October 1984
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80micro

T.M.

A CWC/I PUBLICATION

the magazine for TRS-80 users*

80micro 10/84 #57 A

Bar Codes

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Give Your Micro The Gift of Gab

A Disassembler For the Model 4

What Day Is It? A Fix for CP/M+

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1

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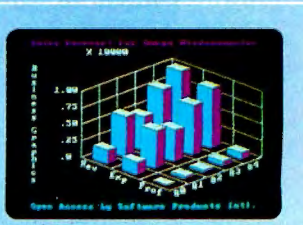

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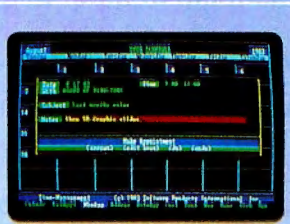
6



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

Article submissions from our readers are welcomed and encouraged. Inquiries should be addressed to: Submissions Editor, 80 Pine Street, Peterborough, NH 03458. Include an SASE for a copy of "How to Write for *80 Micro*." Payment for accepted articles is made at a rate of approximately $50 per printed page; all rights are purchased.

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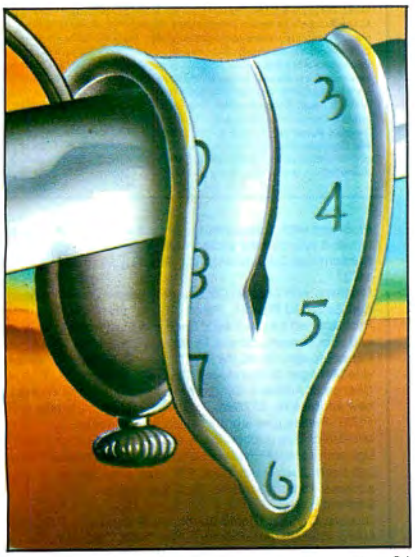

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On the Cover

Features

Departments

LOAD 80

Load 80 gathers together selected programs from this issue of *80 Micro* and puts them on a magnetic medium for your convenience. It is available on tape or disk, and runs on the Models I, III, and 4.

Load 80 programs are ready to run, and can save you hours of time typing in and debugging listings. Load 80 also gives you access to Assembly-language programs if you don't have an editor/assembler. And, it helps you build a substantial software library.

Using Load 80 is simple. If you own a tape system, you load the Load 80 tape as per the instructions provided. If you own a Model I or III disk system, you boot the Load 80 disk and transfer the files to a TRSDOS system disk according to simple on-screen directions. If you own a Model 4, you must convert the programs from Model III TRSDOS to Model 4 disk using the Model 4 CONV command.

Not all programs will run on your system. Some Model III programs, for instance, will run on the Model 4 in the Model III mode, but not in the Model 4 mode. You should check the key box that accompanies the article to find out what system configuration individual programs require.

This page contains a list of this month's Load 80 programs. If you have any questions about them, call Keith Johnson at 603-924-9471.

Yearly subscriptions to Load 80 are $199.97 for disk, or $99.97 for cassette. Individual loaders are available on disk for $21.97 or on cassette for $11.47, including postage. Direct subscription problems or orders for Load 80 to Lori Eaton, c/o *80 Micro*, 80 Pine St., Peterborough, NH 03458.

Directory

Lesson
Article: Testing 1-2-3 (p. 70)
System: Models I and III, 32K RAM (Model I uses Listings 1 and 4 only)
Language: Disk Basic

The Automated Courseware Development System writes computer-based lesson and exam programs.

Cassette filespec: B, C, D, E
Disk filespec: LESSON/BAS, GRAPHICS /BAS, MAKER/BAS, STUDENT/BAS

Project Minder
Article: Time Keeper (p. 84)
System: Models I, II, III, 4, and 2000, 32K RAM
Language: Disk Basic

Project Minder tracks how much time your staff spends working on projects for different business clients.

Cassette filespec: F
Disk filespec: PROJMIND/BAS

Digi-Talk
Article: Sound Software (p. 100)
System: Model III, 48K RAM
Language: Assembly

The Digi-Talk speech synthesizer digitizes a recording of your voice and saves it to disk. You can then play it back through an audio amplifier on your Model III.

Cassette filespec: SPECHA, SPEECH
Disk filespec: SPEECH/SRC (source code), SPEECH/CMD (object code). Requires Radio Shack EDTASM

Buffer
Article: USR Friendly (p. 104)
System: Models I and III, 32K RAM
Language: Disk Basic

Use your disk input/output buffers to load USR routine data.

Cassette filespec: G, H
Disk filespec: BUFFIND/BAS, SCRNFILL /BAS

Disassembler
Article: The Missing Disassembler (p. 108)
System: Model 4, 64K RAM
Language: Basic

This disassembler for the Model 4 gives you a source-code display or printout.

Disk filespec: DISASSEM/BAS

Paint
Article: Fill-Ins (p. 126)
System: Models I and III, 32K RAM
Language: Disk Basic/Assembly

Paint fills in any shape that you draw on the screen.

Cassette filespec: I, PAINTA, PAINT
Disk filespec: PAINTUSR/BAS, PAINT/SRC (source code), PAINT/CMD (object code). Requires Radio Shack EDTASM

Print Buffer
Article: Project 80 (p. 146)
System: Model I/III, 64K RAM
Language: Assembly

Printer buffer control program.

Cassette filespec: BUFFER, PRTBUF
Disk filespec: PRTBUF/SRC (source code), PRTBUF/CMD (object code). Requires Apparat editor/assembler

Interrupt
Article: The Next Step (p. 172)
System: Model III, 32K RAM
Language: Assembly

This demonstration program uses interrupt-handling routines to create a timer that runs while you're on a bulletin board system or using other programs.

Cassette filespec: INTRUP
Disk filespec: INTRUP/SRC (source code), INTRUP/CMD (object code). Requires EDAS editor/assembler

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Table Talk: Comparing the 4/4P, Apple IIc, and PCjr

The technical editors from two of our sister publications met recently to debate the relative merits of the Apple IIc and PCjr.

80 Micro, the journal of obsolete computing, was not invited. No matter. We'll see who doesn't get invited to our next cocktail hour. But just as an academic exercise, I drew up a quickie chart that compares the TRS-80 Model 4 with the above-mentioned computers (see Table 1).

I outfitted the three systems with essentially the same components—128K, two drives, and a monochrome monitor (see Table 2). This required upgrading the basic Model 4 from 64K to 128K, adding a monitor and second drive to the Apple IIc, and adding a monitor, second drive, expanded Basic, and DOS to the enhanced PCjr. I also threw in a parallel printer adapter with the PCjr package, since I thought it would be nice to run a parallel printer off it.

The Model 4, as you can see by the table, stacks up pretty well. It undercuts the IIc by $429 and the PCjr by $523.

The Model 4 is lacking in a few areas, however. It doesn't have color capability, and it produces only mediocre graphics. But how often does the average user need either? Micros are used these days primarily for word processing, accounting, spreadsheet analysis, and data base management, which use text 98 percent of the time.

(Of course, if you really need hi-resolution graphics, the Model 4 hi-res graphics board will give you 640- by 240-pixel resolution for $249.95.)

If you eliminate color and graphics, the Model 4 comes up short in only one other important area. It has less disk capacity than the PCjr (368K compared to 640K). So be prepared to buy a few more disks. (Another parenthetical point: The Model 4 is the only one of the three systems in which you can install an internal hard disk.)

The appropriateness of a system depends ultimately on the user's needs. If you want color and graphics, or you're a serious game player, the Model 4 isn't for you. But if you're primarily interested in nuts-and-bolts applications, the Model 4/4P beats the IIc and the PCjr in a walk. But you knew that anyway, didn't you? ■

Computer: **Base price:**	**Model 4*** **($1,299)**	**Apple IIc** **($1,295)**	**PCjr** **($999)**
Read-only memory	64K	128K	128K
Disk drives	2	1	1
Memory per disk	184K	143K	320K
Monitor	Yes	No	No
RS-232 port(s)	1	2	No
Basic	Yes	Yes	No (†)
DOS included	Yes	Yes	No
Number of keys	70 (‡)	63	62
Cartridge slots	No	No	Yes
Text display (lines by characters)	24 by 80	24 by 80	25 by 80
CPU speed (MHz)	4	1.02	4.77
Cassette port	Yes	No	Yes
Serial port	Yes	Yes	No
Color capability	No	Yes	Yes
Resolution (pixels)	256 by 192	560 by 192	640 by 200

* The Model 4P offers the same configuration, except that it has no cassette port.
† A limited Basic comes with the machine, but Cartridge Basic is required for serious programming.
‡ Includes keypad.

Table 1. The Model 4, Apple IIc, and PCjr: What you get for the base price. (Note: Figures compiled before IBM's revised PCjr).

Computer: **Base price:**	**Model 4** **$1,299**	**Apple IIc** **$1,295**	**PCjr** **$ 999**
64K upgrade	100	—	—
Second drive	—	329	480 (*)
Monitor	—	199	199 (†)
Basic	—	—	75 (‡)
DOS	—	—	65
Parallel adapter	—	—	99
Totals	**$1,399**	**$1,823**	**$1,917**

* Estimated.
† Estimated; IBM monochrome monitor is not PCjr-compatible.
‡ An expanded Basic.

Table 2. What you need to buy to make the system configurations comparable.

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20 more disks are available separately. Each has 3–12 complete typefaces (60–95 characters in each set). These disks cost less than $25 each, and may be purchased at any time.

80 readers' choice micro 1983

If you want to create your own logos, modify our typefaces, or even design entirely new typefaces, then you will also want to order the "Letterset Design System" (LDS). We offer LDS at half-price when you order it along with DOTWRITER. LDS operates in Model III mode on the Model 4.

Versions are available for Epson MX-80 with Graftrax, MX-100 with Graftrax-Plus, RX-80, FX-80, C. ITOH 8510/1550, Microline 84/92/93; Radio Shack's DMP series 200–520 & Gemini 10X, 15X. Please specify printer and computer!

Our print samples were done on an Epson. Sizes vary on other printers. Some of the samples shown here are taken from the additional Letterset disks.

Two disk drives and at least 48K of memory are required. LDS is not available in native Model 4 mode.

Send for free print samples! We've only shown you a few of the 150 DOTWRITER fonts. If you want the best in graphics printing, we suggest you order DOTWRITER today, toll-free.

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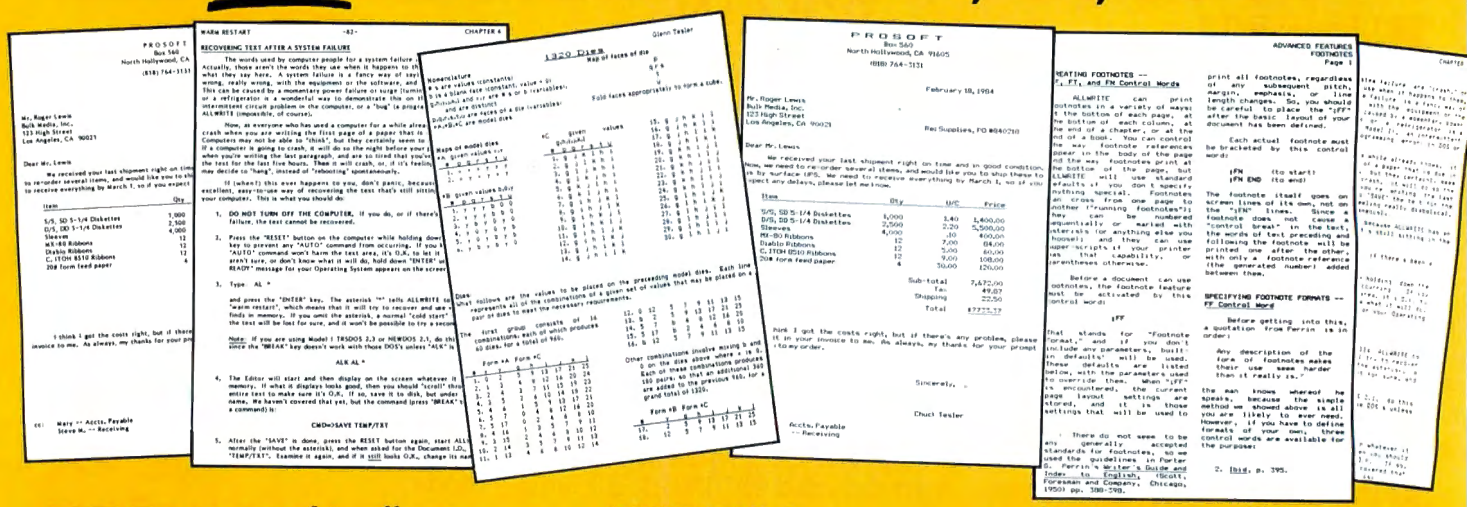

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Change text width at any time; wide lines shift left and right as you type. ALLWRITE preserves double-blanks between sentences, uses the entire screen for text, and displays a complete Status Screen at the touch of a key. Scroll by line, partial screen, full screen, to top or end of file, or to any marked point. Move cursor by character, word, tab, line, or screen.

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ALLWRITE salvages text from bad disks! If a sector goes bad, you won't lose the entire file, because it will skip bad sectors, **read the rest of the file,**

TAKES FULL ADVANTAGE OF YOUR MODEL 4.

The model 4 version of ALLWRITE uses **the entire 80-by-24 screen.** On a 64K machine, you can edit **over 34,000 characters** of text. On a 128K machine, you can edit **THREE FILES AT THE SAME TIME!** The second and third files can be over 32,600 characters each, for a total of **almost 100,000 characters** of text in memory.

and then show you where the lost text belongs. This advanced error recovery turns a disaster into a feeling of profound relief.

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You can store **22 phrases or commands at a time into "soft-keys,"** then press just two keys to retrieve them. This makes frequently-used phrases and formatting controls *a snap to use*. You can store these definitions on disk and build a library of hundreds of pre-programmed keys to fit every one of your applications.

Our specially-designed templates fit right on your keyboard to let you see your settings at all times. Each template is also a Reference ("Cue") Card, so it is always right in front of you when you need it, without using up valuable screen space.

ALLWRITE Is Easy To Learn

ALLWRITE's commands and control keys are easy to remember because they use the first letters of common English words: 'CE' stands for 'Center,' 'Search' and 'Replace' do just that, and so forth. The **on-line HELP menu** offers over fifty screens of topics.

NEWSCRIPT's documentation was acclaimed in every review, and ALLWRITE's 350-page book is even better. Portions of it are designed for beginners, with every feature clearly explained in step-by-step tutorial style. Since you won't always be a beginner, other parts of the book offer advanced topics. There is a cross-reference summary chapter, a 14-page comprehensive index, and a detailed Table of Contents. We've been developing computer programs and manuals for over 20 years, and understand the importance of good documentation.

To make installation easy, we include Tiny DOSPLUS for the Models I and III, and special, pre-tailored versions of **both** TRSDOS 6.2 **and** DOSPLUS IV for the Model 4, all at no extra charge. The Model I and III versions work equally well with all major DOS's.

PROSOFT'S On-Going Customer Support

Perhaps the best reason of all for having ALLWRITE is the continuing support we offer you: friendly, expert, direct support that is unsurpassed in the micro-computer industry. There is no time limit to our support: if you are our customer and you need help, just call or write. We give free updates for 90 days, and charge little or nothing for minor updates thereafter.

Customer Comments

"This is the best software package I have ever received...superb, easy to use, fast, and has more features than the business word-processor at the office." *(E.R.L.)*

"ALLWRITE will soon be the barometer that others will use to compare their products to. For the money and functions, there is no comparison." *(J.G.)*

"Your company and products have to be one of the strongest factors I can think of for keeping me with the TRS-80!" *(J.R.H.)*

"NEWSCRIPT is the Cadillac of word processors. ALLWRITE is the Mercedes Benz!!" *(B.E.)*

"...a very readable manual." *(D.S.)*

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The Dilemmas Persist

John B. Harrell's article, "The DOS Dilemma" (July 1984, p. 48), states that TRSDOS 6.2 comes bundled with the Model 4. That is incorrect; we are currently shipping TRSDOS 6.1.2 with the Model 4.

TRSDOS 6.2 is available separately (catalog number 26-316) for $39.95.

Ed Juge
Director of Market Planning
Radio Shack
Fort Worth, TX

"The DOS Dilemma" faults my favorite disk operating system, MULTIDOS, for not supporting multiple-file selective copying. This is wrong. The VFU/CMD features several modes. The manual (pp. 43–45) describes these features.

Otherwise, Harrell's comprehensive article is a great service to those looking to compare the myriad Radio Shack-compatible DOSes.

Robert L. Green
Clarkston, GA

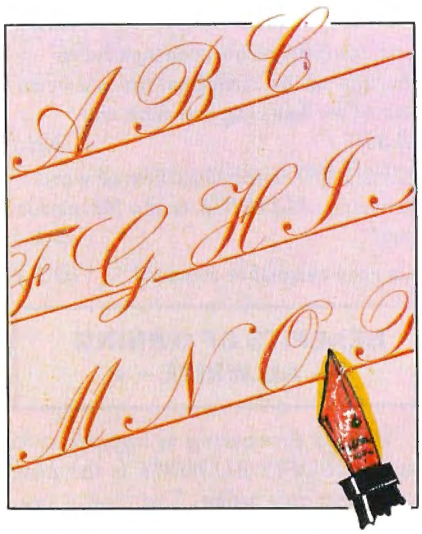
"The DOS Dilemma," fails to accurately state the advantages and disadvantages of the competing DOSes.

Harrell states that NEWDOS80 can't create JCL files. However, NEWDOS80 comes with CHAINBLD/BAS, which does create such files. The other systems offer the Build command in DOS; only CHAINBLD lets you edit previously created files.

The Table indicates that NEWDOS80 lacks a Spool command. It does come with a modified version of Apparat's automatic spooler program.

The Table further indicates that TRSDOS 1.3 doesn't let you reserve memory locations, yet the Clear command with the MEM parameter does this job. Also, options to change keyboard driver parameters are available with the System command.

Harrell states that NEWDOS80 omits a Link command when, in fact, the NEWDOS80 documentation provides specific examples in its Route command detailing how "the routing is equivalent to the Model III TRSDOS function Dual."



Although it's impossible to say which DOS is best, one should not try to make an accurate evaluation without complete and correct information.

Andy Levinson
Studio City, CA

Levinson misses an important point—that "The DOS Dilemma" was not meant as a review, but rather, an attempt to compare the many varied features of these different systems.

I didn't mention the CHAINBLD and spooler features of the NEWDOS-80 because they represent third-party software included on the distribution disk as a stop-gap measure to fill a void recognized in this operating system.

Many of Levinson's comments are valid. For example, it's true that NEWDOS80's System command lets you tailor some keyboard parameters. This, however, doesn't allow for the inclusion of a driver for any other peripheral equipment. Nor does it provide full device independence or the ability to manipulate data via filters.

I didn't mention the NEWDOS80's ability to manipulate records of greater than 256 bytes. In fact, it's the only language for the Models I/III/4, other than PASCAL-80, that does this.

NEWDOS80 is a second-generation disk operating system in the era of third-generation systems. In this respect, it received the highest accolades that it warranted and is still used in many systems.

John Harrell
Washington, DC

JCL Files Revisited

Thanks *80 Micro* and Raymond E. Wilson for "Command Performance" (June 1984, p. 62). The MAKEDO program is by far the most useful Model 4 utility I've seen in *80*.

Only those who've experienced the frustration of re-creating a JCL file because of a single error can appreciate how much time Wilson has saved users with his excellent contribution.

Wm. N. Smyer,
Mississippi State, MS

"Command Performance" wrongly states that you can't modify a JCL file. Using Model 4 Scripsit, you can draw and modify a JCL file.

After completing modifications, use the A option in Scripsit to save a file in ASCII format.

A.W. Read
Ontario, Canada

Read is correct about Scripsit's ability to edit JCL files. Also, TRSDOS for the Models II and 12 has a Build command that lets you edit files.

MAKEDO/BAS has three advantages over other editors. The first is size; space on a TRSDOS disk is at a premium.

The second advantage is cost. The least expensive of the commercial programs, Scripsit, costs about $100.

The third advantage is simplicity. MAKEDO is designed solely to create and edit JCL files, while other programs have more complex functions.

I developed and used this program before others for the Model 4 existed. The function of both the program and 80 Micro *is to help users and programmers use their machines more fully.*

Raymond E. Wilson
Houston, TX

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Send any questions or problems dealing with any area of TRS-80 microcomputing to Feedback Loop, 80 Micro, 80 Pine St., Peterborough, NH 03458.

Q I read your article in the January 1984 issue ("Bill of Fair Repair," p. 164) with some amazement. I own a Model III with a VR Data controller and drives, an RS-232 board, and 48K of RAM, all of which I installed. With the introduction of the Model 4 I became interested in upgrading.

The local computer center refused to sell me the upgrade unless their technician made the installation (it being too complex for me to handle). With much reluctance, I agreed. I also explained what I had done to my unit, and the manager told me that wouldn't be a problem.

Two days later, the computer center called to say they couldn't make the upgrade on account of the non-Tandy controller board. The upgrade required a modification, according to the manager, and Fort Worth ordered them not to touch the unit.

I called VR Data and told them my story. They told me no modification was necessary, and that Radio Shack was just giving me "a hard time." I bought a copy of the installation manual and found no mention of a modification to the board.

So my question is: Where did you get your information that Radio Shack will work on a micro with foreign parts? *(Lou Halpern, Greenville, SC)*

A My information came directly from an "internal distribution information update bulletin" sent to all Tandy stores every six months or so. The last three bulletins have all stated that computers with foreign parts would be serviced, primarily by disconnecting the offending equipment where possible before starting service.

If the customer's complaint can't be isolated to the Radio Shack equipment, then they won't perform the service; i.e., if you're experiencing disk I/O problems, they can't help you since the drives and controller aren't Tandy parts, but they will test memory and all other Tandy sections where possible.

Q Like J. Haynes of Palmer, TX (April 1984, p. 16), I and five of my friends had trouble accessing disks in drive B with CP/M and Pertex FD200 drives.

I used an oscilloscope and found that a low-voltage spike on the motor start-up was resetting the step direction flip-flops in chip U21. The solution I came up with was to open the trace from pin 2 of chip U5 and insert a 100-ohm resistor from pin 2 to the plated-through hole going to resistor R35, and putting a .1 μF capacitor across R35. This has fixed all of our FD200 drives.

As for why this happens with CP/M and not with TRSDOS; CP/M thinks it knows where it is (track register) and sends a step order, which is ignored. The track that the head is over doesn't match the new track register and CP/M locks up. This is also why you have to warm-boot CP/M if you open a drive door or change a disk.

TRSDOS, however, is a bit smarter; if it gets lost, it sends a "home drive head" order, which returns the drive head to track zero, and then TRSDOS steps the head out to the track it wants.

You should make this modification on all drives, even if they work fine now, because they'll fail as the power filters age. *(Richard Shelton, Lakewood, OH)*

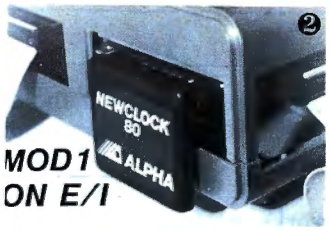
A Thanks for sharing your detective work and solution.

Q I'm the proud owner of a Model 4P. While experimenting with TRSDOS 6.1, I discovered that my drives will format 42 tracks. I did this with the command FORMAT :1 (CYL=42,Q=N,ABS). This procedure puts the directory on track 21, but it functions perfectly. You can make a mirror-image back-up if you answer yes to the prompt. The extra two tracks provide an additional 9K of space, particularly useful on drive zero because the DOS takes up so much room. *(Eric Burstein, Columbus, OH)*

A You're lucky that your drives will let you use the extra tracks; not all TRS-80 thin-line drives allow more than 40 tracks. Just keep in mind that some of your data or programs might not be accessible if you try the 42-track disks in another Model 4/4P computer.

Q Regarding N.S.'s letter in the April issue (p. 13)—I've found a way to use SuperScripsit Dictionary with a document using only two drives. First I kill the demonstration programs to make more room on the system disk. Then I copy my docu-

Newclock-80 $69.95



The right time at the right price! Keep the time and date with quartz accuracy, even when your computer is off. The backup lithium battery (included) will last for over 2 years. Software on tape or disk, please specify. Use "TIMESET" once to set the clock. Use "SETCLK" to set your computer's internal clock (at power up) or use "TSTRING" so that the "TIME$" function reads the Newclock.
Connection: Model I: plugs into the keyboard or expansion interface. Model III: plugs into the 50-pin I/O bus. Compatible with all operating systems.

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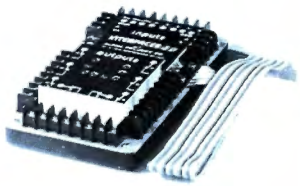
Do you have 2 printers? Get a Printswitch. Stop plugging and unplugging those printer cables. With the Printswitch, you can have 2 printers connected to your computer and you can select either one at the flick of a switch. Works with any printer, plotter, or device that uses the parallel printer port. Simply plug the 14 inch Printswitch cable into your computer, and plug your existing printer cables into the Printswitch. This is the nicest unit on the market. Superior quality board with gold plated edge connectors. For Models I,III, 4 and 4P.

Alpha Joystick $27.95

When it's time for fun, don't be without your Alpha Joystick. Do you know that most action games are Joystick compatible? Stop pounding on your keyboard and enjoy real arcade control. The joystick can also be used with BASIC programs; simply do J=INP(0) to read the joystick position (8 directions and fire button). Model I: plugs into keyboard or expansion interface. Model III, 4 and 4P: plugs into 50-pin I/O bus. The Alpha Joystick comes fully assembled and tested, ready to plug in and enjoy. (Specify Model I, or Model III,4).

Interfacer-80 $159.00



Low cost input and output device. The outputs consist of **8 relays** (rated 2 Amp @125V), easily controlled using "OUT" commands. For example, OUT 0,0 turns all the relays off. Eight LED's show the states of the relays. The **8 inputs** are optically isolated, so it's safe and easy to connect external devices (switches, sensors, thermostats, etc.). Simple "INP" commands read the inputs.
Connection: Mod I: 40 pin bus. Mod III, 4, 4P: requires 50-pin I/O bus converter ($39.95), plugs into 50-pin I/O bus. Comes complete with power supply, cable, and detailed manual.
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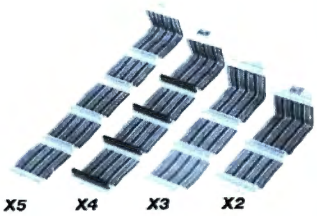
8 channel 8 bit Analog to Digital converter. Your TRS-80 can read voltages, temperatures, pressures, light levels, etc. • Input range: 0 to 5.1 Volts. • Resolution: 20mV. • Conversion time: 120 microseconds. In BASIC, you can take up to 100 readings per second. • Port address: selectable. Up to 8 Analog-80's can be connected to your TRS-80 for a total of 64 channels!
Connection: Model I: 40 pin I/O bus. Model III, 4, 4P: requires 50-pin bus adapter ($39.95). Comes complete with power supply, cable, and manual.

Special Cables



Disk drive extender cable (8")...C160:$9.95
Y-Cable for Mod I bus (40 pin): • **X2-40**...$29 • **X3-40**...$44 • **X4**...$59 • **X5**..$74
Y-Cable for Mod 3 & 4 bus (50-pin): • **X2-50**...$34 • **X3-50**...$49 • **X4-50**...$64
Disk drive cable (34 pin): • 2-drive...**C162:**$32 • 4-drive...**C163:**$45
Extension cable, 4 foot: • For printer and drive (34-pin)...**C165:**$22
• For Mod I bus (40-pin)...**C167:**$24 • For Mod 3 & 4 bus (50-pin)...**C169:**$28
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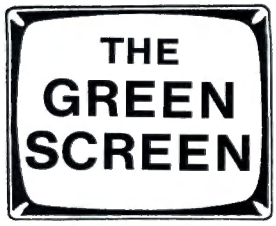

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ments onto it and put the dictionary disk in drive 1. After the dictionary program finishes running, I copy the corrected file onto a storage disk. This works perfectly. *(Blanchard Lee Carter, Los Angeles, CA)*

A: You misread N.S.'s letter. His problem was getting the dictionary to proofread a document that was larger than the available room on the system disk in drive zero; for example, a file of 100 grans out of the 114 available on a data disk (about 40 grans more than the room left with the DOS and SuperScripsit). In that case, the DOS Copy command results in a "disk full" error message.

The only way out is a kludge: You have to use SuperScripsit's Block Copy function to transfer a small enough segment to the drive zero disk, proofread the segment, block copy it to a new file, and repeat until the dictionary has proofread the entire file and you've copied everything to the new file. All in all, a tedious and time-consuming task.

Q: In the April issue (p. 18), Dave Anderson of Los Angeles had a question about an external RS-232 board for the Model I Expansion Interface. The Comm-80 (Micro-Mint Inc., 561 Willow Ave., Cedarhurst, NY 11516; $150) is such a device. It plugs into the E.I. expansion port (or the expansion port of the keyboard) and provides a 40-pin bus connector for future expansion, and a Centronics parallel printer port. I bought one a year ago, and have had no problems with it.

Micro-Mint also sells a replacement for the Expansion Interface, which I purchased a year and a half ago. It, too, has given me excellent performance and is totally compatible with all hardware and software for the Radio Shack interface.

Now for my problem. I have two BASF 6016 drives that have been trouble-free except for what appears to be a lazy head load solenoid on drive zero. When I first boot the system from a cold start, the solenoid kicks out, but immediately retracts before the head has time to read data. After three to five resets, or about one minute, the system boots and runs perfectly. If I turn the system off for a few hours, I can look forward to the problem again about 30 percent of the time. Any ideas? *(John Spitale, North Canton, OH)*

A: First, have you tried switching the two drives to see if only one of them has a problem? Second, have you checked the jumper-block for drive-head options to see if the drives are correctly jumpered to load the head? Third, have you cleaned all the drive cable connectors?

If you've tried all these, I'd suggest taking the drives to a technician for a more thorough check-out. If the solenoids are starting to go, it's time for service.

Q: Would you or any of your readers know how I can hook up my Model III (48K) with my IBM Stand-Alone Composer? The Stand-Alone came out in the early 1970s and produces quality typesetting with font sizes six point to 12 point, and justifies and centers. I can't find anyone who knows of a way to connect the two machines. *(James Lowe, Ridley Park, PA)*

A: I can't help you there—can anyone else?

Q: I enjoyed "CP/M III Ways" (December 1983, p. 122), particularly since I've been considering getting a Holmes VID-80 board. Perhaps you can answer a question: With the VID-80 installed, will my Model III version of Electric Pencil use the 80-character by 24-line display? Can I use the 80 by 24 display with any of the new versions of word processors intended for TRSDOS 6.X and the Model 4? *(Richard Peck, Swarthmore, PA)*

A: The VID-80 supplies the 80 by 24 only to those programs that honor the Model III device control blocks (DCBs) that control the video display. The VID-80 uses its own RAM for the 80 by 24 display, and puts the jump address at the video DCBs. Any program that directly accesses the video memory, bypassing the DCBs, won't use the 80 by 24 display memory on the VID-80 board. Electric Pencil, like most other word processors, uses its own video driver routines, ignoring the DCBs, so it still uses the standard Model III display of 64 by 16.

The Model 4 word processors are designed expressly for TRSDOS 6.X and the Model 4. They won't work at all on the Model III since the methods used to access the keyboard, video, and disk drives are incompatible. Even with the VID-80 board, these programs won't work on the Model III.

Q: I'm puzzled by a symptom of my Model III with TRSDOS 1.3: When using the MEMTEST program, I get the messages "ROM C Checksum should be 2B91 or 2EF8 or 2F64" and "Your Checksum is 2F84." Something seems to be wrong with my checksum, whatever that is. Can you enlighten me? *(Jose Chaves, Tenafly, NJ)*

A: A checksum is a method of verifying the condition of a program, file, or memory. There are many ways to compute a checksum, but the one used in MEMTEST (the memory tester) is to start at the first location in a ROM and add up all the binary numbers stored in the ROM until the top of the ROM is reached. The resulting sum is called the ROM checksum. For example, the message "L2 BASIC" is stored in ROM as "76 50 32 65 66 83 73 67", resulting in a checksum of 512 (in decimal).

The Model III uses two ROMs, the A-B ROM and the C ROM. Radio Shack has revised the ROMs periodically to correct errors or slight bugs, and these alterations change the checksum you get with the MEMTEST program; hence the three possible numbers in the message. MEMTEST doesn't take into account a fourth revision to ROM C made after the program was written. The number you got, 2F84, is correct.

If you want to fix MEMTEST to include your computer's correct checksum, use the patch in the next letter.

Q: If L.L. (December 1983, p. 285) would like his MEMTEST program to show the proper value of 2F84 for his Model III ROM checksum, he should type in the following:

PATCH MEMTEST/CMD (ADD=6573, FIND=32423931,CHG=32463834)

This patch changes the checksum list to include 2F84. *(Pat Maturo, Orange, CT)*

A: Thanks for the patch.

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Q I have a 48K Model III with cassette Basic. Recently, while trying to incorporate a machine-language routine into a Basic program, I encountered a problem: When POKEing the machine-language values into memory locations 32752–32767, using a For...Next loop, I got an overflow error. I avoided this by changing the values to 32751 and 32766 and POKEing the address plus one.

I'm writing because I don't understand why I had to make those changes. I have another program that uses the same technique and it runs fine. What's up? *(M.J. Mockler, Marshfield, WI)*

A First, are you setting the top of memory properly by answering the memory size prompt with 32751? Failing to do so could cause big problems as Basic tromps on your machine-language program while you're putting values into memory.

Second, although none of the manuals says this, you're not supposed to POKE anything into the top 2 bytes of memory. These bytes are reserved for Basic. Write to them at your own risk. (This shouldn't make any difference to you, because you have a 48K machine—the upper limit for a 16K is 32767.)

Third, it's possible, if you're using a large Basic program, that it's interfering with the Basic routine that's trying to put the machine-language routine in place. Putting your machine-language program at the top of memory eliminates the possibility of this problem.

The overflow error, when encountered with the POKE command, has three possible causes. The address you're using exceeds the range −32768 to 32767, the number you're POKEing exceeds the range of zero to 255, or you've done something to the Basic operating system tables in RAM.

Q I've noticed that many of your readers request help with problems stemming from poor electrical contacts in the Model I connectors. Cleaning them usually helps, but only temporarily. Poor connectors are also a problem in high-fidelity gear, and Craig Laboratories of Escondido, CA, has come up with an answer: Cramolin, which comes in two solutions. One removes the oxides usually responsible for poor contact performance and the other coats the contact with an extremely thin protective film. I've used the protective product in a wide variety of applications and it has never failed to solve a connection problem.

I don't know if Cramolin is available directly from Craig Laboratories or not. I bought mine from Old Colony Sound Lab, P.O. Box 243, Peterborough, NH 03458, 603-924-6371. *(Gary Nored, Austin, TX)*

A Practically in my own backyard, and I never even knew they were there! A set of two 2-dram bottles of Cramolin costs $16.

Q I recently purchased a Radio Shack double-density board for my Model I and found no installation instructions or circuit diagram. Can you tell me how to install the board in my Micro Design interface? *(Robert Cooke, Columbus, OH)*

A Installing the double-density board is easy. Start by unplugging and disconnecting the expansion unit from the rest of your computer equipment. Then remove the cover of your Micro Design expansion unit and locate the FDC-1709 disk controller chip (it should be a 40-pin chip with the letters FDC-1709 on top). Note which way the notch in the chip points—you should find a silk-screened outline of a chip with a small notch under the FCD socket.

Use a nail file, a very small screwdriver, or an IC puller to remove the FDC chip from its socket on the circuit board. Insert the FDC chip into the socket on the double-density board, making sure that the chip's notch matches the one silk-screened onto the double-density board. Check carefully for bent pins or legs that aren't properly inserted into the socket.

Now plug the double-density board into the empty FDC socket on the main board of the MD expansion interface, again seeing that the notches all line up in the same direction. Check to make sure that no pins are bent or misaligned.

Now reassemble the expansion case and reconnect everything. Turn on the system, boot up your single-density DOS, and verify that everything works properly. If your disk won't boot, stop. Disassemble the system and make sure that you've properly installed the FCD chip on the double-density board (all the IC chip notches should match their silk-screened outlines) and correctly installed the double-density board on the expansion interface board (the FCD chip's notch facing the way it faced before you removed it from the computer). Then reassemble your computer and test it again. If your system still refuses to boot your old system disk, take everything to a technician.

If your single-density DOS works properly, test your double-density DOS (if one didn't come with the board, you'll have to get one). If the double-density DOS works, then you're ready to get to work with almost twice the disk capacity you had before. Good Luck.

Q Exactly what do I need to convert my Model III from single to dual disk drive? Will I need a new DOS or will TRSDOS automatically know I have two drives? Once I have a dual-drive Model III, can I easily or cheaply upgrade to a Model 4? *(Andrew Tejral, Ridgewood, NJ)*

A All you have to do is buy a second disk drive, no cabinet necessary, and install it in your Model III case. Any competent technician should be able to do it for you quite easily. You might have to get a new drive cable, depending on whether or not your computer has a single-drive or dual-drive interfacing cable. Another possible problem is that the disk drive power supply might not be powerful enough to operate both drives. Only a technician can tell you for sure.

As for upgrading: Converting from a Model III requires replacing the entire logic board at a cost of about $800. By the time you add the cost of your second drive, you've reached the trade-in value of your Model III against a Model 4. For the $1100 or so, plus the trade-in value of your Model III, I'd suggest getting a Model 4 right now. ■

Terry Kepner is a freelance writer and programmer, and the vice-president of Interpro. He's been writing about microcomputers since 1979.

In Touch
The Alpha Newsletter

Welcome to the second issue of *In Touch*. This month, let's answer some common questions about the VS-100 voice synthesizer.

■ **How good is the voice?**
We think it's incredible for the price, but you can judge for yourself by calling our 24 hour Demo Line: (212) 296-0399.

■ **What does it take to make my BASIC programs talk?**
With *TALKER 1.4*, it's simple. With *TALKER 2.0*, it's incredibly easy. If you add an asterisk after a "PRINT" command, the PRINT now speaks. (e.g. PRINT★ "Hello Judy" will speak, not print). If you add an exclamation point instead of an asterisk, the PRINT command will print as usual, and in addition, it will speak! To add speech to your favorite BASIC program simply sprinkle a few "★" and "!" where you want speech. Could it be any easier?

■ **Is it compatible with my DOS?**
The software and hardware do not rely on any DOS feature, therefore the VS-100 system works with any Model I or III DOS.

■ **Do I need any cables?**
No, the VS-100 plugs directly into your TRS-80. It uses the expansion port on your computer, so it doesn't interfere with any printer, disk drive, or RS232 device. On the Model 4P, the card edge is recessed; be sure to order the special 50-pin extender cable

■ **Do I need an amplifier?**
No, the amplifier with volume control is built into the VS-100. All you need is a *small* speaker; we recommend our handsome mini-speaker ($5.95).

■ **Which port does it use?**
All communication between the computer and the VS-100 is done using port 11.

■ **Can I purchase the user manual alone?**
Yes, it is available for $5 plus $1 shipping and handling. (The $5 is applicable towards purchase of the VS-100).

■ **How many words can the VS-100 say?**
There are two ways to make speech synthesizers. One is to use a limited look-up dictionary. The VS-100, on the other hand, uses a much more powerful approach: the "text to speech" automatic translator. This means that *any* word will be pronounced. The text to speech translator, with its 400 pronunciation rules, achieves a 96% success rate.

■ **Can I get speech automatically, without doing any programming at all?**
Yes, Talker 2.0 has very powerful "automatic keyboard echo" and "screen echo" options. Everything that is typed and/or printed on the screen can also be spoken.

We would like to thank all our customers for the very nice feedback that we receive. (Such as the letter at right).

To Alpha Products, 79-04 Jamaica Ave., Woodhaven, NY 11421

Gentlemen:

I seldom write manufacturers of Computer products. However, I am so pleased with my purchase of the VS-100 Voice synthesizer, I felt I must let you know it.

The unit performs EXACTLY as advertised. The documentation furnished is clear, understandable and straightforward. The disk software seems absolutely flawless in use.

The VS-100 is simple to program and flexible enough in programming to accomplish exactly what I wish. I have incorporated it into all my computer tutorials. Congratulations on your product!

Sincerely yours,
Wendell R. Henry

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What is your reason for keeping your TRS-80 mute?

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—Tim Daneliuk, 7/11/83

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2000 and Two: Ovation and MS-Windows

Hot Items

edited by Bradford N. Dixon

Ovation is coming, Ovation is coming! At least, it's supposed to be coming. The long-awaited integrated software package from Ovation Technologies of Norwood, MA, is due to be shipped Oct. 15, 1984.

Ovation representatives were on hand at the Boston Computer Society's June 26, 1984, meeting with prototype copies of their integrated word processing, graphics, and spreadsheet programs (see the Photo).

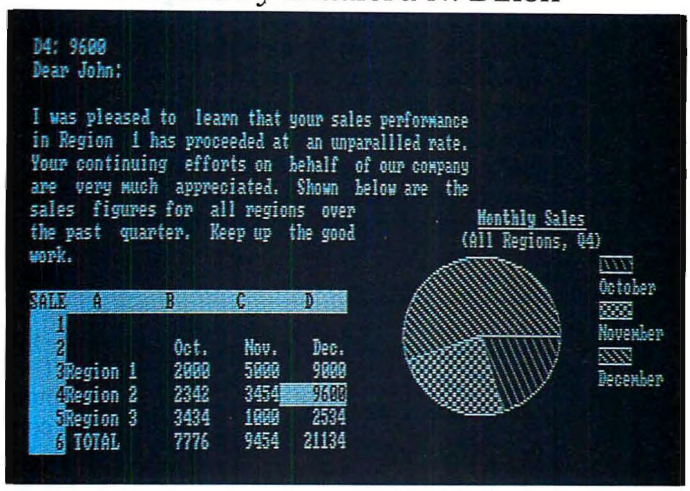


Photo. Ovation: Integrated software for the Model 2000.

The what-you-see-is-what-you-get program for the Model 2000 requires 256K of RAM and a hard disk drive, but those factors are apparently deemed minor expenses in corporate businesses, Ovation's major market.

Even allowing for the fact that Ovation's reps had plenty of practice with their package, Ovation seemed easy to learn. Observers described the software as powerful and fast. Ovation is about to release a potentially popular product—they and Tandy must be hoping it's not arriving too late.

Not to be denied its moment in the spotlight at the Boston Computer Society meeting, Microsoft Corp. of Bellevue, WA, showed off its integrated MS-Windows package, one of Ovation's possible competitors.

Using Tandy's Digi-mouse for the 2000, Microsoft's Joe Vetter put MS-Windows through its paces and described the package as "the first multicolor operating environment." The program uses all the features normally associated with Apple's Mac, such as the mouse interface, icons, and pull-down menus, but with color as an additional feature. MS-Windows contains a terminal program and word processor and supports a graphics device interface for screen printouts. It doesn't require a hard disk like Ovation, but it does need 256K of RAM.

Microsoft is understandably high on its windowing product for the Model 2000 and Vetter feels its usefulness will be even more apparent when a multi-user MS-DOS becomes available.

Tandyland

During the late spring and early summer months, the financial news from the Tandy Towers in Fort Worth, TX, was anything but encouraging. Sales were disappointing for a variety of reasons. Tandy chief executive officer (CEO), John V. Roach, was asked at the above-mentioned meeting of the Boston Computer Society if he thought the financial picture would improve enough to meet his sales expectations. In reply, Roach said, "Sir, sales have never met my expectations."

Commenting further on the sales slow-down, Roach said, "Product shortages due to shifts in product mix and component availability have been a major factor impacting both our traditional and computer businesses. Additionally, rapid changes in product pricing in the microcomputer industry are affecting sales and heightening the competitive environment in that segment of the business. Clearly, product cycles are more important to Tandy than economic cycles. Some of the current sales slowdown can be attributed to these cycles and we believe that new products and pricing for the fall season combined with a better in-stock position will enable us to achieve more traditional sales growth rates."

Just about the time Roach made those remarks, Tandy took action by cutting the price of the 64K, two-drive Model 4 to under $1,300. As for the new products mentioned for the fall season, Roach wasn't talking. Fort Worth watchers will have to wait and see if there'll be something exciting, perhaps a follow-up to Tandy's first MS-DOS micro, or just another variation of Radio Shack's famous stuffed-animal radios.

"Ding-dong—Tandy calling" will probably not be part of the promotion for Tandy's new Home Education Systems division. But, in a sales tactic reminiscent of the Avon lady and the Fuller Brush man, the Tandy Home Education Systems (T.H.E.S.) division began offering in-home demonstrations of a Color Computer 2 package early in July. T.H.E.S. chose 13 cities, including Dallas/Ft. Worth, Atlanta, Denver, San Diego, and New York for the program's roll-out.

The unique shop-at-home service is available only by request from partici-

pating Radio Shack Computer Centers. Tandy hopes to focus the new sales effort on families with preschool and school-age children.

The basic system T.H.E.S. sells is a 64K Color Computer 2 with one disk drive, deluxe joysticks, a modem, and training sessions for two family members at their local Radio Shack Computer Center. In addition to the hardware, customers will get Color Logo and a terminal package for accessing CompuServe or the Dow Jones News/Retrieval Service. Each T.H.E.S. package also offers software bundles from six software groupings designed so a family can "tailor the system to its needs and the ages of the children."

The price for the basic configuration is less than $1,500. You can get more information about the service from the Tandy Home Education Systems division at 1301 W. 22nd St., Suite 400, Oak Brook, IL 60521.

Meanwhile, Tandy continues its efforts to keep in touch with educators as a corporate sponsor of the National Distinguished Principals program. The program recognizes achievements of elementary and middle school principals in each of the 50 states, the District of Columbia, and Puerto Rico.

Tandy CEO John Roach says, "It is time that the top school administrators who foster an atmosphere in which children develop a lifelong love of learning receive the honor and recognition they have long deserved."

Aside from the goodwill gained by sponsoring this program, Tandy may also reap commercial benefits; Radio Shack's Education division has taught more than 400,000 teachers around the country how to use TRS-80s in the classroom. More than 35,000 schools have received free staff development packages and, through Tandy's TRS-80 Educational Grants program, hardware, software, and other computer products have been awarded to educational institutions.

MicroTrends

Tandy isn't the only microcomputer maker emphasizing the education market. So how have school districts reacted to the sales pitch over the last three years?

According to a survey by Quality Education Data Inc. of Denver, CO, "virtually 100 percent of the school districts contacted are now using microcomputers." For the April 1984 telephone survey, QED contacted 9,272 school districts with at least 600 students and found 9,068 of them using at least one microcomputer for classroom instruction. That figure represents 97.8 percent of the districts surveyed.

When QED took its first survey in 1981, only 4,990 out of 9,664 districts could claim at least one microcomputer used in classroom activity.

Of course, although microcomputers may have spread to almost all the school districts in the survey, that doesn't mean they're accessible to a majority of the students. According to Jeanne Hayes, president of Quality Education Data, "The estimate of the number of microcomputers ranges from 300,000–350,000 units so the total number of minutes available for any one student is still far less than would be necessary for true instruction."

Metropolitan Area	Units Installed
New York	435,947
Los Angeles/Long Beach	323,172
Chicago	279,398
Boston	275,863
San Jose	205,303
San Francisco	205,005
Nassau/Suffolk, NY	195,307
Philadelphia/NJ	193,422
Washington/MD, VA	183,546
Oakland	175,387
TOTAL	2,472,350

Table 1. IDC's top 10 personal computer markets.

Company	1983 DP Revenue (in millions)
IBM	$35,603.0
Digital Equip. Corp.	4,826.9
Burroughs Corp.	4,000.0
Control Data Corp.	3,500.0
NCR Corp.	3,333.2
Sperry Corp.	2,799.6
Hewlett-Packard Co.	2,496.0
Wang Laboratories Inc.	1,792.9
Honeywell Inc.	1,661.1
Xerox Corp.	1,200.0
Apple Computer Inc.	1,084.7
TRW Inc.	1,015.0
Tandy Corp.	945.0
Commodore Int'l Ltd.	926.7
Storage Technology Corp.	886.6

Table 2. Datamation*'s top 15 companies in data processing revenues for 1983.*

It seems that whenever a new computer is announced, diehard computerists wonder how much money they can get for their old machine so they can buy the latest model. The second-hand computer market is an industry that hasn't created much fanfare, but used computers are out there and someone must be selling them.

So how much could you expect to get for your old Model I (assuming the Smithsonian Institution doesn't want any more)? According to a June 18, 1984, article in *InfoWorld*, second-hand Model I's go for the paltry sum of $110. Model IIs fare better at $1,200, but that's to be expected.

The *InfoWorld* article doesn't even list a price for a used Model III, which could mean one of two things: people aren't selling their Model IIIs or the computer isn't worth anything on the used computer market. The Model 4 is listed, however, at $1,340 used.

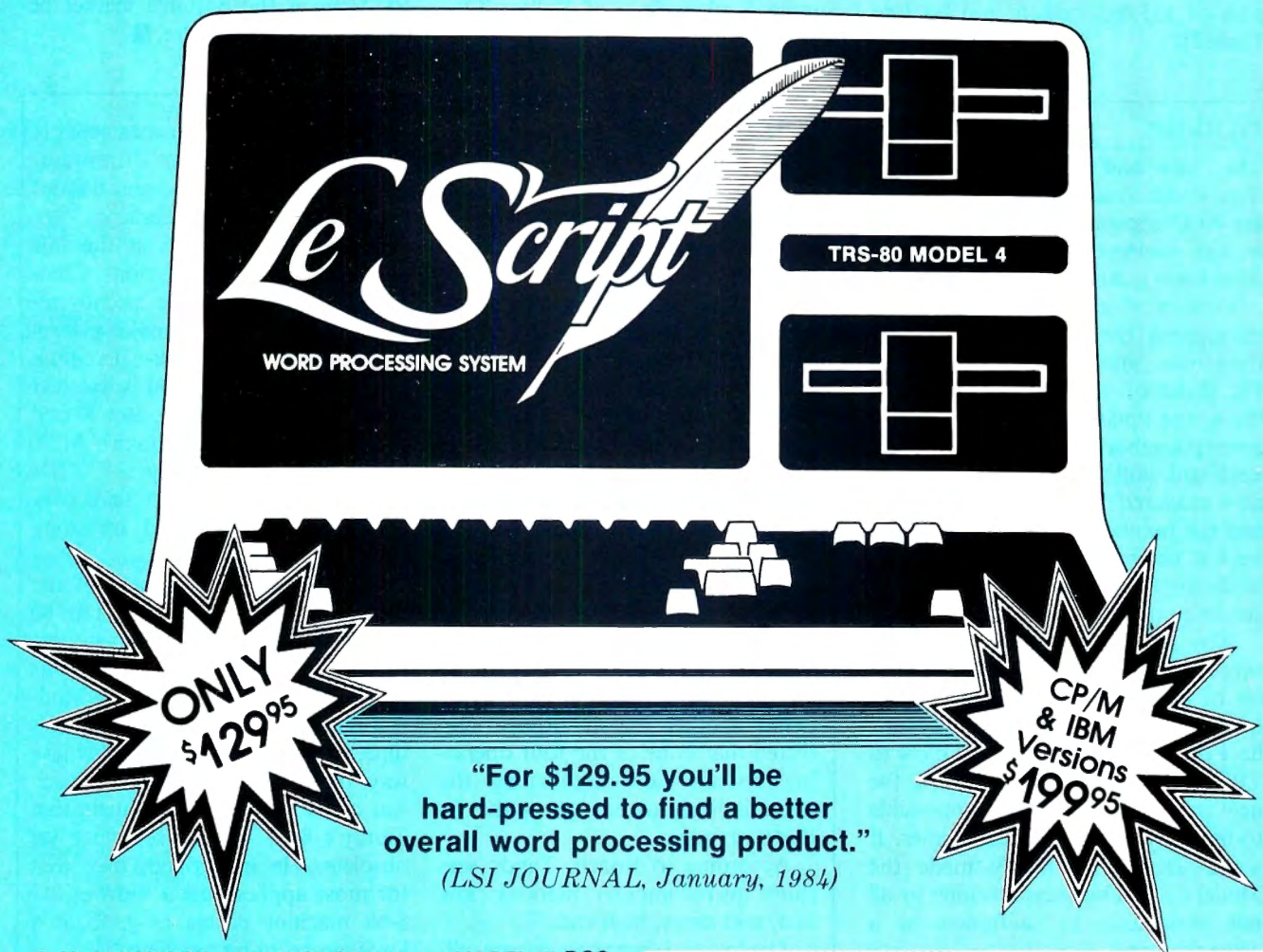
You won't yet find TV ads showing used-computer salesmen smashing CRTs with a sledgehammer, but if the fledgling used-computer market takes off, you never know.

The personal computer boom is very much an urban phenomenon, according to a study conducted by International Data Corporation (IDC), a computer marketing research firm in Framingham, MA. As of January 1, 1984, the top 25 Metropolitan Statistical Areas (translation: big cities) accounted for 43.1 percent of all personal computer units in the U.S. The top 100 MSAs contained 69.5 percent of all personal computer units (see Table 1).

For the study, IDC defined a personal computer as a microprocessor-based system that is programmable in a high-level language, supports peripheral devices, and costs $50–$20,000. The study found 9,525,000 personal computers installed in the United States at a total estimated value of $16,987,000.

Tandy isn't generally thought of as a major player in the world of data processing. However, according to the June 1984 issue of *Datamation* magazine, Tandy ranked 13th with a data processing revenue of $945 million in

TRS-80 MODEL 4
Word Processing Program



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(LSI JOURNAL, January, 1984)

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1983. That ranking represents a rise of three notches from the previous year.

Other microcomputer companies listed in *Datamation*'s top 20 were Texas Instruments (17th), Commodore International Ltd. (14th), and Apple Computer Inc. (11th). IBM led the list with data processing revenues of $35,603 million in 1983 (see Table 2).

The lap-size portable market continues to be a hot spot in the micro industry—too hot for some.

Xerox Inc. entered the portable market last fall with their 1810, a $2,195 entry featuring a 3-line by 80-character LCD screen. Seven months later, Xerox pulled out of the portable business. Sunrise Systems Inc. of Dallas, TX, Xerox's portable producer, cited problems with the machine's firmware and rechargeable battery.

Future Computing Inc., of Richardson, TX, estimates a 53 percent annual growth in portable sales and expects 250,000 units to be sold this year. In light of this, Radio Shack stands to see continued success with its Model 100 even as the portable market becomes more competitive. ■

Update

The "new and improved" Model 4 from Radio Shack that started appearing on Computer Center shelves early in the summer came under attack from some quarters.

Rumors of a Model 5 were flying throughout the spring, but the real thing was anything but remarkable. For those of you who haven't seen them, the updated Model 4's have a green phosphor CRT and a redesigned keyboard, and the four arrow keys are now clustered between the keyboard and the number pad. The feel of the keys is reminiscent of the Model II, while the layout of the arrow keys is similar to that of Tandy's Model 2000.

Why Radio Shack found it necessary to move the arrow keys remains a bit of a mystery. In fact, some diehard TRS-80 gamers think Tandy may have done it to strike the final blow to TRS-80 game companies because the new arrow keys are almost impossible to use for fast-paced arcade games. It seems Tandy has finally made the Model 4 a real business machine by all but eliminating its usefulness as a game machine.

Model 2000 owners who have the *Model 2000 Technical Reference Manual* can find mention of an Arcnet board in the block diagram of their system. Tandy's most ambitious business machine would benefit from networking capability, but as yet the company hasn't announced any software or hardware that uses the 2000 in a network. Don White, the Model 2000 line manager, says his group is looking at networking for the 2000, but he says no products will be available in the immediate future.

Model 2000 users will have to wait to see whether Tandy itself will exploit the machine's potential in local area networks or whether third parties will beat them to it.

The View from The Tower

At the June 26, 1984, meeting of the Boston Computer Society, Tandy's CEO John V. Roach offered some opinions on the direction of the microcomputer industry and how it relates to Tandy's product line in particular. On one issue, the debate over multi-user systems versus networking, Roach said Tandy is looking at both areas to one degree or another. But he indicated Tandy was leaning toward networking for business users, even though the company has no networking capability yet for its Model 2000.

On another matter, Roach predicted that none of the four operating systems now dominating the scene is likely to emerge as the industry standard.

According to Roach, Tandy sees three microcomputer markets: low end, mid range, high end.

The low end comprises micros selling for less than $1,000. Roach says this segment is growing at a fast pace despite the financial troubles of Texas Instruments, Atari, and Timex/Sinclair. "People are buying low-end machines" said Roach, "but they are looking for machines that offer more utility now. Not just game computers." In Tandy's computer line, Roach listed the Color Computer 2 and the Model 100 kneetop portable.

Roach noted, however, that the Model 100 has two disadvantages that prevent it from making much of a push into the home market. "The Model 100 has a limited price/utility function which limits potential sales in the low-end segment." Almost everything a Model 100 owner needs is incorporated in the unit's firmware, so a variety of software and utilities for home users isn't necessary.

Tandy's competition in the low end comes from all directions. Commodore, Atari, and the recently reduced Apple II are all major players in the under $1,000 market. Even the MSX threat from abroad is watched from the Tandy towers. But Roach discounts the role of Japan's MSX operating system, saying, "It's doubtful that MSX will take over and become a standard operating system in the U.S."

In the mid-range segment of the micro market, Roach felt the TRS-80 Model 4 and 4P were important, especially for schools and small businesses. As Tandy sees it, "The Model 4 is a high-volume machine at this time, but its position will slowly give way to 16-bit computers." Roach was quick to point out, though, that Tandy's 8-bit workhorse is not yet obsolete. He mentioned, too, that for most applications a "low-priced 8-bit machine is just as good as a low-volume 16-bit machine."

The most important segment of the micro marketplace is in 16-bit computers. Leading contenders for that market are the IBM PC, Apple's Macintosh, and the Tandy 2000. It's obvious that Tandy is going after a piece of the 16-bit pie with the introduction of the 2000; now that some powerful software is finally getting into Radio Shack Computer Centers, Roach expects Model 2000 sales to start taking off.

Roach conceded that technology is moving so fast that consumers can't keep up. With the emergence of multi-user processors like Intel's 80286, he sees true 16-bit computers (like the Model 2000) becoming standard. ■

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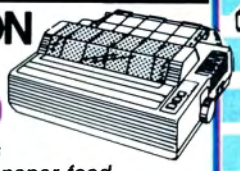

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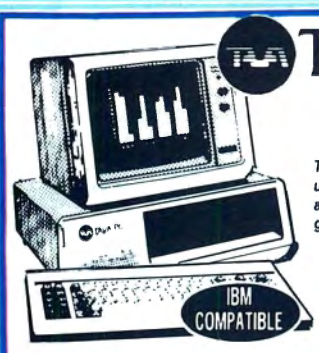

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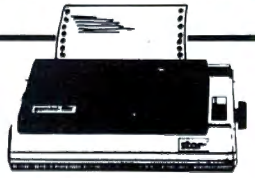

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Full Recovery

David Gobel's method for recovering in-memory Scripsit documents (September 1982, p. 256) doesn't work on my Model III disk Scripsit 3.2, so I made some changes. Once you've loaded the program in memory, you should be able to recover all or most of a document lost through a reset or goof at the keyboard.

Use Debug to enter the code into memory; start at 7AD0 hexadecimal (hex) and end at 7AE1 hex. The code is: 21B8 7DD7 B720 FC22 3853 3E20 3247 53C3 0053. Dump the code onto disk by typing in

```
RECOVER/CMD (START=7AD0,END=
7AE1,TRA=7AD0)
```

The next time you lose a document, hit the reset button, then type in RECOVER and press the enter key. When disk action stops, you'll be back in Scripsit. But don't do anything until you've completed this key sequence: press the shift and up-arrow keys, the enter and up-arrow keys, and the shift and down-arrow keys simultaneously. David Gobel's invaluable article explains why this operation works.

Michael Meyers
12 Hamilton Ave.
Montclair, NJ 07043

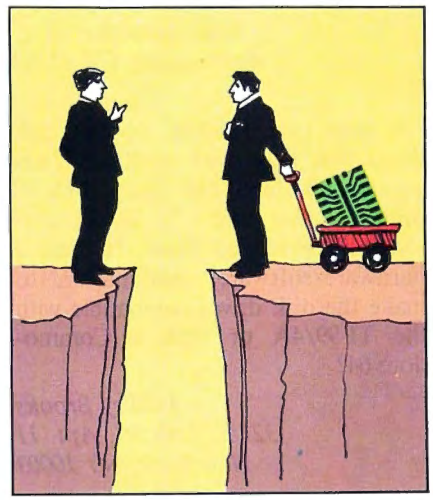
What a Dump!

I'd been looking for a screen dump program like Skip Murrow's DMP 400 screen dump (Tidbit #7, June 1984, p. 143) and was pleased to see it in *80 Micro*. However, I found it necessary to make a few changes.

I added a zero to the first value in line 6030, and, to get a full screen dump, changed the second value to 16320. The line should read:

```
FOR LN=15360TO16320 STEP 64
```

I also had to delete line 6010 to get a full screen dump.



To get the program to print alphanumeric characters, I added these two lines:

```
6073 IFAS>32ANDAS<122ANDDC=2
THEN6210
6076 IFAS>32ANDAS<122AND(DC=1
ORDC=3)THENAS=224:GOTO6210
```

This program has already done wonders for me.

Mark Rife
29 Vassar Drive
Dayton, OH 45406

Wide Open Spaces

I find SuperScripsit's use of the delta symbol to indicate two spaces annoying. Pressing the shift and space bar keys eliminates the delta symbol, but takes time. I came up with two simple patches to get around the problem. The first is for keyboard entries and the second is for ASCII conversions to SuperScripsit format.

For TRSDOS 1.3 users the patches are:

```
PATCH SCR64/CTL (ADD=7F8A,FIND=
20,CHG=18)
PATCH SCR35/CTL (ADD=99C9,FIND=
20,CHG=18)
```

For LDOS with the Model III, use:

```
PATCH SCR64/CTL (D00,38=18)
PATCH SCR35/CTL (D01,30=18)
```

And for LDOS with the Model I:

```
PATCH SCR64/CTL (D00,63=18)
PATCH SCR35/CTL (D02,AA=18)
```

I hope readers will find these patches helpful.

James Reed
9631 Sophora Circle
Dallas, TX 75249

Double Trouble

Dennis Watters was having trouble getting TRSDOS 6.0 to read and write to a double-sided disk (June 1984, p. 29). To format from a single-sided to a double-sided disk, you type in FORMAT (SIDES=2). To back up from a single-sided to a double-sided disk, use: BACKUP SYS:0 :1 (S,I) to put track zero on the disk. The command BACKUP $:0 :1 (S,I) transfers the remaining tracks.

Now I need help. I want to buy a conversion for Montezuma CP/M so it will read a standard IBM-format 8-inch CP/M disk. I have an 8-inch disk controller. Also, I'm looking for patches to eliminate the date, time, and TRSDOS logo on version 1.3.

Gil Seiler
126 Boas Drive
Santa Rosa, CA 95405

Help, Please

I waited from April 1983 to January 1984 for Radio Shack to release CP/M Plus for the Model 4; then I traded my Model III for a Model 4 and bought CP/M. I now find that CP/M doesn't work as outlined in the manual and, more important, I've discovered no way to get any one of the "thousands of CP/M programs" onto my disks.

No dealer I've contacted supports the Radio Shack format. I've been unable to buy WordStar or dBase II, and I assume this holds true for any other popular CP/M program I would

want. In short, I have over $2,000 invested in a computer and operating system that don't work as advertised and for which there is no software available.

If any reader has found a dealer who can supply commercial CP/M programs on Radio Shack-format disks, I hope they'll contact me.

Nate Salsbury
610 Madam Moore's Lane
New Bern, NC 28560

I'm in need of the CP/M and MBasic documentation for Omikron Systems' Mapper I CP/M board. I'll pay any expenses to get them.

Daniel Wolf
220 Greenlee Road
Pittsburgh, PA 15227

I have a Model III with two drives and the Radio Shack high-resolution graphics board. It's been fairly easy to get high-resolution graphics on the screen using the Basic software that came with the board, but I can't dump the screen to my Star Gemini 10X printer; the print utilities supplied by Radio Shack work only with their printers. My printer is of recent vintage and I believe it has Epson-compatible ROMs. Can anybody help with a patch for a screen dump to my printer?

Larry Patterson
5462 Tattershall Ave.
Westminster, CA 92683

I have two Tandon 5¼-inch disk drives that I use with a Model I, expansion interface, and Epson MX-60 printer. I also have a TI-99/4A console with Extended Basic. Is there a hardware/software combination to make the disk drives compatible with the TI-99/4A or with a Commodore 64?

Dudley Brooks
321 E. 12th St., Apt. 11
New York, NY 10003

Does anyone know of an inexpensive file management program that can save, sort, and print out bibliographic data in standard reference format? I often use my Model I with disk Scripsit to write academic papers and reports, and I need to sort bibliographic records by subject and author.

David McCrory
538 Valley Road
Morgantown, WV 26505

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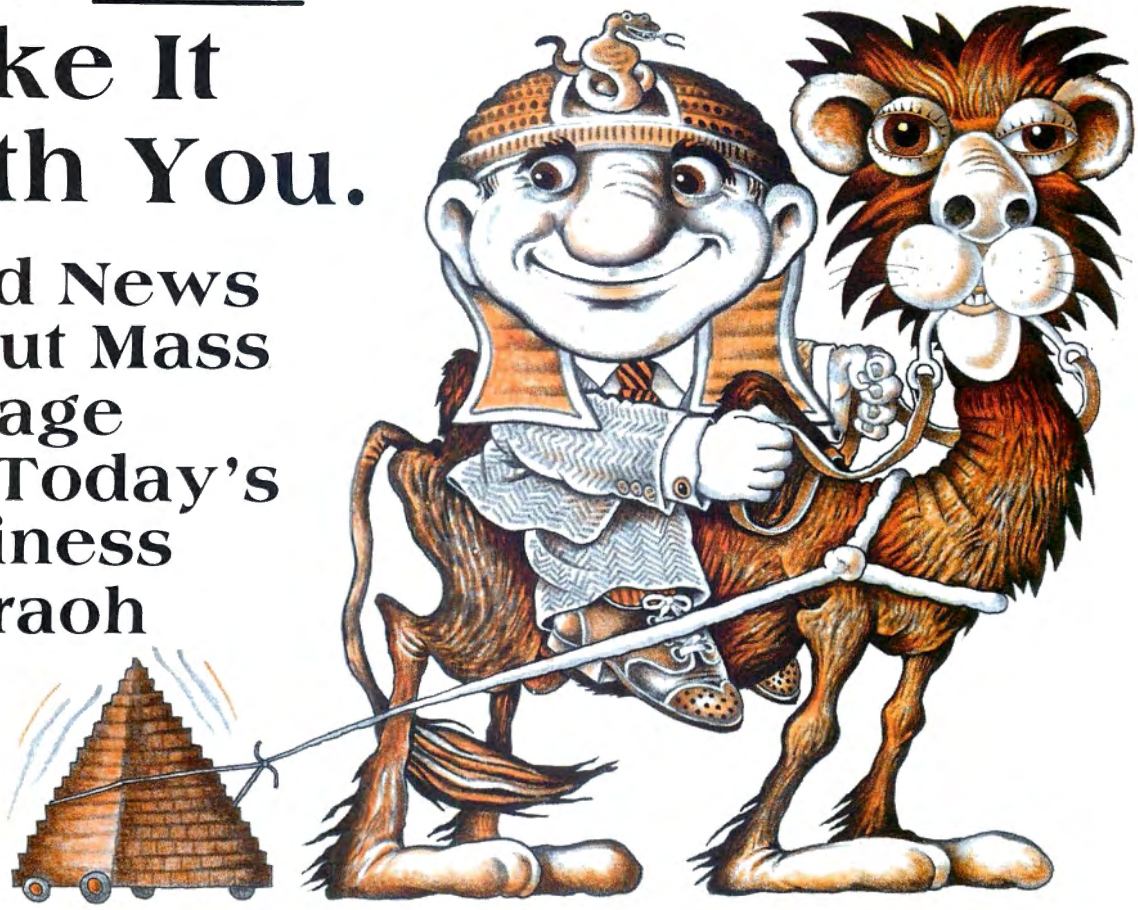

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DEBUG

I've made some corrections to the programs MAKEDO/BAS and TRS/JCL from my article "Command Performance" (June 1984, p. 62). The changes should take care of the problems some readers have experienced. For MAKEDO/BAS:

In line 230: Change all RETURN to RESUME 245

Add the line: 245 RETURN

In line 260: Change RETURN to RESUME 275

Add the line: 275 RETURN

In line 390: Change IL% to W – 1

In line 900: Eliminate :NEXT CHK% (at end of line)

Add the line: 905 NEXT CHK%

In the TRS/JCL program, after line 51 add a line with only a Y; this answers the TRSDOS prompt.

The JCL files in the article were presented only as examples; the BASLIST file won't work unless you have the same Basic file names on disk. Also, the above changes won't work if your drive-zero disk is named Datadisk.

Raymond E. Wilson
7519 Bubbling Spring Lane
Houston, TX 77086

You should make some changes in the Dynaterm terminal program (May 1984, p. 50) in order to free up the control key codes Q and P in the terminal mode. Otherwise, you might run into problems, because most bulletin board services reserve control-Q and control-P for standard protocol. Delete lines 6080–6120 and insert lines 6021–6120 (see the Program Listing). The changes work with versions for the Models I, III, and 4.

David Fischer
141-20 72nd Ave.
Flushing, NY 11367

```
06021           CP      5B      ;UP-ARROW
06022           JP      Z,DEF

06261   DEF     CALL    0049H
06262           RES     5,A
06263           CP      'Q'
06264           JR      Z,STI   ;OPEN BUFF.
06265           CP      'P'
06266           JR      Z,NDI   ;CLOSE BUFF.
06267           JP      TMAIN
```

Program Listing. Corrections to the Dynaterm program.

Readers should make a couple of changes to Program Listing 4 in "A Better Breed of Basic" (July 1984, p. 94). To get this American flag and national anthem graphics and sound demonstration to work, you must begin line 1 with REM and change all zeroes to O's in lines 221–224.

—Eds.

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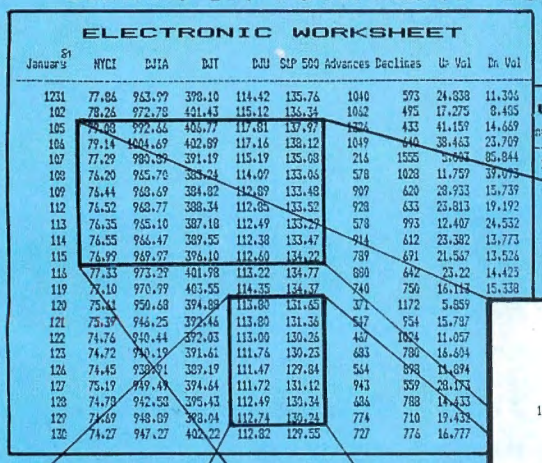

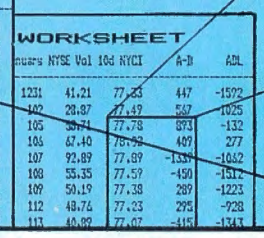

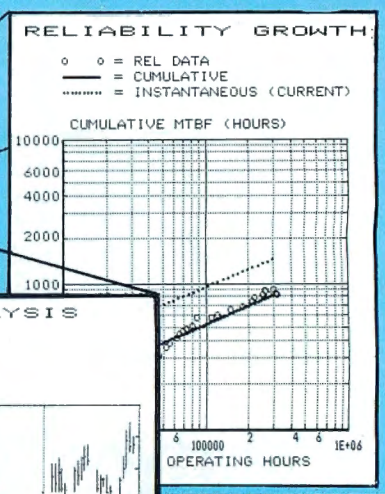

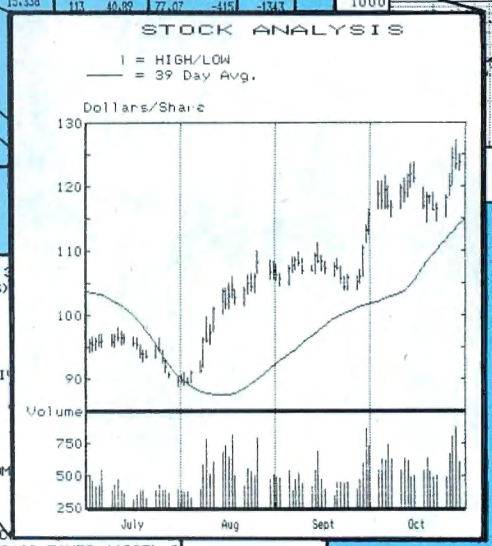

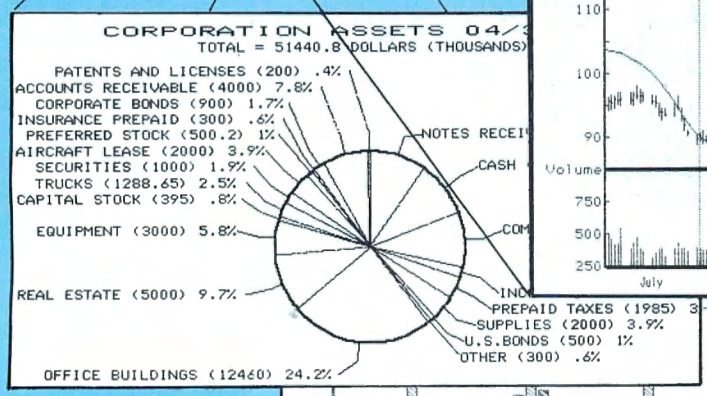

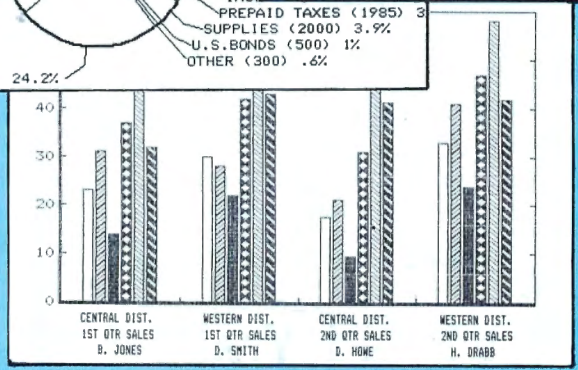

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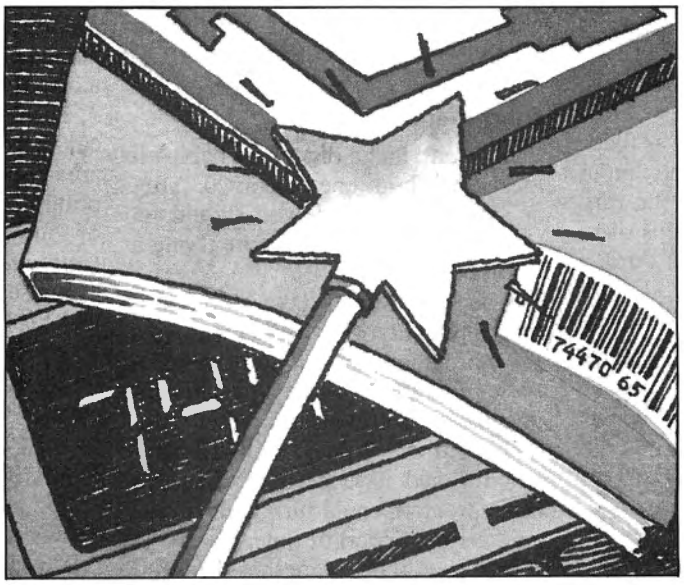
A Wave of the Wand: Model 100 Bar Code Reader

by Carl Oppedahl

edited by Ryan Davis-Wright



I first tested the Model 100 bar code reader by scanning some universal product codes (UPCs). I set up the software, got the "Wand Ready:" prompt, and, bravely grasping the wand, scanned the cover of *80 Micro*.

Nothing happened. I tried again. Nothing. Again. Nothing.

Then the Model 100 beeped. There, on the screen, was the number 07447065947. The bar code reader had worked.

As I was to realize later, you need considerable practice to scan bar codes no matter who makes the reader.

Then I pulled out the April issue of *PCM* magazine, and typed in a Basic program that lets you enter bar-coded Basic programs. I turned to a page filled with bar codes and, after two minutes of scanning, had read in an 18-line program without mistakes.

Yes, bar codes are here. And the Radio Shack reader gives you a reasonably priced way to use them.

What You Get

The bar code wand for the Model 100 is made by Hewlett-Packard. The sensor in the tip is a four-terminal device comprising a red LED (light-emitting diode), a phototransistor, and a focusing lens.

Table 1 lists the software Tandy provides. It comes on a noncopy-protected cassette. Each of the .CO files is a device driver, capable of letting the wand read a particular type of bar code.

The UPC driver reads the 12-digit (type A) codes on most grocery items, but does not read the smaller seven-digit UPCs used on such small and high-volume items as candy wrappers and soda cans. The other two drivers read 3 of 9 and Plessey codes. The former is probably the most widely used code in industry and by the Department of Defense.

The manual says that additional drivers will be available.

How to Use the System

Setting up the bar code hardware is easy: you simply plug the wand into the Model 100's BCR connector. If you're going to use the wand from Basic, your best course is to use one of the drivers. If you're going to read code other than the ones mentioned above (2 of 5, for example), you'll need to write your own driver.

The reliability of a scan depends on both the hardware and software. In this case, both perform well.

UPC codes, for example, appear on plastic, metal, and paper, with varying reflectivity and contrast. The wand does a good job of reading them all. And some codes appear on curved surfaces, so that even with a steady hand you'll get some variation of scanning rate. This can only be corrected by the software, and the UPC driver program does it well.

The 3 of 9 driver read the *PCM* program without any problems.

I didn't test the Plessey driver beyond the demonstration code provided with the wand.

The Documentation

The documentation does a pretty good job of introducing the wand and software to the novice. It illustrates machine-language driver routines with demonstration programs written in Basic.

It is lacking, though, in several areas. First, the manual lacks a full, formal definition of what can happen when you open the WAND: device. Usually, if you attempt to open WAND:, you'll get a function call error. Under what circumstances, exactly, can you open the device? It turns out that you can open it after executing the driver program with the RUNM command, or after loading it with LOADM and calling it with CALL 61824. The manual leaves this unclear. And, there is no index for a reference.

Also, the manual does not adequately warn you about the possibility of overwriting areas of RAM, thus damaging or destroying files. This can happen if you load another program into the area around F199 hexadecimal (hex), which is where the drivers point to. Each driver contains a routine, accessed by a CALL 61807, that protects against such a mishap. Unfortunately, the manual only discusses CALL 61807 in a box on page

12, and doesn't disclose the potential for file destruction. It should include a prominent warning about the necessity of CALL 61807 in the front of the book.

