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80 micro

the #1 magazine for Tandy users

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THE 4D REVIEWED
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80micro 2/86 #73 A

The new disk-based Tandy 600.

A breakthrough in portable computing power and versatility.

Finally—a portable that matches the performance of a desktop computer. Our new Tandy 600 features a 16-bit microprocessor, an 80-character by 16-line display, a built-in $3^1/_2$" disk drive that stores 360K of data and 32K RAM (expandable to 224K*). We've also put the most popular and useful applications into the Tandy 600's resident memory—they're right there the minute you turn on the machine.

Five Resident Applications

With the Tandy 600's larger display and expanded memory, Multiplan's popular "second-generation" spreadsheet can hold more information. Word processing is as easy as using MS-Word. You'll have quicker access to documents and better storage with the built-in disk drive. File is an electronic data base for names and addresses, expenses, client billing, inventory and more. And you can keep a large number of different files on the pocket-size diskettes. With Telecom and the Tandy 600's built-in modem, you're able to communicate with other computers over phone lines. Telecom will even dial the phone number of anyone listed in the File program. Calendar helps you keep track of daily tasks and activities. The Tandy 600 will sound the alarm and display the appointment or message for your convenience

The easy-to-learn resident System Manager lets you run each application, exchange information between applications and manage the files created. It takes care of file management for the disk drive and RAM. You can even set it to turn itself on for unattended operations. And you can add BASIC/ROM (26-3904, $129.95) to write your own programs.

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Tandy...Clearly Superior™

If you've been looking at portable computers, compare them with the Tandy 600 (26-3901, $1599). You'll be amazed at what it can do! Visit a Radio Shack Computer Center today.

*RAM upgrades are in banks of 96K each (26-3910, $399.95). Prices apply at Radio Shack Computer Centers and participating stores and dealers. Multiplan and MS-Word/TM Microsoft Corp.

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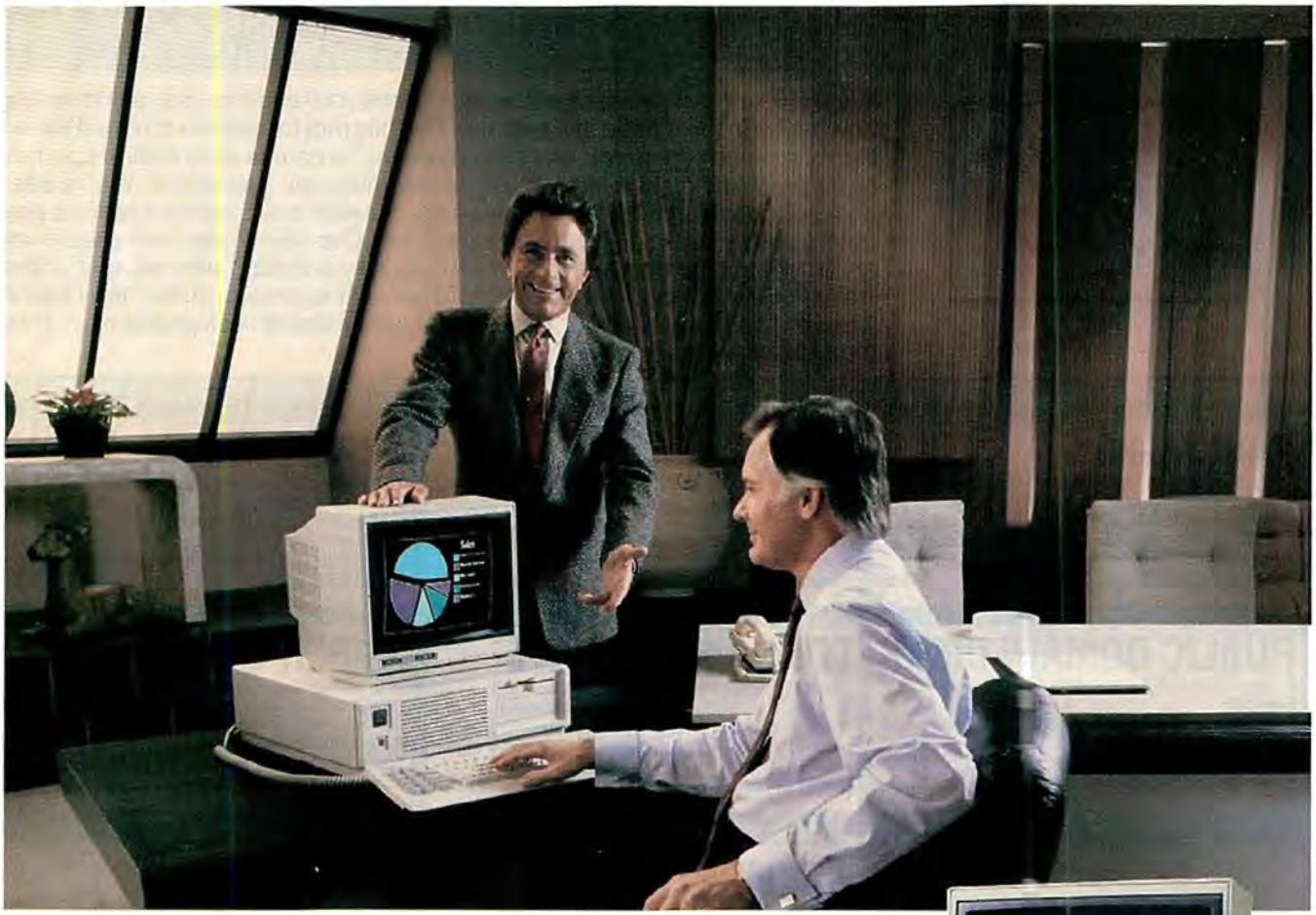

The New Tandy 3000

The difference is power ...and affordability.

Introducing the Tandy 3000 personal computer, the affordable alternative to the IBM® PC/AT. Here's the power you need to manage your business, to network computers, or to create a multiuser system.

Unmatched Compatibility

The Tandy 3000 uses the advanced MS-DOS 3.1 operating system. And since the Tandy 3000 is compatible with programs designed for the PC/AT, as well as the PC/XT, it cuts through today's software confusion. Choose from literally thousands of powerful applications.

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The Tandy 3000 is designed to use the forthcoming XENIX 5.0 multiuser operating system. Two to six people can share the 3000's high speed and storage from low-cost data terminals. The Tandy 3000 is network ready, too.

High-Performance Design

The Tandy 3000 (25-4001, $2599) operates at twice the speed of the industry standard, has 512K of main memory (expandable to 640K on the main board), a high-capacity floppy disk drive, a serial/parallel adapter and ten expansion slots.

Or choose the Tandy 3000 HD (25-4010, $3599) with a built-in 20-megabyte hard disk drive for fast access to volumes of data.

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JMG

Happy New Year! At least it will be by the time you read this. But, as I'm writing now, we're in the middle of November insanity (not to mention cold and snow). But more important to you, our customers, we're hard at work setting up a new order processing/shipping system to streamline our operations. We've been doing our best for more than three years, but with more orders now than ever before, we're falling a little behind the times. Our new system will assure you once again of the best service we can possibly provide...after all, that's what we're here for. So, we'll be working hard behind the scenes, but for now I'll leave you with this thought: If your TRS-80 ever complains of back problems, it's probably just a slipped disk.

PASCAL-80

Easiest version of Pascal to learn! Editor and Compiler are already in memory. Nearly complete subset of standard PASCAL. Offers also many extensions to Pascal, including calls to machine language, screen control, random access files and more!

Models I/III (List $79) $59.50

PRONTO

Specifically designed for the 128K TRS-80 Model 4/4P. Window controller program with many applications. Includes calculator, calendar, a sort utility, terminal facility, address cards, on-line help facility, and much more. "Sidekick" for the Model 4!

Models 4/4P $54.50

ZBASIC 3.0

ZEDCOR's brand new basic compiler. Device independent graphics, 54 digit numeric accuracy, built-in interactive Editor and Compiler, structured Programming Constructs, and much more. The commands stay the same for any and all computers!

MODELS I/III and 4 ..... $79.50

PUBLIC DOMAIN DISKS

A fine collection of software from The Alternate Source!

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Public Domain Package-#1-#6 ..... $49.50
Public Domain Package #7-#12 ..... $49.50
Public Domain Package #1-#12 ..... $89.50

EDAS/PRO-CREATE

One of Misosys' most popular utilities. Both a Full Screen Text Editor as well as a powerful Macro Assembler. Assembler supports nested macros, includes, and conditionals. Works excellently under most DOSes.

