will be found, including Roman numerals and lowercase letters. So, you can find entries like K4IIa, or B0.5Vp. For this program, we use only K4 and B0 and forget all of the rest.

For preparing DATA entry, I have the form shown in Figure 3. I find it a lot easier than trying to type directly from a catalog list. Each twenty-five stars is a DATA line. I mark the line number at the bottom on each column for quick reference.

Program Operation

After the normal opening words, we get the program instructions.

Line 15 tells us we are using spectral class and absolute values.

Line 20 instructs us to enter our values as DATA statements starting at 300. We are also told to enter a title at 299. Remember, use *no* commas in the title!

Line 25: Give an example of DATA line input. Where you put the commas is important.

Line 30 reminds us to count the number in our sample.

Line 35 moves us to the next series of instructions.

Line 45 tells us to type (RUN 50) after we complete DATA lines. It also reminds us again about a title at 299.

Lines 50 to 52 will get the number of stars from you and tells you that the Color Computer is ready to work on your project with the title you gave it.

Line 53 is a timer to hold the message on the screen long enough for you to read it.

Line 55 sets up the high resolution graphics screen.

Lines 60 to 95 construct the X-Y axes and set scale marks along each axis with line commands.

Lines 100 to 112 set up letter strings that will be used to "write" on the screen.

Lines 120 to 126 set up number strings for use on the screen.

Lines 130 to 138 use the DRAW statement with the letter and number strings above to put in headings and scale labels. The chart is now ready for plotting.

Lines 150 to 200: Using DATA lines 300 and up, the program reads spectral class (letter and then number subdivision) and then magnitude. The spectral class is converted to divisions along the X axis: XP. The magnitude is converted to distance down the Y axis: YP.

Line 205 makes the plot point on the screen at XP, YP.

Line 210 puts in the sun as a radius 1 blinking circle as a final flourish and reference point. If it bothers you, delete this line.

Line 250 holds the image on the screen if you decide to delete 210.

A very good discussion of "drawing" letters on the

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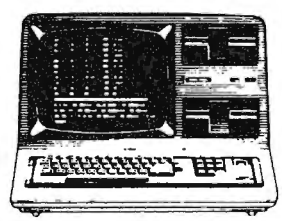

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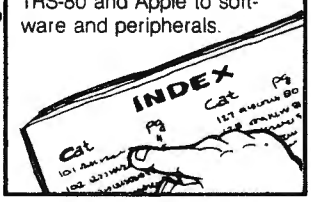

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graphics screen can be found in the May, 1982 issue of the *Rainbow* magazine in the article by M.H. Endres titled "Using a Graphic Character Set for the Color Computer."

Because the listing, as given, already contains a set of 135 values, you can go directly to the RUN 50 command, answer 135, and the plot will be finished in about fifteen seconds. The final point to appear is a blinking spot which is our sun. As noted above, it can be eliminated by deleting line 210.

To run the program from scratch, delete all of the lines starting at 299. Then, you can load your own data. Here are some different versions. You might want to try a sample of the brightest stars versus a sample of the nearest stars. If you respond to the request, "number of stars," with 60, you will get just the nearest stars because the values for lines 300, 301, and 302 have been arranged that way. Line 303 starts the list of DATA for 75 of the brightest stars. Note that no giants show up among the nearby stars and likewise no dwarfs among the brightest. You might want to try samples that are based on relative location: those nearer the galactic equator versus those nearer the galactic poles.

As you look through the reference material, you will notice that many HR Diagrams are constructed in terms of luminosity ratio (in place of magnitude) and color index (in place of spectral class) as opposed to the "classical" version in my program. One of these days, I'll work on a version to operate with new coordinate systems. Or, maybe you can beat me to it!

References

The following books and articles are ones that are within reach on my bookshelves. There are many other good texts to be found in any library under astronomy.

Stars and Nebulas by William J. Kaufmann III, W.H. Freeman and Co.

Atoms, Stars and Nebulae by Lawrence H. Aller, Harvard University Press.

Stars and Clusters by Cecilia payne-Gaposchkin, Harvard University Press.

Burnhams Celestial Handbook Vol. I, II, III by Robert Burnham Jr., Dover Books. Vol I has a good introduction.

Sky and Telescope magazine May and June, 1966. "The Hertzsprung-Russel Diagram Today" by Margherita Hack. Very good on historical development.

Observers Handbook 1982. Editor Roy L. Bishop. Royal Astronomical Society of Canada. Good lists of brightest and nearest stars.

Program Listing for Star-Trac

```
5 CLS:PRINT
1Ø PRINT" ******** STARTRAC ********":
PRINT"   HR DIAGRAM DEMONSTRATION."
12 PRINT" COPYRIGHT R.GIOVANONI OCT.1982
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15 PRINT" USE SPECTRAL CLASS & ABS. MAG.
```


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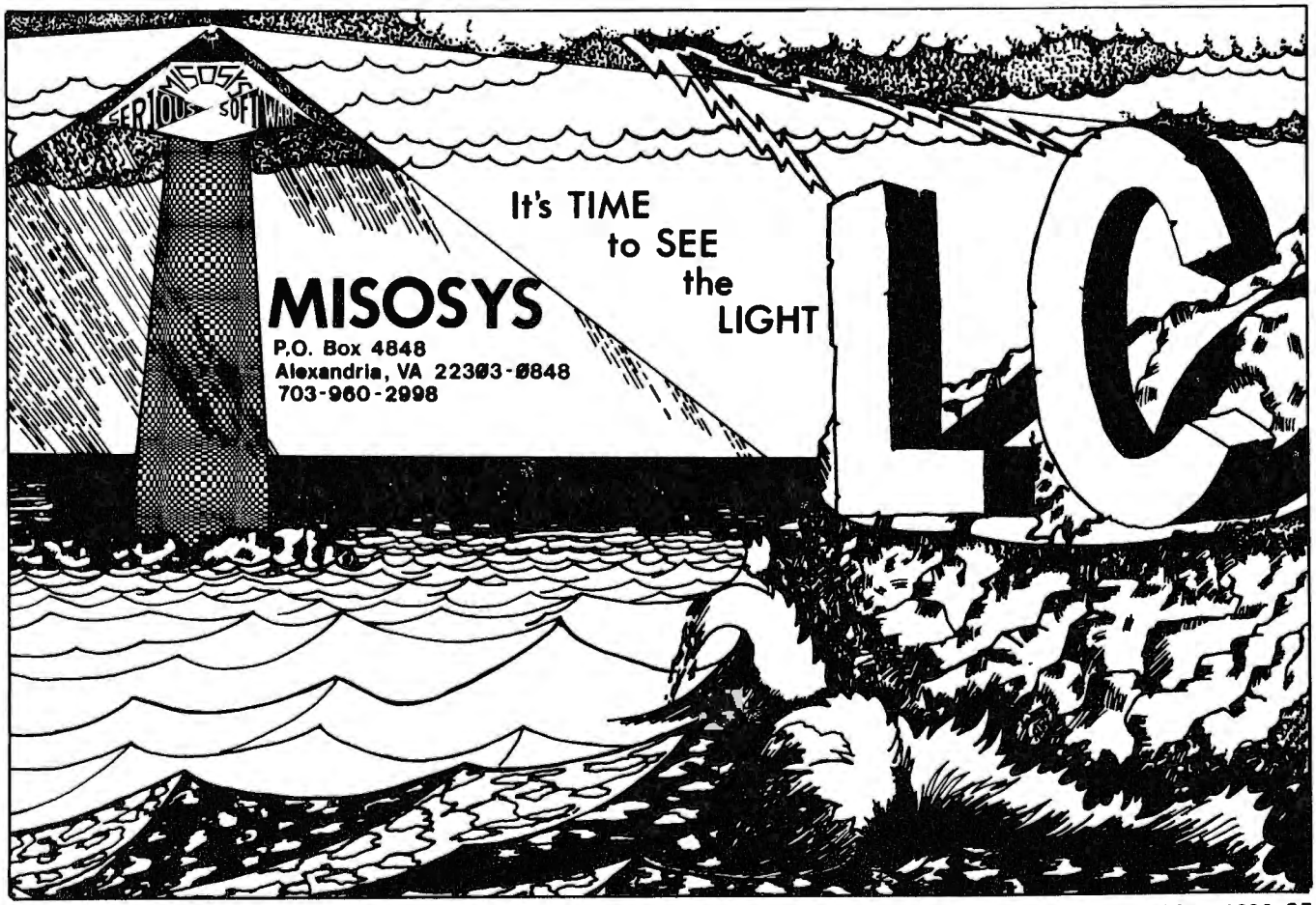
```
":PRINT
20 PRINT" ENTER VALUES AS <DATA>. START
  AT 300. PUT TITLE AT 299":PRINT
25 PRINT" EXAMPLE: CLASS M2,MAG.5  CLASS
  F8,MAG.-2. ENTER M,2,5,F,8,-2"
30 PRINT"  YOU WILL ALSO INPUT NUMBER OF
  STARS YOU ARE PLOTTING.":PRINT
35 INPUT" ARE YOU READY TO CONTINUE";Q$
40 IF Q$="YES" THEN 45
44 CLS:PRINT:PRINT
45 PRINT" AFTER DATA ENTRY IS COMPLETED,
  TYPE <RUN50> THEN HIT <ENTER>.  THIS W
ILL START THE PROCESSING.":PRINT:PRINT"
REMEMBER TITLE AS DATA LINE 299"
46 PRINT" PLEASE GO AHEAD WITH THE DATA
  ENTRY NOW, I'M WAITING!":PRINT"  IGNOR
E THE <BREAK> MESSAGE,     IT WILL GO AWA
Y.":STOP
49 REM THE PROGRAM WILL NOW GO TO WORK O
N THE DATA YOU GAVE IT IN LINE 299 AND U
P.
50 CLS:PRINT:PRINT:PRINT:INPUT" PLEASE E
NTER NUMBER OF STARS      IN YOUR SAMPLE"
;NS
51 READ T$:PRINT:REM GET TITLE
52 PRINT" SIT BACK AND WATCH ME WORK ON
  YOUR PROJECT: "T$
53 FOR T=1 TO 700:NEXT T
55 PMODE 4,1:PCLS:SCREEN 1,1
59 REM MAKE Y&X AXES WITH SCALE   DIVISI
ONS.
60 LINE(20,10)-(20,170),PSET
65 LINE-(255,170),PSET
70 FOR Y=10 TO 170 STEP 20
75 LINE(18,Y)-(20,Y),PSET
80 NEXT Y
85 FOR X=20 TO 230 STEP 30
90 LINE(X,170)-(X,173),PSET
95 NEXT X
99 REM LETTER STRGS
100 O$="BR4U6R4D6L4R4"
101 B$="BR4U6LR4FDGL2R2FDGL4BR5"
102 A$="BR4U4E2F2D2L3R3D2"
103 F$="BR4U3R3L3U3R4BD6"
104 G$="BR4BUU4ER3BD3RL3R2D2GL3R4"
105 K$="BR4U6BR4G3F3"
106 M$="BR4U6F3E3D6"
107 D$="BR4U6LR4FD4GL4BR5"
108 I$="BR4U6LR2LD6LR2"
109 H$="BR4U6BR4D3L3R3D3"
110 R$="BR4U6R3FDGL2RF3"
111 S$="BR4UFR2EH4ER2FBD5"
112 P$="BR4U6R3FDGL3D3BR4"
119 REM NUMBER STRGS
```



```
120 AA$="BR3U6D6"
121 BB$="BR3BU5UR2FDG4R5"
122 DD$="BR3BU3U3D3R4LU3D6"
123 FF$="BR3BU3R3D3L3U6R2BRBD6"
124 HH$="BR3U5ERFD2L3R3D3L3R3"
125 OO$="BR3RHU4ERFD4GLBR3"
126 NN$="BR3BU3R3BD3"
129 REM LABEL CHART AXES & SCALE VALUES.
 WRITE HR DIAGRAM AT TOP
130 DRAW"BM5,8 XM$;"
132 DRAW"BM2,33 XNN$;XHH$;":DRAW"BM2,53X
NN$;XDD$;":DRAW"BM8,73XOO$;"
134 DRAW"BM8,93XDD$;":DRAW"BM8,113XHH$;"
:DRAW"BM4,133XAA$;XBB$;":DRAW"BM4,153XAA
$;XFF$;"
136 DRAW"BM14,182XO$;":DRAW"BM44,182XB$;
":DRAW"BM74,182XA$;":DRAW"BM104,182XF$;"
:DRAW"BM134,182XG$;":DRAW"BM164,182XK$;"
:DRAW"BM194,182XM$;":DRAW"BM235,180XS$;X
P$;"
138 DRAW"BM75,10XH$;XR$;BR5;XD$;XI$;XA$;
XG$;XR$;XA$;XM$;"
149 REM CALCULATE PLOT POINTS
150 FOR N=1 TO NS
155 READ SP$,S,L
160 IF SP$="O"THEN XP=20+S*3 ELSE165
162 GOTO 200
165 IF SP$="B"THEN XP=50+S*3 ELSE170
167 GOTO 200
170 IF SP$="A"THEN XP=80+S*3 ELSE175
172 GOTO 200
175 IF SP$="F"THEN XP=110+S*3 ELSE180
177 GOTO 200
180 IF SP$="G"THEN XP=140+S*3 ELSE185
182 GOTO 200
185 IF SP$="K"THEN XP=170+S*3 ELSE190
187 GOTO 200
190 IF SP$="M"THEN XP=200+S*3
200 YP=INT((L+12)*5+10)
204 REM PLOT THE POINTS AS TINY      DOTS
.
205 PSET(XP,YP,5):NEXT N
209 REM HERE COMES THE SUN!!!
210 CIRCLE(145,94),1:CIRCLE(145,94),1,0:
GOTO 210
250 GOTO250
290 REM ENTER VALUES AS <DATA>       STAR
TING AT LINE 300.FIRST       ENTER TITLE
AS <DATA> LINE       299
299 DATA HR/DEMO
300 DATA G,2,4.8,G,2,4.4,K,4,5.7,M,5,15.
4,M,5,13.2,M,8,16.7,M,2,10.5,A,1,1.4,M,5
,15.3,M,5,13.3,M,6,14.8,K,2,6.1,M,7,14.5
,M,5,13.4,K,5,7.5,K,7,8.3,K,8,7,F,5,2.6,
M,4,11.1,M,5,11.9,M,1,10.3,M,6,13.2,M,2,
9.5,G,8,5.6,M,5,11.9
301 DATA M,5,13.7,M,0,8.7,M,0,10.8,M,3,1
1.8,M,4,13.3,M,7,11,M,5,12.1,M,6,14.9,M,
6,15.2,M,4,10.3,K,7,8.2,M,4,11,M,1,10.3,
M,5,12.8,M,8,13.9,M,4,10,M,5,15.5,M,4,10
.7,M,5,11.7,K,1,5.9,M,4,12.7,M,4,10.9,M,
2,10.2,A,7,2.2,K,0,5.6
302 DATA K,5,7.5,M,4,12.3,M,5,11.6,M,4,1
2.5,A,0,11.2,A,0,14,A,5,11.5,F,0,14.1,F,
0,14.2,F,5,16.1
303 DATA B,9,-.1,F,2,1.6,B,2,-3.4,G,1,3.
7,K,0,.1,K,3,-.2,K,0,-1.1,K,1,.8,G,0,4.8
,B,0,-.3,G,8,.3,K,3,1,M,0,.2,A,5,2.1,K,5
,-4.6,B,3,-2.3,G,8,5.7,F,6,2,B,3,-2.7,A,
5,1.7,F,0,2.9,K,3,-2.4,K,2,.2,A,5,-.1,F,
8,-4.6
304 DATA M,5,-.5,A,2,2,A,3,1.7,M,2,-.5,G
,8,.3,M,4,-1,B,8,-.5,F,5,-4.4,B,5,-3.3,B
,7,-3.2,M,2,-1.5,B,1,-6.1,B,0,-3.7,M,0,-
.5,G,9,-2.1,K,0,.1,A,7,.2,A,0,-1.2,K,5,-
.7,F,6,3.6,K,3,-2.4,F,0,-7.1,K,5,-.4,B,3
,-2.1,A,3,.9
305 DATA B,9,-2.1,B,8,-7.1,G,8,-.6,B,0,-
3.7,B,2,-4.2,B,7,-3.2,G,5,.1,O,9,-6.1,F,
0,-4.6,O,8,-5.1,O,9,-6.1,B,0,-6.8,B,2,-4
.2,B,8,-.6,O,9,-6.6,B,0,-6.9,K,2,0,M,2,-
5.6,A,2,-.3,B,9,.1,M,3,-.6,B,2,-2.4,M,3,
-.6,M,3,-.6,B,1,-4.8,F,0,-3.1
```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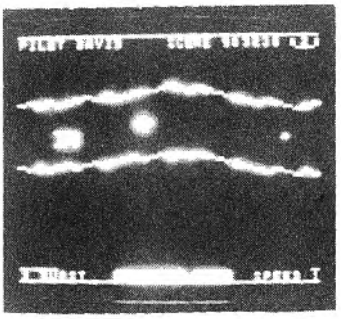

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MID$ = Super function

How to avoid time-consuming garbage collection

Models I/II/III

Dexter Walker, Birmingham, AL

Like many others, I got started with a Level 1, 4K TRS-80. When I (very quickly) went to Level 2 and 16K and, later, to disk, I still had much to learn. There was an awful lot of stuff I just skipped over thinking, "I'll come back and really study that later when I have more time." Well, it's over two years later and I'm up to 48K and two disk drives at home plus a Model II at the office. I still haven't gone back and done all of those good things. Perhaps every other TRS-80 user has done all of his homework but, even so, I suspect someone will find some helpful ideas in this article.

The title, MID$=, is what it's about. That MID$ is on the left side of the equal sign because it can help when you are trying to handle a lot of data in files — especially with random (direct) access files, BASIC sort routines, or when you manipulate a lot of string data.

I was trying to explain to a neophyte user a few days ago what happens when you assign different values to a variable such as A$. What I finally came up with was that if you had a chalkboard, but no eraser, you could write 'A$="CAT" ' on the board, then cross out "CAT" and write "DOG," and then "HORSE," and you could keep doing that until the board was full.

Finally, when there was no more room to write another word, you'd have to do something, and that's about what happens when your machine sits there and stares at you while it does its garbage collecting. If, on the other hand, you did have an eraser, and erased the word you wanted to change each time, you could go on changing words until you ran out of chalk.

Let's assume that there were ten squares painted on the chalkboard and you had to put each letter in a separate square, so there was a limit to the length of the word you could enter. You could use any word that was ten, or fewer, characters long, but if you tried to use a longer word, it wouldn't fit. One other requirement on our imaginary board is that whenever we put up a new word, we must cover up all of the ugly lines marking the squares on the board. To do that, we add spaces to each word to make it the right length. This is what we do when we put records in a random access file on disk: We use a field statement which assigns the length of each field, then we format the data for the file using LSET or RSET, and have blank spaces in each field if the word is shorter than the field length.

When we are GETting the data out of the random access file, we have a choice. If the variable names used in the field statement are Z0$, Z1$, Z2$, etc., and we want to put them into program variables, we can use either of two procedures: (A) A$ = Z0$, or (B) MID$(A$,1) = Z0$.

Using (A), if we had 300 records on file, we would use 300 separate A$'s plus 300 more B$'s, C$'s and so on. With (B), we would use *one* A$ 300 times and never begin to use up the memory or string capacity of the machine.

One of the places where you will use up space in a hurry is in a BASIC sort routine, whether it's a bubble sort or a Shell-Metzner sort (which is quicker). Both do a lot of swapping of data and use up a lot of RAM space. In a bubble sort, with 50 sets of records, there are 50x49 (2450) comparisons made. With 100 records, there would be 9,900 comparisons. In a "worst case" sort, such as taking an A-Z list and changing to a Z-A list, there could be that many data swaps and many more cases of time-consuming garbage collection.

Listing 1 demonstrates one use of the MID$= function. Key in the program exactly as listed and test it using only three or four entries to make sure it works. You will not find the machine locking up with this small amount of data, but it will be easier to debug. Once you get it going, work with about 25 records and it will lock up for you. Then, depending on your memory size, change the CLEAR statement in line 100 to CLEAR 10000 and run 100 records. If you have a machine language sort in DOS, you will be happier than ever, but still see the MID$= function in use. I haven't really worked on this, but it seems to me that the less space you CLEAR, the more often the computer locks up, but the shorter time it takes to clean up the garbage.

Even with a few records, you may notice that, after the second sort, some of the 'words' in the first column have been truncated and have fewer characters than they originally had. Assuming that you have a printer, you can make line 330 into "LPRINT," or (if you have a screen print feature in your DOS) you can use that to compare the original data with the results of the second sort.

When we use the MID$ function in the second sort, we are exchanging data between A$(I) and A$(I+1), and we are trying to stuff an 8-character word into, perhaps, a 6-character space. Only six characters get into that space,

so you lose two. (You may even find them added onto another word!) I guess if the number of records were big enough and enough swaps were made, every word would eventually be cut down to the length of the shortest word in the original list.

Also note (in line 1210 of Listing 1) the two temporary variables used in the sort (X$ and Y$) are defined as ten blank spaces. If you use the MID$(A$,1) statement without having defined A$, you get an "illegal function call" error message.

I have a program on my Model II which currently holds about 325 records, each record consisting of ten fields of varying length, but with a total of 71 characters per record. This program is fairly new and not yet up to an estimated capacity of some 2,000 records. There is a great deal of data handling involved in making four separate monthly listings. More and more time was being spent watching a blinking cursor and wondering if there was time for another cup of coffee before we could get back to work. MID$= has totally eliminated this problem.

If you can't stand watching a bubble sort, or if you want to see proof that MID$ reuses the same space over and over, then key in Listing 2. If you have a DOS that prevents scrolling of headings, you can change Line 120 to keep your headings and run as many swaps as you want. You will notice the locations for A$ show lower and lower numbers. String space is used from the top or memory. Depending on the amount of string space you cleared and the number of swaps you run, you will see the A$ addresses jump back to the top of reserved space, but without any noticeable pause for garbage collecting.

Some day, I *am* going back to read "all that good stuff." In the meantime, I guess I'll be like everyone else and learn things the hard way.

Listing 1 for MID$

```
10 'MIDSTRING FUNCTION DEMO PROGRAM
20 'WRITTEN 9/4/82 BY DEXTER WALKER,
30 '3608 MOUNTAIN LANE,
40 'BIRMINGHAM, AL.  35213
100 ' ******* CREATE TEST FILE *******
110 CLEAR 5000:CLS:PRINT TAB(10)"'MID$'
FUNCTION DEMO PROGRAM":PRINT
120 INPUT"How many Records do you want i
n the Test File ";N
130 DIM A$(N+2), B$(N+2)
140 FOR I=1 TO N
150  FOR J=1 TO RND(5)+4
160  A$(I)=A$(I)+CHR$(64+RND(26))
170  B$(I)=B$(I)+CHR$(64+RND(26))
180 NEXT J
190 B$(I)=LEFT$(B$(I)+"          ",10)
200 NEXT I
210 M=1:GOTO 410
300 ' ***** LIST PRINT SUBROUTINE *****
310 FOR I=1 TO N
320 L1=LEN(A$(I)):L2=LEN(B$(I))
330 PRINT TAB(0)I;TAB(5)A$(I);TAB(19)"LE
N =";L1;TAB(40)B$(I);TAB(54)"LEN =";L2
340 IF I/14=INT(I/14) THEN Z$=INKEY$:IF
Z$="" THEN 340
350 NEXT
360 RETURN
400 '******* DISPLAY OF RANDOM DATA ****
****
410 GOSUB 300
420 PRINT TAB(2)"(Note that entries in t
he second column have 10 characters.)"
430 GOSUB 1500
500 '******* FIRST BUBBLE SORT ********
510 CLS:PRINT"We will now use a Bubble S
ort to sort the FIRST column (A$) "
520 PRINT :PRINT TAB(15)"Hit any key to
start sort.":GOSUB 1500
530 PRINT :PRINT TAB(4)"BE SURE TO NOTE
HOW MANY TIMES THE COUNT 'FREEZES'":GOSU
B 1000
540 FOR J=1 TO 500:NEXT
550 PRINT"To see Sorted Lists, hit any k
ey ":GOSUB 1500:CLS:PRINT"The FIRST colu
mn has now been sorted.":GOSUB 300
560 GOSUB 1500
600 '******* SECOND SORT USING MID$ FUNC
TION *******
610 CLS:PRINT :PRINT"We will now sort th
e SECOND column (B$) using the MID$ rout
ine."
620 PRINT :PRINT TAB(9)"Note that the Re
cord count does not freeze."
630 PRINT :PRINT TAB(14)" To start the s
ort, hit any key.":GOSUB 1500
640 GOSUB 1200
650 FOR J=1 TO 500:CLS:PRINT"Note that t
he SECOND column is now sorted.":GOSUB 3
00
660 PRINT"Hit any key to start over.":GO
SUB 1500
670 CLS:GOTO 100
680 END
1000 ' ******* BUBBLE SORT ROUTINE *****
***
1010 SW=0
1020 P=P+1
1030 FOR I = 1 TO N-1
1040 PRINT@402,"Pass";P;"  Record";I;
1050 IF A$(I)<=A$(I+1) THEN 1090
1060 X$=A$(I):A$(I)=A$(I+1):A$(I+1)=X$
1070 Y$=B$(I):B$(I)=B$(I+1):B$(I+1)=Y$
1080 SW=1
1090 NEXT I
1100 IF SW=1 THEN 1010
1110 PRINT@402,"Sort Done
 "
1120 P=0
```

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```
1130 RETURN
1200 ' ******* BUBBLE SORT ROUTINE with
MID$ ********
1210 SW=0:X$=STRING$(10," "):Y$=STRING$(
10," ")
1220 P=P+1
1230 FOR I = 1 TO N-1
1240 PRINT@468,"Pass";P;"  Record";I;
1250 IF B$(I)<=B$(I+1) THEN 1290
1260 MID$(X$,1)=A$(I):MID$(A$(I),1)=A$(I
+1):MID$(A$(I+1),1)=X$
1270 MID$(Y$,1)=B$(I):MID$(B$(I),1)=B$(I
+1):MID$(B$(I+1),1)=Y$
1280 SW=1
1290 NEXT I
1300 IF SW=1 THEN 1210
1310 PRINT@468,"Sort Done
 "
1320 RETURN
1500 Z$=INKEY$:IF Z$="" THEN 1500 ELSE Z
$="":RETURN
```

Listing 2 for MID$