The manual is also less than clear about what can happen when the Basic program accepting BCR data executes the INPUT# or LINEINPUT# commands. If the reading is successful, the software returns the data as a character string in the INPUT# command, much as if a string were input from some other device. If the read is unsuccessful, Basic ignores the wand read. You don't get an I/O (input/output) error as you would for an unsuccessful cassette load.

Suppose you open WAND as file 1. The manual illustrates wand input with INPUT#1,A$. But can the variable be numeric? The manual is silent on this. (The answer is yes.) And if you input a nonnumeric bar code with a command like INPUT#1,A, you won't get an error message, and the program returns a value of zero.

Suppose you try an OPEN "WAND:" or INPUT# with no wand attached. Again, you won't get an error message.

Is there any difference between INPUT# and LINEINPUT# as far as the wand is concerned? The manual doesn't say, instead lamely referring you to chapter 16 of the Model 100 user's manual, which doesn't mention the bar code reader. As it turns out, INPUT# does what one would think, returning characters only up to a comma or line terminator. For a numeric-only code such as UPC, this means you'll get identical results whether using INPUT# or LINEINPUT#.

Program	Length (bytes)	Function
UPC.CO	830	Reads UPC subset A
PLESY.CO	830	Reads Plessey codes
B3OF9.CO	830	Reads 3 of 9 codes
READBC.BA	430	Demo for reader
INVCRE.BA	1098	Demo inventory file creation
INVENT.BA	1295	Demo inventory maintenance

Table 1. Programs that come with the bar code wand.

Other Warnings

My wand had a disturbing habit—it locked up about one time in 20. After an unsuccessful read, you should release the wand button before trying a second time.

Also, your Model 100 will not automatically shut off when executing a Basic program. Thus, if you're using a Basic program for wand input, it's impossible to protect against battery rundown. An ON WAND GOSUB command would have been nice; then a Basic program could turn itself off after a certain period of time.

You should be aware that the wand draws power from the Model 100. A set of batteries usually lasting 20 hours might therefore last only 14 hours under heavy wand use.

Before you use a wand driver with another program, you must compare the machine-language loading addresses and HIMEM setting to avoid conflict.

Finally, while the plug has special ridges to help it fasten securely, the Model 100 connector does not have corresponding ridges; the wand thus easily pulls loose from the Model 100.

But all in all, the bar code reader will give you a fun, convenient, and reliable way to enter programs or data into the Model 100. Just be sure you reset those RAM vectors after use. ■

Bar Code Reader

★★★½

Tandy/Radio Shack
One Tandy Center
Fort Worth, TX 76102
Model 100
$99.95

Easy to use?	★★★★☆
Good docs?	★★☆☆☆
Bug free?	★★★☆☆
Does the job?	★★★★☆

A Welcome Guide

by Eric Grevstad

There are two pop preachers of the computer gospel. Puckish, cutesy Peter McWilliams is rich and famous, widely reprinted in such journals as *People* and *Playboy*, and has recycled his same 50 pages of material into half a dozen books.

Theatrical, madcap Russ Walter is a cult hero, known mostly to Boston-area techies and programmers, who's published nine editions and revisions of one book, *The Secret Guide to Computers*.

Praise, then, to Birkhauser Boston, which persuaded Walter to make the 10th edition a mass-market paperback. It's a little rough around the edges, but the *Secret Guide* deserves a bigger audience than it could ever have as a series of underground pamphlets.

Tasteless Metaphors

Lots of books teach novices the difference between RAM and ROM, but Walter establishes himself on page one as more ambitious and more irreverent: "This book will turn you into a computer expert even if you're an idiot. In fact, some of the most famous computer experts in the world have read this book—and are idiots!"

This jokey tone continues through the whole book, though it's particularly dense in the beginning. There's some introductory nonsense about Walter's sexy young "wife" (a TRS-80), and good-humored drivel about Birkhauser's firing its editorial staff in favor of lobsters.

Walter compares computing with drug abuse—you become a user supplied by a dealer; addicted, you spend more and more for computing thrills. But he abandons the simile for the declaration "This book is about sex" and quips like, "Putting your sheathed treasure into the box's slit can feel quite sexy. But don't shove too hard. Please be gentle!" (He's talking about inserting disks.) As a comedian, Walter makes Joan Rivers look subtle.

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MICROTERM	64.95
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The affordable 300 baud modem that speaks everyone's language. Operates at full or half duplex, automatic selection of originate/answer modes. Requires 9 volt battery (not included). Volksmodem is a perfect choice for your first modem. (Anchor Automation, Inc.; Cable is $11.95 extra.)

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Compared to his witty industry gossip and techie puns, Walter's sexual humor is sophomoric and sometimes crude. For example, as a metaphor for using the break key, he chortles, "To put the computer out of its misery, you must give it an abortion....You can cause a moral dilemma for traditional Catholics, who fear giving abortions and are even more afraid of 'pulling the plug.' Is God against abortions for computers?"

That's offensive. If there's one thing right-to-lifers and pro-choice advocates agree on, it's that abortion isn't funny.

After the first 15 or 20 pages, though, Walter settles down to write an excellent introduction to computers in general and Basic in particular.

The even-numbered chapters (2, 4, and 6) contain easy, intermediate, and advanced Basic lessons. Walter takes Basic seriously. Most pages introduce two or three new ideas, and the sample programs become sophisticated quite early—with only Print, Data, and For...Next statements, you're writing a program that creates a nicely tabbed and formatted calendar. The steps after the first program, PRINT 5+2, seem to fly by, but Walter's organization makes them logical progressions.

The odd-numbered chapters discuss computers collectively, specifically, and in terms of applications. If Walter's good at Basic, he's superb at micro architecture. There are a few sweeping statements (he never quite says why 5¼-inch disks are "crummy," one of his favorite words), but where McWilliams dismisses silicon as "a fancy word for sand," Walter explains the differences, pros, and cons of NMOS versus CMOS chips in four sparse, sure sentences.

There are also the best, most concise brand-name evaluations I've seen—a page for each of the major manufacturers, with underlined sentences that tell exactly what rookie shoppers should be told (Ataris aren't bad but the company's made fatal mistakes, Apple IIs are primitive but have lots of software, and so on).

The Radio Shack page is a little skimpy; Walter mentions Tandy's marketing clout and various models, but there are too many TRS-80s for him to supply details on each.

Recommendations, Not Applications

Walter sets a good example for readers, following the policy of picking software before recommending hardware. For word processing, he likes the Model 4 because of SuperScripsit; for business, he endorses anything that runs Lotus 1-2-3. For filing, machinery is less important than PFS:File.

Business applications, along with more detail on micro design, advanced Basic, and other languages, are in Volume 2 of the *Secret Guide*; that's probably why Walter's treatment of applications software in Volume 1 seems sketchy.

The book also has two chapters of rather dated material on computers' moving into human roles—electronic romance from 1965's "computer dating" to 1980's Interlude, psychoanalysis programs such as MIT's Joseph Weizenbaum's Eliza, a lot of computer-generated prose and pictures. It's pleasant reading, but not as information-rich as the Basic and hardware chapters—or the appendices, which supply details of Basic dialect differences for specific machines, plus several first-rate indexes.

Conclusions

This is probably the most intelligent beginner's book in the field. McWilliams can write funny captions for old lithographs, but Walter's the one you'd call in the middle of a debugging session.

The one you'd call, literally. Walter has printed his home phone number in every edition of the Guide, and welcomes questions 24 hours a day. If he's willing to do that, I'm willing to overlook his dressing up like the Wicked Witch of the West for computer seminars. ■

The Secret Guide to Computers, Volume 1

★★★½

Russ Walter
Birkhauser Boston Inc.
380 Green St.
Cambridge, MA 02139
349 pp.
$14.95

Well-written?	★★★½☆
Organized?	★★★★☆
Thorough?	★★★½☆
Readable?	★★★★☆

Spectaculator: A Simple, Tape-Based Spreadsheet

by Mare-Anne Jarvela

If you're a math student or a first-time spreadsheet user interested in a VisiCalc clone and you aren't put off by tape-based software, try Spectaculator. Formerly available for the Color Computer only, Spectaculator now lets you budget, forecast, and do mathematical calculations on your Model I, III, or 4 (in Model III mode).

Though tape-based, Spectaculator was, to my surprise, very easy to use. And its price is a plus: Compare Spectaculator's cost of $49.95 with VisiCalc's price tag of $199 and you know it's a bargain.

Spectaculator's spreadsheet comprises 99 columns and 99 rows that accept text, numbers, and formulas. You can enter up to 56 characters per cell (the intersection of a column and row). Numbers can be 16 digits long (with up to six digits to the right of the decimal point). To use long numbers, you change the column width, set at nine characters at the start of the program, using the CW command.

The program's useful Help screen (see Fig. 1) displays all of Spectacula-

Spectaculator

★★★★

Tandy/Radio Shack
One Tandy Center
Fort Worth, TX 76102
Models I and III, 16K RAM
Cassette recorder
$49.95

Easy to use?	★★★★☆
Good docs?	★★★★★
Bug free?	★★★★☆
Does the job?	★★★★☆

tor's commands, with a brief explanation of their function. Press the break key to get into command mode, then the ? key to get to the help screen. (C> is the prompt for a command.) Each command has its own help screen. Pressing the ? key after entering a command provides you with an example of the command's function (see Fig. 2).

Pressing the clear and shift keys makes the cursor backspace and erase characters simultaneously; the left-arrow key lets you change an entire cell entry. The ZW command clears your worksheet so you can load another one from tape or start entering new information.

You can use two commands to enter formulas: RF for row formula and CF for column formula. The option to put an I in front of a formula results in an answer in integers; if you type D instead, six decimal places appear in the answer. The default is two decimal places. SUM adds values from the specified column or row to the figure designated by your marker; SMT gives you cumulative totals and a final total; and SQR produces the square root of the values in the row or column you specify after SQR.

The LI command prints either all or part of your worksheet. The Save option lets you save to tape and LO loads the file back in.

I found Spectaculator simple to work with and had no trouble loading the tape. The documentation, divided into five sections, is hand-holding throughout. Section 1 shows you how to load and run Spectaculator. The second chapter defines and explains the commands, while part three, a sample session, provides a simple example of how to set up, save, and print an addition table. The advanced session in chapter four includes examples of budgeting, statistics, and geometry. The fifth section contains a quick command and key reference summary.

The manual's examples were easy to follow. I learned to print, save, and load without difficulty. The documentation is enhanced by a handy reference card summarizing Spectaculator's commands. ■

Not So NICE

by R. Walter Steur

XYZT Computer Dimensions Inc.'s NICE is one of the first integrated software packages to hit the TRS-80 market. Integrated systems are hot items in the 16-bit market and they're emerging for 8-bit computers as well. They comprise several components such as a spreadsheet, word processor, data base manager, or communications module, among which you can shift easily and quickly—Lotus 1-2-3 is the best known example. Unfortunately, the NICE system falls far short of its stated goal of being a user-friendly, ready-to-use system, despite the power of the ICPL language (interactive control and programming language) on which it's based.

What's in It for You

NICE (an acronym for New Interactive Computing Environment) is a menu-driven system that lets you manage a data base and display and print reports and forms. The package also includes a full-screen text editor called Nicepen (a licensed subset of the original Pencil I word processor) and a VisiCalc interface. A development facility helps you create your own screens, menus, data bases, and report formats. A communications facility is expected to be available in 1984.

NICE is an open system, meaning that the user can integrate his own programs into the system. It's presented as being easy to customize.

NICE is based on XYZT's ICPL, an expansion of their interactive control language (reviewed in the June/July 1982 *80 Micro*, p. 64). The sys-

```
RF:.

ROW FORMULA ENTRY HELP

EXAMPLE FORMULA:
(R1-R2)/2+5*SQR(R3)
OPERATORS: + - * / ! ( )
FUNCTIONS: SUM SQR SMT
PRECEDE FORMULA WITH "I" OR "D" FOR INTEGER OR DECIMAL RESULT
```

Figure 1. Spectaculator's help screen.

```
C>
COPYRIGHT 1983,TANDY CORP. - ALL RIGHTS RESERVED  SP.01.00.00
ET - ENTER TEXT                  EN - ENTER NUMBERS
MM - MOVE MARKER                 CW - CHANGE COLUMN WIDTH
CR - CLEAR ROW                   CC - CLEAR COLUMN
IR - INSERT ROW                  IC - INSERT COLUMN
DR - DELETE ROW                  DC - DELETE COLUMN
SA - SAVE ON TAPE                LO - LOAD FROM TAPE
LI - LIST TO PRINTER             PS - PARTIAL SAVE
RF - ROW FORMULA ENTRY           CF - COLUMN FORMULA ENTRY
CA - CALCULATE                   FR - DISPLAY FREE MEMORY
ZW - ZAP WORK SHEET              EX - EXIT
        SPECIAL KEYS:->
CLEAR - BACKSPACE                ? - HELP LIST
BREAK - ENTER COMMAND MODE
```

Figure 2. Functions of Spectaculator's commands.

NICE

★★☆

XYZT Computer Dimensions Inc.
2 Penn Plaza, Suite 1500
New York, NY 10121
Models I and III
48K RAM
$325

Easy to use?	★★☆☆☆
Good docs?	★★☆☆☆
Bug free?	★★☆☆☆
Does the job?	★☆☆☆☆

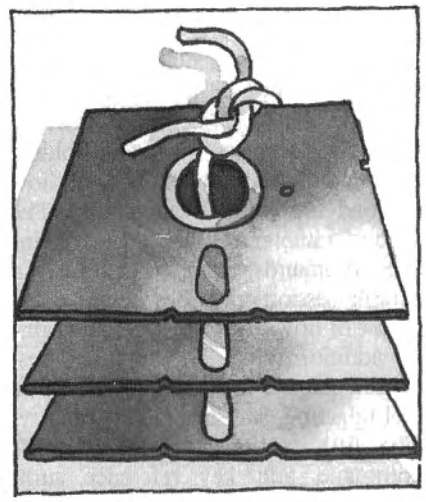
tem nucleus includes the Library Support Option (LSO) module, which manages the creation, access, and control of file libraries. Files can occupy as little as one sector within a library, so LSO is very efficient at handling collections of small files. (LSO was reviewed in detail in the October 1983 *80 Micro*, p. 48).

Overview

The program comes on two single-sided, single-density, 40-track disks. The two non-system disks contain about 175K of program files. As a result, the files don't all fit on a two-drive Model I single-density system.

To initiate NICE, you enter a command line at the DOS Ready level. As the NICE program loads, it displays the computer model number (I or III) and the DOS version you're using. Then comes a full-screen NICE logo with message. Still later an "&ICPL READY" message appears. Finally, you get to see the main menu, 28 seconds (on the Model III) after you enter the command line!

Figure 3 shows the main menu. If you check to find out what the PF keys at the bottom mean, you'll encounter your first significant piece of misinformation in the manual. You're supposed to hold down the PF key combination and press a specified numeral key to perform a variety of functions throughout the system; PF acts like a control key. The manual says the combination is the shift and down-arrow keys, or the control key on the Model 4. But that doesn't work on the Models I, III, and 4. What does work is the shift key with the numeral key.



The first option on the main menu is the NICE tutorial, but more about that later.

Option 3 takes you to the letter menu, from which you can write or edit the sample letter provided using NICE's built-in editor, print the letter, and print a mailing label. If the name and address are in the data base, you can call it for use in the letter or the mailing label using a PF key to find it, but you must know the first few letters of the name.

The Business menu, option 5 of the main menu, appears to provide the primary data base input facility for the system. It lets you enter customer orders of up to five lines, customer names, print short invoices from the order file or from keyboard input, view orders on file, enter or view calls and messages, write and review memos, enter a list of products (with codes and prices), or enter and view business contacts.

Calling option 5 from the Business menu, for example, gives you a customer file that includes the customer's name, address, and phone number. Using the PF keys defined at the bottom of the screen, you can view records in the file, or add, update, or delete a record.

The business contacts option of the menu contains a little surprise. The manual doesn't say you can get technical assistance by phone, but the only entry in the business contacts file lists the company name, address, technical assistance phone number, first names of the program authors, and a message urging you to call in case of problems. Apparently it's assumed the user will be able to follow the manual's directions to this point.

The inquiry menu, titled "Inquires" (*sic*), is similar to the menu I described above. Options include orders, clients, contacts, calls, memos, and products. But this menu allows retrieval only, and lists all records in the selected file in abbreviated form. The report option lets you print out all or a group of records from a data file using a header set-up and predefined format.

The VisiCalc menu provides an interface to the VisiCalc program, an editing facility for DIF (data interchange format) files, and a directory of VisiCalc files. Because both VisiCalc and NICE use large amounts of RAM, the interface calls a procedure using DOS* that saves the current NICE configuration in memory to a temporary disk file, loads and runs VisiCalc. You can use the same feature for other programs, such as full-featured word processors. Saving and reloading the temporary NICE file does take time, however, making it inefficient to jump back and forth between NICE and an applications program.

Option 10 of the main menu gives you a submenu listing specific utilities for four DOSes. (I used DOSPLUS 3.5 for this review.)

The DOS Functions option applies to all the DOSes from this option; you can enter DOS commands or run any program you could normally run from the DOS level. This option includes some enhancements, such as a Move command that copies a specified file from one disk to another and kills the original file. I did find one limitation

```
                Main selection menu              "menu1"
               ----------------------------

 1. NICE tutorial              9. BASIC
 2.                           10. Utilities and DOS functions
 3. Letters                   11.
 4.                           12. Communications
 5. Business menu             13.
 6. Inquiries and reports     14. NICE development
 7.                           15.
 8. Visicalc menu             16. Entertainment

        Your selection > ._ <

                                  (C) 1983 by   .X.Y.Z.T.....
 PF1:busimenu  PF2:help          Computer  Dimensions,  Inc.
```

Figure 3. NICE's main menu.

Continued on p. 184

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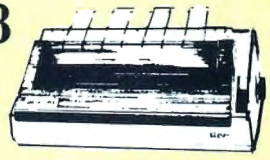

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This is the quality printer that has become the number one seller in the world with Commodore. 120 cps, 80-132 column, 96 ASCII characters, dot matrix with true descenders, emphasized, double strike, bit image and block graphics, parallel interface standard and buffer expandable to 8K. A real winner to meet a broad range of your printing needs.

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Star Radix 15 $738

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Star Delta 15 $588

List $749, **2 or more at $578 each.**

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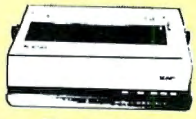

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STAR Gemini 10 $229 Gemini 15 $339

Models are new and with full 6 month warranty. Discontinued now but are almost exactly like the X models, with slightly different electronics and 2 3K buffer built in. 100cps, tractor friction. Only a few left.

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Illustration by Erick Ingraham

FINE LINES

New high-density bar codes make encoded information more space efficient than its alphanumeric counterpart. Davey S. Thornton describes the dense codes and provides a print utility for two of them, Code 128 and Tandycode.

Bar codes represent an easy, efficient way to store and retrieve information. But until recently, conventional codes like the UPC, 3 of 9, and Plessey codes used space liberally; the code took up more room than the characters it replaced. Recently, however, some high-density bar codes have been developed that use space much more efficiently, facilitating bar code applications such as data-base management and bar-coded program listings (see Fig. 1).

In this article, I'll show you how to print two of these high-density codes, Code 128 and the newly developed Tandycode (see the sidebar for more on Tandycode). In January, I'll provide you with a program that reads these codes. In the end, you'll have a complete Model III/4 bar code software system: an encoder and a decoder. In addition to this software, you'll need a reader wand and a bar code interface box; you can find instructions for building these in *80 Micro*'s June 1984 "Project 80" (p. 170).

Bar Code Basics

Two factors are of primary importance in bar code formats: error detection and data density.

Bar codes contain not only coded information identifying a specific item, but some error-trapping code as well. The two most common types of error-trapped bar codes are known as sparse code and record code.

Until recently, most bar codes provided about the same data density. Recently, however, companies have developed high-density bar codes representing both types of error detection. In

Figure 1. Comparing the density of different bar codes. Each code translates to read "80 Micro." (a.) A conventional-density code, 3 of 9, in standard format; (b.) 3 of 9 in compressed format; (c.) A high-density code, Code 128, in standard format; (d.) Code 128 in compressed format; (e.) Dense Tandycode in standard format; (f.) Tandycode in compressed format.

CODE 128 (USD-6)

VALUE	CODE A	CODE B	CODE C	BAR PATTERN B	S	B	S	B	S
0	SP	SP	00	2	1	2	2	2	2
1	!	!	01	2	2	2	1	2	2
2	"	"	02	2	2	2	2	2	1
3	#	#	03	1	2	1	2	2	3
4	$	$	04	1	2	1	3	2	2
5	%	%	05	1	3	1	2	2	2
6	&	&	06	1	2	2	2	1	3
7	'	'	07	1	2	2	3	1	2
8	(	(	08	1	3	2	2	1	2
9	)	)	09	2	2	1	2	1	3
10	*	*	10	2	2	1	3	1	2
11	+	+	11	2	3	1	2	1	2
12	,	,	12	1	1	2	2	3	2
13	—	—	13	1	2	2	1	3	2
14	.	.	14	1	2	2	2	3	1
15	/	/	15	1	1	3	2	2	2
16	0	0	16	1	2	3	1	2	2
17	1	1	17	1	2	3	2	2	1
18	2	2	18	2	2	3	2	1	1
19	3	3	19	2	2	1	1	3	2
20	4	4	20	2	2	1	2	3	1
21	5	5	21	2	1	3	2	1	2
22	6	6	22	2	2	3	1	1	2
23	7	7	23	3	1	2	1	3	1
24	8	8	24	3	1	1	2	2	2
25	9	9	25	3	2	1	1	2	2
26	:	:	26	3	2	1	2	2	1
27	;	;	27	3	1	2	2	1	2
28	<	<	28	3	2	2	1	1	2
29	=	=	29	3	2	2	2	1	1
30	>	>	30	2	1	2	1	2	3
31	?	?	31	2	1	2	3	2	1
32	@	@	32	2	3	2	1	2	1
33	A	A	33	1	1	1	3	2	3
34	B	B	34	1	3	1	1	2	3
35	C	C	35	1	3	1	3	2	1
36	D	D	36	1	1	2	3	1	3
37	E	E	37	1	3	2	1	1	3
38	F	F	38	1	3	2	3	1	1
39	G	G	39	2	1	1	3	1	3
40	H	H	40	2	3	1	1	1	3
41	I	I	41	2	3	1	3	1	1
42	J	J	42	1	1	2	1	3	3
43	K	K	43	1	1	2	3	3	1
44	L	L	44	1	3	2	1	3	1
45	M	M	45	1	1	3	1	2	3
46	N	N	46	1	1	3	3	2	1
47	O	O	47	1	3	3	1	2	1
48	P	P	48	3	1	3	1	2	1
49	Q	Q	49	2	1	1	3	3	1
50	R	R	50	2	3	1	1	3	1
51	S	S	51	2	1	3	1	1	3
52	T	T	52	2	1	3	3	1	1
53	U	U	53	2	1	3	1	3	1
54	V	V	54	3	1	1	1	2	3
55	W	W	55	3	1	1	3	2	1
56	X	X	56	3	3	1	1	2	1
57	Y	Y	57	3	1	2	1	1	3
58	Z	Z	58	3	1	2	3	1	1
59	[	[	59	3	3	2	1	1	1

VALUE	CODE A	CODE B	CODE C	BAR PATTERN B	S	B	S	B	S
60	\	\	60	3	1	4	1	1	1
61	]	]	61	2	2	1	4	1	1
62	^	^	62	4	3	1	1	1	1
63	_	_	63	1	1	1	2	2	4
64	NUL	`	64	1	1	1	4	2	2
65	SOH	a	65	1	2	1	1	2	4
66	STX	b	66	1	2	1	4	2	1
67	ETX	c	67	1	4	1	1	2	2
68	EOT	d	68	1	4	1	2	2	1
69	ENQ	e	69	1	1	2	2	1	4
70	ACK	f	70	1	1	2	4	1	2
71	BEL	g	71	1	2	2	1	1	4
72	BS	h	72	1	2	2	4	1	1
73	HT	i	73	1	4	2	1	1	2
74	LF	j	74	1	4	2	2	1	1
75	VT	k	75	2	4	1	2	1	1
76	FF	l	76	2	2	1	1	1	4
77	CR	m	77	4	1	3	1	1	1
78	SO	n	78	2	4	1	1	1	2
79	SI	o	79	1	3	4	1	1	1
80	DLE	p	80	1	1	1	2	4	2
81	DC1	q	81	1	2	1	1	4	2
82	DC2	r	82	1	2	1	2	4	1
83	DC3	s	83	1	1	4	2	1	2
84	DC4	t	84	1	2	4	1	1	2
85	NAK	u	85	1	2	4	2	1	1
86	SYN	v	86	4	1	1	2	1	2
87	ETB	w	87	4	2	1	1	1	2
88	CAN	x	88	4	2	1	2	1	1
89	EM	y	89	2	1	2	1	4	1
90	SUB	z	90	2	1	4	1	2	1
91	ESC	{	91	4	1	2	1	2	1
92	FS	|	92	1	1	4	1	4	3
93	GS	}	93	1	1	1	3	4	1
94	RS	~	94	1	3	1	1	4	1
95	US	DEL	95	1	1	4	1	1	3
96	FNC 3	FNC 3	96	1	1	4	3	1	1
97	FNC 2	FNC 2	97	4	1	1	1	1	3
98	SHIFT	SHIFT	98	4	1	1	3	1	1
99	CODE C	CODE C	99	1	1	3	1	4	1
100	CODE B	FNC 4	CODE B	1	1	4	1	3	1
101	FNC 4	CODE A	CODE A	3	1	1	1	4	1
102	FNC 1	FNC 1	FNC 1	4	1	1	1	3	1

			B	S	B	S	B	S
103	START (CODE A)		2	1	1	4	1	2
104	START (CODE B)		2	1	1	2	1	4
105	START (CODE C)		2	1	1	2	3	2

		B	S	B	S	B	S	B
	STOP	2	3	3	1	1	1	2

Table 1. The three Code 128 subcodes. This table provided courtesy of Automatic Identification Manufacturers, sole proprietor of the information herein.

sparse code, the dense code is called Code 128; in record code, the new codes are HP-41C and Tandycode (see Fig. 1).

Sparse Code

Sparse code encodes binary data using more bits than the identifying data alone requires. In addition to Code 128, 3 of 9, 2 of 5, Codabar, and UPC codes are examples of sparse codes. In each of these codes, the system that represents the data value is overdefined. The 3 of 9 code, for example, can represent a total of 43 characters using 9 bits of data. This means that there are a total of 512 different code combinations possible, of which only 43 are used. Thus the name sparse code—the code has more than enough data bits to identify the item; it also provides error-detecting and error-correcting capability. Thus the major advantage with sparse code is that it's more likely to produce an error-free read. But a significant disadvantage is that sparse code reduces data density, the amount of information you can fit in a finite space.

Record Code

The second encoding method is record code. Record codes have no additional binary bits for error-detection, but they do maximize data density. They leave error-detection to a single record-check algorithm. A record-check algorithm adds the data values in a bar code and checks it against an expected value for that code. If the two values differ, the record-check algorithm generates an error message.

The most common record code is Hewlett-Packard's HP-41C. Another record code will be available soon from Tandy called Tandycode. It takes advantage of the Model 100's built-in bar code wand interface and available software.

Record code's major disadvantage lies in error detection; because it's left to a record checksum algorithm, it's more susceptible to print or intrinsic errors, such as ink spread. Its major advantage is that record code can provide 1,500–2,000 bytes or more of data to a page. Sparse code is limited to fewer than 1,000 bytes of data per page.

The Key Box

Model III
48K RAM
Disk Basic
Editor/Assembler
Epson MX-80 with Graftrax

You have to compare the two codes to determine which best suits your needs. Tandycode will be the most common method for reading or writing data because of its high data density, but you should use an alternative when accuracy of the read is more important than code density. In such a case, Code 128 is a good alternative.

Code 128

Code 128 can encode the full 128-character ASCII set in one of the most compact sparse codes. Each code comprises three bars and three spaces with a unique start and stop code. Each code sequence contains 11 elements of a .09-inch minimum width. Code parity is defined by even numbers of bars and odd numbers of spaces (see Fig. 2). The pattern of 11 elements holds for all except the stop code, which closes out the code with an extra bar after the third space.

Code 128 has three subcodes (see Table 1) known as Codes A, B, and C. Code A contains all the standard alphanumeric keyboard characters plus control and special characters. Code B includes all upper- and lowercase alphanumeric characters plus special characters. Code C contains a set of two-digit characters from 00–99 decimal.

The last seven characters in Codes A and B and the last three characters in Code C are designated as special characters. They configure the bar code reader and its peripherals instead of being communicated to the user.

Tandycode Specifics

Tandycode consists of a full 256-code binary set or two-digit ASCII set (00–7F hexadecimal [hex]) with 80–FF hex representing European and other special-use characters. Tandycode is a modified version of North American Technology Inc.'s standard text format developed by Walter Banks and Carl Helmers. The standard, which appears in a report titled "Contemporary Applications of Optical Bar Code Technology" (North American Technology Inc., 174 Concord St., Peterborough, NH 03458) provides an in-depth look at individual codes and their applications.

Tandycode code uses both bars and spaces to represent significant data. Either a bar or a space can represent a binary logic 1. The bar or space will be twice the width of a binary logic zero (narrow bar or space). The minimum unit width for a logic zero is .012 inches because that's the minimum the Model 100 bar code reader can read. The expected nominal width is .017 inches.

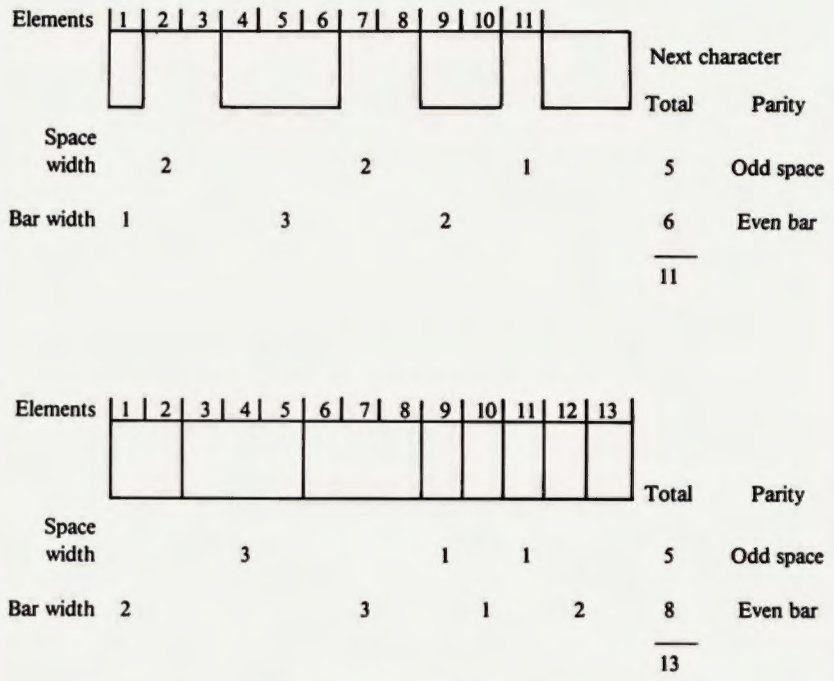

Figure 2. Code 128 structure.

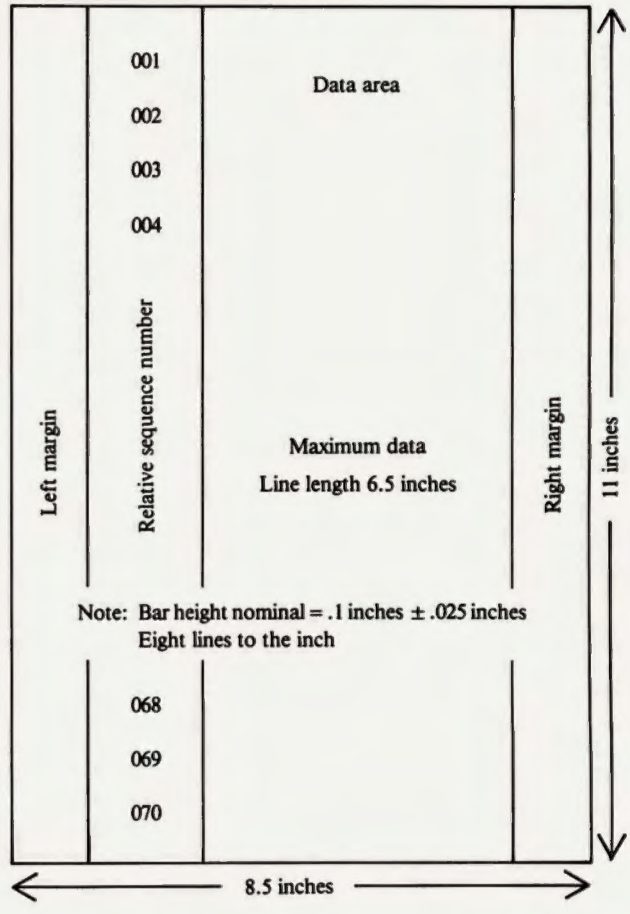

Figure 3. Tandycode page format. Maximum data. Line length 6.5 inches. Note: Bar height nominal = .1 inches ± .025 inches. Eight lines to the inch.

The tolerance for code widths is plus or minus 20 percent based on the formula: tolerance = unit width/5.

The bar or space height is .1 inches plus or minus .014 inches. Given an average of four logic 1's, the average code length is about .2 inches. Using the Tandycode page format shown in Fig. 3, you could have over 2,000 bytes per 8½- by 11-inch page.

Tandycode considers each line as a physical record, and requires that you include the attribute, relative sequence, and checksum bytes with the data (see Fig. 4). The attribute byte tells the system the type of file and other information as shown in Fig. 5.

The checksum algorithm comprises 2 checksum bytes. The first checksum is an 8-bit sum of the attribute byte, relative sequence number, checksum 2, and all the data bytes using end round carry. The code calculates the checksum from this total by using the formula:

checksum1 = 1 + remainder of ((N – 1)/255)

Note that this is equivalent to modulo 255 of (N – 1) plus 1 (for a more complete discussion of modulos, see "Check-Out UPCs," *80 Micro*, November 1983, p. 114).

The code forms checksum 2 by loading the checksum byte with the relative sequence number, then performing a ring shift left. Next, it exclusive ORs the data bytes to the checksum. The attribute byte concludes the process of shift and XORing data.

The code doesn't perform the ring shift following XORing the attribute byte to the checksum. It then adds checksum 2 to checksum 1. The relative sequence number is a value between 1 and 255, and represents the physical record number for the input file.

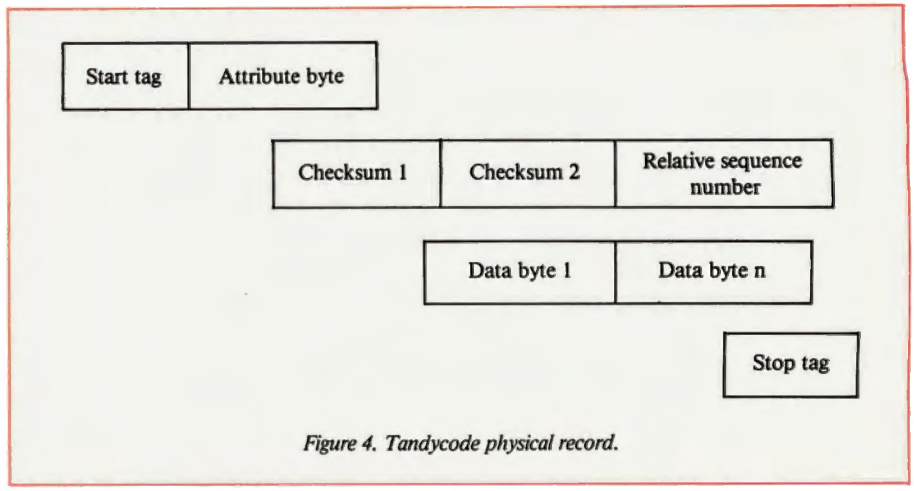

Figure 4. Tandycode physical record.

Bit Pattern

Bit	0		1	
	00	01	10	11
0 1	Machine-language program	Other file	Reserved	Basic program
2	Not last line		Last line	
3	Reserved			
4 5	Reset			
6 7				Set

Figure 5. Tandycode attribute byte.

Printing the Codes

A program that prints bar codes must effectively store data that represents the code's bars and spaces. Program Listing 1, Barprint (p. 52), prints two code formats: Code 128, where logic 1's print bars and logic zeros produce spaces, and Tandycode, where logic 1's produce wide bars or spaces and logic zeros generate narrow bars or spaces. Demo, in Program Listing 2 (p. 144), is a routine that tests Barprint.

Barprint has two entry points that set up the utility to print either Code 128 or Tandycode (see Table 2). You call these entry points from either Assembly language or Basic, and they pass a value of zero to define compressed print or not zero to define standard-width bar code.

When the program defines Code 128 and sends data, it returns a value that represents the number of characters not printed. This happens because sparse code must use shift characters to tell the system when a code is outside the standard ASCII 128 code set. Every time you use a shift character, the number of characters in the data buffer increases by one.

For example, if the data buffer contains 20 characters and you need three shift characters, the program prints a total of 23 characters. To prevent line length errors, Barprint prints the specified number of characters, then returns the number of characters not printed.

Type in and assemble Listing 1 to create Barprint/CMD. Then type in and save Demo. Initialize the system by running Barprint from DOS Ready. An introductory screen will appear followed by DOS Ready. Go into Basic and run Demo. Demo will now use Barprint to print lines of bar code by calling it from Basic (see Fig. 5 for samples).

In your own applications, you can use Barprint to print bar codes by calling entry points for either Assembly language or Basic (see Table 2). If you use Basic entry, each line of Basic code becomes a data string. The data string must have the line length concatenated to its front (X$ = CHR$(Length) + X$).

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Address		Purpose	Entry Value
Assembly	**Basic**		
F345	F33C	Tandycode setup	0 or not 0 Compressed/standard
F322	F319	Code 128 setup	0 or not 0 Compressed/standard
F4CD	F487	Code print entry	HL = Address of data buffer B = Length * Basic entry First Character = length Address of data buffer passed via USR( )
F49D		Initialization Assembly entry	A = SYSDF1/Bit length B = Length C = SYSDF2 D = SYSDF3 HL = Points to data buffer
	F45B	Initialization Basic entry	Start/Stop code setup SYSDF3/STCDLN/SPCDLN
	F470		Set SYSDF1/SYSDF2

Table 2. Barprint entry table.

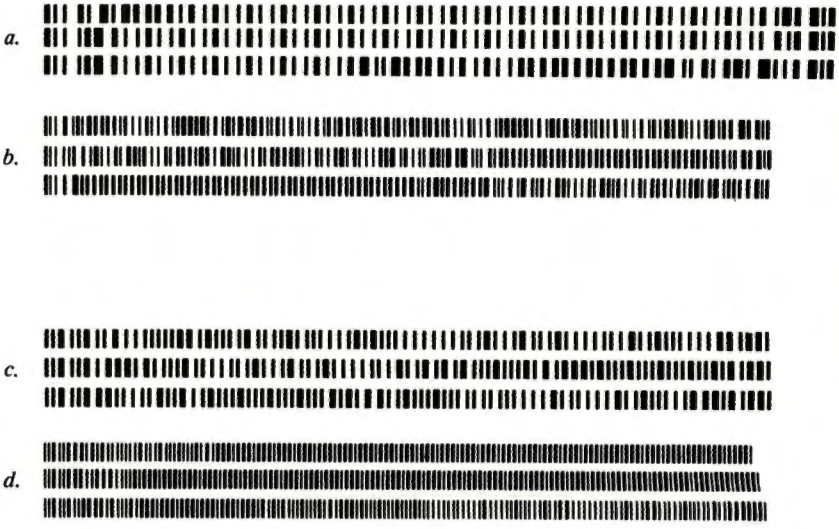

Figure 6. Barprint's sample bar code printout. (a.) Code 128 in standard format; (b.) Code 128 in compressed format; (c.) Tandycode in standard format; (d.) Tandycode in compressed format.

Much of Barprint's power is in its versatility. If you're interested in exploring bar codes further, I'll send you a disk or tape copy of the Barprint EDTASM source and object files plus a copy of the operating manual for $15 postage paid within the continental U.S. Unless you specify otherwise, I'll send a disk. ■

You can contact Davey S. Thornton at 8128 Brucar Court, Gaithersburg, MD 20877.

The Tandycode Difference

by Bradford N. Dixon

People have long recognized the potential of bar codes as a universal format for entering information into, or retrieving information from, a computer. Bar codes save typing time, reduce errors, and quickly transfer data. But a traditional problem with bar codes has been that the code takes up more space than the character it replaces—until now. Tandy has developed its own high-density bar code called Tandycode that offers all the advantages of earlier bar codes but in a significantly more compact format, one that stores 50–100 percent more code per page.

Radio Shack has been marketing a UPC, 3 of 9, and Plessey bar code package (reader wand and printing and reading software) for the Model 100 for over six months. Tandycode's introduction, along with its associated software, makes it possible for the Model 100 to accept text, data, and program listings printed in Tandycode format.

The application expected to garner the most attention is data-base management, in a system involving the Model 100 and Model 4. With a typical set-up, you'll be able to use your Model 100 to collect inventory data from labels printed in Tandycode and then transmit that information to the Model 4, where you can manipulate the data and formulate reports, graphs, and spreadsheets.

Program Listings in Bar Code Format

Bar-coded program listings could signify a new approach to applications software. Magnetic media are only reliable when handled carefully, but a printout of a program in Tandycode would be immune to problems with x-rays, magnetic fields, and rough handling. Consider the savings, too: You'd no longer have to buy costly disks or tapes to reproduce programs; you could simply use a photocopy machine. Even program upgrades could be mailed to program owners instead of having to pick them up at your Radio Shack Computer Center.

Unfortunately, Radio Shack has yet to decide on the best way to provide Tandycode products while maintaining control over their market—what would stop someone from making 60 copies of a bar code program for his local Model 100 user's group?

"There are many ways we could distribute programs and other material in bar code format," said Stewart Weinstock, Tandy's Model 100 line manager. "We're looking at the possibility of making them available to users in our Computer Centers, or in magazine form, or even as downloads from CompuServe." While Tandycode offers possibilities for convenience and ease-of-use, I can't imagine bringing a Model 100 to my local Radio Shack Computer Center to run the bar code wand across the latest offering from Fort Worth. There must be a better way.

A Model 4 Interface

David Frager, product line manager for the Model 4, said that his people were working on a direct Tandycode/Model 4 interface (rather than relying on the Model 100 to upload data). In the future, Model 4 owners can expect to see commercial hardware and software for reading and writing Tandycode with a Model 4, but no announcements are immediately forthcoming. For the time being, Tandycode use will be limited to Model 100 owners and Model III/4 owners who use Thornton's bar code system.

Bar code enthusiasts should watch to see if Radio Shack tries to make Tandycode a standard format for programming purposes. If Radio Shack plays its cards right, they might set the pace in microcomputer bar code applications. ■

See List of Advertisers on Page 176

Program Listing 1. Barprint.

```
00000
00010          ORG     0F300H
00020 ;************ LBAR  ROUTINE **********************
00030 ;  BASELINE CONFIGURATION   MARCH 1984
00040 ;        by   DAVEY S. THORNTON
00050 ;        COPYRIGHT        1984
00060 ;    THIS UTILITY IS DESIGNED TO PROVIDE A MEANS
00070 ;    FOR PRINTING BARCODES OF NUMERIOUS TYPES
00080 ;    THERE ARE TWO MAJOR ENTRY POINTS TO PROVIDE
00090 ;    ACCESS TO THE CODE 128 AND TANDYCODE ROUTINES
00100 ;
00110 ;    THE FOLLOWING DEFINITION WORDS ARE USED TO
00120 ;    CONFIGURE THE SYSTEM FOR PRINTING DESIRED
00130 ;    CODES
00140 ;
00150 ;****************************************
00160 ;SYSTEM DEFINITION WORDS
00170 ;     SYSDF1
00180 ;  07    PRINT DENSITY "DNSITY"
00190 ;  06    CHECK SUM SWITCH  "CKSMAG"
00200 ;  05    STOP SWITCH    "CKSTEN"
00210 ;  04    START SWITCH  "STPONF"
00220 ;  03    ********************
00230 ;  02    *     BIT          *
00240 ;  01    *    LENGTH        *
00250 ;  00    ********************
00260 ;     SYSDF2
00270 ;  ****************************************
00280 ;  * 07    CHECK SUM ALG    "1" USER DEF
00290 ;  * 06      BOTH "0" CODE 128  "1" STREAM DATA
00300 ;  *      BOTH "1" TANDYCODE     CHARACTER CONVERT
00310 ;  ****************************************
00320 ;  * 05  "1" USER DEF 1  "0"  USER DEF 2
00330 ;  * 04    BOTH "0" USER DEF 3
00340 ;  *      BOTH "1" TANDYCODE  CHECK SUM CAL
00350 ;  ****************************************
00360 ;  * 03    PRINT DRIVER "0" EPSON  "1" USER DEFINED
00370 ;  * 02     DATA CONVERT  "0" SPARCE CODE "1" RECORD FORMAT
00380 ;  ****************************************
00390 ;  * 01  CHECK CHARACTER COUNT ALG "1" USER DEFINED
00400 ;  * 00    BOTH "0" CODE 128  "1" RECORD FORMAT
00410 ;  *         BOTH "1" TANDYCODE CHARACTER CONVERT
00420 ;  ****************************************
00430 ;      SYSDF3
00440 ;  ****************************************
00450 ;  * 07
00460 ;  * 06  START CHARACTER LENGTH
00470 ;  * 05
00480 ;  * 04
00490 ;  ****************************************
00500 ;  * 03
00510 ;  * 02   STOP CHARACTER LENGTH
00520 ;  * 01
00530 ;  * 00
00540 ;  ****************************************
00550 CLSCRN  EQU     01C9H
00560 TSCR1E  EQU     3C0EH
00570 SCRN1   EQU     3D94H
00580 SCRN2   EQU     3DD4H
00590 SCRN3   EQU     3E10H
00600 SCRN4   EQU     3E50H
00610 CURADS  EQU     4020H
00620 USRVAL  EQU     0A7FH   ;CALL TO GET DATA FROM BASIC
00630 TOPRAM  EQU     4411H
00640 DOSEX   EQU     4020H
00650 INTDVD  EQU     4451H
00660 BSEXIT  EQU     0A9AH   ;EXIT TO BASIC
00670 CINT    EQU     0A7FH   ;CHANGE INTEGER
00680 CONINT  EQU     0ACFH   ;COMPARE INTEGER
00690 INTDIV  EQU     4451H   ;INTEGER DIVIDE
00700 FLGINT  EQU     0A9DH
00710 MULT    EQU     0BF2H   ;MULTIPLY INTEGER
00720 PRNCHR  EQU     003BH   ;PRINT CHARACTER
00730 PRINT   EQU     021BH   ;DISPLAY LINE
00740 ;INTIALIZE SYSTEM
00750 ;
00760 ;
00770 BEGIN   LD      HL,0F300H
00780         LD      (TOPRAM),HL
00790         CALL    HEADNG
00800         JP      DOSEX
00810 BSET28  CALL    USRVAL
00820         CALL    SET128
00830         JP      BSEXIT
00840 SET128  LD      A,L
00850         LD      (SYSDF1),A
00860         XOR     A
00870         LD      (SYSDF2),A
00880         LD      A,0BDH
00890         LD      (SYSDF3),A
00900         LD      A,(SYSDF1)
00910         LD      HL,686AH
00920         LD      (SPCHR),HL
00930         CALL    SYSSET  ;LOAD SYS DEF VALUES
00940         RET
00950 BSETAN  CALL    USRVAL
00960         CALL    SETAND
00970         JP      BSEXIT
00980 SETAND  LD      A,L
00990         LD      (SYSDF1),A
01000         LD      A,0F3H
01010         LD      (SYSDF2),A
01020         LD      A,43H
01030         LD      (SYSDF3),A
01040         CALL    SETCAL
01050         LD      A,(SYSDF1)
01060         CALL    SYSSET  ;LOAD SYS DEF VALUES
01070         LD      HL,0680H
01080         LD      (SPCHR),HL
01090         RET
01100 REPTLN  DEFB    2       ;PRINT BAR LENGTH
01110 CKCNTM  DEFW    0000H   ;MSB (CHECK CHAR COUNT)
01120 CKCNTL  DEFW    0000H   ;LSB (CHECK CHAR COUNT)
01130 POSIT   DEFB    0       ; POSITION IN THE OUPUT STRING
01140 MSG1    DEFM    'ERROR IN INPUT STRING'
01150         DEFB    0DH
01160 DNSITY  DEFB    0       ;BARCODE PRINT DENSITY
01170 BITLNG  DEFB    0BH     ;BIT STRING LENGTH
01180 OVRRUN  DEFB    0       ;OUTPUT OVERRUN
01190 DOTLNG  DEFW    0000H   ;DOT LENGTH
01200 LENGTH  DEFB    20H     ;STRING LENGTH
01210 ;
01220 ;  BIT DATA TABLE FOR CODE 128
01230 ;
01240 TABLE   DEFW    0D980H
01250         DEFW    0CD80H
01260         DEFW    0CCC0H
01270         DEFW    9300H
01280         DEFW    9180H
01290         DEFW    8980H
01300         DEFW    9900H
01310         DEFW    9880H
01320         DEFW    8C80H
01330         DEFW    0C900H
01340         DEFW    0C880H
01350         DEFW    0C480H
01360         DEFW    0B380H
01370         DEFW    9D80H
01380         DEFW    99C0H
01390         DEFW    0B980H
01400         DEFW    9D80H
01410         DEFW    9CC0H
01420         DEFW    0CE40H
01430         DEFW    0CB80H
01440         DEFW    0C9C0H
01450         DEFW    0DC80H
01460         DEFW    0CE80H
01470         DEFW    0EDC0H
01480         DEFW    0E980H
```

Listing 1 continued

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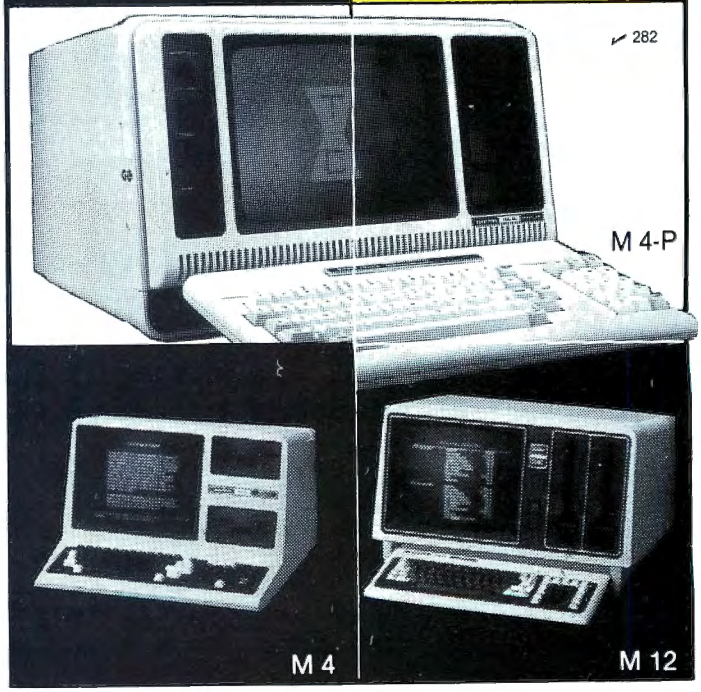

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01490          DEFW    0E580H
01500          DEFW    0E4C0H
01510          DEFW    0EC80H
01520          DEFW    0E680H
01530          DEFW    0E640H
01540          DEFW    0DB00H
01550          DEFW    0D8C0H
01560          DEFW    0C3C0H
01570          DEFW    0A300H
01580          DEFW    8B00H
01590          DEFW    88C0H
01600          DEFW    0B100H
01610          DEFW    8D00H
01620          DEFW    8C40H
01630          DEFW    0D100H
01640          DEFW    0C500H
01650          DEFW    0C440H
01660          DEFW    0B700H
01670          DEFW    0B1C0H
01680          DEFW    8DC0H
01690          DEFW    0BB00H
01700          DEFW    0B8C0H
01710          DEFW    8EC0H
01720          DEFW    0EEC0H
01730          DEFW    0D1C0H
01740          DEFW    0C5C0H
01750          DEFW    0DD00H
01760          DEFW    0DC40H
01770          DEFW    0DDC0H
01780          DEFW    0EB00H
01790          DEFW    0E8C0H
01800          DEFW    0E2C0H
01810          DEFW    0ED00H
01820          DEFW    0EC40H
01830          DEFW    0E340H
01840          DEFW    0EF40H
01850          DEFW    0C840H
01860          DEFW    0F140H
01870          DEFW    0A600H
01880          DEFW    0A180H
01890          DEFW    9600H
01900          DEFW    90C0H
01910          DEFW    8580H
01920          DEFW    84C0H
01930          DEFW    0B200H
01940          DEFW    0B080H
01950          DEFW    9A00H
01960          DEFW    9840H
01970          DEFW    8640H
01980          DEFW    8680H
01990          DEFW    0C240H
02000          DEFW    0CA00H
02010          DEFW    0F740H
02020          DEFW    0C280H
02030          DEFW    8F40H
02040          DEFW    0A780H
02050          DEFW    9780H
02060          DEFW    93C0H
02070          DEFW    0BC80H
02080          DEFW    9E80H
02090          DEFW    9E40H
02100          DEFW    0F480H
02110          DEFW    0F280H
02120          DEFW    0F240H
02130          DEFW    0DBC0H
02140          DEFW    0DEC0H
02150          DEFW    0F6C0H
02160          DEFW    0AF00H
02170          DEFW    0A3C0H
02180          DEFW    8BC0H
02190          DEFW    0BD00H
02200          DEFW    0BC40H
02210          DEFW    0F500H
02220          DEFW    0F440H
02230          DEFW    0BBC0H
02240          DEFW    0BDC0H
02250          DEFW    0EBC0H
02260          DEFW    0F5C0H
02270          DEFW    0D040H
02280          DEFW    0D200H
02290          DEFW    0D9C0H
02300          DEFW    0C758H
02310 ;BASIC ENTRY POINT FOR START/STOP CODE SETUP
02320 ;H REG =START CODE LENGTH MS4BITS AND
02330 ;L REG= STOP CODE LENGTH LS4BITS
02340 SETSS    CALL    USRVAL
02350          LD      A,H
02360          LD      (SYSDF3),A
02370          AND     0FH
02380          LD      (STCDLN),A
02390          LD      A,L
02400          AND     0FH
02410          LD      (SPCDLN),A
02420          JP      0A9AH
02430 ;
02440 ; BASIC ENTRY POINT
02450 ; MOST SIGNIFICANT 4 BITS = DENSITY & CHECK SUM,
02460 ;                           STOP & START SWITCH BITS
02470 ;              NEXT  4 BITS = BIT LENGTH
02480 INTBSC   CALL    USRVAL
02490          LD      A,H     ;H=SYSDF1
02500          LD      (SYSDF1),A      ;LOAD SYS DEF ONE
02510          LD      A,L     ;MOVE SYSDF2 TO A REG
02520          LD      (SYSDF2),A      ;SAVE TO MEMORY
02530          CALL    SYSSET  ;SET SYSTEM VALUES
02540 NOCHNG   LD      A,(MXCRSL)
02550          LD      (LENGTH),A
02560          JP      0A9AH   ;END PRESET ROUTINE
02570 ;
02580 ;BASIC ENTRY FOR MAIN ROUTINE
02590 ;ENTER WITH HL REG POINTING TO DATA STRING
02600 ;EXIT ROUTINE HL WILL HAVE NUMBER OFCHARACTERS
02610 ;WHICH WERE NOT PRINTED IN THE HL REG
02620 BASICE   CALL    USRVAL
02630          LD      B,(HL)  ;GET LENGTH OF STRIN
02640          INC     HL
02650          LD      E,(HL)
02660          INC     HL
02670          LD      D,(HL)
02680          PUSH    DE
02690          POP     HL
02700          CALL    BASCEN
02710          LD      H,0
02720          LD      A,(OVRRUN)      ;UNPRINTED CODE
02730          LD      L,A
02740          JP      BSEXIT
02750 ;ASSEMBLY LANGUAGE ENTRY POINT
02760 ;
02770 ; ENTER A REG = SYSDF1/BIT LENGTH
02780 ;       B REG = LENGTH
02790 ;       C REG = SYSDF2
02800 ;       D REG = SYSDF3
02810 ;      HL REG = DATA STRING ADDRESS
02820 ;
02830 INTIAL   LD      (SYSDF1),A      ;SAVE SYSTEM DEF ONE
02840          LD      (DATABF),HL     ;SAVE DATA BUFFER ADDR
02850          CALL    SYSSET  ;SET SYSDF1 VALUES
02860          LD      A,B
02870          LD      (LENGTH),A      ;SAVE LENGTH
02880          LD      A,D
02890          LD      (SYSDF3),A      ;SAVE SYSTEM DEF THREE
02900          AND     0F0H
02910          RR      A
02920          RR      A
02930          RR      A
02940          RR      A
02950          LD      (STCDLN),A      ;SAVE START CODE LENGTH
02960          LD      A,D
02970          AND     0FH
02980          LD      (SPCDLN),A      ;SAVE STOP CODE LENGTH
02990 ;   SET ERROR CODE VALUE
03000          LD      A,1
03010          LD      (ERRCOD),A
03020          LD      A,C
03030          LD      (SYSDF2),A      ;SAVE SYSTEM DEF TWO
03040          CALL    SETCAL  ;SET CALL SUBS
03050 ;   ASSEMBLY LANGUAGE ENTRY AFTER INTIALIZATION
03060 ;       B = LENGTH
03070 ;       HL = DATA BUFFER ADDR
03080 ;
03090 ; MAIN PROGRAM ENTRY
03100 BASCEN   LD      A,B     ;SAVE LENGTH
03110          LD      (LENGTH),A
03120          LD      (DATABF),HL
03130 CKLNGH   LD      A,(DNSITY)      ;GET PRINT DENSITY
03140          CP      0
03150          JR      Z,COMPRS        ;COMPRESSED CODE
03160          CP      1
03170          JR      Z,STNDEN        ;STANDARD CODE
03180          CALL    ERROR   ;INVALID CODE EXIT
03190 COMPRS   LD      A,(LENGTH)
03200          CP      40H     ;CHECK LENGTH <= 64
03210          JR      Z,CONTU1        ;LENGTH = 64
03220          JR      C,CONTU1        ;LENGTH < 64
03230          LD      A,40H
03240          JR      CONTU1
03250 STNDEN   LD      A,(LENGTH)
03260          CP      20H     ;CHECK LENGTH<32
03270          JR      Z,CONTU1        ;LENGTH = 32
03280          JR      C,CONTU1        ;LENGTH < 32
03290          LD      A,20H   ;LENGTH > 32 SET EQUAL TO 32
03300          LD      (LENGTH),A
03310 CONTU1   LD      IX,DOTBUF       ;POINT TO PRINT BUFFER
03320 ;
03330 ;INTIALIZE OVER RUN COUNTER
03340 ;
03350          LD      IY,OVRRUN       ;POINT TO BUFFER
03360          LD      A,0
03370          LD      (IY),A
03380 ;
03390 ;CLEAR DOT BUFFER  = ZERO
03400 ;
03410          LD      B,4     ;OUTER LOOP COUNT
03420 CLRBUF   PUSH    BC      ;SAVE OUTER LOOP COUNT
03430          LD      A,0     ;CLEAR A REG
03440          LD      B,0     ;INNER LOOP COUNT = 256
03450          LD      HL,DOTBUF       ;POINT DOT BUFFER
03460 CLRBF1   LD      (HL),A  ;LOOP TILL INNER = 0
03470          INC     HL
03480          DJNZ    CLRBF1
03490          POP     BC
03500          DJNZ    CLRBUF  ;CHECK OUTER LOOP = 0
03510 ;
03520 ;SET UP CHECK DIGIT REGISTER
03530 ;
03540          LD      A,0     ;CLEAR ACCUMULATOR
03550          LD      HL,0    ;CLEAR HL REG
03560          LD      (ONSCNT),A      ;CLEAR ONES COUNT
03570          LD      (POSIT),A       ;CLEAR COUNT
03580          LD      (CKCNTM),HL     ;CLEAR COUNT BUF
03590          LD      (CKCNTL),HL
03600 ;
03610 ;SET LENGTH OF CHARACTERS
03620 ;
03630          LD      A,(LENGTH)
03640          LD      B,A
03650 ;
03660 ;SET DATA CONVERSION FORM
03670 ;
03680          LD      A,(DTACOV)
03690          CP      0
03700          JR      Z,SPRCOD
03710          LD      A,255
03720          LD      (SPACE),A
03730          JR      ENCOST
```

Listing 1 continued on p. 138

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Random Thoughts

Models I, III, and 4 Basic all provide a Random command, but since computers are deterministic, how valid are the numbers they produce? Robert P. Sullivan considers this question and describes how you can test the quality of your random numbers.

When you use the Basic RND command in one of your programs, you expect it to generate random numbers. But how can a computer that does nothing but process a series of finite instructions—instructions that have only one possible outcome—generate truly random numbers?

In this article, I'll look at how random number generators work and the problems involved in creating them. In addition, I'll discuss some methods used to generate random numbers, each of which exhibits specific characteristics; I'll also explain some of the tests available to check the reliability of a generator program. Any prospective program must pass as many of these tests as possible.

The RND and Random Commands

The Models I, III, and 4 use two routines, RND and Random, to generate random numbers. The RND function produces the same sequence of random numbers each time you use it, although the sequence may be so large that you won't realize the numbers are repeating.

You use the Random command in conjunction with RND. Including Random at the beginning of a Basic program changes the initial value the RND function uses to generate a series of random numbers and therefore consistently changes the set of numbers produced.

In both cases, however, the output, called pseudorandom numbers, only approximates randomness. To illustrate this idea, I'll examine the RND command.

Random Number Generation in Theory

When Basic executes the instruction Y=RND(0), you expect all decimal values between zero and 1 to be equally likely results, and the number returned to be impossible to predict. But while throwing dice generates truly random numbers, a computer, because it does just what it's told, generates only pseudorandom numbers.

Random number generation is not especially important in game programs, but mathematical simulations and modeling programs must approach true randomness very closely.

These programs depend heavily on your random number generator's ability to produce numbers as randomly as possible. This, in turn, determines the quality, or goodness, of a random-number generator.

I've used the RND routine many times, and my results are almost always acceptable. When they're unacceptable, however, you may question the validity of the random number generator. Without the best possible random number generator, the results of a simulation are always subject to question.

Generating random numbers is a stochastic process, that is, it requires that the numbers generated fall within a finite range, that all numbers within that range be equally likely to appear, and that the number that comes up be unpredictable. Rolling a pair of dice is an example of a stochastic process.

How Random Is the Generator?

Computers are deterministic; they do only what you program them to do, so they can't generate truly random numbers. The instruction Y=RND(0) passes control from Basic to a ROM-based machine-language generator that performs a carefully defined sequence of instructions.

These instructions operate on a starting number, or seed number, and they return the result to the Basic program as the variable Y.

Every time you turn on the computer, it supplies the ROM subroutine with a seed number. Most generators remember the last number generated and use it as the seed for the next execution.

If you know the seed number in a program, you can predict the numbers that the program generates. Therefore, the numbers aren't truly random. The logic in the generator

illustration by Roger Leyonmark

is unchanging, and always produces a specific series of numbers for a given seed number.

Another reason that your computer can't generate truly random numbers involves its built-in precision. All numbers within a range must be equally possible. If your computer is accurate to six digits, it can't generate numbers larger than six digits long. The number 99.33333 is between 1 and 100, for example, but is not a possible result.

When you type the Basic instruction Y=RND(0), the computer generates pseudorandom numbers that are close to true randomness. The challenge to designing such a generator is to produce output so nearly random that for all practical purposes it is random.

A generator that produces only even numbers or numbers consistently divisible by a constant is immediately suspect, since not all numbers are possible results.

A generator that periodically generates several identical numbers in a row is also unacceptable, as are numbers that alternately rise and fall, like the values of the trigonometric sine function.

A more obscure problem might be a generator that produces quality random numbers, then starts over, producing the same series again. How many numbers a routine generates before it starts to repeat its numbers is known as the period of a generator.

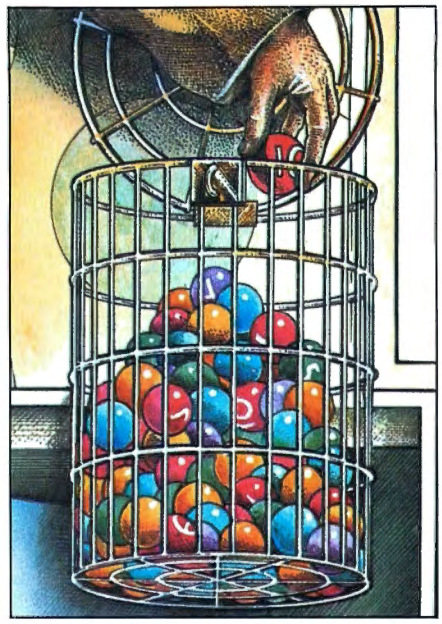
All generators exhibit a period, and much design effort goes toward making the period as long as possible. Generators for business simulation programs require a high level of confidence, and tests of tens of thousands of trials are common. Reliable generators in such cases have periods in excess of several million numbers.

When designing random number generators, you can apply many mathematical tests for undesirable characteristics. Before looking at these tests, however, I'll discuss how to generate random numbers.

Writing a Generator Program

Random number generators fall into three broad categories: additive, congruential, and shift registers. Of these, routines using shift registers are the most reliable.

A fourth, less reliable, method of generating random numbers is the mid-square generator. This method squares a seed number, producing a number larger than required. To generate a six-digit number, for example, the routine squares a six-digit number for a 12-digit



result. It then pulls the middle six digits of the product and returns them as output.

It saves the output as the seed for the next execution. You can easily write this type of generator in Basic, using the STRING$, MID$, and VAL functions. Although the results appear to be random, they do not hold up under mathematical testing, and so aren't useful for strict simulations requirements.

Additive Generators

An additive generator selects two numbers and adds them together. If the result falls within the range of acceptable output, zero to 128, for example, the program uses this number as the seed. Otherwise, the generator divides the result by 128 and uses the remainder as output.

This technique uses modulo arithmetic, which says that to express a number as a modulo, divide the number by the range and use the remainder. Here the modulo is 128.

The routine divides a number by the modulo until it finds a remainder between zero and 128, conforming to the requirement that the number fall within a finite range. If the additive number exceeds 127, the routine divides by 128 again and uses the remainder.

This type of generator is easy to program and produces what appears to be random numbers within a range. Program Listing 1 demonstrates the additive generator and reveals its flaw.

The program checks for a repeat of the starting seed numbers that signal the end of its period. Once the program starts over again, it's useless as a random number generator. Seed numbers such as 4 and 8 have a very short period, limiting the program's utility.

A more general approach overcomes this problem. By starting with a table of numbers rather than just two numbers, you can substantially lengthen the period. By using two successive table numbers to generate random number output and replacing one of the entries in the table after each execution, the routine can repeatedly cycle through the table for seed numbers, creating a longer period.

The determination of periods for random number generators is buried deep in statistical theory. The length of the period depends on the computer's word size—the number of bits in your computer.

On a mainframe computer with a 32- or 36-bit word size, a table of 16 numbers has a period of millions of executions. Eight- or 16-bit computers require slightly longer tables for an equivalent period.

The additive generator's advantage is that it's fast. It requires only add functions, while other generators require multiplication. Additive generators are so fast that their large memory requirements for tables are often of secondary importance.

Congruential Generators

These generators are also known as linear transformation algorithms. If you attach an index subscript to the output from a congruential generator to show the output order, the generator will always conform to the following equation:

$$x = a * x + b$$

The next number is the product of a chosen factor times the current number plus a constant. The period of congruential generators depends on the numbers chosen for factors a and b. Execution is slower than in additive generators because the generator uses multiplication.

Poorly chosen factors can seriously affect the quality of generator output, but relatively small memory requirements and a longer period make this method suitable for many applications.

Program Listing 2 is an example of a congruential generator. It uses the Basic

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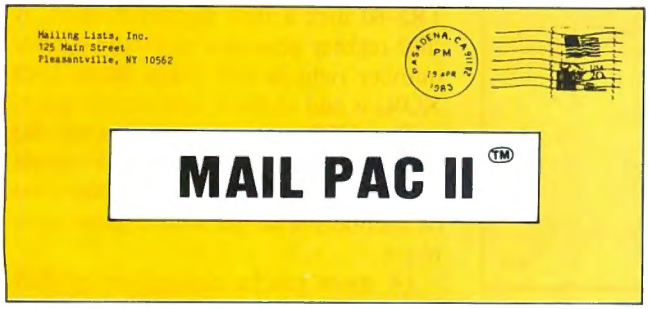

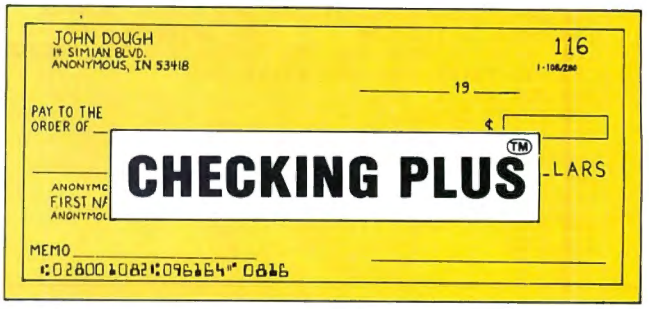

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Program Listing 1. Additive random number generator.

```
10 CLS: PRINT TAB(10)"Simple random number test":PRINT
20 PRINT:INPUT"Enter two starting numbers ";I1,I2
30 IF I1<1ORI2<1 OR I1>255ORI2>255 PRINT"OUT OF RANGE":GOTO 20
40 N=0: J1=I1: J2=I2: REM SET COUNTER, SAVE STARTING PAIR
50 I3=I1+I2
60 IF I3>255 THEN MO=I3-INT(I3/256)*256:I3=MO: REM MODULO ARITH
70 PRINT I3;
80 N=N+1
90 I1=I2: I2=I3
100 IF I1=J1 AND I2=J2 THEN GOTO 120
110 GOTO 50
120 PRINT:PRINT "Using ";J1;" and ";J2
130 PRINT "Generated ";N;" numbers."
140 INPUT "Again";Q$
150 IF LEFT$(Q$,1)="Y" OR LEFT$(Q$,1)="y" THEN CLS:GOTO 20
160 PRINT:PRINT"/END.":END
```

End

Program Listing 2. Congruential random number generator.

```
100 CLEAR 300:CLS
110 INPUT"Enter number of trials";N
120 A$=RIGHT$(TIME$,2):REM GET A SEED NUMBER
130 S=VAL(A$)[2:REM        IN INTEGER FORM
140 IF S>255 THEN S=S-INT(S/256)*256:REM MODULO ARITH
150 T1$=TIME$:REM SAVE START TIME
160 FOR I=1 TO N
170 PRINT INT(S);
180 S=3*S+13:REM THE GENERATOR
190 IF S>255 THEN S=S-INT(S/256)*256
200 NEXT I
210 PRINT:PRINT"START ";T1$
220 PRINT"  END ";TIME$"
230 END
```

End

Program Listing 3. Shift register random number generator.

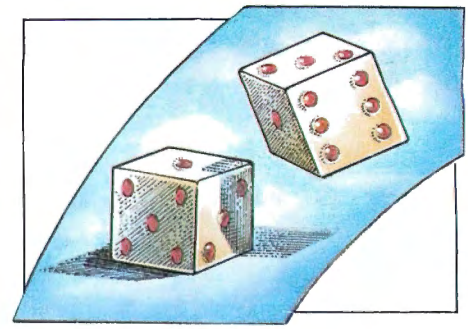
```
100 CLS:CLEAR 500:DEFINT I-N
110 INPUT"Enter total number for test ";N
120 DIM A(10,10)
130 FOR M=1 TO N
140 GOSUB 900: REM <COMPUTER BUSY> FLAG ON SCREEN
150 I=RND(10):J=RND(10):A(I,J)=A(I,J)+1:REM COUNTER
160 NEXT M
170 EV = N/100:REM CALCULATE EXPECTED VALUE
180 POKE 15422,32:REM ERASE BUSY SIGNAL IF THERE
190 FOR I=1 TO 10
200 FOR J=1 TO 10: PRINT A(I,J);
210 CH=CH+(A(I,J)-EV)[2/EV:REM CHI SQUARE CALCULATION
220 NEXT J: PRINT: NEXT I
230 PRINT:PRINT"Chi square = ";CH
240 PRINT"Number of trials = ";N
250 PRINT"Expected value is  ";EV
260 END
900 IF PEEK(15422)=32 THEN POKE 15422,63 ELSE POKE 15422,32
910 RETURN
```

End

Program Listing 4. Serial test's chi square function program.

```
100 CLS:CLEAR 500:DEFINT I-N: RANDOM
110 INPUT"How many trials";N
120 DIM K(N)
130 FOR I=1 TO N
140 J=RND(10)
150 K(J)=K(J)+1: REM COUNT OCCURANCES
160 IF I AND 2 THEN PRINT@62,"*" ELSE PRINT@62," "
161 REM DISPLAY A <COMPUTER BUSY> SIGNAL ON SCREEN
170 NEXT I
180 EV=N/10:REM CALCULATE EXPECTED COUNT PER CELL
190 CH=0
200 FOR I=1 TO 10
210 CH=CH+(K(I)-EV)[2/EV:REM CHI SQUARE CALCULATION
220 NEXT I:PRINT@62," ":REM ERASE BUSY SIGNAL IF THERE
```

Listing 4 continued



TIME$ command to supply a seed number and to measure the time required for number generation. These are helpful techniques for testing. This same generator programmed in machine language is fast and occupies little memory.

Shift Register Generators

The Basic ROM generator in your TRS-80 uses a shift register routine. A shift register generator shifts the current number right or left many times, then XORs it and shifts it right or left again.

The XOR process repeats until the generator outputs a number. Program Listing 3 demonstrates the generation of numbers with the shift register technique.

(A more precise description of shift register routines involves advanced linear algebra techniques that are beyond the scope of this article.)

Using a shift register in conjunction with a congruential generator gives the highest quality random numbers. In this type of routine, the shift register generator supplies a seed to the congruential generator.

Testing the Generator

Many mathematical tests are available to test random number generators. I'll limit my discussion here to the most common tests.

To measure the quality of a generator, you should subject it to as many tests as possible, and make the final reliability decision after it passes all tests. Three of the most common tests are below.

The Serial Test

Your generator must select each number by chance. The serial test checks the degree of randomness between successive numbers to make sure that each number is unrelated to the ones previously generated. Use it to test successive pairs of generator output.

The serial test program defines and sequentially numbers an array relating successive pairs of outputs. For a range of 100, for example, it numbers 10 rows

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Listing 4 continued

```
230 FOR K=1 TO 10:PRINT K(K);:NEXT K:PRINT
240 PRINT"EXPECTED VALUE = ";EV
250 PRINT TAB(7)"Chi square = ";CH
260 INPUT "Again";Q$
270 IF LEFT$(Q$,1)="Y" OR LEFT$(Q$,1)="y" THEN GOTO 100
280 PRINT:PRINT"/END":END
```

End

Program Listing 5. Frequency test using the chi square.

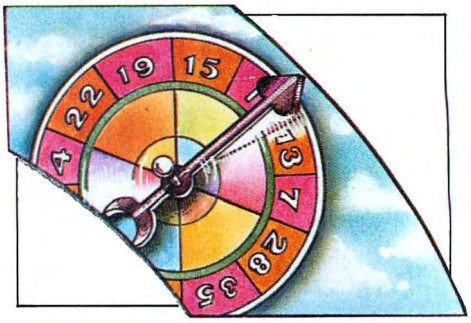
```
10 CLS
20 INPUT"Enter value for N ";N
30 PRINT"Program accomodates runs of lengths 1 through 10"
40 PRINT"and 'all over 10'."
50 FOR I=1 TO 1000:NEXT
60 DIM T(11),R(11)
70 I=0
80 I=I+1
90 IF I>10 THEN 260
100 PRINT@954,"Factor";
110 ON I GOTO 180,200,220
120 J=I+3
130 FOR K=(J-1) TO 1 STEP -1
140 J=J*K
150 NEXT K
160 PRINT@954,"      "
170 GOTO 240
180 T(1)=(5*N+1)/12
190 GOTO 80
200 T(2)=(11*N-14)/60
210 GOTO 80
220 T(3)=(19*N-47)/360
230 GOTO 80
240 T(I)=(2*(I*I+3*K+1)*N-(I*I*I+3*I*I-I+4))/J
250 GOTO 80
260 S=0
270 FOR K=1 TO 10
280 S=S+T(K)
290 NEXT K
300 T(11)=(2*N-1)/3-S
310 K=1
320 L=1
330 R1=0
340 FOR I=1 TO N
345 IF PEEK(16314)=32 THEN POKE 16314,63 ELSE POKE 16314,32
350 X=RND(2)
360 ON K GOTO 370,460
370 IF X>L THEN 410
380 R1=R1+1
390 L=X
400 GOTO 520
410 IF R1>11 THEN R1=11
420 R(R1)=R(R1)+1
430 R1=1
440 K=2
450 GOTO 390
460 IF X>=L THEN 380
470 IF R1>11 THEN R1=11
480 R(R1)=R(R1)+1
490 R1=1
500 K=1
510 GOTO 390
520 NEXT I
530 PRINT"   EXPERIMENTAL    THEORETICAL"
540 FOR I=1 TO 11
550 PRINT "T ";T(I),"    R ";R(I)
560 NEXT I
570 END
```

End

Program Listing 6. Number-of-runs test program.