Models I/III and 4 ..... $69.50

SUPER UTILITY

"The indispensable first aid kit for the TRS-80 users..." Contains over 60 different utilities for repairing, reviving dead files, reformatting, manipulation of files, and lots more!

Super Utility Plus (Models I & III) $59.50
Super Utility 4/4P $69.50
Super Utility MSDOS $79.50

PACKAGE DEAL!

** MTERM **
** MSCRIPT **
** DOSPLUS IVa **

A complete operating system has just become very affordable! This new deal offers an operating system that is much faster and easier to use than TRSDOS. Not only is DOSPLUS IVa itself very user-friendly, it also offers a built-in menu driving system, and of course, GREATLY enhanced BASIC. Other included features of DOSPLUS IVa are: Text Editor, Linker, Assembler; Directory Verification/Repair, Disk Mapping, and File & Disk Editing. As if that is not enough, you now also get MSCRIPT with your purchase of DOSPLUS IVa. That's right, one of the easiest and most convenient to use word processors goes with your purchase. Also, MTERM Smart Terminal (one of the best full featured TRS-80 terminal programs available) is included in this deal. In addition to all of the remarkable features of MTERM, it will also enable you to log on to local Bulletin Boards and tell your friends about this fantastic deal!

DOSPLUS IVa / MSCRIPT / MTERM Package Deal
Models 4/4P (List $329.85) $159.50

SUPERCROSS XT

Designed specifically for transferring data and program files between TRS-80 disks and those of other computers

Models I/III or 4 ..... $ 89.50
with Convert Basic option $ 99.50

T/Maker™

• WORD PROCESSOR • SPREAD SHEET- GRAPHICS • • DATA BASE • & MORE!

This integrated software package for the Models 4/4P, as well as for MSDOS, combines many functions to become one of the best software deals available for any computer. Included are Word Processing, Spread Sheet Analysis (which provide a full range of mathematical functions), Relational Database Management (allows merging, multiple selection criteria, restructure of DataBase, Multiple Sorting etc.), Spelling Checker (55,000 word dictionary, correction feature, ability to create personal and professional dictionaries), Bar Chart Graphics (created directly from SpreadSheet data and supported on any printer), and finally, Data Encryption. If you are worried about learning T-Maker, worry no longer. It has excellent documentation and comes equipped with a Tutorial on the disk. Not only is it a great program, but it is also at a great price!!!

Model 4/4P (List $299) $184.50
MSDOS version (List $450) $294.50

LE SCRIPT

Great printer support, full Model 4 support and much more! On a 128K Model 4, you can have over 90K of text buffer for use on a single file. Model 4 features available while running in Model III mode. By far LeScript is our most popular program!

Models I/III or 4 (List $129.95) $94.50

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LeScript and Electric Webster together!! Needless to say, these two great programs work excellently together!

W.P. Package (List $279.90) $199.50

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Includes 50,000 word dictionary. Features fast checking, interactive correcting and personal dictionary expansion. (Specify computer and word processor when ordering)

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Grammar or Hyphenation options (List $49.95) ..... Each $38.50

APPLICATIONS/BUSINESS

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Powerdot II	$ 34.50
POWERMAIL PLUS	$ 94.50
POWERMAIL PLUS w/Txt Merge	$124.50
LESCRIPT	$ 94.50
LESCRIPT CP/M	$149.50
LESCRIPT MS/DOS	$149.50
ZORLOF II	$ 49.50
MSCRIPT	$ 52.50
LAZYWRITER	$ 99.50
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PowerScript (New Version)	$ 34.50
PowerDriver	$ 24.50
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Electric Pencil w / Spell Check	$139.50
EDX Text Editor (Mod I/III)	$ 24.50
TEXTPRESS	$ 39.50
ELECTRIC WEBSTER	$129.50
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E.W. MS/DOS (Includes options)	$149.50
Datagraph with Pie Option	$109.50
Graphit	$ 34.50
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Howe's System Diagnostic	$ 89.50
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J & M's Disk Driver Analyzer - III	$ 74.50
ENBASE Data Base Manager	$ 64.50
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AFM (Auto File Manager	$ 94.50
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VersaLedger II (Models I/III)	$134.50
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INFOCOM

Better be careful out there... Infocom's latest adventure seems to be the phasing out of their TRS-80 line. We will do our best to keep these popular games in stock, but once they run out, they are gone for good. Hitchhiker's Guide is our first casualty!

"Standard Level" ..... Each $34.50

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Alcor C Compiler	$ 82.50
Alcor Multi-Basic Compiler	$ 82.50
Super Utility 4/4P	$ 69.50
Super Utility 3.2	$ 59.50
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PRONTO (Model 4/4P)	$ 54.50
Other MISOSYS Utilities each	$ 23.50
Edas / PRO-CREATE	$ 69.50
DSMBLR III / PRO-DUCE	$ 23.50
Edas/Dsmblr Combo	$ 89.50
DIS' n' DATA I/III	$ 37.50
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TASMON Monitor (Models I/III/4)	$ 34.50
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CNVBASIC (Models I/III/4)	$ 27.50
Model 4 TOOLBELT	$ 39.50
TOOLBOX for LDOS	$ 39.50
TRAKCESS (Mod I)	$ 19.50
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PRO-ESP Utility Set (Model 4/4P)	$ 23.50
6.2 Plus Enhancements	$ 36.50
Impakt Utility	$ 29.50
NEWBASIC w/Analyst	$ 34.50
Analyst only	$ 19.50
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PASCAL 80 Compiler	$ 59.50
PASCAL 80 for CP/M	$ 36.50
LC / PRO-LC Compiler	$114.50
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ACCEL 3/4 Compiler	$ 44.50
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MULTIDOS Version 1.7	$ 79.50
MULTIDOS (Model 4/4P)	$ 89.50

ELECTRONIC NOTEBOOKS

KSOFT

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SUPERLOG 3 (I/III)	$99.50
LOG (Model I)	$44.50
LOG (Model III)	$44.50

MONTHLY SPOTLIGHT

AFM

The brand new data base manager from PowerSoft. The key-word of this program is "FLEXIBLE". Free-form entry system allows you to enter your data any way you please. Consists of three modules: AFM (Auto File Manager), AFR (Auto File Reporter), and AFU (Auto File Utility). Features fully sorted output by all fields, fully relational, form letter output, relational lookup, mail labels, and much more. Probably the best Data Base Manager available for the TRS-80!

$94.50

CONVERSION PROGRAMS

BASIC 3 TO 4 CONVERT Model 4/4P ONLY (list $49.95)	$39.50
BASIC 4 TO 3 CONVERT Model I/III (list $49.95)	$39.50
BASIC GW CONVERT Model 4/4P ONLY (list $99.95)	$89.50
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POWERSOFT NEWSFLASH #4
** COMDEX REPORT **

Advertisement

Thank you for reading our latest installment of PowerSoft's Newsflash. Happy New Year! We hope you had a great holiday. This space will contain information that doesn't really fit into a regular advertisement. Please let us know your comments. We need to know if you like these little columns and if they are of value to you. We appreciate hearing from you. If you are a new TRS-80™ owner, welcome!

PowerSoft's Special COMDEX REPORT - Even though this NEWSFLASH is written for the February issue, it was actually written on November 25-28, just after we got back from COMDEX. Since this issue will probably appear at the end of December, we hope that most of this info will still be timely. The reason WE were there was to learn what was going to be happening over the next six months so that we can be better prepared to help YOU as new needs arise - networking, new graphic standards, higher capacity hard drives, etc. Like we've stated many times - we are not abandoning the TRS-80. We are expanding our area of knowledge for the future, but we'll still be doing what we do best - supporting the TRS-80, and now the MS-DOS TANDY line - like we have for the past six years.

New from TANDY - Of course by now you've read or heard about the TANDY 3000 - Tandy's answer to the AT market. Perhaps you've even gone down to the store and looked at one. In my opinion this was the hero of the show! It IS a real AT clone - except better in several ways. Main reasons I call it "better" are that it sells for about 40% less than a comparable AT, is 20% faster, and has more slots! It comes with 512K (may be increased to 640K on the motherboard), flicker-free graphics, and built-in onboard clock/calendar. The single 1.2 meg drive model is the entry-level system (holds 40 trk SS or DS). The 3000 starts at $2495 (a real bargain compared to the rest of the market). The deluxe model at $3595 includes a single 1.2 meg drive and an internal 20 meg rigid drive. A second 20 meg drive can also be mounted or another floppy if desired. We've got one on order...