```
10 ' MID$ WITH VARPTR DEMO
20 'WRITTEN 9/5/82 BY DEXTER WALKER,
30 '3608 MOUNTAIN LANE,
40 'BIRMINGHAM, AL.  35213
80 CLEAR 9000:CLS
90 B$=STRING$(6," ")
100 INPUT"How many swaps do you want to
make ";S
110 CLS:PRINT TAB(0)"No.     A$";TAB(19)
"Loc.  Used ";TAB(41)"B$          Loc.  U
sed"
120 ' INSERT CODE TO KEEP ROW 0 FROM SCR
OLLING IF AVAILABLE
200 FOR K=1 TO S
210 FOR J=1 TO 6:X$=X$+CHR$(64+RND(26)):
X$=RIGHT$(X$,6):NEXT
220 FOR J=1 TO 6:Y$=Y$+CHR$(64+RND(26)):
Y$=RIGHT$(Y$,6):NEXT
230 A$=X$:MID$(B$,1)=Y$
240 VA=VARPTR(A$):VB=VARPTR(B$)
250 A1=PEEK(VA+1):A2=PEEK(VA+2):A3=A1+A2
*256
260 B1=PEEK(VB+1):B2=PEEK(VB+2):B3=B1+B2
*256
270 IF AL=A3 THEN 290 ELSE TA=TA+1
280 IF BL=B3 THEN 290 ELSE TB=TB+1
290 AL=A3:BL=B3
300 PRINT TAB(0)K;TAB(7)A$;TAB(17)"@";A3
;"=";TA;TAB(40);B$;TAB(50)"@";B3;"=";TB
310 NEXT
500 Z$=INKEY$:IF Z$="" THEN 500 ELSE Z$=
"":GOTO 80
```

The Model 100

Complete portability at a low price

Cameron C. Brown, Editor

"It will outsell any other computer that Tandy has ever made." That was what Bill Walters, Project Director, had to say about the new Model 100. That is quite a statement, but from what I saw, it is probably true.

Tandy calls the machine a full-featured "Micro Executive Workstation". It is truly portable, not just transportable like the Osborne or Kaypro. It is similar to the Epson HX-20 in design, but offers much more.

The Model 100 is small (2 X 11 7/8 X 8 1/2 inches), light (4 pounds), white or buff colored (not Tandy grey), and easy to use. It comes with a full typewriter keyboard, four cursor keys, four command keys, eight function keys, an imbedded ten-key data pad, a built-in RS-232 and direct-connect auto-answer modem, parallel printer port, cassette I/O port, phone I/O port, and a real-time clock. That is a lot of machine in a small space.

An eight-line by 40-character upper and lowercase liquid crystal display allows for full ASCII and European characters as well as dot-addressable graphics. Many special characters, such as playing card suit symbols and picto-grams, are also included. The display can be adjusted for viewing from almost any angle.

But the strength of the Model 100 lies elsewhere. It comes equipped with a well-designed set of application software that is built into the 32K ROM. The ROM circuit has Microsoft's Extended BASIC as well as a text editor, appointment scheduler, address handler, and a versatile communications package. All of the application programs function in a similar manner. There is no need to learn different key sequences for each one.

It is a machine that first-time computer owners can easily use. It allows for easy access to a business's host computer or link-up to national data bases such as CompuServe. It is unlike anything that Tandy has yet released. It is not meant to be a stand-alone computer. Its value lies in its ability to travel, keep track, and link-up to other computers.

All ROM software and the BASIC were developed by Microsoft. The computer uses an 8085C processor and CMOS chips are used throughout. The machine comes in an 8K ($799), or 24K ($999) RAM version, with optional 8K RAM add-ons ($119.95 plus installation), up to a total of 32K. The 8K version will be available in any Radio Shack store, but go to a Computer Center store for the 24K or higher versions. An additional 32K CMOS ROM can be installed by the user in the bottom of the computer. Tandy plans to release specialized software in these ROM modules and it will bank switch out the main, built-in, 32K ROM when needed. It's my guess

Model 100

that you will be seeing games as well as detailed business and communications routines very soon. Those dot-addressable graphics were added for a reason.

The BASIC is impressive. All calculations are 14-digit double precision and give perhaps the most accurate transcendental mathematical functions in any microcomputer. "Why bother beginners with round-off problems?" was Tandy's rationale for including such precision. There is even a five octave sound generator. According to Mr. Walters, the language is 98 percent Model III compatible. The commands HEX$, DEF USR, RENUM, and AUTO are not part of the Model 100's vocabulary. Its file structure is unique and only allows for sequential, not random files. Arrays, both numeric or string, as well as multi-dimensional are supported.

Since the Model 100 allows for full interrupt, it includes some commands that are unique to it. You can program for communication interrupts with the ON COM or ON MDM (modem) commands. There is also ON TIME$ which takes advantage of the real-time clock. The computer is designed as a general I/O device and has multiple routing capability. Send the modem information over to a Model II, or download from CompuServe to a printer with ease.

The machine is powered by a standard outlet, or will run continuously for 20 hours off its four AA cells. Internal Ni-Cad batteries will store programs or data for eight days on a 32K, or 30 days on an 8K machine; even when the power is turned off. Plugging in the adapter or running the machine off the batteries will automatically refresh the internal batteries.

The built-in software was designed with care. When the computer is powered-up, the menu displays BASIC as well as the programs TEXT, SCHEDL, TELCOM and ADDRSS. TEXT is used to create and edit text files. Pre-programmed function keys allow for move, copy, and delete commands. Tandy refers to the editing as a "cut and paste" operation. The same style of commands are available when editing BASIC programs. When material is "cut" it is moved into a buffer, from which it can be "pasted" into another section. Locations are specified by easy, arrow-key cursor movement. Control and shift keys will jump you a single word, to the top or bottom of the screen, to the end of a line, or to the start or end of text. The editor includes a find function for location of specific words or phrases. Output through a parallel printer port is not difficult. Text and programs can be saved in ASCII format for transmission to another computer.

The keyboard feels slightly small and it would not be my choice for word processing. But the power is in its ability to communicate. It is easy to imagine writing memos to my staff as I fly off to a meeting and sending it back to a Model III as soon as I land.

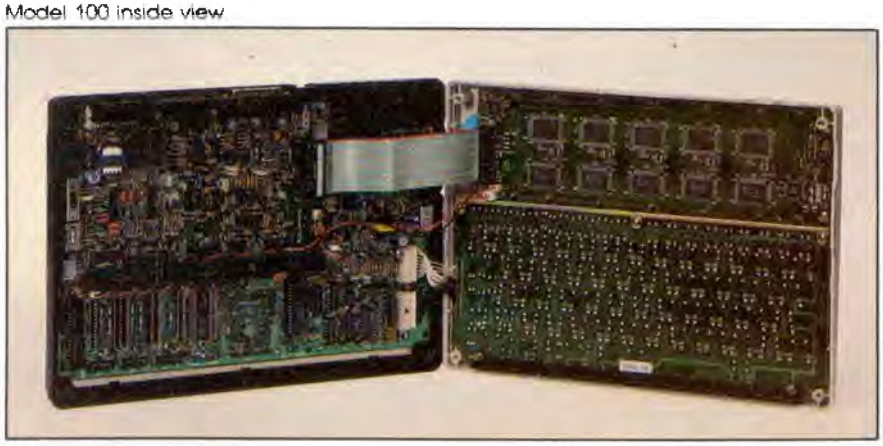
SCHEDL and ADDRSS are programs for user record keeping. SCHEDL allows you to keep track of dates, times, appointments, events and things to do. An easy search routine gives quick retrieval of data. It does require pre-planning on your part so the data is entered in a consistent manner. ADDRSS keeps track of addresses and phone numbers. If you place a colon before each phone number, the Model 100 can automatically call each number when you want it to. The automatic dialing requires a rotary phone, but you can select a speed of 10 or 20 pulses per second. Both programs use the TEXT utility to create their files.

TELCOM controls all communications for the Model 100. It supervises and allows you to set the parameters for the direct-connect auto-answer modem as well as the RS-232. The built-in terminal program allows full or half duplex communication. Uploading or downloading of ASCII files is done by a simple key-stroke. Auto log-on procedures can be put into the ADDRSS file. They can tell the Model 100 what character to look for and what response is desired. You can even specify just part of a number or address and have the TELCOM program search the ADDRSS file for a match. By presetting the parameters into the ADDRSS file you could go directly to the CompuServe menu option you want and never have to answer a question. The communications software gives you full control over baud rate (110 to 19,200), parity, word length, stop bits, X-on and X-off status, and dial speed.

You will have to purchase all of the cables and other materials separately. The parallel printer port uses a 28-pin cable and it sells for $14.95. The 6V DC adapter will cost $5.95. A built-in 40-pin expansion bus lies at the bottom of the computer. It's reasonable to assume that a connector to a full screen monitor is already in the works. Disk drives? I doubt it. This machine is designed for portability and communication. It is not meant to be your only machine for data or text processing.

Tandy may be right. This one could easily be what many people are looking for. I know we plan to cover its progress and use in *80-US Journal*. Perhaps Tandy will change the Ma Bell phrase to be "reach out and touch someone; with a Model 100."

Model 100 inside view



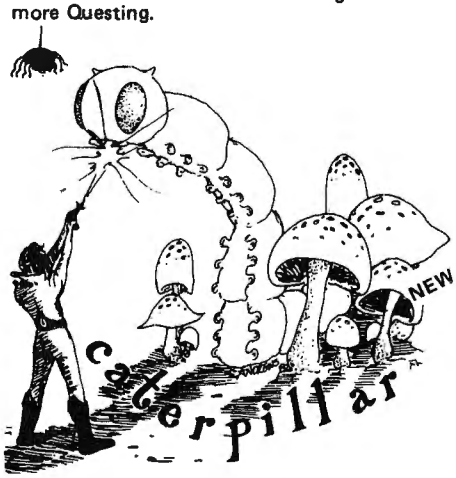
AARDVARK

TRS-80 COLOR COMMODORE 24 VIC-20 SINCLAIR/TIMEX TI99

QUEST – A NEW IDEA IN ADVENTURE GAMES! Different from all the others. Quest is played on a computer generated map of Alesia. Your job is to gather men and supplies by combat, bargaining, exploration of ruins and temples and outright banditry. When your force is strong enough, you attack the Citadel of Moorlock in a life or death battle to the finish. Playable in 2 to 5 hours, this one is different every time. 16k TI99, TRS-80 Color, and Sinclair, 13K VIC-20. $14.95 each.

32K TRS 80 COLOR Version $24.95.

Adds a second level with dungeons and more Questing.



CATERPILLAR

O.K., the Caterpillar does look a lot like a Centipede. We have spiders, falling fleas, monsters traipsing across the screen, poison mushrooms, and a lot of other familiar stuff. COLOR 80 requires 16k and Joysticks. This is Edson's best game to date. $19.95 for TRS 80 COLOR.

ADVENTURES!!!

The Adventures below are written in BASIC, are full featured, fast action, full plotted adventures that take 30-50 hours to play. (Adventures are interactive fantasies. It's like reading a book except that you are the main character as you give the computer, commands like "Look in the Coffin" and "Light the torch.")

Adventuring requires 16k on Sinclair, TRS-80, and TRS-80 Color. They require 8k on OSI and 13k on VIC-20. Sinclair requires extended BASIC. Now available for TI99. Any Commodore 64.

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This is our most challenging ADVENTURE. It is a treasure hunt in a pyramid full of problems. Exciting and tough!

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(by Rodger Olsen & Bob Anderson)

New winner in the toughest adventure from Aardvark sweepstakes. This one takes place on an alien ship that has been deserted for a thousand years – and is still dangerous!

Dungeons of Death – Just for the 16k TRS-80 COLOR, this is the first D&D type game good enough to qualify at Aardvark. This is serious D&D that allows 1 to 6 players to go on a Dragon Hunting, Monster Killing, Dungeon Exploring Quest. Played on an on-screen map, you get a choice of race and character (Human, Dwarf, Soldier, Wizard, etc.), a chance to grow from game to game, and a 15 page manual. At the normal price for an Adventure ($14.95 tape, $19.95 disk), this is a giveaway.

WIZARDS TOWER – This is very similar to Quest (see above). We added wizards, magic, dragons, and dungeons to come up with a Quest with a D&D flavor. It requires 16k extended color BASIC. $14.95 Tape, $19.95 Disk. VIC 20 Commodore 64.

NEW

PLANET RAIDERS – Not just another defenders copy, this is an original program good in its own right. You pilot a one man ship across a planetary surface dogfighting with alien ships and blasting ground installations while you rescue stranded troopers. Rescue all the troopers and be transported to another harder, faster battle. Joysticks required. ALL MACHINE CODE! EDSONS BEST! 16K Tape TRS80COLOR $19.95 – 32K Disk $21.95.

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TINY COMPILER is written in BASIC. It generates native, relocatable 6502 or 6809 code. It comes with a 20-page manual and can be modified or augmented by the user. $24.95 on tape or disk for OSI, TRS-80 Color, VIC 20, or Commodore 64.

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BASIC bits

Sorting numbers as strings and other tips

Models I/III

Thomas L. Quindry, Contributing editor

From time to time this column will be comprised solely of reader questions and answers. Here are some guidelines for those who wish to submit material for answer in a future column.

The questions should refer to BASIC programming techniques. If you are referring to a specific programming problem, please include a listing of the part of the program that contains the problem. Only TRSDOS operating system problems will be covered. Any questions on using short, embedded, machine code routines or general conversion questions for the Models I or III are welcome. (I do not intend to provide conversions to commercial programs.) Feel free to send in tips and suggested topics for future columns. BASIC bits is designed to be your question and answer column.

Question: I will pay a reasonable amount to anyone who will provide me a program that will pass arguments back and forth in BASIC-embedded machine language for a number sort. I have a Model I, level II, 32K, with NEWDOS/80.--J.B., Seattle, WA

Answer: Save your money! Even in mainframe computers, doing a number sort in assembly language is quite a task. I would suggest that, while in BASIC, you first convert all your numeric variables to representative string variables of equal length and use a machine language sort that was designed for strings. Keep the following in mind: Each string representation must have the same number of places to the left of the decimal. That is due to the way in which the sort is analyzed. For example, to sort the numbers 90.9 and 100 you would have to change them to strings equal to 090.9 and 100, respectively, before sorting.

Another problem is the minus sign (-). When using a string sort, the minus sign will cause the negative numbers to be sorted in the wrong order in your array. Strings with a leading minus sign are sorted high to low, followed by the positive "strings" sorted in a low to high order. You can get around this by adding a value to all numbers that insures they are all positive. Then subtract the same value from all numbers before printing them out. You have to watch out for numbers that are too large. Over six digits in single precision is too much and they will be rounded off or changed to exponential notation. In Listing 1, I have given a BASIC program to convert numbers between -5000 and +5000 to string values of even length (with two decimal places). In this example I assume that you are interested in dollars and cents, hence the two decimal places. If you are only dealing with positive numbers, you have quite a bit more leeway and don't have to add the 5000 before your sort. You can also skew to different ranges. Adding 1000 instead of 5000 will allow you to sort numbers between 9000 and -1000. Experiment around. The BASIC routine assumes that you already have a machine language string sort. The syntax used in line 160 is for the string sort routine that is a part of TRSDOS 1.3 for the Model III. If you don't have Model III TRSDOS, or some other model, you will have to provide your own machine language routine and change line 160 to give the proper notation. The July 1980 issue of *TRS-80 Microcomputer News* from Radio Shack contained such a program. An update in their November 1980 issue gave a short BASIC program for sorting digits from 000 to 999 by using the routine in their July 1980 issue. The December 1982 issue of *80-U.S. Journal* contained a machine language sort for the Color Computer. Other magazines have published sort routines as well.

A Disk BASIC command, INSTR, is used in line 70. If you don't have a disk system, substitute lines 80 to 120 to compute the value, X, to be used.

Question: I consider myself a fairly good, amateur programmer. But when I read your articles and fail to understand one word of it, I realize what a computer illiterate I really am! Especially bewildering are those program lines like DATA 205, 127, 10, 125, 33, 1, 60, etc. Where do you get those numbers? Could you suggest a book or two that would get a person a little deeper into his Model I? --J.B., Erie, PA

Answer: There is nothing wrong with your knowledge of BASIC. What you are looking at is a hybrid program. Many programmers include both BASIC and machine language routines together in one program, usually the BASIC program. The machine language portion is usually a short subroutine that enhances the BASIC program. Many of the programs in this column will be a hybrid.

The numbers you were looking at in the DATA statement were the decimal coding for machine language instructions. They were POKEd into memory at a location where they could be called later using the USR function. In order to know what they mean, you would have to understand assembly language programming and also know how to convert each of the data codes into either binary of hexadecimal numbers. You can then look up the mnemonics in a table. It is not my intention that BASIC bits readers know assembly language programming, so I'm glad you asked.

Good books on the subject of BASIC have to include *Learning Level II* by Dr. David Lien. He wrote the Model I learning manual. To get a little deeper into assembly language, get *TRS-80 Assembly Language Programming* by William Barden, Jr. His book is available at Radio Shack for $3.95. Keep in mind that assembly language programming requires a completely different approach than does BASIC and it may or may not come easy to you.

Question: How do programmers get special characters in their BASIC listings? I refer to programs such as those in *CLOAD* magazine which have some animation. I was quite surprised when I LISTed it. --M.E., Scranton, PA

Answer: The answer to your question can be found in my December 1982 column and it included a good example of how it is done. Essentially, you find the location in your BASIC program where you want to put the special characters and POKE them in. You are altering whatever is already in memory at the addresses you POKE.

The easiest way to do this is to define a string such as A$. You must reserve space for your POKEs by entering dummy characters in your string. To POKE in ten special characters into A$ you would start by defining A$ = "1234567890". That gives you ten dummy characters to be altered. Then, using a BASIC statement like X = VARPTR(A$): Y = PEEK(X+1) + 256*PEEK(X+2), you can find the memory location of the string. Starting at Y for the next ten addresses, POKE in the desired characters. My November 1982 column showed what codes will give each graphic character.

Incidently, only the Model III will let you see the graphics characters embedded in your code when it is

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listed. The Model I BASIC interpreter tokenizes the characters before they are listed. That is why a Model I listing will display something like A$ = "DEFINTCLEARGOSUB...".

Question: Why are strings formed by STR$ off in length by one byte? If you input a number, N, and define N$ = STR$(N), N$ seems to add a space to the beginning. For example, if N = 123 then N$ will be of length four, not three. Interestingly, if N$ = "123" you will get LEN(N$) equal to three. --M.E., Scranton, PA

Answer: You have to consider how the variable N is displayed on the screen. Try the following:

N=123: PRINT @0,"THIS IS N": PRINT N

You will notice that the value, 123, starts on the second line, under the "H" of the word THIS. BASIC always adds a space before it is displayed. Now enter the command:

FOR M = 15424 TO 15427: PRINT PEEK(M);: NEXT

The numbers displayed will be 32, 49, 50, and 51. These are the ASCII codes that correspond to space, one, two, and three. They are the four codes which are entered into your string when using N$ = STR$(N) and that is why the string length is four, not three.

There is a perfectly logical reason for it. Let's say you defined N = -123. Using the procedure above, you would find that the minus sign is directly under the "T" in the word THIS, not under the "H". Defining N$ = STR$(N) will also give a length of four, but the first character is a minus sign (not a space). When a number is positive the leading character is always a space. When the number is negative it will be a minus sign.

Be sure to send in your questions to BASIC bits, c/o *80-U.S. Journal*, 3838 So. Warner, Tacoma, WA 98409.

```
10 'SORT PROGRAM FOR NUMERICAL VARIABLES
20 CLEAR100
30 DIMA$(5)
40 FOR N=0 TO 5
50 INPUTA:IFA>4999.99ORA<-4999.99THENPRI
NT"INPUT ERROR, TRY AGAIN!":GOTO50
60 A$(N)=STR$(A+5000):A$(N)=RIGHT$(A$(N)
,LEN(A$(N))-1)
70 X=INSTR(A$(N),".") 'IF NO DISK BASIC
USE 80-120 INSTEAD
80 'X=LEN(A$(N))
90 'IF MID$(A$(N),X,1)="."THEN GOTO 130
100 'X=X-1
110 'IFX=0 THEN GOTO130
120 'GOTO 90
130 IFX=0THENA$(N)=A$(N)+".":X=LEN(A$(N)
)
140 IFX<5THENA$(N)="0"+A$(N):X=X+1:GOTO1
40
150 NEXT
160 N6%=6:CMD"O",N6%,A$(0)'MODEL III SOR
T ROUTINE NOTATION
170 B$="#####.##"
180 FORN=0TO5:B=VAL(A$(N))-5000
190 PRINTUSINGB$;B:NEXT:END
```

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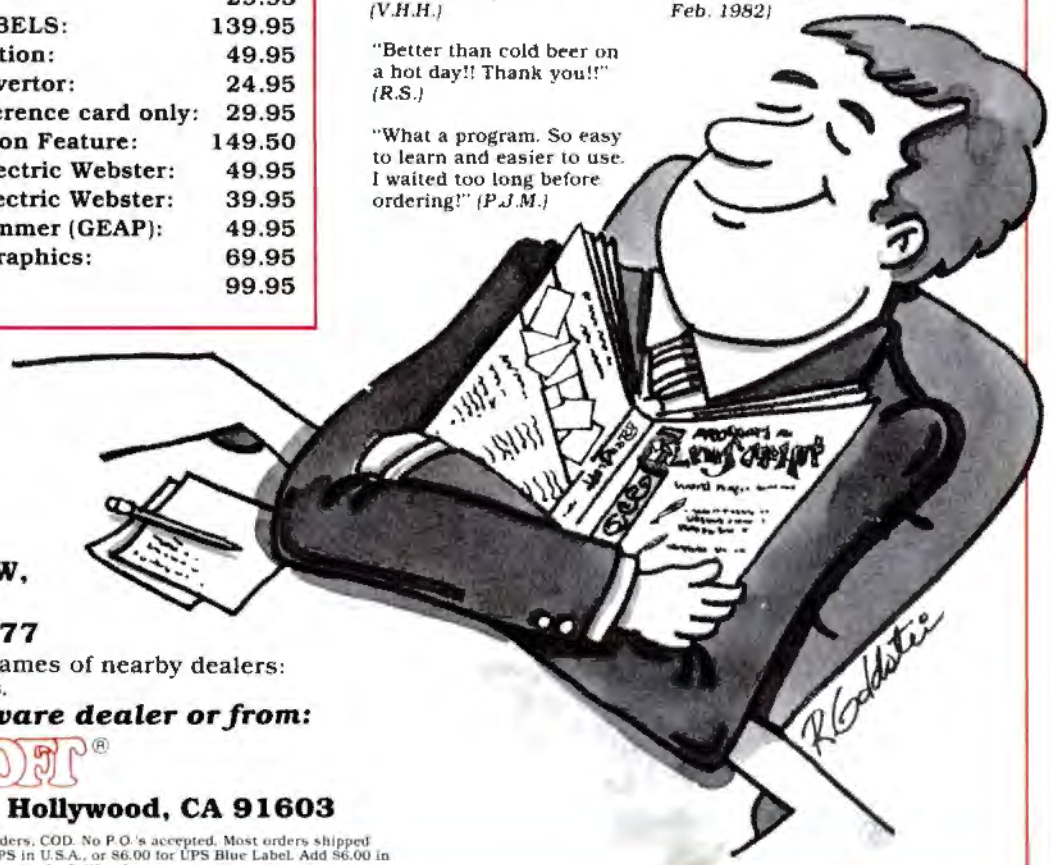

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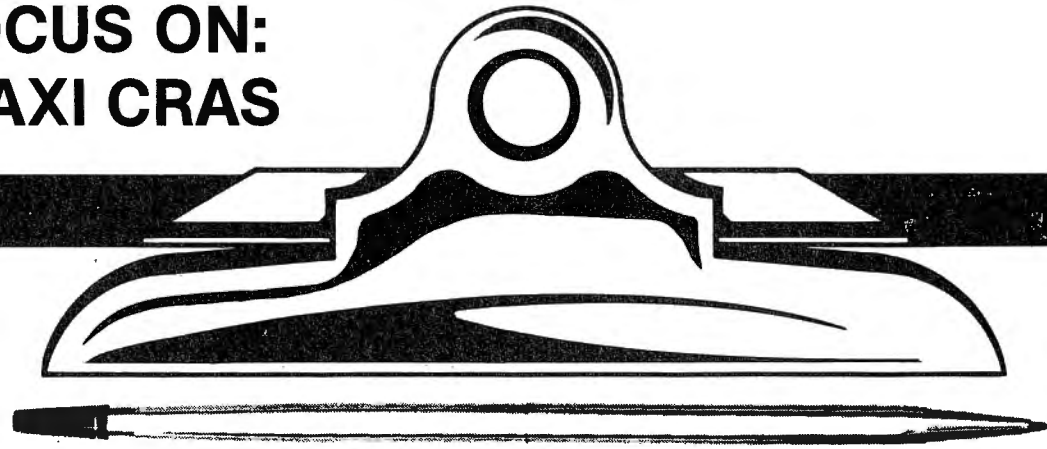

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Model I/III port assignments

What do they really do?

Models I/III

Robert Brown,

Schenectady, NY

Have you ever wondered where those port numbers come from when you see INP(N) and OUT(N) statements in TRS-80 BASIC program listings? My disk head cleaner program, published in the May 1982 issue of *80-U.S. Journal*, triggered a series of letters from fellow hobbyists who wanted to know more about Model III ports and their use. To answer their questions and to improve my own understanding, I decided to do some research. The next few pages describe all the known and documented Model III ports. Every attempt was made to confirm the information and the bit assignments from at least *two* reliable reference sources.

One common misconception, as evidenced by the letters, was a tendency to equate INP with PEEK and OUT with POKE. Ports are *not* memory locations and are manipulated by the central processor at very high speeds. It is very unlikely that one could OUT a value through a port and then find the same value with an INP statement. In fact, often the assignment of bits when a port is *written to* is entirely different from the meaning of the same bits when the same port is *read from.* Probably the confusion arises because the Model I was memory-mapped and communication was with what *seemed* like memory addresses. Actually, there were not RAM addresses, but "addressed devices." Early Model I computers used only one port — FF(H) for the cassette. Later, additional ports were claimed by the RS-232 interface. The same ports are used in the Model III, but the Model III did away with memory-mapping altogether except for the display which is truly memory-mapped.

The Z-80 processor is capable of communicating with 256 "ports" usually assigned to peripheral devices. It uses the address bus and the data bus, sending out an 8-bit port address and a special signal saying, "Hey folks! I have an I/O address here." It is the responsibility of the peripheral device to recognize its unique I/O address and to receive or transmit data. Radio Shack has *reserved* ports 80(H) through FF(H) for system use on the Model III. The remaining ports can be used to communicate with your own peripheral devices with impunity, but when attempting to use the reserved ones, watch carefully for conflicts. Several commercial add-on devices, including speed-up kits, the Mikeegraphic hi-res kit, and some software (notably, Super Utility Plus) use port 254. The Microconnection Modem uses port 208. As port assignments are presented in the table which follows, the approximate Model I equivalent will be listed for those who are transferring their expertise on the earlier computer to the Model III.

When programs designed for the Model I, especially those using sound routines which buzz the cassette relay or output audio through the cassette connector, are run on the Model III, watch for use of port

255. These programs can be easily modified to run on the Model III by using port 236 instead. The ports assigned to the cassette recorder and to the RS-232 are very amenable to use from within BASIC. Make use of these to write your own host programs, intelligent terminal programs, and telephone directory/dialing programs. A good use of these ports is demonstrated in "Write Your Own Communications Programs" by Pat Morgan in *80-U.S. Journal*, November 1982.

With the exception of simple select, restore and seek operations (as were used in the disk head cleaning program mentioned earlier), these ports are difficult to use. Not only must the data be correct, but the timing and sequence is critical. A handy use, within BASIC, is to keep your disk drives spinning between frequent reads or writes. This will make program execution faster. With the information from the table, you only select the drive, check status (bit 7 or port F0H) and reselect it again if necessary. For drive 0:

```
10 OUT(244),1:IF INP(240) <128
THEN 10
10 POKE 14305,1:IF PEEK(14316)
<128 THEN 10 (Model I version)
```

You should notice that there is some confusion as to the use of 37E0H and 37E1H in the Model I. Although incorrect, 37E0H is often used (and, in fact, works) to select drives. Even Bill Barden, Jr., in his treatise, *TRS-80 Disk Interfacing Guide*, says under Disk Selection: "Loading a (Z-80) register with 1, 2, 4, or 8, and performing a store to location 37E0H will select drive 1, 2, 3, or 4 accordingly." But his code a few pages later shows LD A,01 followed by LD (37E1),A. In the Model III, F4H (244) *must* be used for drive selection.

These ports are quite useful from within BASIC and pretty much self-explanatory. The author hereby apologizes for any errors which might have crept into these listings despite his care, and will appreciate receiving reports of any conflicts or erroneous information. Now, break open the champagne and set sail from your nearest port! ■

MODEL III PORT	FUNCTION	MODEL I ADDRESS
E0H (224)	MASKABLE INTERRUPT LATCH	37E0H (14304)
	Bit RESET = Interrupt Request (which directs jumps to the interrupt service routines)	
	Bit 0 — Cassette Interrupt (rising)	Bit 0,1 — Unused
	Bit 1 — Cassette Interrupt (falling)	Bit 2 — Communications Interrupt
	Bit 3 — I/O Bus Interrupt	
	Bit 4 — RS-232 Interrupt (Transmit)	Bit 3,4,5 — Unused
	Bit 5 — RS-232 Interrupt (Receive)	
	Bit 6 — RS-232 Interrupt (Error)	Bit 6 — Disk Interrupt
	Bit 7 — Unused Interrupt #7	Bit 7 — Clock Interrupt
E4H (228)	NON-MASKABLE INTERRUPT LATCH	No Direct Equivalent —
	Bit RESET = Interrupt Request	Non-maskable Interrupts not
	Bit 5 — Front Panel Reset Interrupt	enabled
	Bit 6 — Motor Time-Out Interrupt	
	Bit 7 — Disk Controller Interrupt	
E8H (232)	RS-232/MODEM STATUS REGISTER	PORT E8H
OUT:	Any byte RESETS the interface by strobing the master reset pin of the UART	Exactly as per Model III
IN:	Bit 0 — Serial Data from RS-232	
	Bit 1,2,3 — Unused	
	Bit 4 — RI (Ring Indicator)	
	Bit 5 — CD (Carrier Detect)	
	Bit 6 — DSR (Data Set Ready)	
	Bit 7 — CTS (Clear to Send)	
E9H (233)	RS-232 BAUD RATE SELECT/SWITCH SENSOR	PORT E9H
OUT:	Bits 0-3 — Select Receive Baud Rate	
	Bits 4-7 — Select Transmit Baud Rate	
IN:	Bits 0-2 — Ignore	Exactly as per Model III

Bit 3 — Parity (SET = enabled)
Bit 4 — Stop Bits (SET = 2. RESET = 1)
Bits 5-6 — Word Length (00 = 5, 01 = 6, 10 = 7, 11 = 8)
Bit 7 — Parity (SET = even, RESET = odd)

EAH (234) UART CONTROL/STATUS REGISTER .....PORT EAH

OUT: Bit 0 — DTR (Data Terminal Ready)*
Bit 1 — RTS (Request to Send)*
Bit 2 — BREAK (Disable Transmit Data)
Bit 3-7 — See the assignments, Port E9H

IN: Bit 0-2 — Unused
Bit 3 — (SET = parity error)
Bit 4 — (SET = framing error)
Bit 5 — (SET = overrun error)
Bit 6 — (SET = data sent, register empty)
Bit 7 — (SET = data received, register full)

Exactly as per Model III

* The Radio Shack Model III Service Manual lists these two bits reversed from the assignments shown here.

EBH (235) RS-232 DATA REGISTER .....PORT EBH

OUT: 8-bit parallel transmit data

Exactly as per Model III

IN: 8-bit parallel receive data

ECH (236) MISCELLANEOUS CONTROLS .....No Direct Equivalent — but see Port FFH (255)

Bit 1 — Cassette Motor (SET = on)
Bit 2 — 32 CPL mode (SET = 32 CPL)
Bit 3 — KANA Characters (RESET = KANA)
Bit 4 — I/O Bus (SET = enabled)
Bit 5 — Video Waits (SET = enabled)
Bits 0,6,7 — Unused

F0H (240) FDC COMMAND/STATUS REGISTER.....37ECH (14316)

OUT: Used to issue commands to the disk controller — see Western Digital FD1771/3 and FD-179X technical manuals for bit assignments

Treated Exactly as per Model III Port F0H

IN: Bit 0 — (SET = busy)
Bit 1 — DRQ (SET = data register full)*
Bit 2 — Lost Data/Missing Address*
Bit 3 — CRC (SET = error)*
Bit 4 — Seek Error/Record Not Found (SET = error)*
Bit 5 — (SET = head engaged)*
Bit 6 — (SET = write-protected disk)*
Bit 7 — Not ready *
* These are TYPICAL status reports. Various reports are available depending upon the disk operation in progress.

F1H (241) DISK TRACK UPDATE REGISTER 37EDH (14317)

IN: Current Track

NOTE: This is a READ ONLY Port. Track SELECTION is done by loading the data register

Treated Exactly as per Model III Port F1H

(F3H) with the desired track and then issuing a SEEK command through Port F0H

F2H (242) DISK SECTOR SELECT REGISTER 37EEH (14318)

IN or OUT: 8-bit parallel register for storing or reading desired sector — Treated Exactly as per Model III Port F2H

F3H (243) DISK DATA REGISTER.....37EFH (14319)

IN and OUT: 8-bit parallel register for data — Treated Exactly as per Model III Port F3H

F4H (244) DISK DRIVE SELECT 37E1H (14305)

OUT: Bit 0 — SET = Drive 0
Bit 1 — SET = DRIVE 1
Bit 2 — SET = DRIVE 2
Bit 3 — SET = DRIVE 3
Bit 7 — SET = Double Density

Treated as per Model III Port F4H *if* in double-density mode using write precompensation

IN: Bits 0-3,7 — Ignore
Bit 4 — RESET = Side 0, SET = Side 1
Bit 5 — SET = Write Precompensation Engaged
Bit 6 — SET = Generate Waits

F8H (248) LINE PRINTER STATUS/DATA REGISTER.....37E8H (14312)

OUT: 8-bit parallel Data Port

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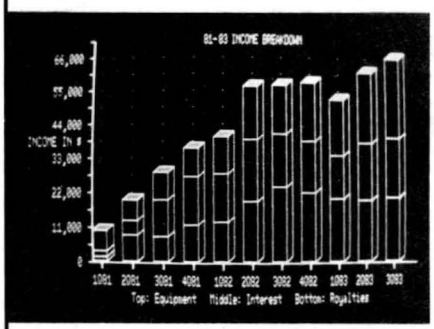

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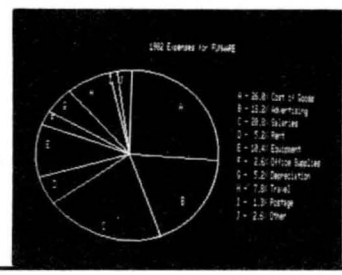

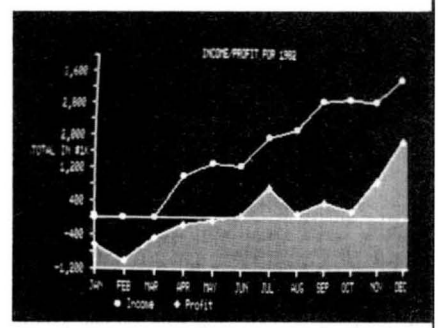

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IN: Bits 0-3 — Unused
Bit 4 — (SET = printer fault)
Bit 5 — (SET = device selected)
Bit 6 — (SET = out of paper)
Bit 7 — (SET = busy)

Very similar to Model III but bit assignment differs slightly

NOTE: The Model III can also use 37E8H (14312) in a PEEK statement. The following code tests printer status and works on BOTH the Model I and III:
10 IF (PEEK(14312) AND 240) < > 48 PRINT "PRINTER NOT READY":GOTO 10

FFH (255) CASSETTE STATUS/COMMAND REGISTER ...PORT FFH

OUT: Bits 0,1 — Output Signal
00 = .85v, 01 = .46v, 10 = 0.0v
Bits 2-7 — Unused

Bits 0,1 — Output Signal
Bit 2 — (SET = motor on)
Bit 3 — (SET = 32 CPL)

IN: Bit 0 — (SET = 1500 baud)
Bit 1 — (SET = motor on)
Bits 2-5 — See same bits, Port 0ECH
Bit 6 — Unused
Bit 7 — (SET = 500 baud)

Bits 4-7 — Ignore
Bits 0-5 — Ignore
Bit 6 — Display Status
Bit 7 — Cassette Input

.....No Direct Equivalent 37E4H (14308)

OUT: 01 = select cassette 1
02 = select cassette 2

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Partial List of Graphics BASIC Commands	
CIRCLE	Draws a circle, arc or ellipse.
GET	Reads the bit pattern in a block on the display screen into an array for alteration and future use.
LINE	Draws a line between points.
PAINT	Paints an area in a specified style.
PUT	Puts contents (bit pattern) of an array onto the screen.
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VIEW	Defines coordinates of a specified block (viewport).

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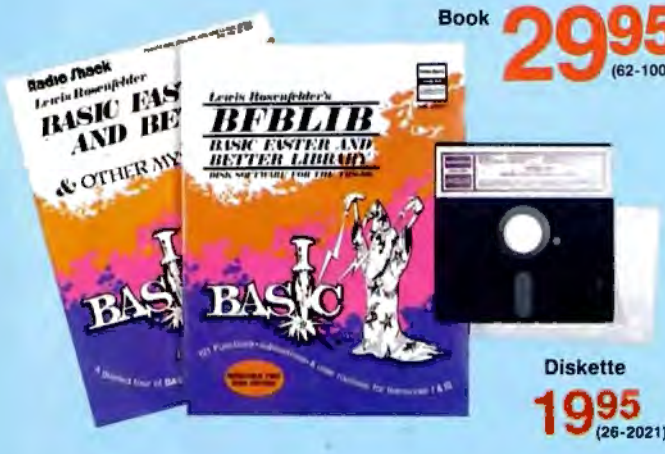

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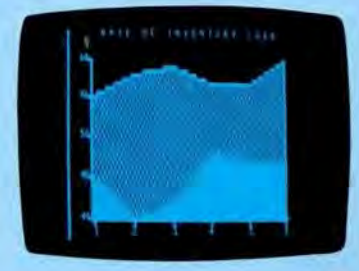

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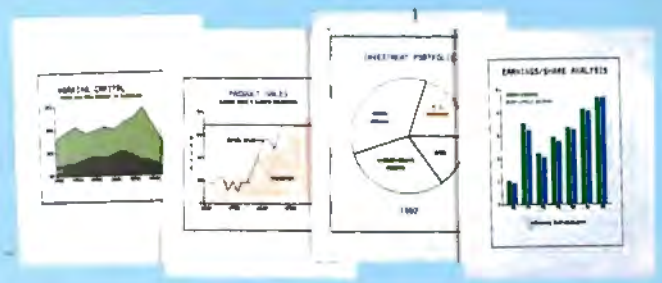

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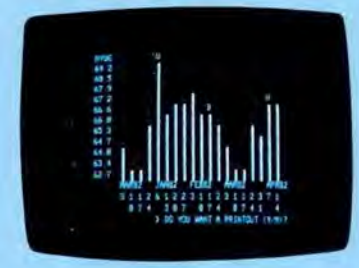

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Operation genius

A peg game with sound

Models I/III, audio amplifier

Chad Barker, Cary, NC

Have you ever played one of those games on a triangle-shaped board that has several pegs on it and you try to jump one peg over another until you have only one peg left on the board (or at least that's what you tried to do)? Well, Operation Genius 3.1 simulates that game. The challenge is to complete Operation Genius in the fewest number of moves possible. The Operation Genius program has sound. To hear it, plug the auxilliary plug that runs to the tape recorder into a small amplifier.

Loading Instructions

Cassette— To load the Operation Genius game from cassette, you must place the tape in the cassette recorder and make sure it is rewound. While in the command mode, type CLOAD and press <ENTER>. Then press the play button on the cassette recorder. After the program has loaded, type RUN and press <ENTER>.

Disk— Go into BASIC and set the number of files to one (1) and do not set memory size. Type: RUN "OPGEN3" and press <ENTER>.

Would you like to load a previous game?

After you run version 3.1, the computer will put the board on the screen and ask: WOULD YOU LIKE TO LOAD A PREVIOUS GAME (Y/N)? If you have played this game before, you might have saved the game on cassette or disk, and you might want to load the game back in and resume play where you left off.

If you do wish to restore a previous game that has been saved, type "Y" for yes. If you are using the disk version, make sure that the disk with the data is in the drive *before* you press <ENTER>! After you press <ENTER>, the computer will print up in the left hand corner "READING DATA . . ." If you are using a cassette system, place the cassette with the data on it in the cassette recorder and press play. If you are using a disk system, the program will immediately look for the data file on the disk.

If an error in the data is detected, the computer will tell you so and ask you if you would like to try again. Answer this question with a "Y" for yes and an "N" for no, depending on whether or not you would like to try again. If the data is okay, the computer will decode the data, place the pegs on the board just like they were when you left off, and ask you for your next move.

If you do not wish to restore a previous game, or you do not have a previous game to restore, answer no to the question by typing an "N". The program will set up the pieces in the starting format and ask for your first move.

How to enter jumps:

Now that you have all the preliminaries out of the way, you can start the game. The computer will display a "FROM:" in the upper left hand corner of the screen. This is asking you what block you want to move a peg from (that block must have either a regular peg or an odd peg).

When you make a jump, the peg you jump is *not* removed from the board. The object is to get the nine regular pegs in the lower right hand corner of the screen into the positions of the nine odd pegs (in the upper left hand portion of the screen) by jumping one peg over another. Then get the nine odd pegs in their positions into the nine positions in the lower right hand part of the screen.

Scoring:

Scoring in this game is very easy. Either you did it right or you did it wrong. To find your score, press the "S" key and <ENTER>. The computer will tell you how many moves you made, and if you completed the game correctly, it will say: "PERFECT! A GENIUS!! NEXT TIME TRY TO DO IT IN FEWER MOVES!" If you did not complete the game correctly, it will print: "YOU WERE NOT ABLE TO FINISH. PRACTICE MAKES PERFECT."

When it gives your score, it will play a little tune and ask you if you would like to try the game again. Answer yes, or no, depending on whether or not you want to play again.

Saving the game

Sometime, you may be playing this game and see that

it is getting late. What you want to do is save the game, and at a later date, pick up where you left off. Well, this is very easy. All you have to do is press "P" while in either the "FROM:" or "TO:" mode, and press <ENTER>. The computer will clear the screen and there will be a short delay (it is preparing the data to be recorded). Then it will tell you to "PREPARE CASSETTE AND PRESS ENTER" (for a cassette system), or "MAKE SURE THE DISKETTE IS IN DRIVE ZERO, IS NOT WRITE PROTECTED, AND HAS AT LEAST ONE GRANULE OF SPACE ON IT. WHEN READY PRESS ENTER." (for a disk system). When the recording medium you are using is ready, press <ENTER>. The computer will write the data out to cassette or disk.

You will be asked if you wish to verify the data that has been saved. Answer this question with yes or no and press <ENTER>. If you wish to verify the data, you will be told to ready the cassette or the diskette to read in the data and press <ENTER>. The computer will verify the data and tell you whether the data is correct or not. If the data is not correct, you will be asked if you would like to try to record the data again. If you would like to try to record the data again, it will start back where it tells you to prepare the tape or diskette.

If the data is correct, it will tell you so (or if you answered no to the question that asks if you would like to verify the data), delay for a while, and jump to asking if you would like to try the game again. Answer yes or no to this question.

As long as you have a little time and patience, you will be able to complete this game. The challenge is to complete it in the fewest number of moves.

Operation Genius Version 3.1

```
10 '**********************
15 '* OPERATION GENIUS    *
20 '* VERSION 3.1         *
25 '* (C) COPYRIGHT 1981 *
30 '*  BY CHAD BARKER     *
40 '**********************
60 CLS:CLEAR1000:DEFSTRR:DIMZ(49),P(49)
   ,Q(49),R(49):RESTORE:PRINT@461,;CHR$(
   23);"OPERATION GENIUS";:PRINT@530,;"V
   ERSION 3.1";
70 B1$=CHR$(156)+STRING$(8,140)+CHR$(15
   6)+STRING$(8,140)+CHR$(156)+STRING$(8
   ,140)+CHR$(156)+STRING$(8,140)+CHR$(1
   56)+STRING$(8,140)+CHR$(156)+STRING$(
   8,140)+CHR$(156)+STRING$(8,140)+CHR$(
   148)
80 B2$=CHR$(149)+CHR$(198)+"1 "+CHR$(14
   9)+CHR$(198)+"2 "+CHR$(149)+CHR$(198)
   +"3 "+CHR$(149)+CHR$(198)+"4 "+CHR$(1
   49)+CHR$(198)+"5 "+CHR$(149)+CHR$(198
   )+"6 "+CHR$(149)+CHR$(198)+"7 "+CHR$(
   149)
90 B3$=CHR$(157)+STRING$(8,140)+CHR$(15
   7)+STRING$(8,140)+CHR$(157)+STRING$(8
   ,140)+CHR$(157)+STRING$(8,140)+CHR$(1
   57)+STRING$(8,140)+CHR$(157)+STRING$(
   8,140)+CHR$(157)+STRING$(8,140)+CHR$(
   149)
100 B4$=CHR$(149)+CHR$(198)+"8 "+CHR$(1
   49)+CHR$(198)+"9 "+CHR$(149)+CHR$(197
   )+"10 "+CHR$(149)+CHR$(197)+"11 "+CHR
   $(149)+CHR$(197)+"12 "+CHR$(149)+CHR$
   (197)+"13 "+CHR$(149)+CHR$(197)+"14 "
   +CHR$(149)
110 B5$=CHR$(149)+CHR$(197)+"15 "+CHR$(
   149)+CHR$(197)+"16 "+CHR$(149)+CHR$(1
   97)+"17 "+CHR$(149)+CHR$(197)+"18 "+C
   HR$(149)+CHR$(197)+"19 "+CHR$(149)+CH
   R$(197)+"20 "+CHR$(149)+CHR$(197)+"21
    "+CHR$(149)
120 B6$=CHR$(141)+STRING$(8,140)+CHR$(1
   41)+STRING$(8,140)+CHR$(141)+STRING$(
   8,140)+CHR$(157)+STRING$(8,140)+CHR$(
   157)+STRING$(8,140)+CHR$(157)+STRING$
   (8,140)+CHR$(157)+STRING$(8,140)+CHR$
   (149)
130 B7$=CHR$(219)+CHR$(149)+CHR$(197)+"
   25 "+CHR$(149)+CHR$(197)+"26 "+CHR$(1
   49)+CHR$(197)+"27 "+CHR$(149)+CHR$(19
   7)+"28 "+CHR$(149)
140 B8$=CHR$(228)+CHR$(149)+CHR$(197)+"
   33 "+CHR$(149)+CHR$(197)+"34 "+CHR$(1
   49)+CHR$(197)+"35 "+CHR$(149)
150 B9$=CHR$(228)+CHR$(157)+STRING$(8,1
   40)+CHR$(157)+STRING$(8,140)+CHR$(157
   )+STRING$(8,140)+CHR$(149)
160 C1$=CHR$(228)+CHR$(149)+CHR$(197)+"
   40 "+CHR$(149)+CHR$(197)+"41 "+CHR$(1
   49)+CHR$(197)+"42 "+CHR$(149)
170 C2$=CHR$(228)+CHR$(149)+CHR$(197)+"
   47 "+CHR$(149)+CHR$(197)+"48 "+CHR$(1
   49)+CHR$(197)+"49 "+CHR$(149)
180 C3$=CHR$(228)+CHR$(141)+STRING$(8,1
   40)+CHR$(141)+STRING$(8,140)+CHR$(141
   )+STRING$(8,140)
190 C4$=CHR$(219)+CHR$(141)+STRING$(8,1
   40)+CHR$(157)+STRING$(8,140)+CHR$(157
   )+STRING$(8,140)+CHR$(157)+STRING$(8,
   140)+CHR$(149)
200 P1$=CHR$(196):P2$=CHR$(174)+CHR$(19
   1)+CHR$(191)+CHR$(157):P3$=CHR$(166)+
   CHR$(166)+CHR$(166)+CHR$(132)
210 R(1)="1AA":R(2)="1BA":R(3)="1CA":R(
   4)="1DA":R(5)="1EA":R(6)="1FA":R(7)="
   1GA":R(8)="2AA":R(9)="2BA":R(10)="2CA
   ":R(11)="2DA":R(12)="2EA":R(13)="2FA"
   :R(14)="2GA":R(15)="3AA":R(16)="3BA":
   R(17)="3CA":R(18)="3DA":R(19)="3EA":R
   (20)="3FA":R(21)="3GA"
220 R(22)="4AA":R(23)="4BA":R(24)="4CA"
```

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```
:R(25)="4DA":R(26)="4EA":R(27)="4FA":
R(28)="4GA":R(29)="5AA":R(30)="5BA":R
(31)="5CA":R(32)="5DA":R(33)="5EA":R(
34)="5FA":R(35)="5GA":R(36)="6AA":R(3
7)="6BA":R(38)="6CA":R(39)="6DA":R(40
)="6EA":R(41)="6FA":R(42)="6GA"
230 R(43)="7AA":R(44)="7BA":R(45)="7CA"
:R(46)="7DA":R(47)="7EA":R(48)="7FA":
R(49)="7GA":R1="4GAGA":R2="1BDCDBDCDB
DCDBDCDBDCDBDCDBDCDBDCDBDCDBDCDBDCDBD
CDBDCDBDCDBDCD":R3="3CECECCCED#FDDDDC
DCDBDCD":R4="4CBCBDBCHRDCBRBCBRBCBRBC
BRBCBRBCBRBCB":GOSUB950
240 DATA3,3,3,1,1,1,1,3,3,3,1,1,1,1,3,3
,3
250 DATA1,1,1,1,9,9,9,1,1,1,1,9,9,9,9,2
,2
260 DATA2,9,9,9,9,2,2,2,9,9,9,9,2,2,2
270 DATA2,2,2,1,1,1,1,2,2,2,1,1,1,1,2,2
,2
280 DATA1,1,1,1,9,9,9,1,1,1,1,9,9,9,9,3
,3
290 DATA3,9,9,9,9,3,3,3,9,9,9,9,3,3,3
300 A$="................................
.....................................
.....................................
.....................................
.....................................
.....................................
....................................."
310 IFK<>0THEN330ELSEX=PEEK(VARPTR(A$)+
2)*256+PEEK(VARPTR(A$)+1)
320 FORN=1TO250:READD:POKEX+N-1,D:NEXT:
K=1:GOTO300
330 A=VARPTR(A$):B=PEEK(A+1):C=PEEK(A+2
):POKE16782,195:POKE16783,B:POKE16784
,C:A=C*256+B:D=A+199:CLS
340 DATA 221,42,143,65,30,220,175,87,22
1,25
350 DATA 215,205,13,38,35,229,213,253,2
25,26
360 DATA 253,110,1,253,102,2,84,133,48,
1
370 DATA 20,95,175,221,119,25,221,229,2
53,225
380 DATA 229,225,223,32,10,225,62,3,221
,119
390 DATA 27,221,119,25,201,43,215,48,7,
214
400 DATA 48,221,119,27,24,246,214,64,20
2,151
410 DATA 25,254,18,32,7,213,221,229,175
,35
420 DATA 24,71,254,2,56,14,254,4,56,9
430 DATA 40,6,254,7,56,1,60,60,60,60
440 DATA 35,79,223,48,196,213,221,229,6
,1
450 DATA 89,175,87,126,254,35,32,2,28,3
5
460 DATA 254,42,32,7,91,35,29,32,2,30
470 DATA 12,203,35,221,25,221,94,1,221,
86
480 DATA 2,253,126,27,40,11,203,58,203,
27
490 DATA 61,24,247,71,87,30,130,27,27,2
13
500 DATA 221,225,126,230,31,35,229,79,1
75,103
510 DATA 111,120,211,255,221,229,209,25
,175,27
520 DATA 187,32,252,186,32,249,211,255,
221,229
530 DATA 209,27,187,32,252,186,32,249,6
2,16
540 DATA 188,48,224,13,32,218,225,221,2
25,209
550 DATA 229,213,221,229,225,30,179,81,
63,237
560 DATA 82,209,233,170,5,90,5,12,5,196

570 DATA 4,128,4,63,4,2,4,200,3,146
580 DATA 3,94,3,46,3,3,3,3,3,32,32
590 PRINT@64,;B1$;:PRINT@128,;B2$;:PRIN
T@192,;B3$;:PRINT@256,;B4$;:PRINT@320
,;B3$;:PRINT@384,;B5$;:PRINT@448,;B6$
;:PRINT@512,;B7$;:PRINT@576,;C4$;:PRI
NT@640,;B8$;:PRINT@704,;B9$;:PRINT@76
8,;C1$;:PRINT@832,;B9$;:PRINT@896,;C2
$;:PRINT@960,;C3$;:POKE16383,133
600 PRINT@0,"WOULD YOU LIKE TO LOAD A P
REVIOUS GAME (Y/N)? ";:NN=1:GOSUB760:
IFNW$="Y"THENGOSUB920
610 POKED,1:A=0:FORM=1TO7:FORN=1TO7:V=N
:A=A+1:GOSUB720:NEXTN,M
620 GOSUB630:G=G+1:GOTO620
630 X=X+1:PRINT@0,;CHR$(255);:PRINT@0,;
"FROM: ";:NN=2:GOSUB760:F=VAL(NW$):PR
INT@0,;CHR$(255);:PRINT@0,;"TO: ";:NN
=2:GOSUB760:T=VAL(NW$)
640 GOSUB840:IFB=0PRINT@0,;"ILLEGAL MOV
E";:POKED,1:NAME(R2):PRINT@0,;CHR$(25
5);:GOTO630
650 M=INT(F/7)+1:N=F-((M-1)*7):P(T)=P(F
):P(F)=1:A=F:X=F:GOSUB710:M=INT(T/7)+
1:N=T-((M-1)*7):A=T:X=T:GOSUB710:RETU
RN
660 PRINT@0,CHR$(255);:PRINT@0,"YOU TOO
K"G"MOVES AND....";:FORN=1TO49:IFP(N)
<>Q(N)THEN670ELSENEXT:GOTO680
670 FORN=1TO1000:NEXT:PRINT@0,CHR$(255)
;:PRINT@0,"YOU WERE NOT ABLE TO FINIS
H. PRACTICE MAKES PERFECT.";:POKED,16
:NAME(R3):GOTO690
680 FORN=1TO750:NEXT:PRINT@0,CHR$(255);
```

```
:PRINT@Ø,"PERFECT! A GENIUS!! NEXT TI
ME TRY TO DO IT IN FEWER MOVES!";:GOT
O86Ø
69Ø POKED,1:FORN=1TO15ØØ:NEXT:PRINT@Ø,;
CHR$(255);:PRINT@Ø,;"WOULD YOU LIKE T
O TRY AGAIN (Y/N) ? ";:NN=1:GOSUB76Ø:
IFNW$="N"GOSUB91Ø:CLS:ENDELSEIFNW$<>"
Y"THEN69Ø
7ØØ RESTORE:G=Ø:PRINT@Ø,;CHR$(255);:PRI
NT@Ø,;"JUST ONE SECOND PLEASE ....";:
FORN=1TO1ØØ:NEXT:POKED,6:NAME(R4):GOS
UB95Ø:GOTO59Ø
71Ø IF(X/7)=INT(X/7)THENV=-65ELSEV=N
72Ø PA=(128*M)+(8*(N-1))+V:ONP(A)GOSUB7
3Ø,74Ø,75Ø:RETURN
73Ø PRINT@PA,;P1$;:NAME(R(A)):RETURN
74Ø PRINT@PA,;P2$;:NAME(R(A)):RETURN
75Ø PRINT@PA,;P3$;:NAME(R(A)):RETURN
76Ø N1=Ø:NW$="":PRINTSTRING$(NN,25);STR
ING$(NN,8);
77Ø PRINTCHR$(14);:FORN=1TO2Ø:N$=INKEY$
:IFN$<>""THEN78ØELSENEXT:PRINTCHR$(15
);:FORN=1TO2Ø:N$=INKEY$:IFN$<>""THEN7
8ØELSENEXT:GOTO77Ø
78Ø NU=ASC(N$):IFNU<>13ORN1=ØTHEN79ØELS
EIFVAL(NW$)>49THENPRINTSTRING$(N1,24)
;:GOTO76ØELSEIFNW$="P"THEN96ØELSEIFAS
C(NW$)=83THENPRINTCHR$(15);:GOTO66ØEL
SEIFNW$="Ø"THENPRINTSTRING$(N1,24);:G
OTO76ØELSEPRINTCHR$(15);:POKED,14:NAM
E(R1):RETURN
79Ø PRINTCHR$(14);:IFNU=24THENPRINTSTRI
NG$(N1,24);:GOTO76Ø
8ØØ IFNU<>8THEN81ØELSEIFN1=ØTHEN77ØELSE
PRINTCHR$(24)CHR$(32)CHR$(24);:NW$=LE
FT$(NW$,LEN(NW$)-1):N1=N1-1:GOTO77Ø
81Ø IFN1=NNTHEN77Ø
82Ø IF(NU<58ANDNU>47)ORNU=89ORNU=78ORNU
=83ORNU=8ØTHEN83ØELSE77Ø
83Ø PRINTN$;:NAME(R(RND(3Ø))):NW$=NW$+N
$:N1=N1+1:GOTO77Ø
84Ø B=Ø:IFP(F)=1ORP(F)=9OR((F+T)/2)=7OR
(F=13ANDT=15)OR(F=9ANDT=7)RETURNELSEI
FP(T)=9ORP(T)=2ORP(T)=3OR(T=9ANDF=7)O
R(T=13ANDF=15)OR((F+T)/2)=15RETURNELS
EFORL=2TO14STEP12:IF((F-T=L)OR(T-F=L)
)AND((P((F+T)/2)=2)OR(P((F+T)/2)=3))B
=1
85Ø NEXT:RETURN
86Ø SG=RND(4):ONSGGOSUB87Ø,88Ø,89Ø,9ØØ:
GOTO69Ø
87Ø KD$="3GDGDEDGD4AD3GDEHEDDLEDDLGDGDE
DGD4AD3GDEHDHEDDDCPCDCDEDGD4CPADADCDA
D3GPGDGDEDGD4AD3GDEHDDFDEDDDCP":POKED
,7:NAME(KD$):RETURN
88Ø FJ$="3GBEBCDCDCBDBEBFBGDGDGDEB4ADAD
AD3GD4AD3GD4ABBBCBDBELCB3GD4CL3GBEBGL
DBEBCL":POKED,8:NAME(FJ$):RETURN
89Ø AK$="4CDDHCDDHCDADB*HADB*HAH3GD4AH3
GD4AH3GHDW4AD3GHF#D4AH3GH4CW3FD4AHCDE
HDHCWCDDHCDDHCHADB*HADB*HAH3GD4AH3GD4
AH3GHDHDHEHFH4ADAD3GPF#H4AH3GH4AH3GHF
H4CHDDCDDHFZ":POKED,4:NAME(AK$):RETUR
N
9ØØ FH$="3GDEHEDEDDDEDFLEHEDDHDDDDCDDDE
LCHGDEHEDEDDDEDFHGD4AHAD3GD4AD3GDFHDD
CT":POKED,4:NAME(FH$):RETURN
91Ø AK$="3GH4CLBDCHEHDLCDDHEHCLCDEHGH5A
ZAH4GLEDEHCHDLCDDHEHCLADAH3GH4CZ":POK
ED,14:NAME(AK$):RETURN
92Ø PRINT@Ø,CHR$(255);:PRINT@Ø,"WHICH D
RIVE WOULD YOU LIKE TO LOAD THE DATA
ON (Ø-3)? ";:NN=1:GOSUB76Ø:OPEN"I",1,
"OPGEN3/DAT:"+NW$:PRINT@Ø,CHR$(255);:
PRINT@Ø,"READING DATA . . .";:INPUT#1
,G,RD$:CLOSE1
93Ø IFLEN(RD$)<>98THENPRINT@Ø,CHR$(255)
;:PRINT@Ø,"DATA FILE ERROR. WOULD YOU
 LIKE TO TRY AGAIN? ";:NN=1:GOSUB76Ø:
IFNW$="N"RETURNELSEIFNW$<>"Y"THEN93ØE
LSE92Ø
94Ø DR=Ø:FORN=1TO97STEP2:DR=DR+1:P(DR)=
VAL(MID$(RD$,N,2)):NEXT:RETURN
95Ø FORN=1TO49:READP(N):NEXT:FORN=1TO49
:READQ(N):NEXT:RETURN
96Ø CLS:PN$="":FORN=1TO49:PN$=PN$+STR$(
P(N)):NEXT:QN$=CHR$(34)+PN$+CHR$(34):
PRINT"WHICH DRIVE WOULD YOU LIKE TO S
AVE THE DATA ON (Ø-3)? ";:NN=1:GOSUB7
6Ø:SD$=NW$
97Ø OPEN"O",1,"OPGEN3/DAT:"+SD$:PRINT:I
NPUT"MAKE SURE THE DISKETTE IN THE DE
STINATION DRIVE IS
NOT WRITE PROTCTED AND HAS AT LEAST ONE
 GRANUEL OF SPACE ON IT.
WHEN READY PRESS ENTER";E$:PRINT#1,G;",
";QN$:CLOSE1
98Ø PRINT"WOULD YOU LIKE TO VERIFY THE
DATA? ";:NN=1:GOSUB76Ø:IFNW$="N"THENG
OTO59ØELSEIFNW$<>"Y"THEN98Ø
99Ø OPEN"I",1,"OPGEN3/DAT:"+SD$:PRINT:I
NPUT"READY DISKETTE IN THE DRIVE AND
PRESS ENTER";E$:INPUT#1,V,RD$:CLOSE1
1ØØØ IFG<>VTHEN1Ø4Ø
1Ø1Ø IFLEN(RD$)<>98THEN1Ø4Ø
1Ø2Ø DF=Ø:FORN=1TO97STEP2:DF=DF+1:Z(DF)
=VAL(MID$(RD$,N,2)):NEXT
1Ø3Ø FORN=1TO49:IFP(N)=Z(N)THENNEXT:PRI
NT:PRINT"==>  DATA OK  <==":FORN=1TO2
ØØØ:NEXT:CLS:GOTO69Ø
1Ø4Ø PRINT:PRINT"DATA BAD!!":PRINT"WOUL
D YOU LIKE TO TRY AGAIN? ";:NN=1:GOSU
B76Ø:IFNW$="N"THENCLS:GOTO69Ø:ELSEIFN
W$<>"Y"THEN1Ø4ØELSE97Ø
```