```
100 REM SHIFT REGISTER RND(0) GEN.
105 CLS:A$="#.####"
110 INPUT"HOW MANY NUMBERS";N
120 INPUT"WHAT FOR A SEED ";S
130 PRINT USING A$;S/32768;
131 PRINT "  ";
140 FOR I=1 TO N-1
150 GOSUB 500
160 PRINT USING A$;S/32768;
```

Listing 6 continued



and 10 columns from zero to nine. It then puts the output from the generator into one of the 100 cells according to its value.

Numbers between zero and .099999 equate to zero, between .100000 and .199999 equate to one, and so on. The program tallies the number of outputs for each array cell and compares program results to the expected results.

Theoretically, after a large number (N) of tallies, N/100 tallies should be in each cell, and no patterns should appear in the final array.

The main diagonals in the array grid should not have tallies higher than the corners, the left side should have as many as the right, no column should be more or less than another, and so on.

The Serial Test's Chi Square Function

The statistical test that evaluates test results is the chi square, or goodness-of-fit test. It tests the results of experimental data against theoretical expectations.

The test squares and averages the successive differences between what you expect in theory and your actual results. The result is a chi square value. Compare this value to the appropriate value in a chi square table to determine the validity of the test.

This test measures how certain you can be that the numbers produced are truly random. This is known as a level of confidence, which usually yields a 90 percent, 95 percent, or in some cases 99 percent certainty of correct results.

When testing a random number generator, experimental results are not often precisely what you predict. In the serial test I expect N/100 counts per cell. The chi square test indicates how much variation from what I expect is due to chance, and how far off from the expected value the cells can be before the generator performs unsatisfactorily.

If the chi square statistic, as calculated from the experimental and expected data, is less than some value found in a chi square table (available in statistical texts), then the experimental data is reasonably consistent with the theoreti-

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9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
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13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
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18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
97	RENTPRCH	Purchase price for rental property
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Listing 6 continued

```
161 PRINT "  ";
170 NEXT I
200 END
500 S1=S*4:REM LEFT SHIFT TWO
510 IF S1>32767 S1=S1-INT(S1/32768)*32768:REM MOD 32768
520 S2=(S AND NOT S1) OR (S1 AND NOT S):REM EXCLUSIVE OR
530 REM IF S2<0 THEN S2=-1*S2
540 IF S2>32768 S2=S2-INT(S2/32768)*32768:REM MOD 32768
550 S1=S2*2:REM LEFT SHIFT ONE
560 IF S1>32768 S1=S1-INT(S1/32768)=32768:REM MOD 32768
570 S3=(S1 AND NOT S2) OR (S2 AND NOT S1):REM EXCLUSIVE OR
580 REM IF S3<0 THEN S3=-1*S3
590 IF S3>32768 S3=S3-INT(S3/32768)*32768:REM MOD 32768
600 S=INT(S3/2):REM RIGHT SHIFT ONE
610 RETURN
```

End

cal data. You can then say with the assigned level of confidence that the generator is acceptable.

If the chi square statistic is larger than the table value, the results are inconsistent with the theoretical data. This doesn't prove that the expected results are wrong, only that the results are inconsistent. You must then conduct more tests or change your theoretical data.

While the chi square test is powerful, it has certain restrictions. The number of trials must be large enough to generate a minimum expected result of five counts per cell. This often makes the number of trials in an experiment high.

When the experiment is complete and the test program has collected the data and performed its calculations, you can compare the calculated value to the table entry at the desired confidence level.

I define the test for this generator so that I expect N/100 counts per cell. The random number generator provides the experimental data. The chi square value shows how well it meets the test.

Program Listing 4 is an example serial test program that calculates the chi square value automatically. I set the value of N (number of trials) to 5,000.

This Basic program takes about 10 minutes to run on the Models III and 4. The large number of trials ensures meeting the limiting requirement on counts per cell. Theoretically, the program should generate 50 counts per cell.

The Frequency Test

In a frequency test, you might, for example, dimension an array at 10, translate the results into zero to nine range intervals, tally each of N random numbers, then tally the generator results into their corresponding cells.

The expected tally in each cell in this example is N/10. The frequency test in Program Listing 5 uses a chi square test to evaluate test results. Comparing the chi square value (experimental data) and the table value indicate how well the generator performs.

Number-of-Runs Test

The number-of-runs test is more complicated. It checks for results that generate too many numbers that successively increase or decrease before changing direction.

The test examines a sample of successive outputs, tallying the number of increasing and decreasing runs and cate-

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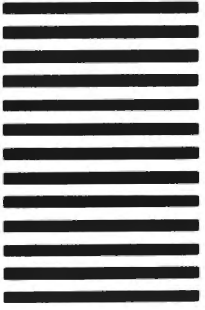

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gorizing them by length. It then compares the occurrences of specific increasing and decreasing run lengths against expected data using the chi square test.

The formulas to determine how many runs of various lengths to expect (the theoretical data) are available in advanced statistical texts. Program Listing 6 shows an example of a number-of-runs test.

Other Tests of Randomness

Many other tests are available to test random number generators. A gap test tests for the number of "non-d" digits occurring between successive occurrences of some digit, d.

For example, if the first number generated is 50, the gap test looks at the number of trials that occur between the following occurrences of 50. You then use the chi square test to determine the relationship of expected and actual results.

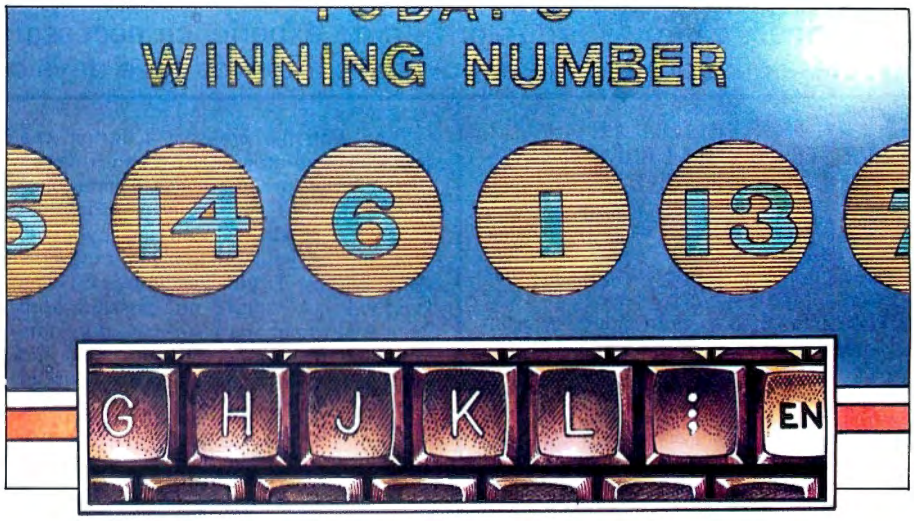
The poker test applies probability calculations for expected values and tests for the counts of one pair, two pair, three of a kind, and other poker hands in hundreds of thousands of groups of five random numbers. Other probability tests generate expected values for testing against generator output.

The random number generators in ROM in most microcomputers are thoroughly tested and can be used with a high degree of confidence. The temptation to substitute some new generator, especially in simulations, should include as a minimum the considerations I have outlined here.

For simulations run in business, a generator must approach true randomness very closely and exhibit a long period. Using a generator of unknown properties invites disaster. ■

For more information on random number generation, see Introduction to Mathematical Statistics, *by Paul G. Hoel; John Wiley and Sons, New York, NY, 1963.*

Contact Robert P. Sullivan at RD #3, Head O'Meadow Road, Newtown, CT 06470.



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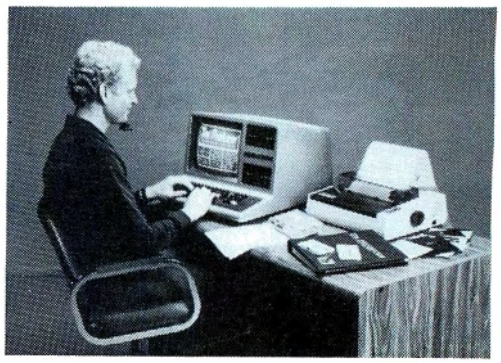

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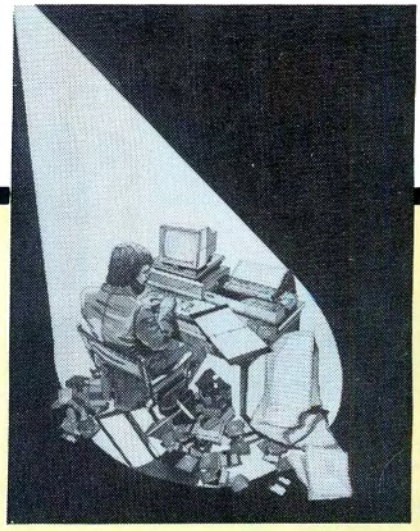

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A. Copella, Northbrook, Illinois

"This is by far my number one software and I will use it anywhere and everywhere I possibly can, both personal and in business."
R.A. Neuman, Okemos, Michigan

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"Very well laid out and organized. One of the best I've seen."
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"One of the best I've seen. We write about 20 volumes of material per year. Take it from a pro, it's good."
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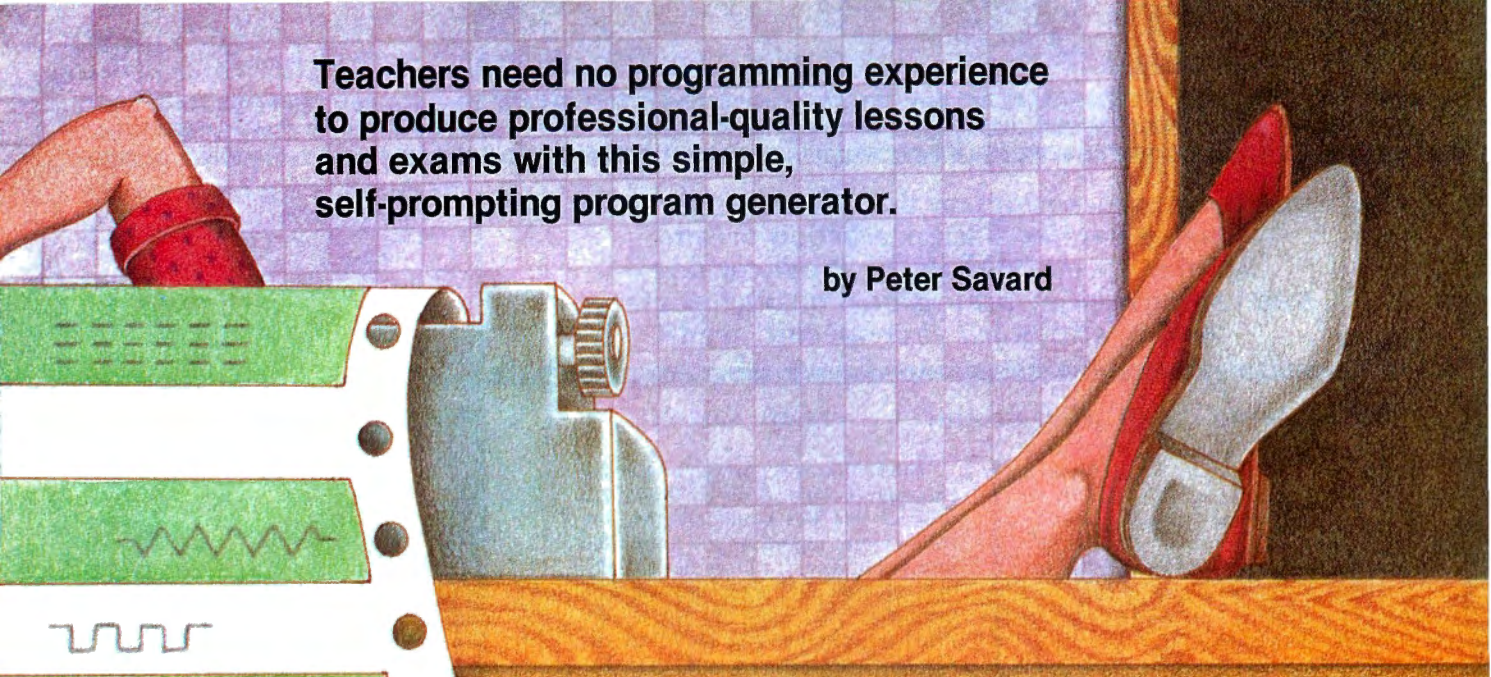
Teachers need no programming experience to produce professional-quality lessons and exams with this simple, self-prompting program generator.

by Peter Savard



My Automated Courseware Development System (ACDS) is an easy-to-use, self-prompting program that teachers with no programming experience can use to write computer-based lessons, exams, and quizzes. Since ACDS is a program generator, the lessons it produces are independent of the ACDS program—you can save an exam to disk and later boot it up on any Model I or III.

ACDS leads you step by step through the development of lessons; in response to program prompts, you choose the test format and enter the questions, answers, instructions, and any text associated with the questions. You can even opt to store a student's test results on disk.

But ACDS isn't limited to the classroom. Parents can use ACDS at home to develop their own educational programs for children, college students can use the system to develop review tests, prospective drivers can put their Department of Motor Vehicles exams on disk to test themselves, and so on.

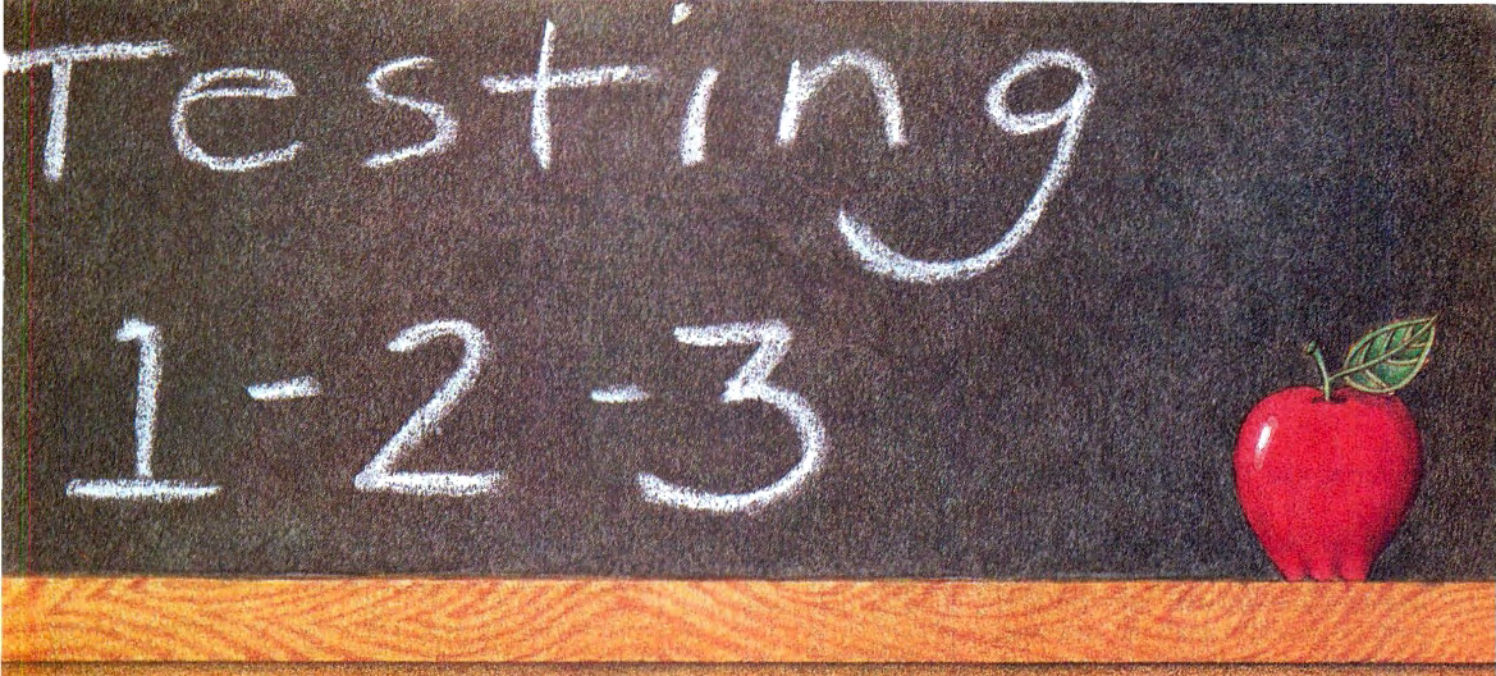
The System

ACDS comprises four programs. The Lesson Machine (Program Listing 1) writes tests in Basic.

The Graphics Worksheet (Program Listing 2) lets you combine text and graphics on the screen using simple commands.

The Menu Maker (Program Listing 3) produces a menu that displays all the tests on a disk.

The Student Reporter (Program Listing 4), stores a file with the student's answers and progress reports. If you use The Student Reporter under DOSPLUS, you should enter the date at the



DOS Ready prompt in the format DATE MM/DD/YY. This way, the student data file will include the correct date in its report.

Before you work with The Lesson Machine, prepare the material that you want presented in the tests. When you're ready, insert the ACDS disk in drive zero, press the reset button, and select The Lesson Machine from the main menu. A note for DOS-PLUS users: You have to open more than one file when you get into Basic. Do this by hitting the enter key at the "How many files?" prompt or by typing in BASIC -F:3 at the Basic prompt.

Setting the Lesson's Parameters

You design your lesson's format by answering a series of questions. The first question asks you under what file name you want your lesson stored on the disk. You can enter a name of up to eight characters, but the first character must be a letter. The master program automatically adds the /BAS extension to your file name, writing it to a Basic file.

The next question asks you to which drive you want the lesson written. You must pick a number from zero to 3.

The third question asks you to give your lesson a title. It can be up to 20 characters long.

Next, you're asked if you want each test question repeated should the student answer incorrectly. If you answer yes, the question repeats itself until the student gets the right answer.

If you opt to repeat test questions, you're asked if you want the material related to the question repeated. If you answer yes, Lesson Maker displays the text that immediately precedes the question, and then repeats the question related to that text.

At the sixth prompt, you can opt to store a student's test results on disk. Using this option, you establish a record of the student's efforts in a file called Students/DAT. You can read this file using The Student Reporter program.

The seventh question gives you the option of returning to a menu. With this option, you can link your lesson with other lessons by a menu created with The Menu Maker.

Option eight lets you type in up to five lines of instructions for the student. The directions appear at the beginning of the test. Both the procedure for entering the directions and entering lines of text and questions are the same.

The ninth question asks you to define the character that separates the alternate and acceptable responses to the lesson's test questions. You can enter as many alternate answers to a question as you wish. The alternate answers must be separated

Illustration by Annie Gusman

by a character not used in the answer itself, and you can't use a space to separate the answers.

The slash character is the default value, but you may use any character as a substitute.

Enter the line increment for the *text/question* section as your next parameter. Here you're selecting the line-number increment for the Basic program that ACDS writes. The default is 10.

Entering the Text and Questions

After you answer the test format questions, ACDS will prompt you to start entering the actual test text and question-and-answer information. Both are entered in much the same way. You're asked whether you're going to write text, a question-and-answer, or if you want to end the test (the actual prompt appears as: "(T)EXT, (Q)UESTION, or (E)ND?)".

If you choose text, you're given 13 lines on which to enter information. You're limited to five lines for each question. After you make a selection, you're asked if you want to display the information on a normal display screen (60 characters per line) or on an expanded-character screen (24 characters per line).

Type in each text or question line exactly as it is to appear on the screen during the test. If you don't need all the lines allocated, type in DONE to end that page or question.

After you enter a question and type DONE, you're asked to enter the answers. Be sure that you include this information right after you enter the question, or the information will appear in the wrong section of the lesson. You can enter as many alternate answers as you wish; they'll all be considered equally correct.

You'll have the opportunity to correct your entries on a line-by-line basis before the program writes the text and questions to disk.

You can enter as many pages of text and questions as you want, in any order, up to the limits of available memo-

The Key Box

LOAD 80

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Program Listing 1. The Lesson Machine lesson generator.

```
10 REM *************************
20 REM *** THE LESSON MACHINE ***
30 REM *** BY PETER G. SAVARD ***
40 REM *************************
50 REM **** INITIALIZATION SECTION ****
60 CLS:CLEAR1000:LN=1000:SE$="/":SF$=CHR$(34):IN=10:NT=1:DIMTM$(14
)
70 CLS:PRINTCHR$(23):PRINT@212,"AUTOMATED":PRINT@276,"COURSEWARE":
PRINT@340,"DEVELOPMENT":PRINT@404,"SYSTEM....":PRINT@460,STRING$(2
0,95):PRINT@596,"THE":PRINT@660,"LESSON":PRINT@724,"MACHINE"
80 FORI=14TO109STEP2:SET(I,0):SET(I+1,0):SET(123-I,47):SET(123-I-1
,47):SET(16,(I-14)/2):SET(112,47-(I-14)/2):NEXTI:FORI=1TO1000:NEXT
I
90 FORI=1TO250:NEXTI:CLS
100 PRINTTAB(4)"T  H  E      L  E  S  S  O  N      M  A  C  H  I
N  E":PRINT:PRINTSTRING$(64,95);:POKE16916,4
110 PRINT:PRINTTAB(5)"The LESSON MACHINE is a program generator. I
t writes ":PRINT"instructional programs based on information you e
nter from the":PRINT"keyboard. The programs which are written are
well documented and";
120 PRINT"can be easily modified by even the novice programmer.":P
RINT:PRINTTAB(5)"Before beginning actual programming of your lesso
n, you":PRINT"should plan out exactly what information is to be pr
esented":PRINT"in each frame, what questions are to be";
130 PRINT" asked and the possible":PRINT"answers for each."
140 GOSUB990
150 CLS:PRINT"UNDER WHAT NAME WILL THE LESSON BE STORED ON THE DIS
K?":PRINT"(8 CHAR. MAX)  ";:GOSUB1010:IFIN$=""THEN150ELSEIFLEN(IN$
)>8THENPRINT:PRINT"NAME TOO LONG!!!":GOSUB1040:GOTO150ELSEF$=IN$+"
/BAS"
160 PRINT:PRINT"ON WHICH DRIVE IS THE LESSON TO BE WRITTEN (0-3)?
 ";:GOSUB1010:IFIN$<"0"ORIN$>"3"THENPRINT:PRINT"ERROR - MUST BE 0,
1,2 OR 3":GOTO160ELSEF$=F$+":"+IN$
170 PRINT:PRINT"WHAT IS THE TITLE OF THE LESSON (20 CHAR. MAX.)":G
OSUB1010:IFIN$=""ORLEN(IN$)>20THENPRINT:PRINT"ERROR - ENTER AGAIN"
;:GOTO170ELSET$=IN$
180 OPEN"O",1,F$:PRINT#1,"10 REM ********************************
**************"
190 PRINT#1,"20 REM ***  THIS LESSON IS ";T$;STRING$(20-LEN(T$),32
)"    ***":PRINT#1,"30 REM ***  TITLE BLOCK & INITIALZATION
   ***":PRINT#1,"40 REM ****************************************
*******":PRINT#1,"50 CLEAR 500:S=0:C=0:ONERRORGOTO62040"
200 PRINT#1,"60 CLS:PRINTCHR$(23):PRINT@212,";CHR$(34);"THE";CHR$(
34);":PRINT@276,";CHR$(34);"LESSON";CHR$(34);":PRINT@340,";CHR$(34
);"MACHINE....";CHR$(34);":PRINT@396,STRING$(20,95)"
210 PRINT#1,"70 PRINT@524,";CHR$(34);"THIS LESSON IS...";CHR$(34);
":PRINT@";652+INT((20-LEN(T$))/2+.5)*2;",";CHR$(34);T$;CHR$(34)
220 PRINT#1,"80 FORI=14TO109STEP2:SET(I,0):SET(I+1,0):SET(123-I,47
):SET(123-I-1,47):SET(16,(I-14)/2):SET(112,47-(I-14)/2):NEXTI:FORI
=1TO250:NEXTI:CLS":CLOSE
230 CLS:PRINT"DO YOU WANT TO REPEAT THE QUESTION (Y/N)? ";:GOSUB10
10:IFIN$<>"Y"ANDIN$<>"N"THEN230ELSERP$=IN$
240 IFRP$="Y"THENPRINT:PRINT"DO YOU WANT TO REVIEW MATERIAL (Y/N)?
 ";:GOSUB1010:IFIN$<>"Y"ANDIN$<>"N"THEN240ELSERM$=IN$
250 PRINT:PRINT"DO YOU WANT A RECORD STORED ON DISK (Y/N)? ";:GOSU
B1010:IFIN$<>"Y"ANDIN$<>"N"THEN250ELSESV$=IN$
260 PRINT:PRINT"DO YOU WANT TO RETURN TO A MENU (Y/N)? ";:GOSUB101
0:IFIN$<>"Y"ANDIN$<>"N"THEN260ELSEM$=IN$
270 PRINT:PRINT"DO YOU WANT TO ADD DIRECTIONS (Y/N)? ";:GOSUB1010:
B$=IN$:IFB$="Y"THENEL=5:GOSUB1050:CLS:N=1:GOSUB380ELSEGOSUB1050:B$
="Y":GOSUB560
280 PRINT#1,"900 REM ************************************":PRINT
#1,"910 REM ***       TEXT & ANSWER BLOCK       ***":PRINT#1,"920 R
EM ************************************":CLOSE
290 CLS:PRINT"DEFINE CHARACTER TO SEPARATE ALTERNATE ANSWERS.":PRI
NT"TO KEEP THE DEFAULT SETTING (/) PRESS ENTER => ";:INPUTSE$
300 PRINT:PRINT"ENTER LINE INCREMENT FOR TEXT/QUESTION SECTION OF
THE":PRINT"PROGRAM. DEFAULT IS 10 => ";:INPUTIN
310 CLS:PRINTTAB(5)"You will now enter the frames of information t
o be present-";:PRINT"ed and the questions which will be asked. Ea
ch frame may contain";:PRINT"up to 13 lines. Each question may con
tain up to 5 lines."
320 PRINT:PRINTTAB(5)"Type each line exactly as it is to appear in
 the lesson":PRINT"If your frame or question contains less than th
e maximum number":PRINT"of lines type 'DONE' following the last li
ne. You will then have";
330 PRINT"a chance to change any of the lines. When asked for the
answers":PRINT"to a question, list all alternatives separated by '
/'":PRINTTAB(20)" eg. YES/yes/Y/y"
340 REM **** TEXT/QUESTION ENTRY ****
350 GOSUB990
360 CLS:POKE16916,0:N=1:INPUT"(T)ext, (Q)uestion, or (E)nd";B$:IFB
$=""THEN360ELSEIFB$="E"THEN620ELSEIFB$="Q"THENN5=N5+1:EL=5:NT=1ELS
EEL=13:PR=1:IFNT=1THENNT=0:RN=LN
```

Listing 1 continued

CP/M...The Software Key That Unlocks Your Model 4

CP/M is the standard 8-bit Z-80 operating system and many thousands of programs have been written to run under this system. With Montezuma Micro's CP/M you can run these programs on your Model 4/4P. Think about all those nationally known programs you've wanted to use. Programs like WordStar; dBASE II; SuperCalc; MultiPlan etc. With our version of CP/M 2.2 all those public domain programs on bulletin boards across the USA are available for free downloading. CP/M is the missing link that joins all this software to your Model 4/4P. Montezuma Micro's CP/M comes ready to use and requires no hardware modifications. This product has been awarded the best and highest ratings in the reviews and we are continuously improving it with you in mind. With our CP/M you get more than just a DOS. You get the other half of your Model 4/4P.

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ry. The program doesn't check to see if your lesson takes up more memory than available when run; you have to do so.

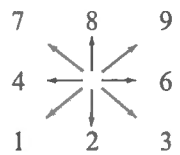
The program writes the text lines as Basic Print statements. The Lesson Machine automatically changes all quotes to single quotation marks. When the lesson's written, the program displays on what disk drive you'll find the lesson, and the file name with which you access it.

The Graphics Worksheet

The Graphics Worksheet is more complex than The Lesson Machine. This program has three operation modes: text, graphics, and storage.

In the text mode, a cursor appears in the upper left corner of the screen. You move the non-destructive cursor anywhere on the screen with the arrow keys. If you type a character, it's displayed at the cursor position. Type the @ character, and the next key you press repeats itself until you press any other key. When you finish entering text, press the clear key to return to the options menu.

With the graphics mode, you can draw on the screen using the shift button and the number keys. The numbers 1–4 and 6–9 define the cursor's movement as follows:



Pressing a number moves the cursor one space in the indicated direction. Pressing the shift key and a number draws in the indicated direction. Type five, and the next number you enter repeats until you press another key. Pressing the clear key returns you to the options menu.

The graphics cursor destroys any data it moves over; it's a good idea to do your graphics first, then add the text. You can use the X and Y values of the cursor (in the graphics mode) and the print position of the cursor (in the text mode) displayed at the bottom of the screen as references for future screen modifications.

Graphics Worksheet's Storage Function

The Graphics Worksheet's storage section lets you save the screen you've created. This section offers four options. The first option, Cancel, returns you to the menu, while the second op-

Listing 1 continued

```
370 FORI=1TO13:TM$(I)="":NEXTI:PRINT:INPUT"(N)ormal or (E)xpanded
screen";NS$:IFNS$="E"THENLL=28ELSELL=60
380 IFNS$="E"THENCLS:PRINTCHR$(23);ELSECLS
390 IFB$="Y"THENPRINT@768,"TYPE 'DONE' AFTER LAST ENTRY":PRINT@256
,;
400 FORI=1TOEL:PRINTUSING"##";I;:PRINT"=>";TM$(I):NEXTI
410 PRINT@896,USING"##";N;:PRINT"=>";:GOSUB1010:IFIN$="DONE"ORIN$=
"done"THEN430ELSEIF(LEN(IN$)>60ANDNS$="N")OR(LEN(IN$)>24ANDNS$="E"
)THENCLS:PRINTTAB(24)"ENTRY TOO LONG":GOSUB990:GOTO380ELSETM$(N)=I
N$
420 N=N+1:IFN>ELAND B$="T"THEN440ELSEIFN>ELANDB$="Q"THEN430ELSE380
430 IFB$<>"Q"THEN440ELSEPRINT@704,CHR$(31);"ENTER ANSWERS SEPARATE
D BY '"SE$"'.":GOSUB1010:TM$(6)=IN$
440 IFNS$="E"THENCLS:PRINTCHR$(23);ELSECLS
450 FORI=1TOEL:PRINTUSING"##";I;:PRINT"=>";TM$(I):NEXTI:IFB$="Q"TH
ENPRINT:PRINT" 6=>";TM$(6)
460 PRINT@896,CHR$(30);"ARE ENTRIES CORRECT (Y/N)";:INPUTB1$:IFB1$
="Y"ORB1$="Y"THEN500
470 PRINT@896,CHR$(30);:INPUT"LINE NUMBER TO CORRECT";L:IFL<1OR(B$
="T"ANDL>EL)OR(B$="Q"ANDL>EL+1)THENPRINT@896,"ERROR - INCORRECT LI
NE NUMBER ":FORJ=1TO1000:NEXTJ:GOTO440
480 IFL>NAND((B$="Q"ANDL<>6)ORB$="T")THENN=L+1
490 PRINT@896,CHR$(30);"  =>";:GOSUB1010:TM$(L)=IN$:GOTO440
500 IFB$="Y"THENLN=200ELSEGOSUB1050
510 IFB$="Q"ANDRP$="Y"ANDRM$="Y"ANDPR=1THENPRINT#1,LN;"IFC=1THENRE
TURN":GOSUB1060:PR=0
520 QL=LN:PRINT#1,LN;"CLS":GOSUB1060
530 IFNS$="E"THENPRINT#1,LN;"EX=32:TB=2":GOSUB1060ELSEPRINT#1,LN;"
EX=64:TB=18":GOSUB1060
540 IFNS$="E"THENPRINT#1,LN;"PRINTCHR$(23);":GOSUB1060
550 FORI=1TON-1:GOSUB1070:PRINT#1,LN;"PRINT";CHR$(34);"  ";TM$(I);
CHR$(34):GOSUB1060:NEXTI:GOTO560
560 IFB$="Y"THENPRINT#1,"300 PRINT:INPUT";CHR$(34);"Please type yo
ur name and press ENTER";CHR$(34);";N$":LN=1000:RETURN
570 IFB$="Q"THENPRINT#1,LN;"AN$=";CHR$(34);TM$(6);CHR$(34);":GOSUB
50000":GOSUB1060ELSEPRINT#1,LN;"GOSUB60000":GOSUB1060
580 IFB$="Q"ANDRP$="Y"ANDRM$="Y"THENPRINT#1,LN;"IFC=1THENGOSUB";RN
:GOSUB1060
590 IFB$="Q"ANDRP$="Y"THENPRINT#1,LN;"IFC=1THEN";QL:GOSUB1060
600 CLOSE:GOTO360
610 REM **** WRITING SUBROUTINE SECTION ****
620 GOSUB1050
630 PRINT#1,"59000 REM ************************************"
640 PRINT#1,"59010 REM ****          HOLD ROUTINE         ***"
650 PRINT#1,"59020 REM ************************************"
660 PRINT#1,"60000 PRINT@896,STRING$(EX,95);"
670 PRINT#1,"60010 PRINTTAB(TB)";CHR$(34);"Press any key to contin
ue";CHR$(34);";"
680 PRINT#1,"60020 C$=INKEY$:IFC$=";CHR$(34);CHR$(34);"THEN60020EL
SERETURN"
690 PRINT#1,"49000 REM ************************************"
700 PRINT#1,"49010 REM ***  QUESTION EVALUATION ROUTINE   ***"
710 PRINT#1,"49020 REM ************************************"
720 PRINT#1,"50000 PRINT@768,";CHR$(34);"Type your answer (press E
NTER)";CHR$(34)
730 PRINT#1,"50010INPUTA$:B=1"
740 PRINT#1,"50020 SS=INSTR(B,AN$,";CHR$(34);SE$;CHR$(34);")"
750 PRINT#1,"50030 IFSS=0THENAC$=AN$ELSEAC$=MID$(AN$,B,SS-1):AN$=R
IGHT$(AN$,LEN(AN$)-SS):B=1"
760 PRINT#1,"50040 IF A$=AC$ THEN 50090 ELSE IF SS<>0 THEN 50020"
770 PRINT#1,"50050 CLS:PRINTCHR$(23):PRINT";CHR$(34);"SORRY ";CHR$
(34);";N$"
780 PRINT#1,"50060 PRINTA$;";CHR$(34);" IS NOT THE CORRECT";CHR$(3
4)
790 PRINT#1,"50070 PRINT";CHR$(34);"ANSWER!!!";CHR$(34)
800 IFRP$="Y"THENPRINT#1,"50080 FORI=1TO1500:NEXT I : C=1: RETURN"
ELSEPRINT#1,"50080 FORI=1TO1500:NEXTI:RETURN"
810 PRINT#1,"50090 CLS:PRINT CHR$(23): PRINT ";CHR$(34);"THAT'S IT
 ";CHR$(34);"N$"
820 :PRINT#1,"50100 PRINT A$;";CHR$(34);" IS THE CORRECT";CHR$(34)
830 PRINT#1,"50110 PRINT";CHR$(34);"ANSWER!!!!";CHR$(34)
840 PRINT#1,"50120 FORI=1TO1500:NEXTI:IFC<>1THENS=S+1"
850 PRINT#1,"50130 C=0:RETURN"
860 PRINT#1,"61900 REM ************************************"
870 PRINT#1,"61910 REM ***      END LESSON ROUTINE       ***"
880 PRINT#1,"61920 REM ************************************"
890 PRINT#1,"62000 CLS:PRINT N$";CHR$(34);", YOU HAVE COMPLETED TH
E LESSON ";T$
900 PRINT#1,"62010 NQ=";N5;":PRINT";CHR$(34);"YOU DID ";CHR$(34);N
5;CHR$(34)"QUESTIONS AND GOT";CHR$(34);"S";CHR$(34);"CORRECT ON TH
E FIRST TRY";CHR$(34):PRINT#1,"62015 PRINT";CHR$(34);"FOR A SCORE
OF";CHR$(34);"INT(S/NQ*100+.5)";CHR$(34)"%.";CHR$(34)
910 IFSV$="Y"THENPRINT#1,"62020 OPEN";CHR$(34);"E";CHR$(34);",1,";
CHR$(34);"STUDENT/DAT";CHR$(34)ELSE930
920 PRINT#1,"62030 PRINT#1,N$;";CHR$(34);",";CHR$(34);";"CHR$(34);
T$;CHR$(34);";";CHR$(34);",";CHR$(34);";LEFT$(TIME$,8);";CHR$(34);
",";CHR$(34);";S,NQ:CLOSE"
```

Listing 1 continued

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tion, Write, translates your screen into Basic program lines that can merge with a Basic program.

With Write, you're asked for the file name of the screen and the drive number to which you want it written. If that file name already exists you're asked if you want it replaced. You're then asked for the beginning line number and the line increment for the lines to be written.

The Save function creates a file that can be loaded back into The Graphics Worksheet for modifications.

The Load option lets you load a screen which has previously been saved for further modifications.

The Menu Maker

Operation of The Menu Maker is simple. You're asked for the file name and the drive number it's to be written on. You then enter the title of the program as it's to appear in the menu and the file name of the program used to store it on the disk. You'll have the opportunity to make corrections before going on. You can have up to nine entries. If you need less room, type in DONE, thus ending the session.

The Student Data File

The Student Reporter reads the student records file, Students/DAT, created by the lesson programs you produce. If you answered no to the sixth question in The Lesson Machine, no record is created. If you answered yes, the file grows until you delete it.

If you plan to create a menu linking various lessons together, The Lesson Machine writes a line in your lesson program that returns you to that main menu. The line number is 62040 and you'll see the statement RUN "MENU". If you give your menu another name, you must change line 62040.

Screen Designing Tips

To design a screen using The Graphics Worksheet to merge into a lesson from The Lesson Machine follow these steps:

- When writing the test, choose a line increment of 20 at the appropriate prompt.
- Enter one line of text where you plan to merge your screen.
- List the resulting lesson and record the line number of the Print statement where you plan to merge your screen.
- When you write the screen to a file in The Graphics Worksheet, use the line number you recorded as your first line number and choose a one-line increment.
- Load your lesson program and type in MERGE followed by the file name, where the file name is the same as that you used when you wrote the screen on the disk.
- When the Ready prompt appears, the screen's included as part of your program.

Improving Loading Speed

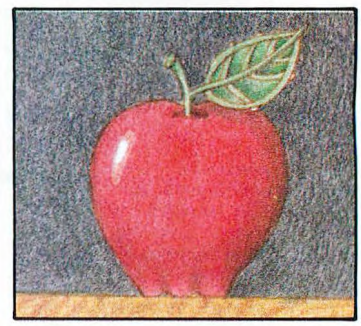
You can reduce lesson and menu loading times by directly loading them into memory and then saving them back to the disk.

If you want to link these programs together into a menu-driven set, create the menu using The Menu Maker. Then change line 2000 in each program so that it reads:

2000 RUN "MENU"

The name in quotations should be the file name of the menu you created. ■

Contact Peter G. Savard at 4370 Shelly Road, Livonia, NY 14487.



Listing 1 continued

```
930 PRINT#1,LN+10"GOTO62000":PRINT#1,"62040 IFERR/2+1=54ANDERL=620
20THENOPEN";CHR$(34);"O";CHR$(34);",1,";CHR$(34);"STUDENT/DAT";CHR
$(34);":RESUME NEXT"
940 IFM$="Y"THENPRINT#1,"62050 PRINT:PRINT:INPUT";CHR$(34);"PRESS
ENTER WHEN READY";CHR$(34);";B$:RUN";CHR$(34);"MENU";CHR$(34)ELSEP
RINT#1,"62050 END"
950 CLOSE
960 CLS:PRINT:PRINT"     Your program has been completed. It has b
een stored on":PRINT"drive # ";RIGHT$(F$,1);" under the file name
=>> ";LEFT$(F$,LEN(F$)-2)" <<=."
970 PRINT:PRINT"     You may now transfer it to another disk, run
it or modify":PRINT"it in any way.":PRINT:PRINT:PRINT:PRINT:GOTO20
00
980 REM **** SUBROUTINES ****
990 PRINT@960,TAB(18)"Press any key to continue.";
1000 A$=INKEY$:IFA$=""THEN1000ELSERETURN
1010 LINEINPUTIN$
1020 IFIN$="y"THENIN$="Y"ELSEIFIN$="n"THENIN$="N"
1030 RETURN
1040 FORI=1TO1000:NEXT:RETURN
1050 OPEN"E",1,F$:RETURN
1060 LN=LN+IN:IFLN>50000THENPRINT"ERROR - NO MORE LINES ALLOWED":F
ORI2=1TO1000:NEXT:CLOSE:GOTO620ELSERETURN
1070 FORJ=1TOLEN(TM$(I)):IFMID$(TM$(I),J,1)=SF$THENMID$(TM$(I),J,1
)="!":NEXTJ:RETURNELSENEXTJ:RETURN
2000 END
3000 SF$=CHR$(34):I=1:LINEINPUTTM$(I):GOSUB1070:PRINTTM$(I)
```

End

Program Listing 2. The Graphics Worksheet screen generator.

```
10 REM  ****************************
20 REM  ** THE GRAPHICS WORKSHEET ***
30 REM  ***  BY PETER G. SAVARD   ***
40 REM  ****************************
50 REM **** INITIALIZATION SECTION ****
60 CLS:CLEAR10000:LN=1000:SE$="/":IN=10:NT=1:DIMTM$(14),L$(14):PT$
=CHR$(244)+CHR$(245)+CHR$(246):PRINTCHR$(21)
70 FORI=1TO9:READCH(I):NEXT:EN=16191
80 CLS:PRINTCHR$(23):PRINT@212,"AUTOMATED":PRINT@276,"COURSEWARE":
PRINT@340,"DEVELOPMENT":PRINT@404,"SYSTEM....":PRINT@460,STRING$(2
0,95):PRINT@596,"THE":PRINT@660,"GRAPHIC":PRINT@724,"WORKSHEET"
90 FORI=14TO109STEP2:SET(I,0):SET(I+1,0):SET(123-I,47):SET(123-I-1
,47):SET(16,(I-14)/2):SET(112,47-(I-14)/2):NEXTI:FORI=1TO1000:NEXT
I
100 FORI=1TO250:NEXTI:CLS
110 ONERRORGOTO950
120 CLS:GOSUB830
130 REM **** MAIN OPTION MENU ****
140 MC=5:BC=0:PRINT@832,STRING$(64,95);:PRINTCHR$(30);"      TEXT
    GRAPHICS        CLEAR        STORAGE        EXIT"
150 GOSUB860
160 ONIGOTO180,310,590,630,660
```

Listing 2 continued

✓ See List of Advertisers on Page 176

Listing 2 continued

```
170 REM **** TEXT ENTRY SECTION ****
180 PO=15360
190 PRINT@896,CHR$(30);"  @ TO REPEAT --- ARROW KEYS MOVE CURSOR -
-- CLEAR KEY EXITS"
200 C=PEEK(PO):GOSUB290
210 POKEPO,95
220 L$=INKEY$:IFL$=""THEN220ELSEA=ASC(L$):IFL$="@"THENR=1:GOSUB570
:GOSUB290:GOTO220ELSEPOKEPO,C
230 IFA=31THEN140ELSEIFA=9THENPO=PO+1ELSEIFA=8THENPO=PO-1ELSEIFA=9
1THENPO=PO-64ELSEIFA=10THENPO=PO+64
240 IFA<>8ANDA<>9ANDA<>10ANDA<>91ANDA<>13THENPOKEPO,A:PO=PO+1
250 IFPO<15360THENPO=15360ELSEIFPO>16191THENPO=16191
260 GOSUB290
270 IFR=1THENC$=INKEY$:IFC$<>""THENR=0:GOTO190
280 IFR=1THENC1=PEEK(PO):POKEPO,95:FORI2=1TO10:
EXTI2:POKEPO,C1:G
OTO230ELSE200
290 PRINT@983,"PRINT @ = ";:PRINTUSING"###";PO-15360;:RETURN
300 REM **** GRAPHICS ENTRY SECTION ****
310 X=0:Y=0:GOSUB550
320 D=0:SET(X,Y)
330 C$=INKEY$:IFC$=""THEN330ELSEA=ASC(C$)
340 IFA=31THEN140ELSEIFA=53ORA=37THENR=1:GOSUB570:GOTO330
350 IFA<33OR(A>41ANDA<48)ORA>57THEN320
360 IFA<48THEND=1:A=A+16
370 IFD=0THENRESET(X,Y)ELSESET(X,Y)
380 IFA<1THEN320
390 ONA-48GOTO400,410,420,430,330,440,450,460,470
400 X=X-1:Y=Y+1:GOTO480
410 Y=Y+1:GOTO480
420 X=X+1:Y=Y+1:GOTO480
430 X=X-1:GOTO480
440 X=X+1:GOTO480
450 X=X-1:Y=Y-1:GOTO480
460 Y=Y-1:GOTO480
470 X=X+1:Y=Y-1
480 IFX<0THENX=0ELSEIFX>127THENX=127
490 IFY<0THENY=0ELSEIFY>38THENY=38
500 GOSUB560
510 IFR=1THENC$=INKEY$:IFC$<>""THENR=0:GOSUB550:GOTO320
520 IFR=1ANDD=0THENSET(X,Y):FORI2=1TO10:NEXTI2
530 IFD=1THENSET(X,Y)ELSERESET(X,Y)
540 IFR=1THEN390ELSEGOTO320
550 PRINT@896,CHR$(30);"5 REPEATS -- 1-9 ERASES - SHIFT 1-9 DRAWS
--CLEAR KEY EXITS"
560 PRINT@982,"X = ";:PRINTUSING"###";X;:PRINT", Y = ";:PRINTUSING
"##";Y;:RETURN
570 PRINT@896,CHR$(30);TAB(18)"PRESS ANY KEY TO STOP DRAWING":IFL$
="@"THENRETURNELSEGOTO560
580 REM **** CLEAR SCREEN SECTION ****
590 PRINT@896,CHR$(31);"YOU HAVE ASKED TO CLEAR THE SCREEN --- PLE
ASE CONFIRM (Y/N)";
600 LINEINPUTC$:IFC$<>"Y"THEN140ELSEFORI=0TO768STEP64:PRINT@I,STRI
NG$(64,32);:NEXTI:GOTO140
610 GOTO140
620 REM **** STORAGE SECTION ****
630 MC=4:BC=5:PRINT@832,STRING$(64,95);:PRINTCHR$(30);"          C
ANCEL        WRITE        SAVE        LOAD"
640 GOSUB860
650 PRINT@896,CHR$(31);:ONIGOTO140,670,670,790
660 CLS:CLEAR50:PRINTCHR$(21):GOTO2000
670 IFI=3THENS=1ELSES=0
680 PRINT@896,CHR$(30);"ENTER FILE NAME OF SOURCE PAGE => ";:LINEI
NPUTF$:IFF$=""THEN140
690 PRINT@896,CHR$(30);"ON WHICH DRIVE IS THE FILE TO BE SAVED (0-
3) => ";:LINEINPUTDR$:IFDR$=""THENDR$="0"
700 F$=F$+":"+DR$
710 OPEN"I",1,F$:CLOSE
720 PRINT@896,CHR$(31);"THIS FILE ALREADY EXISTS --- DO YOU WANT T
O REPLACE IT (Y/N)";:LINEINPUTER$:IFER$<>"Y"THEN680
730 IFS=1THEN750ELSEPRINT@896,CHR$(30);"WHAT IS THE STARTING LINE
NUMBER => ";:LINEINPUTLN$:LN=VAL(LN$):IFLN=0THENGOSUB720:GOTO730
740 PRINT@896,CHR$(30);"ENTER LINE INCREMENT => ";:LINEINPUTIC$:IC
=VAL(IC$)
750 Z=1:FORI=1TO13:L$(I)="":NEXTI:FORI=15360TO16128STEP64:PRINT@89
6,CHR$(30);TAB(20)"READING LINE =>"Z:FORR=0TO63:L$(Z)=L$(Z)+CHR$(P
EEK(I+R)):POKEI+R,191:NEXTR:PRINT@I-15360,L$(Z);:Z=Z+1:NEXTI
760 OPEN"O",1,F$
770 IFS=1THENFORI=1TO13:PRINT#1,L$(I):NEXTI:CLOSE:GOTO140
780 FORI=1TO13:PRINT#1,LN;"PRINT";CHR$(34);L$(I);CHR$(34);";":LN=L
N+IC:NEXTI:CLOSE:GOTO140
790 FORI=1TO16:L$(I)="":PRINT@896,CHR$(30);"ENTER THE FILE NAME =>
 ";:LINEINPUTFW$:IFFW$=""THEN140
800 OPEN"I",1,FW$
810 PRINT@0,;:FORI=1TO13:LINEINPUT#1,L$(I):PRINTL$(I);:NEXTI:CLOSE
820 GOTO140
```

Listing 2 continued

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Listing 2 continued

```
830 PRINT@832,STRING$(64,95);:RETURN
840 PRINT@896,CHR$(30);TAB(18)"INVALID ENTRY --- TRY AGAIN":FORCO=
1TO1000:NEXTCO:RETURN
850 REM **** MENU SELECTION SECTION ****
860 I=1:PRINT@965,"LEFT/RIGHT ARROWS MOVE POINTER ---- <ENTER> TO
SELECT";
870 PRINT@CH(I+BC),PT$;
880 C$=INKEY$:IFC$=""THEN880ELSEA=ASC(C$)
890 IFA<14ANDA<>10THENPRINT@CH(I+BC),STRING$(3,32);
900 IFA=13THENRETURNELSEIFA=9THENI=I+1ELSEIFA=8THENI=I-1ELSE880
910 IFI<1THENI=MCELSEIFI>MCTHENI=1
920 GOTO870
930 DATA897,908,923,935,949,901,915,928,940
940 REM **** ERROR HANDLING SECTION ****
950 IFERR/2+1=62THENPRINT@896,CHR$(31);"THIS DISK IS FULL --- PLEA
SE INSERT A NEW DISK AND SAVE AGAIN"
960 IFERR/2+1=54ANDERL=710THENRESUME730
970 FORI=1TO1000:NEXT:RESUME140
2000 END
```

End

Program Listing 3. The Menu Maker linking program.

```
10 REM **************************
20 REM ***   THE MENU MAKER   ***
30 REM *** BY PETER G. SAVARD ***
40 REM **************************
50 REM **** INITIALIZATION SECTION ****
60 CLS:CLEAR1000:LN=1000:SE$="/":IN=10:NT=1:DIMTM$(14)
70 CLS:PRINTCHR$(23):PRINT@212,"AUTOMATED":PRINT@276,"COURSEWARE":
PRINT@340,"DEVELOPMENT":PRINT@404,"SYSTEM....":PRINT@460,STRING$(2
0,95):PRINT@596,"THE":PRINT@660,"MENU":PRINT@724,"MAKER"
80 FORI=14TO109STEP2:SET(I,0):SET(I+1,0):SET(123-I,47):SET(123-I-1
,47):SET(16,(I-14)/2):SET(112,47-(I-14)/2):NEXTI:FORI=1TO1000:NEXT
I
90 FORI=1TO250:NEXTI:CLS
100 PRINTTAB(10)"T  H  E     M  E  N  U     M  A  K  E  R":PRINT:
PRINTSTRING$(64,95);:POKE16916,4
110 PRINT:PRINTTAB(5)"The MENU MAKER is a program generator. It wr
ites menus":PRINT"which can be used on any disk to run BASIC progr
ams.":PRINT:PRINTTAB(5)"You will be asked to enter the title of th
e programs to be"
120 PRINT"called and the file names used to store them on the disk
.":PRINT"After the last entry, type 'DONE' to end."
130 PRINT:PRINTTAB(5)"There is a limit of 9 programs per menu."
140 GOSUB550
150 CLS:PRINT"UNDER WHAT NAME WILL THE MENU BE STORED ON THE DISK?
":PRINT"(8 CHAR. MAX)  ";:GOSUB570:IFIN$=""THEN150ELSEIFLEN(IN$)>8
THENPRINT:PRINT"NAME TOO LONG!!!":GOSUB580:GOTO150ELSEF$=IN$
160 PRINT:PRINT"ON WHICH DRIVE IS THE LESSON TO BE WRITTEN (0-3)?
 ";:GOSUB570:IFIN$<"0"ORIN$>"3"THENPRINT:PRINT"ERROR - MUST BE 0,1
,2 OR 3":GOTO160ELSEF$=F$+":"+IN$
170 PRINT:PRINT"WHAT IS THE TITLE OF THE MENU ( 3 - 20 CHAR. LINES
)":PRINT"IF THERE IS NO ENTRY PRESS <ENTER>":PRINT:FORI=1TO3:PRINT
I;"=> ";:GOSUB570:T$(I)=IN$:NEXTI
175 T$=T$(1):IFT$(2)<>""THENT$=T$+" "+T$(2):IFT$(3)<>""THENT$=T$+"
 "+T$(3)
180 REM **** MENU SET UP SECTION ****
190 OPEN"O",1,F$:PRINT#1,"10 REM ********************************
*"
200 PRINT#1,"20 REM ***        MENU  MAKER MENU    ***":PRINT#1,"3
0 REM ***   INITIALIZATION SECTION   ***":PRINT#1,"40 REM ********
**************************"
210 PRINT#1,"50 CLS:CLEAR 1000:P=206:DIM CH$(10,2):PT$=CHR$(244)+C
HR$(245)+CHR$(246):PRINTCHR$(21)"
220 PRINT#1,"60 CLS:PRINTCHR$(23):PRINT@212,";CHR$(34);"AUTOMATED"
;CHR$(34);":PRINT@276,";CHR$(34);"COURSEWARE";CHR$(34);":PRINT@340
,";CHR$(34);"DEVELOPMENT";CHR$(34);":PRINT@404,";CHR$(34);"SYSTEM.
...";CHR$(34);":PRINT@460,STRING$(20,95)"
230 LT=0:FORI=652TO780STEP64:LT=LT+1:PRINT#1,70+LT;"PRINT@";I+INT(
(20-LEN(T$(LT)))/2+.5)*2;",";CHR$(34);T$(LT);CHR$(34):NEXTI
240 PRINT#1,"80 FORI=14TO109STEP2:SET(I,0):SET(I+1,0):SET(123-I,47
):SET(123-I-1,47):SET(16,(I-14)/2):SET(112,47-(I-14)/2):NEXTI:FORI
=1TO1000:NEXTI"
250 PRINT#1,"100 REM *** MAIN OPTION MENU ***"
260 PRINT#1,"110 CLS:PRINTTAB(";INT((60-LEN(T$))/2+.5);")";CHR$(34
);T$;CHR$(34);":PRINTTAB(20)";CHR$(34);"ACDS APPLICATIONS MENU";CH
R$(34);":PRINTSTRING$(63,95);"
270 PRINT#1,"120 I=1:PRINT@896,STRING$(63,95);:PRINT@965,";CHR$(34
);"UP/DOWN ARROWS MOVE POINTER ---- <ENTER> TO SELECT";CHR$(34);";
"
280 PRINT#1,"130 C=1"
290 PRINT#1,"140 READ CH$(C,1),CH$(C,2):IFCH$(C,1)=";CHR$(34);"END
```

Listing 3 continued

Listing 3 continued

```
";CHR$(34);"THEN150ELSEC=C+1:GOTO140"
300 PRINT#1,"150C=C-1"
310 PRINT#1,"160 FORI=1TOC:?@212+64*I-1,CH$(I,1):NEXTI"
320 PRINT#1,"170 I=1"
330 PRINT#1,"180 PRINT@P+64*I,PT$;"
340 PRINT#1,"190 C$=INKEY$:IFC$="";CHR$(34);CHR$(34);"THEN190ELSEA=
ASC(C$)"
350 PRINT#1,"200 IF A=10 OR A=91 OR A = 13 THENPRINT@P+64*I,STRING
$(3,32);"
360 PRINT#1,"210 IF A=13THEN240ELSEIFA=10THENI=I+1ELSEIFA=91THENI=
I-1ELSE190"
370 PRINT#1,"220 IFI<1THENI=CELSEIFI>CTHENI=1
380 PRINT#1,"230GOTO180
390 PRINT#1,"240 PRINTCHR$(21);:RUN CH$(I,2)"
400 CLOSE
410 REM **** MENU OPTIONS ENTRY SECTION ****
420 CLS:PRINT"After the last entry, type 'DONE'."
430 I=1
440 PRINT@384,;
450 PRINT"TITLE NUMBER";I;"=> ";:LINEINPUTCH$(I,1):IFCH$(I,1)="DON
E"THENI=I-1:GOTO490
460 PRINT:PRINT"FILE NAME => ";:LINEINPUTCH$(I,2)
470 PRINT:INPUT"ARE THE ENTRIES CORRECT (Y/N)";B$:IFB$="N"THEN450
480 I=I+1:IFI>9THENPRINT:PRINT"NO MORE ENTRIES ALLOWED":FORCC=1TO1
000:  NEXTCCELSEPRINT@320,CHR$(31);:GOTO440
490 GOSUB590
500 FORLN=1TOI:PRINT#1,1000+LN*10;"DATA";CHR$(34);CH$(LN,1);CHR$(3
4);",";CHR$(34);CH$(LN,2);CHR$(34):NEXTLN
510 PRINT#1,"2000 DATA END,END"
520 CLOSE
530 CLS:PRINT"You menu has been written and is stored with the fil
ename":PRINT"<";LEFT$(F$,LEN(F$)-2);">"
540 PRINT@896,;:GOTO2000
550 PRINT@960,TAB(18)"Press any key to continue.";
560 A$=INKEY$:IFA$=""THEN560ELSERETURN
570 LINEINPUTIN$:RETURN
580 FORI=1TO1000:NEXT:RETURN
590 OPEN"E",1,F$:RETURN
2000 END
```

End

Program Listing 4. The Student Reporter file reading program.

```
10 REM ******************************
20 REM ***  THE STUDENT REPORTER   ***
30 REM ***    BY PETER G. SAVARD    ***
40 REM ******************************
50 REM **** INITIALIZATION SECTION ****
60 CLS:CLEAR1000
70 CLS:PRINTCHR$(23):PRINT@212,"AUTOMATED":PRINT@276,"COURSEWARE":
PRINT@340,"DEVELOPMENT":PRINT@404,"SYSTEM....":PRINT@460,STRING$(2
0,95):PRINT@596,"THE":PRINT@660,"STUDENT":PRINT@724,"REPORTER"
80 FORI=14TO109STEP2:SET(I,0):SET(I+1,0):SET(123-I,47):SET(123-I-1
,47):SET(16,(I-14)/2):SET(112,47-(I-14)/2):NEXTI:FORI=1TO1000:NEXT
I
90 FORI=1TO250:NEXTI:CLS
100 PRINTTAB(3)"T  H  E     S  T  U  D  E  N  T     R  E  P  O  R
  T  E  R":PRINT:PRINTSTRING$(64,95);:POKE16916,4
110 PRINT:INPUT"WHICH DRIVE IS THE STUDENT FILE ON (0-3)";DR$
115 ONERRORGOTO220
120 IFDR$<"0"ORDR$>"3"THENPRINT:PRINT"ERROR":GOTO110ELSEF$="STUDEN
T/DAT"+":"+DR$
130 OPEN"I",1,F$
140 PRINT:PRINT"PRINT RECORDS ON (S)CREEN OR (P)RINTER";:INPUTPR$:
IFPR$<>"S"ANDPR$<>"P"THENPRINT:PRINT"ERROR":GOTO140
150 IFEOF(1)THEN190ELSEINPUT#1,N$,L$,DA$,S,NQ
160 IFPR$="P"THEN170ELSECLS:PRINT:PRINT:PRINT"NAME: ";N$:PRINT"LES
SON TITLE: ";L$:PRINT"DATE COMPLETED: ";DA$:PRINT"NUMBER OF QUESTI
ONS DONE: ";NQ:PRINT"NUMBER CORRECT ON FIRST TRY: ";S:PRINT"SCORE:
 ";INT(S/NQ*100+.5);"%"
165 PRINT:INPUT"PRESS ENTER TO CONTINUE";B$:GOTO180
170 LPRINT"NAME: ";N$:LPRINT"LESSON TITLE: ";L$:LPRINT"DATE COMPLE
TED: ";DA$:LPRINT"NUMBER OF QUESTIONS DONE: ";NQ:LPRINT"NUMBER COR
RECT ON FIRST TRY: ";S:LPRINT"SCORE: ";INT(S/NQ*100+.5);"%":LPRINT
STRING$(80,"=")
180 GOTO150
190 CLOSE
200 CLS:PRINT:PRINT:INPUT"DELETE STUDENT FILE (Y/N)";D$:IFD$="Y"TH
ENKILLF$
210 PRINT:INPUT"DO YOU WANT TO READ ANOTHER FILE (Y/N)";A$:IFA$="Y
"THENCLS:RUN110ELSE2000
220 IFERR/2+1=54ANDERL=130THENPRINT:PRINT"THERE IS NO STUDENT FILE
 ON DRIVE "DR$:RESUME210
2000 END
```

End


illustration by Anna Davidian

Time Keeper

by Arnold E. van Beverhoudt Jr.

Project Minder is perfect for businesses that manage several projects simultaneously: It tracks the amount of time each employee spends on a project and calculates the total time spent on each project.

Picture a seven-person office handling seven projects for seven clients all at the same time. Some employees spend all their time on one project; some work on several projects during each pay period. The company bills clients by the hour. Consider the amount of paperwork needed to keep track of the total time spent on each project. If your office fits this description, why not let your computer figure the project time totals?

I developed Project Minder for use in my job with a government agency (see the Program Listing, p. 95). It keeps track of the amount of time each employee spends on a particular assignment and totals the time all employees spend on any one assignment. It also computes the approximate personnel cost of a project.

The program can help public accountants, consultants, lawyers, architects, advertising agencies, and other business people who bill clients on a per-hour, per-day, or per-assignment basis. It runs on the Model I, II, III, 4, or 2000.

Setting Up Record-Keeping Procedures

Some background on my job will help you understand how I developed the program and how it works. My office provides financial assistance to the governments of several U.S. territories, including the U.S. Virgin Islands, Guam, American Samoa, and the Northern Marianas.

ASSIGNMENT AUTHORIZATION

Assignment Number ..... Assignment .....

.....

Date Assigned ..... Type .....

Period Covered .....

Scope and Objectives/Special Instructions/Comments (may be continued on reverse)

.....

.....

.....

Travel authorized to ..... from

..... and return. Approximate number of days

travel to be performed ..... Number of daily returns .....

Number of overnight trips ..... AUTHORIZED: Rental Car ..... Taxi Fare(s) .....

Period to be covered by Authorization .....

Manager ..... Supervisor .....

In Charge .....

Assisted by .....

.....

.....

Estimated Completion Date ..... Estimated Number of Man-days .....

Copy: Assignment File
Employees named above

.....

Manager

COMPLETION REPORT

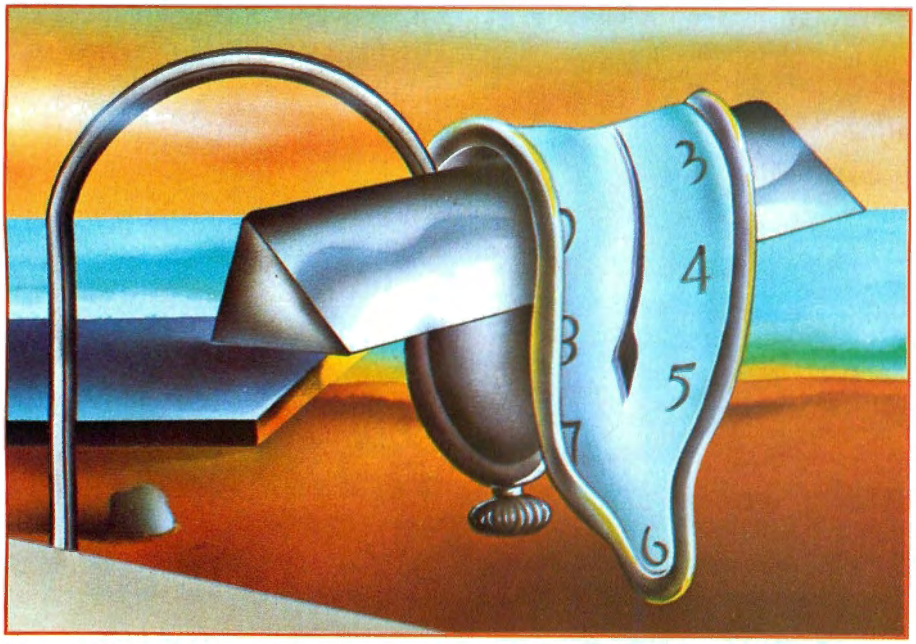
Report Number and Name ....

DATES: Field work: Began ..... Completed .....

Reports: Draft ..... Final .....

Approved .....
(Manager)

Figure 1. Supervisor's assignment authorization form.



The agency has two primary functions: to prepare audits and to provide financial technical assistance by analyzing accounting practices, recommending improvements, and establishing procedures for financial operations.

Almost all of the work we do is for a specific project. For management purposes, we track employees' time on a per-hour basis so we know how much manpower each assignment requires.

When a supervisor initially makes an assignment, he enters the estimated number of man-days required to finish the task and the estimated completion date on an assignment authorization form (see Fig. 1).

Each employee records the time spent on project assignments on a biweekly time report (see Fig. 2). The report is divided into two sections, direct and indirect time.

Indirect time includes hours spent on leave and holidays and on training and administrative duties.

Direct time hours are those devoted specifically to completing an individual assignment. Direct time is further broken down into a series of coded tasks (see Fig. 3). Employees report the number of hours spent on each type of task for each assignment.

The Time Reports

My program provides three reports for direct time worked for each pay period: a summary of the hours each employee works on a particular assignment, the total time the entire office spends on an assignment, and a work history for each employee. You can review these reports on the screen or as a printout.

The detail-by-assignment report gives you basic project assignment information, including assignment number and date assigned, the detailed cumulative time each employee works on each assignment, and approximate personnel costs. Figure 4 shows a printout of a sample report—you'll find the screen display reports differ slightly from the printout versions.

The summary-by-assignment report presents the project assignment number, date completed, estimated and actual man-days required, and total hours

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EMPLOYEE'S BIWEEKLY TIME REPORT

I certify that for pay, per diem, and other official purposes, my time (to the nearest whole hour) for the pay period ended on the above date should be recorded as follows:

	DAY	SUN	MON	TUE	WED	THU	FRI	SAT	SUN	MON	TUE	WED	THU	FRI	SAT	TOTAL
A. Direct Time (List Assignments)	DATE															
1.																
2.																
3.																
4.																
5.																
6.																
B. Indirect Time																
1. Unassigned																
2. Orientation & Trng.																
3. Administration																
4. Other																
C. Leave & Holidays																
D. TOTAL HOURS																
E. Location C																
T																
O																

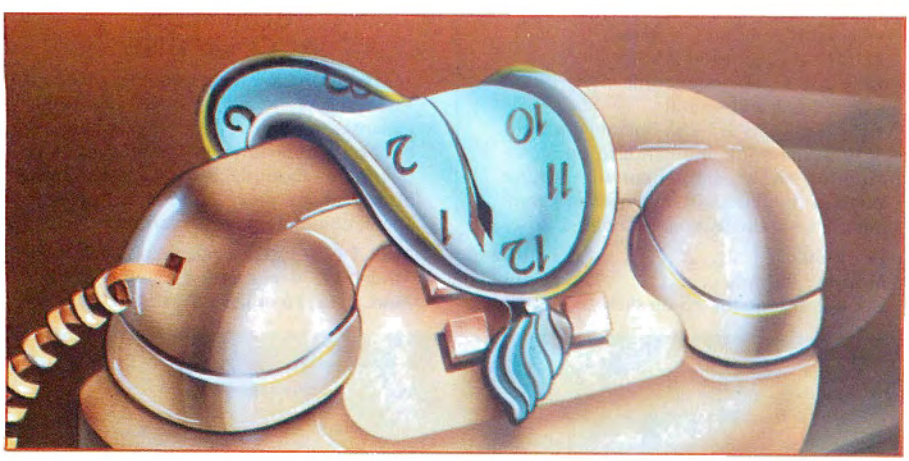
Employee's Signature

Approved (Manager) _____

Figure 2. Employee's biweekly time report form.

Code	Audit Function	Technical Assistance Function
A	Preliminary survey	Review and analysis
B	Audit fieldwork	Instruction and advising
C	Workpaper review	Report preparation
D	Supervisory guidance	New system development
E	Report preparation	Implementation and operation
F	Travel	Travel
G	Report/workpaper referencing	Unused

Figure 3. Direct-time coded tasks.



by task category for each assignment (see Fig. 5).

The summary-by-employee report gives the project assignment number, assignment title, and total hours to date spent on all assignments for each employee requested (see Fig. 6).

Project Minder doesn't develop project assignment schedules or create employee time reports. Employees must still fill them out by hand.

The Program

Project Minder is menu-driven with full prompts at each stage. Independent subroutines are tied to the main menu (see Table 1).

(Note: You need more than one Basic file to run this program; if you're using DOSPLUS, make sure you call for at least two files when you get into Basic.)

To open a file, first enter a pay period date at the prompt. Then select option 2 on the main menu, "Add assignment to existing file." You'll get prompts to number and name the new assignment and list the employees on the project. Once you set up your file, you can use option 4 to enter employee hours by task for each biweekly pay period.

As you saw in Fig. 3, I assigned one-letter codes to each task. Because our agency has two functions, I needed two categories for tasks, one for auditing jobs and one for technical assistance jobs. But the task codes aren't defined within the body of the program, so they can represent anything you want.

The program calculates the personnel cost of an assignment based on an average rate of $145 for an eight-hour day. You can change that rate by assigning a new value to variable R in line 110. To compute costs by hour, assign R the hourly rate, and change the equation AC(A)=AD(A)*R to AC(A)=TT(A)*R in line 4320.

The program allows a maximum of 10 assignments for each file, and a maximum of 10 employees for each assignment. In line 110 of the Listing, MA equals the maximum number of assignments, and ME the maximum number of employees. If you raise these limits above 10, modify the screen display routine in lines 8000–8610 to handle the line scroll problem.

I arranged data elements in a series of arrays. One-dimensional arrays hold basic assignment data (assignment number and title, data assigned, and estimated date of completion). Two-dimensional arrays handle the name and time distribution data for the employees on each assignment.

Two-character variable names corre-

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```
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                         AS OF 10/31/84
                      DETAILS BY ASSIGNMENT
-------------------------------------------------------------------------------
ASSIGNMENT: 83-14      FINANCIAL SYSTEMS SURVEY                 DATE: 02/23/83
IN-CHARGE: WILLIS                        MANAGER: LINDA
ESTIMATED MANDAYS   76      ACTUAL MANDAYS:   75      MANDAYS REMAINING:    1
ESTIMATED COMPLETION DATE: 05/31/83       ACTUAL COMPLETION DATE: 12/15/83
APPROXIMATE PERSONNEL COST: $ 10,875                  REPORT NO.: 003-80-TA
---------- EMPLOYEE ----------  ------------ TOTAL HOURS TO DATE -------------
                                  A    B    C    D    E    F    G   TOT.
LINDA                           173    0  248    0    0   32    0   453
WILLIS                           42    0    0    0    0   16    0    58
WILLIAM                          41    0    0    0    0   16    0    57
ARNOLD                            0    0   32    0    0    0    0    32
TOTALS TO DATE                  256    0  280    0    0   64    0   600
-------------------------------------------------------------------------------
-------------------------------------------------------------------------------
ASSIGNMENT: 83-17(01)  REVENUE AUDIT REVIEW              DATE: 09/10/83
IN-CHARGE: ARNOLD                        MANAGER: LINDA
ESTIMATED MANDAYS   75      ACTUAL MANDAYS:   55      MANDAYS REMAINING:   20
ESTIMATED COMPLETION DATE: 12/31/83       ACTUAL COMPLETION DATE: 11/28/83
APPROXIMATE PERSONNEL COST: $  7,921                  REPORT NO.: 004-80-TA
---------- EMPLOYEE ----------  ------------ TOTAL HOURS TO DATE -------------
                                  A    B    C    D    E    F    G   TOT.
LINDA                            34    0    0    0    0    0    0    34
ARNOLD                          102    0    0    0  301    0    0   403
TOTALS TO DATE                  136    0    0    0  301    0    0   437
-------------------------------------------------------------------------------
```

Figure 4. Detail-by-assignment report printout.

```
                    ASSIGNMENT TIME REPORT
                         AS OF 10/31/84
                      SUMMARY BY ASSIGNMENT
ASSIGN. #   COMPLETED   MANDAYS   ------------ TOTAL HOURS TO DATE -------------
                       EST. ACT.    A    B    C    D    E    F    G   TOT.
83-14       12/15/83    76   75  256    0  280    0    0   64    0   600
83-17(01)   11/28/83    75   55  136    0    0    0  301    0    0   437
```

Figure 5. Summary-by-assignment report printout.

```
                    ASSIGNMENT TIME REPORT
                         AS OF 10/31/84
                      SUMMARY BY EMPLOYEE
---------- ASSIGNMENT ----------  ------------ TOTAL HOURS TO DATE -------------
                                   A    B    C    D    E    F    G   TOT.
EMPLOYEE: LINDA
83-14      FINANCIAL SYSTEMS SURV  173    0  248    0    0   32    0   453
83-17(01)  REVENUE AUDIT REVIEW     34    0    0    0    0    0    0    34
EMPLOYEE: ARNOLD
83-14      FINANCIAL SYSTEMS SURV    0    0   32    0    0    0    0    32
83-17(01)  REVENUE AUDIT REVIEW    102    0    0    0  301    0    0   403
```

Figure 6. Summary-by-employee report printout.

```
9230 LPRINT TAB(60);:LPRINT USINGX$;EH(A,E);:LPRINT TAB(66);:LPR
INT USINGX$;FH(A,E);:LPRINT TAB(72);:LPRINT USINGX$;GH(A,E);:LPR
INT TAB(78);:LPRINT USINGX$;TH(A,E)
```

Figure 7. Models 4 and 2000 conversion.

spond to the data element; AN$ is the assignment number, and DA$ is the date assigned, for example. Table 2 lists all the program variables and the field length of each; A indicates alphanumeric fields and N indicates numeric fields. Don't use commas when you enter data in response to a program prompt.

The program limits string variables' lengths to the number of spaces available in the printed reports. If you enter more characters, the program drops the excess.

Project Minder runs as listed on a Model I, II, or III. For a Model 4 or 2000, you need to change only one line (see Fig. 7), but remember you must leave all spaces as they appear in the Listing or the program won't run properly. Model 2000 users can easily add color; Fig. 8 suggests one way to do so. You can add color at the start of each subroutine. ■

Arnold E. van Beverhoudt Jr. works for the U.S. Dept. of the Interior. He has a master's degree in business administration and is a certified public accountant. You can reach him at P.O. Box 56, St. Thomas, Virgin Islands 00801.

Lines	Subroutine
100–170	Initialize Variables
500–630	Main Menu
1000–1170	Load File from Disk
2000–2160	Add Assignment to File
3000–3140	Add Employee to Assignment
4000–4360	Record Biweekly Hours
5000–5190	Edit the File
6000–6100	Close-out Assignment
7000–7190	Save File to Disk
8000–8620	Display File on Screen
9000–9700	Print File on Printer
10000–10020	End the Program
19999	Center Screen Headings

Table 1. Line description of Time Distribution Summary program.

back-track

The Super User Friendly Disk Utility
For TRS-80* Models I, III and 4III

- Duplicate Most Protected Disks
- Edit (Zap) Sectors
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short cuts for the experienced user
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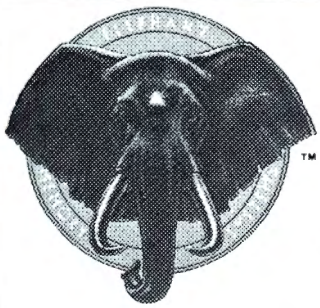

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– One Kit Required for each 16K of Expansion –

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Easy to install kits come complete with 8 ea. 4164-2 (200ns) 64K dynamic RAMs and conversion documentation. Converts TRS-80 color computers with D, E, ET, F and NC circuit boards to 32K. Also converts TRS-80 color computer II to 64K. Flex DOS or OS-9 required to utilize full 64K RAM on all computers.

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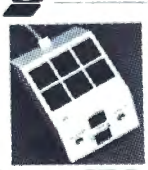

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Variable	Definition	Field
A	Array index for assignment number	2 N
AC	Approximate dollar cost of project	6 N
AC$	Actual completion date	8 A
AD	Actual man-days	4 N
AH	Category "A" hours	4 N
AN$	Assignment number	9 A
AT$	Assignment title	37 A
BH	Category "B" hours	4 N
CH	Category "C" hours	4 N
CL	Control total hours entered by user	4 N
CT	Control total hours computed by computer	4 N
D$	Current pay period date	8 A
DA$	Date assigned	8 A
DH	Category "D" hours	4 N
E	Array index for employee number	2 N
EC$	Estimated completion date	8 A
ED	Estimated man-days to complete	4 N
EH	Category "E" hours	4 N
EN$	Employee name	32 N
F$	Filename	12 A
FH	File name	4 N
GH	Category "F" hours	4 N
H$	Screen heading	64 A
IC$	In-charge (supervisor)	27 A
LC	Line counter	2 N
MA	Maximum number of assignments in file	2 N
ME	Maximum number of employees per assignment	2 N
MR$	Manager's name	27 A
NA	Number of assignments in a specific file	2 N
NE	Number of employees in a specific assignment	2 N
R	Average daily salary rate of employees	4 N
RM	Remaining man-days (estimate less actual)	4 N
RN$	Report number	9 A
ST$	Status of assignment	1 A
T	Loop counter	2 N
TA	Total "A" hours	4 N
TB	Total "B" hours	4 N
TC	Total "C" hours	4 N
TD	Total "D" hours	4 N
TE	Total "E" hours	4 N
TF	Total "F" hours	4 N
TG	Total "G" hours	4 N
TH	Total hours for employee	4 N
TT	Total hours for assignment	4 N
X$	Print edit code—"####"	4 A
X1$	Print edit code—"####-"	5 A
Y$	Print edit code—"$###,###"	8 A
Z	Menu selection variable	2 N
Z$	Input/INKEY$ variable	1 A
ZA$	Assignment number search key	9 A
ZE$	Employee name search key	32 A
ZE	Employee number search key	2 N

Table 2. Program variables.

```
1 SCREEN 3
2 COLOR 4
3 KEY OFF
500 COLOR 4:CLS:PRINT TAB(20);"TIME DISTRIBUTION
SUMMARY":PRINT TAB(27);"MAIN MENU":PRINT
1000 COLOR 1:CLS:H$="LOADING FILE FROM DISK":GOSUB
19999:PRINT
```

Figure 8. Model 2000 color conversion.