We were very disappointed that the 4D was not anywhere in sight at the newly designed $200,000+ Tandy booth. After all, it IS a new model! The 4D is a REAL NEAT computer if you want to stay with the TRS-80 family and a very good value compared to TRS-80's prices previously. For those interested, there wasn't a Color Computer in sight either, but that's probably because the rumored new model isn't ready yet. There WAS a 2000 however, so I know that will make those people feel better.

Now configurations of the TANDY 1200??? On display at the TANDY booth was a dual thin-line floppy drive version of a TANDY 1200 with or without a hard disk! Never saw one of these before! Also a 1200 with a single full height floppy and no hard drive. As you know, the 1200 has always been sold in one configuration only - one full height drive with a 10 meg hard drive. I don't know if these were just done up for the show crowd or were new entries into the line at deadline time. I DO know that there is a new motherboard allowing more slots! This new set of configurations for the 1200, with or without hard drive (for those that want a REAL PC clone and want to build it up as they go), the 1000 and 2000 - again with or without hard drive, and now the 3000 (again floppy or rigid) makes TANDY a real contender in any marketplace. Whatever you want - they can supply it. I could not get a price on the floppy versions of the 1200 or an answer as to when or if they really might be available. I also couldn't find out much about any kind of plans for the 4D except; "it is available in the computer centers and selling fine."

If the only reason you might be thinking of changing to a PC is multiplexing (running several computers off a common hard drive), and you're happy with your TRS-80 and current software, then think again. Multiplexed Hard Drives for the TRS-80 are available from BI-TECH... While at COMDEX we had a chance to visit with Al Rosen of BI-TECH Enterprises. BT has been shipping their Multiplexor for over three years now, as well as a 10 meg cartridge tape backup. We've got a combination of 4's, III's, and I's hooked up to ours (up to 8 machines allowed) and have been running it for years very reliably. BT equipment include our special rigid drivers if specified. A few advantages of our drivers are smaller file allocation sizes, smaller amount of memory required, faster disk I/O, combining Mod III and 4 on same drive, and complete flexibility for custom configurations. Our drivers are available for Bi-Tech equipment, as well as for Percom/Aerocomp, RADIO SHACK 5, 15, and 35 meg, Hard Drive Specialists, and other systems using a WD-1000 type controller. Software Support Group is sanding us a drive soon, so support may be coming if possible...

Other random notes from the show... you MNET-80 old-timers certainly remember Richard Taylor. He created the SIG concept on the SOURCE and early days of MicroNET. We heard from a rep at the source that he was at the show. We looked for four days, but could not find Richard. We have a clue where he is, though, and will attempt to make contact with him. We'll leave complete details on our SIG when we do, and a brief note here when we can... Also met with Bill Louden, another early TRS-80 computerist, pioneer - now manager of the new GE Network. Their system looks good, and they DO have a TRS-80 section! We also met with Phil Manfield from CORNUCOPIA and we hopefully finalized ELECTRIC WEBSTER support of PowerSCRIPT 4.2. Mod 4 now. Maybe III and I later (up to Phil).

Attention SCRIPSIT™ and PowerScript users... New! We are publishing a reference guide to the ever popular SCRIPSIT™ program that contains easy to follow instructions on getting the most from SCRIPSIT™ for Mod I, III, or 4! Although not meant to replace Tandy's manual, it is complete enough to stand alone in its completeness. Explains all the mysteries and ends confusion on commands you never understood before! Contains lots of examples. Many pages actually are printed with SCRIPSIT so that integrity and clearness are maintained. Contains extensive index to the III manual (which doesn't have one). Please see our ad elsewhere for ordering info. REFERENCE MANUAL FOR SCRIPSIT™ applies to all released versions for Model I, III, or 4. - $7.95

We have a brand new Catalog #6! If you are not on our mailing list and haven't received one by now (blue cover), and would like one - please drop us a note or call and ask for one. Groups and clubs may write and request whatever number you need. We're here to help you, so if you have ANY questions please write or call. We know about PC's as well as TRS-80's. Adding a hard drive and have questions? We know hard drives inside and out. If you are a member of CompuServe™, we have a support SIG there that you can reach from any prompt by typing; GO PCS-56. Try it! If you can recommend our products to your associates, please do! Give them our address and suggest they ask us for a catalog. Please see our ad elsewhere here for descriptions of a few of our products. Thank you!

POWERSOFT

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page 29

page 21

page 36

Features

29. **The Model 4D: Tandy's 8-Bit Burro Gets a Boost** *by Terry Kepner*
Rating the revamped Model 4.

36. **The Numbers Game** *by Dave Rowell*
A primer on using numbers in Basic.

42. **Higher Mathematics** *by Merton L. Davis*
A calculator for those times when accuracy really counts. (Models I, III, and 4; Load 80)

44. **Putting Things Precisely** *by D.Y. Barrer*
Double precision for an octet of Basic math functions. (Models I, III, 4; Load 80; Models 1000, 1200, and 2000)

48. **Finding Your Roots** *by Roxton Baker*
The equation solver to use when you're solving more than one. (Models I, III, and 4; Load 80; Models 1000 and 2000)

60. **Sounds Incredible** *by Robert Anderson*
How to make your 4 sound better. (Model 4; Load 80)

66. **Macro Economics** *by Craig Chalken*
Custom macros for TRSDOS 1.3. (Model III; Load 80)

68. **Free the Tandy 14 (K)** *by Robert L. Smith and Dave Rowell*
Squeeze extra memory out of your Tandy 1000. (Model 1000)

84. **Hard Wares: Comparing Two Megamemory Hard Drives** *by Dave Rowell*
The lowdown on two low-priced drives for the 1000.

Departments

6. **Load 80 Directory**

8. **Side Tracks** *by Eric Maloney*

12. **Input**

14. **Feedback Loop** *by Terry Kepner*

21. **Pulse Train** *by Bradford N. Dixon*

25. **Reader Forum**

29. **Reviews**
The Model 4D
HIDRAW
Programmer, DOS-Help
The FastPak
Mailing List System
Unikey
PRO-ZShell

70. **Project 80** *by Roger C. Alford*

84. **Dave's MS-DOS Column** *by Dave Rowell*

88. **MS-DOS New Products**

94. **Basic Takes** *by Richard Ramella*

100. **The Next Step** *by Hardin Brothers*

108. **Spreadsheet Beat**

112. **Tidbit #33**

112. **Tidbit #34**

115. **Express Checkouts**
TRSDOS 6.2 Utilities
MicroZap
Lovejoy's Preparation for the SAT
Monte's Toolkit

120. **New Products**

128. **Fine Lines**

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.

Using Load 80 is simple. If you own a tape system, 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, copy the Model 4 programs from the Load 80 disk to your TRSDOS 6.X disk using the COPY 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.

If you have any questions about the programs, 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 $21.47 or on cassette for $11.47, including postage. To place a subscription order, or to ask questions about your subscription, please call us toll free at 1-800-343-0728 between 9 a.m. and 5 p.m. Or, you can write to Load 80, 80 Pine St., Peterborough, NH 03458.

Directory

Compress/Decompress
Article: Reader Forum (p. 25).
System: Model III, 32K RAM, Series I editor/assembler; Model 4, 64K RAM, EDAS editor/assembler.
Store Scripsit text files on disk economically.
Language: Assembly.
Cassette filespecs: COMPR3 (SRC), COMPR3 (CMD), DCOMP3 (CMD), COMPRS (CMD), DCOMPR (CMD).
Disk filespecs: COMPR3/SRC, COMPR3/CMD, DCOMP3/CMD, COMPRS4/SRC, DCOMPRS4/SRC, DCOMPRS4/CMD.

HiCalc
Article: Higher Mathematics (p. 42).
System: Models I, III, and 4; 16K RAM (Cassette Basic); 32K RAM (Disk Basic).
Calculate with accuracy up to 200 significant digits.
Language: Basic.
Cassette filespec: B.
Disk filespec: HICALC/BAS.

Double
Article: Putting Things Precisely (p. 44).
System: Models I, III, and 4; 16K RAM (Cassette Basic); 32K RAM (Disk Basic).
Get double-precision results for exponentiation and Basic math functions.
Language: Basic.
Cassette filespecs: C, D, E, F, G, H.
Disk filespecs: LOGRTHM/BAS, NATEXP/BAS, EXPDBLE/BAS, TRIG/BAS, ARCTANG/BAS, SQRROOT/BAS.