Captain 80

and the magic software machine

Bob Liddil, Contributing editor

Here's Joe Sysop, suave, smooth operator of the Aggravation 80 Bulletin Board, busily typing away at the keyboard in a last-ditch effort to bring the system on-line before the night traffic begins. All of the poems and short stories that have been so carefully edited and prepared for the magazine section now await the first caller. I reach for the bottom on the modem and turn it on. I wait. The first caller signs on.

He logs on as the Phantom. He skips the sign-on messages which contain an empassioned plea not to bust the board. He goes directly to the main menu, hesitates, then activates the user log. He watches until his name appears, then breaks away. He goes to the message file and scans all of the messages.

Chat attempt. He wants to talk to me. I ignore him and continue to watch. He goes back to main menu and activates a special control code which is the first step in taking down the board. He tries several passwords in response to a prompt from the BBS software, fails to break the board and gets launched back into the main menu again.

He goes to download. I don't maintain many programs in the download section, just a few public domain games and a couple of old utilities. Yet, he pounces on them like a hungry wolverine.

He signs off without a comment after downloading everything in the software section. Not so much as a by-your-leave.

Next comes Gray Ghost. (Doesn't anybody have real names?) He follows the Phantom's pattern almost to the letter. Same log-off — no comment.

All night long it is the same. No one has entered the magazine section. Just download, thank you very much, goodbye . . . and always with pseudonyms, as if they were afraid that they might find an encyclopedia salesman on their doorstep if they gave their names.

Finally, I gave up watching. The result of that evening, as of eleven o'clock, was nine attempts to break the board, two obscene messages which have to be erased, and an order in the software sales section for three mercenaries and an Israeli tank.

The community access bulletin board began as a noble idea. Give computerists nationwide a free place to leave messages for each other and provide files of a particular interest to the system owner and his friends. That's how it is with Magazine 80, the real-life Aggravation 80.

Magazine 80 started life as Message 80 — a skeleton BBS framework written by Richard Taylor, a New York City opera singer with considerable talent as a programmer. It evolved into Connection 80, a more commercially-viable product marketed by Tom Vandestowe of BT Enterprises, a Long Island firm that was in its infancy at the time I bought my software.

I drove from New Hampshire to Long Island and met with Richard Taylor. It was in a little town just up the freeway from Queens. It was my first look at the prototype Programs Unlimited franchised computer stores. Among my purchases, there was an Auto-Connection, made by Microperipheral, and the Connection 80 software.

A Connection 80 is a BBS that is easier to set up than you would imagine, but the rigors of being a SYSOP (system operator) are not for everyone. A dedicated system is required, as is a dedicated phone line. Then there is the data base which features the specialty of your choice. Magazine 80 is the pet name for my BBS, so named because I chose literature as my specialty.

The construction of the data base is accomplished through Pencil (Electric Pencil from IJG) files,

though I'm sure it could be done with Scripsit or any other word processor that will allow you to name a file nnn/PCL. You construct files according to their purpose.

SIGNON/PCL gives the pre-log-on message. INFO/PCL generally gives system information: TRS-80 Model I, two drives, and such as that. The bulletin files, which can contain club news or the like, are used on my system as a magazine for fiction, poetry, or Captain 80 columns, some of which do not make it to the printed page.

The product section (Prod/PCL) allows me to sell things through the board, thus helping to pay for its upkeep. The merchandise section is a product order section where a user can leave a hard copy order with MasterCard or Visa for anything I sell.

The message section is the heart of the system. Here, the users can communicate privately, or publicly, and discuss the topics of the day. In a big city system, or an area with a large telecommunicating population, this section is most heavily used.

The user log identifies previous callers and their locations. It is not a Sysop-controlled section except when it is necessary to clean up some less than PG-rated nickname a user has left behind.

I have evaluated Connection 80 continuously since the spring of 1981 when I brought it on-line. I find the software pleasant to deal with and bug free, the BT Enterprises organization efficient and polite, and, in general, the whole Sysop concept to be intriguing.

So, if you have a spare system, an auto-answer modem, a lot of patience, plus a desire to become a bulletin board system operator, give a call to Tom at BT Enterprises. Ask for him personally, and tell him the Captain sent you. I like his product and his attitude.

Here's Joe Sysop, at the beginning of a new day, examining the hard copy from the BBS activity the night before. Mostly downloaders have called. What a shame that they didn't take time for the magazine, but down at the bottom of the page is a note from a user.

"Enjoyed the stories," it says. "Read them to my little son and he liked them a lot. Best of luck, Bert."

Somehow, that makes it all worthwhile. Maybe I'll do another short story and put it up for tonight.

The telephone number for Magazine 80 is (603) 924-7920. It's only Aggravation 80 on more discouraging days.

He liked the story . . . Hmmmmm.

Magazine 80, located in New Hampshire, is owned and operated by Mr. Liddil. —Ed.

In the chips

Some uses for a byte

Models I/III

Spencer Hall, Associate editor

This month, we're going on a trip. You won't need hiking shoes, a bicycle or a car. You will, however, need a monitor because we're going on an expedition through the memory of your TRS-80 Model I, Level 2. Fortunately, we just happen to have one here in Listing 1. Type it in right now. It's a short job. I'll wait for you.

In case you didn't know, the term "monitor," applied to software, means a program which makes the contents of memory visible. A monitor for programmers, unlike our little sightseeing vehicle, allows the user to change memory contents, run portions of machine code residing in memory and do numerous other useful things. If you have DEBUG, Radio Shack's monitor for Models I and III, you may prefer to travel by air and look down on the landscape as we examine it a byte at a time.

Incidentally, if you have a Model III, come along anyway. You'll be traveling in a slightly different country, but the similarities are enough to make the trip worthwhile. This trip is a very important part of the background which you must have in order to program either Model I or III in Z80 machine language. On this trip, we're going to look at those bytes and learn something about what they mean.

There are three major uses for bytes. First, a sequence of from one to four bytes can be an instruction to the Z80 microprocessor to do something. This is machine language, otherwise known as object code. When we write object code, we are talking to the computer in its own language, using its own symbols. When the computer talks to us, it must use our language and our symbols. It does this by means of the well-known ASCII code (say, "askee"). Upper- and lowercase letters, Arabic numerals, and several other characters which have special meaning to us mortals, each have an ASCII number, or byte. You will find the meaning of these one-byte ASCII codes in your computer manual. There's more to be said about the ASCII code, but it will have to wait until next time.

How does the computer tell whether certain bytes represent an ASCII message for the user or something else? That's a very good question. Although ASCII code may appear in many memory locations, a program never allows the computer to attempt interpretation of ASCII bytes as object code. When it comes time to communicate their meaning to the user, ASCII bytes are moved to special addresses designated for "output." The hardware, that is to say the electronic circuitry, always treats bytes in these locations as ASCII and interprets them for us on the screen or printer.

We've just seen how a computer uses bytes to encode messages to itself, object code, and to the user, ASCII code. Numerical messages (numbers) are a different matter. To display or print numbers, the computer uses ASCII codes, of course. No problem. When it comes to performing mathematical operations, however, we previously learned that numbers must be represented in the binary system. We learned also that an eight-bit microprocessor can only store within itself the integers from zero to 65535, the largest number which can be represented by chaining together two eight-bit bytes. These numbers, in addition to being used by programs, are used by the computer to address memory locations. Larger numbers, with or without decimal points, must be encoded using various schemes before they can be stored or manipulated. Two-byte integers, then, are something special. They are "native" to the microprocessor and can be processed without special handling. This is why using integers in your BASIC programs helps to speed them up.

This third use for bytes, representation of integers, has a peculiar twist. The computer stores the byte containing the small part of the integer, the Least Significant Byte (LSB), first. The other byte containing the larger part of the number, the Most Significant Byte (MSB), is stored in the next address. This cart-before-the-horse situation seems strange and even unnecessary to us humans. I suspect, though I cannot say for sure, that it has something to do with the fact that both humans and microprocessors (when they add numbers)

must start from right to left.

Let's fire up our monitor and get going. First a driving lesson. Your monitor uses only decimal. For those of you who are flying overhead in DEBUG, we'll convert the addresses and bytes as we come to them. On RUN, you are asked where to start looking. You are then asked how many seconds to hold each address. We'll be giving you values for both of these from time to time. After being given the "hold" time, the monitor begins at once to list successive addresses in memory, displaying the decimal value of the byte located there and the symbol it represents in the ASCII coding system . . . if there is one. This symbol may have absolutely no meaning at all if the byte being interpreted is actually used for another purpose.

You can stop the address listing by touching any key. You can start it again, also by touching any key. While the listing is stopped, there are two options. Touching the letter "A" allows you to start listing at another address. You also get a chance to change speed. Answering either, or both, prompts with ENTER, but no new request causes the old value to remain active. Touching the letter "N" causes the program to evaluate and display the integer represented (as LSB and MSB, remember) by the presently-displayed byte and the next oncoming one. This, of course, will be garbage except where we point out some exceptions.

First, to test your ability to "steer" the monitor, RUN it and ask to start at address 261 (0105H for DEBUG). Unless we say otherwise, use a speed of .5 seconds. Now you're seeing some bytes with their ASCII interpretation which look mighty familiar. We're down in the ROM, that 12K program that comes permanently stored in the Model I. What we see are the messages the ROM uses to greet you when you power up. ROM machine code transfers these bytes, one at a time, to addresses 15360 through 15370. That zero byte at address 272 (0110H) stops the transfer process. As each letter is picked up, the machine code asks, "Is this byte zero?" If it is, the program stops transferring and moves on to the next order of business. The logic is identical to IF . . . THEN in BASIC. Contents of the addresses at 15360 to 16383, all 1024 of them, are always interpreted by TRS-80 hardware as ASCII and the equivalent characters, if they are printable, are placed on the screen. Address 15360 is actually our old friend PRINT@ 0.

Can we look at these screen addresses with our monitor? Certainly, but the results are going to be a little weird because their contents will change with every address we scroll onto the screen. The successive addresses displayed will contain whatever is in a particular screen position at the moment. Later, you may wish to experiment. Remove the CLS from the beginning of the monitor program. Now LIST it. When you run it now, the prompts will be near the bottom of the screen. Start the monitor at address 15360 (3C00H) and you will see characters from the program lines displayed at the top of the screen as they are actually stored in memory.

Now, however, let's move on through the ROM. Look at the addresses beginning at 6430 (191EH). These are more familiar words which you see, I hope, not too often

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as you run BASIC programs. The ROM extends all the way from zero to address 12287. It contains machine language routines for executing BASIC programs, saving them to tape, loading them and for every other smart thing the computer knows how to do. We'll pay another visit to the ROM and stay longer after we have learned a little of the language spoken there.

Immediately beyond the ROM of the Model I lies an empty wilderness. There is no memory at all from 12288 (3000H) through 14336 (3800H). The manufacturer just didn't install the chips. This was done so that other equipment attached to the card edge could add ROM using some of these addresses. Our monitor sees a 255 (FFH) byte at these addresses because the bits all appear to be "high." There is hardware beginning at 14337 (3801H), but it is not true memory. Start the monitor here and you will see only zeroes. This is the "keyboard matrix." Each key is wired to one bit of an address in this area. Any key makes its own bit "high" when it is pressed. By reading this apparent memory, the computer can recognize that a given character has been entered.

It just isn't possible for a monitor to display these bytes as they are being changed by a keystroke. The monitor program requires it to "listen" for keystrokes. It is too busy doing this to show us the effect of the keystroke. Even computers can't do two things at once.

The program in Listing 2 can and does show you what happens when a key is pressed. It displays the bytes controlled by the various keys. Run it and it will scan these bytes continuously, displaying what it finds in each. Press any key you wish (except BREAK). The byte to which it is wired will change accordingly. The letter "S" is wired to bit 3 of address 14340. From our previous

Figure 1 — Model I Keyboard Matrix

MEMORY ADDRESS	BIT NUMBER 0	1	2	3	4	5	6	7
	BIT VALUE 1	2	4	8	16	32	64	128
14337	@	A	B	C	D	E	F	G
14338	H	I	J	K	L	M	N	O
14340	P	Q	R	S	T	U	V	W
14344	X	Y	Z					
14352	0	1	2	3	4	5	6	7
14368	8	9	:	;	,	-	.	/
14400	ENTER	CLEAR	BREAK					SPACE
14464	SHIFT							

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lessons, we know that a byte with only bit 3 "high" has a value of decimal 8. You can make several bits in one byte high by holding certain keys down simultaneously. The resulting value of that byte will be the sum of the bits turned on by these keys. Figure 1 is the Model I keyboard matrix.

Next month, we'll resume our journey through the RAM. Too bad we had to leave you stranded out there!

Listing 1 — In the Chips

```
10 CLS
20 PRINT:INPUT"START AT WHAT ADDRESS";A
30 PRINT:INPUT"HOLD EACH ADDRESS HOW MAN
Y SECONDS";S
40 IF A>32767 THEN A=A-65536
50 B=PEEK(A):IF B>31 AND B<192 THEN B$=C
HR$(B) ELSE B$=""
60 PRINT A,B,B$,;
70 FOR J=1 TO 345*S:NEXT
80 Z$=INKEY$:IF Z$="" THEN 130
90 Z$=INKEY$:IF Z$="" THEN 90
100 IF Z$="A" THEN 20
110 IF Z$="N" THEN 150
120 IF Z$="S" THEN 30
130 A=A+1
140 PRINT:GOTO 50
150 PRINT PEEK(A)+256*PEEK(A+1);
160 GOTO 90
```

Listing 2 — In the Chips

```
10 CLS
15 PRINTTAB(5)"TOUCH ANY KEY TO SEE WHIC
H BYTE RESPONDS"
17 PRINT@782,"ALSO TRY MULTIPLE KEYS";
20 PRINT@78,"3801H  14337"
30 PRINT@142,"3802H  14338"
40 PRINT@206,"3804H  14340"
50 PRINT@270,"3808H  14344"
60 PRINT@334,"3810H  14352"
70 PRINT@398,"3820H  14368"
80 PRINT@462,"3840H  14400"
90 PRINT@526,"3880H  14464"
120 PRINT@98,PEEK(14337);
130 PRINT@162,PEEK(14338);
140 PRINT@226,PEEK(14340);
150 PRINT@290,PEEK(14344);
160 PRINT@354,PEEK(14352);
170 PRINT@418,PEEK(14368);
180 PRINT@482,PEEK(14400);
190 PRINT@546,PEEK(14464);
200 GOTO120
```


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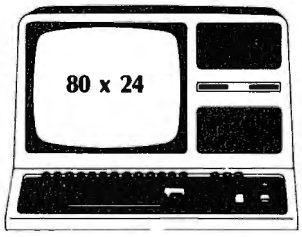

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Exploring VisiCalc

Creating command files

Models I/II/III

Timothy K. Bowman, Contributing editor

In last month's column, I introduced the technique of using command files. This month, let's expand upon that introduction and explore further uses of VisiCalc command files. While it's not totally necessary, I recommend that you review the April, 1983 Exploring VisiCalc column for important background information.

VisiCalc command files are used to cause the VisiCalc program to perform multiple steps without the operator's intervention, apart from loading the command file itself. The technique for using command files can be summarized into the following steps:

1. Start with a clean spreadsheet.
2. Type the specific commands desired into the spreadsheet using the label format (very important).
3. Save the completed command file using the /PF command sequence with a filename suffix of VC. Answer the lower right coordinate question with the cell position that is one below your last entry.
4. Clear the spreadsheet and create, or load, a new spreadsheet.
5. At the cell position you wish to use the command file, type /SL and answer the prompt with the proper filename.

Mass Deleting of Entries

A common need is to perform a mass delete on a spreadsheet. Using the checkbook template from last month's article, let's assume that we want to clear the spreadsheet beneath the column titles. The typical manner to clear the unwanted lines is to use either a /DR (delete row command) or /B (blank cell position command) combined with the /R (replicate command) to blank the desired cell positions within the row.

The command file approach creates a command file that will delete a specified number of lines, and then that command file is input on the appropriate line. Using the instructions above, try to create a command file that will delete ten lines from the spreadsheet. Listing 1 shows a command file that will accomplish this.

Instead of deleting whole lines, let's assume that you want to delete only a portion of the spreadsheet. For example, we want to delete only a portion of the spreadsheet bounded by the area defined with the cell positions D2 to D13 and across to F2 to F13. To accomplish this, use the instructions above and type in Listing 2. Save it under the name BLANK11/VC. Now, whenever you want to blank the above cell positions, load your BLANK11/VC command file and the task is done.

Inserting Formulas or Values

A second major use of VisiCalc command files can be to insert long formulas into any cell position in your favorite spreadsheet. For example, assume that you wish to insert the formula +A1*((A69/F44)*@ABS(C3)) into a number of spreadsheets. To save this as a command file, set the column width equal to 30 (/GC 30 ENTER), follow the instructions at the beginning of this article and type the formula in cell position A1. Whenever you need that particular formula, load the command file. Note that it is not required that the receiving spreadsheet have the same column width as the one used in creating the command file. On the Model I, after loading this command file you will be unable to edit the line. So, this command file may be of limited value. Model III users will be able to edit the inserted formula at will using the /E command.

An ERROR message will occur at the position where the formula is inserted. This error message can be removed by placing values at the appropriate reference points or changing the references in the formula.

A third possible command file use is to store specific values or formulas in predetermined cell locations. Let's assume that we want to store the formula in cell position G19. Following the above instructions, type ">G19:" in position A1. In A2, type the formula using the label format. After storing the command file, load it and you should see the formula stored at position G19.

Setting Mass Formats

Assume that you wish to format the first ten lines in column F with a

$ format. Create the command file from Listing 3. Load the command file and the $ format is established. The command file could be modified to format each of the ten lines in differing formats by changing the command following the colon in each cell position.

Precautions

Although the VisiCalc manual indicates that command files should not be saved with a VC suffix, I find it much more convenient to save them with a VC suffix so that I can read my disk directory from the VisiCalc program. Files which do not have the VC suffix cannot be read directly from VixiCalc.

All commands must be typed using the label format that is viewable between the cursor. When creating command files to save long formulas or commands, set the column width wide enough to accommodate the length of the formula or commands. Only the portion viewable between the cursor is saved in the command file.

The command file should be typed either in one row or one column. Do not mix the two! I suggest that you develop your own style and stick to that format.

Do you have a favorite command file that you would like to share with other readers, or a question related to VisiCalc? If so, write to me in care of *80-U.S. Journal*, including a SASE if you desire a reply. I want to repeat the challenge I made several issues back: Has anyone been able to patch Model III VisiCalc to run on Model I using TRSDOS?

VisiCalc is a registered trademark of VisiCorp.

Listing 1 — VisiCalc

Cell	Entry
A1	"/DR
A2	"/DR
A3	"/DR
A4	"/DR
A5	"/DR
A6	"/DR
A7	"/DR
A8	"/DR
A9	"/DR
A10	"/DR

Listing 2 — VisiCalc

Cell	Entry
A1	">D2:/B
A2	">D3:/B
A3	">D4:/B
A4	">D5:/B
A5	">D6:/B
A6	">D7:/B
A7	">D8:/B
A8	">D9:/B
A9	">D10:/B
A10	">D11:/B
A11	">D12:/B
A12	">E2:/B
A13	">E3:/B
A14	">E4:/B
A15	">E5:/B
A16	">E6:/B
A17	">E7:/B
A18	">E8:/B
A19	">E9:/B
A20	">E10:/B
A21	">E11:/B
A22	">E12:/B
A23	">F2:/B
A24	">F3:/B
A25	">F4:/B
A26	">F5:/B
A27	">F6:/B
A28	">F7:/B
A29	">F8:/B
A30	">F9:/B
A31	">F10:/B
A32	">F11:/B
A33	">F12:/B

Listing 3 — VisiCalc

Cell	Entry
A1	">F1:/F$
A2	">F2:/F$
A3	">F3:/F$
A4	">F4:/F$
A5	">F5:/F$
A6	">F6:/F$
A7	">F7:/F$
A8	">F8:/F$
A9	">F9:/F$
A10	">F10:/F$
A11	">F11:/F$

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What's significant?

The analysis of variance: ANOVA

Models I/II/III

Randolph Townsend, Riverside, CA

The discovery in 1908, by an Irish brewmaster who masqueraded under the pseudonym of "Student", of the relationship between the mean of a population and the variance of that population about the mean value (known as the t-distribution), revolutionized the statistical treatment of small samples. It made possible reasonably accurate estimates of the difference between large groups based on small samples drawn from these groups.

The "t" test of statistical significance remains a major method of evaluating differences between two sets of samples. Because it is limited to comparisons of two sets (treated and untreated, early and late, large and small, etc.), its utility is limited. A more powerful tool was developed from the t-test in the 1920s by individuals concerned with the statistical evaluation of the results of agricultural experimentation, especially field plots.

This tool, called the Analysis of Variance or ANOVA, has turned out to be extraordinarily useful in determining whether several populations, either ones occurring naturally, or ones which are created by treatments applied to an originally uniform population, are significantly different. It allows the researcher to examine a relatively small number of samples, or replicates, from these populations. The utility of ANOVA is by no means limited to agricultural research. It is adaptable to a very wide variety of demographic, industrial and fiscal problems as well as various types of experimentation.

ANOVA designs exist in many different forms, some of which are so sophisticated as to be incomprehensible to the non-biometrician. The original, simplest form is straightforward, easy to analyze and very useful in the evaluation of many different types of data.

This form of ANOVA, called the completely randomized block design, is analyzed by the program listed here. The randomized block design, called completely, because no restrictions are placed on the selection of samples as replicates, can be used to evaluate any number of populations (called treatments here because the program is used in analysis of experimental results) with any number of replicated observations of each treatment. Since a larger number is seldom encountered in our work, and because (with certain types of data) overflow problems become acute with large numbers of treatments or replicates, this

Table 1 — Definitions

DF [degrees of freedom]. Usually the number of items or observations in a given set minus 1 (n-1), used as a divisor in determining mean squares.

F value. The ratio of the mean square for a treatment to the mean square not accounted for by some known factor, e.g., the residual mean square or mean square for error.

Mean. An average. Total of all items in a given treatment divided by the number of items. The usual symbol is X.

Mean Square. The sum of squares for a given group divided by the degrees of freedom for that group, usually designated s^2. The *Standard Deviation* (s) for a group is equal to the square root of the mean square.

Q value. Used in comparison of differences between means. $Q = (X_{max}-X_{min}) \div s_x$. Having looked Q up in a table (included as data in this program), we can calculate D, the difference between two means required for significance at the 5% level, by $D = Q \times s$.