Program Listing. Project Minder.

```
10 REM ***********************************
       ********* PROJECT MINDER *********
       *************** BY ***************
       ** ARNOLD E. VAN BEVERHOUDT, JR.**
99 REM ** INITIALIZATION ROUTINE **
100 CLEAR 5000: DEFINT B-Z: DEFSNG A
110 MA=10:ME=10:NA=0:R=145:X$="####":X1$="####-":Y$="$###,###"
120 DIM ST$(MA),AN$(MA),AT$(MA),DA$(MA),IC$(MA),MR$(MA),ED(MA),A
D(MA)
130 DIM EC$(MA),AC$(MA),NE(MA),RM(MA),AC(MA),RN$(MA),RD$(MA)
140 DIM EN$(MA,ME),AH(MA,ME),BH(MA,ME),CH(MA,ME),DH(MA,ME),EH(MA
,ME)
150 DIM FH(MA,ME),GH(MA,ME),TH(MA,ME),TA(MA),TB(MA),TC(MA),TD(MA
),TE(MA)
160 DIM TF(MA),TG(MA),TT(MA)
170 CLS: INPUT "ENTER THE PAY PERIOD DATE (MM/DD/YY)";D$
230 GOTO 500
500 CLS:PRINT TAB(20);"TIME DISTRIBUTION SUMMARY":PRINT TAB(27);
"MAIN MENU":PRINT
510 PRINT" 1 - LOAD DATA FILE FROM DISK"
520 PRINT" 2 - ADD ASSIGNMENT TO EXISTING FILE"
530 PRINT" 3 - ADD EMPLOYEE TO EXISTING ASSIGNMENT"
540 PRINT" 4 - RECORD BI-WEEKLY EMPLOYEE HOURS"
550 PRINT" 5 - EDIT EXISTING FILE"
560 PRINT" 6 - CLOSE OUT ASSIGNMENT"
570 PRINT" 7 - SAVE EXISTING FILE TO DISK"
580 PRINT" 8 - DISPLAY FILE ON SCREEN"
590 PRINT" 9 - PRINT FILE ON PRINTER"
600 PRINT"10 - END PROGRAM"
610 PRINT:INPUT"ENTER YOUR CHOICE (1 TO 10)";Z
620 ON Z GOSUB 1000,2000,3000,4000,5000,6000,7000,8000,9000,1000
0,500
630 GOTO 500
999 REM ** LOAD FILE ROUTINE **
1000 CLS:H$="LOADING FILE FROM DISK":GOSUB 19999:PRINT
1010 INPUT"DO YOU WANT TO CANCEL THIS COMMAND (Y/N)";Z$
1020 IF Z$="N" GOTO 1040
1030 IF Z$="Y" THEN RETURN ELSE GOTO 1000
1040 PRINT:INPUT"ENTER THE FILENAME";F$
1050 OPEN"I",1,F$
1060 PRINT:PRINT"*** PLEASE WAIT A FEW MOMENTS WHILE THE DATA FI
LE IS LOADED ***"
1070 INPUT#1,NA,D$
1080 FOR A=1 TO NA
1090 INPUT#1,ST$(A),AN$(A),AT$(A),DA$(A),IC$(A),MR$(A),ED(A),AD(
A),EC$(A),AC$(A)
1100 INPUT#1,NE(A),RM(A),AC(A),RN$(A)
1105 INPUT#1,TA(A),TB(A),TC(A),TD(A),TE(A),TF(A),TG(A),TT(A)
1110 FOR E=1 TO NE(A)
1120 INPUT#1,EN$(A,E),AH(A,E),BH(A,E),CH(A,E),DH(A,E),EH(A,E),FH
(A,E),GH(A,E),TH(A,E)
1130 NEXT E
1140 NEXT A
1150 CLOSE 1
1160 PRINT:INPUT"PRESS <ENTER> TO RETURN TO MAIN MENU";Z$
1170 RETURN
1999 REM ** ADD ASSIGNMENT ROUTINE **
2000 CLS:H$="ADDING ASSIGNMENT TO EXISTING FILE":GOSUB 19999:PRI
NT
2010 PRINT"THE CURRENT NUMBER OF ASSIGNMENTS IN THE FILE IS"NA".
":PRINT"THE MAXIMUM ALLOWED IS";MA;"."
2020 IF NA=MA THEN PRINT"SORRY, YOU ARE ALREADY AT THE MAXIMUM L
EVEL.":FOR T=1 TO 1500:NEXT T:RETURN
2030 NA=NA+1:ST$(NA)=" "
2040 INPUT"ENTER ASSIGNMENT NUMBER";AN$(NA):AN$(NA)=LEFT$(AN$(NA
),9)
2050 INPUT"ENTER ASSIGNMENT TITLE";AT$(NA):AT$(NA)=LEFT$(AT$(NA)
,37)
2060 INPUT"ENTER DATE OF ASSIGNMENT (MM/DD/YY)";DA$(NA):DA$(NA)=
LEFT$(DA$(NA),8)
2070 INPUT"ENTER IN-CHARGE";IC$(NA):IC$(NA)=LEFT$(IC$(NA),27)
2080 INPUT"ENTER MANAGER";MR$(NA):MR$(NA)=LEFT$(MR$(NA),27)
2090 INPUT"ENTER ESTIMATED MANDAYS";ED(NA)
2100 INPUT"ENTER ESTIMATED COMPLETION DATE (MM/DD/YY)";EC$(NA):E
C$(NA)=LEFT$(EC$(NA),8)
2110 INPUT"ENTER NUMBER OF EMPLOYEES ON ASSIGNMENT";NE(NA)
2120 FOR E=1 TO NE(NA):
2130 PRINT"ENTER EMPLOYEE NAME - NO.";E;:INPUT EN$(NA,E):EN$(NA,
E)=LEFT$(EN$(NA,E),32)
2140 NEXT E
2150 PRINT:INPUT"WANT ANOTHER ASSIGNMENT (Y/N)";Z$
2160 IF Z$="Y" THEN GOTO 2000 ELSE RETURN
2999 REM ** ADD EMPLOYEE ROUTINE **
3000 CLS:H$="ADDING EMPLOYEE TO ASSIGNMENT":GOSUB 19999:PRINT
3010 INPUT"ENTER ASSIGNMENT NUMBER";ZA$
3020 FOR A=1 TO NA
```

Listing continued

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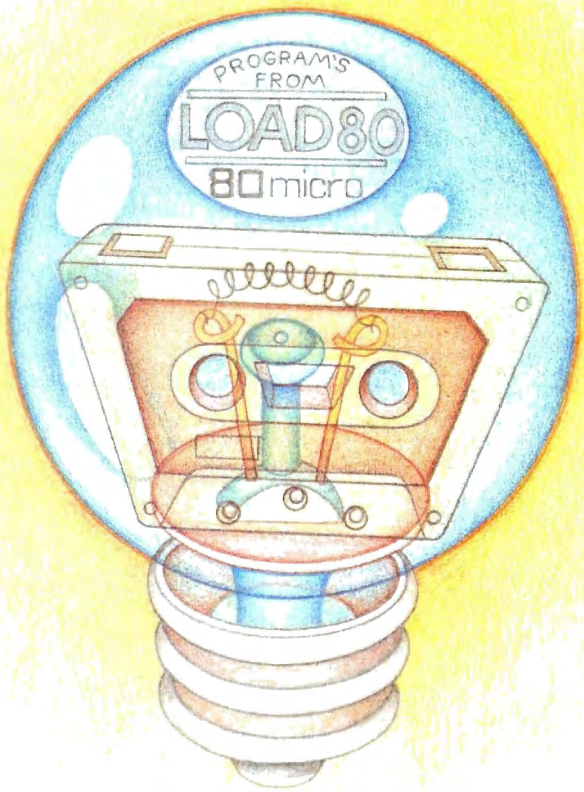

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Signature_____

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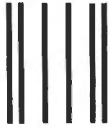

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```
3030 IF AN$(A)=ZA$ THEN GOTO 3065 ELSE NEXT A
3040 PRINT"NO SUCH ASSIGNMENT FOUND"
3050 FOR T=1 TO 1500:NEXT T
3060 RETURN
3065 IF ST$(A)="C" THEN PRINT"THIS ASSIGNMENT IS CLOSED.  CANCEL
 THE COMMAND (Y/N)"; ELSE GOTO 3070
3067 INPUT Z$:IF Z$="N" THEN GOTO 3070 ELSE GOTO 3000
3070 PRINT"THE CURRENT NUMBER OF EMPLOYEES FOR THIS ASSIGNMENT I
S";NE(A);".":PRINT"THE MAXIMUM ALLOWED IS";ME;"."
3080 IF NE(A)=ME THEN PRINT"SORRY, YOU ARE ALREADY AT THE MAXIMU
M LEVEL.":FOR T=1 TO 1500:NEXT T:RETURN
3090 NE(A)=NE(A)+1
3100 INPUT"ENTER EMPLOYEE NAME";EN$(A,NE(A)):EN$(A,NE(A))=LEFT$(
EN$(A,NE(A)),32)
3110 PRINT:INPUT"WANT ANOTHER EMPLOYEE (Y/N)";Z$
3120 IF Z$="Y" THEN GOTO 3070
3130 INPUT"WANT ANOTHER ASSIGNMENT (Y/N)";Z$
3140 IF Z$="Y" THEN GOTO 3000 ELSE RETURN
3999 REM ** RECORD BI-WEEKLY HOURS ROUTINE **
4000 CLS:H$="RECORDING BI-WEEKLY EMPLOYEE HOURS":GOSUB 19999:PRI
NT
4005 AH=0:BH=0:CH=0:DH=0:EH=0:FH=0:GH=0
4010 INPUT"ENTER PAY PERIOD DATE";D$:INPUT"ENTER ASSIGNMENT NUMB
ER";ZA$
4020 FOR A=1 TO NA
4030 IF AN$(A)=ZA$ THEN GOTO 4065 ELSE NEXT A
4040 PRINT"NO SUCH ASSIGNMENT FOUND"
4050 FOR T=1 TO 1500:NEXT T
4060 RETURN
4065 IF ST$(A)="C"THEN PRINT"THIS ASSIGNMENT IS CLOSED.  CANCEL
THE COMMAND (Y/N)";ELSE GOTO 4070
4067 INPUT Z$:IF Z$="N" THEN GOTO 4070 ELSE GOTO 4000
4070 CLS:FOR E=1 TO NE(A)
4080 PRINT E;"- ";EN$(A,E)
4090 NEXT E
4100 INPUT"ENTER EMPLOYEE NUMBER";ZE
4110 IF ZE<1 OR ZE>NE(A) THEN PRINT"NO SUCH EMPLOYEE FOUND":FOR
T=1 TO 1500:NEXT T:GOTO 4070
4120 CLS:PRINT EN$(A,ZE)
4125 AH=0:BH=0:CH=0:DH=0:EH=0:FH=0:GH=0
4130 INPUT"ENTER CODE <A> HOURS";AH
4140 INPUT"ENTER CODE <B> HOURS";BH
4150 INPUT"ENTER CODE <C> HOURS";CH
4160 INPUT"ENTER CODE <D> HOURS";DH
4170 INPUT"ENTER CODE <E> HOURS";EH
4180 INPUT"ENTER CODE <F> HOURS";FH
4190 INPUT"ENTER CODE <G> HOURS";GH
4200 CT=AH+BH+CH+DH+EH+FH+GH
4210 INPUT"ENTER TOTAL EMPLOYEE HOURS";CL
4220 IF CL<>CT THEN PRINT:PRINT"ERROR IN TOTAL EMPLOYEE HOURS.
RE-ENTER DETAILS.":FOR T=1 TO 1500:NEXT T:GOTO 4120
4230 AH(A,ZE)=AH(A,ZE)+AH:TA(A)=TA(A)+AH
4240 BH(A,ZE)=BH(A,ZE)+BH:TB(A)=TB(A)+BH
4250 CH(A,ZE)=CH(A,ZE)+CH:TC(A)=TC(A)+CH
4260 DH(A,ZE)=DH(A,ZE)+DH:TD(A)=TD(A)+DH
4270 EH(A,ZE)=EH(A,ZE)+EH:TE(A)=TE(A)+EH
4280 FH(A,ZE)=FH(A,ZE)+FH:TF(A)=TF(A)+FH
4290 GH(A,ZE)=GH(A,ZE)+GH:TG(A)=TG(A)+GH
4300 TH(A,ZE)=AH(A,ZE)+BH(A,ZE)+CH(A,ZE)+DH(A,ZE)+EH(A,ZE)+FH(A,
ZE)+GH(A,ZE)
4310 TT(A)=TA(A)+TB(A)+TC(A)+TD(A)+TE(A)+TF(A)+TG(A)
4320 AD(A)=(TT(A)/8):RM(A)=ED(A)-AD(A):AC(A)=AD(A)*R
4330 PRINT:INPUT"WANT ANOTHER EMPLOYEE (Y/N)";Z$
4340 IF Z$="Y" THEN GOTO 4070
4350 INPUT"WANT ANOTHER ASSIGNMENT (Y/N)";Z$
4360 IF Z$="Y" THEN GOTO 4000 ELSE RETURN
4999 REM ** EDIT FILE ROUTINE ***
5000 CLS:H$="EDITING EXISTING FILE":GOSUB 19999:PRINT
5010 INPUT"ENTER ASSIGNMENT NUMBER";ZA$
5020 FOR A=1 TO NA
5030 IF AN$(A)=ZA$ THEN GOTO 5070 ELSE NEXT A
5040 PRINT"NO SUCH ASSIGNMENT FOUND"
5050 FOR T=1 TO 1500:NEXT T
5060 RETURN
5070 CLS:PRINT"PRESS <ENTER> TO LEAVE ITEM UNCHANGED.":PRINT
5080 PRINT "ASSIGNMENT NO.: ";AN$(A): INPUT AN$(A):AN$(A)=LEFT$(
AN$(A),9)
5090 PRINT"ASSIGNMENT TITLE: ";AT$(A): INPUT AT$(A):AT$(A)=LEFT$
(AT$(A),37)
5100 PRINT"DATE ASSIGNED: ";DA$(A): INPUT DA$(A):DA$(A)=LEFT$(DA
$(A),8)
5110 PRINT"IN-CHARGE: ";IC$(A): INPUT IC$(A):IC$(A)=LEFT$(IC$(A)
,27)
5120 PRINT"MANAGER: ";MR$(A): INPUT MR$(A):MR$(A)=LEFT$(MR$(A),2
7)
5130 PRINT"ESTIMATED MANDAYS: ";ED(A): INPUT ED(A):RM(A)=ED(A)-A
D(A)
5140 PRINT"ESTIMATED COMPLETION DATE: ";EC$(A): INPUT EC$(A):EC$
(A)=LEFT$(EC$(A),8)
5142 PRINT"DATE COMPLETED: ";AC$(A): INPUT AC$(A):AC$(A)=LEFT$(A
C$(A),8)
5145 PRINT"REPORT NO.: ";RN$(A): INPUT RN$(A):RN$(A)=LEFT$(RN$(A
),9)
5150 FOR E=1 TO NE(A)
5160 PRINT"EMPLOYEE NO.";E;": ";EN$(A,E): INPUT EN$(A,E):EN$(A,E
)=LEFT$(EN$(A,E),32)
5170 NEXT E
5180 PRINT:INPUT"WANT ANOTHER ASSIGNMENT (Y/N)";Z$
5190 IF Z$="Y" THEN GOTO 5000 ELSE RETURN
5999 REM ** CLOSE OUT ASSIGNMENT ROUTINE **
6000 CLS:H$="CLOSING OUT AN ASSIGNMENT":GOSUB 19999:PRINT
6010 INPUT"ENTER ASSIGNMENT NUMBER";ZA$
6020 FOR A=1 TO NA
6030 IF AN$(A)=ZA$ THEN GOTO 6070 ELSE NEXT A
6040 PRINT"NO SUCH ASSIGNMENT FOUND"
6050 FOR T=1 TO 1500:NEXT T
6060 RETURN
6070 INPUT"ENTER DATE COMPLETED";AC$(A):AC$(A)=LEFT$(AC$(A),8)
6080 INPUT"ENTER REPORT NUMBER";RN$(A):RN$(A)=LEFT$(RN$(A),9)
6085 ST$(A)="C"
6090 PRINT:INPUT"WANT ANOTHER ASSIGNMENT (Y/N)";Z$
6100 IF Z$="Y" THEN GOTO 6000 ELSE RETURN
6999 REM ** Save Data Routine **
7000 CLS:H$="SAVING FILE TO DISK":GOSUB 19999:PRINT
7010 INPUT"DO YOU WANT TO CANCEL THIS COMMAND (Y/N)";Z$
7020 IF Z$="N" GOTO 7040
7030 IF Z$="Y" THEN RETURN ELSE GOTO 7000
7040 PRINT:INPUT"ENTER THE FILENAME";F$
7050 OPEN"O",1,F$
7060 PRINT:PRINT"*** PLEASE WAIT A FEW MOMENTS WHILE THE DATA FI
```

Listing continued

Listing continued

```
LE IS SAVED ***"
7070 PRINT#1,NA,D$
7080 FOR A=1 TO NA
7090 PRINT#1,ST$(A);",";AN$(A);",";AT$(A);",";DA$(A);",";IC$(A);
",";MR$(A);",";ED$(A);",";AD$(A);",";EC$(A);",";AC$(A)
7100 PRINT#1,NE(A);",";RM(A);",";AC(A);",";RN$(A)
7110 PRINT#1,TA(A);",";TB(A);",";TC(A);",";TD(A);",";TE(A);",";T
F(A);",";TG(A);",";TT(A)
7120 FOR E=1 TO NE(A)
7130 PRINT#1,EN$(A,E);",";AH(A,E);",";BH(A,E);",";CH(A,E);",";DH
(A,E);",";EH(A,E);",";FH(A,E);",";GH(A,E);",";TH(A,E)
7150 NEXT E
7160 NEXT A
7170 CLOSE
7180 PRINT:INPUT"PRESS <ENTER> TO RETURN TO MAIN MENU";Z$
7190 RETURN
7999 REM ** DISPLAY FILE ROUTINE **
8000 CLS:H$="DISPLAYING THE FILE":GOSUB 19999:PRINT
8010 PRINT TAB(25);"REPORT MENU":PRINT
8020 PRINT" 1 - DETAILS BY ASSIGNMENT"
8030 PRINT" 2 - SUMMARY BY ASSIGNMENT
8040 PRINT" 3 - SUMMARY BY EMPLOYEE"
8050 PRINT" 4 - RETURN TO MAIN MENU"
8060 PRINT:INPUT"ENTER YOUR CHOICE (1 TO 4)";Z
8070 ON Z GOTO 8080,8350,8450,8075
8075 RETURN
8079 REM ** DETAILS BY ASSIGNMENT **
8080 PRINT:INPUT"ENTER ASSIGNMENT NUMBER";ZA$
8090 FOR A=1 TO NA
8100 IF AN$(A)=ZA$ THEN GOTO 8130 ELSE NEXT A
8110 PRINT"NO SUCH ASSIGNMENT FOUND"
8120 FOR T=1 TO 1500:NEXT T:GOTO 8000
8130 CLS:PRINT TAB(21);"ASSIGNMENT TIME REPORT"
8140 PRINT TAB(25);"AS OF ";D$
8150 PRINT TAB(21);"DETAILS BY ASSIGNMENT"
8160 PRINT:PRINT"ASSIGNMENT: ";AN$(A);:PRINT TAB(23);AT$(A)
8170 PRINT"DATE ASSIGNED: ";DA$(A);:PRINT TAB(39);"REPORT NO.: "
;RN$(A)
8180 PRINT"EST. MANDAYS: ";:PRINT USINGX$;ED(A);:PRINT TAB(21);"
ACTUAL MANDAYS: ";:PRINT USING X$;AD(A);:PRINT TAB(45);"REMAININ
G: ";:PRINT USING X1$;RM(A)
8185 PRINT"ESTIM. COMPLETION DATE: ";EC$(A);:PRINT TAB(36);"DATE
 COMPLETED: ";AC$(A)
8190 PRINT"APPROXIMATE PERSONNEL COST: ";:PRINT USING Y$;AC(A)
8200 PRINT"IN-CHARGE: ";IC$(A)
8210 PRINT"MANAGER: ";MR$(A)
8220 PRINT:PRINT TAB(20)"";:INPUT"PRESS <ENTER> FOR TIME DISTRIB
UTION SUMMARY";Z$
8230 CLS:PRINT TAB(21);"ASSIGNMENT TIME REPORT"
8240 PRINT TAB(25);"AS OF ";D$
8250 PRINT"NO. ";AN$(A);:PRINT TAB(21);"DETAILS BY ASSIGNMENT"
8260 PRINT"------- EMPLOYEE -------   A    B    C    D    E    F
   G  TOT."
8270 FOR E=1 TO NE(A)
8280 PRINT LEFT$(EN$(A,E),24);:PRINT TAB(25);:PRINT USINGX$;AH(A
,E);:PRINT TAB(30);:PRINT USINGX$;BH(A,E);:PRINT TAB(35);:PRINT
USINGX$;CH(A,E);:PRINT TAB(40);:PRINT USINGX$;DH(A,E);
8290 PRINT TAB(45);:PRINT USINGX$;EH(A,E);:PRINT TAB(50);:PRINT
USINGX$;FH(A,E);:PRINT TAB(55);:PRINT USINGX$;GH(A,E);:PRINT TAB
(60);:PRINT USINGX$;TH(A,E)
8300 NEXT E
8310 PRINT"TOTALS TO DATE";:PRINT TAB(25);:PRINT USINGX$;TA(A);:
PRINT TAB(30);:PRINT USINGX$;TB(A);:PRINT TAB(35);:PRINT USINGX$
;TC(A);:PRINT TAB(40);:PRINT USINGX$;TD(A);:PRINT TAB(45);:PRINT
 USINGX$;TE(A);
8320 PRINT TAB(50);:PRINT USINGX$;TF(A);:PRINT TAB(55);:PRINT US
INGX$;TG(A);:PRINT TAB(60);:PRINT USINGX$;TT(A);
8330 PRINT:PRINT TAB(20)"";:INPUT"WANT ANOTHER ASSIGNMENT (Y/N)"
;Z$
8340 IF Z$="Y" THEN CLS: GOTO 8080 ELSE GOTO 8000
8349 REM ** SUMMARY BY ASSIGNMENT **
8350 CLS:PRINT TAB(21);"ASSIGNMENT TIME REPORT":PRINT TAB(25);"A
S OF ";D$
8360 PRINT TAB(21);"SUMMARY BY ASSIGNMENT"
8370 PRINT TAB(15);"MANDAYS   --------- TOTAL HOURS TO DATE ----
------"
8380 PRINT TAB(2);"ASSIGNMENT  EST. ACT.    A    B    C    D
E    F    G  TOT."
8390 FOR A=1 TO NA
8400 PRINT TAB(2);AN$(A);:PRINT TAB(12);ST$(A);:PRINT TAB(14);:P
RINT USINGX$;ED(A);:PRINT TAB(19);:PRINT USING X$;AD(A);:PRINT T
AB(25);:PRINT USINGX$;TA(A);:
8405 PRINT TAB(30);:PRINT USINGX$;TB(A);:PRINT TAB(35);:PRINT US
INGX$;TC(A);:PRINT TAB(40);:PRINT USINGX$;TD(A);
8410 PRINT TAB(45);:PRINT USINGX$;TE(A);:PRINT TAB(50);:PRINT US
INGX$;TF(A);:PRINT TAB(55);:PRINT USINGX$;TG(A);:PRINT TAB(60);:
PRINT USINGX$;TT(A)
8420 NEXT A
8430 PRINT:PRINT TAB(20)"";:INPUT"PRESS <ENTER> TO RETURN TO REP
ORT MENU";Z$
8440 GOTO 8000
8449 REM ** SUMMARY BY EMPLOYEE **
8450 PRINT:INPUT"ENTER EMPLOYEE NAME";ZE$:GOSUB 8560
8460 FOR A=1 TO NA
8470 FOR E=1 TO NE(A)
8480 IF EN$(A,E)=ZE$ THEN GOSUB 8530 ELSE 8490
8490 NEXT E
8500 NEXT A
8510 PRINT:PRINT TAB(20)"";:INPUT"WANT ANOTHER EMPLOYEE (Y/N)";Z
$
8520 IF Z$="Y" THEN CLS:GOTO 8450 ELSE GOTO 8000
8530 PRINT AN$(A);" ";LEFT$(AT$(A),13);: PRINT TAB(25);:PRINT US
INGX$;AH(A,E);:PRINT TAB(30);:PRINT USINGX$;BH(A,E);:PRINT TAB(3
5);:PRINT USINGX$;CH(A,E);:PRINT TAB(40);:PRINT USINGX$;DH(A,E);
8540 PRINT TAB(45);:PRINT USINGX$;EH(A,E);:PRINT TAB(50);:PRINT
USINGX$;FH(A,E);:PRINT TAB(55);:PRINT USINGX$;GH(A,E);:PRINT TAB
(60);:PRINT USINGX$;TH(A,E);
8550 RETURN
8560 CLS:PRINT TAB(21);"ASSIGNMENT TIME REPORT"
8570 PRINT TAB(25);"AS OF ";D$
8580 PRINT TAB(22);"SUMMARY BY EMPLOYEE"
8590 PRINT"EMPLOYEE: ";ZE$
8600 PRINT"------ ASSIGNMENT ------    A    B    C    D    E    F
   G  TOT.":
8610 RETURN
8620 GOTO 8000
8999 REM ** PRINT FILE ROUTINE **
9000 CLS:H$="PRINT THE FILE":GOSUB 19999:PRINT
9005 PRINT"MAKE SURE YOUR PRINTER IS READY!"
9010 INPUT"DO YOU WANT TO CANCEL THIS COMMAND (Y/N)";Z$
9020 IF Z$="N"THEN GOTO 9050
```

Listing continued

```
9030 IFZ$="Y"THEN RETURN ELSE GOTO 9000
9050 CLS:PRINT TAB(25);"REPORT MENU":PRINT
9060 PRINT"1 - DETAILS BY ASSIGNMENT"
9070 PRINT"2 - SUMMARY BY ASSIGNMENT"
9080 PRINT"3 - SUMMARY BY EMPLOYEE"
9090 PRINT"4 - RETURN TO MAIN MENU"
9100 PRINT:INPUT"ENTER YOUR CHOICE (1 TO 4)";Z
9110 ON Z GOTO 9120,9320,9430,9115
9115 RETURN
9119 REM ** DETAILS BY ASSIGNMENT **
9120 PRINT:GOSUB 9625:FOR A=1 TO NA:PRINT A;
9125 LPRINT STRING$ (80,"-")
9130 LPRINT"ASSIGNMENT: ";AN$(A);:LPRINT TAB(23);AT$(A);:LPRINT
TAB(66);"DATE: ";DA$(A)
9140 LPRINT"IN-CHARGE: ";IC$(A);:LPRINT TAB(44);"MANAGER: ";MR$(
A)
9145 LPRINT"ESTIMATED MANDAYS ";:LPRINT USING X$;ED(A);:LPRINT T
AB(29);"ACTUAL MANDAYS: ";:LPRINT USING X$;AD(A);:LPRINT TAB(56)
;"MANDAYS REMAINING: ";:LPRINT USING X1$;RM(A)
9150 LPRINT"ESTIMATED COMPLETION DATE: ";EC$(A);:LPRINT TAB(48);
"ACTUAL COMPLETION DATE: ";AC$(A)
9160 LPRINT"APPROXIMATE PERSONNEL COST: ";:LPRINT USING Y$;AC(A)
;:LPRINT TAB(59);"REPORT NO.: ";RN$(A)
9170 LPRINT:LC=LC+7:IF LC>=50 THEN GOSUB 9620
9180 LPRINT"----------- EMPLOYEE -----------  ------------ TOTAL
 HOURS TO DATE -------------"
9190 LPRINT TAB(36);"A";:LPRINT TAB(42);"B";:LPRINT TAB(48);"C";
:LPRINT TAB(54);"D";:LPRINT TAB(60);"E";:LPRINT TAB(66);"F";:
9195 LPRINT TAB(72);"G";:LPRINT TAB(76);"TOT."
9200 LPRINT:LC=LC+3
9210 FOR E=1 TO NE(A)
9220 LPRINT EN$(A,E);:LPRINT TAB(34);:LPRINT USING X$;AH(A,E);:L
PRINT TAB(40);:LPRINT USING X$;BH(A,E);:
9225 LPRINT TAB(46);:LPRINT USING X$;CH(A,E);:LPRINT TAB(52);:LP
RINT USING X$; DH(A,E);
9230 LPRINT TAB(58);:LPRINT USINGX$;EH(A,E);:LPRINT TAB(64);:LPR
INT USINGX$;FH(A,E);:LPRINT TAB(70);:LPRINT USINGX$;GH(A,E);:LPR
INT TAB(76);:LPRINT USINGX$;TH(A,E)
9240 LC=LC+1:IF LC>=50 THEN GOSUB 9620
9250 NEXT E
9260 LPRINT:LPRINT"TOTALS TO DATE";:LPRINT TAB(34);:LPRINT USING
 X$;TA(A);:LPRINT TAB(40);:LPRINT USING X$;TB(A);:LPRINT TAB(46)
;:LPRINT USING X$;TC(A);:LPRINT TAB(52);:
9261 LPRINT USING X$;TD(A);
9270 LPRINT TAB(58);:LPRINT USING X$;TE(A);:LPRINT TAB(64);:LPRI
NT USING X$;TF(A);:LPRINT TAB(70);:LPRINT USING X$;TG(A);:LPRINT
 TAB(76);:LPRINT USING X$;TT(A)
9275 LPRINT STRING$(80,"-"):LPRINT
9280 LC=LC+4:IF LC>=50 THEN GOSUB 9620
9290 LPRINT:LPRINT:LC=LC+2:IF LC>=50 THEN GOSUB 9620
9300 NEXT A
9310 LPRINT CHR$(11):GOTO 9050
9319 REM ** SUMMARY BY ASSIGNMENT **
9320 FOR T=1 TO 8:LPRINT:NEXT T:GOSUB 9625:GOSUB 9400
9325 LPRINT:LC=LC+10
9330 PRINT:FOR A=1 TO NA:PRINT A;
9340 LPRINT AN$(A);TAB(13);AC$(A);TAB(23);:LPRINT USING X$;ED(A)
;:LPRINT TAB(29);:LPRINT USING X$;AD(A);:LPRINT TAB(34);:LPRINT
USING X$;TA(A);:LPRINT TAB(40);:LPRINT USING X$;TB(A);
9350 LPRINT TAB(46);:LPRINT USING X$;TC(A);:LPRINT TAB(52);:LPRI
NT USING X$;TD(A);:LPRINT TAB(58);:LPRINT USING X$;TE(A);:LPRINT
 TAB(64);:LPRINT USING X$;TF(A);
9360 LPRINT TAB(70);:LPRINT USING X$;TG(A);:LPRINT TAB(76);:LPRI
NT USING X$;TT(A):LPRINT
9370 LC=LC+2:IF LC>=50 THEN GOSUB 9620:GOSUB 9400
9380 NEXT A
9390 LPRINT CHR$(11):GOTO 9050
9400 LPRINT"ASSIGN. #   COMPLETED   MANDAYS   ------------ TOTAL
 HOURS TO DATE -------------"
9410 LPRINT TAB(23);"EST. ACT.";TAB(36);"A";TAB(42);"B";TAB(48);
"C";TAB(54);"D";TAB(60);"E";TAB(66);"F";TAB(72);"G";TAB(76);"TOT
."
9420 LPRINT:LC=LC+3:RETURN
9429 REM ** SUMMARY BY EMPLOYEE **
9430 GOSUB 9625:GOSUB 9590
9440 IF LC>=55 THEN GOSUB 9620:GOSUB 9590
9450 INPUT"ENTER EMPLOYEE NAME";ZE$
9460 LPRINT"EMPLOYEE: ";ZE$
9465 LC=LC+2
9470 FOR A=1 TO NA
9480 FOR E=1 TO NE(A)
9490 IF EN$(A,E)=ZE$ THEN GOSUB 9550 ELSE GOTO 9500
9500 NEXT E
9510 NEXT A
9520 LPRINT:LC=LC+1
9530 PRINT:INPUT"WANT ANOTHER EMPLOYEE (Y/N)";Z$
9540 IF Z$="Y" THEN GOTO 9440 ELSE LPRINT CHR$(11):GOTO 9050
9550 LPRINT AN$(A);:LPRINT TAB(10);LEFT$(AT$(A),22);:LPRINT TAB(
34);:LPRINT USING X$;AH(A,E);:LPRINT TAB(40);:LPRINT USING X$;BH
(A,E);:LPRINT TAB(46);:
9551 LPRINT USING X$;CH(A,E);:LPRINT TAB(52);:LPRINT USING X$;DH
(A,E);
9560 LPRINT TAB(58);:LPRINT USING X$;EH(A,E);:LPRINT TAB(64);:LP
RINT USING X$;FH(A,E);:LPRINT TAB(70);:LPRINT USING X$;GH(A,E);:
LPRINT TAB(76);:LPRINT USING X$;TH(A,E)
9570 LC=LC+1:IF LC>=55 THEN GOSUB 9620:GOSUB 9590
9580 RETURN
9590 LPRINT"---------- ASSIGNMENT ----------  ------------ TOTAL
 HOURS TO DATE -------------"
9600 LPRINT TAB(36);"A";TAB(42);"B";TAB(48);"C";TAB(54);"D";TAB(
60);"E";TAB(66);"F";TAB(72);"G";TAB(76);"TOT."
9610 LPRINT:LC=LC+4:RETURN
9619 REM ** PAGE HEADING **
9620 LPRINTCHR$(11)
9625 LPRINT:LPRINT:LC=0
9630 LPRINT TAB(29);"ASSIGNMENT TIME REPORT"
9640 LPRINT TAB(33);"AS OF ";D$
9650 LPRINT
9660 IF Z=1 THEN LPRINT TAB(29);"DETAILS BY ASSIGNMENT"
9670 IF Z=2 THEN LPRINT TAB(29);"SUMMARY BY ASSIGNMENT"
9680 IF Z=3 THEN LPRINT TAB(30);"SUMMARY BY EMPLOYEE"
9690 LPRINT
9700 RETURN
9999 REM ** END PROGRAM ROUTINE **
10000 CLS:H$="ENDING THE PROGRAM":GOSUB 19999:PRINT
10010 INPUT"DID YOU SAVE THE CURRENT DATA FILE (Y/N)";Z$
10020 IF Z$="Y"THEN CLS:END ELSE RETURN
19999 PRINT TAB((64-LEN(H$))/2);H$:RETURN
```

End

by Theodore M. Diament

SOUND SOFTWARE

Here's a new approach to speech synthesis—Digi-Talk digitizes speech or music you've recorded on a cassette and stores it on disk. Later, it decodes the digital signal to reproduce your original recording.

Computer-generated speech can enhance the effect of programs in a number of ways. For instance, you can provide vocal program directions or game hints, or supply direct feedback in educational programs.

Incorporating speech into TRS-80 programs usually means overcoming hardware and memory limitations. But I've developed a unique way to circumvent these drawbacks. Digi-Talk, an Assembly-language Model III program, is a software-based speech synthesizer.

The Digi-Talk program takes speech recorded on a cassette tape, digitizes it, and sends it back through the computer to reproduce speech. You can also save your speech to disk in digital format.

To run the program, you need a 48K Model III with an audio amplifier or tape player. The program stores approximately one minute of speech on a 48K machine.

Speech Problems

To reproduce speech on the TRS-80 you must overcome several obstacles. Before I address these, however, I'll explain the concepts behind creating speech.

You can produce speech by varying the pitch and volume of sound waves. By attaching an audio amplifier to your Model III, you can send sound waves through the cassette port.

The Key Box

LOAD 80

Model III
48K RAM
Assembly Language
Editor/Assembler
Tape Recorder and
Audio Amplifier

A simple program can send sounds through the cassette port to produce a tone; changing the rate at which the computer sends the pulses changes the pitch. You can produce simple music using these techniques. The Model III has no volume control, however, and this limits speech capability.

Figures of Speech

The Model III accesses cassette output through port 255. Typing in OUT (255),A in Assembly language sends a value to the cassette port. Typing in IN A,(255) lets you receive a value from the cassette port.

You can send two codes to the port to produce a sound. Sending a 2 turns the pulse on, and sending a 1 turns the pulse off. Alternating quickly between pulse on and pulse off produces a tone.

The statement IN A,(255) lets your computer receive the codes. A 233 in the A register means that the cassette port has detected a sound. Receiving a 232 means that it detects no sound.

To create speech on the Model III, you can monitor the cassette input while talking into the cassette recorder microphone. The computer stores the values it receives and echoes them out through the port to reproduce speech on your audio amplifier.

Practically Speaking

While this is good in theory, monitoring the cassette port for any length of time means storing many numbers that use up memory. When your computer monitors the cassette port as someone speaks into the microphone, it receives many consecutive 233 and 232 values.

Thus, simply setting up a loop with the statement IN A,(255) and storing the values in consecutive memory locations doesn't work. You could retrieve all values and send a 1 or 2 to the cassette port when the values are 232 and 233, respectively, but 48K of RAM will give you only five seconds of memory at most.

Another alternative is to store the values in bits instead of bytes. If the computer receives a 233, it sets a bit in a storage area. If it receives a 232, it resets the bit. This gives you eight times as much storage per byte as the previous method, but stores only 20 seconds of speech.

The best approach is to monitor the port and count the number of times the computer receives one value before it changes.

To do this I created a routine to set the high bit in a data byte if the first value received was a 233, and to reset it if the value was a 232 (see the Program Listing). The other 7 bits are counters.

If the next port value is the same as the first, Digi-Talk adds to the count. Otherwise, it starts a new data byte.

For example, my data might indicate that the program received 20 values of 233, followed by 98 values of 232, then 34 values of 233, and so on. This technique lets your Model III store up to 127 values in a byte. Depending on the pulses produced, that can mean quite a long speech.

Using Digi-Talk

To run the program, type in and assemble the Program Listing. Then connect the black cassette input plug from your Model III to the ear socket in your cassette recorder, and press the record and play buttons. Now connect the gray output plug (the larger gray plug) from your computer to an audio amplifier.

When you run the program, a menu of options appears. Type R to record and start speaking into the recorder microphone. Press the break key to end the recording session.

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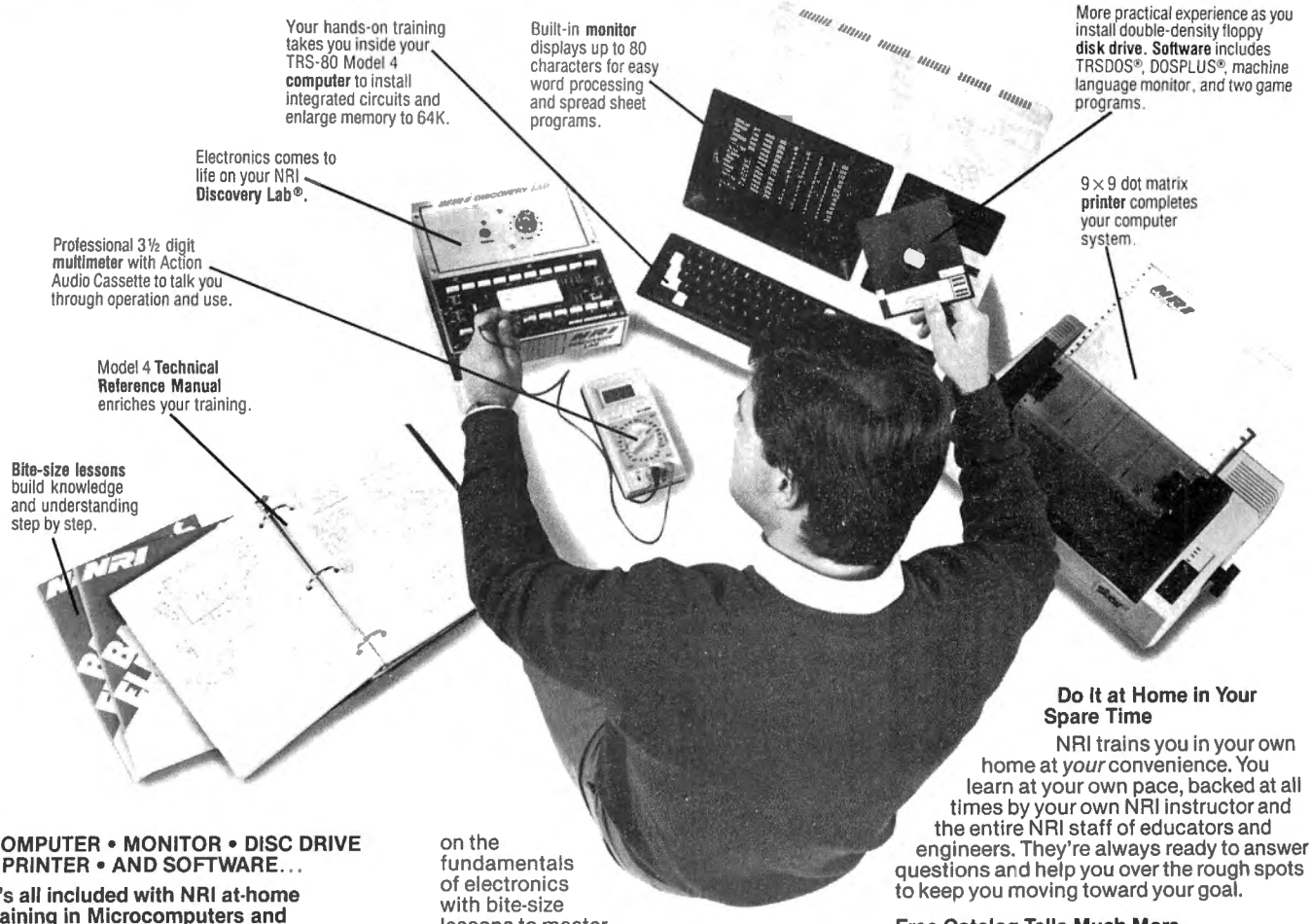

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TRS-80 is a trademark of the Radio Shack division of Tandy Corp.

If you talk too long, the program runs out of memory and crashes. You should be able to speak for 30–60 seconds.

After you press the break key, type P to hear the computer play back what you said. You'll be amazed at the reproduction quality.

To save the speech to disk, type S and a file name. Load it from disk by typing L and the file name.

Last Words

You can use the routines in Digi-Talk in your programs. Remember to leave a large amount of memory for storage. Equate the Data label to the starting memory location of the storage area and call the routines labeled Record or Play.

If you want to compile speech data, note that in the Play routine a data byte value of zero represents the end of the speech.

If you're interested in changing the playback speed, note that the Play routine contains the statement DEFW 0000 hexadecimal in some lines to create a delay of several microseconds. Deleting these lines speeds up play back, and adding to them slows it down.

If you encounter distortion, try to record your speech more clearly, and eliminate background noise.

I suggest incorporating Digi-Talk into games or educational applications where reading instructions becomes tedious. ■

Theodore M. Diament is a computer consultant for two corporations, and is currently a college freshman. Contact him at 148 Wellington Ave., New Rochelle, NY 10804.

Program Listing. Digi-Talk speech synthesizer program.

```
00100 ;--- Speech synthesizer source listing for 80 Micro.
00110 ;--- Written by Theodore Diament in 1984.
00120 ;--- Connect black cassette plug to EAR socket.
00130 ;--- Connect gray cassette output plug to an amplifier.
00140 ;--- Put tape recorder on record.
00150 ;--- When recording, press BREAK to terminate.
00160 ;--- Allows anywhere from 30 to 60 seconds of speech
00170 ;--- on a 48K machine. Do not exceed, or it will bomb.
00180 ;
00190          ORG     5200H           ;END OF DOS
00200 MAIN     CALL    01C9H           ;CLEAR THE SCREEN
00210          LD      HL,MSG1         ;POINT TO MESSAGE
00220          LD      B,14            ;GET NUMBER OF LINES
00230 M1       CALL    021BH           ;DISPLAY A LINE ON SCREEN
00240          DJNZ    M1              ;LOOP TILL DONE
00250 M2       LD      BC,MAIN         ;GET RETURN ADDRESS
00260          PUSH    BC              ;PLACE IT ON THE STACK
00270          LD      B,1             ;GET LENGTH OF INPUT
00280          LD      HL,BUFFER       ;POINT TO BUFFER
00290          CALL    40H             ;GET KEYBOARD INPUT
00300          LD      A,(BUFFER)      ;GET KEYBOARD CHARACTER
00310          RET     C               ;IF <BREAK> THEN RETURN
00320          CP      'Q'             ;IF <Q>
00330          JP      Z,402DH         ; THEN QUIT TO DOS
00340          CP      'R'             ;IF <R>
00350          JP      Z,RECORD        ; THEN RECORD SPEECH
00360          CP      'P'             ;IF <P>
00370          JP      Z,PLAY          ; THEN PLAY BACK SPEECH
00380          CP      'S'             ;IF <S>
00390          JP      Z,SAVE          ; THEN SAVE TO DISK
00400          CP      'L'             ;IF <L>
00410          JP      Z,LOAD          ; THEN LOAD FROM DISK
00420          RET
00430 RECORD   DI                      ;DISABLE INTERRUPTS
00440          LD      HL,DATA-1       ;POINT TO THE DATA-1
00450 R2       LD      A,(14400)       ;GET <BREAK> LOCATION
00460          BIT     2,A             ;IF <BREAK>
00470          JR      NZ,R3           ; THEN EXIT ROUTINE
00480          LD      B,126           ;RESTART COUNTER
00490          INC     HL              ;BUMP POINTER
00500          LD      (HL),1          ;INITIALIZE THE COUNTER
00510          JP      NC,R1           ;IF LOW THEN LEAVE AS IS
00520          SET     7,(HL)          ;ELSE SET HIGH BIT
00530 R1       IN      A,(0FFH)        ;GET CASSETTE INPUT
00540          DEFW    0000H           ;WASTE TIME
00550          DEFW    0000H           ;WASTE TIME
00560          DEFW    0000H           ;WASTE TIME
00570          DEFW    0000H           ;WASTE TIME
00580          CP      233             ;IF HIGH C=0 ELSE C=1
00590          CCF                     ;IF HIGH C=1 ELSE C=0
00600          BIT     7,(HL)          ;IF BYTE IS LOW
00610          JR      Z,LOW           ; THEN GOTO LOW ROUTINE
00620          JP      NC,R2           ;IF LOW SIGNAL THEN EXIT
00630          JR      BUMP            ;ELSE INCREMENT COUNTER
00640 LOW      JP      C,R2            ;IF HIGH SIGNAL THEN EXIT
00650 BUMP     INC     (HL)            ;INCREMENT THE COUNTER
00660          DJNZ    R1              ;LOOP FOR MAXIMUM COUNT
00670          JR      R2              ;IF MAX COUNT THEN INIT
00680 R3       INC     HL              ;GET NEXT BYTE
00690          LD      (HL),0          ;MARK END OF DATA
00700          RET
00710 PLAY     DI                      ;DISABLE INTERRUPTS
00720          LD      HL,DATA         ;POINT TO DATA
00730 P2       LD      A,(HL)          ;GET CURRENT BYTE
00740          AND     127             ;GET 7 LOW BITS
```

Listing continued

Listing continued

```
00750           RET     Z               ;EXIT IF END OF DATA
00760           LD      B,A             ;COUNT=1 TO 127
00770 P1        LD      A,(HL)          ;GET CURRENT BYTE
00780           OR      127             ;A=255 OR A=127
00790           SUB     255             ;IF HIGH C=0 ELSE C=1
00800           CCF                     ;IF HIGH C=1 ELSE C=0
00810           LD      A,1             ;GET LOW OUTPUT CODE
00820           ADC     A,0             ;IF HIGH A=2 ELSE A=1
00830           OUT     (0FFH),A        ;SEND TO CASSETE
00840           DEFW    0000H           ;WASTE TIME
00850           DEFW    0000H           ;WASTE TIME
00860           DEFW    0000H           ;WASTE TIME
00870           DEFW    0000H           ;WASTE TIME
00880           DEFW    0000H           ;WASTE TIME
00890           DJNZ    P1              ;LOOP FOR FULL COUNT
00900           INC     HL              ;BUMP POINTER
00910           JR      P2              ;LOOP TILL DONE
00920 SAVE      CALL    FILSPC          ;GET FILE SPECIFICATION
00930           RET     C               ;IF <BREAK> THEN RESTART
00940           CALL    OPEN            ;PREPARE TO OPEN THE FILE
00950           CALL    4420H           ;INITIALIZE NEW DISK FILE
00960           JP      NZ,ERROR        ;JUMP IF DISK ERROR
00970           LD      HL,DATA         ;POINT TO SPEECH STORAGE
00980 S1        LD      A,(HL)          ;GET CURRENT BYTE
00990           OR      A               ;IF END OF DATA
01000           JP      Z,CLOSE         ; THEN CLOSE THE FILE
01010           LD      DE,DCB          ;ELSE GET DCB
01020           CALL    1BH             ;SEND RECORD TO DISK
01030           JP      NZ,ERROR        ;JUMP IF DISK ERROR
01040           INC     HL              ;BUMP DATA POINTER
01050           JR      S1              ;LOOP TILL DONE
01060 LOAD      CALL    FILSPC          ;GET FILE SPECIFICATION
01070           RET     C               ;IF <BREAK> THEN RESTART
01080           CALL    OPEN            ;PREPARE TO OPEN THE FILE
01090           CALL    4424H           ;OPEN THE DISK FILE
01100           JP      NZ,ERROR        ;JUMP IF DISK ERROR
01110           LD      HL,DATA-1       ;GET DATA AREA - 1
01120 L1        LD      DE,DCB          ;POINT TO DCB
01130           CALL    13H             ;GET DISKETTE BYTE
01140           INC     HL              ;BUMP DATA POINTER
01150           JR      NZ,L2           ;IF BAD READ THEN EXIT
01160           LD      (HL),A          ;ELSE STORE THE BYTE
01170           JR      L1              ;LOOP TILL DONE
01180 L2        LD      (HL),0          ;MARK END OF DATA
01190           CP      1CH             ;IF NOT END OF FILE
01200           JP      NZ,ERROR        ; THEN DISPLAY ERROR
01210           JP      CLOSE           ;CLOSE THE FILE
01220 FILSPC    LD      HL,MSG2         ;POINT TO MESSAGE
01230           CALL    021BH           ;DISPLAY THE MESSAGE
01240           LD      B,12            ;GET MAXIMUM LENGTH
01250           LD      HL,DCB          ;GET DATA CONTROL BUFFER
01260           JP      0040H           ;GET KEYBOARD INPUT
01270 OPEN      LD      HL,BUFFER       ;POINT TO BUFFER
01280           LD      DE,DCB          ;GET DATA CONTROL BUFFER
01290           LD      B,0             ;GET RECORD LENGTH
01300           RET
01310 CLOSE     LD      DE,DCB          ;GET DATA CONTROL BUFFER
01320           CALL    4428H           ;CLOSE THE FILE
01330           JP      NZ,ERROR        ;JUMP IF ERROR
01340           RET
01350 ERROR     OR      192             ;SET BIT 6 AND 7
01360           CALL    4409H           ;DISPLAY ERROR MESSAGE
01370           LD      HL,MSG3         ;POINT TO "Press ENTER"
01380           CALL    021BH           ;DISPLAY THE MESSAGE
01390 E1        CALL    49H             ;WAIT FOR INPUT
01400           CP      0DH             ;IF NOT <ENTER>
01410           JR      NZ,E1           ; THEN LOOP
01420           RET
01430 MSG1      DEFM    '       Speech Synthesizer by '
01440           DEFM    'Theodore Diament (c) 1984'
01450           DEFB    0DH
01460           DEFB    0DH
01470           DEFM    'Attach black cassette input plug to '
01480           DEFM    'the EAR socket.'
01490           DEFB    0DH
01500           DEFM    'Attach gray cassette output plug to '
01510           DEFM    'an audio amplifier.'
01520           DEFB    0DH
01530           DEFM    'Put cassette recorder in RECORD mode.'
01540           DEFB    0DH
01550           DEFM    'When recording, press BREAK to '
01560           DEFM    'to terminate.'
01570           DEFB    0DH
01580           DEFB    0DH
01590           DEFM    'R - Record speech.'
01600           DEFB    0DH
01610           DEFM    'P - Play back speech.'
01620           DEFB    0DH
01630           DEFM    'S - Save speech to diskette.'
01640           DEFB    0DH
01650           DEFM    'L - Load speech from diskette.'
01660           DEFB    0DH
01670           DEFM    'Q - Quit to Disk Operating System.'
01680           DEFB    0DH
01690           DEFB    0DH
01700           DEFM    'Enter your selection: '
01710           DEFB    03H
01720 MSG2      DEFM    'Enter file specification : '
01730           DEFB    03H
01740 MSG3      DEFM    'Press ENTER. '
01750           DEFB    03H
01760 BUFFER    DEFS    256             ;DISK BUFFER AREA
01770 DCB       DEFS    50              ;DATA CONTROL BUFFER AREA
01780 DATA      DEFW    0000H           ;START OF SPEECH STORAGE
01790           END     MAIN            ;EXECUTION LOCATION
```

End

✓ See List of Advertisers on Page 176

by Leland M. Phelps

USR FRIENDLY

This technique for loading USR routines saves time, trouble, and program memory.

You may be put off by USR routines, find them complex and time-consuming, and the very thought of them makes you tense. Relax. I'll explain a painless, nononsense way to load USR data using the disk input/output (I/O) buffers.

I call my technique buffer parking. It saves having to set the top of memory or include long data statements in a Basic program, and you don't have to fuss with a program monitor or T-Bug. What's more, it's free: You don't use a single byte of program memory for USR storage.

The Whys and Wherefores

When you load Disk Basic, most operating systems reserve three 256-byte file buffers plus associated data control blocks. Few programs require more than two file buffers for disk file I/O, leaving you with at least one buffer with room for 255 bytes of USR data. You can always open more files if necessary.

Buffer parking has only three requirements. First, you must be able to relocate the machine-language USR subroutine (no jumps or calls to absolute addresses within the routine). Second, you need a random file containing the USR code. Finally, you have to know the addresses of the buffer(s) you'll use.

Try to use decimal form for the USR code. Integer data in least significant byte/most significant byte (LSB/MSB) format makes it hard to tell routines apart later, because the original machine-language code isn't apparent.

Finding a Parking Space

You can't load the USR data file into a buffer until you find the buffer's starting address. The Table lists the starting addresses of buffers 1-3 for some common DOSes. TRSDOS and NEWDOS80 reserve three I/O buffers when you load Disk Basic. DOSPLUS 3.4D reserves no buffer (zero is default), but you can open three buffers when you get into Basic by typing in BASIC -F:3.

If your DOS isn't in the Table, use my Buffer Finder (Program Listing 1) to locate starting addresses. (If you need only the Table, you can skip to the next section, "Trying It Out.")

To find buffer addresses for your DOS, type in and store Listing 1. Lines

Program Listing 1. Buffer address finder.

```
4 '       ******************************
5 '       *        BUFFIND/BAS         *
6 '       *            BY              *
7 '       *        L. M. PHELPS        *
8 '       ******************************
9 '
20 CLS:PRINT@470,"BUFFER ADDRESS FINDER"
22 DEFINTA-Z
25 PRINT@598,"INPUT DRIVE NO...";:LINEINPUTD$
30 FORI=1TO5:READJ:G$=G$+CHR$(J):NEXT
50 DATA1,2,3,4,5
60 OPEN"R",1,"BUFFIND2/FIL:"+D$
70 FIELD1,5AS A$
80 LSETA$=G$
90 PUT1,1:CLOSE
100 CLS:PRINT"THE SEARCH KEY ' 1 2 3 4 5 ' IS FILED
    IN 'BUFFIND2/FIL'. TYPE 'GOTO 120' TO CONT.."
110 END
120 CLS:PRINT"MOST BUFFER ADDRESSES ARE FOUND IN THE RANGE OF
25450 TO 30750 ---SO START INPUT AT THE BEGINNING OF THAT AREA."
130 PRINT:PRINT"    SINCE THE FILE 'BUFFIND2/FIL' WAS CREATED
    USING BUFFER #1, THE 'KEY' IS ALREADY IN THAT LOCATION.
    THIS TIME AROUND, BOTH BUFFER #1 & #2 CAN BE LOCATED IN ONE
    RUN IF YOU RESPOND TO THE 'INPUT BUFFER #' IN LINE 150"
132 PRINT"    BY TYPING IN '2'."
140 PRINT:PRINT"THEN START SEARCH AT THE LOWEST ADDRESS."
150 PRINT:INPUT"INPUT BUFFER N0. ";N
160 OPEN"R",N,"BUFFIND2/FIL:"+D$
170 GETN,1:CLOSE
180 INPUT"INPUT A TRIAL ADDRESS... ";A
190 B=A:CLS
200 GOSUB270
210 PRINTCHR$(31);
220 FORI=ATOA+199:C=PEEK(I):PRINTC;:IFI=A+199THEN250
222 IFC=1THENK=I
225 IFC=5ANDPEEK(I-1)=4ANDPEEK(I-2)=3ANDPEEK(I-3)=2THEN
PRINT@896,"START ADDR.= ";B;"   BUFFER ADDR. = ";"* ";K;" *"
ELSE230
227 PRINT@960,"  PRESS <BREAK> TO EXIT...";:GOTO250
230 NEXT
250 K$=INKEY$:IFK$=""THEN250ELSE260
260 A=I+1:GOSUB270:GOTO210
270 PRINT@0,"BLK ADDR.="A;:PRINT@28,"PRESS ANY KEY TO CONT...":RETURN
```

End

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120–140 are for information only; you can omit them if you change 120 to 150 in line 100.

The program sets up a visual key, 1 2 3 4 5, and puts it in a random file named BUFFIND2/FIL. The program prompts you to input a buffer number and a trial address (most buffers are between locations 25450 and 30750). The program then loads the search key into the selected buffer and displays a 200-byte block of memory beginning at the start-of-search address.

If the key doesn't appear in the displayed block, press any key to move to the next 200-byte block of memory. Continue until the key numbers appear (see Fig. 1).

The five-digit counter at the top left of the screen represents the starting address of the block. When the search key appears within the block, the digit 1 appears in memory's starting address for the target buffer. Lines 222–225 recognize and validate the key, then print the start-of-search and buffer location addresses at the bottom of the screen.

Even if you want to find all 15 I/O buffers, it should take only a few minutes. After you find each buffer address, press the break key. Then type in GOTO 150 and continue with the next buffer number.

```
BLK ADDR.= 26552              PRESS ANY KEY TO CONT...
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0  0
 0  0  0  0  0  0  0  0  0  0  0  0  1  2  3  4  5

START ADDR.=  26300    BUFFER ADDR. = *  26648  *
  PRESS <BREAK> TO EXIT...
```

Figure 1. Screen display showing search key location in target buffer 2 (NEWDOS80).

Operating System	Version	Model	Buffer Number 1	2	3
TRSDOS	2.3	I	26335	26625	26915
TRSDOS	1.3	III	26232	26592	26952
NEWDOS80	2.0	I	26347	26648	26949
DOSPLUS	3.3	III	28039	28585	29131
DOSPLUS	3.4D	I	28505	29064	29600
DOSPLUS	3.4	III	28527	29073	29619

Table Disk file I/O buffer addresses for selected DOSes.

Program Listing 2. Screen fill program.

```
2 '                  SCRNFILL/BAS
3 '
4 '                   SECTION  A
5 '
6 CLS:PRINT@84,"CREATING USR FILE"
7 DEFINTA-Z
8 PRINT@150,"SCRNFILL/FIL"
10 FORI=1TO12:READJ:U$=U$+CHR$(J):NEXT
15 PRINT:PRINT:LINEINPUT"INPUT DISK DRIVE NO. ...";D$
20 OPEN"R",1,"SCRNFILL/FIL:"+D$
30 FIELD1,12AS A$
40 LSETA$=U$
50 PUT1,1:CLOSE
60 PRINT@468,"SCRNFILL/FIL IS FILED"
70 PRINT:PRINT"TYPE, 'GOTO 200', TO RUN SECTION  1B..."
80 END
100 DATA 33,0,60,17,1,60,1,255,3,237,176,201
150 '
160 '                  SECTION  B
170 '
200 INPUT"INPUT BUFFER #2 ADDRESS...";B
210 OPEN"R",2,"SCRNFILL/FIL:"+D$
220 GET2,1:CLOSE
230 DEFUSR0=B
231 PRINT"TYPE, GOTO 240, TO RUN SECTION  1C..."
235 END
236 '
237 '                  SECTION  C
238 '
240 LINEINPUT"INPUT AN ALPHA CHARACTER...";A$
250 PRINT@0,A$
260 J=USR0(0)
270 GOTO270
```

End

Trying It Out

To create a USR file, you put the USR data into an ASCII string and put the string into a random file. The Basic program opens the random file and places the data in the buffer indicated in the Open statement.

Even if you want to find all 15 I/O buffers, it should take only a few minutes. After you find each buffer address, press the break key.

To demonstrate buffer parking, I'll use a 12-byte machine-language program that fills the screen with a selected alphanumeric character (see Program Listing 2).

The object code taken from the Assembly-language listing is in hexadecimal (hex) format; you must convert it to decimal bytes. The appendix of Radio Shack's Disk Basic manual includes a useful base conversion table. I already converted the hex code in Listing 2 to decimal format.

I've also divided the program by function: Section A creates the USR file, section B loads the USR file into an I/O buffer, and section C executes the USR routine. Sections A and B contain the steps necessary for buffer parking; section C follows standard USR procedure.

Load the program and run section A to store the USR data in the file

SCRNFILL/FIL. With the USR routine in the file, run section B by typing in GOTO 150.

The USR routine should now reside in the first 12 bytes of buffer 2. To check it, type in:

```
CLS:FORI=BTOB+11:PRINT
PEEK(I);:NEXT
```

The top of the screen displays the 12 bytes of the USR routine loaded from SCRNFILL/FIL.

Now type GOTO 240 to run section C. Type in a character, and the screen instantly fills. Line 250 prints the character at screen position zero. Line 260 calls the USR routine, which repeats printing the character 1,023 times.

File It

You can assemble any number of machine-language programs into a USR file as long as the total byte count of the routines loaded into any one buffer doesn't exceed 255. If you need more than 255 bytes, distribute the routines among two or more buffers.

Figure 2 shows a screen display of a typical buffer loaded with 221 bytes of machine-language data representing three separate USR routines. The highlighted decimal values indicate the first byte of each routine; they're the starting addresses you enter in their respective DEFUSRn statements.

It takes only two Basic program lines to load and define the locations of the three USR routines. In this example, the starting address is that of NEWDOS80 buffer 3:

```
80 OPEN"R",3,"USR8/FIL:1":GET3,1:
CLOSE
85 DEFUSR0=26949:DEFUSR1=27011:DEF
USR2=27052
```

That's all there is to buffer parking. Give it a try; it could become one of your favorite programming tools. ■

```
205  127  10  229  78  35  94  35  86  235  121  183  40  9
62  32  190  32  4  13  35  24  243  235  225  113  35  115
35  114  205  127  10  229  6  0  78  35  94  35  86  235  9
43  121  183  40  9  62  32  190  32  4  13  43  24  243  225
113  201  0  0  205  127  10  34  129  105  33  192  63  237
75  129  105  237  66  68  77  42  129  105  17  64  0  237
82  84  93  42  129  105  237  176  58  32  64  214  64  50
32  64  201  205  127  10  229  221  225  221  110  2  221
102  3  229  43  86  43  94  43  43  43  43  43  43  126  221
110  4  221  102  5  213  229  79  203  225  203  57  41  235
41  235  203  57  48  248  203  71  40  8  193  9  235  193  9
235  24  2  193  193  193  9  235  9  6  0  79  221  203  0
70  32  19  213  235  9  229  235  183  237  82  229  193  225
209  40  2  237  176  43  24  19  43  229  183  237  66  229
35  183  237  82  229  193  225  209  40  2  237  184  235  71
62  0  119  43  16  252  201
```

Figure 2. USR routines in an I/O buffer (221 bytes).

Leland M. Phelps is a mechanical engineer who has been programming in Basic since 1964. You can reach him at P.O. Box 27, Route 3, Northfield, MN 55057.

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The Missing Disassembler

Here's the Model 4 disassembler that Radio Shack forgot—it translates Model 4 object code into more readable source code.

If you've bought a Model 4, you probably know that Radio Shack doesn't offer a disassembler program. And without one, you can't convert your Assembly-language programs into more readable source code. Unless you're good at reading hexadecimal and opcode, you're stuck.

The Model III disassembler is difficult to convert for the Model 4, so I wrote one myself. Disassembler is a 48K Model 4 Basic program that breaks down object code and displays or prints out the source code (see the Program Listing, p. 110).

Using Disassembler

Using the program is easy. You must first know the memory location of the routine you want to disassemble. Enter the starting address in decimal or hexadecimal (hex) format. For hex entries, use the form &HNNNN or NNNNH.

The address must be in the range zero to 65535 (FFFFH). If you answer with a negative number, Disassembler converts it to the correct address by adding 65536. Unless you stop disassembly by pressing the break key, the program continues running; it recycles to 0000 hex when it reaches the top of memory.

For a printout of the disassembled program,. turn on your printer before starting. The program tests whether the printer is available and provides output accordingly (lines 200 and 380). This is a handy technique that programmers often use in Model I/III software, but the Model 4 manual doesn't document it.

Disassembler prints each address in decimal, hex, Z80 opcode, Z80 mnemonic code, and ASCII code (see the Figure for sample output). A hex address indicates absolute and relative jumps. If the program encounters an illegal opcode, it prints "Illegal Command" and beeps.

I wrote Disassembler in standard Microsoft Model 4 Basic, and used no returns to DOS or references to memory addresses. Although I use TRSDOS 6.1, the program should run under any operating system that supports the Model 4 Basic commands. ■

Contact J.C. Sprott at 5002 Sheboygan #207, Madison, WI 53705.

Address		Z80	Z80		
Decimal	Hex	Opcode	Mnemonic Code		ASCII
6267	187B	F6AF	OR	AFH	;
6269	187D	C5	PUSH	BC	;
6270	187E	D5	PUSH	DE	;
6271	187F	F5	PUSH	AF	;
6272	1880	CDF718	CALL	18F7H	;
6275	1883	1E01	LD	E,01H	;
6277	1885	21001D	LD	HL,1D00H	; !
6280	1888	F1	POP	AF	;
6281	1889	2807	JR	Z,1892H	; (
6283	188B	CDD818	CALL	18D8H	;
6286	188E	3E16	LD	A,16H	; >
6288	1890	180A	JR	189CH	;
6290	1892	CDEB19	CALL	19EBH	;
6293	1895	CCDB19	CALL	Z,19DBH	;
6296	1898	FE06	CP	06H	;
6298	189A	3E17	LD	A,17H	; >
6300	189C	D1	POP	DE	;
6301	189D	C1	POP	BC	;
6302	189E	C9	RET		;
6303	189F	D5	PUSH	DE	;
6304	18A0	CDCA18	CALL	18CAH	;
6307	18A3	E5	PUSH	HL	;
6308	18A4	2E00	LD	L,00H	; .
6310	18A6	CDD818	CALL	18D8H	;
6313	18A9	E1	POP	HL	;
6314	18AA	3E11	LD	A,11H	; >
6316	18AC	D1	POP	DE	;
6317	18AD	C9	RET		;
6318	18AE	CDB218	CALL	18B2H	;
6321	18B1	C8	RET	Z	;
6322	18B2	D5	PUSH	DE	;
6323	18B3	CDCA18	CALL	18CAH	;
6326	18B6	2E00	LD	L,00H	; .
6328	18B8	CDEB19	CALL	19EBH	;
6331	18BB	CCDB19	CALL	Z,19DBH	;
6334	18BE	D606	SUB	06H	;
6336	18C0	D1	POP	DE	;
6337	18C1	C8	RET	Z	;

Figure. Sample output from Disassembler.

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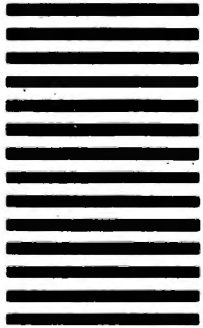

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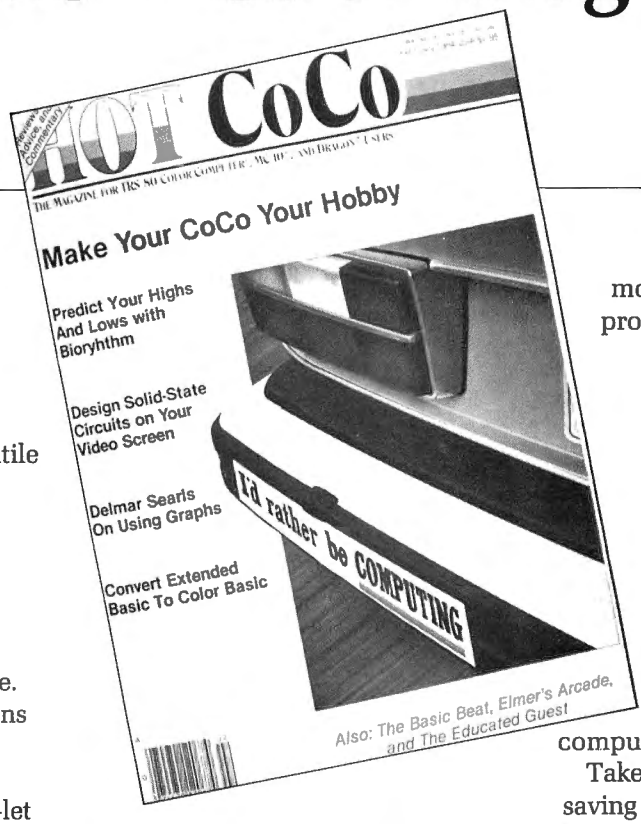
Program Listing. Disassembler program for the Model 4.