Solver
Article: Finding Your Roots (p. 48).
System: Models I and III; Model 4 with changes. 16K RAM (Cassette Basic). 32K RAM (Disk Basic).
Solve linear and nonlinear equations for their roots.
Language: Basic.
Cassette filespec: I.
Disk filespec: SOLVER/BAS.

Sound
Article: Sounds Incredible (p. 60).
System: Models 4 and 4P, 64K RAM; Edas editor/assembler.
An easy and efficient advanced sound routine.
Language: Assembly.
Cassette filespecs: J, K, SOUND (CMD).
Disk filespecs: SOUND/BAS, MUSIC/BAS, SOUND/SRC, SOUND/CMD.

Commando
Article: Macro Economics (p. 66).
System: Model III, TRSDOS 1.3 32K RAM; Apparat editor/assembler.
Create customized macros.
Language: Assembly.
Cassette filespec: COMMAN (SRC), COMMAN (CMD).
Disk filespecs: COMMANDO/SRC, COMMANDO/CMD.

Converter
Article: Project 80 (p. 70).
System: Models I, III, and 4; 32K RAM; 8748 Assembler.
Controller software for the serial-to-parallel converter.
Language: Assembly.
Cassette filespec: SERTOP (SRC), SERTOP (CMD).
Disk filespecs: SERTOPAR/SRC, SERTOPAR/CMD.

Life
Article: The Next Step (p. 100).
System: Model 4, TRSDOS 6.2 64K RAM; Edas editor/assembler.
Simulate the game of life.
Language: Assembly.
Cassette filespec: LIFE (CMD).
Disk filespecs: LIFE/SRC, LIFE/CMD.

Data Base
Article: Spreadsheet Beat (p. 108).
System: Models 4 and 4P 64K RAM; VisiCalc.
Use VisiCalc as a data base.
Cassette filespec: L.
Disk filespec: READER/BAS.

BAS = Basic SRC = source code CMD = object code

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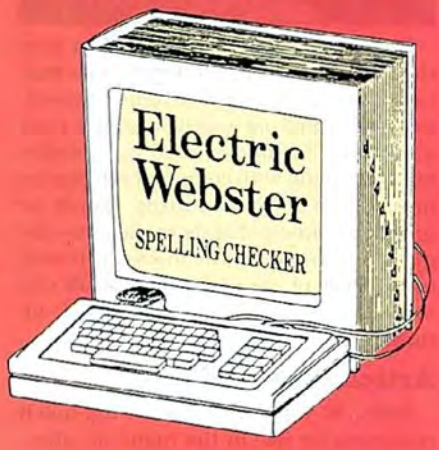

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Tandy 1000 New BMOC

Getting information on computer sales from Tandy is like trying to get a membership list from the Irish Republican Army. The only way to get a real idea of how various models are moving is to ask the stores, so that's what we did last fall. The results show that Tandy's MS-DOS machines are the overwhelming favorites these days, and are likely to be so in the foreseeable future.

We polled 100 randomly selected Radio Shack Computer Center (RSCC) personnel. Here's what we found:

- Some 88 percent say computer sales in 1985 were up from 1984.
- The Model 1000 is the best-seller in 79 percent of the stores, with the 1200 second at 11 percent. Other systems with a best-seller ranking were the 2000 (4 percent), 6000 (4 percent), Color Computer (1 percent), and 100 (1 percent).
- Seventy-one percent say the 1000 will still be number 1 in the fall of 1986.
- Eighty-three percent say IBM compatibility is important to Tandy sales.
- About 68 percent say the Model 4D has a bright to extremely bright future. The rest say the TRSDOS machine's future is dim or nonexistent.
- Eighty-two percent predict that Tandy's portables will become more popular.
- Some 94 percent say that third-party support helps their computer sales, and 80 percent say more such support is needed.
- Only 53 percent use Express Order Software (EOS) to obtain products for their customers, but 96 percent of that group say their customers like the service.

These results show conclusively that the Model 1000 has taken over the grunt work as Tandy's top-selling microcomputer. MS-DOS is no longer the future: It has become the present.

Fort Worth should take special note of the response to our questions regarding third-party support. RSCC managers believe emphatically that the company should open its doors to software firms.

History has already proven several times that a microcomputer manufacturer cannot be successful if it is not supported by an active, healthy third-party market. Unfortunately, while the Apple and IBM third-party industries were exploding, Tandy was neglecting, and in some cases discouraging, the many fledgling companies producing TRSDOS software. The results were disastrous—IBM and Apple thrived while Tandy wilted on the vine.

Photograph by Frank Cordelle

Tandy has shown during the last year that it does not want to repeat this mistake with its MS-DOS machines. It is selling more third-party software, has built a healthy EOS library, and is currently experimenting with computer magazines in the RSCCs. The company should be gratified to know that its managers—the guys out on the front lines—will welcome more of the same. The result can only be more happy customers and, ultimately, more sales for Tandy.

Articles Wanted

Many of you have written top-notch programs for use in the home or office. Some of you have perfected programming techniques to make your computing easier and more pleasurable. And we think it's high time you wrote it up for *80 Micro* so others can benefit.

Writing articles for us is easy. Let's say, for instance, that you've written a program for your business that you think others might be able to use. First, you write a letter to our Submissions Committee telling us what the program does and asking whether it's something we'd like to look at. We'll send you a reply, along with our writer's guidelines, which will tell you exactly how to submit your manuscript. It's as easy as that.

(If you want to read our guidelines before you query us about a specific article, send us a stamped, self-addressed envelope, and we'll send you a copy.)

We're looking for all kinds of articles right now, particularly for the Models III, 4, and 1000. We'd like to see some short, useful programs that will help businessmen and home users to be more productive. We're always in the market for science applications, and we never tire of good, original programming utilities.

We'd also like to see articles explaining to our readers how they can become better programmers.

Incidentally, we'll pay you for anything we publish—$50 to $100 per printed page, depending on the type and quality of the material.

Problems with Programs?

Having problems with a program published in *80 Micro*? Before you throw out your computer (or, worse, cancel your subscription), here's an explanation of how we process a program for publication, and how you can troubleshoot one if it doesn't run properly.

All of our programs go through our tech department several times for checking and debugging. We print out all listings on our NEC Spinwriter directly from disks provided by the authors, thus further decreasing the possibility of data entry errors. Thus, while we do not claim to catch all bugs (particularly errors in a program's logic), we manage to find most of them, and can guarantee with some confidence that our programs will run as published.

If you type in a listing and can't get it to run, first check the System Requirements box to make sure that the program is written for your system. You won't get a Model III program to run as is on a Model 4, or a disk-based program to work from Cassette Basic.

If you're getting syntax errors, check, double-check, and triple-check your code. You'll be amazed by how well typos can hide themselves. Some common errors include minus signs instead of equals signs, extra parentheses, and colons where semicolons should be.

If you still can't get the program to work, and are convinced that you are not at fault, write the author. Give the author a short description of your system. Be specific about your problem, explaining where the error occurred and what, if any, error messages you got. Send a copy of the program listing, marking where the program didn't do what you thought it would do.

Finally, if you want a reply, be sure to include a self-addressed, stamped envelope. ■

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36 more letterset disks are available separately. Each has 3–12 complete typefaces. The disks costs less than $25 each and you may purchase them at any time.

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If your VisiCalc spreadsheets are too wide for your printer, our "LONGVIEW" option may be just what you need. It is an add-on that turns spreadsheets sideways so that DOTWRITER can print them down the page instead of across. LONGVIEW comes with three additional fonts.