Significance. Statistical evaluations such as "F" and "t" use the null hypothesis, i.e., it is assumed that the values being tested come from the same population. If the ratio of the variance of the population whose mean is being tested to that due to error exceeds certain values based on the laws of probability, the null hypothesis is not proven and the test is said to be significant. A level of probability (the odds that the difference did not occur due to chance) is usually appended to an evaluation of significance. In this program, the 0.05 (19/1) level is used.

Sum of Squares. The sum of the squares of the deviations of individual values from the mean value of a given population. This is usually obtained by assuming a mean of zero, squaring all the values in a group and correcting for the fact that the mean is not zero by subtracting a correction factor (C) obtained by squaring the total of all values in the analysis and dividing by the total number of values $C = (X)^2 \div N$.

program is dimensioned for 20 treatments and 20 replicates. In our work, it is most commonly used for three to four treatments with ten to fifteen replicates. Some portions of the program (like the "Q" data table) have an even more restricted size. For machines with a small RAM capacity, the dimensions in line 40 can be changed from 20 to 10 or even less, except for Q, which is dimensioned for the data table in lines 1050 to 1230.

Line 50 converts the somewhat garbled DATE$ of the Model II to a neater form and, if you prefer, it can be replaced on any of the TRS-80s with a simple DATE$.

The input of an experimental description and treatment names uses a small subroutine (lines 1430 to 1470) rather than the BASIC input command. At a relatively small cost in memory, this permits the use of commas, colons and periods in the title and names without the usual "extra ignored" remark.

The program is designed to input data stored on disk by other programs or input from the keyboard, in which case an option to save the data is included. If data are stored by another program, note that it must include treatment number, replicate number, names of treatments and data arrayed by treatment and replicate in the order shown in lines 140 to 150. If the data are entered from the keyboard, a correction routine is available in lines 230 to 260.

However the data are entered, computation starts on line 320 and terminates at line 400. The computation is standard (see the reference or any statistics text) involving obtaining the sums and sums of squares of the whole array and of treatments and replicates separately.

The results are printed out on the screen and then on a line printer. If a large number of treatments are encountered, an input query after line 540 may be desirable to prevent the ANOVA table from scrolling off the top of the screen.

The printout (Figure 1) gives the data and identifying title followed by an ANOVA table (Figure 2) providing the sums of squares (corrected for the assumption made in computation that the mean is zero), the degrees of freedom and the mean square (the ratio of sum of squares to degrees of freedom) associated with treatments, replicates and the residual (error) term. The mean squares for treatments and replicates, divided by the residual mean square, give the "F" ratio, the significance of which may be evaluated by the use of an F table (see reference). Since the primary interest is not in whether some treatments are significantly different from some others, but which treatments are significantly different from which others, the program proceeds to calculate Duncan's "D" value using Duncan's table of Q values which are derived from Student's t value (see reference). The Da value, calculated by multiplying the square root of the residual mean square divided by the number of replicates by the Q value from the table included in the program, is used to evaluate the significance of differences between treatments.

This process is actually best done by inspection, using as a basis the principle that treatments whose mean values do not differ by more than D are drawn from the same population (confirming the null hypothesis) while those which do show greater differences are significantly different. The significance being estimated with this table of Q values is at the 5% level, i.e., $P < 0.05$. This is to say that the chances are 19 to 1 that the difference is a real one, based on the sample size used. Stated another way, if the experiment was repeated twenty times, a difference of this size should occur by pure chance only once.

As a convenience and since, in most analyses of variances, a large number of different populations are not found, the program does a minimal job of identifying different populations. This is done by sorting the treatment mean values in descending order. For this purpose, the subroutine at lines 1260 to 1420 arranges the means in their rank order, moving the treatment name with its mean value. Lines 570 to 600 separate three levels of different populations. All treatments are assigned DI$(1) or "a," which was read in from data line

Table 2 — Procedures for RBANOVA

Before running the program, the data to be analyzed should be organized into an array like that which will be entered. That is, the treatments are in sequence and the replicates are in the same sequence in each treatment.

After entering "RUN", there is a slight delay while the table of "Q" values is read in, after which you are asked for an experimental description. This can be as terse as you like, but will accommodate up to 253 characters. If more text is needed, a second opportunity is offered. If not needed, simply press ENTER.

You are then asked to name the treatments. This is limited to 20 characters by the dimensioning of the printout. After treatments are named and the number of replicates entered (the program assumes that the same number will be present in each treatment), you are asked to enter the data in order. After data are entered, an opportunity to correct erroneous entries appears. If an error is to be corrected, enter the number, *not* the name of the treatment, and the number of the replicate in error. When the data are all correct, an "N" answer to the error question leads to computation and display on the screen of the analysis. If a printer copy is needed, a "Y" response to the "HARD COPY" question reproduces the same screen display on the printer. If a copy of the data array is needed, a "Y" response to the final question produces this. To repeat the analysis, "RUN" is required again, although a GOTO at the end of the program leading to the screen clearing line at the start would avoid the wait while the "Q" table is read again.

The entries which ask for a "Y/N" response use an INKEY$ response and do not need an ENTER to follow, but all other entries do require an ENTER.

1240. A mean value which differs from the highest mean value (M1(1)) by more than the D value is identified and that value (and lower mean values) are assigned the designator "B."

The process is repeated once more, with any values differing from both the highest, and some other lower value by more than D, being given a "c." These letters are printed with the mean values and the mean minus D. If inspection of the mean and mean minus D values indicates that more than three populations are present, the assignment of letters can be carried further by hand. The lowercase letters are conventionally used to represent populations significantly different at the 5% level.

The printout offers an option to print the original data, which can be useful for record purposes and for studying the results of an analysis where a significant F value for replicates is found. This happens in cases where the randomly chosen replicates show some association or similarity between the individuals comprising a given replicate group as in the example given here. When this occurs, it is desirable to attempt to identify the reasons for this similarity of replicates in case some similar factors may be at work with the treatment values.

This program, a relatively simple one of less than 150 lines, has proven very useful in a biochemical laboratory, but should be equally helpful in a business or home environment, where confidence in the reality of differences between samples of various kinds, such as the impact of specific advertisements on sales, the effect of home improvements (such as insulation) on energy use, the relationship between level of tire inflation and gasoline mileage and similar questions, can be a satisfying, even valuable, commodity.

As an example of how the ANOVA can be used for non-scientific purposes, the sample ANOVA presented here is taken from records of natural gas use in my home. The treatments are six-month time periods, before and after certain improvements in the energy efficiency of the house were made. The replicates are not really random replicates at all, but are the total gas use in therms for the months of January through June in the years selected. It is noticeable that gas use is high in the January-March period, drops somewhat in April and May, and rises again in June because our air conditioner is gas powered.

Since these replicates are not random, but represent a slice of varying climate which is similar in each of the treatment years, the F value of 9.59 indicates a significant difference between replicates. In this case, the significance is at the 1% level ($P < .01$) because the F required for that level of significance for 3 and 15 degrees of freedom is only 4.56 (see reference).

In this analysis, the order of the treatments is not altered by the ranking subroutine. The years were entered in the sequence in which they actually occurred and each resulted in a lower mean value. The

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

STRIKE FORCE

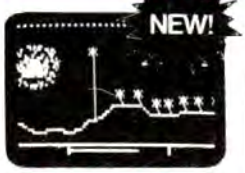
As the primary defender of a world of cities under deadly alien attack, you weaponry is the latest: rapid fire missiles, long range radar and incendiary star shells. Your turret helicopter absorbs only a limited number of impacts. A complex game of strategy, skill and reflexes from Melbourne House. Price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

NEW!

PANIK

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

NEW!



SEA DRAGON

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

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TOP TEN

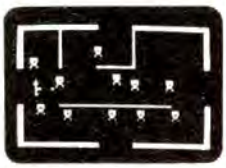
1. SCARFMAN *All time favorite*
2. PANIK *Remarkable Voices*
3. PENETRATOR *Rave reviews*
4. ARMORED PATROL *Super 3D graphics*
5. CATERPILLAR *Good rendition*
6. CRAZY PAINTER *Unique game concept*
7. DEFENSE COMMAND *Tough struggle*
8. STELLAR ESCORT *Fast and Challenging*
9. ROBOT ATTACK *With voice*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

STELLAR ESCORT

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

ROBOT ATTACK

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



LUNAR LANDER

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

SUPER NOVA

Asteroids that ominously around the screen. You must destroy the asteroids before they destroy you. Big asteroids break into little ones. Your ship will respond to thrust, rotate, hyperspace and fire. Watch out for that saucer with the laser! As reviewed in May '98 Byte Magazine. Price A

NEW!

OUTHOUSE

Oh, no! The mighty protector of this area, but a quaint wooden structure. For reasons unknown a dastardly band of miscreants wish to vandalize, loot and otherwise destroy the little town house. Your patrol craft, lasers and smart bombs to deal with this terror. From SSM with sound. Price A

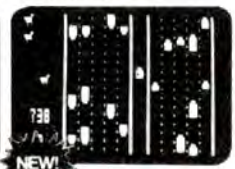
GALAXY INVASION

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

LASER DEFENSE

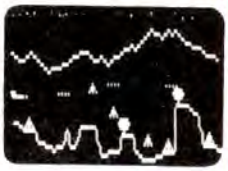
In this game of TRM's high energy lasers and particle beams, you control the U.S. strategic defense satellite system. From your viewpoint high above the globe you intercept Soviet nuclear missiles in flight and attempt to destroy the scattered missiles. With sound from MED Systems. Price A

NEW!



CHICKEN

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



PENETRATOR

Soar swiftly over jagged landscape, dodging, ducking and dive to avoid obstacles and enemy missiles attacks. Will mines or wind tear the bunkers to penetrate you're well armed with bombs and multiple forward missile capability. From Melbourne House. Features sound, trainer mode and customizing program. Price E

DEFENSE COMMAND

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

NEW!

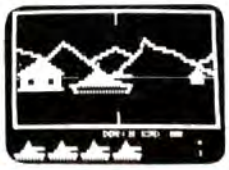
BOUNCEOIDS

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

BEST SELLER

SCARFMAN

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



ARMORED PATROL

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

CATERPILLAR

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

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1) EDAS Source file format
2) EDTASM Source file format
3) BASIC data statements
4) BASIC strings
5) BASIC arrays (New in version I 3!)
6) Load File Format
Many more features! Completely cursor controlled PowerDRAW comes complete with PDRAW/CMD as well as three other utilities written by Kim for extending the use of PowerDraw Also has 3 printer drivers including one that is specifically written for the Epson printer with or without Graftrax! That means all the graphics you design may be printed out PERFECTLY on your printer! Works with joystick also

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preinsulated year saw a mean use of 153 therms per month. The addition of ceiling insulation to bring the house to the R-19 standard in California had a slight, but not significant, effect on average gas use. The installation of rolling insulated shutters on some large windows caused a further decrease in gas utilization, but the difference was still not statistically valid. Only when a new, heavy shake roof and two wind turbines were installed did the use of gas drop to a level which can confidently be attributed to more than chance. In this case, the fourth mean is followed by both b and c, indicating that it is different from treatment 1 and from treatment 2, although not from treatment 3. The improvements, of course, each contributed to the final result and the last treatment's efficacy is approximated by the 40-therm difference between it and gas use before the roof and ventilator installation. Although this difference is smaller than the D value, it is not statistically significant.

Reference

Snedecor, G.W. and W.G. Cochran, *Statistical Methods*, Sixth Edition. Iowa State University Press, Ames, IA (1967).

Figure 1 — Sample Energy Data for RBANOVA Program Input

```
TREATMENT                          REPLICATE
                        1      2      3      4      5      6

PREINSULATION       213.00 175.00 148.00 107.00 118.00 158.00
INSULATE R-19       188.00 176.00 137.00  96.00  97.00 211.00
ROLL. SHUTTERS      176.00 174.00 105.00  59.00  67.00 141.00
ROOF/VENTS          161.00 112.00 111.00  55.00  23.00  20.00

DATA ID = ENERGY
```

Figure 2 — RBANOVA Output

```
Fri 20 Aug 1982
USE OF NATURAL GAS IN THERMS PER MONTH AS AFFECTED BY CONSERVATION MEASURES
REPLICATES ARE THE MONTHS JANUARY THROUGH JUNE IN THE ORDER LISTED

                              ANOVA
-----------------------------------------------------------------
SOURCE      SS          DF          MEAN. SQ.       F

TREATMENT   20833.2     3           6944.39     9.02042
REPLICATE   36924.7     5           7384.93     9.59266
RESIDUAL    11547.8     15          769.852
TOTAL       69305.6     23
-----------------------------------------------------------------
STANDARD ERROR OF A TREATMENT MEAN = 11.3273
DUNCAN'S Q VALUE = 4.56
DUNCAN'S D VALUE = 51.6527

                    ---------------

 RANK TREATMENT          MEAN      MEAN-D      POPULATION

 1  PREINSULATION        153.167   101.514       a
 2  INSULATE R-19        150.833    99.1807      a
 3  ROLL. SHUTTERS       120.333    68.6807      a
 4  ROOF/VENTS           80.3333    28.6807      bc
```

Program Listing for RBANOVA

```
10 REM ANALYSIS OF VARIANCE - SIMPLE RAN
DOMIZED BLOCK - CALLED 'RBANOVA'
20 REM SEE SNEDCOR AND COCHRAN, STATISTI
CAL METHODS, 6TH ED. CH. 10 (C) 1982 R.
TOWNSEND
30 CLEAR 5000
40 DIM X(20,20),S1(20),S2(20),T$(20),Q(2
0,10)
50 D1$=LEFT$(DATE$,3):D2$=MID$(DATE$,7,2
):D3$=MID$(DATE$,4,3):D4$=MID$(DATE$,9,4
):B$=D1$+" "+D2$+" "+D3$+" "+D4$
60 FOR I=1TO18:FOR J=2TO10:READ Q(I,J):N
EXT J:NEXT I
70 FOR I=1TO9:READ D$(I):NEXT I
80 CLS:PRINT TAB(20) "ANOVA: COMPLETE RA
NDOMIZED BLOCK":PRINT
90 PRINT "ENTER DESCRIPTIVE TITLE OF EXP
ERIMENT ";:GOSUB 1430:A$=XX$:PRINT
100 PRINT "ENTER ADDITIONAL INFORMATION
ABOUT EXPERIMENT ";:GOSUB 1430:C$=XX$:PR
INT
110 PRINT "ENTER DATA FROM DISK, Y/N? ";
:GOSUB 1250:PRINT Y$
120 IF Y$="Y" THEN 130ELSE IF Y$="N" THE
N 170ELSE 110
130 INPUT "ENTER DATA ID";Z$
140 OPEN "I",1,Z$:INPUT#1,N,M:FOR I=1TON
:INPUT#1,T$(I):NEXT I
150 FOR I=1TON:FOR J=1TOM:INPUT#1,X(I,J)
:NEXT J:NEXT I
160 CLOSE 1:GOTO 330
170 INPUT "ENTER NUMBER OF TREATMENTS";N
180 FOR I=1TON:PRINT "ENTER NAME OF TREA
TMENT ";I;:GOSUB 1430:T$(I)=XX$:PRINT:NE
XT I:PRINT
190 INPUT "ENTER NUMBER OF REPLICATES";M
200 FOR I=1TON:FOR J=1TOM
210 PRINT"ENTER VALUE FOR ";T$(I);" TREA
TMENT, REPLICATE";J;
220 INPUT X(I,J):NEXT J:PRINT:NEXT I
230 PRINT "ANY ERRORS, Y/N? ";:GOSUB 125
0:PRINT Y$
240 IF Y$="N" THEN 270ELSE IF Y$="Y" THE
N 250ELSE 230
250 INPUT "ENTER TREATMENT AND REPLICATE
 NOS.";I,J
260 PRINT "VALUE FOR TREATMENT ";T$(I);"
 REPLICATE ";J;:INPUT X(I,J):GOTO 230
270 PRINT"SAVE DATA ON DISK, Y/N? ";:GOS
UB 1250:PRINT Y$
280 IF Y$="N" THEN 330ELSE IF Y$="Y" THE
N 290:ELSE 270
290 INPUT "ENTER DATA ID";Z$
300 OPEN"O",1,Z$:PRINT#1,N,M:FOR I=1TON:
PRINT#1,T$(I):NEXT I
310 FOR I=1TON:FOR J=1TOM:PRINT#1,X(I,J)
:NEXT J:NEXT I
320 CLOSE 1
330 FOR I=1TON:FOR J=1TOM:T1=T1+X(I,J):T
2=T2+X(I,J)^2:NEXT J:NEXT I
340 FOR I=1TON:FOR J=1TOM:S1(I)=S1(I)+X(
I,J):NEXT J:NEXT I
```

```
350 FOR J=1TOM:FOR I=1TON:S2(J)=S2(J)+X(
I,J):NEXT I:NEXT J
360 CF=T1^2/(N*M):T0=T2-CF
370 FOR I=1TON:TT=TT+S1(I)^2:NEXT I:TR=(
TT/M)-CF
380 FOR J=1TOM:RT=RT+S2(J)^2:NEXT J:RR=(
RT/N)-CF
390 N1=(N*M)-1:N2=N-1:N3=M-1:N4=N1-N2-N3
:ER=T0-TR-RR
400 F1=(TR/N2)/(ER/N4):F2=(RR/N3)/(ER/N4
)
410 CLS
420 PRINT B$:PRINT A$
430 PRINT TAB(30) "ANOVA"
440 PRINT"-------------------------------
--------------------------------"
450 PRINT"SOURCE";TAB(12);"SS";TAB(22);"
DF";TAB(42);"MS";TAB(52);"F"
460 PRINT "TREATMENT";TAB(10);TR;TAB(20)
;N2;TAB(40)TR/N2;TAB(50) F1
470 PRINT "REPLICATE";TAB(10);RR;TAB(20)
N3;TAB(40)RR/N3;TAB(50) F2
480 PRINT "RESIDUAL"; TAB(10) ER;TAB(20)
 N4;TAB(40) ER/N4
490 PRINT "TOTAL";TAB(10);T0;TAB(20) N1
500 PRINT "-------------------------------
--------------------------------"
510 XX=SQR((ER/N4)/M):A=XX*Q(N4,M)
520 PRINT "STANDARD ERROR OF A TREATMENT
 MEAN =";XX
530 PRINT "DUNCAN'S Q VALUE =";Q(N4,M)
540 PRINT "DUNCAN'S D VALUE =";A
550 FOR I=1TON:M1(I)=S1(I)/M:TR$(I)=T$(I
):NEXT I
560 GOSUB 1260
570 FOR I=1TON:DI$(I)=D$(1):NEXT I
580 FOR J=2TON:FOR I=2TO9
590 IF M1(J)<M1(1)-A  THEN DI$(J)=D$(I)
600 IF DI$(J)=>D$(I) THEN 620
610 NEXT I
620 NEXT J
630 FOR I=2TON:FOR J=3TO9:FOR K=2TON
640 IF M1(I)<M1(K)-A THEN DI$(I)=DI$(I)+
D$(J):NEXT K
650 IF DI$(I)=D$(J) THEN 660:NEXT J
660 NEXT I
670 FOR I=1TON:PRINT I;T$(I);TAB(25);M1(
I);TAB(34) M1(I)-A;TAB(50) DI$(I)
680 NEXT I
690 PRINT "PRINT OUT HARD COPY, Y/N?":GO
SUB 1250
700 IF Y$="Y" THEN 710ELSE STOP
710 LPRINT B$:LPRINT A$
```


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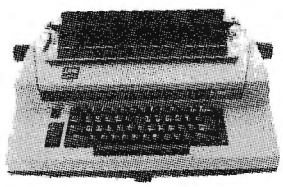