```
10 CLS: PRINT TAB(34)"DISASSEMBLER": PRINT
20 PRINT TAB(33)"By J.C. Sprott": PRINT
30 PRINT TAB(22)"For hard copy, turn on line printer.": PRINT
40 DEFSTR A-H: DEFINT I-O: DIM J,I,K,B,G,H,JK,F,L,B(255),A(255),L(255),A1(7),A2(
7),A3(3),A4(27),B1(7),G(3)
50 FOR I=1 TO 25: READ J: L(J)=1: NEXT: FOR I=1 TO 26: READ J: L(J)=2: NEXT
60 FOR I=0 TO 63: READ A(I): NEXT: FOR I=64 TO 127: A(I)="LD": NEXT: A(118)="HAL
T"
70 FOR K=0 TO 7: READ A1(K): NEXT: FOR I=128 TO 191: A(I)=A1((I AND 120)/8): NEX
T
80 FOR I=192 TO 255: READ A(I): NEXT
90 FOR K=0 TO 7: READ B1(K): NEXT
100 FOR I=1 TO 62: READ B(I): READ C: IF C<>"" THEN B(I)=B(I)+","+C
110 NEXT
120 FOR I=64 TO 127: B(I)=B1((I AND 56)/8)+","+B1(I AND 7): NEXT: B(118)=""
130 FOR I=128 TO 143: B(I)="A,"+B1(I AND 7): NEXT
140 FOR I=144 TO 191: B(I)=B1(I AND 7): NEXT
150 FOR I=192 TO 255: READ B(I): READ C: IF C<>"" THEN B(I)=B(I)+","+C
160 NEXT
170 FOR K=0 TO 7: READ A2(K): NEXT: FOR K=1 TO 3: READ A3(K): NEXT: FOR K=0 TO 2
7: READ A4(K): NEXT
180 INPUT"Starting address";AZ: IF AZ="" THEN Z=0 ELSE IF RIGHT$(AZ,1)="H" THEN
Z=VAL("&H"+LEFT$(AZ,LEN(AZ)-1)) ELSE Z=VAL(AZ)
190 IF Z>-32769! AND Z<32768! THEN I=Z ELSE IF Z>32767 AND Z<65536! THEN I=Z-655
36! ELSE PRINT"Illegal starting address": SOUND 7,0: GOTO 180
200 LP=((INP(248) AND 240)=48)
210 CLS: PRINT" ADDRESS";TAB(12)"HEX";TAB(24)"OPCODE";TAB(36)"SOURCE CODE";TAB(6
2)"ASCII"
220 IF LP THEN LPRINT TAB(5)" ADDRESS";TAB(17)"HEX";TAB(29)"OPCODE";TAB(41)"SOUR
CE CODE";TAB(67)"ASCII"
230 J=PEEK(I): H=HEX$(I): IF I<0 THEN Z=65536!+I ELSE Z=I
240 L=LEN(H): IF L<4 THEN H="0"+H: GOTO 240
250 IF J=221 OR J=253 THEN J1=PEEK(I+1): A(J)="ILLEGAL": B(J)="": L=1: GOSUB 520
: L(J)=L: IF A(J)="ILLEGAL" THEN B(J)="COMMAND": ELSE IF J=253 THEN MID$(B(J),IN
STR(B(J),"X"),1)="Y": IF J1=41 THEN B(J)="IY,IY"
260 IF J=237 THEN J1=PEEK(I+1): A(J)="ILLEGAL": B(J)="": L=1: GOSUB 830: L(J)=L:
 IF A(J)="ILLEGAL" THEN B(J)="COMMAND"
270 G="": FOR K=0 TO L(J): G(K)=HEX$(PEEK(I+K)): IF LEN(G(K))<2 THEN G(K)="0"+G(
K)
280 G=G+G(K): NEXT
290 B=B(J): IF INSTR(B,"000NN") THEN MID$(B,INSTR(B,"000NN"),5)=RIGHT$(G,2)+MID$
(G,2*L(J)-1,2)+"H"
300 IF INSTR(B,"00DIS") THEN E=HEX$(Z+PEEK(I+1)+L(J)+1-2*(128 AND PEEK(I+1))): M
ID$(B,INSTR(B,"00DIS")+4-LEN(E),1+LEN(E))=E+"H"
310 IF INSTR(B,"IND") THEN MID$(B,INSTR(B,"IND"),3)=RIGHT$(G,2)+"H"
320 IF INSTR(B,"00N") THEN MID$(B,INSTR(B,"00N"),3)=RIGHT$(G,2)+"H"
330 F="": FOR K=0 TO L(J): JK=PEEK(I+K): IF JK>31 AND JK<128 THEN F=F+CHR$(JK)
340 NEXT
350 IF J=203 THEN J1=PEEK(I+1): IF J1<64 THEN A(J)=A2(INT(J1/8)): B=B1(J1 AND 7)
: IF A(J)="" THEN B=""
360 IF J=203 AND J1>63 THEN A(J)=A3(INT(J1/64)): B=RIGHT$(STR$(J1 AND 7),1)+","+
B1(J1 AND 7)
370 PRINT Z;TAB(12)H;TAB(24)G;TAB(36)A(J);TAB(44)B;TAB(62)"; ";F: IF B="COMMAND"
 THEN SOUND 7,7
380 IF LP THEN LPRINT TAB(5)Z;TAB(17)H;TAB(29)G;TAB(41)A(J);TAB(49)B;TAB(67)"; "
;F
390 IF I>32766-L(J) THEN I=I+L(J)-65535!: GOTO 230
400 I=I+1+L(J): GOTO 230
410 DATA 6,14,16,22,24,30,32,38,40,46,48,54,56,62,198,203,206,211,214,219,222,23
0,238,246,254
420 DATA 1,17,33,34,42,49,50,58,194,195,196,202,204,205,210,212,218,220,226,228,
234,236,242,244,250,252
430 DATA NOP,LD,LD,INC,INC,DEC,LD,RLCA,EX,ADD,LD,DEC,INC,DEC,LD,RRCA,DJNZ,LD,LD,
INC,INC,DEC,LD,RLA,JR,ADD,LD,DEC,INC,DEC,LD,RRA,JR,LD,LD,INC,INC,DEC,LD,DAA,JR,A
DD,LD,DEC,INC,DEC,LD,CPL,JR,LD,LD,INC,INC,DEC,LD,SCF,JR,ADD,LD,DEC,INC,DEC,LD,CC
F
440 DATA ADD,ADC,SUB,SBC,AND,XOR,OR,CP
450 DATA RET,POP,JP,JP,CALL,PUSH,ADD,RST,RET,RET,JP,,CALL,CALL,ADC,RST,RET,POP,J
P,OUT,CALL,PUSH,SUB,RST,RET,EXX,JP,IN,CALL,,SBC,RST,RET,POP,JP,EX,CALL,PUSH,AND,
RST,RET,JP,JP,EX,CALL,,XOR,RST,RET,POP,JP,DI,CALL,PUSH,OR,RST,RET,LD,JP,EI,CALL,
,CP,RST
460 DATA B,C,D,E,H,L,(HL),A
470 DATA BC,000NN,(BC),A,BC,,B,,B,,B,00N,,,AF,AF',HL,BC,A,(BC),BC,,C,,C,,C,00N,,
,,00DIS,,DE,000NN,(DE),A,DE,,D,,D,,D,00N,,,00DIS,,HL,DE,A,(DE),DE,,E,,E,,E,00N,,,
NZ,00DIS,HL,000NN,(000NN),HL,HL,,H,,H,,H,00N,,,Z,00DIS,HL,HL,HL,(000NN),HL,,L,,L
,,L
480 DATA 00N,,,NC,00DIS,SP,000NN,(000NN),A,SP,,(HL),,(HL),,(HL),00N,,,C,00DIS,HL
,SP,A,(000NN),SP,,A,,A,,A,00N,NZ,,BC,,NZ,000NN,000NN,,NZ,000NN,BC,,A,00N,0,,Z,,,
,Z,000NN,,,Z,000NN,000NN,,A,00N,8,,NC,,DE,,NC,000NN,00N,A,NC
490 DATA 000NN,DE,,00N,,10H,,C,,,,C,000NN,A,00N,C,000NN,,,A,00N,18H,,PO,,HL,,PO,
000NN,(SP),HL,PO,000NN,HL,,00N,,30H,,PE,,(HL),,PE,000NN,DE,HL,PE,000NN,,,00N,,28
H,,P,,AF,,P,000NN,,,P,000NN,AF,,00N,,30H,,M,,SP,HL,M,000NN,,,M,000NN,,,00N,,38H,
""
500 DATA RLC,RRC,RL,RR,SLA,SRA,,SRL,BIT,RES,SET
510 DATA LDI,CPI,INI,OUTI,,,,,LDD,CPD,IND,OUTD,,,,,LDIR,CPIR,INIR,OUTIR,,,,,LDDR
,CPDR,INDR,OTDR
520 IF J1=9 THEN A(J)="ADD": B(J)="IX,BC"
530 IF J1=25 THEN A(J)="ADD": B(J)="IX,DE"
540 IF J1=33 THEN A(J)="LD": B(J)="IX,000NN": L=3
550 IF J1=34 THEN A(J)="LD": B(J)="(000NN),IX": L=3
560 IF J1=35 THEN A(J)="INC": B(J)="IX"
570 IF J1=41 THEN A(J)="ADD": B(J)="IX,IX"
580 IF J1=42 THEN A(J)="LD": B(J)="IX,(000NN)": L=3
590 IF J1=43 THEN A(J)="DEC": B(J)="IX"
600 IF J1=52 THEN A(J)="INC": B(J)="(IX+IND)": L=2
610 IF J1=53 THEN A(J)="DEC": B(J)="(IX+IND)": L=2
620 IF J1=54 THEN A(J)="LD": B(J)="(IX+"+HEX$(PEEK(I+2))+"H),00N": L=3
630 IF J1=57 THEN A(J)="ADD": B(J)="IX,SP"
640 IF (J1 OR 56)=126 AND J1<111 THEN A(J)="LD": B(J)=B1((J1-70)/8)+",(IX+IND)":
 L=2
650 IF (J1 OR 7)=119 AND J1<>118 THEN A(J)="LD": B(J)="(IX+IND),"+B1(J1-112): L=
2
660 IF J1=126 THEN A(J)="LD": B(J)="A,(IX+IND)": L=2
670 IF J1=134 THEN A(J)="ADD": B(J)="A,(IX+IND)": L=2
680 IF J1=142 THEN A(J)="ADC": B(J)="A,(IX+IND)": L=2
690 IF J1=150 THEN A(J)="SUB": B(J)="(IX+IND)": L=2
700 IF J1=158 THEN A(J)="SBC": B(J)="A,(IX+IND)": L=2
710 IF J1=166 THEN A(J)="AND": B(J)="(IX+IND)": L=2
720 IF J1=174 THEN A(J)="XOR": B(J)="(IX+IND)": L=2
730 IF J1=182 THEN A(J)="OR": B(J)="(IX+IND)": L=2
740 IF J1=190 THEN A(J)="CP": B(J)="(IX+IND)": L=2
750 IF J1=225 THEN A(J)="POP": B(J)="IX"
760 IF J1=227 THEN A(J)="EX": B(J)="(SP),IX"
770 IF J1=229 THEN A(J)="PUSH": B(J)="IX"
780 IF J1=233 THEN A(J)="JP": B(J)="(IX)"
790 IF J1=249 THEN A(J)="LD": B(J)="SP,IX"
800 IF J1=203 AND PEEK(I+3)<63 THEN IF (PEEK(I+3) AND 7)=6 AND PEEK(I+3)<>54 THE
N A(J)=A2((PEEK(I+3) AND 56)/8): B(J)="(IX+"+HEX$(PEEK(I+2))+"H)": L=3
810 IF J1=203 AND PEEK(I+3)>69 THEN IF (PEEK(I+3) AND 7)=6 THEN A(J)=A3((PEEK(I+
3) AND 192)/64): B(J)=RIGHT$(STR$((PEEK(I+3) AND 56)/8),1)+",(IX+"+HEX$(PEEK(I+2
))+"H)": L=3
820 RETURN
830 IF (J1 OR 56)=120 AND J1<>112 THEN A(J)="IN": B(J)=B1((J1 AND 56)/8)+",(C)"
840 IF (J1 OR 56)=121 AND J1<>113 THEN A(J)="OUT": B(J)="(C),"+B1((J1 AND 56)/8)
850 IF J1=66 THEN A(J)="SBC": B(J)="HL,BC"
860 IF J1=67 THEN A(J)="LD": B(J)="(000NN),BC": L=3
870 IF J1=68 THEN A(J)="NEG"
880 IF J1=69 THEN A(J)="RETN"
890 IF J1=70 THEN A(J)="IM": B(J)="0"
900 IF J1=71 THEN A(J)="LD": B(J)="I,A"
910 IF J1=74 THEN A(J)="ADC": B(J)="HL,BC"
920 IF J1=75 THEN A(J)="LD": B(J)="BC,(000NN)": L=3
930 IF J1=77 THEN A(J)="RETI"
940 IF J1=82 THEN A(J)="SBC": B(J)="HL,DE"
950 IF J1=83 THEN A(J)="LD": B(J)="(000NN),DE": L=3
960 IF J1=86 THEN A(J)="IM": B(J)="1"
970 IF J1=87 THEN A(J)="LD": B(J)="A,I"
980 IF J1=90 THEN A(J)="ADC": B(J)="HL,DE"
990 IF J1=91 THEN A(J)="LD": B(J)="DE,(000NN)": L=3
1000 IF J1=94 THEN A(J)="IM": B(J)="2"
1010 IF J1=98 THEN A(J)="SBC": B(J)="HL,HL"
1020 IF J1=103 THEN A(J)="RRD"
1030 IF J1=106 THEN A(J)="ADC": B(J)="HL,HL"
1040 IF J1=111 THEN A(J)="RLD"
1050 IF J1=114 THEN A(J)="SBC": B(J)="HL,SP"
1060 IF J1=115 THEN A(J)="LD": B(J)="(000NN),SP": L=3
1070 IF J1=122 THEN A(J)="ADC": B(J)="HL,SP"
1080 IF J1=123 THEN A(J)="LD": B(J)="SP,(000NN)": L=3
1090 IF J1>159 AND J1<188 THEN IF A4(J1-160)<>"" THEN A(J)=A4(J1-160)
1100 RETURN
```

End

Now you can learn how to use your color computer for more than just games... with HOT CoCo magazine.



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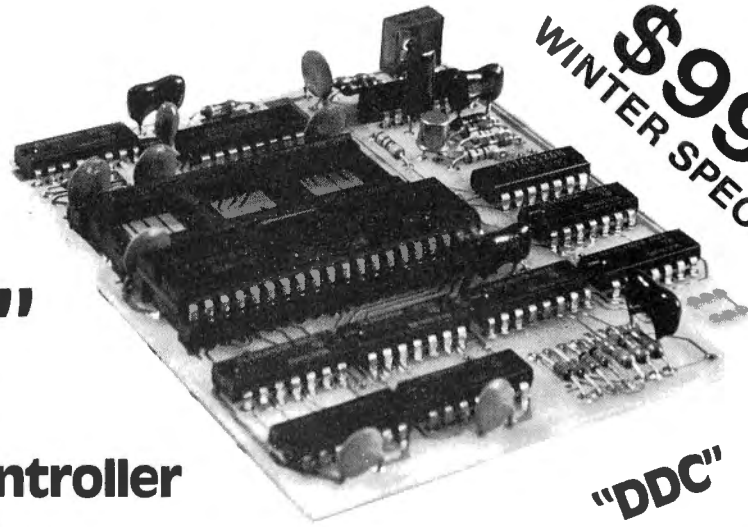

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The test consisted of formatting 40 tracks on the diskette and writing a 6DB6 data pattern on all tracks. The 6DB6 pattern was chosen because it is recommended as a "worst case" test by manufacturers of drives and diskettes. An attempt was then made to read each sector on the disk once - no retrys. Operating system was Newdos/80, Version 1.0, with Double Zap, Version 2.0. Unreadable sectors were totalled and recorded. The test was run ten times with each double density controller and the data averaged. Test results are shown in the table.

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★ TEST RESULTS ★

MFR & PRODUCT	SECTORS LOCKED OUT (AVG)
AEROCOMP "DDC"	0
PERCOM "DOUBLER II"	18
PERCOM "DOUBLER A"	250
LNW "LNDOUBLER"	202

Note: test results available upon written request. All tests conducted prior to 8-25-81

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MFR. & PRODUCT	SECTORS LOCKED OUT	
	WITHOUT "DDS"	WITH "DDS"
PERCOM "DOUBLER II"	18	1
PERCOM "DOUBLER A"	250	0
LNW "LNDOUBLER"	202	0

Note: Same test procedures as "DDC".
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See opposite page ▸▸▸▸▸▸

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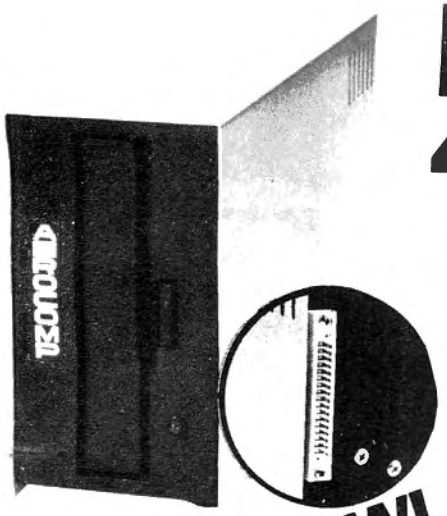

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by Charles F. Alexander

THE DATING GAME

CP/M Plus for the Model 4 has an annoying habit: When you answer its date prompt, it records the following day's date on your disk. Here's how you can correct the problem.

I waited a year for CP/M Plus for the Model 4. And since I wasn't interested in waiting another year for Radio Shack to fix its bugs, I took matters into my own hands.

Every time you boot up CP/M Plus and enter the date, you encounter a bug. The computer records a date one day later than the one you enter. I isolated and corrected this bug, and I'll show you how. I'll also introduce you to CP/M Plus's Basic input/output system (BIOS). Once you know your way around the BIOS, you can begin to unlock the mysteries of your operating system.

Date Stamping

The date-stamping feature of CP/M Plus records the date and time when you create or access a file. But unless you can get around its bug, all date stamps are off by one day. That can be a real problem, especially for business users who need accurate records of file use.

Of course, you can always ignore the initial date and time prompts by pressing only the enter key. But then if you use date/time stamps, you get the default date, Dec. 15, 1982. That's even worse than being one day off.

CP/M Plus's Date.COM utility is much better. With the Date Set command, you can type in the correct date and time. But Date.COM isn't the ultimate solution. The utility requires an extra step or two, and it doesn't actually eliminate the bug.

The Key Box

Model 4
64K RAM
128K RAM with changes indicated
CP/M Plus

Identifying the Culprit

The first question I asked is why the boot-prompted date doesn't work although Date.COM does. The answer lies in the makeup of CP/M Plus. Digital Research Inc.'s CP/M Plus package includes the Basic disk operating system (BDOS), the command control processor (CCP), and transient utilities such as SID, MAC, Date, and dozens of others. These are all proven programs that run on any computer with CP/M capability.

But the BDOS can't communicate with your computer without going through a BIOS. So Radio Shack had to develop a BIOS specific to the Model 4 to complete the CP/M operating system.

When you boot up and get the date and time prompts, you're within Radio Shack's BIOS. The Date.COM utility, however, is independent of the BIOS as a part of Digital's package. The problem, then, is in the BIOS; so is the solution.

Digging In

I'll begin by exploring part of the BIOS. Be sure that you have a disk containing the symbolic instruction debugger (SID) in the default drive. At the system prompt A>, type in SID. You should see a sign-on message and a pound symbol (#), the SID prompt. Type in DCB00 to get a display of the first page of the BIOS (see Fig. 1).

Now type in LCB00 and you'll see the 8080 mnemonics for the first 11 BIOS instructions. Notice that these are all Jump (JMP) instructions. The first 36 instructions in the BIOS make up the jump table (see Table 1).

All implementations of the BIOS, regardless of manufacturer, must start with a jump table in this order. The jump vectors can vary but their relative positions within the jump table must always be the same. This lets CP/M's standard BDOS communicate with different BIOSes. In fact, the jump table is the only way the BDOS can communicate with the BIOS.

Now type in LCB70,CB97. Your screen should look like Fig. 2. This is the main cold boot subroutine; remember, the date error occurs during the boot-up process.

Notice that CB98 hexadecimal (hex) is the vector for cold boot as well as for the warm boot. Look on the screen at the instructions at CB85 hex and CB88 hex. They load the warm boot vector into the HL register and then transfer it to CB01 hex, the address of the cold boot vector in the jump table.

In this way, the system initializes itself to prevent inadvertent cold boots. These two instructions form a trap to prevent destruction of data by software calling for a cold boot.

Now for a step-by-step look at the cold boot. First, the instruction at CB70 hex disables interrupts, letting the boot proceed uninterrupted by hardware maintenance routines. Next, the stack pointer is set to 8100 hex.

The instructions from CB74 to CB7E hex set up and invoke a block move. The source address goes into the HL register, and the destination goes into DE. Then the length of the move goes into BC. An LDIR instruction performs the block move.

The ?? symbols at CB7D indicate that the Z80 instruction lacks a corresponding 8080 instruction. When this happens, the uninterpreted instruction combines with the subsequent instruction; in this case, CB7D and CB7E combine to indicate LDIR in Z80.

What does the block move do? When you load the system, the first logical sector, from 100 to 180 hex, contains the CP/M configuration data. The begin-

ning of the transient program area (TPA) is at 100 hex, so this data must move or the first program you load will overwrite it. The instructions at CB74–CB7E hex move the data to a protected area in high memory.

The instruction at CB7F calls a subroutine that initializes page zero, which contains the entry points to the BIOS and the BDOS, as well as to the file control blocks and default buffer. These aspects of CP/M are beyond the scope of this article.

The remaining instructions complete the cold boot subroutine. Take a closer look at the instruction that calls the sign-on routine at E670 hex.

The Bug Exposed

Type in DE670. You're now looking at the page of the BIOS containing the date bug (see Fig. 3).

Type in LE670,E6A2 (see Fig. 4). The first 10 instructions, from E670–E68D hex, initialize some variables in the system control block (SCB), using the CP/M configuration data. The SCB is a buffer at the top of the BDOS that contains the system variables, including the date and time (see Table 2).

Type in DE670. You're now looking at the page of the BIOS containing the date bug. The section of code from E702-E73A hex is the bug's nest.

The next instruction calls the subroutine at E635 hex, which initializes the drive table. E696 hex prints the sign-on message, while the location of the message text is E82C–E99A hex. The instructions from E6A3–E701 hex prompt you for the date and store your input as six ASCII digits from location E7F6–E7FB hex.

You can check this out by typing in GE6A9,E702 and entering the date at the prompt. The G command runs that section of the program in real time and breaks execution at E702 hex, returning you to the SID prompt (#). Now look at the date buffer by typing in DE7F6, E7FB. You'll see the date you just entered as ASCII digits.

Figure 5 shows the next section of code, from E702–E73A hex. You're looking at the bug's nest. Refer to Table 2, and you'll see that the date is stored in the SCB at location CAF4 hex. The method of storage is the number of days in hex since Jan. 1, 1978.

The instruction at E702 hex retrieves the ASCII code for the year from the date buffer (E7FA–E7FB hex). The subroutine at E7D9 hex converts these 2 ASCII bytes to 1 hex byte. For example, the digits 8 and 4 in ASCII become 54 hex, which is equivalent to 84 decimal.

```
CB00: C3 98 CB C3 98 CB C3 1C CC C3 22 CC C3 2B CC C3  ..........''..+..
CB10: 31 CC C3 37 CC C3 40 CC C3 17 CE C3 EA CD C3 1A  1..7..@.........
CB20: CE C3 1F CE C3 24 CE C3 41 CE C3 5E CE C3 46 CC  .....$..A..←..F.
CB30: C3 32 CE C3 4C CC C3 52 CC C3 58 CC C3 E1 CD C3  .2..L..R..X.....
CB40: 35 D1 C3 E5 CD C3 82 CE C3 87 CE C3 0A D0 C3 F8  5...............
CB50: E5 C3 E9 CD C3 2E CE C3 0F D0 C3 00 00 C3 00 00  ................
CB60: C3 00 00 C3 2D D0 C3 10 D0 C3 43 D0 00 00 00 00  ....-.....C.....
CB70: F3 31 00 81 21 00 01 11 32 E5 01 80 00 ED B0 CD  .1..!...2.......
CB80: B5 CB CD 70 E6 21 98 CB 22 01 CB CD E0 CB CD EF  ...P.!..''......
CB90: CB CD B2 E5 FB C3 00 01 F3 31 00 81 CD B5 CB CD  .........1......
CBA0: E0 CB CD B2 E5 3A AE E5 B7 28 06 21 C8 CF CD 5F  .....:...(.!...._
CBB0: D5 FB C3 00 01 21 00 00 11 01 00 01 FF 00 36 C9  .....!.........6.
```

Figure 1. First page of CP/M Plus's BIOS.

Jump Table Address	Subroutine Address	Name	Description
CB00	CB98	BOOT	cold boot
CB03	CB98	WBOOT	warm boot
CB06	CC1C	CONST	console input status
CB09	CC22	CONIN	console input
CB0C	CC2B	CONOUT	console output
CB0F	CC31	LIST	printer output
CB12	CC37	AUXOUT	auxiliary output
CB15	CC40	AUXIN	auxiliary input
CB18	CE17	HOME	move disk head to Trk 0
CB1B	CDEA	SELDSK	select disk drive
CB1E	CE1A	SETTRK	set track number
CB21	CE1F	SETSEC	set sector number
CB24	CE24	SETDMA	set DMA address
CB27	CE41	READ	read sector
CB2A	CE5E	WRITE	write sector
CB2D	CC46	LISTST	printer status
CB30	CE32	SECTRN	translate sector (logical to physical)
CB33	CC4C	CONOST	console output status
CB36	CC52	AUXIST	aux. input status
CB39	CC58	AUXOST	aux. output status
CB3C	CDE1	DEVTBL	get device table addr.
CB3F	D135	?CINIT	initialize char. i/o
CB42	CDE5	GETDRV	get drive table addr.
CB45	CE82	MULTIO	multiple sector i/o
CB48	CE87	FLUSH	force buffer flushing
CB4B	D00A	?MOVE	memory to memory move
CB4E	E5F8	?TIME	get/set time
CB51	CDE9	BNKSEL	select memory bank
CB54	CE2E	SETBNK	specify bank for i/o
CB57	D00F	?XMOVE	set bank for buffer
CB5A	0000		
CB5D	0000		
CB60	0000		
CB63	D02D		user #1
CB66	D010		user #2
CB69	D043		user #3

Table 1. Jump table for the BIOS.

Apparently, the programmer forgot to include 1978 in the addition, and started the loop with 1979.

```
CB70   DI                    disable interrupts
CB71   LXI    SP,8100        set stack pointer
CB74   LXI    H,0100         source
CB77   LXI    D,E532         destination
CB7A   LXI    B,0080         length of block
CB7D   ??=    ED             should be LDIR in Z80
CB7E   ORA    B              combines with ED above
CB7F   CALL   CBB5           initialize page zero
CB82   CALL   E670           sign-on message
CB85   LXI    H,CB98         prevent future cold boots
CB88   SHLD   CB01
CB8B   CALL   CBE0           initialize devices
CB8E   CALL   CBEF           initialize drives
CB91   CALL   E5B2           load CCP
CB94   EI                    re-enable interrupts
CB95   JMP    0100           jump to CCP
```

Figure 2. Main cold boot subroutine.

Variable Name	Variable Address	Description
@CIVEC	CABE	console input vector
@COVEC	CAC0	console output vector
@AIVEC	CAC2	auxiliary input vector
@AOVEC	CAC4	auxiliary output vector
@LOVEC	CAC6	printer output vector
@BNKBF	CAD1	buffer address for banked BIOS
@CRDMA	CAD8	current DMA address
@CRDSK	CADA	current disk
@VINFO	CADB	BDOS variable "info"
@RESEL	CADC	FCB flag
@FX	CADF	BDOS error message function
@USRCD	CAE0	current user number
@MLTIO	CAE6	current sector count for MULTIO
@ERMDE	CAE7	long or short error messages
@ERDSK	CAEC	error disk
@MEDIA	CAF0	drive door open
@BFLGS	CAF3	BDOS message size flag
@DATE	CAF4	date in days since 1/1/78
@HOUR	CAF6	hour in BCD
@MIN	CAF7	minute in BCD
@SEC	CAF8	second in BCD
?ERJMP	CAFB	BDOS error message vector
@MXTPA	CAFE	maximum TPA address

Table 2. Names and addresses of SCB variables.

The routine tests the year with the ANI 03 instruction to determine if it's odd or even. If it's odd, a flag at E7EB hex increments from 1C to 1D hex. The year then decrements by 4E hex, which corresponds to 78 decimal. At this point, the A register holds the number of years since Jan. 1, 1978: six for 1984.

The instructions at E71B, E71E, and E721 hex set up the registers to total the days per year. The BC register holds the number of days in a regular year (365), and the DE register holds the number of days in a leap year (366).

The next 12 instructions act as a loop for the four-year cycle between leap years. Each time you add days to the HL register, the count of years in the A register decreases. When the A register reaches zero, the sequence jumps out of the loop and stores the number of days in the SCB. If any years remain in the A register at the end of the loop, the loop starts again.

The loop for 1984 begins at E724 hex. The first instruction adds 365 days to the HL register, representing 1978. The A register decreases to five and you skip the conditional jump because the A register isn't zero.

Next, the routine adds 366 days from register DE to HL. This represents 1979, so the number of days should be 365—you have an extra day. If you follow the loop through all six years, you'll see that 1979 and 1983 count as leap years. Here, at long last, is the bug. The instructions at E729 hex and E72E hex are in reverse sequence. Apparently, the programmer forgot to include 1978 in the addition, and started the loop with 1979.

The Fix

Now that you know where the bug is, how do you correct the BIOS? Unfortunately, Radio Shack doesn't supply source files for their implementation of the BIOS. But you've been using a powerful tool all along, the symbolic instruction debugger.

```
E670: 2A 9F E5 22 BE CA 2A A1 E5 22 C0 CA 2A A3 E5 22  *..''..*..''..*..''
E680: C2 CA 2A A5 E5 22 C4 CA 2A A7 E5 22 C6 CA CD 35  ..*..''..*..''...5
E690: E6 3E 80 32 B9 DA 21 26 E8 CD 1B CD 3E 04 D3 E0  .>.2..!,....>...
E6A0: DB EC FB 21 CB E9 CD 1B CD 21 9B E9 CD 1B CD CD  ...!.....!......
E6B0: FC E7 DA 65 E7 32 F6 E7 CD FC E7 DA 65 E7 32 F7  ...E.2......E.2.
E6C0: E7 CD 09 CB CD 18 E8 FE 2F C2 A3 E6 CD FC E7 DA  ......../.......
E6D0: 65 E7 32 F8 E7 CD FC E7 DA 65 E7 32 F9 E7 CD 09  E.2......E.2....
E6E0: CB CD 18 E8 FE 2F C2 A3 E6 CD FC E7 DA 65 E7 32  ...../.......E.2
E6F0: FA E7 CD FC E7 DA 65 E7 32 FB E7 CD 09 CB FE 0D  ......E.2.......
E700: 20 F9 2A FA E7 CD D9 E7 79 E6 03 C2 12 E7 21 EB  .*.....Y.....!.
E710: E7 34 79 DE 4E DA A3 E6 CA A3 E6 21 00 00 01 6D  .4Y.N......!...M
E720: 01 11 6E 01 09 3D CA 38 E7 09 3D CA 38 E7 19 3D  ..N..=.8..=.8..=
```

Figure 3. Page of BIOS containing date bug.

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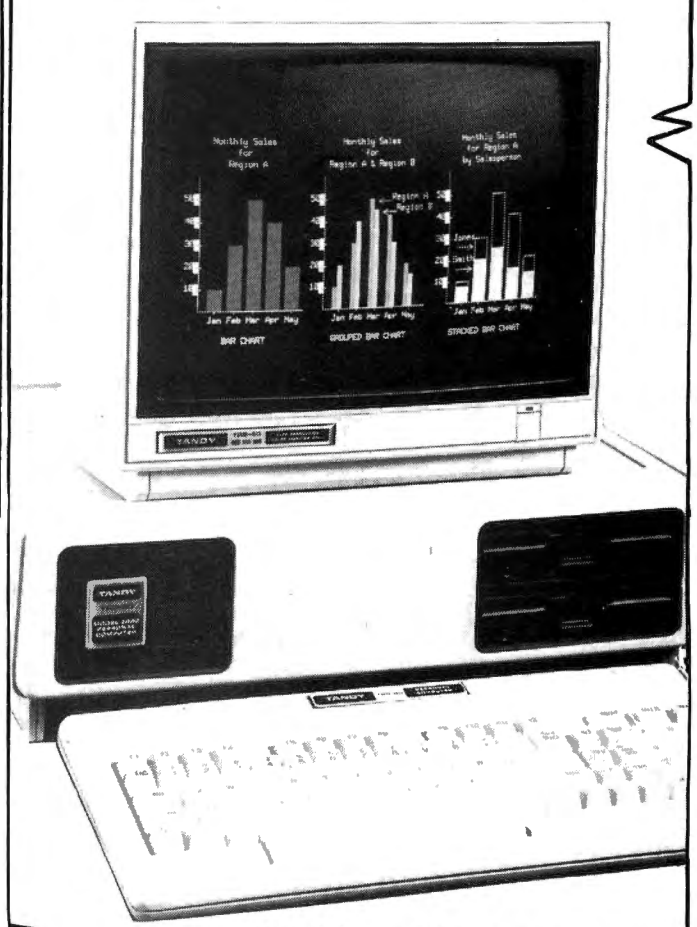

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To get your changes onto disk, you must change the memory image. If you try to save the system to disk from its high memory location, it won't be in proper sequence for the CP/M loader to handle on future boots.

```
E670   LHLD   E59F    get value
E673   SHLD   CABE    @civec
E676   LHLD   E5A1    get value
E679   SHLD   CAC0    @covec
E67C   LHLD   E5A3    get value
E67F   SHLD   CAC2    @aivec
E682   LHLD   E5A5    get value
E685   SHLD   CAC4    @aovec
E688   LHLD   E5A7    get value
E68B   SHLD   CAC6    @lovec
E68E   CALL   E635    initialize drive table
E691   MVI    A,80
E693   STA    DAB9
E696   LXI    H,E82C  print sign-on message
E699   CALL   CD1B
E69C   MVI    A,04
E69E   OUT    E0
E6A0   IN     EC
E6A2   EI
```

Figure 4. Instructions for sign-on routine.

```
E702   LHLD   E7FA    get year
E705   CALL   E7D9    convert to hex digit
E708   MOV    A,C
E709   ANI    03      odd or even
E70B   JNZ    E712    even
E70E   LXI    H,E7EB  odd
E711   INR    M
E712   MOV    A,C
E713   SBI    4E      get # years since 1978
E715   JC     E6A3    invalid year
E718   JZ     E6A3    ''      ''
E71B   LXI    H,0000  clear counter
E71E   LXI    B,016D  365 days
E721   LXI    D,016E  366 days (leap year)
E724   DAD    B       add normal year
E725   DCR    A       one less year to add
E726   JZ     E738    done
E729   DAD    D       add leap year
E72A   DCR    A       one less year to add
E72B   JZ     E738    done
E72E   DAD    B       add normal year
E72F   DCR    A       one less year to add
E730   JZ     E738    done
E733   DAD    B       add normal year
E734   DCR    A       one less year to add
E735   JNZ    E724    repeat until done
E738   SHLD   CAF4    store days in SCB
```

Figure 5. Continuation of instructions for sign-on routine.

Don't correct the bug until you make a back-up of the system disk you regularly use. (Of course, you shouldn't be using the original disk at all, but a back-up of that disk. So you're making a back-up of a back-up.)

Use COPYSYS.COM to create another system back-up. You need CPM3.SYS and CCP.COM on this disk, so answer Y to the program's prompts. You can use PIP.COM to transfer the CCP. Then, make sure CPM3.SYS is Read/Write.

Set.COM should be in your default drive. Type in SET B:CPM3.SYS [RW], if your working copy is on drive B. Return to SID and load the system files into the TPA by typing in SID B:CPM3.SYS at the A> prompt.

The SID sign-on message should look like that in Fig. 6. The value under "Next" shows the next free address after the loaded program. PC tells you that the program begins at 100 hex, the lowest point in the TPA. These two values indicate that the loaded program occupies the space from 100–3FFF hex. The value under "End" shows the highest address available in the TPA when you've got SID.COM resident in memory.

CPM3.SYS is a reverse-order file; the first page you encounter in the TPA is actually the last page of the system. At the SID prompt, type in D04A0,04CF. Then enter DE720,E74F. You're looking at both the memory image of the bug's nest in the TPA, and the final location after it's loaded.

To get your changes onto disk, you must change the memory image. After you load the CPM3.SYS file at boot-up, the CP/M loader program transfers the modules to their final locations. If you try to save the system to disk from its high memory location, it won't be in proper sequence for the CP/M loader to handle on future boots.

To change the memory image, you replace the DAD D (19 hex) instruction at location 04A9 hex with a DAD B (09 hex) instruction. At location 04AE hex

```
NEXT   MSZE   PC    END
4000   4000   100   90FF
```

Figure 6. SID sign-on message.

```
04A0: 01 11 6E 01 09 3D CA 38 E7 09 3D CA 38 E7 19 3D  . . n . . = . 8 . . = . 8 . . =
04B0: CA 38 E7 09 3D C2 24 E7 22 F4 CA 2A F6 E7 CD D9  . 8 . . = . $ . '' . . * . . . .
04C0: E7 21 E9 E7 AF 86 0D 23 C2 45 E7 5F 16 00 2A F4  . ! . . . . . # . E . _ . . * .
```

Figure 7. Map of corrected memory.

do the reverse, replacing a DAD B with a DAD D. This puts the leap year in its proper place, as the second year after 1978.

Type in S04A9. The SID will echo the location and give the present byte value (19). Type 09. This changes the value at 04A9. Press the period key to get out of the set mode. To change the other byte, type in S04AE. Then type 19 at the prompt, and finally, press the period key to get back to the SID prompt.

Now look at the area again by typing in D04A0,04CF (see Fig. 7). Look at the bytes circled in the figure. You should see a 09 hex at 04A9 hex and a 19 hex at 04AE hex.

You can now save the CPM3.SYS file back to disk with the command WB:CPM3.SYS,100,3FFF. This dumps the entire memory image to a file named CPM3.SYS on drive B. If you forgot to set the file already on the disk to Read/Write, you get a write error and the operation aborts.

Now you're ready to test it out. Remove the disks and turn the computer off, then on again. Insert your newly modified system disk into drive A and boot it up. Enter the date and time at the prompts. When you get the CCP prompt, A>, be sure to have Date .COM in the default drive and type in Date. You should get the right date.

Now that you have a corrected back-up, you can overwrite your original back-up CPM3.SYS using COPYSYS .COM. Be sure to set the destination file to Read/Write first. I strongly advise you not to try to modify the original disk supplied by Radio Shack.

Changes for 128K RAM Systems

To correct the date utility in a 128K RAM system, type in the following:

```
SET B:CPM3.SYS[RW]
SID B:CPM3.SYS
S0538
09
.
S053D
19
.
WB:CPM3.SYS,100,5CFF
```

Armed with the utilities I've discussed, you should have no trouble spending hours exploring and experimenting with your Model 4 CP/M Plus. ■

Charles Alexander is a personnel administrator for Ford Motor Company. You can write to him at 188 E. 11th St., Clifton, NJ 07011.

See List of Advertisers on Page 176

by Bob Covington

Rooting Out ROM Routines

The Model III's read-only memory provides many subroutines you've probably been writing by hand. Here's how you can access them.

When programming in Assembly language, you probably find yourself writing a lot of cumbersome subroutines. If so, you may have been wasting your time. The Model III's ROM already contains many useful subroutines that you can access from your programs if you know their memory locations.

I've compiled several tables that provide this information. The areas I've covered include the keyboard, video display, printer, RSTs, interrupts, device control blocks (DCBs), and ROM exits. Be careful when using ROM calls that aren't documented in your technical reference manual, because disk operating systems sometimes destroy vital memory locations the ROM subroutines use.

The Keyboard

The keyboard is memory-mapped and is located from 3801–3880 hexadecimal (hex). Whenever you press a key, the computer sets the corresponding bit in a specific ROM address. Table 1 shows how the computer decodes each key in memory.

When a program requires keyboard input, the routine accessed at 2B hex converts the keyboard memory into ASCII text. Then, 2B hex jumps to the keyboard DCB, which usually jumps to 3024 hex (unless you or the DOS modifies it). The routine at 3024 hex decodes the keyboard memory into ASCII text and returns control to the user.

Table 2 provides a list of keyboard subroutines that use the routine at 2B hex. For example, the routine at 49 hex waits until you type in a character on the keyboard; it then returns the character to the A register. The routines at 40 hex or 5D9 hex insert a line of text into the buffer that HL specifies. The routines at 358 hex and 384 hex call 2B hex and 49 hex, respectively, but do not destroy the DE register. Use caution with the latter routines, because they don't operate properly from DOS Ready.

When your program needs to detect a key quickly, it must scan the memory from 3801–3880 hex to find a specific bit pattern. The Model III ROM uses this technique to determine when you've pressed the break key. It checks the break key every 30 clock cycles if you include a call to the routine at 2BD hex; this is much faster than using the keyboard driver routine to check keys.

The Display

The video display is also memory-mapped, and it's located from 3C00–3FFF hex. Each byte represents one of the 1,024 character positions on the screen. Table 3 describes the ROM calls and important addresses for the video display.

If you load the video memory with an ASCII character, that character appears on the screen. To print a character on the screen, call the routine at 33 hex. This routine loads the C register with the character from the A register, jumps to the video DCB, and usually jumps to the driver routine at 473 hex. This driver provides screen protection, a blinking cursor, a definable cursor, and relative cursor positioning (PRINT@). The routine at hex address 473 uses the extra bytes in the DCB to define the cursor character and position.

The Printer

The printer is a port-mapped device at port number 248 (0F8 hex). When the computer sends output to this port, the printer prints a character. Input from this port provides the printer's current status. Table 4 lists the bit patterns for printer status.

When you tell the computer to print something, it calls the routine at 3B hex. This routine jumps to the printer DCB, which, in turn, jumps to the printer driver at 3C2 hex. The driver checks to see if the printer is ready, prints the character, and updates the line and character count in the DCB.

The ROM has two routines that use the routine at 3B hex. The routine at 1D9 hex prints the screen's contents on the printer. The second routine, at 214 hex, sends a carriage return to the printer.

The Restart Commands

The Z80 microprocessor supports 1-byte calls known as restart (RST)

Bit	3801 Hex	3802 Hex	3804 Hex	3808 Hex	3810 Hex	3820 Hex	3840 Hex	3880 Hex
0	@	H	P	X	0	8	enter	left shift
1	A	I	Q	Y	1	9	clear	right shift
2	B	J	R	Z	2	:	break	
3	C	K	S		3	;	↑	
4	D	L	T		4	,	↓	
5	E	M	U		5	-	←	
6	F	N	V		6	.	→	
7	G	O	W		7	/	space	

Table 1. Keyboard memory configuration.

commands. RSTs can call the hex memory locations 00, 08, 10, 18, 20, 28, and 38 hex. The ROM uses the RST command by putting frequently used subroutines in these memory locations. Table 5 lists information about the RSTs.

Interrupts

The Model III has an elaborate maskable interrupt system that supports easy-to-use interrupts on many of the input/output (I/O) devices. The Model III's hardware allows interrupts in several instances: when the cassette port is high or low (every 33.33 milliseconds), when an interrupt is on the I/O bus, when the RS-232 is ready to transmit, when the RS-232 receives a character, and when an RS-232 error has occurred.

You can enable or disable each interrupt independently by changing the bit patterns on port 224 (0E0 hex). To select an interrupt option, set the appropriate bits on port 0E0 hex (RST 38 hex shows the bit patterns).

When the computer encounters an interrupt, the Z80 executes an RST 38 hex command, which jumps to the routine at 4012 hex, which normally jumps to the ROM interrupt routine. This routine checks to see what caused the interrupt and jumps to the routine at the appropriate address. When this new routine finishes executing, an RET instruction returns to the task that the computer was executing before the interrupt. Most of these jumps are into RAM, and you can direct them into any machine-language program. Table 6 shows the interrupt vectors.

If you don't want to use the ROM interrupt driver, insert a new routine by changing the address at 4012 hex to that of the new driver. This driver must acknowledge the real-time clock and cassette interrupts and jump to them when necessary. If the routine fails to do this, the real-time clock and the cassette don't reset their interrupt requests, and the computer immediately executes an interrupt and locks up.

The Device Control Block

The Model III accesses most of its I/O devices through its DCB. This area of memory contains 8 bytes of data

002B hex	Instantaneous read of keyboard Exit conditions: A ASCII character (A = 0 if no key is pressed) DE Altered
0040 hex	Wait for a line from the keyboard (with length restrictions). Output goes to screen Entry conditions: B Maximum length of line (excluding enter) HL Points to storage buffer in RAM Exit conditions: C flag Status of the break key (if it was the terminator) B Number of characters entered HL Points to storage buffer in RAM DE Altered
0049 hex	Wait for single character from keyboard Exit conditions: A ASCII character DE Altered
028D hex	Check for the break key only Exit conditions: NZ Set if the break key is pressed A Altered
0358 hex	Nondestructive instantaneous read of keyboard This routine does not work from DOS Ready Exit conditions: A ASCII character (A = 0 if no key is pressed)
0384 hex	Nondestructive single character keyboard wait. This routine does not work from DOS Ready Exit conditions: A ASCII character
05D9 hex	(See 0040 hex) Actual routine of 0040 hex
4099 hex	The most recent character entered
400C hex	Called when the break key is pressed
4019 hex	Caps lock switch. 0 = upper- and lowercase, 1 = no lowercase

Table 2. Keyboard subroutines.

See List of Advertisers on Page 176

about each I/O device. The first byte specifies whether the device is an input or output device. The second and third bytes point to the driver routine for the device. The rest of the bytes contain the device's parameters. Table 7 describes the use of each byte in the DCB for all the devices.

Each of the device I/O calls I explained earlier (2B hex, 33 hex, and 3B hex) prepares the computer to use its main I/O routine at 46 hex. When the computer calls an I/O routine, it loads the DE register with the DCB address for that device, jumps to the routine at 13 hex for an input device or the one at 1B hex for an output device, and passes control to the routine at 46 hex. This routine finds the DCB driver address and passes control to the device.

The Model III makes it easy for you to intercept the DCB drivers and write a new driver for any customized application. When you're intercepting an output device, the C register contains the character that will be sent to the device. When you're intercepting input devices, load the A register with the character to be returned from the device. To exit both types of drivers, simply execute an RET (Return) command. If the program filters certain characters only, save the old DCB address and jump to it after the routine is completed.

The Model III ROM offers two powerful subroutines that route and reinitialize the DCBs. Call the routine at 69 hex to reinitialize the DCBs to their original boot-up values. This is especially useful to stop the computer from routing devices.

Calling the routine at 6C hex routes the device at 4222 hex to the one at 4220 hex. Place the name of the device you want to route in each of these addresses. Possible names are KI (keyboard), DO (display), RI (RS-232 in), RO (RS-232 out), and PR (printer). Be careful when routing devices; an error could be disastrous.

Bit	Status
0	Unused
1	Unused
2	Unused
3	Unused
4	Printer fault
5	Device selected
6	Out of paper
7	Busy

Table 4. Bit patterns for the printer's status.

0033 hex Display an ASCII character at current cursor position
Entry conditions:
A ASCII character
Exit conditions:
DE Altered

01C9 hex Clear screen and home cursor
Exit conditions:
All registers altered

021B hex Display a line
Entry conditions:
HL Points to RAM buffer where the text is located (terminated by 03 or 0D hex)
Exit conditions:
HL Points to first character after terminator
DE Altered

0298 hex Turn display clock on
Exit conditions:
A Altered

02A1 hex Turn display clock off
Exit conditions:
A Altered

033A hex Nondestructive single character prints on screen
Entry conditions:
A ASCII character

0FAF hex Print the decimal equivalent to the number in HL at the current cursor position
Entry conditions:
HL Number to be printed
Exit conditions:
A Altered

401C hex Cursor blink switch. 0 = blink, 1 = no blink

4020 hex Cursor address

403D hex Current character per line status. 0=64, 8=32

Table 3. ROM calls and important addresses for the video display.

0000 hex Resets computer

0008 hex Compares the next byte after the call to that of the input buffer. Then it does an RST 10H if there's no syntax error
RAM vector: 4000 hex
ROM vector: 1C96 hex
Entry conditions:
HL Points to RAM buffer (character to be checked)
Byte after RST 08H is character to be checked
Exit conditions:
RST 10H if no error

0010 hex Inputs next non-blank character from RAM buffer
RAM vector: 4003 hex
ROM vector: 1D78 hex
Entry conditions:
HL Points to RAM buffer 1
Exit conditions:
HL Points to character in RAM buffer
A ASCII character
C flag Set if digit (0–9), else reset
Z flag Set if colon (:), else reset

0018 hex Compares DE and HL
RAM vector: 4006 hex
ROM vector: 1C90 hex
Entry conditions:
HL First 16-bit value
DE Second 16-bit value
Exit conditions:
C flag Set if address HL is less than DE, reset if address HL is greater than DE
Z flag Reset if address HL is greater than DE, set if address HL equals DE

0020 hex Checks type flag and sets various flags for its result
RAM vector: 4009 hex
ROM vector: 25D9 hex
Entry conditions:
40AF hex contains type flag
Exit conditions:
S flag Set if integer, otherwise reset
Z flag Set if string, otherwise reset
P/V PO (cleared) if single precision, else PE
C flag Reset on double precision, else set
A Altered

0028 hex Called on break key
RAM vector: 400C hex

0030 hex User-definable Restart
RAM vector: 400F hex

0038 hex Maskable interrupt vector
RAM vector: 4012 hex
Interrupt setup:
4012 hex must contain vector to interrupt routine
Set 0E0 hex to interrupts wanted. Put a copy of value in 4213 hex

Bit
- 7 User-defined interrupt (must be defined through hardware)
- 6 Set for RS-232 interrupt on error
- 5 Set for RS-232 receive interrupt
- 4 Set for RS-232 transmit buffer empty interrupt
- 3 Set for I/O interrupt
- 2 Set for real-time clock interrupt
- 1 Set for 1,500 baud low interrupt (read port 255 to clear interrupt request on each interrupt)
- 0 Set for 1,500 baud high interrupt (read port 255 to clear interrupt request on each interrupt)

Table 5. Restarts from 0000 to 0038 hex.

↙ See List of Advertisers on Page 176

More Features

The Model III ROM contains more exits that let you intercept or completely change the ROM's actions. Most of these exits are designed for the DOS's use, but with care you can use them for any application. Before using any of them, look at a disassembly of the ROM to see what you can and cannot destroy. Table 8 lists all ROM exits and their normal way of return. These exits should be there, assuming no other routines are in place at that address.

Table 9 lists miscellaneous calls, jumps, and memory locations. Each description should give the information you need to access the routine. ■

Write to Bob Covington at 1239 Cheverly Court, St. Louis, MO 63146.

On interrupt:

3365 hex	Vector for cassette high interrupt
3369 hex	Vector for cassette low interrupt
4046 hex	Vector for RTC interrupt
403D hex	Vector for I/O bus interrupt
4206 hex	Vector for RS-232 transmit interrupt
4209 hex	Vector for RS-232 receive interrupt
4040 hex	Vector for RS-232 error interrupt
4043 hex	User defined interrupt (define through hardware)

If ROM routine is not used:

Check bit 2 of 0E0 hex. If it is set, read 0EC hex

Check the bits in Table 5 to see what type of interrupt is generated

Bits are reset for interrupt request

Table 6. Vectors for the interrupts.

Key Word or Function	Hex Address	Type of Return
CMD	4173	RET
Line	41A3	RET
Open	4179	RET
Field	417C	RET
Get	417F	RET
Put	4182	RET
Close	4185	RET
Load	4188	RET
Merge	418B	RET
Name	418E	RET
Kill	4191	RET
LSET	4197	RET
RSET	419A	RET
Save	41A0	RET
System	41E2	RET
Print	41CA	RET
DEF	415B	RET
INSTR	419D	RET
FN	4155	RET
CVI	4152	RET
CVS	4158	RET
CVD	415E	RET
EOF	4161	RET
LOC	4164	RET
LOF	4167	RET
MKI$	416A	RET
MKS$	416D	RET
MKD$	4170	RET
&	4194	RET
Input	41D6	RET
End	41BB	RET
Run + character	41C7	RET
List & LLIST	41DF	RET
NEW	41BB	RET
USR	41A9	RET
1A19H Entry	41AC	RET
After Basic line decode	41B2	RET
During error	41BE	RET
Single key input (358H)	41C4	RET

Table 8. ROM exits and their normal way of return.

Keyboard

4015 hex	Device type (01)
4016 hex	Driver address (3024 hex)
4017 hex	Driver address
4018 hex	System use
4019 hex	Capital character switch
401A hex	System use
401B hex	System use
401C hex	Blinking cursor status (0 = solid, 1 = blinking)

Display

401D hex	Device type (07)
401E hex	Driver address (0473 hex)
401F hex	Driver address
4020 hex	Character position
4021 hex	Character position
4022 hex	Character at cursor position
4023 hex	Cursor character
4024 hex	System use

Printer

4025 hex	Device type (06)
4026 hex	Driver address (03C2 hex)
4027 hex	Driver address
4028 hex	Lines per page
4029 hex	Current line count
402A hex	System use
402B hex	System use
402C hex	System use

RS-232 Input

41E5 hex	Device type (01)
41E6 hex	Driver address (301E hex)
41E7 hex	Driver address
41E8 hex	Input byte
41E9 hex	System use
41EA hex	System use
41EB hex	System use
41EC hex	System use

RS-232 Output

41ED hex	Device type (02)
41EE hex	Driver address (3021 hex)
41EF hex	Driver address
41F0 hex	Output byte
41F1 hex	System use
41F2 hex	System use
41F3 hex	System use
41F4 hex	System use

RS-232 Initialize

41F5 hex	Device type (02)
41F6 hex	Driver address (301B hex)
41F7 hex	Driver address
41F8 hex	Baud rate code
41F9 hex	Parity/word length/stop bits
41FA hex	Wait switch
41FB hex	System use
41FC hex	System use

Table 7. How the bytes in the device control blocks are used.

0013 hex Define input device (DCB)
Entry conditions:
DE DCB address
Exit conditions:
A Value of device

001B hex Define output device (DCB)
Entry conditions:
DE DCB address
A Value to put on device

0046 hex Define I/O device
Entry conditions:
BC Pushed
DE DCB address
B 1 for input device, 2 for output device
A Value to put on device (output only)
Exit conditions:
A Value from device (input only)

0060 hex Delay call
Entry conditions:
BC Delay value. Delay is approximately 2.46+ (14.8*BC) = number of microseconds. If value BC is 0000 or 65536, the delay is approximately 1 second.
Exit conditions:
BC Altered
A Altered

022E hex (J) Enable interrupts and return to Basic

260D hex Find address for variable (VARPTR)
Entry conditions:
HL Points to buffer where variable name is stored
Exit conditions:
DE Points to address of variable
All registers altered

2B02 hex Get value of variable or expression (ex. 1 + 1). This call will evaluate any legal statement and return the correct value for the expression
Entry conditions:
HL Points to buffer where variable name is stored
Exit conditions:
DE Contains integer value of variable

1A19 hex Return to Basic level

40B1 hex Pointer to top of memory minus 2

40A2 hex Current line number being executed (FFFF hex if no program is running)

40A4 hex Pointer to start of Basic program

40EA hex Line where last error occurred

40F0 hex Pointer to line where Basic processes error

Table 9. Miscellaneous calls, jumps, and memory locations.

Tidbit #11

I use a cassette-based system and generally store more than one file on a tape. My problem arises when I want to update a file and re-record it over the old code. The tape counter is too inaccurate for me to properly position the record head. So I devised a way to mark the beginning of a program with the PRINT#-1 command and relocate that position with the INPUT#-1 command.

When I dump a file to tape for the first time, I first execute a PRINT #-1, "***" command. This magnetically marks the beginning of the file. The tape stops after execution of this command. Then I execute a command that dumps the file to tape.

To find the same starting point again, I position the tape in about the right spot using the tape counter. Then I put the recorder in the play mode and execute an INPUT#-1;Q$ command. After reading the sync marker *** into Q$, the tape stops, right where I originally started recording the file. Now you can switch the recorder to the record mode and execute the file dump command.

You can add this program to any Basic program that already has Load and Dump routines. All you have to do is add the lines to the end of your program and insert the necessary GOSUB commands.

The program uses the variable X as a flag, and it's set to zero before file transfer by the GOSUBs. You must put the GOSUBs immediately before the commands that read and dump the file to tape, however.

N.A. Douglas
Ottawa, Ontario, Canada

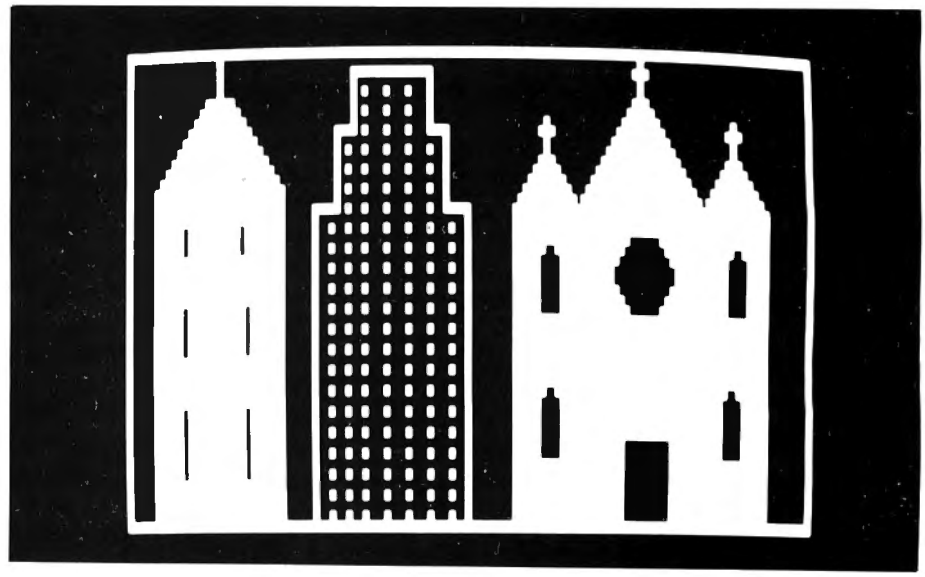
```
    50  X=0:GOSUB1020 REM LINE  FOLLOWING  IS START  OF
   TAPE READ
150 X=0:GOSUB1000M  REM LINE FOLLOWING IS START OF FILE
    DUMP
1000 PRINTCHR$(15)@196,"PRESS -1 TO FIND SYNC
MARKER"@268,"2 TO PLACE SYNC MARKER"@332,"3 TO RETURN
TO MENU"
1010 Q$=INKEY$:IFQ$=""THEN1010ELSEIFASC(Q)<490RASC
     (Q$)>51THEN1010ELSEQ=VAL(Q$):IFQ=3THEN14ELSEIFQ=2
     THEN1060ELSEIFQ=1THENX=1
1020 PRINT@452,"CASSETTE IN >PLAY< MODE ? -";:
Q=0:INPUT "<ENTER> TO FIND SYNC MARKER";Q
1030 IFQ<>0THEN1020ELSEPRINT@580,"LOOKING FOR SYNC
MARKER.. . .":INPUT#-1,Q$
1040 PRINT@708,"SYNC MARKER "Q$" FOUND -";:Q=0:INPUT
"<ENTER> TO CONTINUE";Q
1050 IFQ<>OTHEN1040ELSEIFX=0RETURN
1060 PRINTCHR$(15)@448,CHR$(31)TAB(4)"CASSETTE IN
>RECORD< MODE ? - ";:Q=0:INPUT"<ENTER> TO CONTINUE";Q
1070 IFQ<>OTHEN1060ELSEIFX=1RETURN
1080 PRINT#-1,"***"
1090 PRINT@580,"sync marker placed - ";:Q=0:INPUT"
<ENTER> TO CONTINUE";Q
1100IFQ<>OTHEN1090ELSERETURN
```

FILL-INS

Filling in graphics shapes on your Model I or III used to be tough work, but not anymore. Paint lets you draw any shape on the screen and fill it in with a touch of the space bar.

Drawing a figure on your screen with a Model I/III graphics program is easy, but filling in that shape isn't much fun. You have to store the graphic in strings, which is cumbersome and wastes memory, or use the Set statement to light each pixel within the shape, which is slow and inflexible. It's even harder to fill in a nonstandard outline you created from the keyboard.

My Paint program makes things much simpler. You draw a shape on the screen, then move to any point within the shape and press the space bar. The program fills in the figure almost instantly (see the Photo).



Drawing the Figure

When you run the program, it automatically draws lines marking the top and bottom of the screen, and lights the point in the center. You use the arrow keys to draw lines; for diagonal lines, press two keys at the same time. You can move without drawing a line or erase a line by holding down the enter key along with the arrow key(s). When you're ready to fill in an enclosed shape, move to any point within the shape and press the space bar.

The Paint routine is fast and the algorithm is highly efficient, so it uses the stack space sparingly. The program passes the location of the point within the shape to the routine by way of a USR statement.

Although the Paint routine is in machine language, you can see how it works by first looking at the algorithm in Basic (see Program Listing 1). Lines 255–290 form the heart of the program.

The X and Y variables store the coordinates of the point position when you press the space bar. The program first determines whether or not it can move the point to the left; if it can, it decrements the X coordinate and starts again at line 255. Otherwise it tries to move the point up. If it can't move the point up or left, the program checks whether it should save the point on the stack in array S; it does so if the point can move right and down and if it finds the point to the southeast blocked.

Then the program checks whether or not it can move the point right or down; if so, it fills in the point, adjusts the coordinates, and starts over. If the point can't move, the program checks what's been added to the stack. If the pointer is zero, the program has completely filled in the figure. Otherwise, the program removes the last point added to the stack and starts the fill from that point.

Adding Speed

Program Listing 2 replaces the Basic version of the algorithm with the machine-language Paint routine. It works the same way, but much faster. The program assumes that you've loaded the machine-language code into memory at F000 hexadecimal (hex). You can put it anywhere, but be sure to reassemble the source code if you have a 32K or 16K machine.

Program Listing 3 is the source code for the Paint routine. The algorithm is the same; so is the logic, with a few exceptions. The routine uses the stack as storage. The program saves the pointer in a buffer so it can indicate when no points remain to be filled.

The program stores the current point in the DE register in Y,X format. The TRYL (try left) subroutine pushes it on the stack; the subsequent subroutines pop DE off to obtain the value and push it back on. The Stack routine does the same, then pushes the point once more. If the routine must return to the location, it leaves the point on the stack.

The TRYR and TRYD subroutines first adjust the registers to test the adjacent point, then test it, then readjust to light the current point, and adjust the registers to move to the new point. All

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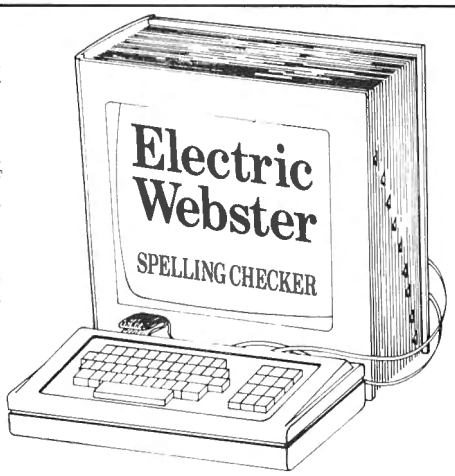

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the Try subroutines remove the current point from the stack after a successful move, replacing register DE with the adjacent point.

I adopted the Test/Set segment of the program from William Barden's book, *TRS-80 Assembly Language Programming* (Radio Shack, 1980). The last section of code replaces a space with an empty graphics block before setting any points, preventing extraneous pixels' being lit and making for neater painting.

You can use the program as is to create graphics, or you can incorporate it into games, computer-assisted design programs, or applications. It gives your computer some of the graphics power of more expensive machines, and I think you'll find it an enjoyable and handy addition to your software library. ■

David Lewis is a student majoring in computer science at Union College in Schenectady, NY. You can write to him at 80 Micro, *80 Pine St., Peterborough, NH 03458.*

Program Listing 1. Drawing program with the Paint routine in Basic.

```
5 DEFINTA-Z:CLS:DIMS(200)
8 FOR G=0TO127:SET(G,0):SET(G,47):NEXT: FOR G=0TO47: SET (0,G): SE
T (127,G):NEXT
10 X=64:Y=24:SET(X,Y)
20 FORG=1TO90:NEXT:G=PEEK(14400):IF G=0 THEN 20
25 IF G AND 1 THEN RESET(X,Y)
30 IF G AND 8 THEN Y=Y-1
40 IF G AND 16 THEN Y=Y+1
50 IF G AND 32 THEN X=X-1
60 IF G AND 64 THEN X=X+1
62 IF X<1 THEN X=1 ELSE IF X>126 THEN X=126
64 IF Y<1 THEN Y=1 ELSE IF Y>46 THEN Y=46
65 IF G AND 128 THEN 200 : REM TIME FOR FILL
70 SET (X,Y):GOTO20
200 G=0:RESET (X,Y): REM ERASE POINT
255 IF NOTPOINT(X-1,Y) THEN X=X-1: GOTO 255
260 IF NOTPOINT(X,Y-1)THEN Y=Y-1:GOTO255
265 IF POINT(X+1,Y+1) AND NOTPOINT(X+1,Y) AND NOTPOINT(X,Y+1) THEN
 G=G+1:S(G)=X*256+Y
270 IF NOTPOINT(X+1,Y) THEN SET(X,Y): X=X+1: GOTO 255
280 IF NOTPOINT(X,Y+1) THEN SET (X,Y): Y=Y+1: GOTO 255
290 SET(X,Y):IF G=0 THEN 20
        ELSE X=S(G)/256: Y=S(G)-X*256: G=G-1: GOTO 255
```

End

Program Listing 2. Drawing program with the Paint routine in machine language.

```
5 DEFINTA-Z:CLS:DIMS(200)
7 X=&HF000: MS= X/256:  LS= X-MS*256:  IF PEEK(16396)=201 THEN POK
E 16526,LS: POKE 16527,MS ELSE DEFUSR=X
8 FOR G=0TO127: SET(G,0): SET(G,47): NEXT: FOR G=0TO 47: SET(0,G):
 SET (127,G): NEXT
10 X=64:Y=24:SET(X,Y)
20 FORG=1TO90:NEXT:G=PEEK(14400):IF G=0 THEN 20
25 IF G AND 1 THEN RESET (X,Y)
30 IF G AND 8 THEN Y=Y-1
40 IF G AND 16 THEN Y=Y+1
50 IF G AND 32 THEN X=X-1
60 IF G AND 64 THEN X=X+1
62 IF X<1 THEN X=1 ELSE IF X>126 THEN X=126
64 IF Y<1 THEN Y=1 ELSE IF Y>46 THEN Y=46
65 IF G AND 128 THEN 200 : REM TIME FOR FILL
70 SET (X,Y):GOTO20
200 RESET (X,Y):  G=USR(256*Y+X):GOTO20
```

End

Program Listing 3. Source code for the Paint routine.

```
F000            00020          ORG     0F000H  ;RELOCATABLE ON RE-ASSEMBLY
F000 CD7F0A     00030          CALL    0A7FH   ;GET USR ARGUMENT
F003 EB         00040          EX      DE,HL   ;GET POINT INTO DE
F004 ED7373F0   00050          LD      (BUFFER),SP     ;SAVE STACK POINTER
                00060
F008 D5         00070 TRYL     PUSH    DE      ;SAVE POINT. IT WILL BE DESTROYED
F009 7B         00080          LD      A,E     ;FIND X VALUE
F00A FE01       00090          CP      1       ;MUST BE IN RANGE 1 TO 126
F00C 3809       00100          JR      C,TRYU  ;JUMP IF NOT.
F00E 1D         00110          DEC     E       ;(X-1,Y)
F00F CD79F0     00120          CALL    TEST    ;FIND IF POINT IS LIT OR NOT
F012 2003       00130          JR      NZ,TRYU ;WANT IT UNLIT. SO TRY UP INSTEAD
F014 E1         00140          POP     HL      ;ELSE REMOVE OLD DE FROM STACK
F015 18F1       00150          JR      TRYL    ;AND CONTINUE WITH NEW DE=(X-1,Y)
```

Listing 3 continued

Listing 3 continued

```
                00160
F017 D1         00170 TRYU      POP     DE      ;GET POINT INTO DE REGISTER
F018 D5         00180           PUSH    DE      ;AND SAVE IT AGAIN
F019 7A         00190           LD      A,D     ;FIND Y VALUE
F01A FE01       00200           CP      1       ;MUST BE IN RANGE 1 TO 46
F01C 15         00210           DEC     D       ;(X,Y-1)
F01D CD79F0     00220           CALL    TEST
F020 2003       00230           JR      NZ,STACK        ;JUMP IF LIT
F022 E1         00240           POP     HL      ;ELSE REMOVE POINT
F023 18E3       00250           JR      TRYL    ;AND CONTINUE WITH NEW DE
                00260
F025 D1         00270 STACK     POP     DE      ;GET POINT IN DE REGISTER
F026 D5         00280           PUSH    DE      ;AND SAVE IT AGAIN
F027 D5         00290           PUSH    DE      ;AND SAVE IT YET AGAIN.
F028 1C         00300           INC     E       ;CHECK (X+1,Y)
F029 CD79F0     00310           CALL    TEST
F02C 200C       00320           JR      NZ,CONT1        ;SKIP IF LIT
F02E 14         00330           INC     D       ;CHECK (X+1,Y+1)
F02F CD79F0     00340           CALL    TEST
F032 2806       00350           JR      Z,CONT1 ;WANT THIS ONE LIT
F034 1D         00360           DEC     E       ;CHECK (X,Y+1)
F035 CD79F0     00370           CALL    TEST
F038 2801       00380           JR      Z,TRYR  ;WANT THIS ONE BLACK
F03A D1         00390 CONT1     POP     DE      ;REMOVE POINT FROM STACK IF
                00400                           ;IT DOESN'T SATISFY NEEDS
                00410
F03B D1         00420 TRYR      POP     DE
F03C D5         00430           PUSH    DE
F03D 7B         00440           LD      A,E
F03E FE7F       00450           CP      127
F040 300E       00460           JR      NC,TRYD ;X MUST BE IN RANGE 1 TO 126
F042 1C         00470           INC     E       ;(X+1,Y)
F043 CD79F0     00480           CALL    TEST
F046 2008       00490           JR      NZ,TRYD ;JUMP IF LIT
F048 1D         00500           DEC     E       ;ELSE RESTORE ORIGINAL DE
F049 CD75F0     00510           CALL    SET     ;AND LIGHT POINT
F04C 1C         00520           INC     E       ;GET BACK TO (X+1,Y)
F04D E1         00530           POP     HL
F04E 18B8       00540           JR      TRYL
                00550
F050 D1         00560 TRYD      POP     DE
F051 D5         00570           PUSH    DE
F052 7A         00580           LD      A,D
F053 FE2F       00590           CP      47
F055 300E       00600           JR      NC,UNSTCK
F057 14         00610           INC     D
F058 CD79F0     00620           CALL    TEST
F05B 2008       00630           JR      NZ,UNSTCK
F05D 15         00640           DEC     D
F05E CD75F0     00650           CALL    SET
F061 14         00660           INC     D
F062 E1         00670           POP     HL
F063 18A3       00680           JR      TRYL
                00690
F065 D1         00700 UNSTCK    POP     DE      ;REMOVE CURRENT POINT FROM CONSIDERATI
ON
F066 CD75F0     00710           CALL    SET     ;BUT SET IT FIRST.
F069 AF         00720           XOR     A       ;CLEAR CARRY
F06A 2A73F0     00730           LD      HL,(BUFFER)     ;FIND PREVIOUS STACK VALUE
F06D ED72       00740           SBC     HL,SP   ;FIND DIFFERENCE
F06F C8         00750           RET     Z       ;RETURN IF NONE
F070 D1         00760           POP     DE      ;ELSE GET A NEW DE VALUE
F071 1895       00770           JR      TRYL
                00780
F073 0000       00790 BUFFER    DEFW    00      ;SAVE STACK POINTER
                00800
F075 3EC6       00810 SET       LD      A,0C6H  ;SET B,(HL) INSTRUCTION
F077 1802       00820           JR      TEST10
F079 3E46       00830 TEST      LD      A,46H   ;BIT B,(HL) INSTRUCTION
F07B 32B8F0     00840 TEST10    LD      (INST+1),A      ;STORE BYTE
F07E D5         00850           PUSH    DE      ;SAVE REGISTER FOR TEST
F07F 7A         00860 ADDRES    LD      A,D     ;GET Y VALUE
F080 06FF       00870           LD      B,0FFH  ;-1
F082 04         00880 LOOP      INC     B       ;SUCCESSIVE SUBS FOR DIVISION
F083 D603       00890           SUB     3       ; BY THREE
F085 F282F0     00900           JP      P,LOOP  ;LOOP IF STILL POSITIVE.
F088 C603       00910           ADD     A,3     ; ELSE RESTORE. QUOT IN B, REM IN A.
F08A CB27       00920           SLA     A       ;MULT REMAINDER BY 2
F08C 4F         00930           LD      C,A     ;STORE
F08D 68         00940           LD      L,B     ;QUOTIENT TO L
F08E 2600       00950           LD      H,0
F090 0606       00960           LD      B,6     ;CNT FOR *64.
F092 29         00970 LOOP1     ADD     HL,HL   ;QUOT *2.
F093 10FD       00980           DJNZ    LOOP1   ;CONTINUE UNTIL QUOT*64.
F095 1600       00990           LD      D,0     ;DE NOW HAS ONLY X VALUE.
F097 CB3B       01000           SRL     E       ;FIND IF X IS ODD
F099 3001       01010           JR      NC,CONT ;JUMP IF IT ISN'T
F09B 0C         01020           INC     C       ;C HAS REM*2 + 1
F09C 19         01030 CONT      ADD     HL,DE   ;HL HAS QUOT*2+ INT(X/2)
F09D 11003C     01040           LD      DE,3C00H
F0A0 19         01050           ADD     HL,DE   ;FIND POINT
F0A1 CB21       01060           SLA     C       ;ALIGN TO FIELD
F0A3 CB21       01070           SLA     C
F0A5 CB21       01080           SLA     C
F0A7 3AB8F0     01090           LD      A,(INST+1)      ;GET INSTRUCTION
F0AA 81         01100           ADD     A,C     ;SET FIELD
F0AB 32B8F0     01110           LD      (INST+1),A      ;STORE
F0AE 7E         01120           LD      A,(HL)  ;FIND VALUE OF BYTE
F0AF FE20       01130           CP      32
F0B1 2002       01140           JR      NZ,CONT0        ;JUMP IF NOT SPACE
F0B3 CBAE       01150           RES     5,(HL)  ;MAKE IT 0, NOT 32
F0B5 CBFE       01160 CONT0     SET     7,(HL)  ;MAKE IT A GRAPHICS BYTE
F0B7 CB         01170 INST      DEFB    0CBH
F0B8 00         01180           DEFB    0
F0B9 D1         01190           POP     DE      ;RESTORE REGISTER
F0BA C9         01200           RET             ;FROM CALL
F000            01210           END     0F000H
00000 Total Errors
```

End

↙ See List of Advertisers on Page 176

THE PERFECT WAVE

Use your TRS-80 to measure distances with sound.

Many of us learned about sonar by watching destroyers hunt U-boats in old World War II movies. The destroyer would send out a sound wave (ping) and wait for an echo (pong). The elapsed time between the sound's transmission and reception told the operator how far away the submarine was, and therefore when to drop depth charges.

The project I'll describe lets you develop a sonar measuring system with your Model I/III. While you probably won't be using your micro to track subs, you can use it for other, more practical, applications. Some examples include measuring volume, aiding divers in murky waters, or controlling quality on an assembly line. In a lighter vein, you can also use the program as a game subroutine to create an invisible joystick.

Besides your TRS-80, all you need for this project is a cassette recorder, an audio amplifier, and a piece of cardboard. The program is accurate to the half-centimeter (about two-tenths of an inch) within a range of about 1 to 80 cm (½ inch to 31½ inches), but you can increase the range with a more sensitive microphone and stronger amplifier.

The program, Sonar-80, runs on a Model I or III cassette or disk system. Program Listing 1 is the Basic routine, while Program Listing 2 is the machine code that Listing 1 POKEs into high memory. Line 25 automatically saves the memory size, so you don't have to answer the MEM SIZE? prompt in the future.

The Key Box

Models I and III
16K RAM Cassette Basic
32K RAM Disk Basic
Cassette recorder
Audio amplifier or a radio with phono input jack

Setting Up Your Sonar

Type in Listing 1. Disconnect the AUX and Remote cables from your cassette recorder. Then plug the AUX cable into an audio amplifier or radio with a phono input jack (see Fig. 1). If you own a CTR-41, remove the dummy plug from the MIC jack, too.

Stand the recorder on end and place it face to face with the amp, leaving about 20 cm (8 inches) between the two. Turn the amp on and set the volume to ½. On your recorder, push the record and play buttons while depressing the small record-lock trigger at the rear of the cassette compartment. Type in RUN and press the enter key.

You should now hear a continuous ticking sound and your screen should read:

```
VALUE FROM (HL) = 40
DISTANCE IN CENTIMETERS = 20
```

Underneath this you should see a line of periods with a cursor sitting on top.

If the program locks up, the chances are you've set the volume too low. Hold down the break key and snap your fingers near the cassette mike to break out of the loop. Set the volume slightly higher on the audio amplifier, and run the program again.

When you've got the program running, move the amp closer to the mike. Notice that the distance and register values drop and that the graphics block moves left. If you move the amp away from the mike, the values increase and the cursor moves to the right.

The Assembly-Language Subroutine

I wrote the business end of this program in Assembly language because it must execute quickly. The machine-language subroutine consists of two parts, a pulse generator and a pulse pick-up. The pulse generator sets the HL register to zero and sends one square wave pulse to the cassette port (0FF hexadecimal).

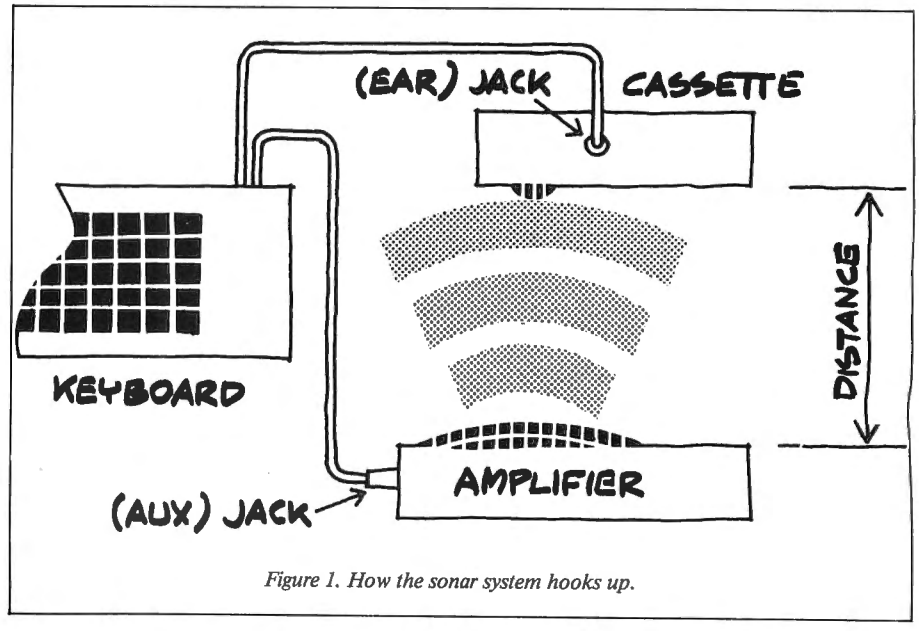

Figure 1. How the sonar system hooks up.

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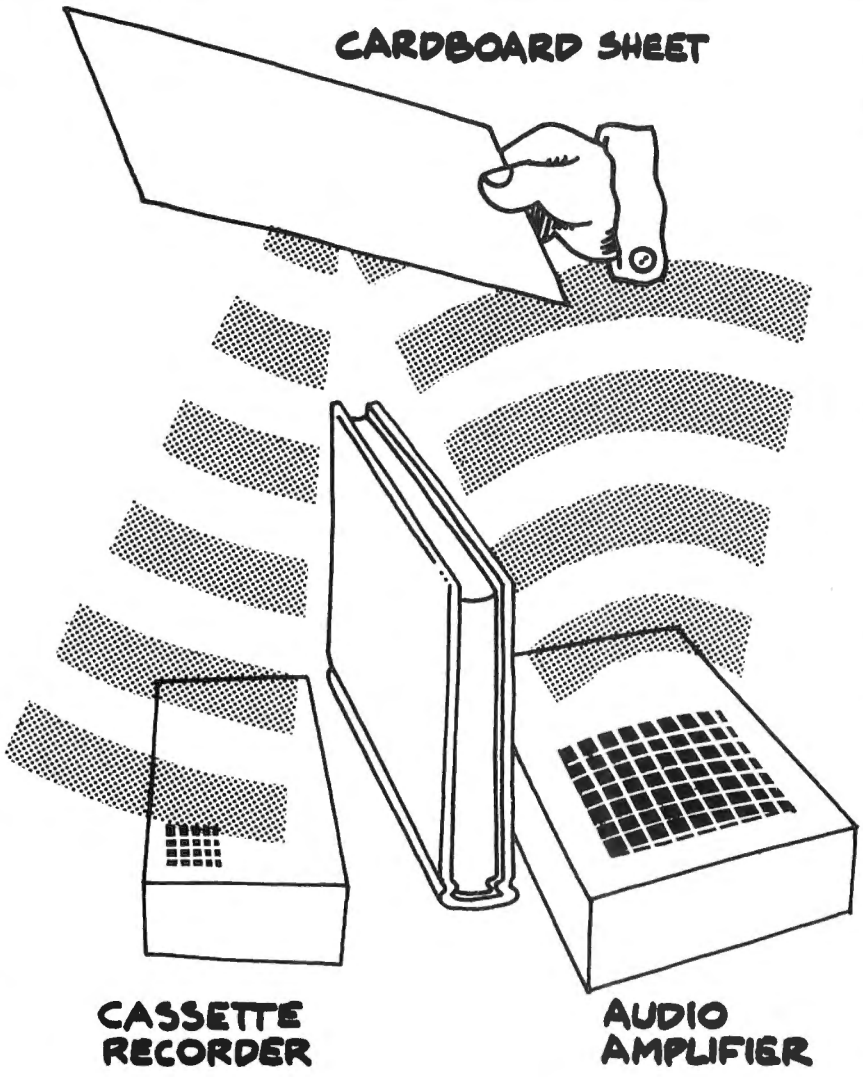

Figure 2. Follow the bouncing sound wave.

This pulse goes to the AUX cable connected to the amp and sends out a ping through the speaker.

When the sound wave begins its journey to the cassette mike, the subroutine enters the pulse pick-up mode. The HL register increments and the computer monitors the cassette port for any incoming signal from the EAR cable connected to the recorder. If it doesn't receive a signal, the program loops back, increments HL, and continues to loop until the mike senses the pulse that caused an exit from the subroutine and a return to Basic. The program then returns an accumulated count in the HL register to Basic.

The monitor shows the value returned to Basic, along with the distance between the mike and the speaker. Line 100 of Listing 1 calculates the distance; if it doesn't match the actual distance, change the .7 value in the formula and check the accuracy again. The speaker response in your amp may be different than it is in mine. Position the amp at various locations and measure the distance to ensure that it corresponds to the display.

Now put the recorder in its normal position on a table and turn the amp on its back. Prop a book between the recorder and amp as shown in Fig. 2. This will keep any stray sound from reaching the mike. Turn on the amp and put the cassette in the record mode. Type in RUN and, while holding a piece of cardboard in a horizontal position about 40 cm above the recorder and

Tidbit #12

Here's a simple way to address envelopes with SuperScripsit that takes advantage of SuperScripsit's user key sequence.

After typing in the last character of your document, leave the cursor in position and print your letter. Then put an envelope in the printer and hit control-U to start the user key sequence. You'll be asked to name your user function with any digit between zero and nine. Follow the instructions below exactly.

Press the enter key, and hit shift/up-arrow, down-arrow until the cursor sits just ahead of the name and address. Now press control-S and the down-arrow until the cursor is just beyond the address block. Hit control-E, control-B, press the C key, hit shift/down-arrow, press the enter key three times, and press control-R. Now position the cursor in front of the new address block and hit control-S, and move the cursor until it's directly beyond the address block. Hit control-E and move the cursor to the desired address position on the envelope (approximately position 3.5). Hit control-M, press the L key, hit control-B, press the A key, hit control-B, press the P key, hit the enter key, then hit control-U.

You've printed the envelope and created a keystroke sequence for addressing future envelopes more efficiently. To print your next envelope, all you do is leave the cursor after the last character of the letter and press the control key along with the user key sequence number you chose earlier. The command sequence is already programmed and will address the envelope as long as your spacing format doesn't change.

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amp, press the enter key. You'll notice that the distance is around 80 cm. This is because the distances from the speaker to the cardboard and from the cardboard to the mike are 40 cm each.

Rapidly move the cardboard up and down. Notice that the graphics block mimics this movement exactly. You can think of the cardboard as the submarine, and the recorder and amp as the destroyer.

Applications

I'm sure you'll be able to come up with some ideas on how to use this sonar system. Here are a few suggestions to get you thinking:

- You could set up a speaker mike at an assembly line (see Fig. 3). As the products move past the speaker and mike, the program measures their distance for proper alignment. When an item is misaligned, an alarm sounds and you can remove or adjust the object.
- A diver working in waters with poor visibility could attach a mike and speaker to his face mask (see Fig. 4). The computer would be on board the boat, and distances of objects could be transmitted to the diver through a small ear speaker. Four clicks in the diver's ear might signify that he is 4 meters from an object.

Blind people might use the same concept, although the person would have to carry a small computer around with him.

- You can use this device to check liquid levels in tanks, by bouncing sound off the liquid's surface (see Fig. 5). This could be especially useful if the tank holds toxic substances.
- Finally, you gamers can use this system to replace a joystick by using a piece of cardboard to move the cursor.

I've kept the Basic program simple to let you adapt it to your needs. The program also shows that the cassette port can be used not only as a digital device, but as an analog-to-digital converter for measuring angles, velocities, and distances without extra hardware. ■

You can reach Michael O'Reilly at Condominio El Pueblo No. 102, Apartado 284, 1100 Tibas, Costa Rica.

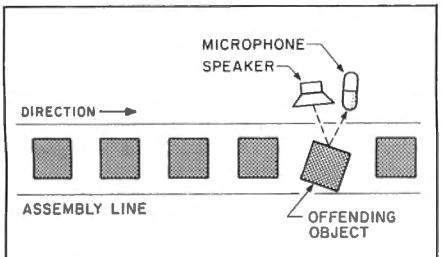

Figure 3. The system can be used to help with quality control on an assembly line.

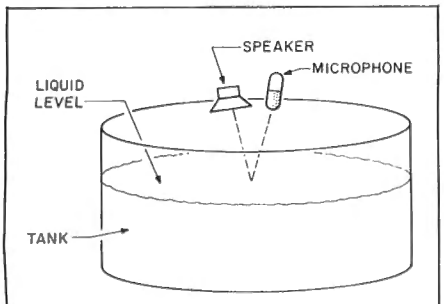

Figure 5. You can use the system to measure volume in vats full of toxic liquid.

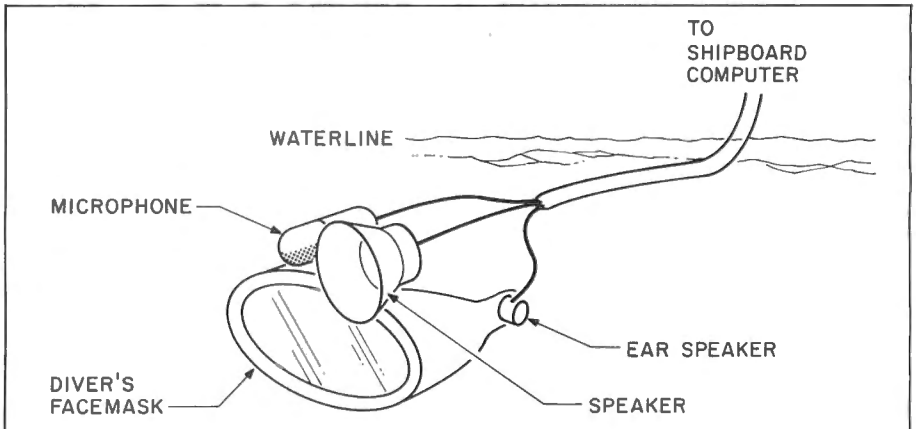

Figure 4. Divers can use sonar to alert them of dangerous objects in murky water.

Program Listing 1. Sonar-80.