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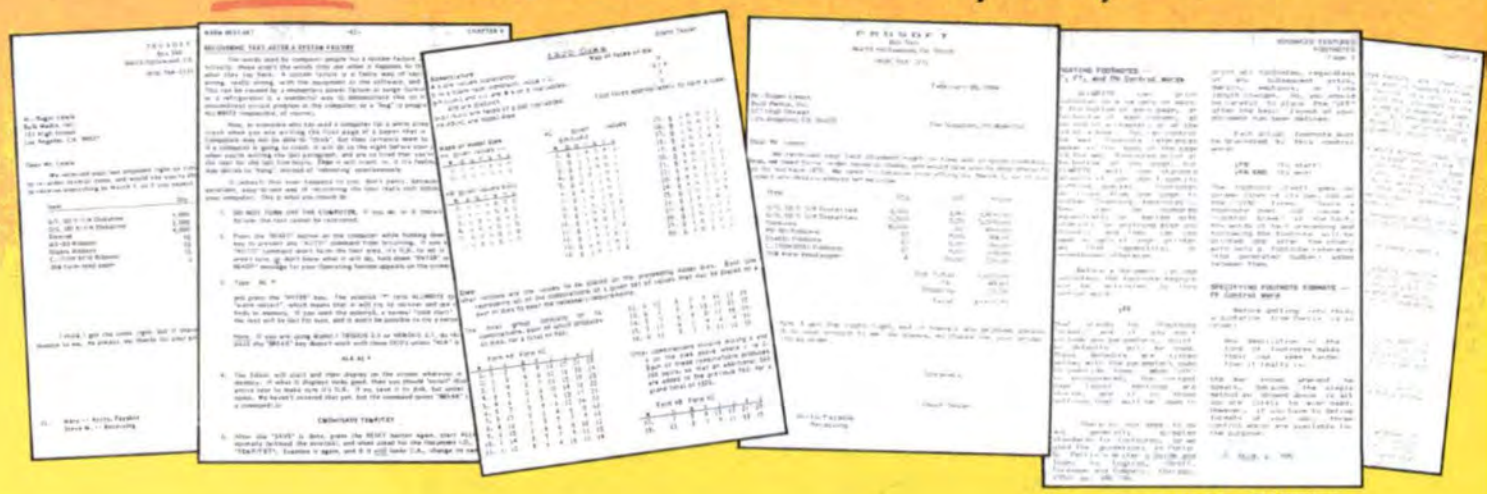

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ALLWRITE shows you where you forgot to turn off underlining, boldface, italics, or double-width. Special on-screen Preview feature shows page breaks and page layouts . . . including underlining and boldface. In "Summary" mode, ALLWRITE quickly flags formatting errors without wasting time printing all the text. These standard features make document preparation faster and easier than ever!

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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.

ALLWRITE's superb documentation will get you started quickly. 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 23 years, and understand the importance of good documentation.

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80 MICRO, Nov., 1984

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"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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And the Winner Is. . .

The contest for a better name for our xT.CAD computer-aided drafting software (Input, July 1985, p. 12) surpassed our wildest expectations. Over 200 entries flooded my office by the end of July. To all participants, many thanks.

The ideas ranged from honestly informative, such as Electric Draftsman, to pleasantly flattering, such as Terrific CAD. We particularly enjoyed the many cheerful proposals such as CADet, CAD Can, Cadillac, Caddy, Cadzooks, Fat CAD, Let-M-Draw, and Volks CAD. They brightened our deliberations and produced a unanimous runner-up: The Drafthorse by Frank P. Boimare III of Kenner, LA. But the winner is catchy, short, and unique, with a respectable technical ring to it: Datum by Ralph Vital of Riverdale, NJ. Both received a free copy of xT.CAD.

Will we change the name? Maybe, maybe not. After all, many contestants submitted as their first choice our own favorite: xT.CAD.

Chris Brozek
President, Microdex Corp.
Tucson, AZ

4D Deception?

I've had my Model 4D for some time now and I can tell you that the photo in your Pulse Train column (October 1985, p. 21) is not that of a 4D. First of all, the 4D is not a Radio Shack machine—it is a Tandy 4D and the name tags look quite different. Also, the 4D has an "extra" key between the clear and @ keys. This is a backspace key and is in the position of the left arrow on the original Model 4 keyboard.

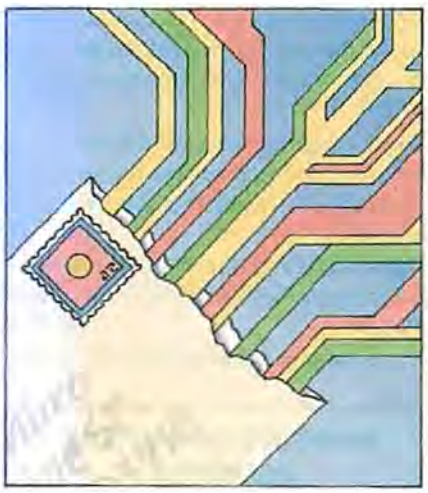
The 4D did not come with 128K of core memory as your article indicates; it came with 64K only, and the extra core memory costs extra, just as with the old Model 4.

James R. Primm
Paris, MO

The photo of a Model 4 was never meant to deceive our readers into thinking it was a 4D. The story contains information about both products and, at press time, no 4D photos were available. My source in Fort Worth made no mention of the new moniker for the machine or the rearranged keyboard.

You are right in saying that the 4D comes with only 64K and must be upgraded at additional cost to its full 128K capacity.

—Bradford N. Dixon



Staying Alive: 8-Bit Computing

The role of 8-bit computers in the world of 16-bit machines is open to question. One of the many areas in which the Model 4 shines is that of programming languages. It runs reasonably priced compilers for Pascal, C, Forth, and Lisp.

80 Micro readers may not be aware of all these compilers because some are available as CP/M versions only. The companies with CP/M compilers, Borland and The Software Toolworks, do not advertise in your magazine, but Alcor, which does advertise, offers CP/M versions of C and Pascal at a price much lower than the Tandy versions.

In some cases the Model 4 compiler is almost identical to its implementation on 16-bit and mainframe computers. I hope that *80 Micro* and its readers can keep 8-bit computing alive and well by showing the power of the Model 4 in the field of high-level computer languages.

Bennett D. Shulman
Lansing, MI

MS-DOS: Where It's At

Fredrick Keyser (Input, October 1985, p. 14) hit the nail right on the head [regarding MS-DOS]. I have subscribed to *80 Micro* for nearly five years, but I have now joined the MS-DOS ranks. I need a magazine like yours used to be for me with the Model III. Even Tandy has acknowledged that MS-DOS is where it's all happening by joining the ranks, whereas in the past they have stuck to proprietary operating systems.

It seems to me that only the diehards will stick with a more expensive, less powerful Model 4D until Tandy gives the thumbs down. I echo Keyser's cry: Get with MS-DOS (as the man says, no need to drop the Models I/III/4 coverage), expand, and recover the authority that was once *80 Micro*'s in the personal computing world.

Ray S. Preston
Rarotonga, Cook Islands

CADD Potential

The Rembrandt program listed in the September 1985 issue ("Drawing in Detail," p. 56) has made all my subscription money well spent. Jim Abbassian and Glen Sparks did an excellent job, and the potential of this program as a good computer-aided design and drafting (CADD) system for the Models III/4 is out of this world.

Someone should strongly encourage Abbassian and Sparks to develop this program into a full-blown CADD system so us poor folks could enjoy it. Keep up the good work and have fun.

Robert H. Aymar
Glenwood, MD

80 Micro's BBS is open 24 hours a day. It offers programs you can up- and download, special-interest groups, and a classified section. You can reach the board at 603-924-6985; UART settings are 300/1,200 baud, 8-bit words, 1 stop bit, no parity.

Send your letters to Input, 80 Micro, 80 Pine St., Peterborough, NH 03458. We reserve the right to edit letters.

Illustration by Mark Fisher

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FEEDBACK LOOP / by Terry Kepner

Send your questions or problems dealing with any area of Tandy/Radio Shack microcomputing to Feedback Loop, 80 Micro, 80 Pine St., Peterborough, NH 03458.

Q: Is it possible to use the new IBM Color-Jet Printer with the Tandy 1000? I've had this printer on trial for a couple of days and have used the initializing code IBM recommends (PRT 3852A), but I can't get the printer to accept the shift/print screen-dump command.

My chief interest is computer-assisted art. I have a CGP-220 but find its color reproduction capacities limited in comparison to the IBM. *(Carl N. Adams, Tucson, AZ)*

A: In four-color mode the Tandy 1000 is supposed to work exactly like the IBM PC, and you should be able to get a screen dump to the Color-Jet Printer. In higher color modes, the Tandy 1000 emulates the IBM PCjr. The IBM store I called didn't know if the Color-Jet Printer would work with an IBM PCjr.

You need to read Appendix G in your printer guide, and load and run the file PRT3852B from the disk included with the printer. This will set up the printer to accept the screen-dump codes the PCjr uses, and should take care of your problem.

If neither of these solutions works, you need to determine just what printer codes the 1000 sends from the screen-dump routine and devise a printer driver to convert these to codes the Color-Jet Printer can use. The Color-Jet Printer is capable of an eight-color spectrum if you mix the proper inks. If you want more colors, the printer won't help you.

Q: I have a problem getting my Diablo 1650 RO serial printer to work with a Tandy 2000 computer. I haven't been able to get the proceed (data set ready) light on the printer to go on.