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```
720 LPRINT C$
730 LPRINT" "
740 LPRINT TAB(30)"ANOVA"
750 LPRINT "-----------------------------
-----------------------------------"
760 LPRINT"SOURCE";TAB(12)"SS";TAB(22)"D
F";TAB(40)"MEAN. SQ.";TAB(55)"F"
770 LPRINT" ":LPRINT"TREATMENT";TAB(10)T
R;TAB(20)N2;TAB(40)TR/N2;TAB(50)F1
780 LPRINT"REPLICATE";TAB(10)RR;TAB(20)N
3;TAB(40)RR/N3;TAB(50)F2
790 LPRINT "RESIDUAL";TAB(10)ER;TAB(20)N
4;TAB(40)ER/N4
800 LPRINT "TOTAL";TAB(10)T0;TAB(20)N1
810 LPRINT "-----------------------------
-----------------------------------"
820 LPRINT"STANDARD ERROR OF A TREATMENT
 MEAN =";XX
830 LPRINT "DUNCAN'S Q VALUE =";Q(N4,M)
840 LPRINT"DUNCAN'S D VALUE =";A
850 LPRINT" ":LPRINT "
          ==========":LPRINT " "
860 LPRINT" RANK TREATMENT";TAB(27)"MEAN
";TAB(36)"MEAN-D";TAB(47)"POPULATION"
870 LPRINT " "
880 FOR I=1TON
890 LPRINT I;TAB(4) T$(I);TAB(25) M1(I);
TAB(35) M1(I)-A;TAB(50) DI$(I)
900 NEXT I
910 PRINT "PRINT OUT DATA, Y/N? ";:GOSUB
 1250:PRINT Y$
920 IF Y$="Y" THEN 930ELSE 40
930 PN$="      ##":P$="####.##"
940 LPRINT " "
950 LPRINT"TREATMENT";TAB(M*6)"REPLICATE
"
960 LPRINT" "; TAB(17)" ";:FOR I=1TOM:LP
RINTUSING PN$; I;:NEXT I
970 LPRINT" ":LPRINT" "
980 FOR I=1TON
990 LPRINT TR$(I); TAB(20)" ";:FOR J=1TO
M:LPRINTUSING P$; X(I,J);:NEXT J
1000 LPRINT " "
1010 NEXT I
1020 LPRINT" ":LPRINT"DATA ID = ";Z$
1030 LPRINT CHR$(12)
1040 END
1050  REM "Q" TABLE- NO. TREAT HORIZ.,D.
F. VERT
1060  DATA 18,26.7,32.8,37.2,40.5,43.1,4
5.4,47.3,49.1
1070  DATA 6.09,8.28,9.8,10.89,11.73,12.
43,13.03,13.54,13.99
1080  DATA 4.5,5.88,6.83,7.51,8.04,8.47,
8.85,9.18,9.46
1090  DATA 3.93,5,5.76,6.31,6.73,7.06,7.
35,7.6,7.83
1100  DATA 3.61,4.54,5.18,5.64,5.99,6.28
,6.52,6.74,6.93
1110  DATA 3.46,4.34,4.9,5.31,5.63,5.89,
6.12,6.32,6.49
1120  DATA 3.34,4.16,4.68,5.06,5.35,5.59
,5.8,5.99,6.15
1130  DATA 3.26,4.04,4.53,4.89,5.17,5.4,
5.6,5.77,5.92
1140  DATA 3.15,3.88,4.33,4.66,4.91,5.12
,5.3,5.46,5.6
1150  DATA 3.11,3.82,4.26,4.58,4.82,5.03
,5.2,5.35,5.49
1160  DATA 3.08,3.77,4.2,4.51,4.75,4.95,
5.12,5.27,5.4
1170  DATA 3.06,3.73,4.15,4.46,4.69,4.88
,5.05,5.19,5.32
1180  DATA 3.03,3.7,4.11,4.41,4.64,4.83,
4.99,5.13,5.25
1190 DATA 3.01,3.67,4.08,4.37,4.59,4.78,
4.94,5.08,5.2
1200 DATA 3,3.65,4.05,4.34,4.56,4.74,4.9
,5.03,5.15
1210 DATA 2.98,3.62,4.02,4.31,4.52,4.7,4
.86,4.99,5.11
1220 DATA 2.97,3.61,4,4.28,4.49,4.67,4.8
3,4.96,5.07
1230 DATA 2.96,3.59,3.98,4.26,4.47,4.64,
4.79,4.92,5.04
1240 DATA "a","b","c","d","e","f","g","h
","i"
1250 Y$=INKEY$:IF Y$="" THEN 1250ELSE RE
TURN
1260 REM SUBROUTINE FOR SORTING ALPHABET
IC DATA
1270 MM=N
1280 MM=INT(MM/2)
1290 IF MM=0 THEN RETURN
1300 K=N-MM
1310 J=1
1320 I=J
1330 L=I+MM
1340 IF M1(I)>=M1(L) THEN 1400
1350 TT=M1(I):TT$=T$(I)
1360 M1(I)=M1(L):T$(I)=T$(L)
1370 M1(L)=TT:T$(L)=TT$
1380 I=I-MM
1390 IF I>=1 THEN 1330
1400 J=J+1
1410 IF J>K THEN 1280
1420 GOTO 1320
1430 XX$="":REM INPUT ROUTINE FOR ENTERI
NG EXPTL. DESCRIPTION
1440 X$=INKEY$:IF X$="" THEN 1440
1450 IF X$=CHR$(13) THEN RETURN
1460 PRINT X$;:IF X$=CHR$(08) THEN 1480
1470 XX$=XX$+X$:GOTO 1440
1480 XX$=LEFT$(XX$,LEN(XX$)-1):GOTO 1440
```

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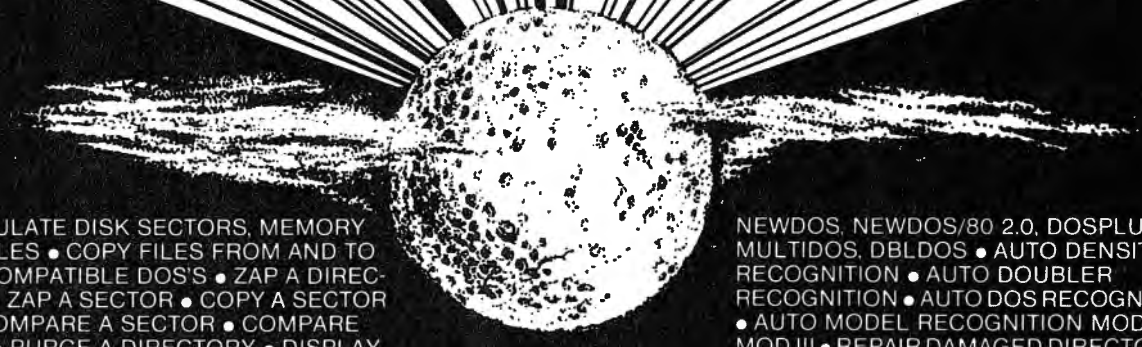

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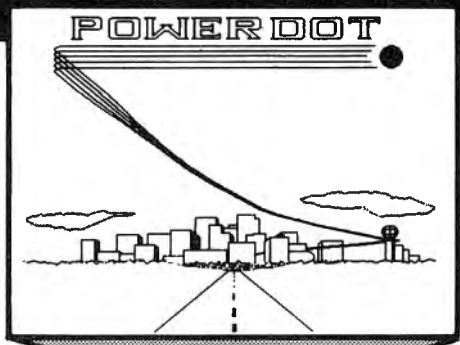

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Tandy topics

Ed Juge, Director, Computer Merchandising
1500 One Tandy Center, Ft. Worth, TX 76102

Last month I promised you some really exciting news, but I spoiled my own fun by asking Cam Brown to come down to Fort Worth and look over our latest computer... the TRS-80 Model 100. His review should be in this issue. I know you don't need to read two reviews, but I gotta' get my two cents worth in.

TRS-80 Model 100

Since December I've been carrying a 100 around with me. On the road, it's great! Instant communications with the office via electronic mail; when it's convenient for them and me. One of our Product Managers spent a week on the Colorado ski slopes... every night I kept him posted on happenings, and he replied to any questions that came up. (No, I'm not really a slave-driver... he requested the updates.)

Last week, I attended a convention in California, and kept in touch on a daily basis, without having to worry about time zones and catching someone at his or her telephone.

When I went to Comdex, I sent home thumbnail sketches of the new products I saw, received questions about them, and was able to go back for a second look and answer those questions.

My last couple of Topics columns have been prepared on the Model 100, some while travelling, and some with the computer on my lap while watching TV. Programs and data can be stored on cassette, or transferred via RS-232 to my Model II for disk storage. Text can then be processed and formatted on Scripsit, spell-checked, etc. The process is fairly simple on Model II Scripsit, if you have two disks. It goes like this:

1) Boot on a non-Scripsit disk and go into Terminal mode. Turn on the RAM buffer.

2) Select the TELCOM program on the Model 100, press TERM, UPLOAD, and give it the filename to upload.

3)Close the Model II RAM buffer and write the file to disk.

4)Boot under Scripsit, open a Scripsit file with the name you choose, select "U"tilities, "C"onvert, and type in the filename of the file you just dumped from the buffer (onto your second disk).

The new Scripsit Utilities package should be available by now (for Model II/12 Scripsit), and it has an even more simplified method; directly into Scripsit through the RS-232.

For personal use, I considered a Sony Typecorder when it came out, for the very purpose of making better use of those airborne hours, even though it had only a one-line display. Then when Epson announced their portable, it was a giant step forward. I'd have owned one of those, had it not been for the Model 100's development.

The machines we've been calling portable are more accurately described as "transportables"... Osborne, Otrona, Kaypro, Comaq, etc. They're great if you need to carry your computing power between two or more fixed locations. But if your need is true portability then there just isn't anything like the Model 100 on the market today. And the 100's eight-line by 40-character screen is more than a reasonable tradeoff for its extreme portability. Of course, many owners will never buy or write a piece of software. The built-in applications will do everything some people will want to do.

Well, I'm doing what I said I wouldn't do; duplicate the review in this issue. Sorry!

By the way, drop by your nearest Radio Shack and get your copy of the new RSC-9 computer catalog. Model 100 isn't in it, because it came out too early, but there are lots of other new goodies!

Pocket Computer, Model PC-4

In the new catalog you will find our new $69.95 PC-4. It's a super little (only 3/8 x 6-1/2 x 2-3/4 inch) pocket powerhouse, programmable in BASIC, with lots of features. There's a $39.95 cassette interface and a $79.95 printer to go with it. Display is a 12-character LCD, but lines can be up to 62 characters long. Strings can be up to 30 characters long, and string commands include LEN, MID, and VAL. Memory carries 544 program steps, expandable to 1568 with an optional plug-in 1K ROM.

RSC-9 also shows our latest software and accessories. There is a new, larger model of our "Space Saver Desk". The top measures 48 x 24 inches, and it's only $69.95. Great for your Model III or Color Computer.

Sales, Sales... Who's got the sales?

A couple of months ago *(March, 1983 issue --Ed.)*, Cam Brown suggested in his editorial that we talk more about sales volumes, etc. Well, that's one subject he and I haven't discussed, and certainly I can understand his point of view. On the other hand, we compete with no other vendor for retail shelf space, so

we don't have to prove to retailers what a job we're doing. We're a large NYSE-listed corporation, so even speculation about details within our company touches off a rash of questions from the media. And of course, we see no reason to give our competition a "target" to shoot at. In short, there just isn't any good sound business reason for making that information public.

Now, if you go to our last Annual Report, on page 21, you'll find it stated that in fiscal year 1982, computers were 30.7 percent of our $2,032,555,000 in net sales. I'll let you do your own calculating, since virtually all of you have your own computers. The report goes on to list the percentages of that computer business which were done in Model IIIs (27.2%), Models II and 16 (25.7%), Color Computers (7.2%), Pockets (2.5%), Printers (16.7%), Software (8.5%), and other (12.2%). So, within some limits, you should be able to guestimate a ballpark figure.

Most analysts and researchers have divided the computer market into segments. Whether you agree or not with the actual divisions, it's obvious that there is a "Home Computer" market, variously defined as up to $500 or $1000, or "anything hooking to a home TV." Then there is the "Personal Computer" market, $1000 to $5000 or so, and the "Business Micro" market being $5000 to somewhere between $15,000 and $30,000, depending on whose view you accept.

Obviously, the home market is going to be dominated by the lowest priced, most widely distributed product(s). Even our 6,000 USA outlets aren't going to compete with a computer distributed by 20,000 chain stores. We will capture a significant portion of the "high-end" home market. I'd rather not speculate too much about the other markets, since I'm not convinced anybody has meaningful sales numbers from any manufacturer. One highly-respected research firm's 1982 numbers indicate that we're certainly one of the three leaders in one of the other fields, and #1 in the other by a significant margin. Interestingly, their projections for the field in which they don't believe we lead, show us gaining market share by 1985, and one of the top three losing share during that time. But... all this is one company's opinion. Right or wrong...?

To complicate the issue even further, we have our own distribution system, so our sales figures are based on sales to end users. I suspect that most manufacturers' sales numbers are based on shipments "if sold" (even though they do seem to be adjusted for retail prices). Does that indicate that all shipments to dealers and distributors are counted as sales? What about those folks' ending (i.e., unsold) inventories? So, I contend that playing these numbers games is dangerous, and largely meaningless. And that's another reason we don't throw numbers around.

So, I'm out of time and over my word budget. If you think the Model 100 is the last trick up our sleeve, just wait until next month!

LOVELOVELOVEL

Designing active bandpass filters

Cut your design time down to just a few minutes

Models I/II/III

Jim Weir, V.P., Radio Systems Technology, Grass Valley, CA

The op-amp multiple-feedback bandpass filter has come to be a staple of the electronic engineer's bag of tricks. While difficult to implement back in the days of 6SN7's (i.e., tubes), today's four-for-a-buck high-gain low-distortion IC amplifiers make the design of stable, high gain, high Q filters child's play. That is, a child armed with a TRS-80 Model II and this program.

The equations (lines 210 and 530) are not particularly difficult. In fact, I used to design these filters in about 10 minutes of keystroking my venerable old HP-35 (Hewlett-Packard). Now *there*, children, was a machine. *No* memory, *no* programming, dim LED readout, only $500, and a six-month wait to get one. Anyway, the problem was that certain combinations of input values would cause the required circuit values to be impossible to attain. Just try to buy a -1300 ohm resistor! This would cause much grief in my heart, not to mention another ten minutes of keystroking, and another ten minutes after *that* if the second try was no good, and so forth. Usually, about the third or fourth try, I came up with a filter that was on frequency, the right Q, and could be made from available parts. Now, I grant you that an engineer in the 1950's would have given his eye teeth and sold his children into bondage for such a rapid filter design; I knew that there was a better and faster way. Enter the accounting department's TRS-80 Model II.

Allow me to digress for just one paragraph. The filters that we are about to discuss are intended to take one band of frequencies out of a signal containing a multitude of frequencies and noise, amplify it, and output this small section of the frequency spectrum for whatever purpose you choose. Suppose, just for grins, that a burst of 400 Hz tone on your home telephone line (say, from a tone pad) means "turn on the oven." Thus, anyone calling your house and touch-toning a 400 Hz signal will turn on the oven. Touch-toning 1000 Hz turns on the garage lights, 2500 Hz turns on the electric blanket, and so on. Then, three filters, one tuned to 400 Hz, one tuned to 1000 Hz, and one tuned to 2500 Hz, all fed from the telephone line, will turn on (through a relay circuit) the oven, the garage, and the bed. In the electronic world, this is known as tone code signalling, and is the easiest and most reliable way of remote-controlling an electrical device. End of digression.

In my field of aviation electronics (not to mention ham radio, photography, security systems, and general goofing around) there have been literally hundreds of times that I needed an audio filter. Out came the calculator, and an hour later I had the design, right up to the day where I did 15 of them in a row. That evening, I stole about two hours of time on the company TRS-80 Model II accounting machine and programmed in the design equations for the multiple feedback filter. This filter, Figure 1, is comprised of two capacitors, three resistors, and an amplifier commonly called an op-amp. In this program, center frequency and Q (Figure 2), along with C1 and C2 values, are input data. The program calculates the three remaining resistor values for you. If, for some reason, these resistors are not satisfactory, you may input new frequency, Q, and capacitor values quickly and the design time is shortened from an hour to less than a minute.

I have used this program 90 percent of the time to perform a filter design. However, every now and again I come across some already-designed filter in an article, and just for engineering satisfaction, I want to "reverse engineer" the author's design — I want to know his selection of center frequency and Q, given his R and C values. (Heaven forbid I should ever have to analyze one of my *own* filters, because I keep perfect notebooks. Don't all of us practicing engineers?)

At any rate, this program will allow you to design a multiple feedback bandpass filter or analyze one that has already been designed.

There are some limitations. Equations are good from as low a frequency as when the capacitor leakage does not become a problem to as high a frequency as when the op-amp response does not become a problem. Generally, for $Q < 20$ and Gain < 20, frequencies from 10 Hz to 50K Hz are okay.

Low Q and high gain don't cut it. If Q is less than the

square root of gain divided by 2, the op-amp will give you large errors (see line 195).

Low resistor values are hard to realize. Most filter programs stop at 1000 ohms, but I have designed filters with R values below 100 ohms. Very carefully. This program alerts you at the 10 ohm level. See line 215.

Enough of theory, let's design a filter to split the fan marker (Figure 3) from the rest of the marker beacon frequencies in an aircraft instrument landing system marker beacon receiver. The circuit demands that we have a voltage gain of 15 from input to output, and the system requires a Q of 8. The only variable is the choice

Figure 1

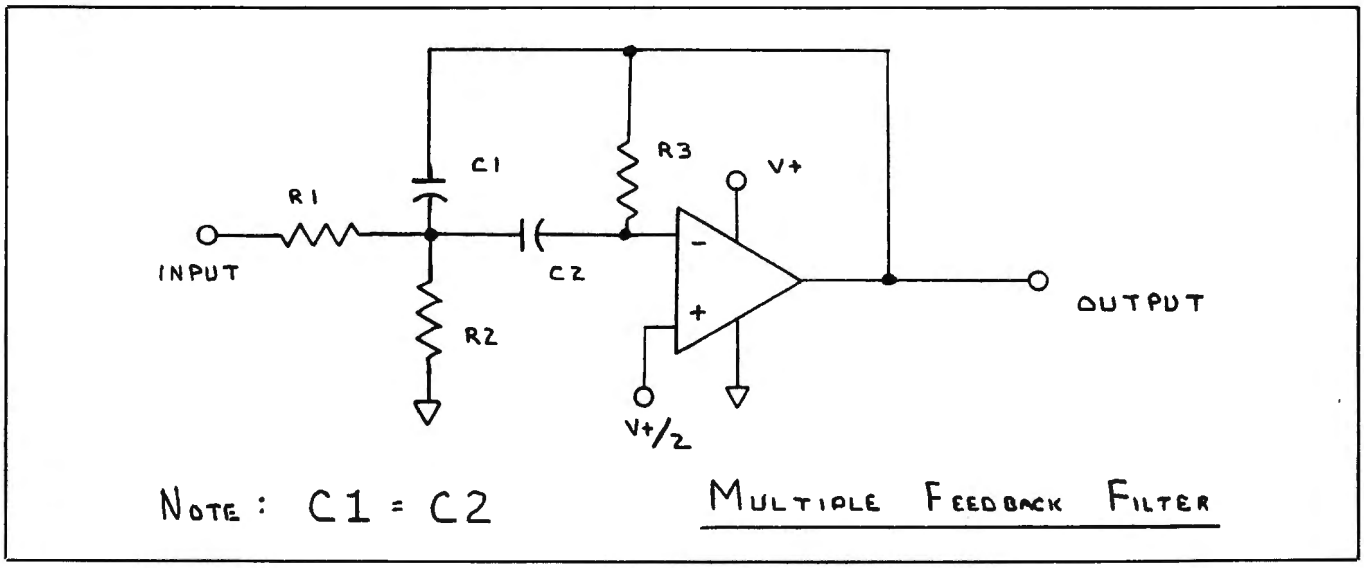


Figure 2

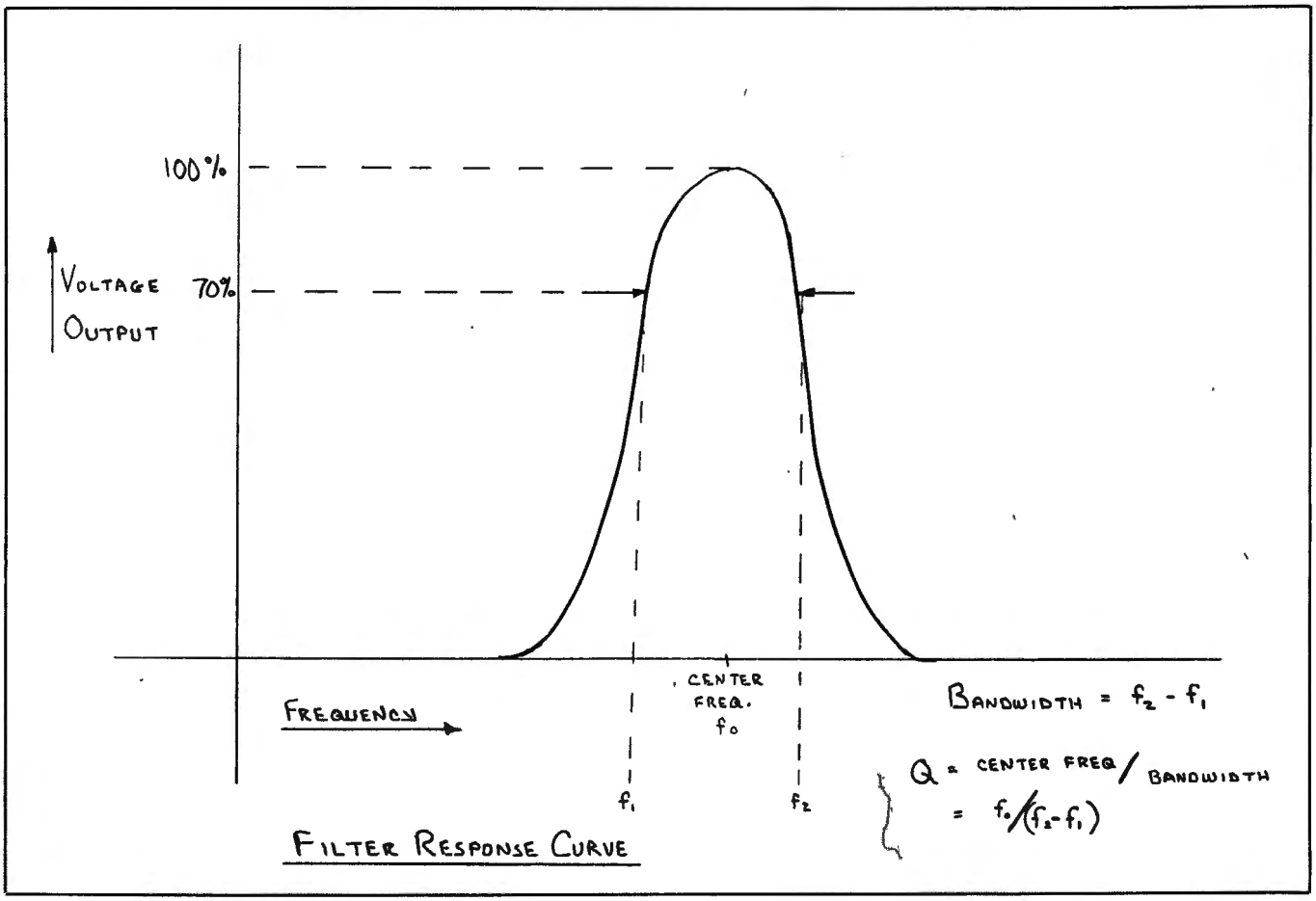


Figure 3a

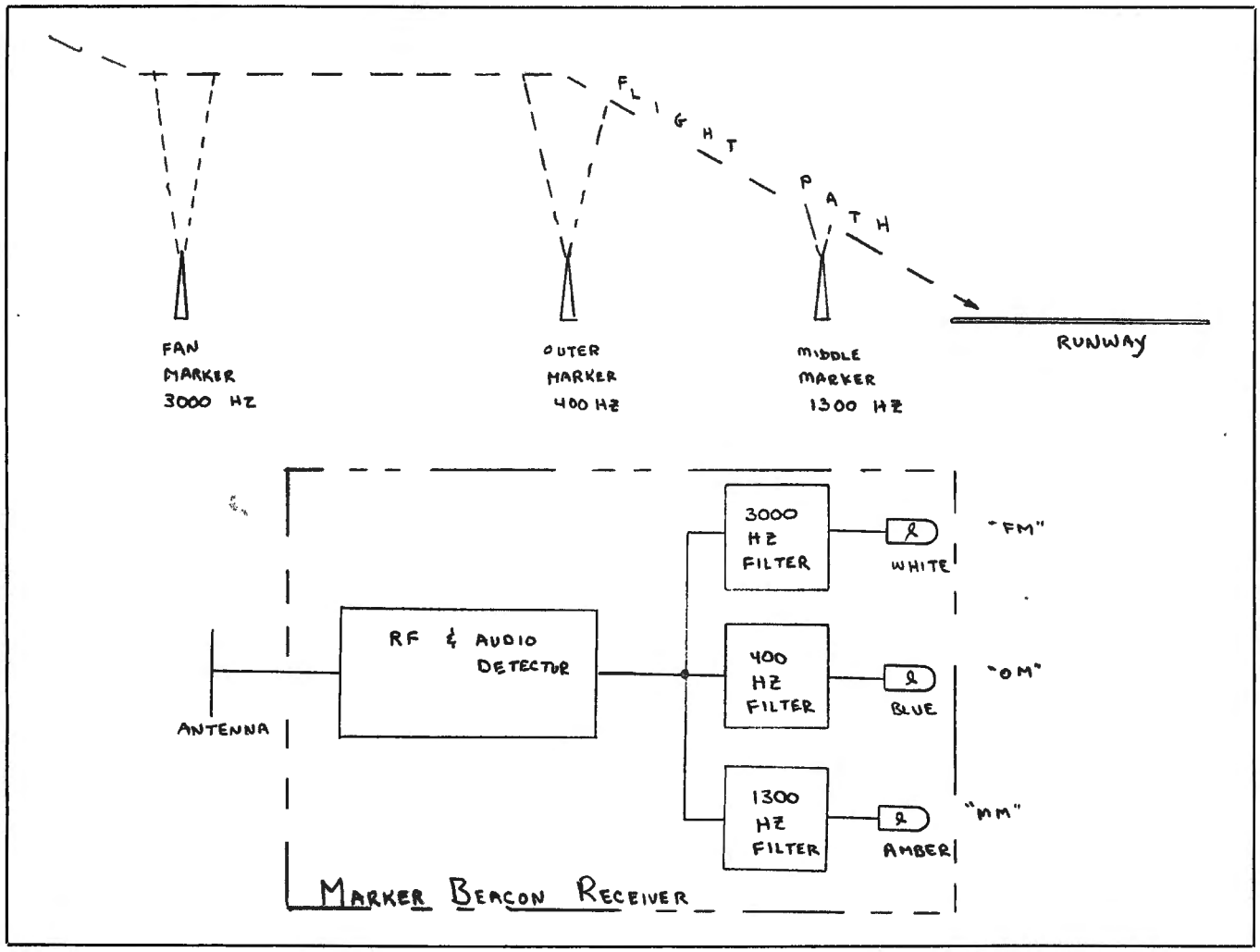
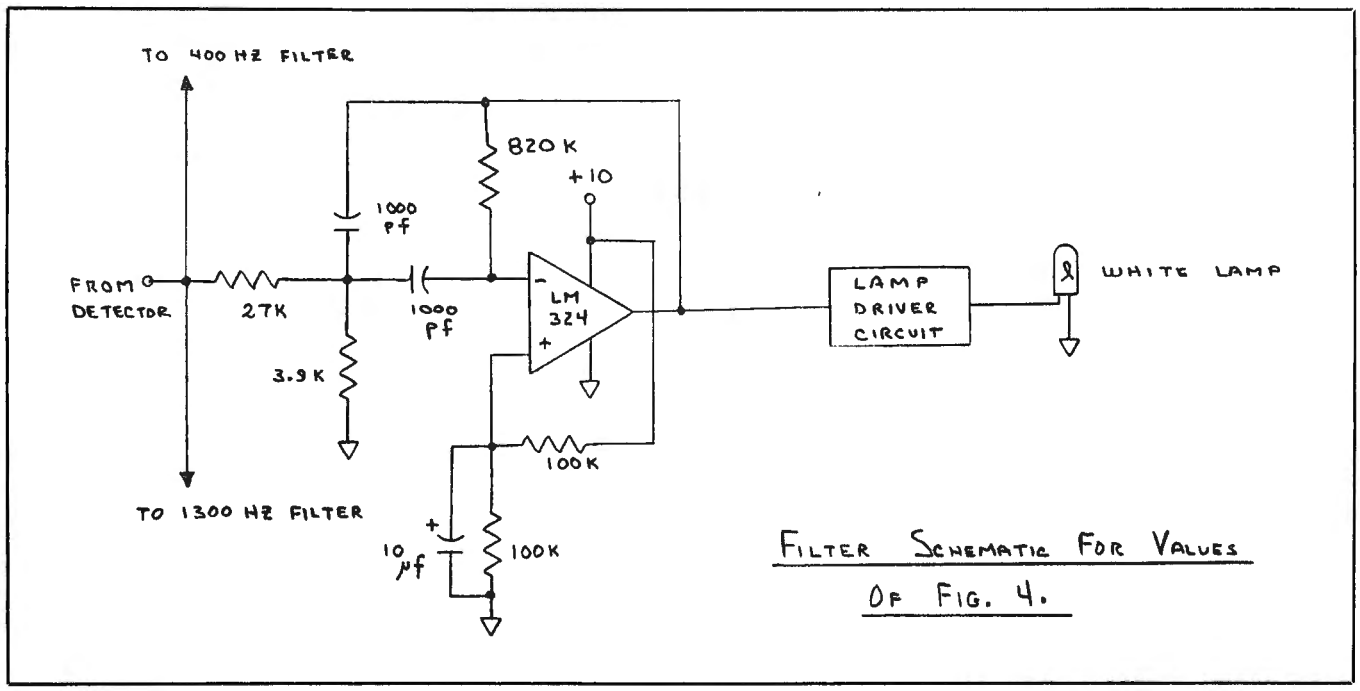


Figure 3b



of feedback capacitors.

Choosing C1 and C2 to be 1000 pF would allow R1 to be 27K (a standard value), R2 to be 3.9K, and R3 to be 820K (Figure 4).

Increasing C1 and C2 to 4700 pF amends all resistor values, and R2 may now become a problem over temperature. In general, R values below 1000 ohm are considered trouble spots to watch (Figure 5).

Just for giggles, increasing the feedback capacitors to 10 microfarads produces the expected warning message, and resistor values that are quite impossible to realize (Figure 6).

That's it. For a quarter's worth of op-amp and a dime's worth of resistors and capacitors, you can build an audio filter with gain and Q of your choosing. Just remember the limitations of this design: Keep all resistor values above 1000 ohms, or so. Keep Q>=square root (2 X gain) or thereabouts. Q > 25 may be difficult to work with

Figure 4

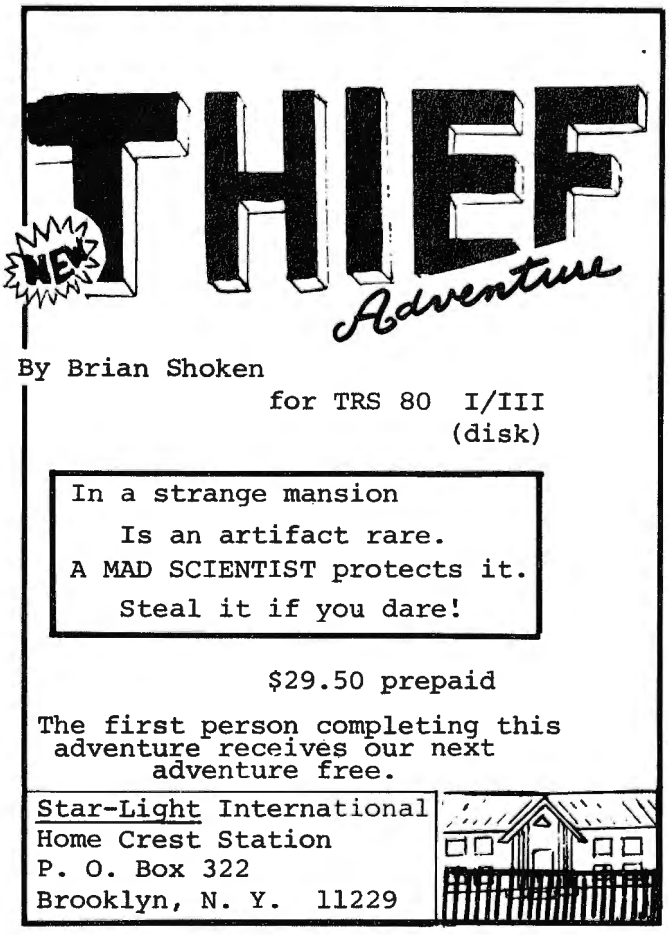
```
CAPACITOR VALUES =  1000  PF                                    .01,18,22.
GAIN =  15  TIMES THE INPUT
Q =  8
CENTER FREQUENCY =  3000  HZ


IS ALL THIS CORRECT (Y OR N)? Y


R1=  28294.2 OHMS
R2=  3755.87 OHMS
R3=  848827 OHMS

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

Figure 5

```
CAPACITOR VALUES =  4700  PF                                    .01,20,24.
GAIN =  15  TIMES THE INPUT
Q =  8
CENTER FREQUENCY =  3000  HZ


IS ALL THIS CORRECT (Y OR N)? Y


R1=  6020.05 OHMS
R2=  799.122 OHMS
R3=  180602 OHMS


IS ALL THIS CORRECT (Y OR N)? Y

THE VALUES YOU SELECTED MAKE IT IMPOSSIBLE TO DESIGN A PRACTICAL FILTER.  NOTE
THE EXTREMELY LOW OR NEGATIVE VALUES FOR THE RESISTORS.  SUGGEST YOU TRY AGAIN.

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

Figure 6

```
R1=  2.82942 OHMS
R2=  .375587 OHMS
R3=  84.8827 OHMS

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
```

considering temperature, component tolerance, etc. High gains and high Q may cause a beautiful phenomenon called oscillation if care is not taken on the layout of your circuit. Resistor values above 10 megohms will be difficult to achieve in practice, and will lead to errors in the design.

One interesting note (see line 530) is that varying R2 will move the center frequency around without varying gain or Q. Thus, a very well-behaved tunable filter may be made by making R2 a variable resistor.

Summary

You tell the program the center frequency, Q, and capacitor values you wish to use, and the necessary resistor values will be calculated for you. Conversely, you tell the program the R and C values of a filter and it will calculate the center frequency and Q of a previously designed filter. The bandpass filter is by far the most often used configuration of active filter. However, low pass and high pass filters are certainly possible using this technology.

Program Listing — FILTER/MAY