```
10 ' ***** SONAR-80 *****
15 ' MODEL I/III CASSETTE OR DISK BASIC
17 ' MODEL III CONVERSION BY THOMAS QUINDRY
20 ' ENTRY ADDRESS 7FE9H   32745D
25 POKE16561,232:POKE16562,127
30 DEFINTA-Z:CLS:CLEAR100
40 FORP=32745TO32765:READA:POKEP,A:NEXT
50 POKE16526,233:POKE16527,127
60 PRINT@320,"!.....
.....!"
65 ON ERROR GOTO 150
70 X=USR(D)
75 ON ERROR GOTO 0
80 PRINT@0,"VALUE FROM (HL)=";X;"     "
90 SET(XAND127,14)
100 PRINT@64,"DISTANCE IN CENTIMETERS=";(X-10)*.7;"     "
110 RESET(XAND127,14)
120 GOTO70
130 END
140 DATA33,0,0,62,1,211,255,62,2,211,255,35,219,255,203,127,40,2
49,195,154,10
150 DEFUSR=32745:RESUME
```

End

Program Listing 2. The Assembly-language subroutine that Sonar-80 POKEs into memory.

```
                00100 ;         ***** SONAR-80 SUBROUTINE *****
                00110 ;
                00120 ;PULSE GENERATOR ***
                00150 ;
7FE9            00160           ORG     7FE9H     ;AND ENTRY
7FE9 210000     00170 PULSE     LD      HL,0      ;WIND UP CLOCK
7FEC 3E01       00180           LD      A,01H     ;000000(01)
7FEE D3FF       00190           OUT     (0FFH),A  ;HIGH
7FF0 3E02       00200           LD      A,02H     ;000000(10)
7FF2 D3FF       00210           OUT     (0FFH),A  ;LOW
                00220 ;
                00230 ;PULSE PICK UP ------------
                00240 ;
7FF4 23         00250 EAR       INC     HL        ;BUMP COUNTER
7FF5 DBFF       00260           IN      A,(0FFH)  ;MONITOR PORT
7FF7 CB7F       00270           BIT     7,A       ;NORMAL GIVES BIT 7 LOW
                00280                             ;SIGNAL GIVES BIT 7 HIGH
7FF9 28F9       00290           JR      Z,EAR     ;IF BIT 7 LOW, LOOP AGAIN
7FFB C39A0A     00300           JP      0A9AH     ;RETURN TO BASIC WITH
                00310                             ;ARGUMENT IN 'HL'
0000            00320           END
00000 Total Errors
```

End

by Michael Conwell

WARNIER DIAGRAMS

Warnier diagrams provide the same information as program flowcharts, but in a more readable format.

Before you can key in code, there's the sometimes lengthy, sometimes arduous task of program design. The basic tool used in this process is the flowchart. The familiar diamond for decisions, parallelogram for input/output, circle for connectors, and arrow to map the sequence of events provide a secure and proven system to visually represent program logic. But despite the flowchart's proven worth, better ways to design programs may exist.

One such method is the Warnier diagram. This system employs braces to define the hierarchy of association and operation, an exclusive OR symbol and a Boolean negation symbol to represent the decision process, and a set of strategically placed parentheses to represent the looping procedure.

Warnier diagrams were developed by Jean Jacques Warnier, a French mathematician, to symbolically describe the hierarchy of relationships within static entities such as corporations. The technique was then adapted for program design.

Hierarchy to Program Logic

Consider the theoretical organization chart in Fig. 1. A Warnier diagram for this hierarchy tips the organization chart on its side, and replaces lines with braces (see Fig. 2). The diagram shows that the president overrides all, followed by all three vice-presidents, the five managers (two, one, and two responsible to each vice president, respectively), and then the workers.

Now consider a simple program to print the even integers from 2 through 100. Figure 3 shows a flowchart for this program; the Warnier diagram of the same program would look like Fig. 4.

The flow begins at the top of the leftmost brace, and continues down until it is directed into another brace (whenever a "universal"—something which spawns a brace—is encountered), at which point control enters from the top and exits from the bottom, returning to the point of origin (the universal that sent it into the brace in the beginning). In both the flowchart and Warnier diagram the flow of execution is:

- Start
- Set NUM to 2
- Go into the loop where:
  a. Print NUM
  b. Increment NUM by 2
- Check the value of NUM; if it is less than 100, then repeat steps a and b until the value exceeds 100, when excecution of the loop is ended.
- Stop.

Consider Fig. 5, a strictly theoretical example. The flowchart description shows a process A, an input of B, a decision on the relationship of A to B with branches depending on the out-

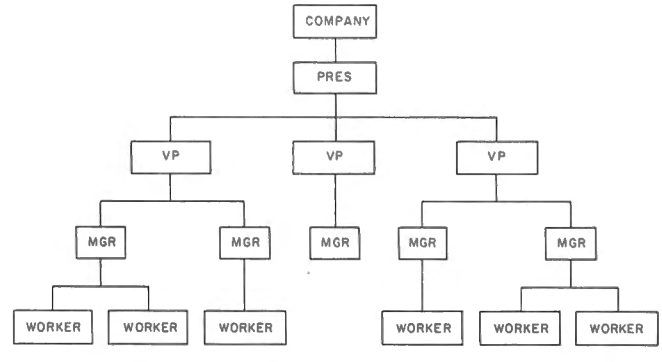

Figure 1. Theoretical organization chart.

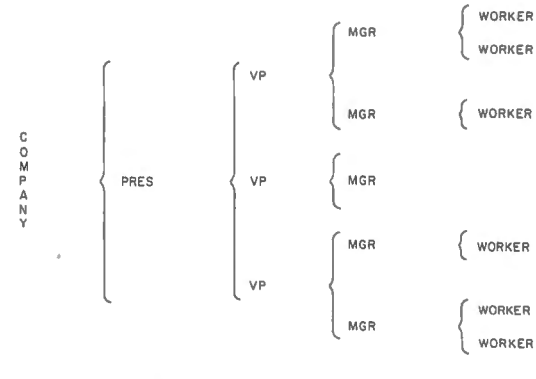

Figure 2. Warnier representation of Fig. 1's flowchart.

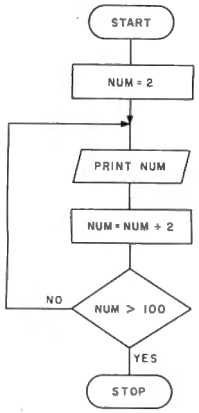

Figure 3. Flowchart of program to print even integers from 2–100.

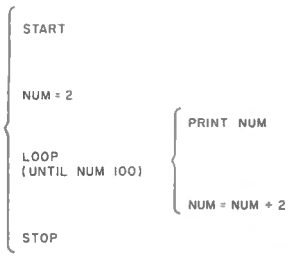

Figure 4. Warnier diagram of program that prints integers from 2–100.

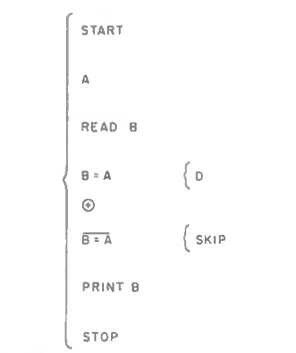

Figure 6. Warnier diagram of Fig. 5's flowchart.

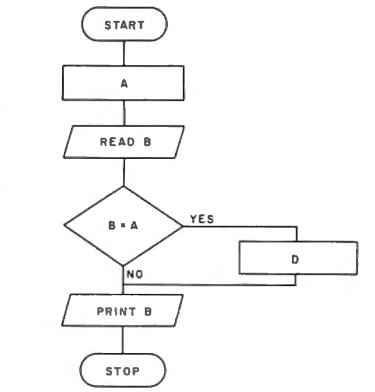

Figure 5. Theoretical flowchart.

come, the printing of B, and finally an end to execution.

The Warnier diagram describes the same thing, but its unique form is demonstrated in Fig. 6.

In this example, the series of executions begins with Start. Next, A is executed and B is read, followed by a decision on the relationship of B to A. If B = A, then D is executed; if the negation of B = A is true, no action occurs at this point (Skip) and control drops down to the next statement, Print B. This statement would be executed following D if B = A was found to be true. Finally, the program would stop executing.

The decision statement uses the exclusive OR symbol (the circle with a cross) and the Boolean negation symbol over its second part. It states that if the decision is true, it cannot also be false. Thus, if B = A, then it cannot be the case that B ≠ A (the exclusive OR concept).

A somewhat more complicated example is found in Fig. 7 and the accompanying Warnier diagram (Fig. 8). Consider the logic of the decision path. If A = B and A = 2*B and A = 3*B, then E is executed. If A=B and A = 2*B, but A ≠ 3*B, then D is executed. The events which follow the various paths are readable and clear. Thus if A≠B, neither E nor D nor C would be executed, only F or G, depending on the condition A = B/2.

A few short paragraphs and illustrations will not convert you to the use of Warnier diagrams. But investigate the alternative, and maybe you will adopt them. Matched against flowcharts for more complex programs, they provide a clearer and more readable presentation of program logic. ■

Michael Conwell can be reached at 321 University Drive, East Lansing, MI 48823.

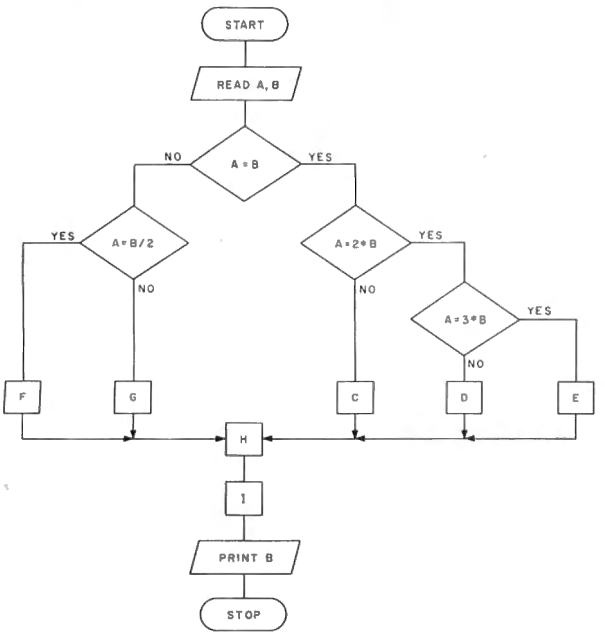

Figure 7. A complex theoretical flowchart.

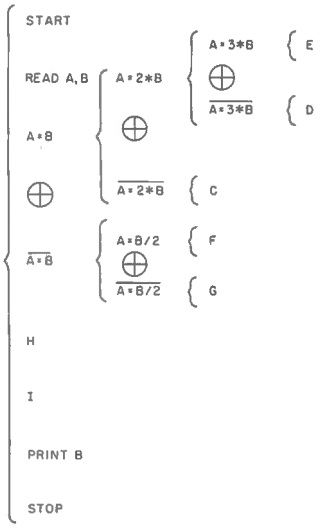

Figure 8. Warnier diagram of Fig. 7's flowchart.

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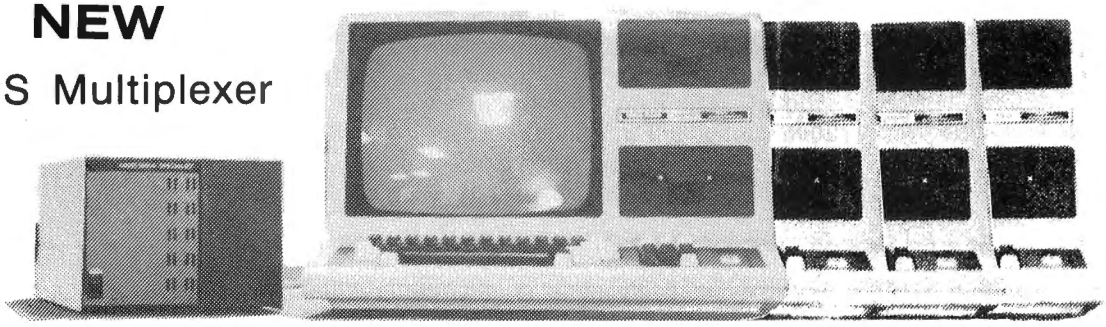

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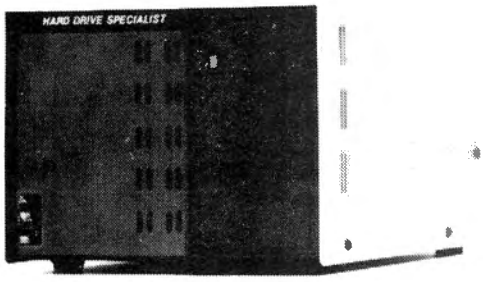

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Listing 1 continued from p. 54

```
03740 SPRCOD  LD      A,0
03750         LD      (SPACE),A
03760         LD      A,255
03770 ENCOST  LD      (BAR),A
03780 ;
03790 ;START LOAD OF PRINT FILE
03800 ;
03810         CALL    STARTB  ;LOAD FIRST BAR SEQUENCE
03820         CALL    DOTLNI  ;CALCULATE DOT LENGTH
03830         CALL    GETDAT  ;LOAD PRINT BUFFER
03840         LD      A,(TNDYCD)
03850         CP      0
03860         JR      NZ,STPCHR
03870         CALL    CKC128  ;CALCULATE CHECK CHAR
03880 STPCHR  CALL    STOP    ;STOP CHAR
03890 ;
03900 ;PRINT BAR CODE
03910 ;
03920         LD      HL,DOTBUF       ;GET DOT BUFFER ADDR
03930         PUSH    HL
03940         POP     DE      ;MOVE TO DE REG
03950         PUSH    IX
03960         POP     HL      ;MOVE LAST ADDR TO HL
03970         SCF
03980         CCF
03990         SBC     HL,DE   ;DOT LENGTH
04000         LD      (DOTLNG),HL     ;SAVE DOT LENGTH
04010         LD      A,(REPTLN)      ;BAR PRINT REPEAT
04020         LD      B,A
04030 BARLOP  LD      A,1BH   ; ESCAPE
04040         CALL    OUT
04050         LD      A,33H   ;SET LINE SKIP
04060         CALL    OUT
04070         LD      A,1
04080         CALL    OUT
04090         PUSH    BC
04100         CALL    OUTLIN  ;PRINT DRIVER CALL
04110         POP     BC
04120         DJNZ    BARLOP  ;LOOP
04130         RET     ;RETURN CALLING ROUTINE
04140 ;
04150 ;   SET UP CALL SUBROUTINE
04160 ;
04170 SETCAL  LD      A,(SYSDF2)
04180         PUSH    AF
04190         AND     0C0H
04200         CP      0C0H
04210         POP     BC
04220         LD      A,B
04230         JR      NZ,CK76ZR
04240         CALL    CHRCNG
04250         JR      AFT76
04260 CK76ZR  PUSH    AF
04270         AND     0C0H
04280         CP      0
04290         POP     BC
04300         LD      A,B     ;RESTORE A REG
04310         JR      NZ,SKP76
04320         CALL    C128ST
04330         JR      AFT76
04340 SKP76   BIT     7,A     ;CHECK COUNT ALG USR DEF
04350         CALL    NZ,USRDF1
04360         BIT     6,A     ;CHECK COUNT ALG TANDY CODE
04370         CALL    NZ,STRCNT
04380 AFT76   PUSH    AF
04390         AND     60H
04400         CP      60H
04410         POP     BC
04420         LD      A,B
04430         JR      NZ,CK54ZR
04440         CALL    TCNTLN
04450         JR      AFT54
04460 CK54ZR  PUSH    AF
04470         AND     60H
04480         CP      0
04490         POP     BC
04500         LD      A,B     ;RESTORE A REG
04510         JR      SKP54
04520         CALL    D128ST
04530         JR      AFT54
04540 SKP54   BIT     5,A     ;BIT COUNT ALG USR DEF
04550         CALL    NZ,USRDF2
04560         BIT     4,A     ;BIT COUNT ALG STREAM DATA
04570         CALL    NZ,BCNTAL
04580 AFT54   BIT     3,A     ;PRINT DRIVER USR DEF
04590         CALL    NZ,USRDF3
04600         BIT     2,A     ;SET DTACOV SPARCE/RECORD FORM
04610         JR      Z,SKDCOV
04620         PUSH    AF
04630         LD      A,1
04640         LD      (DTACOV),A
04650         POP     AF
04660 SKDCOV  PUSH    AF      ;SAVE CHARACTER VALUE
04670         AND     3       ;CLEAR BITS 02 THROUGH 07
04680         CP      3       ;ARE BITS 01 & 00 SET
04690         POP     BC      ;RETRIVE CHARACTER VALUE
04700         LD      A,B     ;MOVE TO A REG
04710         JR      NZ,CK10ZR
04720         CALL    TNDCOD  ;PRINT TANDYCODE
04730         JR      ENSUST
04740 CK10ZR  PUSH    AF
04750         AND     3
04760         CP      0
04770         POP     BC
04780         LD      A,B     ;RESTORE A REG
04790         JR      NZ,SKDTCV
04800         CALL    E128ST
04810 SKDTCV  BIT     1,A     ;CHECK SUM COUNT ALG
04820         CALL    NZ,USRDF4
04830         BIT     0,A     ;CHECK SUM ALG
04840 SYSCK3  CALL    NZ,CKSTRM
04850         LD      A,(SYSDF1)      ;GET SYSTEM DEF VALUE
04860         AND     0FH     ;CLEAR MS4 BITS
04870         LD      (BITLNG),A
04880 ENSUST  RET
04890 ;
04900 ; EXCHANGE ADDRESS ROUTINES
04910 ;
04920 C128ST  LD      HL,CHRST1
04930         PUSH    HL
04940         POP     DE
04950         LD      HL,CHRSET
04960         CALL    TRSADR
04970         RET
04980 D128ST  LD      HL,(DRVR3)
04990         LD      A,L
05000         OR      H
05010         CALL    Z,ERROR
05020         PUSH    HL
05030         POP     DE
05040         LD      HL,DOTLNI
05050         CALL    TRSADR
05060         RET
05070 E128ST  LD      HL,CHKCNT
05080         PUSH    HL
05090         POP     DE
05100         LD      HL,CHCRCT
05110         CALL    TRSADR
05120         RET
05130 USRDF1  LD      HL,(CHKADR)
05140         LD      A,L
05150         ADD     A,H
05160         CALL    Z,ERROR
05170         PUSH    HL      ;MOVE TO DE REG
05180         POP     DE
05190         LD      HL,CHKCNI
05200         CALL    TRSADR
05210         RET
05220 STRCNT  LD      HL,CKCSRM       ;GET ADDR OF SUB CALL
05230         PUSH    HL      ;MOVE TO DE REG
05240         POP     DE
```

Listing 1 continued

Listing 1 continued

```
05250           LD      HL,CHKCNI
05260           CALL    TRSADR  ;CHANGE CALL
05270           RET
05280 USRDF2    LD      HL,(DRVR1)      ;CHECK FOR ADDR
05290           LD      A,L
05300           ADD     A,H
05310           CALL    Z,ERROR
05320           PUSH    HL      ;MOVE TO DE REG
05330           POP     DE
05340           LD      HL,DOTLNI
05350           CALL    TRSADR  ;CHANGE CALL
05360           RET
05370 BCNTAL    LD      HL,(DRVR2)
05380           LD      A,L
05390           OR      H
05400           CALL    Z,ERROR
05410           PUSH    HL      ;MOVE TO DE REG
05420           POP     DE
05430           LD      HL,DOTLNI
05440           CALL    TRSADR  ;CHANGE CALL
05450           RET
05460 TCNTLN    LD      HL,TCKCHR
05470           PUSH    HL
05480           POP     DE      ;MOVE TO DE REG
05490           LD      HL,DOTLNI
05500           CALL    TRSADR
05510           RET
05520 USRDF3    LD      HL,(PRDRVR)
05530           LD      A,L
05540           ADD     A,H
05550           CALL    Z,ERROR
05560           PUSH    HL      ;MOVE TO DE REG
05570           POP     DE
05580           LD      HL,PRNDRV
05590           CALL    TRSADR  ;CHANGE CALL
05600           RET
05610 USRDF4    LD      HL,(CHCHRD)     ;REPLACE CHECK SUM CNT ALG
05620           LD      A,L     ;CHECK ADDR NOT ZERO
05630           ADD     A,H
05640           CALL    Z,ERROR ;ADDR = 0 ERROR RETURN
05650           PUSH    HL
05660           POP     DE      ;MOVE TO DE REG
05670           LD      HL,CHCRCT
05680           CALL    TRSADR  ;REPLACE ADDRESS
05690           RET
05700 CKSTRM    LD      HL,CKCSTR
05710           PUSH    HL
05720           POP     DE
05730           LD      HL,CHCRCT
05740           CALL    TRSADR
05750           RET
05760 TNDCOD    LD      HL,TANDYC
05770           PUSH    HL
05780           POP     DE
05790           LD      HL,GETDAT
05800           CALL    TRSADR
05810           LD      A,1
05820           LD      (TNDYCD),A      ;SET FOR TANDYCODE
05830           RET
05840 CHRCNG    LD      HL,CHRST2       ;RESET CALL
05850           PUSH    HL
05860           POP     DE      ;MOVE TO DE REG
05870           LD      HL,CHRSET
05880           CALL    TRSADR
05890           RET
05900 TRSADR    PUSH    AF
05910           LD      A,0CDH
05920           LD      (HL),A
05930           INC     HL
05940           LD      (HL),E
05950           INC     HL
05960           LD      (HL),D
05970           POP     AF
05980           RET
05990 ;
```

```
06000 ;CONVERT CHARACTERS TO BIT CODE FORM
06010 ;
06020 ROUTLP    LD      HL,(DATABF)     ;GET DATA BUFFER ADDR
06030           LD      A,(LENGTH)      ;GET LENGTH
06040           LD      B,A
06050 LOOP1     LD      A,(HL)  ;GET FIRST VALUE
06060           INC     HL      ;STEP POINTER
06070           PUSH    BC      ;SAVE CHARACTER LENGTH
06080           PUSH    HL      ;SAVE BUFFER ADDR
06090           PUSH    AF      ;SAVE CHARACTER VALUE
06100           LD      A,(DTACOV)      ;CHECK DATA CONVERT FORM
06110           CP      0       ;DTACOV=0 CODE 128
06120           POP     AF      ;RESTORE CHARACTER VALUE
06130           JR      NZ,STCONV
06140           CP      20H     ;<20H = CONTROL CHARACTER
06150           JR      C,CONCOD        ;CONTROL CODE
06160           SCF     ;CLEAR CARRY
06170           CCF
06180           SBC     A,20H   ;ASCII FORM
06190           CP      60H     ;NOT ASCII?
06200           JR      NC,NOASCI       ;NOT IN THE ASCII SET
06210 STCONV    CALL    CHKCNT
06220           CALL    CHRSET
06230           POP     HL      ;RETRIVE BUFFER ADDR
06240           POP     BC
06250           DJNZ    LOOP1
06260           JR      EXIT
06270 CONCOD    INC     (IY)    ;COUNT CONTROL CODE USE
06280           PUSH    AF
06290           LD      A,62H
06300           CALL    CHKCNT
06310           CALL    SHIFT
06320           POP     AF      ;RESTORE CHARACTER
06330           ADD     A,40H
06340           CALL    CHKCNT
06350           CALL    CHRSET
06360           POP     HL
06370           POP     BC
06380           DJNZ    LOOP3
06390           JR      EXIT
06400 LOOP15    JR      LOOP1
06410 NOASCI    CP      0C0H    ;UPPER OR LOWER 64 BYTES?
06420           JR      NC,LAST64
06430           INC     (IY)    ;COUNT CONTROL CODE USE
06440           PUSH    AF
06450           LD      A,62H
06460           CALL    CHKCNT
06470           CALL    SHIFT
06480           POP     AF      ;RESTORE CHARACTER
06490           SCF     ;CLEAR CARRY FLAG
06500           CCF
06510           SBC     A,60H
06520           CALL    CHKCNT
06530           CALL    CHRSET
06540           POP     HL
06550           POP     BC      ;RETRIVE CHAR LENGTH
06560           DJNZ    LOOP3
06570           JR      EXIT
06580 LAST64    PUSH    AF
06590           LD      A,60H
06600           CALL    CHKCNT
06610           CALL    FNC3
06620           POP     AF      ;RESTORE CHARACTER
06630           SCF     ;CLEAR CARRY FLAG
06640           CCF
06650           SBC     A,0A0H
06660           CALL    CHKCNT
06670           CALL    CHRSET
06680           POP     HL
06690           INC     (IY)    ;COUNT CONTROL CODE USE
06700           POP     BC      ;RETRIVE CHAR STRING LENGTH
06710           DJNZ    LOOP3
06720           JR      EXIT
06730 LOOP3     DJNZ    LOOP15
06740 EXIT      RET
06750 ;
```

Listing 1 continued

Listing 1 continued

```
06760 ;SYSTEM SET (SET SYSTEM DEFINITION VALUES)
06770 ;
06780 SYSSET  LD      A,0
06790         LD      (DNSITY),A
06800         LD      (CKSMAG),A
06810         LD      (STPONF),A
06820         LD      (STRONF),A
06830         LD      A,(SYSDF1)      ;GET SYS DEF
06840         BIT     7,A             ;CHECK DENSITY
06850         JR      Z,BITCK6
06860         PUSH    AF
06870         LD      A,1
06880         LD      (DNSITY),A
06890         POP     AF
06900 BITCK6  BIT     6,A     ;CHECK SUM ON/OFF
06910         JR      Z,BITCK5
06920         PUSH    AF
06930         LD      A,1
06940         LD      (CKSMAG),A
06950         POP     AF
06960 BITCK5  BIT     5,A     ;STOP CHAR ON/OFF
06970         JR      Z,BITCK4
06980         PUSH    AF
06990         LD      A,1
07000         LD      (STPONF),A
07010         POP     AF
07020 BITCK4  BIT     4,A     ;START CHAR ON/OFF
07030         JR      Z,BITEN
07040         PUSH    AF
07050         LD      A,1
07060         LD      (STRONF),A
07070         POP     AF
07080 BITEN   AND     0FH     ;CLEAR MS4BITS
07090         LD      (BITLNG),A
07100         LD      A,(SYSDF3)      ;GET START/STOP COD LNG
07110         PUSH    AF
07120         AND     0FH
07130         LD      (SPCDLN),A
07140         POP     AF
07150         AND     0F0H
07160         RR      A
07170         RR      A
07180         RR      A
07190         RR      A
07200         LD      (STCDLN),A      ;STORE START COD LN
07210         RET
07220 ;THIS SUBROUTINE WILL CONVERT BIT PATTERN TO DOT
07230 ;FORM IN THE DOT BUFFER CODE 128
07240 ;
07250 CHRST1  PUSH    BC      ;SAVE REGISTERS
07260         PUSH    DE
07270         PUSH    HL
07280         PUSH    AF
07290         LD      A,(POSIT)       ;GET PRESENT POSITION
07300         INC     A
07310         LD      (POSIT),A       ;SAVE INCREMENTED POSITION
07320         LD      A,(DTACOV)      ;CHECK TYPE OF CODE
07330         CP      0
07340         JR      Z,SPRCTB
07350         POP     AF      ;RETRIVE VALUE
07360         LD      E,0     ;CLEAR D REG
07370         LD      D,A     ;MOVE VALUE TO E REG
07380         JR      STLOOP
07390 SPRCTB  POP     AF      ;RETRIVE CHAR VALUE
07400         LD      HL,TABLE        ;BIT PATTERN TABLE START ADDR:
07410         LD      D,0
07420         LD      E,A     ;LOAD BAR CODE VALUE
07430         ADD     HL,DE
07440         ADD     HL,DE
07450         LD      E,(HL)  ;GET BIT PATTERN
07460         INC     HL      ;POINT NEXT BYTE
07470         LD      D,(HL)
07480 STLOOP  LD      A,(BITLNG)      ;GET BIT LENGTH
07490         LD      B,A
07500 LOOP2   RL      E       ;MOVE LSB OF BYTE 2 TO CARRY
07510         RL      D       ;MOVE CARRY TO MSB BYTE 1 LSB TO CARRY
07520         JR      C,ST255
07530         LD      A,(DNSITY)      ;COMPARE DENSITY
07540         CP      1
07550         JR      Z,DOUBL0        ;DOUBLE DENSITY
07560         JR      SNGL0   ;SINGLE DENSITY
07570 DOUBL0  LD      A,(SPACE)       ;DOT FILL DOUBLE
07580         LD      (IX),A  ;INCREMENT DOT BUFFER
07590         INC     IX
07600 SNGL0   LD      A,(SPACE)       ;DOT FILL SINGLE
07610         LD      (IX),A  ;INCREMENT DOT BUFFER
07620         INC     IX
07630         LD      (IX),A
07640         INC     IX      ;ACCOUNT FOR BAR OVERLAP
07650         LD      A,(DTACOV)
07660         CP      0
07670         CALL    NZ,RCDSP2
07680         DJNZ    LOOP2   ;NEXT CHARACTER
07690         JR      ENDCRS  ;END ROUTINE
07700 ST255   LD      A,(DNSITY)
07710         CP      1
07720         JR      Z,DOUBLF
07730         JR      SNGLF
07740 DOUBLF  LD      A,(BAR) ;DOUBLE DENSITY BAR
07750         LD      (IX),A  ; INCREMENT DOT BUFFER
07760         INC     IX
07770         LD      A,(DTACOV)
07780         CP      0
07790         CALL    NZ,RCDSP1
07800 SNGLF   LD      A,(BAR) ;SINGLE DENSITY BAR
07810         LD      (IX),A  ;INC DOT BUFFER
07820         INC     IX
07830         LD      A,(DTACOV)
07840         CP      0
07850         CALL    NZ,RCDSP1
07860         CALL    NZ,RCDSP2
07870         DJNZ    LOOP2   ;NEXT CHARACTER
07880 ENDCRS  POP     HL      ;END ROUTINE
07890         POP     DE
07900         POP     BC
07910         RET
07920 ;
07930 ;  RECORD CODE SPACE
07940 ;
07950 RCDSP1  LD      A,255
07960         LD      (IX),A
07970         INC     IX
07980         RET
07990 RCDSP2  LD      A,0
08000         LD      (IX),A
08010         INC     IX
08020         LD      (IX),A
08030         INC     IX
08040         RET
08050 ;
08060 ;CONTROL CHARACTER START CODE
08070 ;     SUBROUTINE
08080 FNC3    LD      A,(SPEC1)
08090         CALL    CHRSET
08100         RET
08110 ;
08120 ;SHIFT CONTROL START CODE
08130 ;     SUBROUTINE
08140 SHIFT   LD      A,(SHFT)
08150         CALL    CHRSET
08160         RET
08170 ;
08180 ;STOP CODE START CODE
08190 ;     SUBROUTINE
08200 STOP    LD      A,(STPONF)      ;SKIP STOP CHAR ?
08210         CP      0
08220         JR      NZ,STPND
08230         LD      A,(BITLNG)
08240         PUSH    AF
08250         LD      A,(SPCDLN)      ;STOP CHAR BIT LENGTH
08260         LD      (BITLNG),A      ;LOAD STOP BIT LNG INTO BITLNG
```

Listing 1 continued

Listing 1 continued

```
08270           LD      A,(SPCHR)       ;GET TABLE ENTRY/BIT PATTERN
08280           CALL    CHRSET
08290           POP     AF
08300           LD      (BITLNG),A
08310 STPND     RET
08320 ;
08330 ;   START B CODE
08340 STARTB    LD      A,(STRONF)      ;SKIP START CHAR ?
08350           CP      0
08360           JR      NZ,ENSTRB
08370           LD      A,(BITLNG)
08380           PUSH    AF
08390           LD      A,(STCDLN)
08400           LD      (BITLNG),A
08410           LD      A,(STRCOD)
08420           CALL    CHRSET
08430           POP     AF
08440           LD      (BITLNG),A
08450           PUSH    HL
08460           LD      HL,104  ;START B CHAR VALUE
08470           LD      (CKCNTL),HL
08480           POP     HL
08490 ENSTRB    RET
08500 ;
08510 ;CHECK CHARACTER COUNT
08520 ;    SUBROUTINE
08530 CHKCNT    PUSH    DE
08540           PUSH    BC
08550           PUSH    HL
08560           PUSH    AF
08570           CALL    ONECNT
08580           LD      H,0     ;LOAD CHAR VALUE INTO HL REG
08590           LD      L,A
08600           LD      A,(POSIT)       ;GET POSITION
08610           LD      E,A     ;MOVE POSITION TO DE REG
08620           LD      D,H
08630           CALL    MULT    ;MULTIPLY POSIT * CHAR VALUE
08640           CALL    FORBAD  ;ADD RESULT TO CHECK CHAR ACC
08650           POP     AF
08660           POP     HL
08670           POP     BC
08680           POP     DE      ;RETRIVE REGISTERS
08690           RET
08700 ;
08710 ; ERROR SUBROUTINE
08720 ;
08730 ERROR     LD      A,(ERRCOD)
08740           CP      1
08750           JR      NZ,ERR2
08760           LD      HL,PMSG1
08770           CALL    PRINT
08780           JP      DOSEX
08790 ERR2      LD      HL,PMSG2
08800           CALL    PRINT
08810           JP      DOSEX
08820 ;
08830 ;CALCULATE CHECK CHARACTER
08840 ;   TAKE CHECK CHARACTER  COUNT AND DIVIDE BY 103
08850 ;   REMAINDER IS THE CHECK CHARACTER
08860 ;
08870 CKC128    LD      HL,(CKCNTL)
08880           PUSH    HL
08890           POP     DE
08900           LD      HL,(CKCNTM)     ;GET MOST SIG TWO BYTES
08910           PUSH    HL      ;MOVE TO BC REG
08920           POP     BC
08930           CALL    BITDIV  ;DIVIDE 4 BYTE INTEGER
08940           CALL    CHRSET
08950           RET
08960 ;
08970 ;PRINT DRIVER SUBROUTINE
08980 ;OUTLN IS A PRINT DRIVER FOR THE EPSON MX 80 PRINTER.
08990 ;IF ANOTHER PRINTER IS USED THIS SUBROUTINE MAY HAVE
09000 ;TO BE CHANGED. THE PRINT DRIVER MUST TAKE A STREAM OF
09010 ;"0" AND "FF" AND PRINT SPACES AND BARS. MOST DOT
09020 ;MATRIX PRINTERS PRINT A SPACE WITH A "0" AND A BAR
09030 ;WITH A "128" OR "256".
09040 ;
09050 OUTLIN    LD      HL,(DOTLNG)     ;GET DOT LENGTH
09060 ;   SET GRAPHIC PRINT
09070           LD      A,1BH   ;ESCAPE
09080           CALL    OUT
09090           LD      A,4CH   ;HIGH RES GRAPHIC MODE SET
09100           CALL    OUT
09110           LD      A,L     ;PASS N1
09120           CALL    OUT
09130           LD      A,H     ;PASS N2
09140           CALL    OUT
09150           LD      HL,(DOTLNG)     ;LOAD HL WITH DOT LENGTH
09160           PUSH    HL
09170           POP     DE      ;MOVE TO DE REG
09180           LD      HL,DOTBUF
09190 DOTLOP    LD      A,(HL)
09200           INC     HL      ;POINT TO NEXT CHAR
09210 PRSLOP    CALL    OUT
09220           DEC     DE
09230           CALL    DEZRO
09240           JR      Z,PRNEND
09250           JR      DOTLOP
09260 ;   COMPARE DE = ZERO ?
09270 DEZRO     PUSH    HL
09280           PUSH    AF
09290           LD      A,D
09300           OR      E
09310           CP      0       ;=ZERO ?
09320 ENDZRC    POP     HL
09330           LD      A,H
09340           POP     HL      ;RESTORE REG
09350           RET
09360 NOZRO     CP      1       ;CLEAR ZERO FLAG
09370           JR      ENDZRC
09380 ;
09390 ;  PRINT CHARACTER TO PRINTER
09400 OUT       PUSH    DE
09410           CALL    PRNCHR
09420           POP     DE
09430           RET
09440 PRNEND    LD      A,0DH
09450           CALL    OUT
09460           LD      A,1BH
09470           CALL    OUT
09480           LD      A,40H
09490           CALL    OUT
09500           RET
09510 ;
09520 ; BIT BY BIT DIVIDE ROUTINE
09530 ; INPUT HL POINT TO SINGLE PREC. VARIABLE
09540 ; ROUTINE WILL DIVIDE 24 BIT VALUE BY 103
09550 ; OUTPUT  A= REMAINDER  RESULT IN C/D/E REG'S
09560 BITDIV    LD      HL,103  ;DIVISOR
09570           LD      B,25    ;BIT SHIFT COUNT
09580           LD      A,0     ;CLEAR ACCUMULATOR
09590           SCF     ;CLEAR CARRY
09600           CCF
09610 DIVLOP    SBC     A,L     ;SUBTRACT DIVISOR
09620           JR      C,ADBAK ;NEG ADD BACK
09630           SCF     ;POSITIVE SET CARRY
09640 ROTATE    RL      E
09650           RL      D
09660           RL      C
09670           PUSH    AF
09680           LD      A,B
09690           CP      1
09700           JR      Z,ENDQ
09710           POP     AF
09720           RL      A
09730           DJNZ    DIVLOP  ;NEXT SHIFT?
09740           JR      ENDR    ;DIVIDE COMPLETE
09750 ADBAK     ADD     A,L
09760           SCF     ;CLEAR CARRY FLAG
09770           CCF
```

Listing 1 continued

Listing 1 continued

```
09780           JR      ROTATE  ;SHIFT THREE BYTES
09790 ENDQ      POP     AF
09800 ENDR      RET
09810 ;
09820 ;   FOUR BIT ACCUMULATOR  INPUT IN HL REG
09830 ;
09840 FORBAD    PUSH    BC
09850           PUSH    IY
09860           PUSH    HL      ;SAVE REGISTERS
09870           LD      IY,CKCNTM
09880           LD      HL,(CKCNTL)
09890           POP     BC
09900           ADD     HL,BC
09910           JR      C,MULBAD
09920 MULBD1    LD      (CKCNTL),HL
09930           POP     IY
09940           POP     BC      ;RETRIVE REGISTERS
09950           RET
09960 MULBAD    INC     (IY)
09970           JR      MULBD1
09980 ;
09990 ;CHECK DOT LENGTH OVERRUN
10000 ;
10010 COLCHK    LD      DE,(MAXPRN)     ;MAXIMUM DOT LENGTH
10020           SCF
10030           CCF
10040           SBC     HL,DE
10050           JR      Z,ENERCK
10060           LD      A,2
10070           LD      (ERRCOD),A
10080           CALL    NC,ERROR
10090 ENERCK    RET
10100 ;
10110 ;  SUBROUTINE DIRECTORY CALL
10120 ;
10130 CHKCNI    CALL    CKC128
10140           RET
10150 PRNDRV    CALL    OUTLIN
10160           RET
10170 DOTLNI    NOP
10180           NOP
10190           NOP
10200           RET
10210 CHCRCT    CALL    CHKCNT
10220           RET
10230 GETDAT    CALL    ROUTLP
10240           RET
10250 CHRSET    CALL    CHRST1
10260           RET
10270 ;
10280 ;CHECK COUNT FOR RECORD FORMAT
10290 ;
10300 CKCSTR    PUSH    AF      ;SAVE CHAR VALUE
10310           LD      A,(CKSCNT)
10320           POP     BC
10330           PUSH    BC      ;CHAR VALUE
10340           ADD     A,B
10350           JR      NC,END41C
10360           INC     A
10370 END41C    LD      (CKSCNT),A
10380           POP     AF      ;RETRIVE CHAR VALUE
10390           RET
10400 ;
10410 ; STREAM CHARACTER CHECK ALG
10420 ;
10430 CKCSRM    LD      A,(CKSCNT)
10440           CALL    CHRSET
10450           RET
10460 ;
10470 ; TANDYCODE  PRINT BUFFER FILL ROUTINE
10480 ;
10490 TCKCHR    LD      HL,(DATABF)     ;GET DATA BUFFER ADDR
10500 ; CALCULATE CHECKSUM 2
10510           LD      A,(LENGTH)      ;INCLUDE ATTR & REL SEQU
10520           LD      B,A
10530           NOP
10540           LD      IY,ONSCNT
10550           XOR     A
10560           LD      (IY),A  ;CLEAR ONES COUNT
10570           LD      D,A     ;CLEAR CHECK 2 COUNT
10580           DEC     B
10590           INC     HL      ;POINT FIRST DATA BYTE
10600           LD      A,(HL)  ;GET ATTRIBUTE VALUE
10610           CALL    CK2CNT
10620           RLCA
10630           LD      C,A
10640           DEC     B
10650           INC     HL
10660 CKS2LP    LD      A,(HL)
10670           CALL    CK2CNT
10680           XOR     C
10690           RLCA
10700           LD      C,A
10710           INC     HL
10720           DJNZ    CKS2LP
10730           LD      HL,(DATABF)
10740           LD      A,(HL)  ;GET ATTRIBUTE
10750           CALL    CK2CNT
10760           XOR     C
10770           LD      (CKSUM2),A      ;SAVE CHECK SUM 2
10780           CALL    CK2CNT
10790           LD      A,D
10800           LD      (CKSUM1),A
10810           CALL    ONECNT
10820           RET
10830 ;
10840 ;  CONVERT DATA AND MOVE TO DOT BUFFER
10850 TANDYC    LD      HL,(DATABF)     ;GET DATA BUFFER ADDR
10860           LD      A,(HL)  ;GET ATTRIBUTE
10870           CALL    CHRSET  ;CONVERT
10880           INC     HL
10890           LD      A,(CKSUM1)      ;GET CKECK SUM 1
10900           CALL    CHRSET  ;CONVERT
10910           LD      A,(CKSUM2)      ;GET CHECK SUM2
10920           CALL    CHRSET  ;CONVERT
10930           LD      A,(HL)  ;GET REL SEQU NO.
10940           CALL    CHRSET  ;CONVERT
10950           INC     HL
10960           LD      A,(LENGTH)
10970           DEC     A       ;SET TO START OF DATA BYTES
10980           DEC     A
10990           LD      B,A
11000 TANLOP    LD      A,(HL)  ;GET DATA
11010           INC     HL
11020           CALL    CHRSET  ;CONVERT
11030           DJNZ    TANLOP
11040           RET
11050 ;
11060 ; ONES COUNT SUBROUTINE
11070 ;
11080 ONECNT    PUSH    AF      ;SAVE REG
11090           LD      A,8
11100           LD      B,A
11110           POP     AF
11120           PUSH    AF
11130           PUSH    IY
11140           LD      IY,ONSCNT
11150           SCF     ;CLEAR CARRY FLAG
11160           CCF
11170 ONCNLP    RL      A
11180           JR      NC,ENONCN
11190           INC     (IY)
11200           INC     (IY)
11210 ENONCN    DJNZ    ONCNLP
11220           POP     IY      ;RETRIVE REGISTERS
11230           POP     AF      ;RETRIVE AF REG
11240           RET
11250 ;
11260 ;  TANDYCODE CHARACTER CONVERT AND DOT BUF FILL
11270 ;
```

Listing 1 continued

Listing 1 continued

```
11280 CHRST2  PUSH    BC      ;SAVE REGISTERS
11290         PUSH    HL
11300         PUSH    AF
11310         LD      A,(DTACOV)
11320         BIT     0,A
11330         JR      NZ,TBLDR
11340         POP     AF
11350         LD      E,0     ;MOVE DATA TO DE REG
11360         LD      D,A
11370         LD      D,A
11380         JR      PRODAT
11390 TBLDR   POP     AF
11400         LD      HL,TABLE
11410         PUSH    HL
11420         POP     DE      ;MOVE TO DE REG
11430         LD      HL,(TALOFS)
11440         ADD     HL,DE
11450         LD      E,A
11460         LD      D,0
11470         ADD     HL,DE
11480         ADD     HL,DE
11490         LD      E,(HL)
11500         INC     HL
11510         LD      D,(HL)
11520 PRODAT  LD      A,255   ;SET FOR BAR
11530         LD      C,A
11540         LD      A,0
11550         LD      (SPCACN),A      ;SET SPACE INC = 0
11560         LD      A,(BITLNG)      ;GET BIT LENGTH
11570         LD      B,A     ;MOVE TO B REG
11580 CONVLP  RL      E
11590         RL      D
11600         PUSH    BC      ;SAVE BIT COUNT
11610         LD      A,(DNSITY)      ;GET DENSITY
11620         JR      NC,TSPCE
11630         ADD     A,1
11640 TSPCE   ADD     A,1
11650         LD      B,A
11660         LD      A,(SPCACN)      ;ACCOUNT FOR SPACE ?
11670         ADD     A,B
11680         LD      B,A     ;MOVE RESULT TO B REG
11690         LD      A,0
11700         LD      (SPCACN),A
11710         LD      A,C     ;GET DOT VALUE
11720 TLOOP1  LD      (IX),A
11730         INC     IX
11740         DJNZ    TLOOP1
11750         POP     BC
11760         DJNZ    CONVL2
11770         NOP
11780         POP     HL
11790         POP     BC      ;RETRIVE REGISTERS
11800         RET
11810 CONVL2  LD      A,255
11820         ADD     A,C
11830         LD      A,255
11840         LD      C,A
11850         JR      C,SETZR ;NEXT IS SPACE
11860         JR      CONVLP
11870 SETZR   LD      A,0
11880         LD      C,A     ;SET DOT VALUE
11890         LD      A,1
11900         LD      (SPCACN),A      ;ACC FOR SPACE = 1
11910         JR      CONVLP
11920         RET
11930 ;CHECKSUM 2 COUNT ROUTINE
11940 CK2CNT  PUSH    AF
11950         PUSH    BC
11960         CALL    ONECNT
11970         ADD     A,D
11980         JR      NC,NOCRRY
11990         INC     A
12000 NOCRRY  LD      D,A
12010         POP     BC
12020         POP     AF
12030         RET
12040 ;
12050 ;   INTRO HEADING PRINT ROUTINE
12060 ;
12070 HDTBL1  DEFW    9595H
12080         DEFW    0AA95H
12090         DEFW    0BF95H
12100         DEFW    9580H
12110         DEFW    0AABFH
12120         DEFW    9580H
12130         DEFW    95AAH
12140         DEFW    95AAH
12150         DEFW    0AAAAH
12160         DEFW    0BF80H
12170         DEFW    9580H
12180         DEFW    0AAAAH
12190         DEFW    0AAAAH
12200         DEFW    9595H
12210         DEFW    0AAAAH
12220         DEFW    0AAAAH
12230         DEFW    9595H
12240 HDTBL2  DEFW    8095H
12250         DEFW    95B7H
12260         DEFW    95B7H
12270         DEFW    95B7H
12280         DEFW    8080H
12290         DEFW    0B780H
12300         DEFW    0B795H
12310         DEFW    9595H
12320         DEFW    949FH
12330         DEFW    0AB95H
12340         DEFW    8081H
12350 HDTBL3  DEFW    848DH
12360         DEFW    858DH
12370         DEFW    8585H
12380         DEFW    8487H
12390         DEFW    8080H
12400         DEFW    8580H
12410         DEFW    8780H
12420         DEFW    8584H
12430         DEFW    8B85H
12440         DEFW    8A85H
12450         DEFW    8080H
12460 HEADNG  CALL    CLSCRN
12470         LD      IX,HDTBL1
12480         LD      HL,TSCR1E
12490         LD      B,5
12500 OUTLOP  PUSH    BC
12510         LD      B,22H   ;FILL LINE
12520 INRLOP  LD      A,(IX)
12530         LD      (HL),A
12540         INC     HL
12550         INC     IX
12560         DJNZ    INRLOP
12570         LD      IX,HDTBL1
12580         LD      DE,001EH
12590         ADD     HL,DE
12600         POP     BC
12610         DJNZ    OUTLOP
12620         LD      B,2
12630         LD      HL,SCRN1
12640         LD      IX,HDTBL2
12650 HDMSG2  PUSH    BC
12660         LD      B,22
12670 HDMSG1  LD      A,(IX)
12680         LD      (HL),A
12690         INC     IX
12700         INC     HL
12710         DJNZ    HDMSG1
12720         LD      B,22
12730         LD      HL,SCRN2
12740         POP     BC
12750         DJNZ    HDMSG2
12760         LD      HL,SCRN3
12770         LD      (CURADS),HL
```

Listing 1 continued

Listing 1 continued

```
12780           LD      HL,PMSG3
12790           CALL    PRINT
12800           LD      HL,SCRN4
12810           LD      (CURADS),HL
12820           LD      HL,PMSG4
12830           CALL    PRINT
12840           RET
12850 PMSG1     DEFM    'USER DEFINED CALL NOT LOADED'
12860           DEFB    3
12870 PMSG2     DEFM    'DOT BUFFER OVERRUN'
12880           DEFB    3
12890 PMSG3     DEFM    'by      Davey S. Thornton'
12900           DEFB    3
12910 PMSG4     DEFM    'COPYRIGHT            1984'
12920           DEFB    3
12930 ERRCOD    DEFB    0       ;EXIT ERROR CODE VALUE
12940 DATABF    DEFW    0000H
12950 SPACE     DEFB    0
12960 BAR       DEFB    255
12970 SPEC1     DEFB    60H     ;CONTROL CHAR CODE 128
12980 SHFT      DEFB    62      ;SHIFT CHAR CODE 128
12990 SPCACN    DEFB    0
13000 SPBLNG    DEFB    0DH     ;STOP CODE BIT LENGTH CODE 128
13010 CKSCNT    DEFW    0000H   ;CHECK SUM COUNT
13020 CKCNTA    DEFW    0000H   ;CHECK CHARACTER COUNT
13030 BTCNTD    DEFB    0       ;BIT COUNT OFFSET
13040 MAXPRN    DEFW    960
13050 MXCRSL    DEFB    40H     ;MAX COMPRESSED PRINT
13060 MXSTDL    DEFB    20H     ;MAX STANDARD PRINT
13070 CKSUM1    DEFB    0       ;TANDYCODE CHECK SUM 1
13080 CKSUM2    DEFB    0       ;TANDYCODE CHECK SUM 2
13090 TNDYCD    DEFB    0       ;TANDY CODE FLAG
13100 NPOSIT    DEFB    0       ;LENGTH DECREMENTED
13110 ONSCNT    DEFW    0000H   ;ONES COUNT
13120 CKSMAG    DEFB    0       ;CHECK SUM SWITCH ON/OFF
13130 STPONF    DEFB    0       ;STOP CHAR SWITCH ON/OFF
13140 STRONF    DEFB    0       ;START CHAR SWITCH ON/OFF
13150 DTACOV    DEFB    0       ;DATA NOT CODE 128 VALUE POINTER
13160 TALOFS    DEFW    0000H   ;TABLE OFFSET VALUE
13170 PRDRVR    DEFW    0000H   ;PRINT USR DEF DRIVER
13180 DRVR1     DEFW    0000H   ;USR DEF1
13190 DRVR2     DEFW    0000H   ;ADDR USER DEF2
13200 DRVR3     DEFW    0000H
13210 CHKADR    DEFW    0000H   ;ADDR USER DEF CHK SUM ALG
13220 CHCHRD    DEFW    0000H   ;CHECK CHAR COUNT ROUTINE
13230 SYSDF1    DEFW    000DH   ;SYSTEM DEF ONE
13240 SYSDF2    DEFW    0000H
13250 SYSDF3    DEFB    0       ;SYSTEM DEF THREE
13260 SPCHR     DEFB    106     ;STOP CODE TABLE/BIT VALUE
13270 STRCOD    DEFB    68H     ;START CODE TABLE/BIT VALUE
13280 STCDLN    DEFB    0BH     ;START CODE LENGTH
13290 SPCDLN    DEFB    0       ;STOP CODE LENGTH
13300 DOTBUF    DEFS    0400H   ;DOT PRINT BUFFER
13310           END     BEGIN
```

End

Program Listing 2. Demo.

```
10 '*****************************************
20 '*     THIS ROUTINE WILL TEST THE LBAR UTILITY
30 '*      THE LBAR UTILITY MUST BE LOADED FIRST THEN
40 '*      WHEN THIS ROUTINE IS RUN IT WILL ASK FOR
50 '*      THE FILE TO BE PRINTED THE CODE TYPE AND
60 '*      THE LENGTH OF THE CODE.
70 '*          by  DAVEY S. THORNTON
80 '*****************************************
90 CLEAR 1000
100 CLS:B$=""
110 DEFUSR1=&HF32F
120 DEFUSR0=&HF30C
130 DEFUSR2=&HF47A
140 AT=195:AFT=227
150 PRINT"         BARCODE MODE SELECTION
                    1.  TANDYCODE (COMPRESSED)
                    2.  TANDYCODE (STANDARD)

                    3.  CODE 128  (COMPRESSED)
                    4.  CODE 128  (STANDARD)
160 C$=INKEY$:IF C$="" THEN 160
170 C=VAL(C$)
180 IF C>4 OR C<1 THEN 130
190 ON C GOTO 200,210,220,230
200 Y=USR1(8):GOTO 240
210 Y=USR1(136):GOTO 240
220 Y=USR0(11):GOTO 240
230 Y=USR0(139)
240 CLS
250 PRINT"            ENTER FILE NAME"
252 PRINT"  THIS TEST WILL TREAT ALL INPUTS AS"
254 PRINT"  BASIC FILES FOR TANDYCODE ATTRIBUTE DEFINITION"
260 INPUT X$
270 OPEN "I",1,X$
280 ONERROR GOTO 0
290 INPUT "ENTER LINE LENGTH";L:SQ=1
300 IF L>60 OR L<10 THEN 290
310 LINE INPUT# 1,D$
320 IF EOF(1) THEN CLOSE:GOTO 410
325 IF LEN(B$)+L>=255 THEN350
326 IF LEN(D$)<L THEN 310
330 IF LEN(D$)+LEN(B$)>=255 THENB$=B$+LEFT$(D$,L):D$=RIGHT$(D$,LEN
(D$)-L) ELSE B$=B$+D$: D$=""
340 IF LEN(B$)<L THEN 310
350 ON C GOTO 360,360,470,470
360 O$=CHR$(AT)+CHR$(SQ)+LEFT$(B$,L)
370 SQ=SQ+1:Q=VARPTR(O$)
380 Y=USR2(Q):GOSUB 550
390 B$=RIGHT$(B$,LEN(B$)-L)
400 IF LEN(B$)<L THEN 330 ELSE 360
410 L=LEN(B$)
420 ON C GOTO 430,430,510,510
430 O$=CHR$(AFT)+CHR$(SQ+1)+B$
440 Q=VARPTR(O$)
450 Y=USR2(Q):GOSUB 550
460 GOTO 110
470 O$=LEFT$(B$,L):B$=RIGHT$(B$,LEN(B$)-L)
480 Q=VARPTR(O$):Y=USR2(Q):GOSUB 550
490 IF Y<>0 THEN IF LEN(B$)<L THEN B$=RIGHT$(O$,Y) ELSE B$=RIGHT$(
O$,Y)+RIGHT$(B$,LEN(B$)-L) ELSE IF LEN(B$)<L THEN B$=""ELSE B$=RIG
HT$(B$,LEN(B$)-L)
500 IF LEN(B$)<L THEN 330 ELSE 350
510 O$=B$
520 Q=VARPTR(O$)
530 Y=USR2(Q):GOSUB 550
535 GOTO 100
540 END
550 LPRINT CHR$(27)"@";:LPRINT
560 RETURN
```

End

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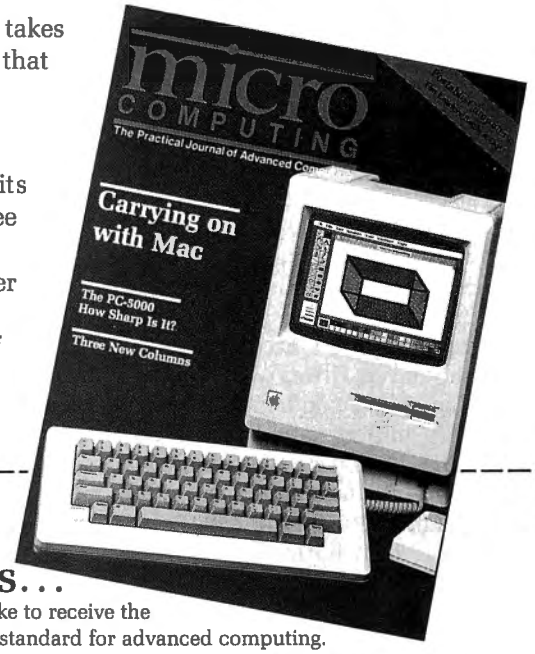

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Assembling and Running The Printer Buffer

Last month I described a printer buffer's functions and the parts you'd need to build one. This month I'll describe how to assemble the printer buffer and get it running.

When you turn on your computer, resistor R4 and capacitor C1 create an R/C time constant of about 22 milliseconds that sends a reset signal to the Z80 reset input and other board devices. When the reset signal goes inactive, the Z80 executes instructions from location 0000 hexadecimal (hex). You must start the printer buffer firmware (the ROM and the control program) from this location.

The crystal X1, the resistors R1 and R2, and the three gates for the U5 chip generate the clock required to time the system. The Z80's output lines can't directly drive all the board devices, making the buffers necessary to provide the current drive.

U2 and U3 are address line buffers, while U9 buffers various control signals. The U4 chip is a bidirectional data bus buffer, transmitting and receiving data to and from the Z80.

The U7 chip buffers the busy and fault-indication signals coming from the printer and provides a tri-state bus that lets the Z80 check the printer signals. If desired, you can connect the signals, after they're buffered, to the computer (J1).

The PC6 and the PC7

A few things about the operation of the 8255A chip should be mentioned. After you allocate all the necessary signals for sending or receiving data or handshaking, two input/output (I/O) signals still remain: PC6 and PC7. These two signals drive the status LEDs; PC6 drives a "Buffer OK" LED, while the PC7 drives a "Printer Fault" LED. When either goes low, the appropriate LED lights up; otherwise the LED remains off.

Once you set up the 8255A, it handles many functions automatically. When the computer sends a character to it, handshaking takes place automatically. The 8255A signals the Z80's interrupt pin (INT/, pin 16) when it receives a character. The Z80 then reads the character from the 8255A, and the 8255A inactivates the interrupt signal. When the Z80 sends characters to the 8255A for transmission to the printer, the 8255A (with the 74LS161) produces the proper handshaking signals.

The 74LS161— The Digital One-Shot

The 74LS161 (U11) operates as a digital one-shot (monostable multivibrator). Triggered by the 8255A OBFB signal, the 74LS161 uses the CPU clock as its timing signal. Normally OBFB is high, keeping the parallel enable signal (PE/) low (active). This makes the bit values at the D inputs appear at the outputs; the data strobe to the printer, Q2, in particular is high.

When you write a character to the 8255A (port B), OBFB is low, making the parallel enable inactive. This starts the 74LS161 counting (on the rising edge of each clock pulse input). On the clock pulse's rising edge, Q3 is high and Q2 to the printer is low. Four clocks later, Q2 is high again, and the 74LS161 count enable goes inactive. Thus the printer receives a 1.6 microsecond (400 ns/clock cycle × 4 clock cycles) data strobe pulse.

Dual D-type Flip-Flop

U10 is a 74LS74 dual D-type flip-flop (FF). You use its two flip-flops independently. The FF with the lower pin numbers works as a busy output signal latch. With the buffer reset, the FF's output is high, and the computer registers an active busy signal. This prevents the computer from sending characters while the buffer initializes itself.

When the buffer control program finishes initializing, it writes a zero to the FF, clearing the busy status. The program can reset it at any time.

Use the second FF (with the higher pin numbers) for the RAM block select. The lower 16K block of RAM shares the address space of the upper 16K with only one block active at one time. On reset, the output of the second FF goes to zero, giving the upper 16K the space. You can change this by writing a 1 or zero to the FF.

Low- and High-Order Address Bytes

Since the dynamic RAMs are 64K-bit devices, they require 16 lines to address all bits. The 16-pin packages the RAMs come in make this difficult to accomplish. To use the smaller package, you have to multiplex the RAM chips' address inputs. With the low-order address byte placed on the eight RAM address lines, the row address strobe line (RAS/) is taken low. This latches the address byte into the RAM chips. The high-order address byte is then put on the RAM address lines, followed by the falling of the column address strobe (CAS/).

To get the timing right, I used a digital delay line (the U29) to produce some of the signals. The 74LS157s (the U12 and the U13) act as 2-1 line switches, from the low-order address byte to the high-order address byte. The dynamic RAM support circuitry

---

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refreshes the RAM chips and checks that bus conflicts don't arise when you access the ROM.

The Eighth Bit

Since the Z80 provides only a 7-bit refresh address, I added the U30 and the U31 to provide the eighth bit that the 64K dynamic RAM chips require. The buffer toggles the eighth bit (A7) every 128 refresh cycles.

All read or read/write devices accessible to the Z80 (except the ROM or RAM) appear in the Z80's I/O space. You must access them using In and Out instructions. The Table shows the I/O map used.

Printer Buffer Control Program

The printer buffer queues characters as they're received. A queue is a first-in/first-out (FIFO) logical device. Generally considered a linear data structure, the queue always builds in one direction, without wraparound. The circular buffer I used for this project is like a queue, but it includes wraparound. Figure 1 illustrates the operation of a circular buffer.

Controlling the printer buffer with software is relatively simple. In fact, the most complicated aspect of this particular buffer is keeping track of

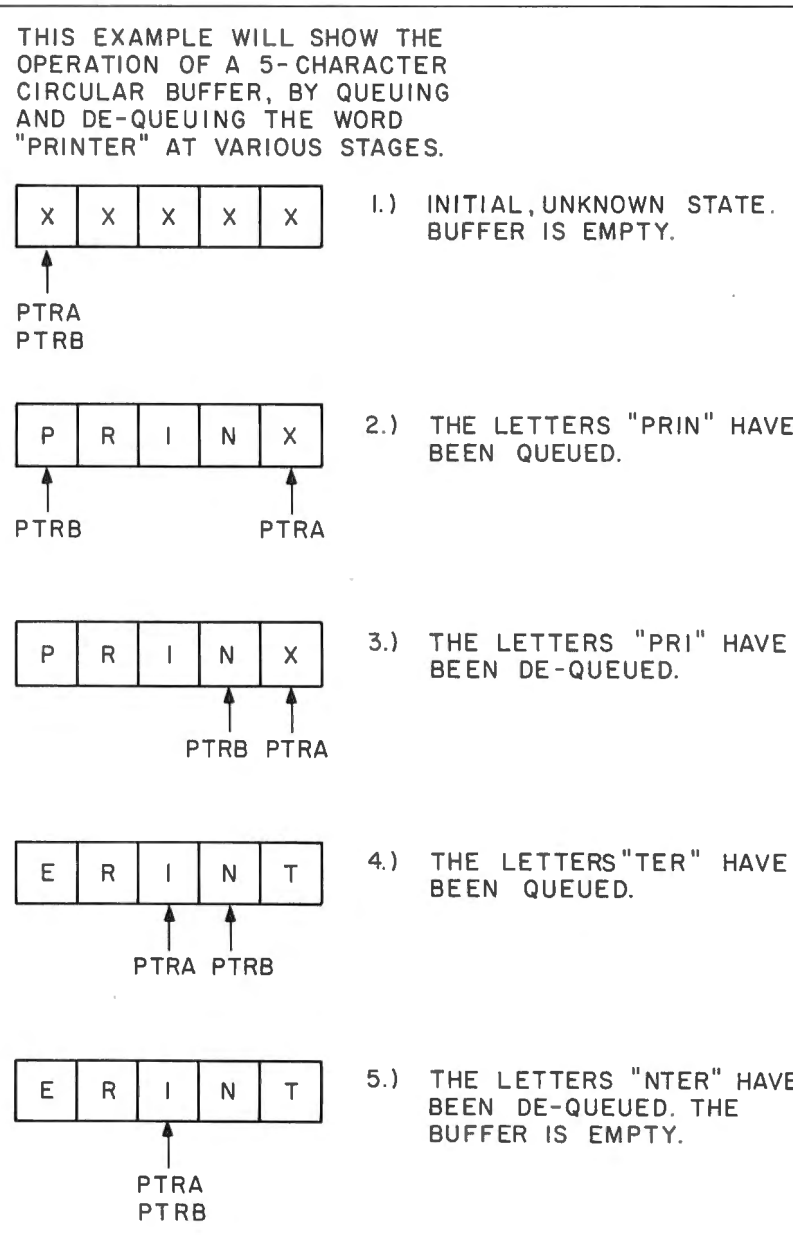

Figure 1. Circular buffer illustration.

RAM block swapping, and even that isn't difficult.

Figure 2 shows a flowchart for the control program and the Program Listing. Following the flowchart, initialize the buffer before using it. The hardware makes sure that no characters arrive before the software's ready (by using the busy FF described above).

After the reset, it's important to check that the 8255A is stable. If the 8255A isn't stable it might not accept your first commands. By setting up the stack pointer, you ensure proper operation of the printer buffer. The stack pointer operates the interrupts and the subroutines. And, by allotting 20 bytes of RAM for the stack, you'll have more than enough RAM for the program.

Before initializing everything else, include a brief delay loop. Then, after the delay loop, send the program-

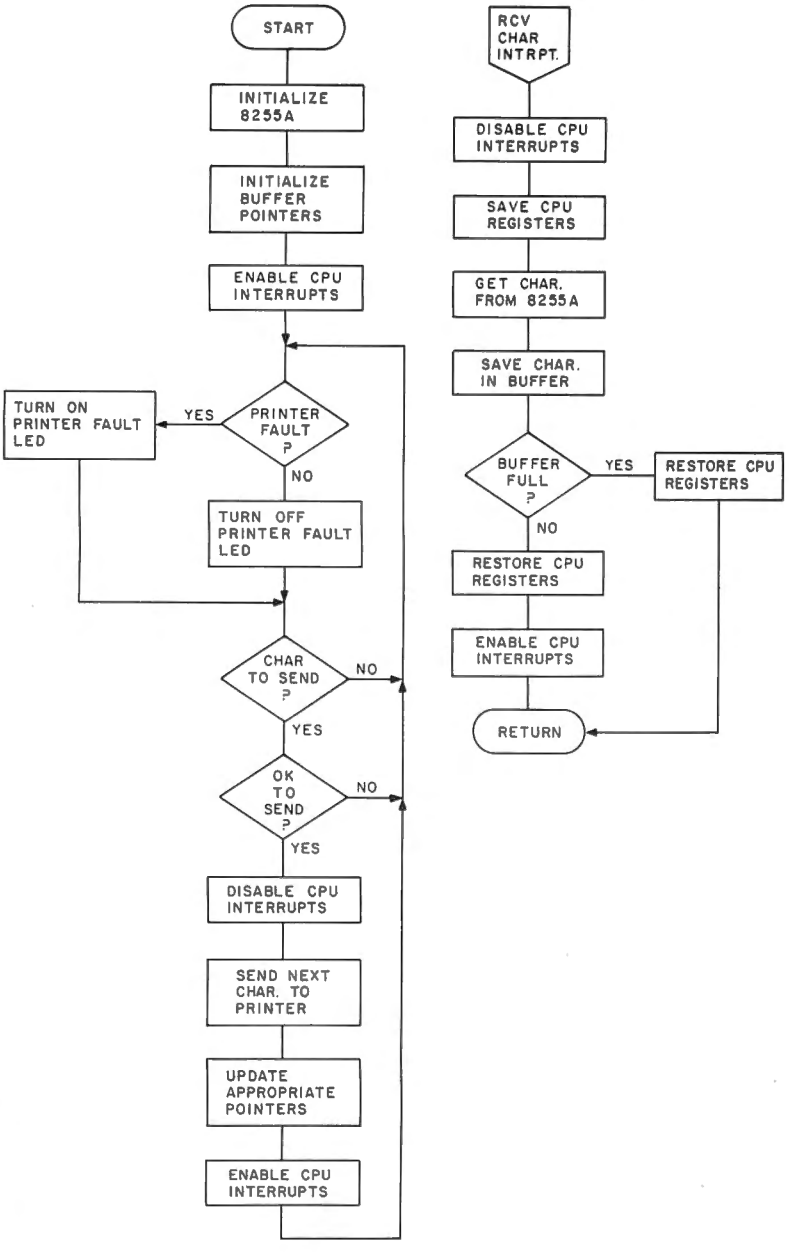

Figure 2. Buffer control program flowchart.

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mable peripheral interface (PPI) set-up command byte. This configures the 8255A for Port A Mode 1 input and Port B Mode 1 output. Then send a 01H to the FF7s for initialization, though the reset should do this.

Set the Z80 interrupt at Mode 1—the only acceptable interrupt for the Z80. The Z80 always vectors to location 0038 hex (in ROM) when set for the Mode 1 interrupts.

The software now initializes the buffer memory pointers. These pointers keep track of where the next character coming in is to go, and where the next character leaving is taken from. Each pointer actually consists of absolute memory address pointer, and a byte specifying the RAM block. There's also a 16-bit count value for the character count, and a flag indicating the presence or absence of at least one character in the buffer.

With the data direction specified for the PC6 and PC7 lines, the "Buffer OK" LED turns on and the "Printer Fault" LED turns off. This enables the PPI interrupts and the Z80 interrupts, completing the initialization and preparing the buffer for operation.

After initialization, the program enters its main loop. The loop checks to determine that the buffer has received a character. If so, it calls the CHRPTR routine to turn the "Printer Fault" LED on or off. It then determines (using the Zero flag) if the printer can accept a character. If yes, the Zero flag returns set. If the printer's ready, subroutine SENCHR sends the next character to the printer, or the main loop begins again.

The SENCHR and SERVIC Routines

If SENCHR sends no characters, the program continues looping, looking for characters and updating the "Printer Fault" LED.

If a character is sent to the printer buffer, the PPI interrupts the Z80,

I/O Address Range	Suggested Address(es)	Direction	Purpose
00–7F hex	00–03 hex	I/O	8255A PPI
80–FF hex	80 hex	O	U10—Flip-flops DB0 = Busy out BB1 = RAM block select
80–FF hex	80 hex	I	U7—Printer status byte DB0 = Paper out DB1 = Select DB2 = Fault DB3 = Busy (input)

Table. Buffer I/O map.

and invokes the SERVIC routine. By disabling the Z80 interrupts during the SENCHR subroutine and again during the interrupt service routine, you avoid potential problems. The SERVIC routine saves the main Z80 registers, and gets the appropriate pointer values. It reads the received character and stores it in the proper memory location.

When the SERVIC routine finishes its processing, it checks for a full buffer (both pointers being equal). If the buffer isn't full, the registers are restored, interrupts are reenabled, and the control returns to the point where it was interrupted.

If the buffer's full, SERVIC restores the Z80 registers, but doesn't reenable Z80 interrupts. Then control returns to the interrupt point. Without reenabling interrupts, the Z80 won't accept any further requests from the PPI.

The PPI receives one more character from the computer, but it holds it (with the busy output signal active) until the buffer can accept characters. This happens when a character is sent to the printer. Whenever a character is sent out, Z80 interrupts are reenabled, letting more characters be received (as in the SENCHR subroutine).

This uses a total of 29 bytes of RAM, leaving 65536−29=65507 bytes for RAM storage. Since the 8255A can hold one additional character, the printer's buffering capability is 65508 characters. If you want a few additional bytes, reduce the amount of memory set aside for the stack.

Using the Printer Buffer

Once everything's operational, just plug in the cables and turn on the power: The printer buffer takes it from there. The system's "Buffer OK" LED message goes on, and the "Printer Fault" LED reflects the status of the printer. Send data to the buffer as if it were your printer. You'll be amazed at how fast the computer comes back—ready for more work. ■

Write to Roger C. Alford at Washtenaw Digital Systems, P.O. Box 2041, Ann Arbor, MI 48106. Please include a self-addressed envelope for a reply.

Program Listing. Printer buffer control program.