I had a special cable made that was supposed to make the two machines compatible. The pin configurations on the new serial cable were the same except that pins 2 and 3 were reversed and pins 15, 17, and 22 were connected with pin 20.

I've talked to Radio Shack and they tell me the printer should run under MS-DOS using the Mode command. I tried the Mode command under MS-DOS versions 2.11.01 and 2.11.02 and haven't been able to get it to work.

Do you know what might be wrong? Do I need a special printer driver? I'm using the printer on a Model I with a UP1-3 serial printer interface from Binary Devices. *(Keith Edison, Winfield, IL)*

A: The first thing that strikes me is that your cable is wrong. You should switch pins 2 and 3 only when you link two computers. When connecting to a communications device such as a modem or serial printer, lines 2 and 3 go straight through. Your cable should be: 1–1, 2–2, 3–3, . . .7–7, 8–8, and 20–20.

Q: I have a Model 4P and have just received my copy of DOSPLUS IVA. Having used DOSPLUS 3.5, I find the new software easy to use—that is, except for a small /CMD file, More.

I read in an IBM ad that More.COM displays file listings one screen at a time. The utility displays "MORE" at the bottom of the screen and you press any key to continue.

I've tried this (typed in MORE < file name >) and all combinations I can think of. All that happens is that I get a "Program not found" statement or the disk drive whirs awhile and then goes off into limbo.

Is there a slight chance I might have missed something in the documentation, and if so could you tell me where to find it? *(Robert Kyle, Minneapolis, MN)*

A: The More file is explained in the tech support section of your DOSPLUS IVA manual, according to the people at Micro Systems Software. You use the More utility with the Pipe and Filter operations of DOSPLUS to make the display pause every 24th line and wait for you to press a key before continuing (just like the MS-DOS program, as you ascertained). Typing in MORE with a file name or by itself won't work. The proper syntax would be:

< DOS command > < SPACE > < file name > < PIPE symbol > < MORE >

For example, DIR < PIPE symbol > MORE would paginate the directory video display. The Pipe symbol is a broken vertical bar. See pages 1-21 and 1-22 (the Pipes and Filter section) for an example of how to use this command.

Hope that helps, and good luck.

Q: This concerns the letter from Carlos H. Matos (June 1985, p. 16) about NEWDOS/80 1.0 and the Radio Shack double-density adapter. NEWDOS/80 1.0 doesn't support any double-density operation. When you add the Radio Shack double-density adapter to a Model I, NEWDOS/80 1.0 will no longer work.

Apparat has a patch for this problem. All you need to do is contact us and ask for zap 64 for version 1.0, and we'll send it out at no charge. You'll have to remove the adapter if you want to apply the patch yourself. This problem doesn't exist with the other double-density adapters available, such as the LNW Research, Aerocomp, or Percom doublers.

Zap 64 will have nothing to do with double-density operation—it'll just get Matos working again with the doubler present. If he wants to get double-density operation, he will have to get either NEWDOS/80 2.0, LDOS, MULTIDOS, DOSPLUS (as you stated in your reply), or just use TRSDOS 2.8 included with the doubler. *(Brian L. Uitti, NEWDOS/80 Support, Apparat Inc., Denver, CO)*

A: Thanks for writing.

Q: I plan to buy a 256K Tandy 1000 with two drives, a 9-inch monitor, and internal modem and I want to begin investing through the stock market. Can you tell me which is the best type of modem to purchase, which is the best telecomputing service to subscribe to, and what pertinent programs are available for the Tandy 1000?

Half of the August 1985 issue of *Family Computing* was devoted to telecomputing programs available for analyzing investments, financial data bases, and

Illustration by Mark Fisher

The Amazing A-BUS

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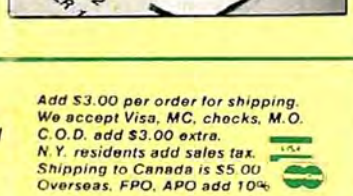

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on-line stock brokers. Unfortunately, all of the investment software listed applied to Commodore 64, IBM PC, and Apple computers. *(Anthony DeVito Jr., E. Patchogue, NY)*

A: Don't worry—the Tandy 1000 is an IBM PC clone. This means that most of the software developed for the IBM PC will work on the Tandy 1000 as well. The only exceptions are certain graphics-oriented machine-language programs, but even most of these will run on the 1000, as long as you have enough memory for the program.

If you want to make sure that the software will run, check with your local Radio Shack Computer Center to see if the software you want is available through their Express Order Software (EOS) system (software manufacturers test all EOS programs before Tandy lists them). Do your research beforehand and then check with the store to see if the manufacturers are in the Tandy EOS system. If they aren't, call them directly and ask if they have any Tandy 1000 customers you could talk to to find out if they foresee any problems.

Q: I recently bought the Model III high-resolution (hi-res) board from Radio Shack, then attempted to install it myself. Although the board came without instructions, I was able to obtain a copy of them and I installed the board exactly as the instructions said.

But when I turned on my system, drive 1 lit up, drive zero didn't light up, the reset button didn't work, and I heard a clicking noise from the power supply. I turned off the computer and replaced the old cables in their original positions. The system seemed to work fine.

When I tried printing this letter on my word processor, I found out something is sending my computer the "Printer busy" signal. Do you know what could be wrong? *(John L. Dauphiny, Bellingham, WA)*

A: According to my Radio Shack technician, installing the hi-res board on a Model III is quite an ordeal: Making things fit is hard. The board comes with a new radio frequency interference (RFI) shield and the tolerances among the main printed circuit board, the hi-res board, the RFI shield, and the back of the computer are quite close.

You may have done something wrong. On the main logic board you remove one integrated circuit (IC) pin and jumper it to another (ground). From the clicking coming from the power supply, it sounds as if you cut and grounded the wrong pin, possibly the 5-volt line. With the ICs as closely packed as they are, it's possible that you cut the pin on the wrong chip, or jumpered to the wrong chip.

The pin you cut is an enable pin. It controls the input of the input/output (I/O) bus (normally prohibiting access to the bus by the hi-res board). Because you're playing with bus I/O chips, if you have the wrong chip or pin, you might ground out one of the printer data or status lines. You need a technician to take a good look at your computer. Sorry I can't be of more help.

Q: I've owned a 48K two-drive Model III for about four years, and I've been using a Radio Shack Line Printer VII with it. It was slow, but OK for a starter. Recently, I acquired a Star Micronics Delta-10 printer (parallel interface). It does all kinds of nice things, but unfortunately it does them only while in Basic and then only if I've run the driver that Delta's manual provides for "problem" codes.

If I don't run the driver, all LPRINT and LLIST commands hang up. When under TRSDOS 1.3, I can't print anything. That includes DIR(PRT), LIST(PRT), Dual, SuperScripsit, Profile, and any machine-language programs I've written that involve printing. The library commands and my programs hang up and I must reset. The commercial software displays a "Printer not ready" error message.

Star's technical support says the problem lies with TRSDOS. My Radio Shack Computer Center "thought" it was a printer port and replaced it for $125.

Thanks for any help you can give me. *(Tom Clay, Pottstown, PA)*

A: What you need to do is install the driver program in high memory as a protected routine before attempting any printer output. All the DOS routines use the device control blocks in RAM to send data to a printer. If the DCBs point to your driver program in high memory, then all printer output will go through your driver program first. Contact a local TRS-80 user's group and try to find a machine-language programmer to convert the program supplied by Star into a DOS program you can load at the start of every computer session.

Q: I bought a Datamaster data base program from Microcorp of Philadelphia. It comes with the LDOS system on the same disk and is single-sided, 40-track, double-density. The disk is an auto-boot: it starts configuring, prompts for initials, date, and so on, and then displays an error code 2, "Directory read error." Following instructions, I can get into the LDOS system on this disk without error and I tried to format both single- and double-sided disks. The directory shows the data backed up, but both back-up disks give the same error.

I sent my computer to Tandon to be checked and everything seemed to be OK. At the local Radio Shack store the Datamaster boots up and loads OK on a Model 4 in Model III mode. Can you define the problem for me? *(John D. McCormack, Federal Way, WA)*

A: You may have a slight drive alignment problem, or your drives may be very dirty and in need of cleaning. First, put the disk in drive 1 with a system disk (say one of the back-ups, so you still have the same DOS) in drive zero. Now try to read the disk. Try backing up the disk with the original in drive 1 and the blank in drive zero.

If you continue to have trouble, try a single-drive back-up in drive zero, then in 1. If you still can't get a good load, try making a back-up at your store, using their machine (since you say the program works there, you shouldn't have any problems getting a good disk).