```
10 'PROGRAM TO DESIGN MULTIPLE FEEDBACK
ACTIVE FILTER
20 'BY JIM WEIR, RADIO SYSTEMS TECHNOLOG
Y
30 'FILE NAME "FILTER/BAS"
40 CLS:CLEAR:DEFINT Z:PI=3.14159:ONERROR
GOTO1000
50 ZD$="":PRINT:PRINT:PRINTCHR$(26)"FILT
ER DESIGN ROUTINE FOR MULTIPLE-FEEDBACK
FILTERS":PRINTCHR$(25):PRINT:PRINT:PRINT
"DO YOU WANT TO ":PRINT"1. DESIGN A FILT
ER":PRINT"2. ANALYZE A FILTER":PRINT "3.
 EXIT THE PROGRAM"
55 PRINT:INPUT ZD$:ZD=VAL(ZD$):IF ZD<1 O
R ZD>3 THEN 50
60 ON ZD GOTO 100, 500, 70
70 END
100 CLS:PRINT"FILTER DESIGN ROUTINE":PRI
NT:PRINT
120 ZC$="": INPUT"IS THE CAPACITOR DATA
IN PICOFARADS (P) OR MICROFARADS (M)";ZC
$:IF ZC$="P" THEN CZ=1E-12 ELSE IF ZC$="
M"THEN CZ=1E-6 ELSE 40
125 VC=0:INPUT"FEEDBACK CAPACITOR VALUE
(BOTH CAPACITORS SAME VALUE) ";VC:VZ=ABS
(VC*CZ)
130 ZF$="":PRINT: INPUT"IS THE FREQUENCY
 DATA IN HERTZ (H), KILOHERTZ (K) OR MEG
AHERTZ (M)"; ZF$:IF ZF$="H"THEN FZ=1:ZF$
="": ELSE IF ZF$="K"THEN FZ=1E3 ELSE IF
ZF$="M"THEN FZ=1E6 ELSE 40
135 VF=0:INPUT"CENTER FREQUENCY";VF:VL=V
F*FZ:PRINT
140 PRINT"GAIN IS ABSOLUTE (NOT DB), Q I
S NONDIMENSIONAL"
160 VA=0: INPUT"GAIN";VA:VQ=0: INPUT"Q(Q
=FREQUENCY/BANDWIDTH)";VQ
170 CLS: PRINT "CAPACITOR VALUES =  ";VC
;" ";ZC$;"F"
180 PRINT "GAIN =  ";VA;" TIMES THE INPU
T"
190 PRINT "Q =  ";VQ:PRINT "CENTER FREQU
ENCY =  ";VF;" ";ZF$;"HZ"
195 IF VQ<SQR(ABS(VA)/2) THEN PRINT "YOU
R Q IS LOW AND YOUR GAIN IS HIGH. YOU AR
E GOING TO GET ERRORS FROM THE OP-AMP"
200 Z$="Y":PRINT:PRINT: INPUT"IS ALL THI
S CORRECT (Y OR N)";Z$: IF Z$<>"Y" THEN
100
210 R3=VQ/(PI*VL*VZ):R1=R3/(2*VA):R2=(R1
*R3)/((4*VQ*VQ*R1)-R3)
215 IF R1<10 OR R2<10 OR R3<10 THEN PRIN
T:PRINT"THE VALUES YOU SELECTED MAKE IT
IMPOSSIBLE TO DESIGN A PRACTICAL FILTER.
  NOTE  THE EXTREMELY LOW OR NEGATIVE VA
LUES FOR THE RESISTORS. SUGGEST YOU TRY
AGAIN.":PRINT:PRINT
220 PRINT:PRINT:PRINT "R1= ";R1;"OHMS":P
RINT "R2= ";R2;"OHMS":PRINT "R3= ";R3;"O
HMS":PRINT:PRINT:INPUT"DO YOU WANT TO IN
PUT DIFFERENT VALUES";Z$:IF Z$<>"Y" THEN
 40 ELSE 100
500 CLS:PRINT "FILTER ANALYSIS ROUTINE":
PRINT:PRINT
510 R1=0:R2=0:R3=0:INPUT"R1 IS THE INPUT
 RESISTOR. VALUE IN OHMS  ";R1:PRINT:INP
UT"R2 IS THE RESISTOR TO GROUND FROM R1.
 VALUE IN OHMS  ";R2:PRINT:INPUT"R3 IS T
HE FEEDBACK RESISTOR FROM OUTPUT TO INVE
RTING INPUT";R3
520 VC=0: CV$="":PRINT:INPUT"CAPACITOR I
N PICOFARADS (P) OR MICROFARADS (M) ";CV
$:IF CV$<>"P" AND CV$<>"M" THEN 520 ELSE
INPUT"CAPACITOR VALUE ";VC:IF CV$="P" TH
EN CV=VC*1E-12 ELSE IF CV$="M" THEN CV=V
C*1E-6
530 FO=(1/(2*PI*CV))*SQR(((1/R1)+(1/R2))
*(1/R3)):AO=R3/(2*R1):Q=FO*PI*CV*R3
540 ZF$="": IF FO>1E6 THEN ZF$="M":FO=FO
/1E6:ELSE IF FO>1E3 THEN ZF$="K":FO=FO/1
E3
550 PRINT:PRINT:PRINT "CENTER FREQUENCY
=  ";FO;" ";ZF$;"HZ":PRINT:PRINT "GAIN =
   ";AO;"  ABSOLUTE GAIN (NOT DB).  180
 DEGREES PHASE SHIFT AT C/F.": PRINT:PRI
NT"Q =  ";Q
560 Z$="Y":PRINT:PRINT:INPUT"DO YOU WANT
 TO ANALYZE ANOTHER FILTER (Y or N) ";Z$
:IF Z$<>"Y" THEN 40 ELSE 500
1000 CLS:PRINT "ERROR ";ERR;" JUST OCCUR
RED IN LINE ";ERL;" SORRY ABOUT THAT":FO
R I=1 TO 6000:NEXT:RESUME 10
```

Com 80

Downloading over the radio

Donald L. Stoner, Mercer Island, WA

Mr. Stoner, our Com 80 columnist, is Vice-President of Engineering at the MicroPeripheral Corporation, Redmond, WA. His company played a key role in the development of the radio downloading project. The initial downloading on March 6th of a message was successful and hundreds of Seattle area computer users sent in letters verifying reception of the "secret" password. KMPS planned a broadcast on April 3rd, 1983, for TRS-80 and Apple computers. An experimental 4800 baud message will also be tested. — Ed.

By the time you read this, one of the most exciting innovations in the field of personal computing will be taking place. I am referring to the downloading of programs by transmitting digital data on the main channel of a broadcast station.

Main channel? By way of explanation, I have to tell you about another system that seems to be in vogue for FM transmission of digital data. It is possible to send out several audio channels on an FM station by using subcarriers. The two assigned "subs" are generated by modulating the main channel audio with either a 53 kHz or 75 kHz signal. This signal, in turn, can be modulated with audio or digital data. Naturally, you never hear this high a frequency and are not aware of its presence. This is the way commercial-free music is transmitted to stores and offices.

This subcarrier broadcast system has a couple of disadvantages. It is very susceptible to what is called multipath distortion. This is the same effect that puts ghosts on your TV screen. It is caused by the signal arriving from two different directions and, therefore, at two different times.

However, the biggest disadvantage of subcarrier transmission is the cost. Special receivers are required, which are capable of extracting the high frequency subcarrier and removing and processing the modulation or data. These receivers are expensive.

There is another way of accomplishing the same thing and it is called main channel broadcasting. You actually hear the data just as you would the announcer's voice or the broadcast music. This system does not cost you, the consumer, anything! For example, if you have an acoustic-coupled modem, you can lean it up against the speaker of your AM or FM radio and dump the data into your computer just as if the information were coming in from the telephone line. *(You also need a terminal program and RS-232 --Ed.)* If you have a direct-connect modem, purchase an RJ-11 jack at your local Radio Shack store (part no. 279-355) for $2.19. Connect the red and green wires (ignore the black and yellow wires) to the speaker terminals on your radio or stereo. Insert the mini-plug from your modem into the jack. It's as simple as that!

Those in the Puget Sound area are within the broadcast coverage area of the world's first station to take the lead in this new technology. Radio station KMPS (1300 kHz AM and 94.1 mHz FM) is presently conducting tests and downloading digital data at 300 baud. The first broadcast was on March 6th at 7:30 AM and was received over the region. Users were told to tape record the broadcast and then play the recording back through the modem (set to originate mode).

To support the new technique, a low cost method of downloading data (pat. pending) on the main FM channel at 4800 baud has been developed by The MicroPeripheral Corp. of Redmond, WA. KMPS is conducting high-speed tests at 1200, 2400, and 4800 baud. Wouldn't it be great to download an 8K game in something like 17 seconds? You can do it, and the necessary equipment costs lest than the cartridge for an Atari video game! Speaking of these, the new technique even permits downloading to a RAM-pack that can be plugged into an Atari, Intellivision or other video game machines.

The 300 baud, main channel downloading system is the brainchild of George Garrett (a radio amateur, AC7X, by the way), the News Director at KMPS. If you would like additional information, or if your user group/club would like to be placed on the information mailing list, write the news department at radio station KMPS, 1507 Western Ave., Seattle, WA 98101 or call (206) 622-2512.

Basically BASIC

FOR . . . NEXT loops

For all models

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One of the many powerful features of a computer is its ability to perform a repetitive task a number of times. This is called looping.

Beginning programmers often have difficulty understanding FOR . . . NEXT loops. In the operation of a loop, several things happen simultaneously. A programmer must understand everything that's happening in the loop.

The FOR Statement

The generalized form of the FOR statement is: FOR *Index Variable = Initial Value* TO *Final Value* (STEP *Increment*). Let's start with a simple example program:

```
10 FOR X=1 TO 5
20 PRINT X
30 NEXT X
```

The program prints 1 2 3 4 5. What's happening? The variable X in line 10 is a counter (known as the index variable). Its job is to count the number of times the loop executes. The FOR statement assigns the initial value (1 in this example) to the counter when the loop is first entered.

Line 20 is the "do" portion of the loop — a statement, or number of statements, defining the process to be performed. In this example, it prints the value of the counter X.

The NEXT statement in line 30 increments (adds 1 to) the counter. It then tests the counter against the final value to see if the loop has executed enough times. If it hasn't, the program loops back to line 20 with a new value for X and runs again.

Now, let's make a few changes in our program and see what happens:

```
10 FOR K=2 TO 10 STEP 2
20 PRINT K
30 NEXT K
```

We've changed the index variable to K (it can be any valid, non-subscripted, numeric variable), changed the initial value to 2 (it doesn't have to be 1), and added STEP 2. This prints 2 4 6 8 10.

STEP

STEP tells the NEXT statement the amount to increment the counter. It doesn't have to be an integer: change STEP in line 10 to STEP .5. The program prints 2, 2.5, 3, 3.5 . . .

STEP can also be negative if you want to count backward. Change line 10 in the first program to read: 10 FOR X=5 TO 1 STEP -1. The output becomes 5 4 3 . . .

If STEP is omitted, the computer uses a default increment of 1 (as in the first example).

Here's a program that tests various inputs. It uses variables for the initial value, final value, and STEP increment (expressions could be used in place of these variables).

```
10 INPUT "Initial Value";A
20 INPUT "Final Value";B
30 INPUT "Step Increment";C
40 FOR X = A TO B STEP C
50 PRINT X
60 NEXT X
```

While you're experimenting with various inputs, try inputting an initial value of 1, a final value of 5, and a step increment of -1. Then, try inputting an initial value of 7, a final value of 2, and a positive step increment. Logically, these shouldn't work. The first set of inputs tries to count backward from 1 to 5. The second set attempts to count forward from 7 to 2. You'll find that, in each case, the initial value gets printed. The TRS-80's BASIC interpreter will run once through a loop even if the logic is wrong (not all computers do this). It's something to be aware of when you're debugging a program.

The NEXT Statement

The operation of the NEXT statement often makes FOR . . . NEXT loops difficult for beginners. Here is where the index variable is incremented — the value of STEP is added to it (subtracted if STEP is negative). The

new value of the index is then compared to the final value. If the new index value is higher (less, if STEP is negative), the program continues to the statement following NEXT. If not, the program goes through the loop again. The tricky part is that when the loop is completed, the value of the index variable is always greater (less, if STEP is negative) than the final value.

Add this line to the last program:

```
70 PRINT "Value of X is";X
```

Run the program a few times until you're comfortable with the fact that the value of the counter is different than the final value.

Programming Tips

1. Indent the "do" portion of loops. It makes them easier to read. This is especially true with nested loops.
2. Indicating the index variable after NEXT is optional. Including it makes loops easier to read. In nested loops, it shows that the loops are properly nested.
3. Reserve variables to be used as counters in all of your programs. This makes your programs easy to analyze and debug. I use the variables X, Y, and Z (following Lewis Rosenfelder's conventions in *BASIC Faster and Better*).
4. Use a different set of variables for counters in subroutines. As you become a more experienced programmer, you'll build a library of subroutines (such as Spencer Hall's "Z-Subs", *80-U.S. Journal*, Jan. 1982) that you use frequently and plug into your programs automatically. I started using different counter variables in subroutines after I went from an X loop in the main program into an X loop in a subroutine and wondered why my program wasn't working. I now use variables XS, YS, and ZS for counters in subroutines.
5. If your counter won't have any fractional values, use an integer variable to speed execution of your loop (e.g., FOR X%=1 TO 10 . . . NEXT X%).
6. If you want to delay your program for a period of time (e.g., to leave a message on the screen for 10 seconds), use a timing loop (sometimes called a "delay loop). The form for this is FOR X=1 TO (delay) : NEXT X. The delay for the Model I is about 370/second, for the Model II, it's about 670/second, and for the Model III, it's about 400/second.

Because reading speeds vary, a better way of leaving messages on the screen is to use an INPUT statement at the end of your message (e.g., INPUT "PRESS ENTER TO CONTINUE";R) to allow the user to read the message at his own speed.

7. Don't jump out of a FOR . . . NEXT loop. Once it enters a loop, the computer wants to complete it. To halt execution of a loop, set the value of the index variable to its final value and execute a NEXT statement. For example: IF (condition is true) THEN X=(final value) : NEXT X : GOTO (next line to be executed).

Conclusion

Next time, we'll look into nested loops. Meanwhile, study Table I, which summarizes the workings of the parts of FOR . . . NEXT loops. When you understand how all of the parts work, FOR . . . NEXT loops will have lost a lot of their mystery. That's BASIC.

Table I — FOR . . . NEXT Summary

FOR Statement:
Form: FOR Index Variable = Initial Value TO Final Value (STEP Increment)

Index Variable (Counter):
1. Assigned Initial Value by the FOR statement when the loop is first entered.
2. Must be a numeric variable (not subscripted).
3. Incremented in NEXT statement by STEP value.
4. Value can be changed within the loop.

Initial Value:
1. Follows equal sign in FOR statement.
2. Assigned in Index when FOR statement is first executed.
3. Can be a constant, variable or expression.
4. Value can't be changed from within the loop.

Final Value:
1. Follows TO in FOR statement.
2. Used to determine if Index exceeds Final Value after incrementation.
3. Value set when FOR statement is first executed.
4. Can be a constant, variable or expression.
5. Value can't be changed from within the loop.

STEP:
1. NEXT statement increments Index by the value of STEP.
2. Optional — value of 1 is used if no STEP is included in FOR statement.
3. Can be a constant, variable or expression.
4. Can be positive or negative integer or fraction.
5. Value can't be changed from within the loop.

NEXT Statement:
Increments Index by value of STEP; defaults to 1 if STEP omitted.
2. Checks the incremented value of the Index against the Final Value; if the value of the Index exceeds (is less than if STEP is negative) the Final Value the program proceeds to the statement following NEXT.
3. Stating the Index Variable after NEXT (e.g., NEXT X) is optional.
4. A single NEXT statement for a nested loop can list more than one Index Variable (e.g., Next X, Y, Z). This will perform the NEXT operation for each variable in the order listed.
5. In a nested loop, the first NEXT applies to the last FOR.

Nested Loop:
1. A loop inside another loop.
2. Each time the outside loop executes once, the inside loop executes completely.
3. Each FOR statement must have its own next statement. The first NEXT applies to the last FOR.

Anti-math

An arithmetic game for the youngsters

Color Computer

Craig Hunt, Gaithersburg, MD

This program was developed for my son, David, as an educational tool and a game. It should be suitable for anyone in elementary school. In this game, an "anti-mather" meteor from outside our galaxy descends to menace the earth. To destroy the meteor, the student must launch a math missile by correctly answering the question which is displayed. Three meteors must be destroyed. The first can be destroyed with two missiles. The second requires three missiles, and the final meteor needs five missiles to destroy it. At the end of each round of play, the score is displayed in the form of a fraction. For example, 10/10 is a perfect score, while 5/10 would be five of ten correct.

Several functions are available from the keyboard to provide flexibility in configuring the game. These are:

C (Color) Changes the color set.

G (Go) Starts a round of play. G may be entered during a round of play to skip a question, but the skipped question will be counted as wrong.

L (Level) Sets the level of difficulty from 1 to 5. Levels 1 to 3 are addition or subtraction problems with 1 being easiest. Levels 4 and 5 are multiplication problems with level 4 being the easiest.

Q (Quit) Ends the game.

T (Time) Decreases the time allowed for each round of ten questions. The default delay is 60. One press of the T key reduces that to 30; a second press, 15; the third press returns the delay to the default of 60 and a tone sounds to signal this.

- (Minus) Sets questions in levels 1 to 3 to subtraction.
+ (Plus) Sets questions in levels 1 to 3 to addition.

To play Anti-Math, enter and RUN the game. The playing screen will be displayed, but no problem or menacing meteor will be seen. Choose your color, level, problem type, and time delay. When ready, press G. The meteor and question will appear. A correct answer to the question will launch a "math missile." If you enter an incorrect digit, a tone will sound. You will be given three tries. If, after three attempts, you cannot answer the

Table 1

A ..... correct answer to the problem
AM ..... array to store the meteor
AX ..... X coordinate of the meteor
AY ..... Y coordinate of the meteor
C ..... color set indicator
CP ..... number of correct answers
D1 ..... units digit of N1
D2 ..... units digit of N2
E ..... count of digits in error
G ..... indicates game is in run status
H ..... hits made on the meteor
I ..... numeric value of I$
I$ ..... keyboard input
I1 ..... digit 1 of the answer
I2 ..... digit 2 of the answer
I3 ..... digit 3 of the answer
IC ..... input digit count
L ..... level of difficulty
ML$ ..... missile launch sound
MM ..... array to store the missile
MS$ ..... minus sign draw string
MX$ ..... missile explosion sound
MY ..... Y coordinate of the missile
N1 ..... first number used in the problem
N2 ..... second number used in the problem
PS$ ..... plus sign draw string
Q ..... index to Q$
Q$ ..... array of numeral draw strings
QX ..... X coordinate for numeral
QY ..... Y coordinate for numeral
S$ ..... indicates plus or minus
T ..... value of TIMER
T1 ..... tens digit of N1
T2 ..... tens digit of N2
TD ..... time delay
TP ..... total problems
TS$ ..... times sign draw string
X ..... FOR . . . NEXT loop control
XC ..... random color set
XM ..... random PMODE
Z ..... hits needed to destroy the meteor

question, the correct answer will be displayed. The scan of the input is on a digit-by-digit basis. This provides more immediate feedback to the student, giving him a better idea of where in the problem he went wrong.

After ten questions, the meteor will either be destroyed, or descend to earth where it will cause a little "craziness." The score will then be displayed. To play again, merely press G. To finish, press Q.

Let's take a quick look at the detail of Anti-Math. Table 1 contains a list and description of the variables used in Anti-Math. To understand the operation of this program, you will find the table quite helpful. Lines 10 to 70 display a title. This is not necessary for the operation of the game, but I feel that it adds a nice touch to the program. You don't? Delete it. The sound effects are stored in lines 80 to 90. Lines 100 to 150 create the graphics for the playing screen. The string data in line 160 are the draw strings for the numerals 0 to 9. Line 170 loads these values into the array Q$. Lines 180 to 300 finish out the screen by drawing a dummy problem (lines 220 to 250), displaying the difficulty level (line 260), clearing the meteor (line 270), and displaying a "math missile" (line 300).

In addition to the graphics setup, the keyboard loop, and the routines to process commands, there are a few general routines used by other parts of the program. The error routine in lines 640 to 690 sounds the warning tone when an incorrect digit is entered, and displays the correct answer when the error limit is reached. Lines 700 to 730 contain the routine which draws a numeral on the graphics screen. The code in lines 740 to 840 creates the problem based on the level of difficulty and the problem type. A correct answer causes a transfer to the routine at line 850 which launches a "math missile." In that routine, a check is made to see if the meteor has been damaged enough to disintegrate (line 950). At the conclusion of the game, the score is displayed by the code in lines 980 to 1010, and if the meteor has struck the earth, we have some "anti-mather" craziness contained in lines 1020 to 1100.

The game has several strong points as an educational exercise. The ability to set skill level and choose the type of problem is vital when students of varying skill will be using the same system. The feedback of the final score is important, but perhaps more important is the immediate feedback on each digit of the answer as it is entered. This allows for the correction of typing errors, as well as math errors. Nothing is quite as frustrating as making a typing error and not being allowed to fix it. Educational games should not be frustrating. Along the same lines, the student should feel that he controls the computer, not the other way around. That is why simple commands which change color (C), start the game (G), or stop the game (Q) are important.

This is a good program, but it was designed for use in my home, not in a classroom. It should be looked at as a starting point for your own design. In fact, that is the major role of any program from a magazine article. This program could be enhanced to handle division, or to show the intermediate steps of complex multiplication or addition. A musical reward for a good score, or a retest of missed problems, could be added. The possibilities are endless.

This game should prove entertaining to any elementary school children. My son David seems to enjoy it. I hope your children like it as much as mine do!

Program Listing for Anti-Math

```
5 'TITLE PAGE
10 CLEAR 1000
20 CLS(8)
30 PRINT@204,"ANTI-MATH";
40 PRINT@392,"COPYRIGHT 1982 BY";
50 PRINT@425,"SADARE SOFTWARE";
60 FOR X=150 TO 225: SOUND X,1: NEXT X
70 PMODE 1,1: PCLS
75 'SOUND EFFECTS
80 ML$="T255;V31;O1;1;10;1;3;4;2;5;6;3;5
;6;4;9;8"
90 MX$=";V25;7;8;1;2;2;6;9;6;7;5;1;2;1;;
6;6;9;3;4;8;9;6;5;4;8;5;1;9;3;5;5;V20;4;
6;7;5;5;8;9;1;4;5;4;3;4;3;7;5;3;4;9;1;2;
3;4;9;2;3;V15;2;3;4;5;9;4;1;3;2;9;1;4;1;
5;9;2;1;2;9;1;2;V10;1;1;2;1;9;4"
95 'MAKE METEOR, MISSLE, EARTH
100 CIRCLE(168,10),10,6
110 PAINT(168,10),6,6
120 DRAW"BM168,160;C7;D6G2;BR4;H2"
130 COLOR 6,5
```


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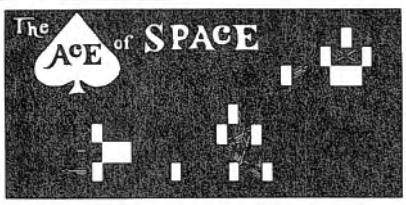
```
140 LINE(44,172)-(255,174),PSET,B
150 DIM AM(7),MM(1),Q$(9)
155 'DRAW STRINGS FOR NUMERALS
160 DATA "D8R4U8L4","BM+2,0;D8","R4D4L4D
4R4","R4D8L4;BM+2,-4;L2","D4R2;BM+2,-4;D
8","BM+4,0;L4D4R4D4L4","BM+4,0;L4D8R4U4L
4","R4D8","BM+2,+4;R2D4L4U8R4D2","BM+0,+
8;R4U8L4D4R4"
170 FOR X=0 TO 9: READ Q$(X): NEXT X
180 GET(156,0)-(180,20),AM,G
190 GET(166,160)-(170,168),MM,G
195 'DRAW STRINGS FOR +, -, X
200 PS$="BM4,94;R4H2D4": MS$="BM4,94;R4"
: TS$="BM4,92;F4;BU4;G4"
210 COLOR 7,5
220 DRAW PS$
230 LINE(4,102)-(28,102),PSET
240 Q=0: QX=22: QY=78: GOSUB 700
250 QY=90: GOSUB 700
260 L=1: Q=L: QX=234: QY=180: GOSUB 700
270 LINE(156,0)-(180,20),PRESET,BF
272 S$="+"
275 'DRAW THE WORD "SCORE"
280 DRAW"BM48,180;L4D4R4D4L4;BM56,180;L4
D8R4;BM60,180;D8R4U8L4;BM68,180;D8;BR4;U
2H2E2U2L4;BM80,180;L4D8R4;BU4;L2;BM84,18
2;R4;BD4;L4"290 AX=156: AY=0: C=1: TD=60
300 PUT(166,160)-(170,168),MM,PSET
310 SCREEN 1,1
315 'SCAN FOR NUMBER OR LETTER
320 I$=INKEY$
330 IF I$="" THEN 440 ELSE IF I$="G" THE
N 480 ELSE IF I$="C" THEN 370 ELSE IF I$
="L" THEN 390 ELSE IF I$="+" OR I$="-" T
HEN 340 ELSE IF I$="Q" THEN CLS: END ELS
E IF I$="T" THEN 1110 ELSE 590
335 'CHANGE TO ADD OR SUBTRACT
340 S$=I$: LINE(4,92)-(8,96),PRESET,BF
350 IF S$="+" THEN DRAW PS$ ELSEDRAW MS$
360 GOTO 320
365 'CHANGE COLOR SET
370 IF C=0 THEN C=1 ELSE C=0
380 SCREEN 1,C: GOTO 320
385 'CHANGE LEVEL
390 LINE(234,180)-(238,188),PRESET,BF
400 L=L+1: IF L>5 THEN L=1
410 Q=L: QX=234: QY=180: GOSUB 700
420 IF L>3 THEN S$="X": LINE(4,92)-(8,96
),PRESET,BF: DRAW TS$ ELSE IF S$="X" THE
N I$="+": GOTO 340
430 GOTO 320
435 'UPDATE METEOR POSITION
440 IF G=0 THEN 320
450 IF TIMER>T+TD THEN LINE(AX,AY)-(AX+2
4,AY+4),PRESET,BF: AY=AY+4: PUT(AX,AY)-(
AX+24,AY+20),AM,PSET: T=TIMER ELSE 320
460 IF AY>144 THEN 1020
470 GOTO 320
475 'START A NEW ROUND OF PLAY
480 IF TP=10 THEN 980
490 LINE(234,180)-(240,188),PRESET,BF
500 IF Z=2 THEN Z=3 ELSE IF Z=3 THEN Z=5
 ELSE Z=2
510 LINE(92,180)-(130,188),PRESET,BF
520 LINE(AX,AY)-(AX+24,AY+20),PRESET,BF
530 LINE(14,78)-(26,98),PRESET,BF
540 GOSUB 740
550 G=1: AX=156: AY=0: T=0: H=0
560 PUT(AX,AY)-(AX+24,AY+20),AM,PSET
570 TIMER=0
580 GOTO 320
585 'CHECK NUMERIC INPUT
590 IF I$>"9" OR G=0 THEN 320 ELSE I=VAL
(I$)
600 IF IC=3 THEN IF I3=I THEN IC=2: Q=I3
: QX=6: QY=106: GOSUB 700: GOTO 320 ELSE
 640
610 IF IC=2 THEN IF I2=I THEN IC=1: Q=I2
: QX=14: QY=106: GOSUB 700: GOTO 320 ELS
E 640
620 IF IC=1 THEN IF I1=I THEN Q=I1: QX=2
2: QY=106: GOSUB 700: GOSUB 850 ELSE 640
630 GOTO 320
635 'PROCESS AN ERROR
640 SOUND 50,3: E=E+1: IF E<3 THEN 320
650 IF IC=3 THEN IC=2: Q=I3: QX=6: QY=10
6: GOSUB 700
660 IF IC=2 THEN IC=1: Q=I2: QX=14: QY=1
06: GOSUB 700
670 Q=I1: QX=22: QY=106: GOSUB 700
680 IF TIMER>T+TD THEN LINE(AX,AY)-(AX+2
4,AY+4),PRESET,BF: AY=AY+4: PUT(AX,AY)-(
AX+24,AY+20),AM,PSET: E=E-1: T=TIMER
690 IF E>0 THEN 680 ELSE GOSUB 740: GOTO
 320
695 'DISPLAY A DIGIT
700 LINE(QX,QY)-(QX+4,QY+8),PRESET,BF
710 IF Q=10 THEN Q=0
720 DRAW"BM"+STR$(QX)+","+STR$(QY)+Q$(Q)
730 RETURN
735 'GENERATE THE PROBLEM
740 IF L=1 OR L=4 THEN N1=RND(9): N2=RND
(9) ELSE IF L=2 OR L=5 THEN N1=RND(99):
N2=RND(9) ELSE N1=RND(99): N2=RND(99)
750 TP=TP+1: IF TP>10 THEN 980
760 IF S$="-" AND N2>N1 THEN N2=RND(N1)-
1
770 LINE(14,78)-(26,98),PRESET,BF
780 IF N1<10 THEN Q=N1: QX=22: QY=78: GO
SUB 700 ELSE T1=FIX(N1/10): D1=N1-(T1*10
): Q=T1: QX=14: QY=78: GOSUB 700: Q=D1:
QX=22: GOSUB 700
790 IF N2<10 THEN Q=N2: QX=22: QY=90: GO
SUB 700 ELSE T2=FIX(N2/10): D2=N2-(T2*10
```