```
00100 ;*******************************************************
00110 ;            PRINTER BUFFER CONTROL PROGRAM            *
00120 ;                                                      *
00130 ;    This program controls the operation of the        *
00140 ; Project 80 printer buffer. It first initializes all  *
00150 ; I/O devices, then resets the various memory pointers. *
00160 ; Since the RAM is bank-switched to permit access to   *
00170 ; the full 64K bytes of memory for character storage,  *
00180 ; the program also keeps track of all characters       *
00190 ; received and sent, including the bank selection      *
00200 ; requirements.                                       *
```

Listing continued

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Listing continued

```
                        00210 ;    Characters received from the computer cause an     *
                        00220 ; interrupt to the Z80. The interrupt service routine   *
                        00230 ; reads the character from the 8255A PPI, completing    *
                        00240 ; the computer/buffer handshaking. As characters are    *
                        00250 ; transmitted to the printer, the appropriate strobe    *
                        00260 ; signal is also generated.                             *
                        00270 ;    The program also lights the "BUFFER OK" LED after  *
                        00280 ; initialization, and lights the "PRINTER FAULT" LED    *
                        00290 ; whenever a printer fault condition is detected.       *
                        00300 ;                                                       *
                        00310 ;              Written by  Roger C. Alford              *
                        00320 ;***************************************************
                        00330 ;
                        00340 ;
0000                    00350 PORTA   EQU     00H     ;8255A PORT A - BUFFER INPUT
0001                    00360 PORTB   EQU     01H     ;8255A PORT B - BUFFER OUTPUT
0003                    00370 COMAND  EQU     03H     ;8255A COMMAND PORT
0080                    00380 SPCL    EQU     80H     ;OUTPUT TO SPECIAL FLIP-FLOPS
0080                    00390 PRNTR   EQU     80H     ;INPUT FROM PRINTER
                        00400 ;
0000                    00410         ORG     0000H   ;START OF ROM - BOOT LOCATION
0000 C36900             00420 PRBUFR  JP      MAIN            ;JUMP TO MAIN PROGRAM
                        00430 ;
0038                    00440         ORG     0038H
0038 C3F400             00450 INTRPT  JP      SERVIC          ;JUMP TO INTERRUPT SERVIC
                        00460 ;
0069                    00470         ORG     0069H
                        00480 ;
                        00490 ;***************************************************
                        00500 ;    This section of code is the initialization     *
                        00510 ; section. It is executed only once, immediately after *
                        00520 ; buffer power-up or reset. The stack pointer is first *
                        00530 ; set up, allowing interrupt and subroutine         *
                        00540 ; processing. A brief delay is then executed to allow *
                        00550 ; all buffer hardware to stabilize. The 8255A PPI is *
                        00560 ; then set up to permit Mode 1 I/O, then the memory  *
                        00570 ; pointers are initialized to allow characters to be *
                        00580 ; buffered in a 64K-byte circular buffer. Finally, the *
                        00590 ; appropriate LED's are turned on or off, character  *
                        00600 ; input is enabled, and receive inputs are enabled.  *
                        00610 ;***************************************************
0069 311D40             00620 MAIN    LD      SP,TOPSTK       ;POINT TO TOP OF STACK
006C 21FF3F             00630         LD      HL,3FFFH        ;GET START-UP DELAY VALU
006F 2B                 00640 DELAY   DEC     HL              ;DECREMENT COUNT
0070 7C                 00650         LD      A,H             ;CHECK FOR ZERO COUNT
0071 B5                 00660         OR      L               ;COUNT = 0?
0072 20FB               00670         JR      NZ,DELAY        ;IF NOT, KEEP UP DELAY
                        00680                                 ;THINGS SHOULD BE STABLE
0074 3EB4               00690         LD      A,0B4H          ;GET PPI SET UP BYTE
0076 D303               00700         OUT     (COMAND),A      ;SET UP PPI:
                        00710                                 ;  A=MODE 1 INPUT
                        00720                                 ;  B=MODE 1 OUTPUT
0078 3E01               00730         LD      A,01H           ;GET LATCH SET UP BYTE
007A D380               00740         OUT     (SPCL),A        ;SELECT BUFFER BUSY AND
                        00750                                 ;   RAM BLOCK 0
007C ED56               00760         IM      1               ;SET Z80 FOR INT MODE 1
007E 211D40             00770         LD      HL,BUFFER       ;PT TO BEG OF BUFFR AREA
0081 220040             00780         LD      (RCVPTR),HL     ;SAVE IN RCV PTR AREA
0084 220240             00790         LD      (SNDPTR),HL     ;SAVE IN SEND PTR AREA
0087 AF                 00800         XOR     A               ;ZERO ACCUMULATOR
0088 320840             00810         LD      (CHRFLG),A      ;CLEAR CHAR PRESNT FLAG
008B 320440             00820         LD      (RCVPAG),A      ;CLEAR RECEIVE PAGE
008E 320540             00830         LD      (SNDPAG),A      ;CLEAR SEND PAGE
0091 210000             00840         LD      HL,0000H        ;CLEAR HL REGISTER PAIR
0094 220640             00850         LD      (COUNT),HL      ;CLEAR CHARACTER COUNT
0097 3E0C               00860         LD      A,0CH           ;GET LED 1 ON COMMAND
0099 D303               00870         OUT     (COMAND),A      ;TURN ON BUFR OK LED
009B 3E0F               00880         LD      A,0FH           ;GET LED 2 OFF COMND
009D D303               00890         OUT     (COMAND),A      ;TURN OFF PRTR FLT LED
009F AF                 00900         XOR     A               ;CLEAR ACCUMULATOR
00A0 D380               00910         OUT     (SPCL),A        ;UNBUSY BUFFER
00A2 3E09               00920         LD      A,09H           ;GET INT A ENABLE CMD BYT
```

Listing continued

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Listing continued

```
                        00930          OUT     (COMAND),A      ;ALLOW INPUT INTERRUPTS
00A4 D303               00940          EI                      ;ENABLE Z80 INTERRUPTS
00A6 FB                 00950 ;
                        00960 ;*****************************************************
                        00970 ;  MNLOOP is the main code section. It calls the    *
                        00980 ; various subroutines necessary to keep track of the*
                        00990 ; printer status, and to send characters when       *
                        01000 ; appropriate.                                      *
                        01010 ;*****************************************************
00A7 3A0840             01020 MNLOOP   LD      A,(CHRFLG)      ;GET CHR PRSNT FLAG
00AA B7                 01030          OR      A               ;CHECK FOR CHARACTER
00AB 2005               01040          JR      NZ,PROCES       ;IF YES, PROCESS IT
00AD CDBC00             01050          CALL    CHKPTR          ;ELSE, UPDATE PRTR LED
00B0 18F5               01060          JR      MNLOOP          ;LOOP AGAIN
00B2 CDBC00             01070 PROCES   CALL    CHKPTR          ;CHEK FOR PRTR READY
00B5 20F0               01080          JR      NZ,MNLOOP       ;IF NOT READY, LOOP AGAIN
00B7 CDCE00             01090          CALL    SENCHR          ;ELSE, SEND A CHARACTER
00BA 18EB               01100          JR      MNLOOP          ;LOOP AGAIN
                        01110 ;
                        01120 ;*****************************************************
                        01130 ;  CHKPTR checks the status of the printer. It sets *
                        01140 ; or resets the "PRINTER FAULT" LED as appropriate, *
                        01150 ; based on the printer fault condition lines. Also, the*
                        01160 ; zero flag is used to indicate the printer ready   *
                        01170 ; state. If the zero flag is set, the printer is ready,*
                        01180 ; otherwise it is busy.                             *
                        01190 ;*****************************************************
00BC DB80               01200 CHKPTR   IN      A,(PRNTR)       ;GET PRINTER STATUS BYTE
00BE 47                 01210          LD      B,A             ;SAVE VALUE IN B REG.
00BF EE06               01220          XOR     06H             ;COMPLEMENT BITS 1 AND 2
00C1 E607               01230          AND     07H             ;LOOK AT ONLY LOW 3 BITS
00C3 3E0E               01240          LD      A,0EH           ;GET PRTR STS LED ON CMD
00C5 2002               01250          JR      NZ,PRFLT        ;IF NOT ZERO, PRNTR FAULT
00C7 3E0F               01260          LD      A,0FH           ;ELSE, GET LED OFF CMD
00C9 D303               01270 PRFLT    OUT     (COMAND),A      ;SEND LED COMMAND BYTE
00CB CB58               01280          BIT     3,B             ;CHECK PRINTER BUSY BIT
00CD C9                 01290          RET                     ;RETURN BUSY STATUS
                        01300 ;
                        01310 ;*****************************************************
                        01320 ;  SENCHR sends the next character in the buffer to *
                        01330 ; the printer, then updates all affected buffer memory*
                        01340 ; pointers.                                         *
                        01350 ;*****************************************************
00CE F3                 01360 SENCHR   DI                      ;NEED INTRPTS OFF NOW
00CF 2A0240             01370          LD      HL,(SNDPTR)     ;GET SEND PTR VALUE
00D2 3A0540             01380          LD      A,(SNDPAG)      ;GET SEND PAGE VALUE
00D5 D380               01390          OUT     (SPCL),A        ;SEND VALUE TO FF
00D7 7E                 01400          LD      A,(HL)          ;GET CHARACTER FROM MEMRY
00D8 D301               01410          OUT     (PORTB),A       ;SEND TO THE PRINTER
00DA 3A0540             01420          LD      A,(SNDPAG)      ;GET PAGE AGAIN
00DD CD3201             01430          CALL    INCPTR          ;INCREMENT CHAR POINTER
00E0 320540             01440          LD      (SNDPAG),A      ;SAVE NEW PAGE VALUE
00E3 220240             01450          LD      (SNDPTR),HL     ;SAVE NEW SEND PTR VALUE
00E6 2A0640             01460          LD      HL,(COUNT)      ;GET CHAR. COUNT
00E9 2B                 01470          DEC     HL              ;DECREMENT COUNT
00EA 220640             01480          LD      (COUNT),HL      ;STORE NEW COUNT
00ED 7C                 01490          LD      A,H             ;CHECK FOR ZERO COUNT
00EE B5                 01500          OR      L
00EF 320840             01510          LD      (CHRFLG),A      ;COUNT = 0?
00F2 FB                 01520          EI                      ;STORE RESULT IN CHR FLAG
00F3 C9                 01530          RET                     ;RE-ENABLE INTERRUPTS
                        01540 ;                                 ;DONE - RETURN
                        01550 ;*****************************************************
                        01560 ;  SERVIC services the Z80 interrupt caused by a    *
                        01570 ; received character. The character is read in, then*
                        01580 ; placed in memory, with the appropriate pointers being*
                        01590 ; updated. If the buffer memory is not yet full,    *
                        01600 ; interrupts are re-enabled before returning, otherwise*
                        01610 ; they are kept disabled until room is available.   *
                        01620 ;*****************************************************
00F4 08                 01630 SERVIC   EX      AF,AF'          ;SWAP AF REGISTERS
00F5 D9                 01640          EXX                     ;SWAP GP REGISTERS
00F6 2A0840             01650          LD      HL,(RCVPTR)     ;GET RECEIVE PTR VALUE
```

Listing continued

Listing continued

```
00F9 3A0440   01660          LD      A,(RCVPAG)      ;GET RECEIVE PAGE VALUE
00FC D308     01670          OUT     (SPCL),A        ;SET UP PROPER RAM PAGE
00FE DB00     01680          IN      A,(PORTA)       ;GET CHARACTER FROM COMP
0100 77       01690          LD      (HL),A          ;STORE CHAR IN BUFFR RAM
0101 3A0440   01700          LD      A,(RCVPAG)      ;GET PAGE VALUE AGAIN
0104 CD3201   01710          CALL    INCPTR          ;INCREMENT MEMORY PTR
0107 320440   01720          LD      (RCVPAG),A      ;STORE NEW PAGE VALUE
010A 220040   01730          LD      (RCVPTR),HL     ;STORE NEW PTR VALUE
010D 47       01740          LD      B,A             ;PUT PAGE VALUE TEMP IN B
010E E5       01750          PUSH    HL              ;SAVE RCVPTR ON STACK
010F 3E01     01760          LD      A,1             ;GET NEW CHAR PRSNT FLAG
0111 320840   01770          LD      (CHRFLG),A      ;SET FLAG - CHAR. IS IN
0114 2A0640   01780          LD      HL,(COUNT)      ;GET CHARACTER COUNT
0117 23       01790          INC     HL              ;INCREMENT COUNT
0118 220640   01800          LD      (COUNT),HL      ;STORE NEW COUNT VALUE
011B E1       01810          POP     HL              ;RESTORE HL POINTER
011C 3A0540   01820          LD      A,(SNDPAG)      ;GET SEND PAGE VALUE
011F B8       01830          CP      B               ;CHECK FOR A PAGE MATCH
0120 2009     01840          JR      NZ,NOMACH       ;IF NOT, ALL IS OK
0122 ED5B0240 01850          LD      DE,(SNDPTR)     ;ELSE, GET SND PTR VALUE
0126 B7       01860          OR      A               ;CLEAR CARRY FLAG
0127 ED52     01870          SBC     HL,DE           ;COMPARE PTR VALUES
0129 2804     01880          JR      Z,RESTOR        ;IF SAME, RETURN WITHOUT
              01890                                  ;  RE-ENABLING INTERRUPTS
              01900                                  ;  SO NO MORE CHARS CAN
              01910                                  ;    BE SENT TO BUFFER
012B 08       01920 NOMACH   EX      AF,AF'          ;RESTORE AF REGISTERS
012C D9       01930          EXX                     ;RESTORE GP REGISTERS
012D FB       01940          EI                      ;RE-ENABLE INT - ALL OK
012E C9       01950          RET                     ;DONE - RETURN
012F 08       01960 RESTOR   EX      AF,AF'          ;RESTORE AF REGISTERS
0130 D9       01970          EXX                     ;RESTORE GP REGISTERS
0131 C9       01980          RET                     ;DONE - RETURN, BUF FULL
              01990 ;
              02000 ;*********************************************************
              02010 ;   INCPTR increments the buffer memory pointer values *
              02020 ; in HL and the Accumulator, and performs pointer value *
              02030 ; modification or wraparound when necessary. This       *
              02040 ; allows a circular buffer to be maintained. The value  *
              02050 ; in HL is an absolute memory address, addressible from *
              02060 ; the Z80. The value in the Accumulator is the RAM page *
              02070 ; select value.                                         *
              02080 ;*********************************************************
0132 F5       02090 INCPTR   PUSH    AF              ;SAVE AF REGISTERS
0133 23       02100          INC     HL              ;INCREMENT 16-BIT PTR
0134 7C       02110          LD      A,H             ;CHECK FOR PAGE CHANGE
0135 B5       02120          OR      L               ;HL=0?
0136 2802     02130          JR      Z,CHGPAG        ;IF YES, CONTINU BELOW
0138 F1       02140          POP     AF              ;ELSE, RESTORE AF REG
0139 C9       02150          RET                     ;DONE - RETURN
013A F1       02160 CHGPAG   POP     AF              ;GET CURRENT PAGE VALUE
013B B7       02170          OR      A               ;CHECK FOR PAGE ZERO
013C 2006     02180          JR      NZ,CHG2         ;IF NOT, CONTINUE BELOW
013E 3E02     02190          LD      A,02H           ;GET NEW PAGE 1 VALUE
0140 2100C0   02200          LD      HL,0C000H       ;POINT TO BEG OF NEW PAGE
0143 C9       02210          RET                     ;DONE - RETURN
0144 AF       02220 CHG2     XOR     A               ;CLEAR ACC - PAGE 0
0145 211D40   02230          LD      HL,BUFFER       ;PT TO BEG OF BUFFER AREA
0148 C9       02240          RET                     ;DONE - RETURN
              02250 ;
4000          02260          ORG     4000H           ;START OF RAM AREA
0002          02270 RCVPTR   DEFS    2               ;RECEIVE CHAR. BUFR POINTER
0002          02280 SNDPTR   DEFS    2               ;SEND CHAR. BUFR POINTER
0001          02290 RCVPAG   DEFS    1               ;RECEIVE PAGE VALUE
0001          02300 SNDPAG   DEFS    1               ;SEND PAGE VALUE
0002          02310 COUNT    DEFS    2               ;CHARACTER COUNT
0001          02320 CHRFLG   DEFS    1               ;CHARACTER PRESENT FLAG
0014          02330 STACK    DEFS    20              ;Z80 STACK AREA
0000          02340 TOPSTK   DEFS    0               ;TOP OF STACK LOCATION
0000          02350 BUFFER   DEFS    0               ;BEGINNING OF BUFFER AREA
              02360 ;
0000          02370          END     PRBUFR
00000 TOTAL ERRORS
25873  TEXT AREA BYTES LEFT
```

End

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Storing and Retrieving Messages With Your BBS

One advantage of a BBS is that you can satisfy a wide variety of user interests by setting aside different areas of the bulletin board as special-interest sections. For instance, you can establish one section for person-to-person messages, an area for owners of particular computers, a section for public-domain programs, and so on. These divisions allow the user to read only the messages in a desired section. This benefits both the user, who can skip sections of the board of little interest, and to the sysop, who can restrict access to some sections, reserving space for private use.

Last month we introduced the idea of these message centers and described how message information was stored in two places, one for the section number where a message was stored (S2$), the other for the actual text of the message. S2$ is bit-mapped, and each bit of the 8-bit byte in S2$ stands for something different.

We've divided the BBS Express's message board into 15 separate sections, represented in S2$ as 0123456789ABCDE. This way, you can tag messages for specific sections of the board.

Messages/BBS, our file of headers, stores the section number of an incoming message. Because you can store a number from zero to 15 using only 4 bits of binary data, we'll use the first 4 bits of each byte in S2$ (bits 0–3) to store the message's section number.

Fortunately, that leaves 4 bits available for other uses. Because you have to know whether or not an addressee has received his message, you can assign that task to bit 4 by using the following code: 1 = message received, 0 = message not yet received. Thus, if bit 4 is a zero, the addressee hasn't gotten his message.

Since privacy is sometimes necessary on a bulletin board, BBS Express lets you store private messages which only the sender, the receiver, and the sysop can access. You can ensure this

by setting up the code 1 = private, 0 = public and storing that code in bit 5.

Bits 6 and 7 are left unassigned and are available for future expansion. One possibility is to mark a message as permanent so that it would never be scrolled off the board. Another possibility is to determine whether or not there's a reply to a message.

Bit-Mapping and Binary Format

While it's true that bit-mapping in Basic requires a large code overhead, it is an important technique for any Basic programmer. We're using bit-mapping in BBS Express for tutorial value as well to provide a practical and efficient way to store message information. To better understand bit-mapping in Basic, first consider the system in binary format.

Start by setting S2$ to CHR$(0), which is CHR$(00000000) in binary. This allows the variable to make fresh assignments for each new message. The message is assigned a section number between 1 and 15, which in binary is a number between 00000001 and 00001111.

A logical OR can include the section number in S2$ without disturbing the other bits. You do this in Basic by executing a logical OR with the ASCII value of S2$ and the number of the specific section, N%. For example, S2$ = CHR$(ASC(S2$) OR N%).

How does this work? First, assume that N% is 10 (00001010 binary), and S2$ is 0 (00000000 binary). In binary, ORing N% and S2$ is 00000000 OR 00001010 or 10 decimal. Thus you've merged the section number into S2$.

Although you could have achieved the same result by simply executing S2$ = CHR$(N%), the technique is what's important as you'll use it later to merge other information into S2$.

We mentioned earlier that to make a message private, you set bit 5 of S2$ to 1. This is done with a logical OR as

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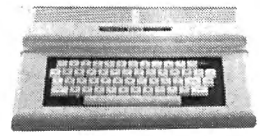

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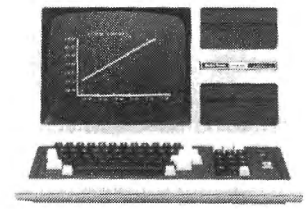

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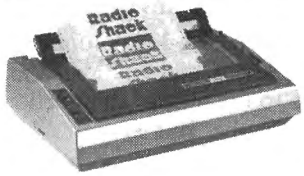

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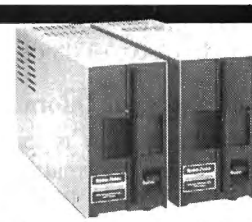

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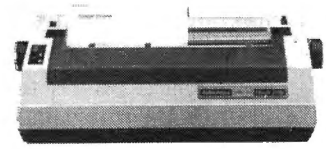

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well. This byte, with only bit 5 set (00010000), translates to 16 decimal. If you execute a logical OR with the ASCII value of S2$ and 16, all the bits in S2$ will be unaffected, except for bit 5, which is set.

In binary format, S2$ is now CHR$(00001010). 00001010 OR 00010000 = 00011010, or 26 decimal.

The Private flag is set, while the section number remains unchanged.

In a similar fashion, let bit 4 be responsible for marking a retrieved message. Set bit 4 by executing an OR with 32 (00100000 binary). S2$ = CHR$ (ASC(S2$) OR 32). In binary, 00011010 OR 00100000 = 00111010, or 58 decimal.

Other methods exist to do the same thing. For example, you can get the same result with S2$ = CHR$(ASC (S2$) + 10 + 16 + 32). But, because you'll be using logical ANDs to retrieve the information stored in S2$, you should use logical ORs to store it. In other words, what OR has wrought, AND will unwrought.

Start with S2$ = CHR$(58), 00111010 in binary. To recover the section number N%, use AND with the ASCII value of S2$ and 15 (00001111 binary). For example, N% = (ASC(S2$) AND 15), 58 AND 15 = 10, our section number.

To print the message, you first must recover it from the secret file.

Notice that bits 1–3 are unaffected, while bits 4–7 are bypassed. If you turn this around to 11110000, or 240 decimal, you can mask out bits 1–3 and isolate the top 4 bits for manipulation. Looking at this example in binary: 58 is 00111010. 00111010 AND 11110000 = 00110000, or 48 decimal.

Storing and Retrieving Information

All that remains now is to insert a code that transfers information to and from the disk where the BBS stores it. Program Listings 1 and 2 do just this: Listing 1 loads information onto the disk, while Listing 2 removes information from the disk.

In Listing 1, for example, line 3280 calls line 3290 as a subroutine. This lets the caller leave a message in one of two ways: with the L (Leave) command, or by replying to a displayed message. By creating a subroutine out of lines 3290–3640, you can call information from two places in the program.

Line 3280, the routine for leaving a message, begins by setting S7$ to CHR$(0). If line 3290 is called from a Reply command, S7$ will already contain the high 4 bits from S2$.

Throughout the program, GOSUB 130 acts as the call to the machine-code Receive section (RECV). GOSUB 130 returns with count equal to the number of characters entered over the communications link or keyboard, while I$ contains the characters.

Lines 3320–3340 prompt the section number of the message, and assign S6$ to the digit of that section. S9$ receives the number of the section, which corresponds with S6$.

Line 3610 LSETs the information into the file fields and places the assembled record into Messages/BBS, the message log, at record SN, the variable holding the number of messages on the system.

Program Listing 2 recovers the information. The header printing routine will then use this information, which we'll look at more extensively next month.

To print the message number, you first must recover it from the secret file constructed last month. This is done by setting N = VAL (RIGHT$(2$,4)). For example, if the file name is MSG0110, then N would be 110.

Since the "To," "From," and "Subject" sections of the message prompt are strings, no conversion is necessary. It is necessary, however, to assign variables so that you can manipulate them later. The variables T$, TT$, and S8$ are assigned the values To, From, and Subject, respectively.

Because of the mask with 240, S9$ gets the section number from S2$. You'll want the BBS program to print the digit of the section number, rather than its value. In our example, the section number was 10. Therefore, you want to print "Section: A" not "Section: CHR$(10)". Because CHR$(10) is a line feed, there's no need to print it.

Using Basic's MID$ function, S6$ retrieves the digit to print. You can see

Program Listing 1. BBS module for writing messages to disk.

```
3280 GOSUB220:S7$=CHR$(0):GOSUB3290:GOTO1720
3290 IF LEN(MN$)=254 THEN PRINT"Message board filled.  Please call
 back":RETURN
3300 PRINT"To: ";:GOSUB130:PRINTCHR$(17):IF CT=0 THEN RETURN ELSE
TT$=LEFT$(I$,CT)
3310 PRINT"Subject: ";:GOSUB130:PRINTCHR$(17):S8$=LEFT$(I$,CT)
3320 PRINT"Section:(Tap ENTER for list) ";:GOSUB130:PRINTCHR$(17)
3330 IF CT=0 THEN GOSUB830:IFCT=0THEN 3320
3340 S6$=LEFT$(I$,1):S9$=CHR$(INSTR("0123456789ABCDE",S6$)):IF (S9
$>CHR$(0))AND(INSTR(UA$,S6$)>0) THEN PRINTS$(ASC(S9$))ELSE 3320
3610 LSET F1$=NA$:LSET T2$=TIME$:LSET F2$=A$:LSET T1$=TT$:LSET S1$
=S8$:LSET S2$=CHR$((ASC(S7$) AND 32) OR (ASC(S9$))):PUT 1,SN:PRINT
"Awaiting delivery.":GOTO3640
3640 POKE MN,250:RETURN
```

End

Program Listing 2. BBS module that calls messages to the screen.

```
346 REM          DECODE MESSAGE HEADER
347 REM          RECORD IN BUFFER ON ENTRY
348 REM          EXIT: T$="TO:"
                       TT$="FROM:"
                       S8$="SUBJECT"
                       S9$=SECTION #
                       S6$=SECTION DIGIT
                       S7$=PUBLIC/PRIVATE RETRIEVED/NOT
350 E$=INKEY$:N=VAL(RIGHT$(F2$,4)):T$=T1$:TT$=F1$:S8$=S1$:S9$=CHR$
(ASC(S2$) AND 15):S7$=CHR$(ASC(S2$) AND 240):S6$=MID$("0123456789A
BCDE",ASC(S9$),1)
420 RETURN

1221 REM
1222 REM       Decide if printer is ready
1223 REM
1230 PR=(PR)AND((PEEK(&H37E8)AND240)=48):RETURN
```

End

this process in line 350 of Listing 2. In our example, S2$ is assigned the 10th character in the string 0123456789 ABCDE, which is A.

The high 4 bits of S2$ will go to S7$ for the header printing routine to use. This indicates the status of the message, i.e., whether the message is private or public and whether or not it's been retrieved by the addressee.

If ASC(S7$) AND 32 is 32, the message is private and the program will print a P. If the ASCII value of S7$ AND 16 is 16, then the addressee has retrieved the message, and the program will print an (X).

The printing routine uses a Boolean variable, PR, to indicate whether the output will go to the printer or the screen. If it goes to the screen, it is then transmitted through the communications line to the caller.

The sysop may elect to have output directed to the printer rather than to the screen with the sysop's Hard Copy option or by invoking the P command after a message appears. Choosing the Hard Copy option from the sysop's menu will set PR to true (−1). This works, assuming that the printer works properly. Line 1230 checks the printer status before allowing output to the printer.

Memory address &H37E8 is the printer status location. A PEEK to this address returns a byte that represents the current state of the printer. Because you're concerned here with the top 4 bytes, you execute an AND with 240. If the statement (PEEK (&H37E8) AND 240)=48) is true AND if PR is true (−1), the message is printed to the line printer instead of the screen.

If the printer isn't ready, ((PEEK (&H37E8) AND 240)=48) will not be true. In this case, PR will go to zero and the message will be printed to the screen.

In next month's BBS Express, we'll deal more with printing, so stay tuned. ■

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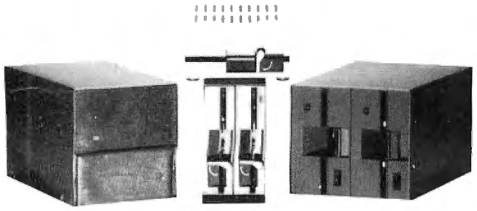

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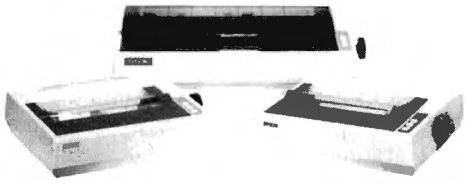

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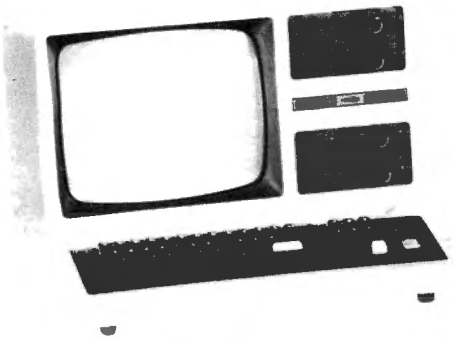

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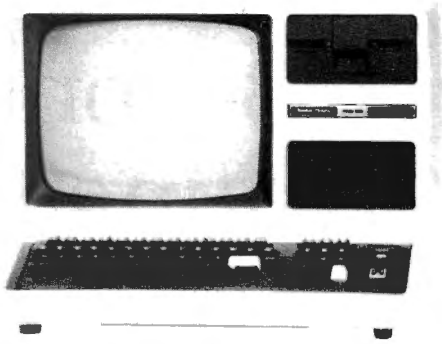

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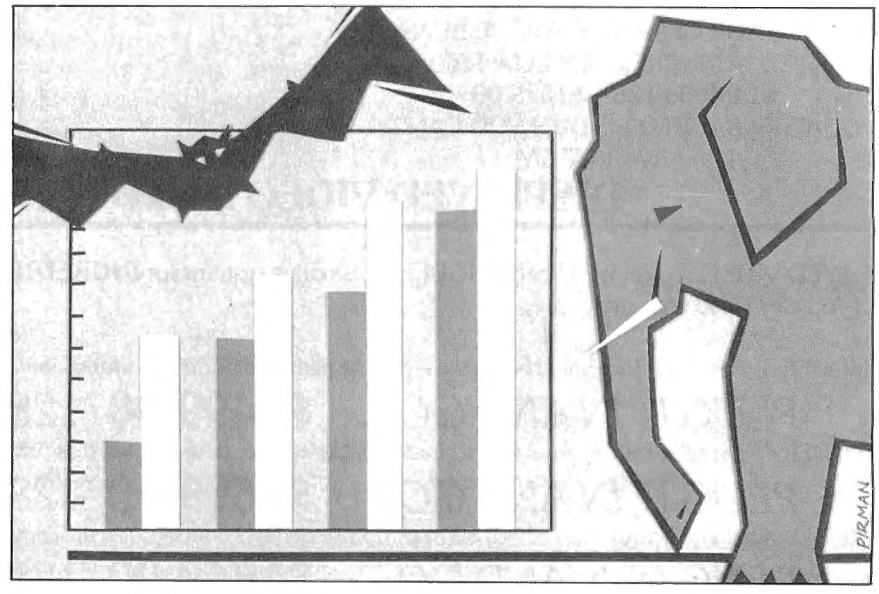
Beyond the Keyboard: Creating Character Graphics



Your computer provides a contingent of variously shaped, ROM-based figures called character graphics. If you know how to retrieve them and how to make them work together, you're on your way to some fancy graphics effects for art, animation, and decoration.

This month I'll travel among these strange creatures of the light and show how you can use them.

Model I/III/4 Graphics

You can generate graphics characters by using ASCII codes 128–191 on the Model I/III/4. Program Listing 1, Character Graphics, is a short routine that displays all but one of the Model I/III/4 graphics symbols; it doesn't display CHR$(128) since that represents a blank space.

The computer forms each graphics character using a box of six cells, two horizontal by three vertical. The ASCII codes from 128–191 use every combination of lights on and off to create the 64 character shapes.

To see this for yourself, try Giant Blip in Program Listing 2. This program displays an enlarged graphics character of your choice. Type in and run the program. At the prompt, type in a number between 128 and 191 and hit the enter key.

Giant Blip displays the appropriate character graphics in the upper left corner of the screen. Tap any key to try another shape.

Last month I discussed ASCII code and how each character has a corresponding ASCII number. That goes for graphics characters, too. Typing in PRINT CHR$(187) prints the character graphic 187.

If you type in A$=CHR$(187), then type in PRINT ASC(A$) and hit the enter key, the computer prints the number 187, the ASCII value assigned to that variable. These techniques are useful for manipulating character graphics.

You can print a string that repeats the same graphics character up to 255 times. Type in CLEAR 1000 and hit the enter key to clear sufficient string space, then type in PRINT STRING$(255,157) and press the enter key.

The 255 is the number of times you want the computer to print the graphics character, and 157 represents the character's ASCII number. Change these values to produce a desired graphics character and string length.

You can also assign a single value to a string variable: A$=CHR$(134). Now make this part of a STRING$ expression by typing in PRINT STRING$(64,A$). To streamline the program, make a variable worth the STRING$ value: A$=STRING$(32,178).

An even more complex approach is to make a string variable equal to three characters. Type in Z$=CHR$(134)+CHR$(135)+CHR$(136). Then type in PRINT Z$ and press the enter key. The computer prints the three graphics characters in a row.

The result here isn't impressive, but by experimenting with this technique you can create new graphics shapes.

Try running Concatenated Graphics in Program Listing 3. The program prints three graphics characters in a row, followed by the corresponding ASCII codes. It then lets you change any of the three characters to create new shapes.

The program starts by prompting you for character 1, 2, or 3. Type in a number, but don't press the enter key. The program then prompts you for an ASCII number between 128 and 191.

The Key Box

Models I and III
Model 4
Model 100

Type in a whole number within this range and press the enter key.

The computer prints three graphics characters at the bottom of the screen with the corresponding ASCII numbers to the right, and returns continuously for a changing value of any of the characters.

By randomly adding three graphics characters, you might, for example, blunder onto the combination that looks like an elephant. But you'll never find it unless you try.

Program Listing 4, 12-Month Bar Graph, shows how to use the STRING$ statement to print graphs and charts. The program prompts you to title the chart and to input values of 100 or fewer units for each month of the year. As soon as you enter the December values, the program prints the chart. The bar lengths correspond to the values you enter.

Graphics characters also work well for screen ornamentation. Frame, in Program Listing 5, uses three string variables to frame the screen. In lines 130–150 the program assigns the string variables to represent parts of the frame.

Run the program and a frame shape appears. Then hit the break key, type in CLS, hit the enter key, and type in PRINT A$. Try this for B$ and C$ to see how I put the strings together in manageable lengths.

Model 100 Graphics

The Model 100 uses a liquid crystal display instead of the Model I/III/4 phosphor display, and its graphics differ from those of the Model I/III/4. The ASCII numbers 123–159 and 224–255 represent the Model 100's graphics characters. A complete ASCII character table appears on pp. 211–216 of the Model 100 owner's manual.

The Model 100 graphics set uses two- by two-cell graphics characters. Between CHR$(224), which is a blank, and CHR$(239), which is a filled box, 16 basic graphics combinations exist.

CHR$(240) to CHR$(250) represent characters that create lines for framing. CHR$(255) is a checkered square, and characters 251–254 are diagonal graphics.

Bat in Program Listing 6 uses the diagonal graphics characters to dis-

Program Listing 1. Character Graphics program.

```
100 REM * CHARACTER GRAPHICS *
110 REM * TRS-80 MODELS I, III AND 4
120 CLS
130 FOR X=129 TO 191
140 PRINT X;CHR$(X)" ";
150 N=N+1
160 IF N=9 THEN N=0: PRINT: PRINT
170 NEXT X
180 END
```

End

Program Listing 2. Giant Blip graphics enlargement program.

```
100 REM * GIANT BLIP *
110 REM * TRS-80 MODELS I, III AND 4
120 DATA 11,25,331,345,651,665
130 FOR X=1 TO 6
140 READ K(X)
150 NEXT X
160 CLS
170 V$=STRING$(14,191)
180 INPUT "ENTER CHARACTER GRAPHIC NUMBER - 128 TO 191";A
190 IF A<128 OR A>191 THEN CLS: GOTO 180
200 A=INT(A)
210 CLS
220 PRINT CHR$(A)
230 FOR X=21 TO 79 STEP 28
240 FOR Y=0 TO 45
250 SET(X,Y)
260 NEXT Y,X
270 FOR Y=0 TO 45 STEP 15
280 FOR X=21 TO 77
290 SET(X,Y)
300 NEXT X,Y
310 H=1
320 FOR A=0 TO 2
330 FOR B=0 TO 1
340 IF POINT(B,A)=-1 THEN GOSUB 380
350 H=H+1
360 NEXT B,A
370 IF INKEY$="" GOTO 370ELSE GOTO 160
380 FOR L=K(H) TO K(H)+256 STEP 64
390 PRINT ` L,V$;
400 NEXT L
410 RETURN
420 END
```

End

Program Listing 3. Concatenated Graphics program.

```
100 REM * CONCATENATED GRAPHICS *
110 REM * TRS-80 MODELS I, III AND 4
120 FOR X=1 TO 3
130 C$(X)=CHR$(128)
140 NEXT
150 CLS
160 PRINT "CHARACTER 1,2,3 ?"
170 A$=INKEY$
180 A=VAL(A$)
190 IF A<1 OR A>3 GOTO 170ELSE A=INT(A)
200 INPUT "ASCII NUMBER: 128 TO 191";B
210 IF B<128 OR B>191 GOTO 200
220 C$(A)=CHR$(B)
230 PRINT @ 896,C$(1);C$(2);C$(3);
240 PRINT ASC(C$(1));ASC(C$(2));ASC(C$(3));
250 PRINT @ 0,CHR$(255);
260 PRINT @ 0,"";
270 GOTO 160
280 END
```

End

Program Listing 4. 12-Month Bar Graph program.

```
100 REM * 12-MONTH BAR GRAPH *
110 REM * TRS-80 MODELS I, III AND 4
120 CLEAR 500
130 CLS
140 DIM M(12)
```

Listing 4 continued

Listing 4 continued

```
150 A$="JANFEBMARAPRMAYJUNJULAUGSEPOCTNOVDEC"
160 INPUT "NAME OF GRAPH";B$
170 IF LEN(B$)>64 THEN PRINT "NAME OF GRAPH TOO LONG... TRY AGAIN.
": GOTO 160
180 D=1
190 FOR X=1 TO 34 STEP 3
200 PRINT MID$(A$,X,3)" TOTAL TO 100 UNITS"
210 INPUT V
220 IF V<1 OR V>100 THEN PRINT: PRINT "NUMBER OUTSIDE LIMITS..": G
OTO 200ELSE M(D)=V/2: D=D+1
230 NEXT X
240 CLS
250 PRINT B$
260 PRINT
270 X=1
280 V=1
290 FOR F=128 TO 832 STEP 64
300 PRINT @ F,MID$(A$,X,3)" "STRING$(M(V),143);M(V)*2
310 X=X+3
320 V=V+1
330 NEXT F
340 END
```

End

Program Listing 5. Frame-graphics program.

```
100 REM * FRAME *
110 REM * TRS-80 MODELS I, III AND 4
120 CLS
125 CLEAR 500
130 A$=CHR$(151)+STRING$(62,131)+CHR$(171)
140 B$=CHR$(149)+STRING$(62,128)+CHR$(170)
150 C$=CHR$(181)+STRING$(62,176)+CHR$(186)
160 PRINT A$;
170 FOR X=1 TO 13
180 PRINT B$;
190 NEXT X
200 PRINT C$;
210 GOTO 210
220 END
```

End

Program Listing 6. The Bat Model 100 animation program.

```
100 REM * The Bat *
110 REM * TRS-80 MODEL 100 8K
120 CLS: CLEAR 250
130 DEFSTR A-D
140 C=CHR$(224)
150 A=C+CHR$(252)+CHR$(238)+CHR$(237)+CHR$(254)+C
160 B=C+CHR$(253)+CHR$(238)+CHR$(237)+CHR$(251)+C
170 FOR E=1 TO 2
180 IF E=1 THEN FOR F=80 TO 115 ELSE FOR F=115 TO 80 STEP -1
190 IF F/2=INT(F/2) THEN D=A ELSE D=B
200 PRINT @ F,D;
210 FOR T=1 TO 100
220 NEXT T,F,E
230 GOTO 170
240 END
```

End

Program Listing 8. Template animation program.

```
100 REM * Template *
110 REM * TRS-80 Models I, III, 4 and 100
120 CLS
130 A$(1)=CHR$(X)+CHR$(X)+CHR$(X)
140 B$(1)=CHR$(X)+CHR$(X)+CHR$(X)
150 C$(1)=CHR$(X)+CHR$(X)+CHR$(X)
160 A$(2)=CHR$(X)+CHR$(X)+CHR$(X)
170 B$(2)=CHR$(X)+CHR$(X)+CHR$(X)
180 C$(2)=CHR$(X)+CHR$(X)+CHR$(X)
190 FOR A=1 TO 2
200 PRINT @ 0,"";
210 PRINT A$(A)
220 PRINT B$(A)
230 PRINT C$(A)
240 FOR T=1 TO 100
250 NEXT T,A
260 GOTO 190
270 END
```

End

Program Listing 7. Jumpy Model 100 program.

```
100 REM * Jumpy *
110 REM * TRS-80 Model 100 8K
120 CLS
130 FOR X=1 TO 2
140 IF X=1 THEN A$=CHR$(147)
    ELSE A$=CHR$(148)
150 PRINT @ 60,A$;
160 FOR T=1 TO 50
170 NEXT T,X
180 GOTO 130
190 END
```

End

play a bat flitting back and forth across the screen.

Another animation program, Jumpy, repeatedly prints character strings 147 and 148 to get a jumping effect (see Program Listing 7).

More Animation

Try creating animation using the graphics characters on your system and Template in Program Listing 8. When you type in this listing, use your imagination and fill in the missing ASCII codes.

Template is a demonstration of two-stage animation that contains nine graphics characters. The idea is to create two three- by three-cell figures. The program represents the first figure as A$(1), B$(1), and C$(1) in lines 130–150.

The second animation stage is A$(2), B$(2), and C$(2) in lines 160–180. The program won't work as shown, however. You must replace the X's in the CHR$(X) statements with the graphics characters' numbers for your machine.

First create a shape on a three- by three-cell grid and make a second shape that relates to the first so that the movement makes sense. Template displays the two animation stages over each other.

Try expanding Template to an eight- by eight-cell grid in five animation stages, or make it larger if you like. Soon you'll have cartoon characters running across your screen.

Animation offers the most interesting use of character graphics, but the applications are endless.

Coming soon: To err is human, but if you want your Basic programs to forgive, don't miss my discussion of error codes next month. ■

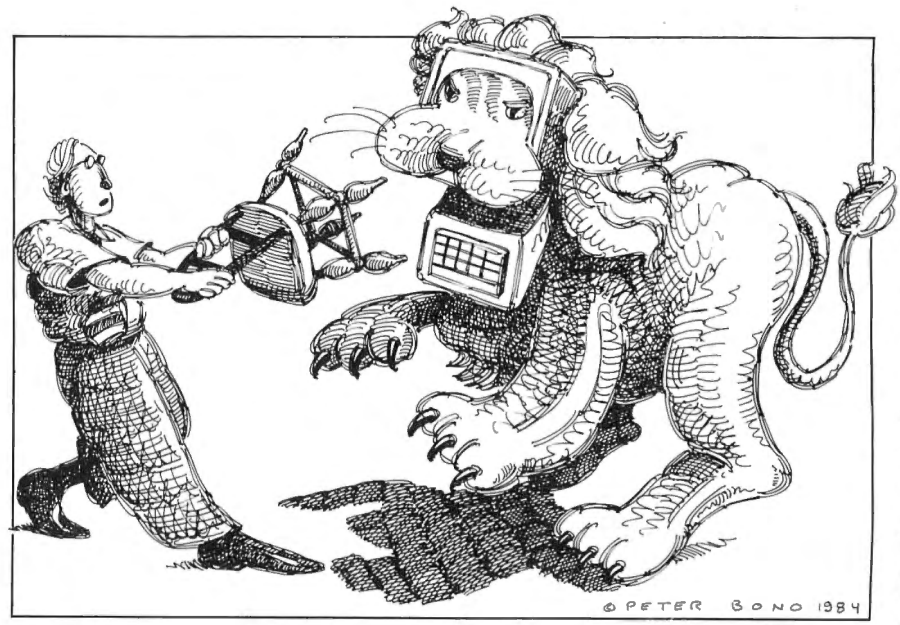
You can reach Richard Ramella at 1493 Mt. View Ave., Chico, CA 95926.

Tackling Some Tougher Pascal Programs

Last month, you learned about Pascal's advanced data types. Now you're ready to put those data types to work in more interesting and complex programs.

To review, arrays are collections of data elements of the same type. Records hold elements of different types. Enumerated types have all possible data values listed in the program's type declaration and the values have an inherent order. Subrange data types contain subsets of larger ordinal data types.

You declare these user-defined data types in the Type section of your program. The showTypes program (see Program Listing 1) demonstrates the use of a number of different data types.



Take a Number

The Matrix Algebra program (Program Listing 2) performs addition, multiplication, and subtraction on two-dimensional arrays.

The program passes arrays by reference to the procedures. As you may remember, when you pass a variable by reference, the procedure can alter its value; you're dealing with the original value of the variable in memory. However, a variable passed by value is also stored in another location, and you can alter it in the procedure without changing its original value.

In this program, you're passing the arrays by reference to save space, not to protect them from side effects; it takes up too much room to store them in two places at the same time.

You do have the option of using global variables instead of passing the arrays to the procedures. But that defeats the primary reason for using procedures. When you use global variables in a procedure, as in the example below, the routine works only on those variables:

```
procedure addMatrix;
  { uses global variables: i, j, rows, columns as
  the size of the arrays and adds matrices A and B
  and returns C }
  for i:= 1 to rows do
    for j:= 1 to columns do
      c[i,j] := a[i,j] + b[i,j];
end;
```

If you wanted to add matrices D and E, you'd have to write a new procedure. But if you pass the arrays, you can plug any array into the procedure as long as it matches the type declared in the procedure parameter list. So you can add arrays A and B and return C, or add D and E and return F, all with the same procedure:

```
procedure addMatrix (var a,b,c: matrix:
rows,columns: integer);
var     i,j: integer;
for i:= 1 to rows do
  for j:= 1 to columns do
      c[i,j] :=[i,j] + b[i,j];
end;
```

You can invoke this procedure to add matrices A and B and return the result in C with:

```
addMatrix(a,b,c,rows,columns);
```

or add matrices D and E and return the result in F (with *n* rows and *m* columns):

```
addMatrix(d,e,f,n,m);
```

The ChooseOption procedure of the algebra program uses another advanced programming feature, the variant record. Option is a variant record passed by reference. It has only one field, but that field varies; it can be a number from zero to 4 or it can be one of the elements of the enumerated type OptionType:

```
optionType = (null, add, A*x*B, B*x*A, quit);
```

The variant field has two names, one for each variant. The name option.num indicates a value between

zero and 4, inclusive. The name option.cmd indicates a value from the enumerated type optionType. Alcor Pascal stores the enumerated type as a value between zero (for null) and 4 (for quit). So, you can enter the value as a number (using option.num) and use it as a command (option.cmd).

To indicate the function you want the program to perform, you type in a number. For example, 1 calls for adding matrices, 3 calls for postmultiplying B by A. A Read statement assigns that value to option.num. Option.cmd has the corresponding command. This makes the program much easier to read—take a look at the case statement at the end of the program. The value of option.cmd determines the case. Option.cmd = add calls one procedure; option.cmd = A*x*B calls another, and so on.

Making the Grade

And now for something completely different: a program that records and prints out student test results (see Program Listing 3). An array of 50 student records holds the data, including a student's name (a character array), a letter grade, the number of questions (a subrange type), and a Boolean array containing the student's answers to a true/false test.

You can experiment with additions to the program. For example, it would be handy to have an editing routine in case you enter an incorrect value. Or you could modify the program so it grades the tests. Just enter a special record with an ID value of zero, and name it Key. The program can then compare each student's answers with the key, and compute a grade. If you're working with a multiple choice test, you can even have the routine print out the wrong answers along with the correct answer (see Program Listing 4). ■

You can write to Bruce Powel Douglass c/o 80 Micro, *80 Pine St., Peterborough, NH 03458.*

Program Listing 1. Demonstration of advanced data types.

```
program showTypes
type
  vector = array [1..10] of real;  { declare an array type }
  cRec   = record    { declare a record type }
    id: integer;
    name: string;
    itemList: array [1..5] of string;
    end;    { end ot record type declaration }
  signedByte = -128..127;  { subrange type }
  color = (red, blue, green, yellow, orange);
var
  a: vector;
  b: cRec;
  c: signedByte;
  d: color;
begin
  { assign the third element in the array a }
  a[3] := -3.23;
  { put values in the fields of record-type variable b }
  b.id := 14;
  b.name := bldstr('Jane Doe');
  b.itemList[1] := bldstr('color TV');
  { assign c a value in the range }
  c := 244 mod 17;
  d := blue;
end.
```

End

Program Listing 2. Matrix Algebra program.

```
program matrixAlgebra;
type
  matrix= array [1..10,1..10] of real;
  optionType = (null,add,AxB,BxA,quit);
  command = record
    case boolean of
      true:  (num: 0..4);
      false: (cmd: optionType);
    end;
                        { }
var
  first,second,third: matrix;
  fRows,fColumns,sRows,sColumns,tRows,tColumns: integer;
  option: command;
```

Listing 2 continued

Listing 2 continued

```
errorInParameters: boolean;
                        {  }
procedure inputMatrix(var a: matrix; var
            rows,columns: integer);
var
  i,j: integer;
begin
 write('Enter the number of rows: ');
 readln(rows);
 write('Enter the number of columns: ');
 readln(columns);
 for i:= 1 to rows do
   for j:= 1 to columns do
     begin
     write('Enter element ',i:1,',',j:1,': ');
     readln(a[i,j]);
     end;
 end;   { end procedure inputMatrix }
                        {  }
procedure listMatrix(var a:matrix; rows,columns: integer);
var
  i,j: integer;
begin
  for i:= 1 to rows do
    begin
    for j:= 1 to columns do
      write(a[i,j]:8:3);
    writeln;
    end;
end; { end procedure listMatrix }
                        {  }
procedure addMatrix(var a,b,c: matrix;
   rows,columns: integer; var cRows,cColumns: integer);
var
  i,j: integer;
begin
  cRows:= rows;  cColumns:= columns;
  for i:= 1 to rows do
    for j:= 1 to columns do
      c[i,j]:= a[i,j] + b[i,j];
  end; { end addMatrix }
                {  }   procedure multiplyMatrix(var a,b,c: matrix;
   a_rows,a_columns,b_rows,b_columns: integer;
   var c_rows,c_columns: integer);
var i,j,k: integer;
begin
 if a_columns<>b_rows then
   begin
   writeln('ERROR!');
   errorInParameters := true;
   end
   else begin
       for i:= 1 to a_rows do
         for j:= 1 to b_columns do
           begin
           c[i,j]:= 0;
           for k:= 1 to a_columns do
             c[i,j]:= c[i,j]+a[i,k]*b[k,j];
           end;
     c_rows:= a_rows;  c_columns:= b_columns;
     end; { if }
  end;  { multiplyMatrix }
                        {  }
  procedure chooseOption(var option: command);
  begin
    writeln('Options:');
    writeln('1.  add matrices A and B');
    writeln('2.  multiply A * B');
    writeln('3.  multiply B * A');
    writeln('4.  terminate program');
    readln(option.num);
  end;
                        {  }
begin { main program }
  inputMatrix(first,fRows,fColumns);
  inputMatrix(second,sRows,sColumns);
  repeat
    errorInParameters:= false;
    chooseOption(option);
    case option.cmd of
      add: addMatrix(first,second,third,
           fRows,fColumns,tRows,tColumns);
      AxB: multiplyMatrix(first,second,third,
           fRows,fColumns,sRows,sColumns,tRows,tColumns);
      BxA: multiplyMatrix(second,first,third,
           sRows,sColumns,fRows,fColumns,tRows,tColumns);
    end; { case }
```

Listing 2 continued

See List of Advertisers on Page 176

Listing 2 continued

```
        if not(errorInParameters) then
          listMatrix(third,tRows,tColumns);
      until option.cmd=quit;
    end.
```

End

Program Listing 3. Student test program.

```
program  studentTest;
type
  oCommand = (null, load, save, inputRec, print, quit);
  optionCommand = record
    case boolean of
      true:   (num:0..5);
      false:  (cmd: oCommand);
    end;
  sRec = record
    name: array [1..20] of char;
    id: integer;
    grade: char;
    numOfQuestions: 0..100;
    answers: array [1..100] of boolean;
    end;
  sList = array [1..50] of sRec;
                          {  }
var
  students: sList;
  option: optionCommand;
  numOfRecords: 0..50;
                          {  }
procedure inputStudentRecords(var students: sList);
var
  i: integer;
                          {  }
procedure enterStudentRecord(var student: sRec);
var
  i: integer;
                          {  }
  function  getAnswer(num: integer): boolean;
  var
    ch: char;
  begin
    write('Enter answer to question number ',i:1,': ');
    readln(ch);
    if ch='T' or ch='t' then getAnswer := true
      else getAnswer := false;
    end;
                          {  }
begin
  with student do begin
    write('Enter student name: ');
      readln(name);
    write('Enter student id: ');
      readln(id);
    write('Enter student letter grade for this test: ');
      readln(grade);
    write('Number of questions on test: ');
      readln(numOfQuestions);
    for i:= 1 to numOfQuestions do
       answers[i] := getAnswer(i);
    end;  { with }
  end; { enterStudentRecord }
                          {  }
begin { inputStudentRecords }
  write('How many student records to enter: ');
  readln(numOfRecords);
  for i:= 1 to numOfRecords do
    begin
    students[i]:= students[1];  { initialize }
    enterStudentRecord(students[i]);
    end;
end; { inputStudentRecords }
                          {  }
procedure printStudentRecords(var students: sList);
var
  i,j: integer;
begin
  writeln('Student List');
  writeln('There are ',numOfRecords:1,' records');
  for i:= 1 to numOfRecords do
    with students[i] do begin
      writeln('Name: ',name);
      writeln('ID: ',id:1);
      writeln('Grade: ',grade);
      for j:=1 to numOfQuestions do
        begin
```

Listing 3 continued

Listing 3 continued

```
                if answers[j] = true then write(j:1,'=T  ')
                  else write(j:1,'=F  ');
                if j mod 10=0 then writeln;
                end; { for j }
            end; { with }
        end; { printStudentRecords }
                                { }
        procedure saveStudentRecords(var students: sList);
        var
          i: integer;
          recordFile: file of sRec;
        begin
          writeln('Enter name of output disk file');
          rewrite(recordFile);
          writeln('writing ',numOfRecords:1,' records');
          for i:= 1 to numOfRecords do
            write(recordFile,students[i]);
          close(recordFile);
        end; { saveStudentRecords }
                                { }
        procedure loadStudentRecords(var students: sList);
        var
          recordFile: file of sRec;
        begin
          writeln('Enter name of input disk file');
          reset(recordFile);
          numOfRecords := 0;
          while not eof(recordFile) do
            begin
            numOfRecords := numOfRecords + 1;
            read(recordFile,students[numOfRecords]);
            end; { while }
          close(recordFile);
          writeln(numOfRecords:1,' student records loaded.');
        end; { loadStudentRecords }
                                { }
        procedure chooseOption(var option: optionCommand);
        begin
          writeln('Options:');
          writeln('1. Load file from disk');
          writeln('2. Save file to disk');
          writeln('3. Key in file');
          writeln('4. Print file');
          writeln('5. Quit program');
          readln(option.num);
        end;
                                { }
        begin { main program }
        repeat
          chooseOption(option);
          case option.cmd of
            load:     loadStudentRecords(students);
            save:     saveStudentRecords(students);
            inputRec: inputStudentRecords(students);
            print:    printStudentRecords(students);
          end;
        until option.cmd = quit;
        end.
```

End

Program Listing 4. Test-grading routine.

```
procedure gradeTest(var student: sRec);
var
  i, wrongAnswers, percentRight : integer;
begin
  { sList[1] is the key }
  writeln('Grading ',student.name);
  wrongAnswers := 0;
  with sList[1] do
    for i:= 1 to numOfQuestions do
      if student.answers[i] <> answers[i] then
        begin
        wrongAnswers := wrongAnswers + 1;
        write('Question ',i:1,' is wrong. ');
        writeln('Correct is ',answers[i]);
        end;
    writeln('There are ',wrongAnswers:1,' incorrect answers.');
    percentRight := round(numOfQuestions / wrongAnswers) * 100;
    case percentRight of
      90..100: student.grade := 'A';
      80..89:  student.grade := 'B';
      70..79:  student.grade := 'C';
      otherwise  student.grade := 'F';
    end;  { end of CASE statement }
    writeln(student.name,' has a letter grade of ',student.grade);
  end; { with }
end;  { grade }
```

End

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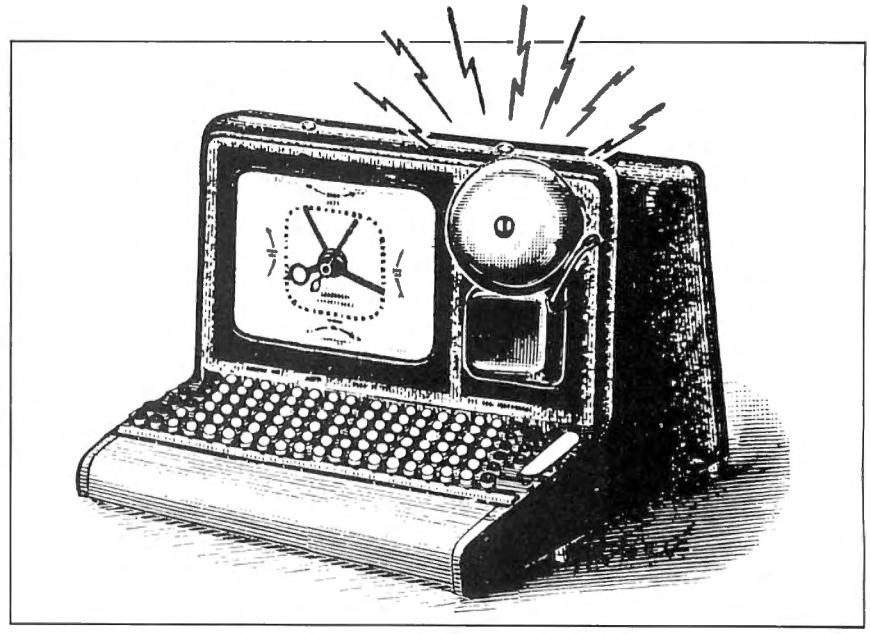
Double-Action Programming With the Z80 Chip



When you run a program, whether it's in machine language or Basic, it seems to run straight through from beginning to end. As programmers, you might think that a TRS-80's Z80 microprocessor is dedicated to whatever task you're asking the computer to do.

However, the Model I with an Expansion Interface, the Models III, 4, and 4P are really primitive multi-tasking systems. Several times a second, a clock "heart beat" interrupts the Z80 and momentarily forces it to perform one or more tasks quite different from the main program it's running.

You can use this multi-tasking ability to make your computer perform two chores simultaneously. For example, while you're working with one program, you can run a simple timer that triggers a screen display when it reaches a given value. I find this useful when I'm using an electronic bulletin board; I set the timer to tell me when a certain amount of time has expired so I don't run up connect-time or long-distance charges. My timer works with LDOS 5.1.4; you'll have to adapt it to your own DOS (see the Program Listing).

Before fully explaining the program, I'll discuss the theory behind using interrupts on the TRS-80.

Two Types of Interrupts

The Z80 chip recognizes two kinds of interrupts, both generated by the computer or a hardware peripheral. The most common type is a non-maskable interrupt (NMI), meaning you can't use software to make the Z80 ignore it. A low signal on pin 17 of the CPU alerts the Z80 chip to an NMI. When that signal arrives, the Z80 finishes the program instruction it is currently executing, places the contents of the program counter on the stack, and then takes its next instruction from memory location 0066 hexadecimal (hex).

An NMI is the hardware equivalent to the instruction CALL 0066H with only minor differences. On a Model I, you can only generate an NMI by pressing the reset button, sending the computer into its warm routine. The Models III and 4 use NMIs as part of the disk interface, and their reset buttons are wired to the Z80's reset pin.

Of more interest to most programmers are the maskable interrupts, since you can filter them out of the system. During time-critical tasks, such as disk and cassette access, you can turn off the interrupts with a Disable Interrupts (DI) instruction (0F3H).

In most other situations, you should leave the interrupts on with an Enable Interrupts (EI) instruction (0FBH), which maintains the system clock and opens up a path for other interrupts. The Model I with an Expansion Interface uses maskable interrupts for disk access, the real-time clock, and RS-232 processing. The Models III and 4 use maskable interrupts for RS-232 communications, input/output bus interrupts, the real-time clock, and 1,500-baud cassette operations.

The Z80 chip can operate in three different maskable interrupt modes. You can set the mode with Interrupt Mode 1 (IM1), Interrupt Mode 2 (IM2), or Interrupt Mode 3 (IM3) Assembly-language commands. Unfortunately, the hardware in the Models I, III, and 4/4P only supports one mode, IM1. When you turn on or reset your computer, part of its housekeeping (whether in ROM or in the RAM boot of a Model 4) is to set IM1. If you like to wear both a belt and suspenders, add the IM1 command to any program you write that uses interrupts, but it's generally unnecessary.

The hardware uses pin 16 to alert the Z80 chip to maskable interrupts. When the Z80 is in IM1 with interrupts enabled, a signal on that pin makes the Z80 save the current program counter on the stack and then invoke a restart to location 0038 hex (RST 38H), which is essentially the same as a CALL 0038H instruction. The Models I and III ROMs contain a JP 4012H instruction at 0038 hex, so

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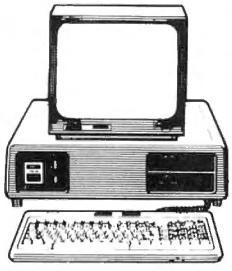

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that various routines in RAM can handle the interrupt signals.

The first thing an interrupt-handling routine must do is clear the interrupt latch, a hardware gate that shows what generated the interrupt signal. The Model I clears the interrupt latch by reading location 37E0 hex with an instruction such as LDA,(37E0H). The Models III and 4 do this by reading port 0E0 hex with an instruction such as IN A, (0E0H). The bit pattern in the A register after the read indicates what piece of hardware brought about the interrupt.

Unless you're writing a communications routine, a disk driver, or an interface program for a custom piece of hardware, you need only be concerned with interrupts that the real-time clock produces. The Model I Expansion Interface includes a crystal-driven clock that interrupts the Z80 40 times each second. The Model III uses the ac cur-

Program Listing. Demonstration of interrupt-handler routines.

```
00100 ;*********************************
00110 ;*                               *
00120 ;* Demonstration Interrupt       *
00130 ;*      Handler Routines         *
00140 ;*                               *
00150 ;*********************************
00160 ;Written for Model III with LDOS 5.1.3/5.1.4
00170 ;
00180 ;Equates:
00190 @KEYIN  EQU     0040H   ;Accept a line of input
00200 @EXIT   EQU     402DH   ;Normal return to DOS
00210 @TIME   EQU     3036H   ;Get time of day (hh:mm:ss)
00220 @ADTSK  EQU     403DH   ;Add an interrupt task
00230 @RMTSK  EQU     4040H   ;Remove an interrupt task
00240 @RPTSK  EQU     4043H   ;Replace current task
00250 @KLTSK  EQU     4046H   ;Remove current task
00260 HIGH$   EQU     4411H   ;Highest unused RAM address
00270 @DSPLY  EQU     4467H   ;Display message on video
00280 KFLAG$  EQU     429FH   ;System Flag K
00290 ;
00300 ;*****
00310 ;       The first section displays the current system
00320 ;       time and gets the termination time from the
00330 ;       user. No error-checking is done; if the user
00340 ;       enters an impossible time, the end message
00350 ;       will never appear.
00360 ;*****
00370 ;
00380         ORG     5200H
00390         LD      HL,MSG1         ;HL==> 1st message
00400         CALL    @DSPLY          ;Put it on video screen
00410         LD      HL,BUFF1        ;HL==> Buffer
00420         CALL    @TIME           ;Time to buffer
00430         LD      (HL),0DH        ;Put <CR> at end
00440         LD      HL,BUFF1        ;HL==> buffer again
00450         CALL    @DSPLY          ;Display current time
00460         LD      HL,MSG2         ;HL==> Rest of message
00470         CALL    @DSPLY          ;Put it on screen
00480         LD      B,5             ;Input message length
00490         LD      HL,BUFF2        ;HL==> input buffer
00500         CALL    @KEYIN          ;Input time to end
00510 ;
00520 ;*****
00530 ;       Now the interrupt routines, along with the
00540 ;       necessary storage buffers, are moved to
00550 ;       high memory. Then control is returned to
00560 ;       DOS through the normal 402DH exit.
00570 ;*****
00580 ;
00590         LD      HL,(HIGH$)      ;HL ==> Top unused RAM
00600         LD      BC,LAST-TCB     ;BC = Length of routines
00610         XOR     A               ;Clear Carry Flag
00620         SBC     HL,BC           ;Find new HIGH$ value
00630         LD      (HIGH$),HL      ;And save it
00640         INC     HL              ;HL = new TCP address
00650         PUSH    HL              ;Save for later
00660         LD      DE,0015H        ;Offset from TCB to TASK
00670         ADD     HL,DE           ;Find new TASK address
00680         LD      (TCB),HL        ;Store address in TCB
00690         POP     HL              ;Recover load address
00700         LD      DE,TCB          ;DE ==> current addr.
00710         EX      DE,HL           ;DE ==> new address
00720                                 ;HL ==> current addr.
00730         PUSH    DE              ;Save new address
00740         LDIR                    ;Move it all
00750         POP     DE              ;DE ==> New TCB
00760         LD      A,0             ;Use slot 0
00770         CALL    @ADTSK          ;Add task to chain
00780         JP      @EXIT           ;Back to DOS
00790 ;
00800 ;*****
00810 ;       The initialization messages
00820 ;*****
00830 ;
00840 MSG1    DB      0AH,'Interrupt Timer',0AH,0AH
00850         DB      'Current system time is:',0DH
00860 ;
00870 MSG2    DB      0AH,'Enter target time:',0AH
00880         DB      '(hh:mm)',0DH
00890 ;
00900 ;*****
00910 ;       The interrupt routines.
00920 ;       Memory requirements:
00930 ;       The first two bytes must point to the beginning
00940 ;       of the first routine.
00950 ;
00960 ;       Space must be allocated for the buffers:
00970 ;       BUFF1 holds the current system time as
00980 ;             hh:mm:ss<CR> (9 bytes)
00990 ;       BUFF2 holds the target time as
01000 ;             hh:mm<CR> (6 bytes)
01010 ;
01020 ;       On entry to the interrupt routine, IX ==> TCB
01030 ;*****
01040 ;
01050 TCB     DEFW    TASK            ;TCB==>Start of routine
01060 COUNT   DB      120             ;4 * 30 sec (Mod III)
01070                                 ;Use 5*30 = 150 on Mod I
01080 BUFF1   DS      9               ;Space for system time
01090 BUFF2   DS      6               ;Space of user input
01100 ;
01110 ;*****
01120 ;       TASK1 merely waits 30 seconds (using the counter
01130 ;       byte) and, at the end of that time, invokes
01140 ;       TASK2 on the NEXT clock interrupt.
01150 ;*****
01160 ;
01170 TASK    CALL    @RPTSK          ;Set TASK1 as routine
01180 TASK1   DEC     (IX+2)          ;Decrement counter
01190         RET     NZ              ;Leave if not yet zero
01200         CALL    @RPTSK          ;Otherwise set next task
01210 ;*****
01220 ;       TASK2 checks the target time against the current
01230 ;       system time. If no match is found, it resets the
01240 ;       counter byte and invokes TASK1 again.
01250 ;*****
01260 ;
01270 TASK2   PUSH    IX              ;Transfer IX address
01280         POP     HL              ;     to HL
01290         INC     HL              ;Point HL
01300         INC     HL              ;     to
01310         INC     HL              ;     BUFF1
01320         CALL    @TIME           ;Get time in BUFF1
01330         LD      A,(IX+3)        ;First byte in A
01340         CP      (IX+12)         ;First byte of target
01350         JR      NZ,NOTNOW       ;Go if no match
01360         LD      A,(IX+4)        ;2nd byte of time
01370         CP      (IX+13)
01380         JR      NZ,NOTNOW       ;Go if no match
01390         LD      A,(IX+6)        ;4th byte of time
01400         CP      (IX+15)         ;   (skip ':')
01410         JR      NZ,NOTNOW       ;Go if no match
01420         LD      A,(IX+7)        ;5th byte of time
01430         CP      (IX+16)
01440         JR      Z,NOW           ;Go if times match
01450 NOTNOW  LD      (IX+2),120      ;Reset counter
01460         JR      TASK            ;Set TASK1 again
01470 ;
01480 ;*****
01490 ;       When the target time is found, a new set of
01500 ;       tasks is placed in the chain.
01510 ;       The first routine displays the word TIME at
01520 ;       the center of the top screen line.
01530 ;*****
01540 ;
01550 NOW     CALL    @RPTSK          ;Set next task in chain
01560         LD      HL,'IT'         ;Get 2 chars of message
01570         LD      (3C1EH),HL      ;Put on screen
01580         LD      HL,'EM'         ;Get next 2 characters
01590         LD      (3C20H),HL      ;Put on screen
01600         CALL    @RPTSK          ;And set next task
01610 ;
01620 ;*****
01630 ;       The final interrupt task places 4 underline
01640 ;       characters where the word TIME was, then checks
01650 ;       for a <PAUSE> character (<SHIFT><@>). If no
01660 ;       <PAUSE> is found, control returns to the TIME
01670 ;       routine. Otherwise, the entire set of routines
01680 ;       is dropped from the interrupt chain via @KLTSK.
01690 ;       Notice that the high memory used by the routines
01700 ;       is not recovered.
01710 ;*****
01720 ;
01730 BLANK   LD      HL,05F5FH       ;HL = 2 underlines
01740         LD      (3C1EH),HL      ;And put on screen
01750         LD      (3C20H),HL      ;   twice
01760         LD      A,(KFLAG$)      ;Get system flag K
01770         AND     00000010B       ;Check for <PAUSE>
01780         JR      Z,NOW           ;Go if no pause
01790         CALL    @KLTSK          ;Remove TASK from chain
01800                                 ;   if <PAUSE> pressed
01810 LAST    EQU     $               ;Mark end for relocation
01820         END     5200H
```

End

rent line to generate a clock interrupt 30 times a second. The Model 4 (in either Model III or 4 mode) uses the ac current line to generate either 30 or 60 interrupts per second, depending on the system speed.

By using the clock interrupts, you can write programs that share the Z80 with other programs. Normally, you consider an interrupt-driven program a background task, while the main program executing in memory is called the foreground program. Background tasks include such things as a blinking cursor, type-ahead facilities, and despooling a printer file.

If you're using a DOS other than TRSDOS, your manual includes the necessary information for adding interrupt-driven routines. If you're using TRSDOS 6.X, you need the *Model 4 Technical Reference Manual* to find that information. Remember that background tasks need to be short; if they're too long, the foreground program never gets to work.

LDOS 5.1.3 / 5.1.4

@ADTSK	<4410 hex>	[403D hex]
@KLTSK	<4419 hex>	[4046 hex]
@RMTSK	<4413 hex>	[4040 hex]
@RPTSK	<4416 hex>	[4043 hex]

Model I TRSDOS 2.3

Has the same tasks at the same addresses as Model I LDOS, though the TRSDOS 2.3 manuals do not document those addresses.

Model III TRSDOS 1.3

Does not have a task processor available in RAM.

NEWDOS80 2.0

@ADTSK	<4410 hex>	[447B hex]
@RMTSK	<4413 hex>	[4413 hex]

DOSPLUS 3.5

@ADTSK	<4410 hex>	[4413 hex]
@RMTSK	<4413 hex>	[4416 hex]

MULTIDOS

@ADTSK	<4410 hex>	[44D2 hex]
@RMTSK	<4413 hex>	[44D5 hex]

TRSDOS 6.X and DOSPLUS 4.0

@ADTSK	SVC# 29
@RMTSK	SVC# 30
@KLTSK	SVC# 32
@RPTSK	SVC# 31
@CKTSK	SVC# 28

(@CKTSK checks a task slot to determine if it is currently active or unused.)

Table. Interrupt task processor DOS routines. The Model I addresses are shown in the <> brackets. The Model III addresses are in the [ ] brackets. I used LDOS task names throughout for consistency. See your manual for specific details about your DOS.

A Demonstration

Every DOS except TRSDOS 1.3 includes routines to add or delete background tasks (MULTIDOS calls them foreground tasks), though those routines are undocumented in the TRSDOS 2.3 manual. Each DOS handles the routines differently, and I wrote this month's demonstration program for Model III LDOS 5.1.4 because LDOS has the clearest documentation and its routines are the easiest to use to interrupt task handling. Once you understand the program, you should be able to adapt it to your own DOS.

The program displays the current system time and asks for a target time in hours and minutes (it ignores seconds), then relocates the working interrupt task to high memory and protects it there by resetting the HIGH$ pointer.

If you're unfamiliar with LDOS, you might wonder about the $ and @ characters in the program labels. The LDOS manual describes memory locations and routines available to programmers, and the *Model 4 Technical Reference Manual* continues with these conventions. Any label that begins with an @ is a DOS routine normally available for access by other programs. Any label that ends with a $ is a memory location or table that's also available to other programs.

My demonstration program isn't complex, but you need to understand how LDOS (and other DOSes except TRSDOS 1.3) handles interrupt tasks. LDOS maintains 12 slots for clock-interrupt routines. The first eight (slots zero through 7) are low priority; routines added to those slots are called on every eighth clock beat (5 times a second on a Model I, 15 times every 4 seconds on a Model III). The top 4 slots, numbered 8–11, are used for high-priority tasks that are called every clock beat. Some slots are designated for system functions and options, others are available to programmers.

When the hardware clock sends an interrupt signal, the Z80 jumps to 0038 hex, then to 4012 hex, and from

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- ☐ 1. Yes
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F. Do you own a computer that is not a Tandy model?
- ☐ 1. Yes
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there to an interrupt-handling routine. That routine (which is a part of DOS) checks the type of interrupt that has occurred; if it's a clock interrupt, the routine sends program control to a task processor. The task processor decides which tasks in which slots should get attention on this clock interrupt, and calls each of those tasks in order. However (and this is where things become a little tricky), the address the task processor finds in the task slot is not the address of the corresponding interrupt routine.

Each task slot contains a 2-byte pointer to a data structure called a task control block (TCB). The TCB begins with the 2-byte address of the interrupt task, and may contain any other bytes of information you want. To get to the actual interrupt task, the task processor first saves all registers (except the prime set and, in the Model I, the IY register) and loads the IX register with the address in the task slot. Then it jumps to the address to which the value in the IX register points. Therefore, the task slots are a set of pointers to pointers to routines.

This double indirection is not sheer madness. In fact, it makes programming much simpler. Your interrupt routine can store information such as counter bytes or internal buffers in the TCB and then find that information with an offset from the IX register. The first byte of such storage is at IX+2 when you call the task program.

LDOS provides four task-handling routines to further simplify programming interrupt routines. The first, @ADTSK, places the address contained in the DE register in the task slot indicated by the value in the A register. A second routine, @RMTSK, removes a task from the slot number indicated by the value in the A register. All DOSes except TRSDOS 1.3 provide these routines (see the Table).

The other two task handlers are unique to LDOS. @KLTSK removes the currently operating task from its task slot. An interrupt program can use @KLTSK to remove itself from a task slot without knowing to what slot it is connected. Finally, a task that wants to modify itself uses @RPTSK. This routine replaces the current address at the beginning of the TCB with the address immediately following the instruction CALL @RPTSK. In a sense, CALL @RPTSK says to the task processor, "From now on, when you call this task, start with the instruction immediately following this one."

It's much easier to understand how these DOS routines work in practice. In the Listing, line 770 calls @ADTSK to insert the first interrupt routine into task slot zero. Notice how the program sets the DE and A registers before calling @ADTSK.

I wrote the demonstration program as an initialization module plus four separate interrupt routines. The first decrements a counter byte at IX+2 for 30 seconds until the counter reaches zero, then uses @RPTSK to set up the next routine to be called the next time the task processor sends control to this slot. The second routine gets the current time from the system, and compares it digit by digit with the target time. If the times don't match, the program sets the counter byte again, and control returns to the first routine.

If the second routine finds a match, the program sets the third routine's address in the TCB with @RPTSK. When the task processor calls it, the third routine prints the word TIME in the center of the top video line and installs the final routine with @RPTSK. The last routine replaces the word TIME with four underline characters and checks a system flag to see if you've pressed the pause character (the shift and @ keys). If you haven't, control returns to routine 3. If you have, @KLTSK clears the task slot completely. After the pause, the computer doesn't call any of the routines again.

The Table contains the information about task handling that I've gleaned from the documentation of the current releases of other major DOSes. I haven't tried rewriting this program to run on any other DOS; I'll leave the experimenting to you. ■

Contact Hardin Brothers through CompuServe (leave your messages on section zero of the SASIG message board), or write to him at 280 N. Campus Ave., Upland, CA 91786.

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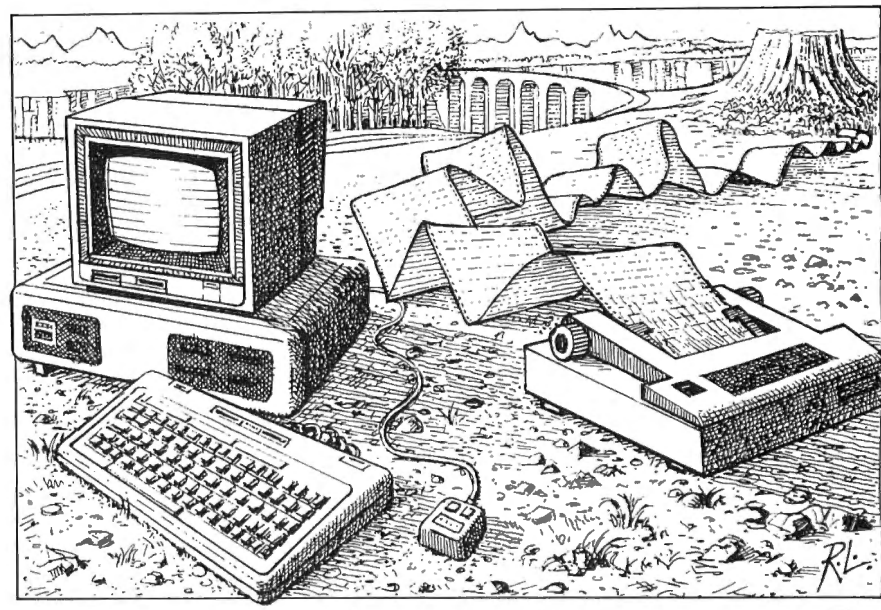
Quick Conversion for Model I/III/4 Basic



Now that you're getting more familiar with your Model 2000, you may wonder how you can use the abundant Model I/III/4 Basic software. I rewrote a public-domain utility to create a program called Change that converts Model I, III, or 4 Basic programs to Model 2000 format (see the Program Listing, p. 180).

The Basic Problem

Last month I explained how to transfer VisiCalc files from the Model III to the 2000 across the RS-232 interface using a null modem. You can use the same procedure with Basic programs, as long as you save them as ASCII files.

Change converts a Basic program so you can transfer it to the 2000 in ASCII. I wrote the program for Model 4 Basic; to use it on the Model I/III, replace the Clear statement in line 160 with CLEAR 15000.

Converting a Basic program isn't hard once you understand the program's internal storage. Microsoft Basic scans lines as you enter them from the keyboard (or from a disk or cassette if you're loading an ASCII file), and converts key words to tokens to ease interpretation.

Basic then stores program lines internally and on disk as a linked list of token strings. A null byte (00 hex) terminates each string. Each line contains a pointer that points to the start of the next line; the last pointer is a program terminator of 2 null bytes.

Basic stores key words as 1-byte entities with values greater than 127. It stores characters that don't represent part of a token as individual ASCII character bytes.

Change is a structured Basic program that accomplishes this conversion. It flags any lines containing tokens that it can't properly convert or that function differently because of addressing so you can inspect them.

The heart of the conversion process is the key word table that Change's Setup subroutine establishes. This table forms a one-to-one correspondence between the key word's numerical representation and the character string for the converted program file. You must enter the table exactly as it appears in the Listing, including the blanks in the strings, to assure correct blank insertion in the final program.

The Token subroutine is the workhorse of the conversion process. It analyzes each byte and decides what special actions the program must take. The subroutine handles the colon, processes the conversion of the Clear, Print, and data statements, and flags the error and questionable tokens.

Change converts Print statements if they contain an @ character after the Print token. The program assumes that the screen size is 16 lines by 64 characters, and preserves it by using Locate statements with the proper row and column numbers formed from the numerical value following the @. Change flags PRINT@ statements containing variables or expressions so you can inspect them.

These PRINT@ statements are the only area of your program that you must adjust to use Change for another MBasic interpreter.

The logic-handling of the PRINT@ statements must be compatible with the target interpreter. For example, the Model 4 has a corresponding PRINT@(row,col) notation, and CP/M machines usually have a corresponding cursor positioning sequence that you can print as a character string. Don't forget to convert the CLS statement to the appropriate screen commands if the target MBasic interpreter doesn't have this command.

Line 2260 adds a line-feed character (CH = 10: GOSUB 280) to each converted line. This is necessary for correct file structure under MS-DOS and CP/M. To use the program with systems that don't require a line feed after a carriage return, remove these two statements from line 2260.

If you'd like a copy of Change on disk, send a self-addressed mailer and a blank disk to me at 1519A Carswell Circle, Bolling Air Force Base, Washington, DC 20336. Specify the DOS and computer you'll be using. ■

Contact John B. Harrell III c/o this column, 80 Micro, 80 Pine St., Peterborough, NH 03458, or via CompuServe at 73016,1326.

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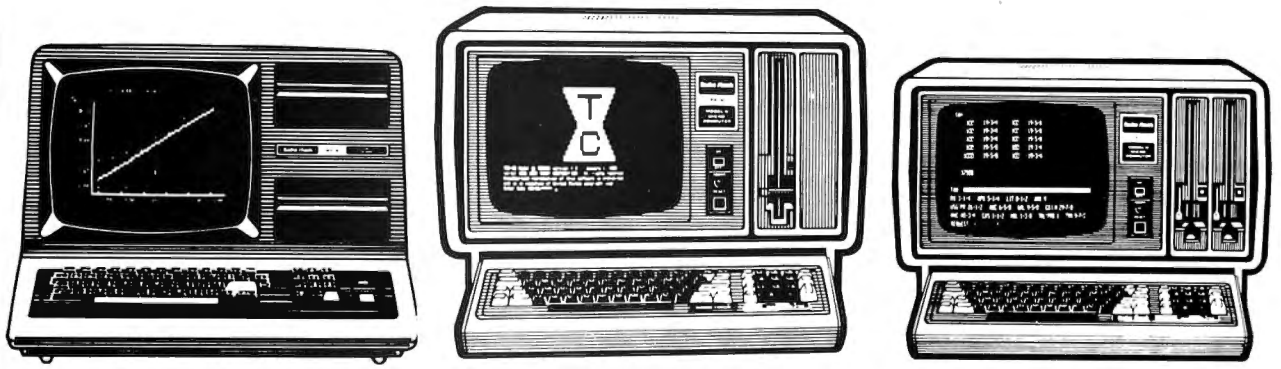

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232

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Program Listing. Change conversion utility for the Model 2000.