If that also fails, you have a problem with your disk drive head. It's too weak to properly read a marginal data sector on the disk, and it's also too weak to write a reliable one itself. You might have to replace it.

Q: I bought a Model 4P in May 1985 and am having trouble accessing direct-access files opened on disks from my Model 4. I have a system disk in drive zero and the Basic program with the direct-access file in drive 1 on the 4P. When I try to retrieve an individual record using the Get statement, the computer stops and I can't press any key to get anything to respond. To start again, I must press the reset button, which of course means I lose the data I typed in.

I sent the 4P to the service center. They replaced the logic PCB (AX-9500) and said the alignment on the two drives was OK. When I got the computer back, I tried the Model 4 disks, and it still didn't work. I bought a disk drive analyzer, and the 4P passed the radial alignment, disk speed, disk clamp, and write/read tests.

I tested the Model 4, and the radial alignment test failed for drive zero, but drive 1 passed all the tests. The Model 4 disks work on my Model 4 and also work at my local Radio Shack Computer Center. Sometimes I got a "No disk in drive 1" message using the Model 4 disks in my 4P by typing in SYSTEM "CAT:1" from Basic.

I took the Model 4 disk for drive 1, purged the data file, and used the Create command to create a new file using the 4P. This time I could retrieve an individual record with no problem. Would the radial alignment in drive zero of my Model 4 affect the data writing/reading in drive 1, which in turn disabled my 4P

from getting a record from the Model 4's data file? Or is my 4P still not working right? I am using TRSDOS 6.2. *(Lyn McAllister, New London, IA)*

A: It sounds as if the two disk drives are aligned differently from each other, but close enough to pass the alignment test used on the test disk. I'm told that the alignment disk is quite generous in what it defines as "good" alignment. If one drive is at one edge of the test track and the other is at the other edge, they will both pass, but they won't read each other's data. The only solution is a more stringent alignment.

The head amplitude of the drives affects this situation. A strong amplitude will compensate slightly for the misalignment (except, perhaps, to take a few extra spins of the disk to pull off the data). The problem could be either with the 4P or your original Model 4.

Q: I need information on how to upgrade my Model 4 from 16K to 64K or from 64K to 128K. In the 128K conversion, I know you need a PAL (program array logic) chip in C72. What is done to C72 in a 64K upgrade? What speed chips are ideal? *(Roy Hoff, Altoona, WI)*

A: First, remove the 16K chips from their sockets. Next, clip out the capacitors beside the sockets labeled C68–C96. Change the jumper pin settings to these specifications: E2-E3, E4-E5, E11-E12, and add jumper E7-E8 (with the exception of this last one, the jumpers are connected to other positions for 16K chips). The jumpers remove the 12-volt line from the chip sockets so that the new 64K chips don't get zapped. Plug in the 64K chips and that's all.

Upgrading from 64K to 128K is simpler: Remove the DIP (dual in-line package) shunt and replace it with the PAL chip, plug in the 64K chips, and that's all there is to it.

Q: I have a Model I Level II with the Exatron Stringy Floppy (ESF) and an Epson RX printer. I've been thinking of upgrading to a Model 1000 or the 4D. Can I use my Epson printer with the 4D? It uses parallel connections.

More important, would it be possible to use the ESF with the 4D or the 1000? It uses the same cable as the printer. This would save me from retyping a lot of programs. Also, I could use my word processor, The Electric Pencil. *(James C. McCord, Fairbanks, AK)*

A: Your Epson should work as well with the 4D as it does with your Model I. The Exatron Stringy Floppy won't work on the Model 4D because the driver software for it doesn't exist. The ESF for the Model I uses a small 2K cache of ROM for its operating system. This cache took advantage of a "hole" of unused addresses between the end of Level II ROM and the start of RAM. The Model 4D uses this "hole." Plugging in the ESF will cause problems.

To use the Exatron you need to write a driver software routine that tells the 4D how to use it and where it is in ports addressing. Sorry, but I don't know of anyone who has done that.

Q: I liked the idea of using Memdisk in association with a host function ("The Perfect Host," September 1985, p. 41). My problem is that I am using LDOS 5.1.4 in a Model III and two Lobo Max-80s. Do you know of a Memdisk look-alike for 5.1.4 that I can use to access excess memory? The Max-80s both have 128K.

I'm already using one computer as a host and another in a Basic program to create a totally operator-free system to transfer files late at night using LMODEM. I'm working on nonautomatic transfers controlled from a Model 100. *(Tony Sowers, Halfway, OR)*

A: I, too, have a Lobo Max-80 with 128K. If you're interested in a Memdisk for these machines, write to Logical Systems Inc. (11520 N. Port Washington Road, Mequon, WI 53092, 414-355-5454) and ask for their Memdisk program. It sells for $39 plus $1 shipping and handling (with prepayment).

For more information about the Lobo computers, write to MAXIMUL, Box 19525, Orlando, FL 32814, where you will find a club of like-minded enthusiasts.

Q: I have a 64K Model 4 and a 48K Model I. In the August 1985 issue (p. 14), William Kirksey asked about transferring Radio Shack's MicroChess to disk. The first problem to overcome is that the program cassette is really two programs. The first is a loader and the second is a data file read and stored in memory by the first program. The data file program is what Kirksey is after.

I used the loader program to get the MicroChess program into memory so I could download it back to tape as a stand-alone program. I did this by using RSM-2D, which read in the loader program. After it's in memory, you must change the last jump in the loader to pass control back to RSM-2D instead of the MicroChess program.

After you modify the loader, it passes control to load MicroChess into memory. You must obtain the starting location on MicroChess from the code of the loader, the byte count (length of the program), and the starting point (the old jump that you modify). In using these three addresses, you can dump memory back to the tape using the RSM-2D Punch command.

When MicroChess is on tape as a true program file, you can transfer it to disk. I didn't stop here but modified MicroChess to load above DOS and save and load the game progress to disk.

A few points about doing the transfer: First, the loader is the key. It holds all the information you need to make the modifications. Second, MicroChess reads the menu at the end of the program directly into video memory. This is a second program modification you have to handle. I did so and appended it so MicroChess could call it during game play.

For complete details on the modifications and transfers, have anyone interested contact me and I'll help them as best I can.

In the same issue (p. 17), Lawrence Kiefer asked about upgrading to disk on his Model I. I want to sell my Model I keyboard, interface, and monitor, and also a lot of Model I software. *(John H. McMurtry, Thornton, CO)*

A: Thanks for the tips on transferring MicroChess. If anyone wants to contact John H. McMurtry about his modifications to MicroChess, write to him at 3751 E. 122nd Ave., Thornton, CO 80241. And John, I've forwarded your equipment offer to Lawrence Kiefer.

Q: Of the DOSes I use, only NEWDOS/80 gets the file length correct with Scripsit. Both MULTIDOS and DOSPLUS make the file length one sector too long. LDOS makes the file length so that it includes all of the last sector regardless of where the file ends in that sector.

This file-length error causes all kinds of problems when I'm using programs that read the file length from the directory to find the end of file (EOF). Also DOSPLUS, MULTIDOS, and LDOS can't even properly list their own Scripsit files. They list a bunch of garbage on the end every time, because even the DOSes look at the directory to locate the EOF.

I need a patch to make MULTIDOS, DOSPLUS, and LDOS state the file length correctly. It may be hopeless with LDOS, but for MULTIDOS and DOSPLUS it should be fairly easy. *(Edward O. Noble, Mesilla Park, NM)*

A: The problem isn't entirely with the DOSes; Scripsit doesn't use the standard method to determine where to put the EOF in a sector. For some reason, the Scripsit author decided to use his own way of deciphering the EOF byte count in the sector.

I don't have any patches available that do what you want, but maybe someone out there has a solution for this problem. ■

Terry Kepner is a freelance writer and programmer who has been writing about microcomputers since 1979.