```
): Q=T2: QX=14: QY=90: GOSUB 700: Q=D2:
QX=22: GOSUB 700
800 IF S$="+" THEN A=N1+N2 ELSE IF S$="-
" THEN A=N1-N2 ELSE A=N1*N2
810 IF A>99 THEN IC=3: I3=FIX(A/100): I2
=FIX((A-(I3*100))/10): I1=A-((I3*100)+(I
2*10)) ELSE IF A>9 THEN IC=2: I2=FIX(A/1
0): I1=A-(I2*10) ELSE I1=A: IC=1
820 LINE(6,106)-(26,114),PRESET,BF
830 E=0
840 RETURN
845 'LAUNCH A MATH MISSLE
850 PLAY ML$
860 FOR MY=160 TO 10 STEP -10
870 LINE(166,MY)-(170,MY+8),PRESET,BF
880 IF PPOINT(166,MY-10)<>5 AND PPOINT(1
66,MY-10)<>1 THEN 920
890 PUT(166,MY-10)-(170,MY-2),MM,PSET
900 PLAY"V10;1;2;3;3;2;1"
910 NEXT MY
920 CIRCLE(168,MY+4),10,5: CIRCLE(168,MY
+4),8,7:  PAINT(168,MY+4),8,7: PLAY ML$+
MX$: PAINT(168,MY+4),5,5
930 PUT(166,160)-(170,168),MM,PSET
940 CP=CP+1
950 H=H+1: IF H=Z THEN CIRCLE(AX+12,AY+1
0),6,7: CIRCLE(AX+12,AY+10),4,8: PAINT(A
X+12,AY+10),5,8:PAINT(AX+12,AY+10),8,7:
PAINT(AX+12,AY+10),5,5: GOTO 480
960 GOSUB 740
970 GOTO 320
975 'DISPLAY SCORE
980 DRAW"BM108,188;E8;BR6;D8;BR4;R4U8L4D
8"
990 IF CP=10 THEN DRAW"BM96,180;D8;BR4;R
4U8L4D8" ELSE QX=100: QY=180: Q=CP: GOSU
B 700
1000 LINE(AX,AY)-(AX+24,AY+20),PRESET,BF
1010 CP=0: TP=0: G=0: GOTO 290
1015 'METEOR CRAZINESS
1020 PAINT(AX+12,AY+16),8,5
1030 FOR X=1 TO 100
1040 XM=RND(4)
1050 XC=RND(2)-1
1060 PMODE XM,1
1070 SCREEN 1,XC
1080 NEXT X
1090 PMODE 1,1: SCREEN 1,1: COLOR 7,5
1100 GOTO 980
1105 'CHANGE TIMING
1110 IF TD=15 THEN TD=60: SOUND 160,1: G
OTO 320
1120 TD=TD/2
1130 GOTO 320
```

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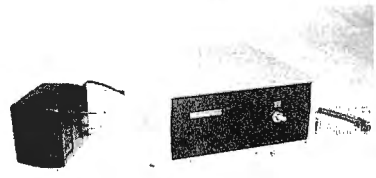

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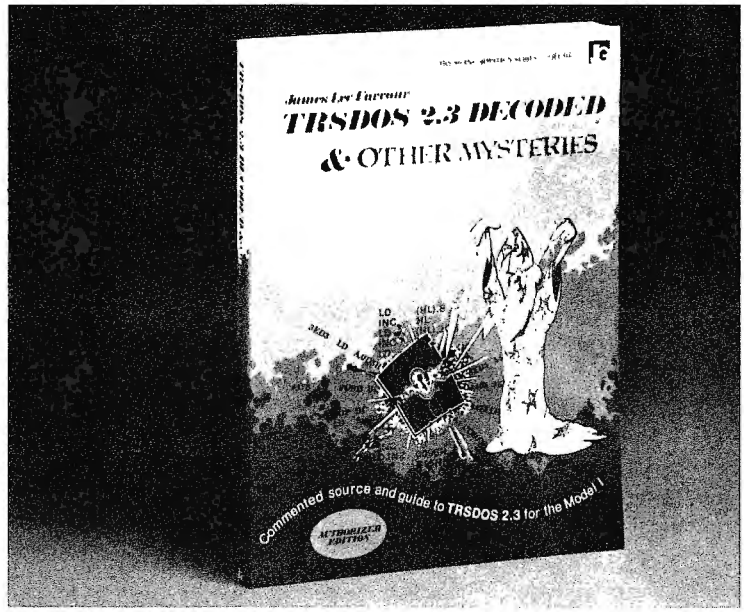

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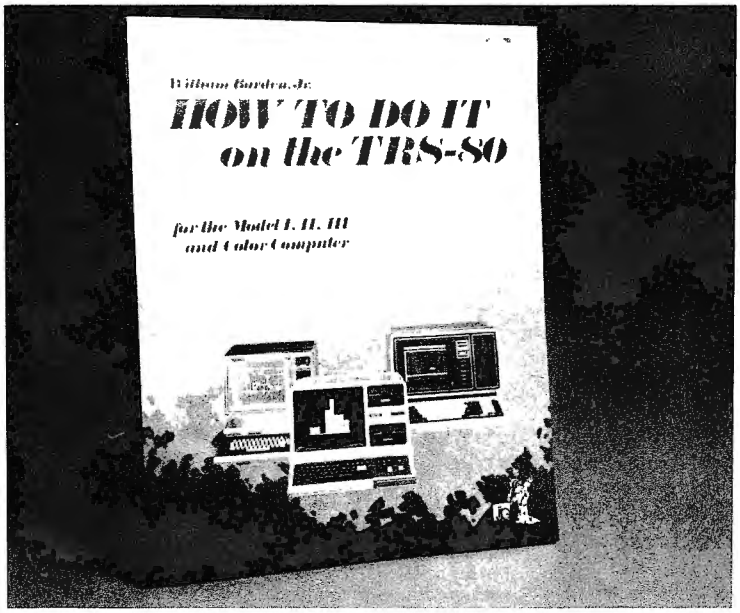

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Newscript, according to a recent survey, is the second most popular word processing program for the TRS-80 models I and III, second only to Scripsit. If present Scripsit owners could trade-up for the difference in price ($25), I would be willing to bet that Newscript would soon become number one. It is that good! You may have already read my review in the February 1982 issue of *80-US Journal*.

How do you improve on perfection? Well, Chuck Tesler, the creator of Newscript, is not one to sit at his keyboard and pretend that his code is beyond improvement. He listens to his users, and he responds. Version 7.0 is a greatly improved Newscript, with added features and is virtually bug-free.

Newscript's fame has always been its unbeatable print formatter. After all, it's the appearance of the finished product that really counts. Newscript produces some of the neatest and well-proportioned hard copy I have ever seen come out of any microcomputer. Version 7.0 now supports virtually every printer on the market, both serial and parallel types. Not only will it drive any printer, but it utilizes almost every hardware and software feature that has been built-in to any printer.

If more than one printer is being used by the system, it is very simple to tell Newscript which one is attached. Simply call up the printer menu, select your printer by number, and the rest is automatic. The program takes care of all the CHR$ codes that are required by your particular printer.

Instead of having to manually insert the special codes within your text, the program takes care of it when it is being printed. If you want a word underlined, you simply issue the underline symbols in your text. That is much easier than having to look it up in the printer manual and insert the required codes, which vary from printer to printer.

For users with daisywheel printers, a proportional spacing option is available. This allows each line to be evenly spaced, with the same white space between each letter and each word. It almost looks like typeset. This option is not required for Daisy Wheel II or proportional dot-matrix printers such as the Line Printer IV. A new printer spooler greatly improves the throughput, especially when printing proportionally spaced text.

Editing requires speed and ease of entry. Newscript stands out in this area. An improved "garbage collection routine" lets text grow in size with no slow down in entry time. The ENTER key is now a normal typewriter carriage-return linefeed; not a blank line of text.

The Edit and Script functions are faster. Control-BREAK now splits lines at the cursor and the default tab and form letters code characters have changed. A disk-resident width table has been added for use with daisywheel printers. Conditional hyphenation is possible with the choice of a hard or soft hyphen. A hard hyphen is a minus symbol within text, while a soft hyphen is a user-defined symbol that prints only when it must be used as the last character in a line.

A HELP function has been added to quickly find a particular control word. You can now select from the menu Microproof or Electric Webster spelling checkers as well as a graphics program called GEAP. The integration of those routines with Newscript makes it one of the easiest word processing systems around.

The documentation is totally new. It is a softbound, 277 page manual written by Chuck Tesler and Bruce Powel Douglass. The manual assumes no previous knowledge and has excellent tutorial sections for the novice. It is well illustrated, with actual screen displays, and some excellent art work. The quick reference guide provides enough information to keep experienced users out of the manual.

Newscript 7.0 is now also distributed by IJG and B. Dalton Booksellers, as well as several independent book dealers. In addition, Prosoft has added a full-time customer service person to answer all user questions or problems. Owners of earlier versions of Newscript may obtain version 7.0 by sending in their original diskette and $10 to Prosoft.

Jim Klaproth

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In addition to notifying all serious TRS-80 programmers about this new source book and actively seeking dealers throughout the U.S. and Canada, the staff is also getting ready for the second edition (Jul-Dec 83) which is scheduled for publication in July 1983. Complete details are in the first edition which is now available through your favorite store or bookstore (ask for ISBN 0-912043-00-8) or you can order direct from us by sending $4.95 (plus $1.00 postage and handling) to:

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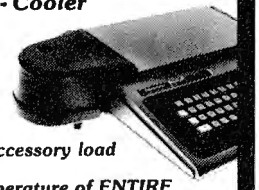

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identification markers. Features include automatic pen selection, chart hold-down, and touch panel pen-motion controls. It is driven through the computer's RS-232 interface. Disk software is supplied that is menu-driven; there is no programming necessary. It is easy to draw, save and recall professional line and pie charts, complex bar graphs, designs and more. The plotter comes with six hard-nib pens. Replacement pens are available at $3.95 each.

The plotter accepts paper sizes up to 8.5 x 11 inches. The plot size is 7 x 9.25 inches. Its speed is 2.8 inches per second and there are 200 steps per inch. The dimensions of the plotter are 6 x 13.5 x 10.5 inches. It weighs 20 pounds and uses standard, 115 volts AC 50/60 Hz, current.

When you buy this plotter you will receive a diskette containing a program called "Tandy Graph" for your particular model. This is a BASIC program, menu-driven, where answering simple questions will produce a bar, line, or pie chart as per your inputs. These may be saved on diskette and recalled and printed again. Upon recall, you have the option to change the colors but no provision has been made to add data or edit data already saved. This would have been a very useful addition to an already handy software package.

The plotter provides 93 upper- and lowercase printable characters, in four orientations. It also provides for six marker symbols. The colors provided are black, red, blue, green, violet, and orange. Felt tipped pens are also available for writing on transparencies (useful for overhead projection presentations).

Aside from the program, Tandy Graph, the accompanying manual provides a complete set of plotter commands for developing your own particular plotting program. Both absolute and relative positioning are possible. Ten different types of dashed lines are built-in and selectable. It is also possible to specify circle or arc plotting with a command that is followed by the location of a center and the desired size. The resolution of the arc is plus or minus one degree.

The plotter may also be operated manually by using its touch-sensitive controls. These include movement in four directions, pen up or pen down, as well as selection of local or remote operation.

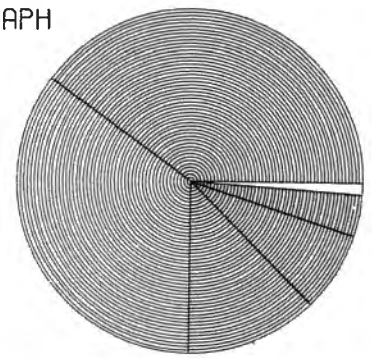
The accuracy and resolution for a machine of this size and price are quite impressive. The digital steps, when drawing a circle, are fine and not apparent without close examination through a magnifying glass.

The uses of this plotter for business graphs and charts are rather obvious. In use as an engineering tool, however, the possibilities are endless. One could program a series of subroutines representing the common electronic schematic symbols and then call them as needed. Computer logic diagrams are another possibility. Almost any engineering drafting could be done using this plotter, if one stays within its size constraints.

Six different and selectable colors are what really make this plotter outstanding. It has been said that a picture is worth a thousand words. Let's add that color further enhances the picture's worth by another thousand.

I. Mike Schmidt

GRAPH



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A printer is used primarily to print words. Some printers can do high resolution graphics by dot addressing, such as the Epson with Graftrax and the C.Itoh 8510. Although one can produce acceptable plots with these graphics printers, they are not as good as what can be produced on a device especially made for plotting. These devices are called, oddly enough, digital plotters.

A digital plotter takes your commands, like DRAW TO, and changes the information, not into a bunch of dots turned on, but rather into an analog movement of a pen across the paper. Thus the plots are made from lines and curves, smoothly connected; not a group of dots trying to make you think that it is really a line. For this reason, and the fact that plotters can generally "address" smaller distances than graphics printers, plotters are preferred

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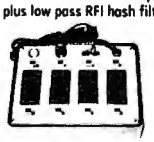

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The main disadvantage to having a plotter is that it, generally, makes a lousy printer; even though it can often print text at many different angles. Often the plotter becomes a specialty piece of hardware that cannot be used to do most of the things that a printer can do. With many computer installations, the cost effectiveness of having a plotter is a serious concern. Most plotters cost a minimum of $1500.

The Strobe plotter is the most inexpensive one on the market, at a mere $785 plus the interface. It has a resolution of 0.002 inches; about 50 microns. Good enough for most purposes and better than a number of more expensive models. The plotter can draw alphanumeric characters and print lines of text vertically or horizontally. Text printed vertically has the characters rotated by 90 degrees.

The Strobe plotter is a drum plotter. The paper is secured on a drum. The pen moves only left or right, and the drum moves to position the pen up and down. It takes 8.5 by 11 inch paper and unlike most plotters, normal plastic shank pens may be used rather than expensive plotter pens.

The Strobe plotter can also be used to digitize information from a piece of paper. The plotter is placed in SEEK mode by a command from your computer. Then use keys on the plotter to "drive" the pen around to the appropriate point on the drum. The ENTER key on the plotter is used to transmit the digital coordinates of that point to the computer. It makes entry of coordinates from a map quite simple and painless.

The Strobe Model 100 plots at three inches per second and has a minimum step size of .002 inches. It weighs only nine pounds and is 3 1/2 inches high by 16 1/8 inches wide and 8 1/2 inches deep. The Model I interface plugs into the bus port on the left side of the expansion interface. The Model III interface uses the RS-232 port. With the plotter you get a number of colored pens and some special non-porous paper. Normal paper can be used, but the ink tends to spread if it is very porous.

A hardware device is usually only as good as the software used to drive it. The Strobe plotter does fail a bit here; although the software is useable and does work. My complaint is that it is not as easy to use as other plotters, such as the HP 7225B.

The software manual contains commented source listings and flowcharts for machine code driver routines for the Z80, 8080, and 6502 CPUs. The drivers include useful routines for plotting and drawing alphanumeric characters, lines, PEN UP and PEN DOWN, SEEK, scaling and drawing a character, rotating a character, etc. These can be helpful for someone wishing to develop special drivers for specific purposes. These drivers also come on disk and are interfaced with documented BASIC programs via the USR functions. A person familiar with BASIC and USR calls should have no trouble writing specialty software. For those not wanting to delve into the programming of the plotter, several BASIC programs are provided.

The most useful BASIC program is called DRAW8/BAS. It is used to plot mathematical curves. You may choose the type of line (solid, dashed, dotted, etc.), plot a variety of symbols, and connect those symbols with lines. Plots may be linear versus linear, log versus linear, or log versus log. You can name your axes parallel to the axis (the rotation of characters by 90 degrees makes labeling a breeze), draw axes, or a grid.

There are two manuals, one for hardware and one for software. Both are fairly good and informative. They contain needed information such as technical specifications, plotter operation, 90-day warranty information, and explanations, listings, and flowcharts of the machine language drivers for the plotter.

The hardware quality is excellent, particularly for the money. The software is not quite as good, mostly because it is not as user-friendly as I like. Still, Strobe has made the listings and logic flow of the software quite accessible. It is relatively easy to develop your own plot routines. There are few things in this world that are excellent for the money; the Strobe 100 Digital Plotter is one of them.

Bruce Powel Douglass

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The TRS-80 digitizer is quite an interesting machine. It is very simple to use and even easier to connect. We were sent the device for evaluation and had it running on a TRS-80 Model II.

A digitizer is just a fancy word for a device that sends a signal through the RS-232 port. The signal is a eight byte word in which the first four bytes represent an X location and the last four denote a Y location. By setting an arbitrary position as (0,0), you can proceed to specify various locations. The digitizer consists of one arm which is free to move in two directions (back and forth, or in and out). The moving arm is always perpendicular to a similar fixed arm. At the end of the movable arm is a small cross-hair and magnifying lens for locating your position. By depressing a send switch, contact is made and a signal is sent to the computer. The contact of the two arms of the digitizer specifies its location in relation to an origin that you set earlier. Once you have the (X,Y) coordinates, it is left to you to write the code to store or make use of the data.

You are able to make skew adjustments for cases in which your document is not aligned directly with the digitizer. In any case, it is assumed you wish to compute on an orthogonal (perpendicular) coordinate system and that the document and digitizer are on the same plane.

I was impressed by the accuracy of the machine. Measurements of a location were accurate to plus or minus one percent. I didn't think my hands were that steady. The device has an actual measurement-field size of 11 inches by 17 inches.

Once you have the ability to locate points on a coordinate system, numerous applications become possible. With just a little help from Calculus, you can take function values and compute area, length, perimeter, even the equation of a graphed set of data. A set of contour maps could be used to calculate volume. Locations from a photograph could be used to store a digital representation of the picture.

Included with the digitizer is a manual that gives instructions for interfacing with a Model I/II/III/16 or Color Computer. The device can be directly connected to any RS-232 or cassette I/O port. You have to provide the RS-232 cable or 4-pin cassette plug (I have always thought they should be provided with the equipment). Driver routines for accessing the signal are given, as well as a very simple program that demonstrates the capability of the digitizer.

Purchasers should be sure to get a copy of the July/August 1982 *Radio Shack Newsletter* for a correction to the Model II driver as well as a copy of a program for calculating areas. Also, Radio Shack's March 1983 issue contained an enhanced version for the Model II user.

One slight problem was noted with the equipment. The sending switch that is located at the end of the moveable bar had a tendency to stick in the on position. Often we had to reset the device to break out of a continuous stream of data being received by the computer. For the price, it could be a better switch.

The digitizer was fun, highly accurate, and easy to install. At $449, you had better have a serious need for its use.

Cameron C. Brown

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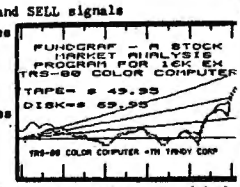

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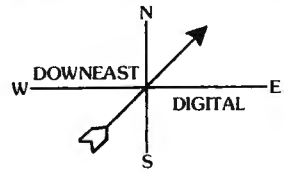

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E. J. Neiburger, D.D.S., Editor
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Model 16 Database

CDDS, a relational database management system that uses the Motorola 68000 processor is available for the TRS-80 Model 16. It uses menus and an English subset query language. The package supports a variety of file structures and has an introductory price of $595. Contact Data Management Systems, 211 N. El Camino Real, Suite 101C, Encinitas, CA 92024 or call (619) 942-0744.

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Add over forty commands to Model I/III Disk BASIC with this new utility from Modular Software Associates. It allows you to create custom versions of NEWBASIC, combines assembly language graphics ability with BASIC, adds commands for spooling, sound, RS-232 initialization, pre-defined and user defined keys for keywords, line labeling, moving READ/DATA pointer and more. Its price is $39.95 on disk from Modular Software Associates, 209 18th St., Huntington Beach, CA 92648 or call (714) 960-6668.

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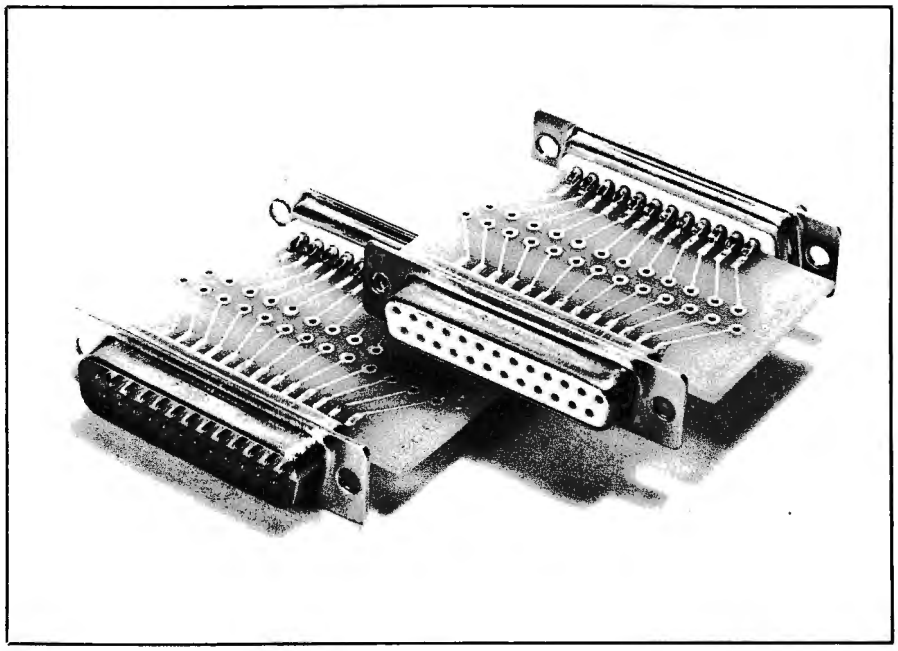

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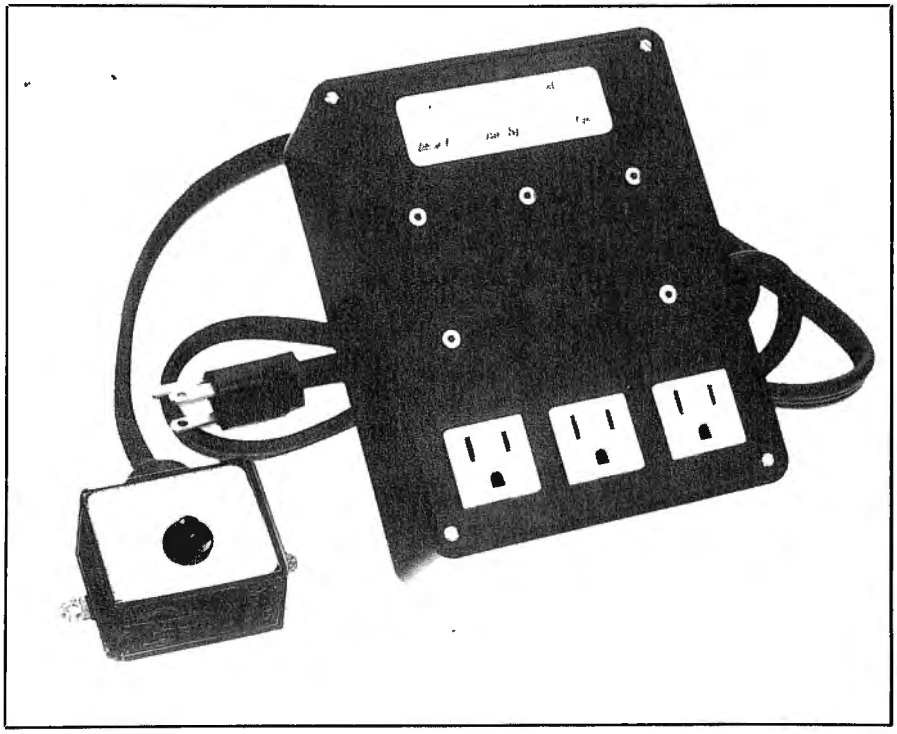

you can generate special report headers and labels for VisiCalc DIF files through your Scripsit. Liaison, from Kjell Engineering, allows for easy transfer of VisiCalc DIF to Scripsit or back. Reports can be enhanced by using Scripsit for special printer effects. The package includes user-choices for sort requirements, column width, and more. Contact Kjell Engineering, 4357 Echo Glen Dr., Dallas, TX 75234.

Low-priced Modem

The Comstar Research Modem uses the cassette port of the Model I and needs no expansion interface or RS-232. It operates at 300 baud, half-duplex, in send or receive mode. It comes complete with software for $99.95 and will be available soon for the Model III and Color Computers. Contact Comstar Research, P.O. Box 771, Madison Heights, MI 48071 or call (313) 541-4840.

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PC-2 Spreadsheet

Super SST is a spreadsheet program for the Radio Shack PC-2 and Sharp PC-1500 pocket computers with 8K memory. It uses machine language routines for quick handling of large matrices. A typical 140 cell array containing data and mathematical expressions can be analyzed in about ten seconds. A CE-150 or equivalent printer/cassette interface is required. The program package is provided on cassette tape with an instruction book for $49.95. Contact Pocket Computer Newsletter, P.O. Box 232, Seymour, CT 06483 or call (203) 888-1946.

PowerDRIVER

The PowerDRIVER series of printer drivers from Powersoft allows users of SuperScripsit to effectively use non-Radio Shack printers. Utilities are available for the Prowriter 8510 dot-matrix from Leading Edge, the Starwriter F-10 Daisy Wheel, and the Epson MX-80/100 series with Graftrax or Graftrax+. PowerDRIVER comes on a Model I or III bootable disk and also contains patches for running SuperScripsit under LDOS. It costs $29.95 from Powersoft, 11500

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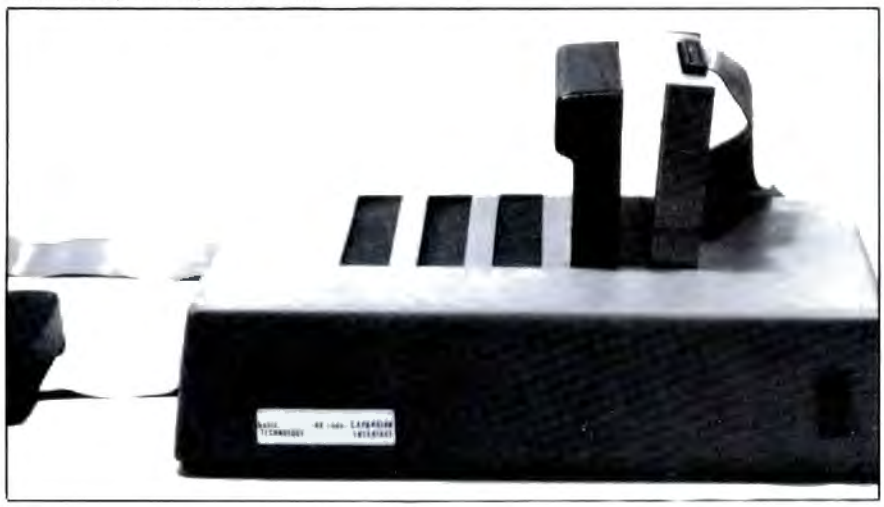
Color Computer expansion bus



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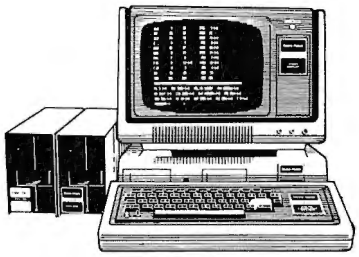

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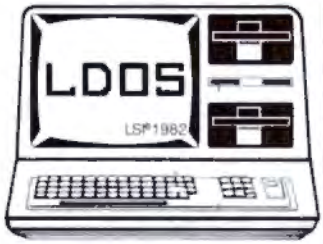
Volume 1 No. 2 ★ SPECIAL EDITION ★★★ April 1, 1983



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