```
10 ' ************************************************************
20 ' *                                                          *
30 ' *              CHANGE MODEL I/III BASIC TO                 *
40 ' *               TANDY MODEL 2000 MS-BASIC                  *
50 ' *                                                          *
60 ' *           written by: John B. Harrell  III               *
70 ' *                                                          *
80 ' *                                                          *
90 ' *    Change will convert a Model I/III compressed Basic    *
100 '*   program of less than 32,767 bytes to the proper ASCII  *
110 '*   format for transmission to the Model 2000.  The con-   *
120 '*   verted program as well as any errors and/or question-  *
130 '*   able statements is listed to the video display.        *
140 '*                                                          *
150 '************************************************************
160 CLEAR: DEFINT A-Z
170 GOTO 2060
180 '
190 '    ABORT - display error message and quit
200 '
210 PRINT MS$
220 PRINT
230 ON ERROR GOTO 0
240 END
250 '
260 '   OUTCH - output one character to the display and
270 '           to the converted file
280 '
290 PRINT CHR$(CH);
300 PRINT #2,CHR$(CH);
310 RETURN
320 '
330 '   OUTTOKEN - output the character string representation
340 '           of the BASIC token to the display and file
350 '
360 PRINT KW$(CH-128);
370 PRINT #2,KW$(CH-128);
380 RETURN
390 '
400 '   SETUP - set up the string array containing the proper
410 '           values for the tokens.  There is a one-for-one
420 '           correspondence for each element of KW$
430 '
440 '           MAKE SURE THAT THE TABLE BELOW IS ENTERED
450 '           EXACTLY IN THE ORDER AND CHARACTERS SPECIFIED
460 '
470 DIM KW$(127)
480 FOR I=0 TO 127
490 READ KW$(I)
500 NEXT I
510 RETURN
520 DATA "END ","FOR ","RESET","SET","CLS ","SYSTEM ","RANDOMIZE "
530 DATA "NEXT ","DATA ","INPUT ","DIM ","READ ","LET "," GOTO "
540 DATA "RUN ","IF ","RESTORE "," GOSUB ","RETURN ","REM"
550 DATA "STOP "," ELSE ","TRON ","TROFF ","DEFSTR ","DEFINT "
560 DATA "DEFSNG ","DEFDBL ","LINE ","EDIT ","ERROR ","RESUME "
570 DATA "OUT ","ON ","OPEN ","FIELD ","GET ","PUT ","CLOSE "
580 DATA "LOAD ","MERGE ","NAME ","KILL ","LSET ","RSET "
590 DATA "SAVE ","SYSTEM ","LPRINT ","DEF ","POKE ","PRINT "
600 DATA "CONT ","LIST ","LLIST ","DELETE ","AUTO ","CLEAR "
610 DATA "CLOAD ","CSAVE ","NEW ","TAB("," TO ","FN ","USING "
620 DATA "VARPTR ","USR ","ERL ","ERR "," STRING$"," INSTR"
630 DATA " POINT"," TIME$ "," MEM "," INKEY$ "," THEN "," NOT "
640 DATA " STEP ","+","-","*","/","^"," AND "," OR ",">","="
650 DATA "<"," SGN"," INT"," ABS"," FRE"," INP"," POS"," SQR"
660 DATA " RND"," LOG"," EXP"," COS"," SIN"," TAN"," ATN"
670 DATA " PEEK"," CVI"," CVS"," CVD"," EOF"," LOG"," LOF"
680 DATA " MKI$"," MKS$"," MKD$"," CINT"," CSNG"," CDBL"
690 DATA " FIX"," LEN"," STR$"," VAL"," ASC"," CHR$"," LEFT$"
700 DATA " RIGHT$"," MID$","","","","","",""
710 '
720 '   GETFILE - get file specs and open proper input and
730 '           output buffers - exits to ABORT on an error
740 '
750 PRINT
760 LINE INPUT "Enter filespec for compressed BASIC input: ";F1$
770 MS$="Input file ("+F1$+") open error."
780 ON ERROR GOTO 210
790 OPEN "I",1,F1$
800 ON ERROR GOTO 0
810 CLOSE 1
820 OPEN "R",1,F1$,1
```


Listing continued

Listing continued

```
830 FIELD 1,1 AS CH$
840 LINE INPUT "Enter filespec for ASCII text output file: ";F2$
850 MS$="Output file ("+F2$+") open error."
860 ON ERROR GOTO 210
870 OPEN "O",2,F2$
880 ON ERROR GOTO 0
890 RETURN
900 '
910 '   GETCH - get next token byte from input file and
920 '           return as integer value in CH
930 '
940 GET 1
950 CH = ASC(CH$)
960 RETURN
970 '
980 '   LINENUMBER - read next line number from BASIC input
990 '           file and convert and print it to both the
1000 '           conversion file and the display
1010 GOSUB 940
1020 NM! = CH
1030 GOSUB 940
1040 NM! = NM! + CH * 256
1050 NM$ = RIGHT$(STR$(NM!),LEN(STR$(NM!))-1)+" "
1060 PRINT NM$;
1070 PRINT #2,NM$;
1080 RETURN
1090 '
1100 '    END - check for the terminal marker in a compressed
1110 '          BASIC program.  This marker is a pointer word
1120 '          consisting of 2 bytes of 00 hex.
1130 '          Returns status in Z, 0 = no EOF, -1 = EOF
1140 '
1150 IF EOF(1) THEN Z=-1: RETURN
1160 GOSUB 940
1170 NM! = CH
1180 IF EOF(1) THEN Z=-1: RETURN
1190 GOSUB 940
1200 NM! = NM! + CH * 256
1210 IF NM! = 0 THEN Z=-1 ELSE Z=0
1220 RETURN
1230 '
1240 '  TOKEN - process the BASIC compressed token values
1250 '          Special cases are interpreted as follows:
1260 '          1) the logical end-of-line marker (:) can
1270 '          have three separate cases: a) it is a logical
1280 '          end of line, b) hidden before an ELSE token
1290 '          or c) hidden before a (') remark token.  2) if
1300 '          token is less than 128, then output the value
1310 '          3) otherwise it is a valid token and must be
1320 '          treated for special cases: a) CLEAR - no string
1330 '          space is required after CLEAR and it is deleted
1340 '          b) "PRINT @ number," is converted to the MBASIC
1350 '          LOCATE row,col: PRINT ...  c)DATA statements
1360 '          are copied to a logical or physical end of
1370 '          line, d) errors and questions are printed for
1380 '          other tokens as follows:
1390 '
1400 '          ERRORS                    QUESTIONABLE
1410 '          ------                    ------------
1420 '
1430 '          SET                       INP
1440 '          RESET                     OUT
1450 '          POINT                     POKE
1460 '          CLOAD                     PEEK
1470 '          CSAVE                     USR
1480 '          SYSTEM                    POS
1490 '          CMD                       ERROR
1500 '          ERR                       RND (handled different)
1510 '          NAME
1520 '
1530 '          TOKEN returns status of the end of statement
1540 '          in the variable Z, -1 if EOS is detected and
1550 '          0 if EOS was not detected as the next token to
1560 '          be processed.  A one character look-ahead tech-
1570 '          is used to process the compressed file.
1580 '
1590 IF ZV=0 THEN Z=-1: RETURN
1600 IF ZV <> ASC(":") THEN 1680
1610 GOSUB 940
1620 IF CH = 149 THEN GOSUB 360: Z = 0: RETURN ' : ELSE seq
1630 IF CH <> 147 THEN 1670 ' not a REM token
1640 C1 = CH: GOSUB 940
1650 IF CH = 251 THEN GOSUB 360: Z = 0: RF = -1: RETURN ' was '
```

Listing continued

↙ See List of Advertisers on Page 176

Listing continued

```
1660 C2 = CH: CH = ZV: GOSUB 290: CH = C1: GOSUB 360: RF = -1:
     ZV = C2: GOTO 1590 ' process sequence as valid ": REM ?"
1670 C1 = CH: CH = ZV: GOSUB 290: ZV = C1: GOTO 1590 ' simple :
1680 IF ZV < 128 THEN CH = ZV: GOSUB 290: Z = 0: RETURN '
     not a token -- some character
1690 IF ZV <> 184 THEN 1720 ' not a CLEAR token
1700 CH = ZV: GOSUB 360
1710 GOSUB 940: IF (CH <> ASC(":")) AND (CH <> 0) THEN 1710 ELSE
     ZV = CH: GOTO 1590
1720 IF ZV <> 178 THEN 1930
1730 '*******************************************************
1740 '   Model 2000 dependent handling of "PRINT @ number,"
1750 '   follows.  This may be changed to suit the particular
1760 '   MBASIC interpreter's needs (CP/M, Model 4, XENIX)
1770 '*******************************************************
1780 GOSUB 940: IF CH = ASC (" ") THEN 1780
1790 IF CH <> ASC ("@") THEN C1 = CH: CH = ZV: GOSUB 360: CH =
     C1: GOTO 1900 ' not a PRINT @ statement
1800 GOSUB 940: IF CH = ASC(" ") THEN 1800
1810 IF (CH >= ASC("0")) AND (CH <= ASC("9")) THEN 1830
1820 C1 = CH: CH = ZV: GOSUB 360: CH = ASC("@"): GOSUB 290:
     ZV = C1: EF = -1: GOTO 1590 ' Can't decipher the PRINT @
1830 PRINT "LOCATE ";: PRINT #2,"LOCATE ";: PS = CH - 48
1840 GOSUB 940: IF (CH >= ASC("0")) AND (CH <= ASC("9")) THEN
     PS = PS * 10 + CH - 48: GOTO 1840
1850 ZR = INT(PS/64): ZC = INT(PS - ZR * 64) + 1: ZR = ZR + 1
1860 ZR$ = RIGHT$(STR$(ZR),LEN(STR$(ZR))-1)
1870 ZC$ = RIGHT$(STR$(ZC),LEN(STR$(ZC))-1)
1880 PRINT ZR$;",";ZC$;": PRINT ";:
     PRINT #2,ZR$;",";ZC$;": PRINT ";
1890 IF CH = ASC(",") THEN GOSUB 940 ELSE EF = -1
1900 IF CH = 34 THEN SF = NOT SF
1910 ZV = CH: GOTO 1590
1920 '*************  END PRINT @ CODE ************************
1930 CH = ZV: GOSUB 360: IF ZV = 147 THEN RF = -1: Z = 0: RETURN
1940 QF =((ZV = 219) OR (ZV = 160) OR (ZV = 177) OR (ZV = 229)
     OR (ZV = 193) OR (ZV = 220) OR (ZV = 158) OR (ZV = 222)):
     IF QF THEN Z = 0: RETURN
1950 EF =((ZV = 131) OR (ZV = 130) OR (ZV = 198) OR (ZV = 185)
     OR (ZV = 186) OR (ZV = 174) OR (ZV = 133) OR (ZV = 195) OR
     (ZV = 169)): IF EF THEN Z = 0: RETURN
1960 IF ZV <> 136 THEN 2020
1970 GOSUB 940
1980 IF SF OR (CH = ASC(":")) OR (CH = 0) THEN 2010
1990 GOSUB 290
2000 GOTO 1970
2010 ZV = CH: GOTO 1590
2020 Z = 0: RETURN
2030 '
2040 '          Main program
2050 '
2060 CLS
2070 PRINT " CHANGE - Convert Model I/III BASIC programs"
2080 PRINT "          to Tandy Model 2000 MBASIC"
2090 PRINT
2100 GOSUB 750 ' get and open input and output files.
2110 GOSUB 470 ' set up keyword array
2120 GOSUB 940 ' get header byte
2130 IF CH <> 255 THEN MS$=CHR$(13)+"Input file is not a compres
sed BASIC file.": GOTO 210
2140 GOSUB 1150 ' while not end of program do
2150 IF Z THEN 2300 ' found the end of the program
2160 GOSUB 1010 ' get and convert line number
2170 RF = 0: SF = 0: EF = 0: QF = 0 ' set all flags FALSE
2180 GOSUB 940 ' get first byte of statement
2190 IF CH = 0 THEN 2250 ' end of program statement
2200 IF RF OR SF THEN GOSUB 290: GOTO 2230
2210 CS = CH
2220 IF CH <> ASC (" ") THEN ZV = CH: GOSUB 1590: CH = CS: IF Z
     THEN 2250
2230 IF CH = 34 THEN SF = NOT SF
2240 GOTO 2180
2250 IF SF AND (NOT RF) THEN CH = 34: GOSUB 290
2260 CH = 13: GOSUB 290: CH = 10: GOSUB 280
2270 IF QF THEN PRINT "**************** Questionable statement **
**************"
2280 IF EF THEN PRINT "********************* Bad token *********
**************"
2290 GOTO 2140
2300 CLOSE
2310 END
```

End

✓ See List of Advertisers on Page 176

Continued from p. 40

to using DOSPLUS commands from this screen: The ICPL system automatically converts the at sign (@) (used by DOSPLUS in routing to a printing and other commands) to an ampersand (&), making such a command invalid.

The communications menu of my version had only one option set-up, that for the Uniterm terminal program. Since I don't own Uniterm, I added menu options for Ultraterm, Ultrahost, and three Ultraterm utilities, using the DOS* procedure for maximum buffer space. This worked quite satisfactorily.

The NICE development facility (option 14 on the main menu) lets you format a screen, menu, or report. The manual includes a tutorial on using the facility. You can use the data base submenu to create and manage data-base files; it includes utilities for printing file control data, merging, and clearing out files, and for re-creating a damaged file index. The ICPL submenu is intended primarily for programmers.

You can go directly from the development menu to NICE Basic, a Basic interpreter with ICPL features added. Basic can execute almost any ICPL function or command, so Assembly-language programmers can write new commands for Basic; for example, you can call an Assembly-language routine instead of resorting to a USR routine.

The last option on the main menu is called Entertainment. Entertainment consists of a submenu with two items, pool and coffee. If you select coffee, the screen shows a menu of four coffee and doughnut items from the "Russian Tea Room" and asks you to make a choice. Any selection results in an out-of-stock message and a request for another choice. This continues three times and then you're told it's closing time. There's no obvious or subtle way to exit the cycle until it's complete, at which point you're returned to the main menu. Pool consists of a dot endlessly and aimlessly bouncing from one bumper to another, with no user control, no instructions, and no way to get out short of pressing the break key. So much for the entertainment menu.

The User Guide is loaded with errors. It's disorganized and scatters information on a single subject. To compound this, the documentation lacks an index.

The NICE Tutorial

According to the manual, if you press PF2 from a menu screen, "you will see a 'HELP' screen containing useful information describing the functions of that particular screen." There are 15 menus in the program as issued, but just three corresponding help screens, for the letter, business, and utilities menus. In all other cases, you get the general help screen, which suggests you go to the tutorial.

Again according to the manual, using an interactive, comprehensive tutorial is the quickest and easiest way to learn the system. But of the 40 screens in the tutorial system, only three are interactive. The others present a summary of the information in the manual in a condensed and, perhaps, better organized form.

The introductory section of the tutorial describes the makeup of the NICE system, reassures the novice that he needn't get involved in the inner workings of ICPL to use the system effectively, and then states that it's necessary to learn only "several" (translation: 26) ICPL commands to write "professional-quality programs" in Basic. Further, you learn that you can use the ICPL procedures supplied to create data-base files, etc., with no programming. You're all excited and eager for more information and suddenly you're dumped into the Russian Tea Room for a coffee break. What frustration! There is one plus to the screen tutorial: It does have the correct formula for using the PF keys.

Nicepen

You can access the Nicepen editor from the menus or from the DOS level. The brief section of the manual dealing with Nicepen summarizes the commands, features, and file management procedures. Although it shows printing specifications, the manual gives no information whatsoever about their use or even the default values.

The character repeat rate of the Nicepen I used was extremely fast at the normal 2 MHz computer speed and unmanageable at 4 MHz and higher. Because no installation module comes with Nicepen, I had no simple way to adjust the rate; XYZT gave me instructions by phone for slowing it down. Also, I found the right-hand shift key didn't work, at least for the Model 4 in Model III mode. Not being familiar with Electric Pencil, I found it strange to use the shift key/space bar combination as the control key.

Documentation and Support

I can only characterize the documentation as poor. It comes in four separate sections: the User Guide and the LSO, Nicepen and ICPL sections. The on-screen tutorial is a fifth, summary part.

The User Guide, in particular, is loaded with errors—factual, typographical, and grammatical. Some of the screen illustrations are different in detail from the screens they represent. The guide is disorganized and scatters information on a single subject. To compound the problem, the documentation lacks an index. Finally, in an attempt to be ultra user-friendly, the writing becomes so goody-goody that it's condescending.

The ICPL section of the manual is undoubtedly the best of the lot and it's apparent that the authors felt much more at ease writing for programmers than users.

As I mentioned, XYZT provides a phone number for technical assistance. If you're fortunate enough to have someone answer your call, you'll probably get a knowledgeable answer to your question.

Problems and Limitations

One major problem, of course, is the documentation. The authors of this program badly need the assistance of someone who understands the documentation needs of the non-programmer as well as the programmer.

Another major problem is the user programs supplied as models. Certainly they are "ready to run" but they're too simplistic to be useful. What use is a 10-sector letter library with one short

letter in it and only seven sectors left? Or a 10-record data-base file? Granted, the manual does state that you have to create new files to fit the system to your needs.

The data-base system as it stands provides only a primitive search capability. The report facility lets you start printing at the first record that matches a given specification, but you have to determine the number of records to be printed in advance; you can't specify an end to printing by a key match.

The sample customer file lists customers by full names. Because of the requirement that matching start with the first character in the field, John Smith comes before Santa Claus and Thomas Adam would be last! Certainly the user can create a new file in which the first and last names are in different fields with the last name as the key, but my point is that the example file should have had separate name fields.

The authors appear to have underestimated the average user's needs and expectations, while overestimating the user's willingness and/or ability to reprogram NICE to suit his requirements. For example, the tutorial says you can develop a Profile-type data base in about two hours. The authors seem to be unaware that some readers may not even know what a Profile-type data-base file is, let alone how to develop one.

Summary and Conclusion

In order to put the NICE program into perspective, I'll compare it to another integrated program, T/Maker, which runs on the Model 4 with CP/M. The new version T/Maker includes a text editor, full-featured word processor, spreadsheet, list manager, keyboard macro facility, and a relational data base; it lists for $450.

Now what does NICE offer? It has a subset of a first-generation word processor, a primitive data base manager/report writer, and facilities for creating interactive screens and menus for use with the data files/report writer. The documentation is poor. To put it bluntly, NICE is not even in the same league as the other program.

The documentation totals 202 pages, of which 129 are devoted to ICPL and LSO. Only 73 pages apply to the user-oriented aspects of the system. In essence, NICE is the ICPL program with a variety of very basic programming examples included. It does not warrant a price much (if any) greater than the $150 at which ICPL has been advertised and at the current $325 it is grossly overpriced.

Even as a programmer's tool, I could recommend NICE only at a substantially reduced cost and with significantly improved documentation. It would require a complete rewrite, upgrading, and expansion to be considered a useful integrated software applications program. It is a tremendous disappointment to find that NICE is not all that nice. ■

Serious Graphics For the Model 4

by David L. Engelhardt

If standard Model 4 graphics bore you, try Radio Shack's Hi-Res Graphics Board. Its 640- by 240-pixel display lets you create circles, squares, intricate shapes, and more in great detail. You can even simulate animation with some of the commands available.

To use the high-resolution board, you need 64K of RAM and one disk drive. The software runs under TRSDOS 6.01.02. Unfortunately, the board works only in the Model 4 mode.

What You Get

The high-res board is about the size of a 3- by 5-inch index card, considerably smaller than the Model III's, and plugs into its mating connector on the main CPU board.

High-Res Graphics Board

★★★★

Tandy/Radio Shack
One Tandy Center
Fort Worth, TX 76102
Model 4, 64K
$249.95

Easy to use?	★★★★☆
Good docs?	★★★☆☆
Bug free?	★★★★☆
Does the job?	★★★★★

The disk you get includes a new version of Basic called BASICG (see Table 2 for a list of commands), eight stand-alone graphics utilities, example programs, and a graphics subroutine library to link graphics capabilities to higher-level languages like Fortran.

The BASICG disk does not contain the system routines to let you use JCL files. You'll have to remove some of the examples on the BASICG disk to free up more space and copy SYS11/SYS from another system disk.

The board uses two screens, one for text and the other for graphics. The SCREEN # command switches from one to the other. You can't display both screens at the same time, but you can simulate a single screen by rapidly switching back and forth. The trade-off may be sync and flicker problems. Machine-language programs might be able to handle such switching more effectively.

The board turns pixels off (black) and on (white). You can get shades by setting different dot combinations. You control dot positions with X,Y coordinates; (0,0) is the upper left corner and (639,239) is the lower right. Getting a dot just where you want it can be tricky; you can't be sure of its exact location.

If you're familiar with GW-Basic, you'll recognize many of the commands in Table 2. I'll briefly describe some of the more important ones:

Circle lets you draw five different types of figures: circles, ellipses, arcs, pie-slices, and points. You create different shapes with different command parameters.

The Get command lets you save graphics displays to an array you designate. The saved contents consist of a rectangular pixel area that is either the entire screen or, with the View command, a portion of it.

Put writes the rectangular pixel area back to the screen. Several logic and action operators—PSET, Preset, Or, And, and XOR—give you different visual effects.

You can simulate animation by saving a small graphics display with the Get command, clearing the screen or area, and putting it back in a slightly different position with the Put com-

mand. However, BASICG isn't fast enough to do this effectively, and you'll notice flicker. The smaller the graphics object, the less flicker you'll get. Animation is better handled with machine language.

You write text to the graphics display with the PRINT #−3 command. Text can consist of string constants, string variables, numeric constants, variables or expressions. You can write in specific directions via the GLOCATE command. Simply set the cursor with GLOCATE before using the PRINT #−3 command, and you can write at an angle of 0, 90, 180, or 270 degrees.

You can draw lines in any style by setting the pixel arrangement in 16-bit groups. For example, the binary number '1000 1111 1111 1000' (&H8FF8) gives you a series of dots and dashes. This feature is useful for enhancing graphics displays.

The dot manipulation commands are &POINT, Preset, and PSET. The first command tests dot positions for an off/on condition, while the latter two set or reset dots respectively. Preset and PSET are actually almost identical; the only difference is that they have different default values. One or the other probably would have sufficed.

You can redefine the screen size or create a viewport with the View command. This is handy if you want to use only a section of the screen for graphics manipulations. You have to create the screen outside the viewport before you redefine the screen size.

BASICG is 6.6K bytes larger than standard Basic. You can run your programs from either Basic, but you can't run programs with BASICG statements in standard Basic.

Three of the utility programs let you dump graphics to the printer. Unfortunately, you can only use a Radio Shack printer with graphics capabilities. One utility dumps to printers with a 9½-inch carriage, and the others to printers with 15-inch carriages. You should try them all for the best results.

You can save and retrieve graphics displays with the GLOAD and GSAVE utilities from either BASICG or TRSDOS.

The Manual

The manual is more a reference guide than an instruction book, which Radio Shack indicates is what they wanted. It needs more examples, and could be clearer on how to use some of the commands. I found a few typos that are not critical and are obvious when you come across them. Be prepared to spend some time experimenting with the commands as you're learning them.

The manual contains both BASICG and Fortran graphics commands. It says that you can link graphics to several languages, but emphasizes Fortran; it describes each command you would use with Radio Shack's Fortran package (catalog number 26-2219). The commands are the same except for a few syntax and parameter differences.

The documentation also has the source listings for the eight utilities, which I was quite pleased to see; they'll help me with my machine-language routines.

Circle	Draws a circle, semicircle, ellipse, arc, point.
CLR	Clears the graphics screen.
Get	Reads the contents of a rectangular pixel area into array for future use by Put.
GLOCATE	Sets the graphics cursor and the direction for putting characters on the graphics screen.
Line	Draws a line from the startpoint to the endpoint in the specified line style and color. Also creates a box.
Paint	Paints an area, starting from a specified point. Also paints a specified style.
&POINT	Returns the off/on color value of a pixel.
Preset	Sets an individual dot (pixel) off (or on).
PSET	Sets an individual dot (pixel) on (or off).
PRINT #−3	Writes characters to the graphics screen.
Put	Stores graphics from an array onto the graphics screen.
Screen	Selects the graphics or text screen.
View	Creates a viewport which becomes the current graphics screen.
&VIEW	Returns the current viewport coordinates.

Table 2. BASICG commands and functions.

GCLS	Clears graphics screen.
GLOAD	Loads graphics memory from disk.
GPRINT	Lists graphics on the printer.
GPRT2	Prints graphics display on the printer without 90 degree rotation.
GPRT3	Prints graphics display on the printer without 90 degree rotation.
GROFF	Turns graphics screen off.
GRON	Turns graphics screen on.
GSAVE	Saves graphics memory to disk.

Table 3. Graphics utilities.

Appendices include a command reference summary and some sample programs written in BASICG and Fortran.

Conclusion

I was intrigued by the detail and capabilities of the graphics board. After a while, I found myself wanting to see some programs that use the board's features. Unfortunately, the board doesn't have much software support yet.

I was also disappointed to find that Radio Shack doesn't support the board in the Model III mode. I was unable to find out whether any Model III graphics software will operate the Model 4 board.

If you're ready for high-resolution graphics for either experiments or applications, you should seriously consider Radio Shack's Hi-Res Graphics Board. It offers more graphics than is currently available on the standard computer. ■

About the Card

This card is not an introduction to CP/M and is meant for experienced users. The command explanations are terse but detailed enough to provide adequate information for a quick refresher.

The first two panels are devoted to name conventions. They also provide information on ambiguous file names that many CP/M commands use. Next is a convenient list of the most frequently used file extensions. Last, you get a detailed description of the file control block layout.

After a summary of special keyboard function keys and control functions, the card presents the command summaries, in alphabetical order with concise descriptions of command options. Much of the remainder of the card is devoted to the command descriptions.

The card thoroughly discusses the features of the CP/M assembler, text editor, and dynamic debugging tool (DDT). This is an exceptionally concise run-down of the features these utilities provide.

A Standard Reference

by John B. Harrell III

An overwhelming amount of technical information on CP/M is available in reference manuals. Unfortunately, much of it is poorly organized, with cryptic explanations of commands and features.

Nanos Systems' Reference Card for the CP/M System will help. It's a detailed, 20-panel pocket reference card that concisely covers the significant commands and features of CP/M-80 (versions 1.3, 1.4, and 2.2), CP/M-86 (for the IBM PC and its clones), and MP/M (a multiuser version of CP/M for 8-bit machines).

Reference Card for CP/M System

★★★

Nanos Systems Corp.
P.O. Box 24344
Speedway, IN 46224
$5.95

Well-written?	★★★★☆
Organized?	★★★☆☆
Thorough?	★★★★☆
Readable?	★★★☆☆

✓ See List of Advertisers on Page 176

The card also lists the Basic input/output system (BIOS) and the Basic disk operating system (BDOS) function calls. But be sure that the linkages are correct for your system.

Unfortunately, the card doesn't have information specifically for Radio Shack's CP/M Plus for the Model 4/4P. It also has some misplaced data and omissions. For example, the ASM parameter that prints an Assembly listing file is missing.

Nevertheless, this is a superior collection of information that provides an instant reference for CP/M users. It's far easier to use than most other CP/M documentation. This feature alone makes the card worthwhile. ■

A Strong Link

by Terry Kepner

Micro-Link II is an able Model 4 communications package that uses TRSDOS 6.0 or DOSPLUS 4.0 to take advantage of the Model 4's 80-character by 24-line display, 4 MHz speed, all-RAM mode, and better DOSes.

The package includes the main program, its seven associated overlay modules, and two ancillary utilities (RET/CMD and ABCON/CMD). The overlays maximize the buffer space available (40K) for data transmission and reception.

Program Features and Operation

Micro-Link II provides the features most commonly used in data communications: full- or half-duplex operation; printer on/off control; internal line-feed on/off control (some systems send a line feed with each carriage return); creating, saving, loading, and transmitting log-on messages; uploading to a BBS; transferring files using Christensen protocols (for CP/M computers); sending and receiving binary files; eight 63-character user buffers; reading the display directory; displaying, changing, and saving modem parameters; and clearing, opening, closing, displaying, loading, saving, transmitting, and typing buffer commands.

In addition, you can get a Help menu (a display of all the above commands), clear the screen, or return to DOS. If you decide to return to DOS, you can later use the special Return program (RET/CMD) to return to Micro-Link II if you haven't executed any DOS commands or programs that overwrite Micro-Link's position in memory.

The buffer options are a little complex. You can transmit data in four ways: the block format sends a control-R to tell the computer you're communicating with to open its buffer, transmits the file, then sends a control-T to tell the other computer that file transmission is complete and to close the buffer.

The Prompt format sends the file one line at a time and waits after each carriage return for the other computer to respond with a prompt character indicating when it's ready for the next line.

Upload operates similarly to the prompt-format transmission but automatically transmits binary files 128 characters at a time.

Christensen protocol is the same as Prompt except that each transmitted line contains 128 characters and a checksum byte. An error results in the retransmission of the "bad" block, providing you with up to 10 retries before aborting the transmission.

You can receive data in three ways: through the automatic buffer, which automatically opens the buffer when it receives a control-R and closes it when control-T arrives; manual operation via clear-B; and Christensen protocol, which sends a prompt character, which you define, to the other computer after each line of data received.

Micro-Link II

★★★½

Bi-Tech Enterprises Inc.
10 Carlough Road
Bohemia, NY 11716
Model 4
TRSDOS, DOSPLUS
$49.95

Easy to use?	★★★★★
Good docs?	★★★☆☆
Bug free?	★★★★☆
Does the job?	★★★☆☆

↙ See List of Advertisers on Page 176

Binary files are machine-language programs or compressed-format Basic programs that contain ASCII codes higher than 127. Using the Upload feature, you can transmit a binary file directly, but you must be using 8-bit data words instead of the standard 7-bit word. You can also use the binary file transmission function to convert the binary file to ASCII format (program length is limited to 24K) and transmit it that way. If you receive such a file, you can use the ABCON utility program to convert the ASCII file back to its binary form.

Drawbacks

One disadvantage to Micro-Link is that it uses the clear key as a control key to access its functions (leaving the real control key so you can transmit any special control codes to the other computer). This means that you can't use the DOS keystroke multipliers with Micro-Link.

Another problem is that you can't disable the control-R and control-T buffer control characters when sending data in block format (my Model 100 ignores these characters, and uses control-Z to close the buffer).

The only potential problem is that Micro-Link's disk directory command might have difficulties with 80-track double-headed or hard drives because of the number of files that can be in the directory. In that case, you must exit Micro-Link II, examine the directory, and restart the program. RET/CMD may not allow you to re-enter the program properly, so it isn't recommended.

The Docs

Micro-Link's documentation is adequate. It's printed on card stock in a three-ring 7- by 9-inch binder. While the manual doesn't have a reference card, you can easily remove page 5 and use it for that purpose.

All in all, Micro-Link II is a good, moderately priced communications program for the Model 4. ■

Pro-Create

★★★★

Misosys
P.O. Box 4848
Alexandria, VA 22303
Model 4
64K, 1 Disk Drive
$100

Easy to use?	★★★★☆
Good docs?	★★★★☆
Bug free?	★★★★★
Does the job?	★★★★★

A New Creation

by Mark D. Goodwin

Pro-Create, Misosys' Model 4 version of its popular EDAS IV editor/assembler, is one of the best such programs on the market. Even the most demanding programmers will find its many advanced features impressive.

The assembler is outstanding—its ability to use macros is by far the best I've ever seen. And the editor will do everything a Radio Shack editor/assembler can, and more.

About Macros and Conditionals

You use macros in source code to replace a repetitive series of instructions. Pro-Create lets you nest macros to eight levels, pass parameters by position or key word, test a passed parameter's length from within the macro, and create labels within the macro that are unique to each invocation of that macro.

Pro-Create also fully supports conditionals. You can thus easily use the same source code to produce many different versions of a program. Furthermore, you can use the conditionals within macros.

The Assembler

The program offers a Get directive for assembling source code files directly from disk. The length of the programs you can assemble is thus limited only by the size of the symbol table and the amount of disk space you have available.

You can use Pro-Create's Search directive to search partitioned data sets for commonly used source code routines. You will, however, need to spend $40 on Misosys' PRO-PaDS, a utility that lets you build a library of routines.

These are but the highlights. In addition, Pro-Create offers the ability to assemble core image files, the ability to assemble into memory, interactive linkage to Debug, 15-character labels, binary constants, powerful pseudo-ops, sorted symbol tables, new expression operators, and new switches for controlling listings.

The Editor

Pro-Create's editor looks a lot like that of Radio Shack's editor/assemblers. Its advanced features let you copy and move a line or a block of lines, modify strings globally, save and load source code files in many different formats, display memory usage statistics, and execute TRSDOS 6.X library commands from within the editor's environment.

And More

Here are some of Pro-Create's other attractive features:

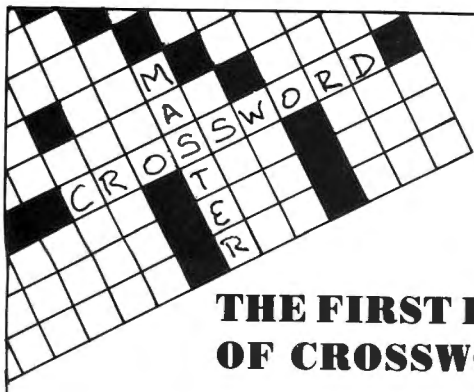
- The editor and assembler are co-resident. This can save time, particularly when performing trial assemblies, because you don't need to save the source code on disk before assembling.
- Pro-Create can produce a disk file of all the label references in a program. The XREF utility can then compile a complete cross-referenced listing of the labels. You'll find this useful for tracking down problems in programs that use multiple disk files.
- The manual is well-written and well-organized. Misosys also includes a copy of Micro Logic Corp.'s handy Z80 quick-reference card. ■

The Signalman XII: Talk is Cheap

by Bradford N. Dixon

Because people increasingly use computers as data terminals in telecommunications, a wide range of modems have flooded the micro market. The only problem now is in deciding which one best suits your needs.

Anchor Automation's Signalman Mark XII is one entry you don't want to overlook. It does the same job as such popular modems as the Hayes Smartmodem and Novation Smartcat, but at a lower price.



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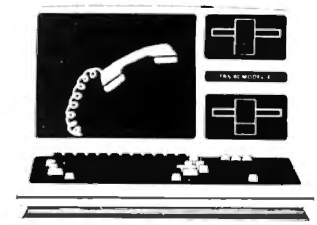

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The Unit

The Signalman is a 300-/1,200-baud auto-answer/auto-dial modem that stores one telephone number and detects dial tones and busy signals automatically. Since you control the modem with your terminal program, you don't need to change internal DIP switches as you do with the Novation Smartcat.

The modem's front panel provides all the operational indicators you need: an HS light showing when the modem is operating at high speed (1,200 baud), a carrier-detect indicator (CD), a send data/receive data light (SD/RD), and a modem-ready indicator (MR). The modem's on/off switch, a feature Novation's Smartcat lacks, is to the right of these lights.

The Mark XII is 6 inches wide, 9½ inches deep and 1½ inches high. It makes a perfect platform for your desk telephone. The plastic case is close in color to the gray of Radio Shack's Models I and III for clash-conscious computerists.

Included in the package is a 6-foot telephone cable, a 110-volt power adaptor, and a 25-pin RS-232 connector already installed and ready to plug into your computer.

Using the Signalman Mark XII

When you turn on the Signalman, it runs a self-check test to make sure its hardware is functioning properly and sends an "OK" message to the screen. The modem's default values are 1,200 baud operation in the full-duplex mode with the automatic answer function enabled. If you're running a bulletin board system using the Signalman, you're ready to go as soon as you turn on the power.

In the auto-answer mode, the Mark XII senses the baud rate of the calling computer and adjusts its own rate to match. It does the same when calling a host computer.

I tested the Signalman in its manual and auto-dial modes to access *80 Micro*'s BBS and CompuServe. I also used it in the auto-answer mode in conjunction with *80*'s BBS to receive incoming calls. The modem performed flawlessly.

The Documentation

Telecommunications is exciting, but without good directions from the software and hardware you use, it can also be frustrating. The 30-page owner's manual is complete and the directions are explicit and understandable. The tone of the manual is educational without being condescending, and it will appeal to computer novices and experts alike.

Anchor Automation includes a command menu in the modem's firmware to make the modem even easier to use (see Fig. 4). They also provide a handy quick-reference command card you can tape to the modem.

Please Hang Up

Hayes Microcomputer Products and Novation have similar and possibly more powerful modems, but they're also more expensive. Mail-order houses list the Hayes Smartmodem 1200 for $469 to $539 while the Novation Smartcat 103/212 lists for $410 in the same ads. The Signalman Mark XII's suggested retail price is $399, but at least one mail-order house offers it for $250.

Anchor Automation has a winner in their modem. In a field dominated by Hayes and Novation, the Signalman is one modem that performs all basic functions and more without the higher price. ■

+++	Online ESC	F0	Half duplex
O	Online RTN	F1	Full duplex
A/	Command RPT	H0	On hook
A	Answer	H1	Off hook
D	Dial	T	Tone
P	Pulse	,	Wait
;	CMD MD RTN	Z	Reset

Figure 4. The Signalman XII's command menu.

Signalman Mark XII Modem

★★★★½

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6913 Valjean Ave.
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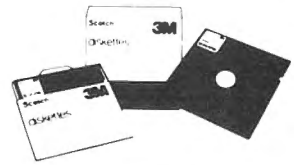

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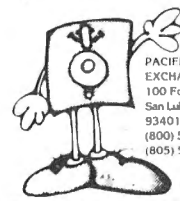

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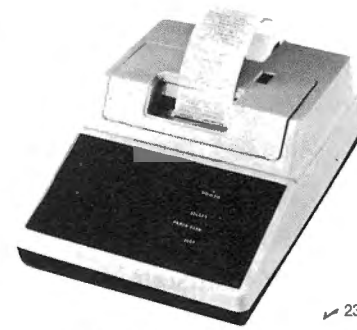

✓ 233

Dot Matrix Printer Interfaces with TRS-80

Featuring a **TRS-80** compatible parallel interface, Addmaster Corporation has produced a new dot matrix printer, Model 170. The interface includes a Centronics-type handshake and DB-25 interface connector, Baudot, and day—and time clock. The Model 170 provides 18 or 21 characters per line, 6 lines per inch print density, on standard 2½" adding machine tape. Designed to use with personal computers, Model 170 will produce hard and carbonless copies of programs, data or results. **Write Addmaster Corporation, 416 Junipero Serra Dr., San Gabriel, CA 91776 or call 213/285-1121.**

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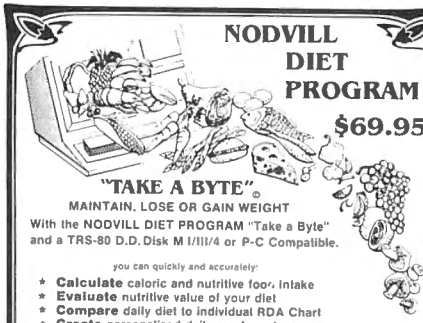

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Your Printstation In Life

The GLP and the Printstation 240, 250, and 354 printers from Centronics Corp. (1 Wall St., Hudson, NH 03051, 603-883-0111) are designed for transportability and office work.

The compact, 6.6 lb. GLP dot-matrix printer ($299) offers block graphics, correspondence- and draft-quality printing, and enlarged, condensed, emphasized, and double-strike print modes and is small enough (13 by 7½ by 2.8 inches) to accompany your Model 4P.

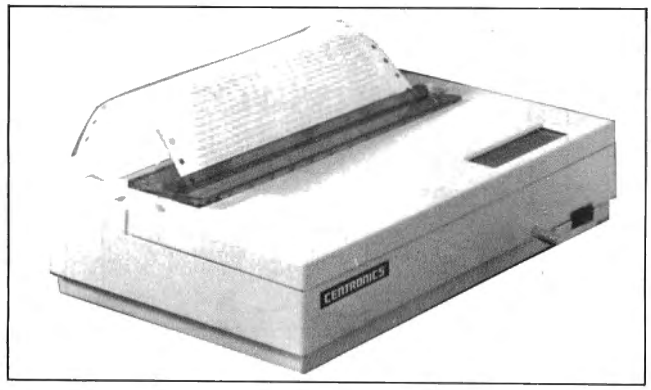
It prints superscripts and subscripts and accepts cut-sheet or roll paper. An optional tractor feed accepts 8-inch fan-fold paper.

The GLP printer runs at 50 characters per second (cps) for draft-quality and 12 cps for correspondence-quality printing.

The Printstation 240 24-pin dot-matrix printer ($1,495) features normal- and high-density print modes, proportional fonts, and runs with systems that support daisy-wheel printers.

It prints at 160 cps in draft mode (80 cps in correspondence mode) and prints pin-addressable graphics and condensed, enlarged, and emphasized characters.

The Printstation 250 dot-matrix printer ($1,299) prints in seven colors, generates charts and graphs, and automatically feeds documents. It prints at 185 cps for proportional printing, 160 cps in draft-quality mode, and 40 cps for correspondence-quality mode.



The GLP compact dot-matrix printer is one of four new printers from Centronics.

It also features a bidirectional, logic-seeking print head, pin-addressable graphics, and printer setup and diagnostics controls.

The Printstation Model 354 dot-matrix printer handles fan-fold or single sheets and runs at 220 cps draft mode, 50 cps correspondence mode. Capabilities include proportional printing, margins, automatic centering, bold and shadow print, variable fonts, and pin-addressable graphics. It costs $2,195 and offers an optional bin feeder.

Reader Service ✓ 555

1-2-3 for the 2000

Tandy's Model 2000 now runs Lotus 1-2-3. Lotus 1-2-3 combines data-base management, spreadsheet, and graphics programs in a single integrated package. The spreadsheet offers up to 2,048 rows and 256 columns, cell and page formatting, statistical, financial, and calendar functions.

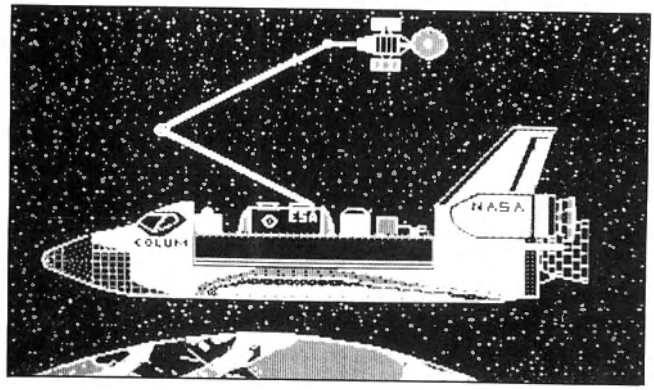
You can use spreadsheet data with Lotus' graphics program to create and display bar and line graphs, pie charts, and X-Y graphs.

Lotus' information management program lets you quickly enter or retrieve more than 2,000 data-base records. Data base information is available for statistical analysis, reports, or for spreadsheet models and graphs.

Lotus' Macro Command Language lets you develop automatic command sequences for faster operation. Lotus 1-2-3 includes an MS-DOS operating system and tutorial programs for the beginning user.

It's available at Radio Shack stores. For more information contact Tandy Corporation/Radio Shack at 1800 One Tandy Center, Fort Worth, TX 76102.

Reader Service ✓ 551



The Grafyx Solution add-on board enhances Model III/4 resolution.

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The Grafyx Solution add-on board plugs into your Model III or 4 graphics connector to increase resolution to 640 by 240 pixels.

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The package also includes Extended Graphics Basic for creating lines, boxes, ellipses, circles, and arcs. You can fill areas with 256 patterns, change the viewing area, and save screen sections.

The Grafyx Solution ($199.95) is available from Micro Labs Inc., 902 Pinecrest, Richardson, TX 75080, 214-235-0915.

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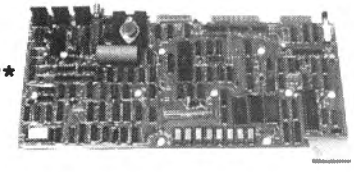

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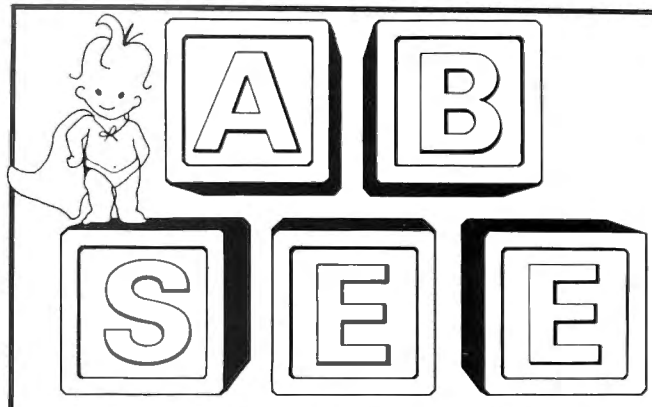

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See Our Product Review in July '84 Issue of *80 Micro**
(Article by Gary Ludwig)

**I recommend you get your hands on A-B-SEE before its author, David Dahl, realizes how seriously underpriced it is... A-B-SEE is an ingenious, thoroughly professional Model III file editor, word processor, screen graphics, and telecommunications program. Because of its integrated nature and flexibility, this package can do the job of a half-dozen individual utilities and programs.*

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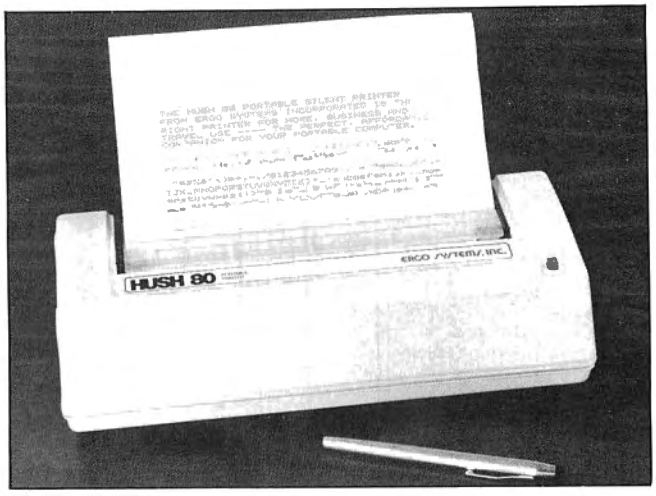
This statistical software package contains programs in forecasting, stocks, bonds, options, futures, and foreign exchange. An optional 220-page handbook ($19.95) explains how to use the programs for profitable planning and forecasting.

The programs require 48K and one disk drive. Contact Programmed Press at 2301 Baylis Ave., Elmont, NY 11003, 516-775-0933.

Reader Service ✓ 552

A Transportable Thermal Printer

Ergo Systems Inc.'s Hush 80 portable dot-matrix thermal printer ($159.99) features 80-column bidirectional printing at 80 cps, and comes with an interface and cable.



Hush 80 combines the quietness of a thermal printer with speed and portability.

At 28 ounces and 12 by 5½ by 3 inches, the Hush 80 fits easily into a briefcase. An optional rechargeable battery pack keeps you printing while you're on the road. RS-232 and serial interfaces are available.

The Hush 80 comes with a 100-foot roll of thermal paper and a 9-volt wall transformer/power cable. Printer paper is contained in the unit for greater portability.

For more information contact Ergo Systems Inc. at 1360 Willow Road, Menlo Park, CA 94025, 415-322-3746.

Reader Service ✓ 559

Storage to the Max

IJK Inc.'s 2.46-megabyte disk upgrade system for the Models III and 4 has enough storage capacity to back up hard disk systems.

The upgrade hardware lets you boot up 48-tracks-per-inch (tpi) disks, and the accompanying software reads and writes in high-density mode (192 tpi) using specially formatted disks. A speed-up kit reduces disk input/output time by half.

The drive features a 500-bit-per-second transfer rate, 3 millisecond track-to-track access time, and a track-following servo to ensure on-track read/write

✓ *See List of Advertisers on Page 176*

head positioning. The unit requires no preventive maintenance.

Specially formatted disks are available from IJK or their dealers. The upgrade system is $1,195 for one drive. An additional drive is $595 from IJK Inc., 24646 S.E. 192, Maple Valley, WA 98038, 206-432-9414.

Reader Service ✓ 553

Dust Off Your Computer

Dirt and dust build up in the unreachable areas of a computer system: between the keys, inside the printer, and inside disks and disk drives.

The Dust-Off System II kit from Falcon Safety Products Inc. (1065 Bristol Road, Mountainside, NJ 07092, 201-233-5000) blows away dirt in computers, media, and peripherals with a dry propellant.

Keep dirt and dust out of your computer, peripherals, and media with the Dust-Off System II kit.

Also included are a Mini-Vac that picks up dust and lint particles and a 2-foot extender hose for cleaning inside equipment.

The optional Stat-Off II attachment ($17.95) produces an ionized blast to neutralize static electricity buildup.

The System II package is $42.50. Kit components are also available separately.

Reader Service ✓ 562

Model III Windowing

The Windowpad integrated windowing and note-processing utility for 16K, 32K, and 48K Model IIIs works within applications programs to write, recall, and edit memos and notes without loss of data in your primary program.

Windowpad loads into top-of-memory for protection from Basic programs and runs with applications programs or as a stand-alone program.

The program saves operations performed on the ap-

plication program while you're using Windowpad. After Windowpad completes execution, it restores the application program functions.

A complementary personnel filing program, SASSE, is also available. It has expandable, movable windows, and can perform multiple tasks simultaneously.

Windowpad is $20 plus $1.25 shipping and handling. Contact En Fleur Corp. (2494 Sun Valley Circle, Silver Spring, MD 20906, 301-598-4532) for more information.

Reader Service ✓ 554

Shrinking Basic

Well-commented programs facilitate debugging and clarify program logic. Once you're familiar with a program, however, these lines lose their usefulness and waste memory space.

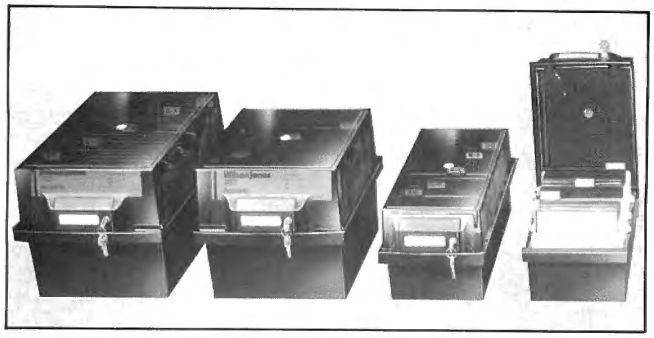
Shrink ($24.95) compresses Basic programs to the smallest possible size without altering program logic and data. It removes remarks and unnecessary spaces, and combines statements into as few lines as possible. You can then run larger programs and execute programs faster.

If you need to edit a program, Break ($19.95) puts each statement on its own line. For even clearer listings, Insert ($19.95) puts spaces before and after each Basic operator and key word.

All three utilities execute from the overlay area of your operating system while the Basic program resides in memory. No saving and loading is necessary. Load the program once, then insert spaces and break lines for corrections, or shrink it and run it from RAM.

The programs run on the Models I, II, III, 4, 12, and 16. A complete package with all three utilities is $49.95 from Gulf States Computer Services, 10039 Bissonnet, Suite 130, Houston, TX 77036, 713-270-9003.

Reader Service ✓ 561



Multi Form disk trays keep your disks under lock and key.

Keying into Your Disk Box

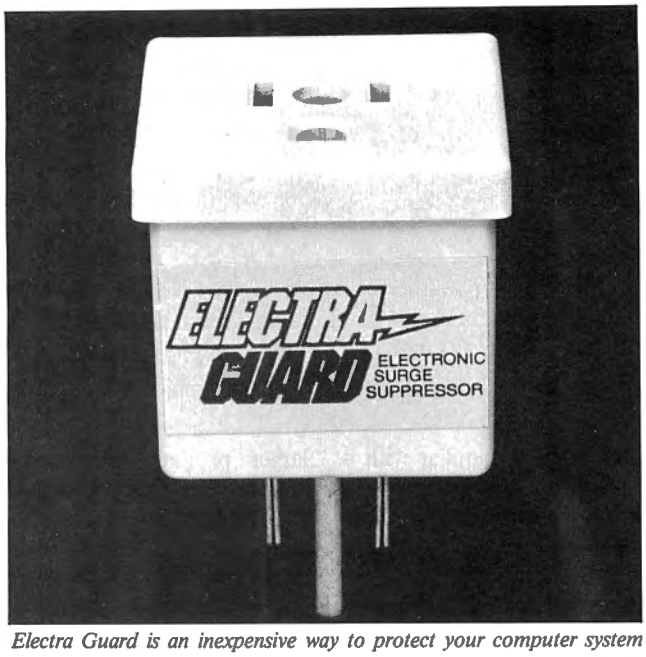
Multi Form disk trays from Wilson Jones Co. (6150 Touhy Ave., Chicago, IL 60648, 312-744-7700) keep your 5¼- and 8-inch disks under lock and key.

✓ See List of Advertisers on Page 176

The trays are stackable and have label holders and snap-out dividers for organizing disks. The 80-disk trays come with five dividers; 40-disk boxes come with three. Extra dividers are available.

Each tray is constructed of high-impact polystyrene with a smoke-tint top and includes a carrying handle. Trays for 5¼-inch disks are $39.95 for 40-disk capacity and $49.95 for 80-disk capacity. Eight-inch disk trays are $49.95 for 40-disk capacity and $59.95 for 80-disk capacity.

Reader Service ✓ 564



Electra Guard is an inexpensive way to protect your computer system from power surges.

Surge Safety

Electra Guard System 3 ($18.95) protects your computer system from power surges of up to 50,000 watts and filters line noise. The unit plugs into your wall outlet and guards equipment operating at up to 1,875 watts. Electra Guard stops power surges in less than five billionths of a second.

A red indicator light tells you that Electra Guard is working properly. The unit comes with a five-year warranty on parts and labor and is available from Computer Power Solutions, 8800 49th St. N., Suite 203, Pinellas Park, FL 33565, 800-237-6010.

Reader Service ✓ 566

TRSDOS Training

You bought a Model 4, and now you must learn how to use it. Radio Shack's disk-based Training for TRSDOS program ($74.95) introduces new owners to operating systems, disk utilities, file commands, and JCL files.

Developed for Radio Shack by Cdex Corp., Training for TRSDOS is available through Radio

See List of Advertisers on Page 176

Shack stores. It includes tutorial disks and a reference guide containing exercises and sample JCL programs.

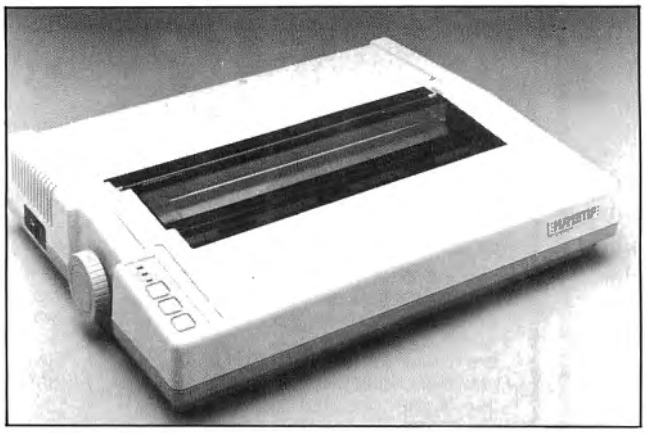
Contact Tandy Corporation/Radio Shack (1800 One Tandy Center, Fort Worth, TX 76102) for more details.

Reader Service ✓ 560

Four Ways to Print

Riteman Computer Printers (Airport Business Park, 431 N. Oak St., Inglewood, CA 90302, 213-453-6688) offers four lightweight printers for your TRS-80.

The Riteman Plus dot-matrix printer ($399) offers both pin-feed and friction-feed printing at 120 cps. It has DIP switches on the outside panel for easy access and uses a cartridge ribbon and a steel cable for printer movement. A tractor feed is optional.



The Riteman Blue Plus fits into a briefcase and prints at 140 cps.

The Riteman II 160 cps dot-matrix printer comes with 2K ($549) or 8K RAM ($599) and uses pin- or friction-feed paper with a tractor-feed option.

Riteman's Blue Plus model ($499) prints at 140 cps and features Epson RX-80 FT and MX-80 FT Graftrax Type III modes. The Blue Plus comes with a pin- and friction-feed system. Tractor feed is optional.

The Riteman 15 is a 160 cps bottom- and rear-feed dot-matrix printer for business use. It features front-panel controls, a cartridge ribbon, and 2K ($799) or 8K ($849) RAM.

All four printers include a one-year warranty.

Reader Service ✓ 568

Settling Computer Differences

PCD Systems' UCSD p-System operating system for the Models 4 and 4P ($650) gives you software compatibility with the IBM PC and other 8-, 16-, and 32-bit machines.

The p-System lets you write programs on the Model 4 in Fortran or Pascal, compile them, write them to an IBM-formatted disk, and run them on an IBM PC under the p-System. No recompiling is necessary.

It works by using overlay techniques and segment-swapping to achieve virtual

The only way to WIN is to ENTER:

80 Micro's Young Programmers' Contest 1984–1985

Grand Prize $300 and publication

3 1st prizes—$200 each and publication
3 2nd prizes—$100 each and possible publication
3 3rd prizes—$50 each and possible publication
Honorable Mentions—Free subscription to **80 Micro** and possible publication
(These prizes are in addition to our regular article price.)

If you're an aspiring programmer, 18 years or younger, enter **80 Micro**'s 3rd Annual Young Programmers' Contest. Your entry must be for the TRS-80 Models III, 4, or 4P only. Programs will be judged on originality, documentation (more on this below), and program elegance. The age categories are 11 and under, 12 through 14, and 15 through 18. All entries will be judged by the **80 Micro** staff.

Rules

1. Final entries must be received by October 1, 1984.
2. All entries must be submitted in a 10 × 13" envelope and must include: typewritten, double-spaced documentation; a printed copy of the program listing; a magnetic disk or cassette containing the program listing, the documentation, and any figures or tables; and a completed entry blank.
3. Documentation should consist of an explanation of the program, its purpose, how to use it, and the necessary software and hardware needed to use it, including disk operating system (DOS) and memory requirements. (If your entry requires unusual hardware configurations, query us before submitting.) Good documentation also points out the interesting algorithms and program techniques used without giving a line-by-line account.
4. Entries must be original and unpublished.
5. All winning entries become the property of *80 Micro*.
6. Your age as of October 1, 1984 will determine the category in which you will be judged. You must not have turned 19 by that date.
7. You may submit as many entries as you like; however, each one must be submitted separately and must include all of the information and materials described above.

The *80 Micro* Young Programmers' Contest

Name_____

Age_____ Date of Birth_____

Street_____

City_____

State_____ Zip_____

Phone_____

Machine
(circle one)

- Model III
- Model 4
- Model 4 P

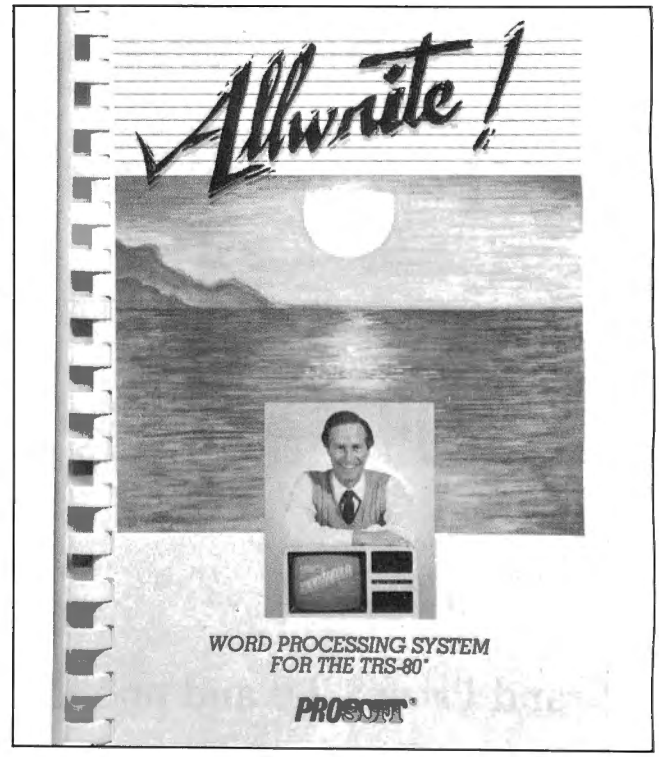
Include this form with your entry and return to:

Young Programmers' Contest

80micro

80 Pine Street
Peterborough, NH 03458

NEW PRODUCTS



Prosoft's Allwrite is an advanced word processor for the Models I, III, 4, and 4P.

memory capability and compacts compiled code to accommodate programs much larger than would normally fit in RAM.

Software developed under the p-System on the Model 4 also runs on the Models II, 12, and 16.

Contact PCD Systems Inc., P.O. Box 277, Penn Yan, NY 14527, 315-536-7428 for more details.

Reader Service ✓ 574

The Write Word Processor

The Allwrite word processor for the Models I, III, 4, and 4P features two-key commands and special "soft keys" to create paragraphs, center text, and invoke other functions.

The package formats tables of contents, indexes, and footnotes, and processes data from several disks as a single document.

Allwrite has a help file of 50 subjects and includes quick-reference cue cards that fit on your keyboard. Allwrite is compatible with Electric Webster 1.7 and DotWriter 4.0. The Model 4 version supports an 80-character by 24-line screen and edits up to three files at a time on a 128K system.

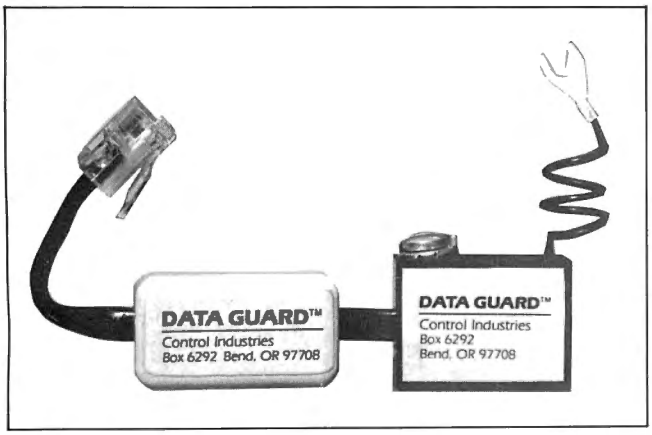
Allwrite is $249.95 and includes a 350-page manual. For more information contact Prosoft, P.O. Box 560, N. Hollywood, CA 91603, 213-764-3131.

Reader Service ✓ 563

Interactive Printing

The Interprinter printer control program works interactively with other programs to control your Epson printer.

It saves the current screen, then displays a menu for print modes, line feeds, variable line spacing, form feeds, form lengths,



Data Guard protects data transmissions on shared phone lines.

and other printer controls. Interprinter also lets you print messages on forms that the host program prints.

After execution, Interprinter restores the host program and its screen. The program runs on the Models I, III, and 4 under TRSDOS 1.3 and 2.3. Special formats are also available.

Interprinter is $29.95 from Comtrol Data Systems, P.O. Box 151, Asbury Park, NJ 07712, 201-988-1399.

Reader Service ✓ 567

The Data Dilemma

Every time you transmit data over a shared telephone line you risk losing your connection and your data if someone picks up an extension.

Rather than going to the expense of buying a dedicated line, you can install Dataguard ($39.95). This simple device connects to extension phones to give your modem priority.

Dataguard works automatically and requires no power source. You can select an in-phone model that installs out of sight or opt for a 12-foot snap-in cord model that replaces your current phone cord.

Contact Control Industries (Box 6292, Bend, OR 97708, 503-389-1969) for more information.

Reader Service ✓ 569

CP/M Plus Software

Alpha Technologies (P.O. Box 1908, Huntsville, AL 35807, 205-881-3343) responds to the lack of Model 4 CP/M software by offering popular software packages formatted for CP/M Plus.

Products available include Ashton-Tate's dBase II, dUtil from Fox & Geller, Microsoft's Multiplan, and The Word Plus from Oasis, and others.

Pricing information is available upon request.

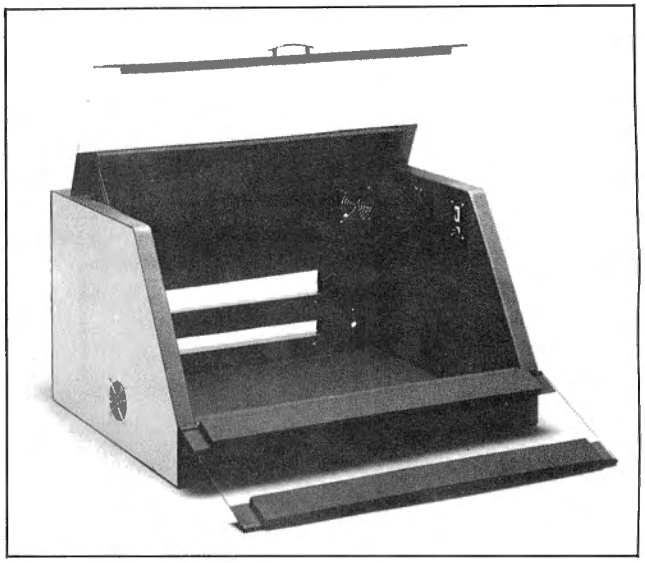
Reader Service ✓ 572

The Alternate Text Processor

The EDX text processor and formatter for the Models I and III lets you execute command sequences of up to 128 keystrokes by pressing a single key. The program also features column formatting for keying in program listings and other columnar data.

A scrolling mode has controls for pauses, scrolling speed, and direction. File size is limited only by your disk system's capacity.

✓ See List of Advertisers on Page 176



A Lexan sound cover cuts printer noise in the office or home.

EDX supports pages up to 128 characters wide, and its search and replace feature searches for wildcard entries, including decimal digits or any lowercase character.

The cut-and-paste function has 26 buffers for manipulating chunks of text, and an error recovery system lets you use DOS commands while running the program.

EDX includes a 100-page manual and a disk for $29.95 plus $3 shipping. For more information contact The Alternate Source at 704 N. Pennsylvania Ave., Lansing, MI 48906, 517-482-8270.

Reader Service ✓ 556

Printing in Silence

The new office printer works great, but it's so noisy you can't hear yourself think. Instead of putting it in another room, you can put it in a Lexan sound cover and relax.

These lightweight, impact-resistant, attractively designed, plastic noise-reduction cabinets accommodate any printer without interfering with interface connections.

Small fans inside the cabinet keep your printer cool, and top and front doors open wide for easy access. Lexan sound covers start at $495 and are available from Supply Source, 175 Middlesex Turnpike, Bedford, MA 01730, 800-343-4688.

Reader Service ✓ 570

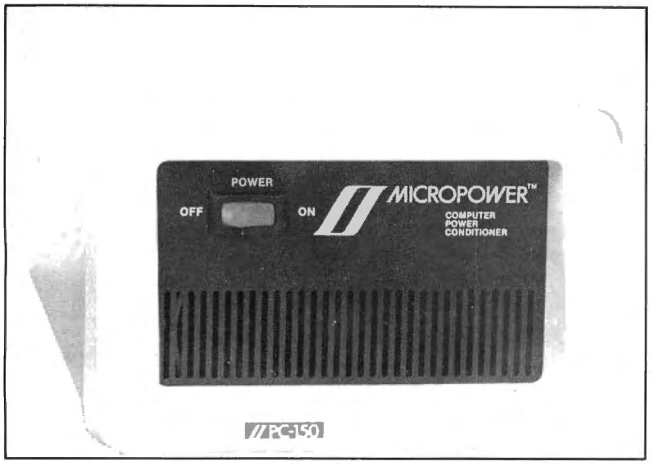
Programming in pC

The pC programming language and compiler for the Model I/III produces programs that run up to 50 times faster than Basic programs. The pC compiler translates source programs from pC into Z80 instructions.

pC uses structured programming statements such as While and If...Then... Else, and has a library of over 60 functions. Other functions access documented routines in ROM and TRSDOS, and support disk files, graphics, memory management, and strings.

You can redirect input and output files when running pC programs, and you can call pC routines from Assembly-language programs.

The pC package includes a manual and disk with a



Micropower line conditioners protect against brown-outs and surges, regulate voltage, and filter power line noise.

File Merge utility, runtime library, utility library, and pC source code. It's $99.95 from Allegro Software, P.O. Box 6593, Station J, Ottawa, Ontario, K2A 3Y7, Canada.

Reader Service ✓ 557

Suppressing Products

The Micropower PC series line conditioners combine voltage regulation, surge and spike protection, noise attenuation, and brown-out protection in one package.

Micropower regulates voltage within 2 percent, filters noise, and includes an on/off switch, three output receptacles, and a 6-foot power cord.

Conditioners are available in 150 volt-Ampere ($219) and 275 volt-Ampere ($289) sizes. For more information contact Albar Inc., P.O. Box 2368, Lynnwood, WA 98036, 206-771-4006.

Reader Service ✓ 571

Chipmunk Drive

Chipmunk is a 3½-inch portable disk drive for the Model 100 that comes with Disk Basic and a menu-driven operating system.

The drive fits into a briefcase with the Model 100 and includes a rechargeable battery pack and adapter plug. Chipmunk accepts additional drives, and also includes connecting cables, manuals, and a disk for $550.

For more information contact Holmes Engineering, 5175 Greenpine Drive, Murray, UT 84123, 801-261-5652.

Reader Service ✓ 573

Communications Connection

The Password 300-baud, auto-dial, auto-answer modem ($199) has a built-in RS-232 cable and operates with Telpac, Crosstalk, Perfect Link, Transcend, and other communications software.

Password 300 disconnects automatically and monitors dial tone, ring, busy, and other line signals to diagnose problems. It's light enough to carry in a coat pocket or briefcase, and comes with a power adapter and Velcro mounting strips.

For more information contact U.S. Robotics Inc., 1123 W. Washington Blvd., Chicago, IL 60607, 312-733-0497.

Reader Service ✓ 575

✓ See List of Advertisers on Page 176

NEW PRODUCTS

DIFFERENT TRACK

Turn your monitor into a TV set with the Taxan 305.

High-Resolution TV

While others are using their television sets as monitors, you can take advantage of the better picture quality of your monitor by turning it into a TV.

The Taxan Model 305 tuner ($129.95) turns any composite monitor with audio into a color television. A TV-tuned monitor has a clearer picture than most color TVs and saves space by letting your television and computer system share monitors.

For more information contact Taxan Corp., 18005 Cortney Court, City of Industry, CA 91748, 818-810-1291.

Reader Service ↙ 565

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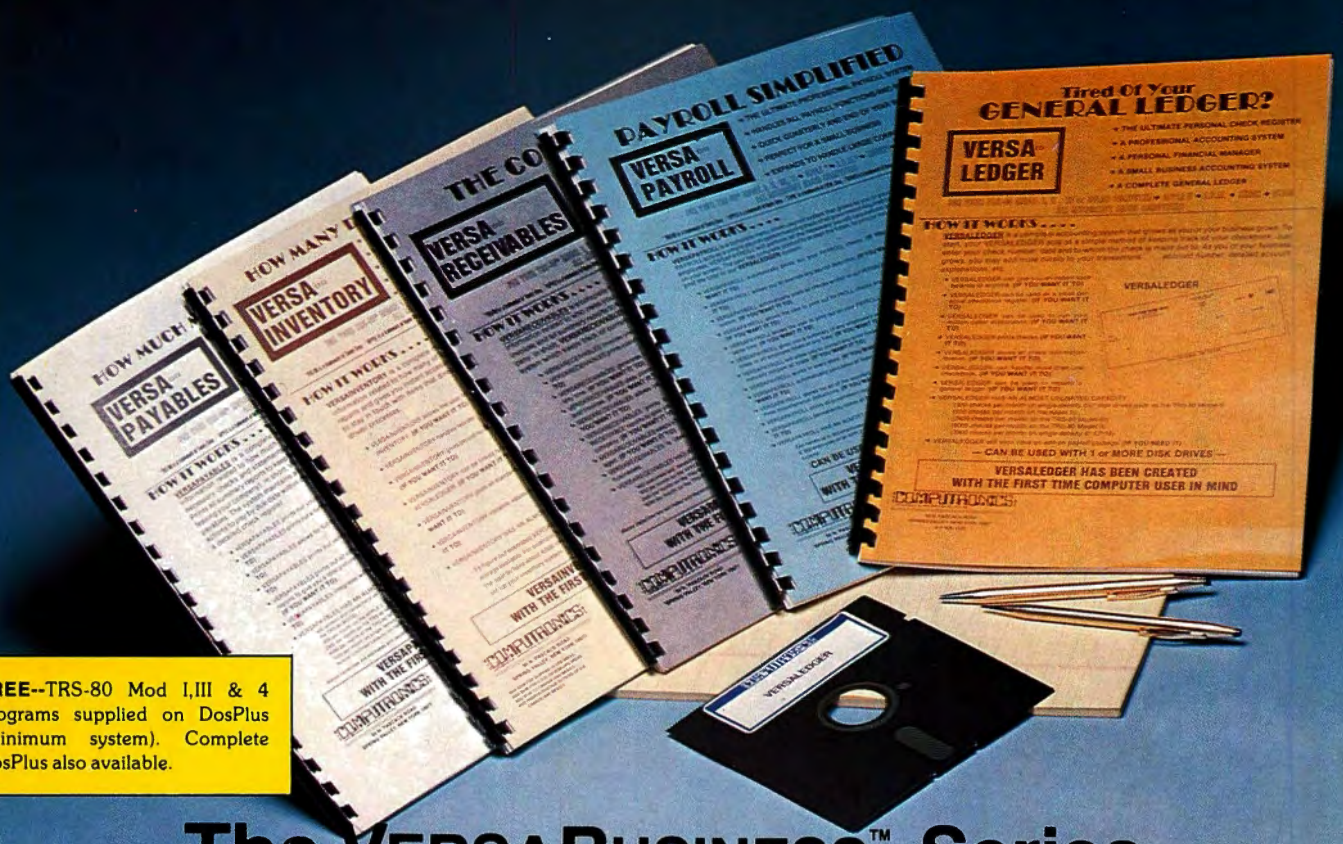
New Products listings are based on information supplied in manufacturers' press releases. 80 Micro *has not tested or reviewed these products and cannot guarantee any claims.*

Introducing the Most Powerful Business Software Ever!

TRS-80™ (Model I, II, III, or 16) • APPLE™ • IBM™ • OSBORNE™ • CP/M™ • KAYPRO™



FREE--TRS-80 Mod I,III & 4 programs supplied on DosPlus (minimum system). Complete DosPlus also available.

The VERSABUSINESS™ Series

Each **VERSABUSINESS** module can be purchased and used independently, or can be linked in any combination to form a complete, coordinated business system.

VERSARECEIVABLES™ $99.95

VERSARECEIVABLES™ is a complete menu-driven accounts receivable, invoicing, and monthly statement-generating system. It keeps track of all information related to who owes you or your company money, and can provide automatic billing for past due accounts. VERSARECEIVABLES™ prints all necessary statements, invoices, and summary reports and can be linked with VERSALEDGER II™ and VERSAINVENTORY™.

VERSAPAYABLES™ $99.95

VERSAPAYABLES™ is designed to keep track of current and aged payables, keeping you in touch with all information regarding how much money your company owes, and to whom. VERSAPAYABLES™ maintains a complete record on each vendor, prints checks, check registers, vouchers, transaction reports, aged payables reports, vendor reports, and more. With VERSAPAYABLES™, you can even let your computer automatically select which vouchers are to be paid.

VERSAPAYROLL™ $99.95

VERSAPAYROLL™ is a powerful and sophisticated, but easy to use payroll system that keeps track of all government-required payroll information. Complete employee records are maintained, and all necessary payroll calculations are performed automatically, with totals displayed on screen for operator approval. A payroll can be run totally, automatically, or the operator can intervene to prevent a check from being printed, or to alter information on it. If desired, totals may be posted to the VERSALEDGER II™ system.

VERSAINVENTORY™ $99.95

VERSAINVENTORY™ is a complete inventory control system that gives you instant access to data on any item. VERSAINVENTORY™ keeps track of all information related to what items are in stock, out of stock, on backorder, etc., stores sales and pricing data, alerts you when an item falls below a preset reorder point, and allows you to enter and print invoices directly or to link with the VERSARECEIVABLES™ system. VERSAINVENTORY™ prints all needed inventory listings, reports of items below reorder point, inventory value reports, period and year-to-date sales reports, price lists, inventory checklists, etc.

VERSALEDGER II™ $149.95

VERSALEDGER II™ is a complete accounting system that grows as your business grows. VERSALEDGER II™ can be used as a simple personal checkbook register, expanded to a small business bookkeeping system or developed into a large corporate general ledger system **without any additional software.**

- VERSALEDGER II™ gives you almost unlimited storage capacity (300 to 10,000 entries per month, depending on the system),
- stores all check and general ledger information forever,
- prints tractor-feed checks,
- handles multiple checkbooks and general ledgers,
- prints 17 customized accounting reports including check registers, balance sheets, income statements, transaction reports, account listings, etc.

VERSALEDGER II™ comes with a professionally-written 160 page manual designed for first-time users. The VERSALEDGER II™ manual will help you become quickly familiar with VERSALEDGER II™, using complete sample data files supplied on diskette and more than 50 pages of sample printouts.

SATISFACTION GUARANTEED!

Every **VERSABUSINESS™** module is guaranteed to outperform all other competitive systems, and at a fraction of their cost. If you are not satisfied with any **VERSABUSINESS™** module, you may return it within 30 days for a refund. Manuals for any **VERSABUSINESS™** module may be purchased for $25 each, credited toward a later purchase of that module.
All CP/M-based Computers must be equipped with Microsoft BASIC (MBASIC or BASIC-80)

To Order:
Write or call Toll-free (800) 431-2818 ⌐9
(N.Y.S. residents call 914-425-1535)

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* add $4 for C.O.D. or non-UPS areas
* add $5 to CANADA or MEXICO
* add proper postage elsewhere

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All prices and specifications subject to change / Delivery subject to availability.

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"THE RESULTS ARE IMPRESSIVE..."
—Dennis Kitsz, 80 Microcomputing; 12/82

Langley-St. Clair's* *Soft·View*™
Replacement CRT's
eliminates the strobe, flicker and fatigue from TRS-80's.™

Now you can upgrade your monitor with the new medium persistence green or amber phosphor tube.

State-of-the-art systems such as IBM™ and Apple III™ do not use the less costly "P4" B&W display tube because it is actually intended for TV viewing and its rapid strobes (60 times per second) cause irritating eye fatigue.

No amount of "green plastic" will solve this problem. But the new ***Soft·View*** CRT display tube from Langley-St. Clair will.

- Available in slow decay Green or medium decay "European Amber" (the standard in Europe)
- Made with Lead/Strontium impregnated glass that stops X-ray emission.
- Of high-contrast face glass that also stops most U.V. radiation.
- Available in frosted glass with extra Anti-Glare benefits.
- Easily installed...comes with pre-mounted hardware.
- Warranted for one full year against manufacturing defects or tube failure.
- The finest quality double-dark glass phosphor fields to produce dramatic contrast.
- Ideal for Word Processing and Programming, yet fast enough for Games and Graphics.

LSIS *Soft·View*™ CRT'S

☐ #GN42 Green Phosphor	$79.95
☐ #GN42G Green Phosphor w/Anti-Glare	$89.95
☐ #OR34 Amber Phosphor	$89.95
☐ #OR34G Amber Phosphor w/Anti-Glare	$99.95
also available:	
☐ #R22G Red Phosphor w/Anti-Glare	$139.95
☐ #B22G Blue Phosphor w/Anti-Glare	$139.95

Plus: $7.00 for packing and UPS Shipping
$17.00 for Overseas, Parcel Post or UPS Blue Label
Add Sales Tax where applicable.
(Inquire about the CRT's we have available for many other computer models)

For MasterCard and Visa Orders only, call
800/221-7070 (in N.Y. call 212/989-6876)

Langley-St. Clair Instrumentation Systems, Inc.
132 West 24th St., New York, N.Y. 10011

Actual unretouched photo.
*World's largest supplier of upgraded replacement CRT's.
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