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*** 4-STAR Review - July 1985 issue ***

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-George Antunes, Oct.'85 *80-MICRO*

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Do you have problems with "protected" disks on your Tandy 1000, 1200, 3000, IBM, or other PC compatible? *We don't mean trading software,* but making archival backups of your purchased MASTER disks and running your protected business applications from your hard disk. We have a program called *COPY II PC* that will handle these tasks for you. *COPY II PC* will backup most protected PC software. It also makes using your hard disk as convenient as it was designed to be! No longer will you need to use a "key disk" on most software (applications - not games). You can run directly from your hard disk with *NOKEY,* included with the *COPY II PC* package. Insert NOKEY in your BATCH file for fast, easy, automatic execution of your "protected" applications.This is sold for making archival backups of your own purchased software for your own use or running from your own hard drive only. TANDY 1000 requires memory card because of needed DMA chip that resides there.
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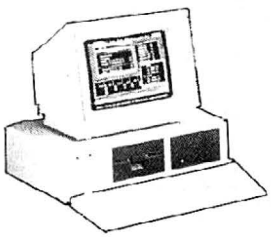

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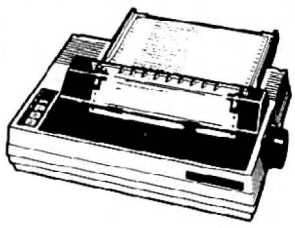

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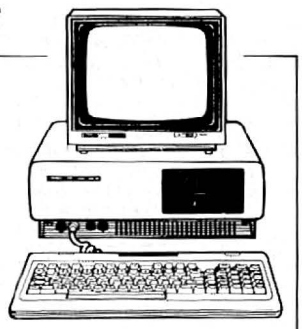

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Tandy's New Contenders: One Heavyweight, One Bantam

Tandyland

Fall is the traditional time for computer product introductions, and Tandy kicked off the 1985 season with two unveilings: one expected, the other a surprise. The anticipated machine, a high-end IBM PC AT clone called the Tandy 3000, rounds out Tandy's IBM-compatible line (see Photo 1). The surprise was a laptop called the Tandy 600 (see Photo 2), a product some insiders considered too kludgy to bring to market (see Pulse Train, December 1985, p. 21).

Photo 1. The Tandy 3000.

At first glance, the Tandy 3000 appears to be a strong entry in the race for the title of "Best PC AT Clone." It uses an 80286 processor (the same type found in the AT), has 10 expansion slots (of which eight are available in the standard configuration), and supports the CM-1 high-resolution monitor Tandy introduced with the Tandy 2000.

The stripped-down 3000 gives you 512K of RAM and one 1.2-megabyte floppy drive for $2,599. Add a 20-megabyte internal hard disk and the price jumps to $3,599 (see p. 22 for more on the 3000).

Like Tandy's other portables, the 600 has a liquid-crystal display (LCD) and comes with ROM-based software. It uses LCD and disk-drive technology that wasn't cost-effective when Tandy introduced the Tandy 200 a year ago.

The 600's 80-character by 16-line screen might disappoint some potential buyers, since 24 lines are now the industry standard. But as Tandy's buyer for the machine, Stewart Weinstock, put it, "We'd rather come out with a machine that has a readable screen than one that we'll have to replace when the LCD technology we want becomes available."

Also disappointing is the fact that the 600 isn't a true MS-DOS machine. It runs on an IBM-compatible 80C88 CPU, but without screen compatibility you'll find running MS-DOS applications difficult, if not impossible.

The 600's price is also a surprise. In its base configuration of 32K RAM (expandable to 224K), five ROM-based firmware programs (but not Basic), and a built-in 3½-inch floppy drive with 360K of storage capacity, it will cost you $1,599. It will be interesting to see if Tandy puts its "Advanced Technology Series" tag on this one. (For a detailed rundown of the Tandy 600's features, see the sidebar on p. 22.)

Fiscal quarter ending:

	Sept.	Dec.	Mar.	June
1985	41.7	NA	NA	NA
1984	37.4	76.6	21.9	53.2
1983	59.7	101.2	62.6	58.4

NA = not available

Table. Tandy's quarterly net income (in millions of dollars).

More Tandy hardware news: The company will not produce a thin-line Model 100/200. Buyer Weinstock said Tandy did consider a new, thinner design, but felt that the redesign would force an increase in prices.

Weinstock told me that Tandy would make no changes in the 100 or 200 line for at least six months to a year. Both machines continue to sell at rates acceptable to Tandy, though sales are somewhat less than what Tandy expected when it introduced the machines.

Tandy is similarly adamant about supporting the Model 4. Though Weinstock, also Tandy's Model 4 buyer, admits that the Model 1000 has affected the 4's sales, the 8-bit machine remains popular, particularly in the education market. The 4 also does well with small businesses. The consensus is that the Model 4 remains in Tandy's plans for the next 12 to 18 months.

Tandy's financial health was looking better as the 1985 Christmas sales season approached. In the first quarter of fiscal 1986, which ended in September 1985, Tandy showed an 11.5 percent profit gain. The news was especially welcome after Tandy's significant drop in profits in fiscal 1985 (see Pulse Train, December 1985, p. 21).

Tandy's net income for the quarter rose to $41.7 million from $37.4 million a year ago (see the Table). The improvement is due, in part, to the popularity of the Models 1000 and 1200. However, Eugene Glazer, an analyst with Dean Witter Reynolds, says sales have improved in "traditional" areas of Radio Shack's consumer electronics business as well.

Photograph supplied by Tandy Corp.

The Tandy 3000 at a Glance

Vital Statistics:

- 16-bit 80286 Intel microprocessor; motherboard supports an optional 80287 math coprocessor.
- Standard configuration includes 512K RAM, 20-megabyte hard disk, and one 5½-inch, 1.2-megabyte floppy drive for $3,599.
- User-selectable floppy for 1.2-megabyte compatibility or 720K format for Tandy 2000 compatibility.
- Second internal floppy channel for a 360K drive or another 1.2-megabyte floppy drive.
- Configuration can incorporate two floppy drives and a hard disk, or one floppy drive and two hard disks.
- Ten expansion slots accommodate IBM PC AT cards (though only eight are available).
- Seven IBM PC AT slots (one used in standard configuration).
- Two IBM PC XT slots.
- One IBM PC XT half slot (used by standard serial/parallel adapter).
- Standard 84-key IBM-compatible keyboard.
- Dimensions: 6.5 inches high
  19 inches wide
  18 inches deep
- Standard real-time clock with CMOS RAM and battery back-up.

Compatibility and operating systems:

- Depending on configuration, compatible with the IBM PC, XT, AT; and the Tandy 2000, 1200HD, 1000, and 1000HD.
- Runs MS-DOS 3.1 with DeskMate and Basic ($99).
- Xenix 5.0 (including multiuser DeskMate available March 1986).

Notes:

The suggested monitor is Tandy's high-resolution CM-1 monitor. However, the machine also supports other IBM-compatible monitors.

Total memory availability on the main board is 640K, although you can expand the 3000's RAM up to 15 megabytes of memory using optional, third-party memory expansion boards.

The 80286 CPU runs at 8 megahertz.

Dennis Young, Tandy's buyer for the 3000, describes it as a machine for "power users." The computer's case is metal, similar to the 1200HD's, and the keyboard cord is "industrial strength" heavy.

Internally, the machine has a replaceable filter in front of the cooling fan, with "shock mounted" hard disks to prevent head crashes due to vibration during shipping or moving.

Though Tandy says the keyboard is IBM-compatible, some key locations differ from those of IBM machines and Tandy's other MS-DOS keyboards. One obvious difference is the absence of a break key. To exit a program on the 3000, you must press the control-C key combination.

The version of DeskMate that comes with MS-DOS 3.1 looks the same as the Tandy 1200HD version, but it runs much faster on account of the processor's 8 MHz operation ■

Photo 2. The Tandy 600.

The Tandy 600 at a Glance

Vital Statistics:

- Standard 32K CMOS RAM expandable to 224K with 96K upgrade kits ($399 each).
- Built-in 3.5-inch floppy drive with 360K capacity.
- Flip-up 80-character by 16-line LCD.
- Internal 300-baud auto-answer/auto-dial modem.
- Low-power, 16-/8-bit 80C88 CPU.
- Features include:
  - Standard RS-232C port
  - External floppy disk drive port
  - Parallel printer port
  - Full-feature keyboard
  - Built-in NiCad batteries and charger (lasts about 11 hours on a charge)
- Optional ROM slot allows use of custom applications by removing the Multiplan ROM.
- Built-in multipurpose clock.
- Sleep function to save battery life.
- Basic ROM is optional.

Onboard Firmware:

- Microsoft Works, the 600's system manager. It acts as a simple operating system to allow file manipulation in RAM and on disk.
- Word, a word processing program that's closely related to Microsoft Word, though not exactly the same. Word features right justification, global search and replace, automatic page numbering, and more.
- Calendar, an appointment book program that includes an alarm function.
- File, a simple data base manager similar to PFS:File. You can use it to construct data bases for addresses, expenses, inventory, or to maintain a phone book for auto-dialing from Telecom.
- The Tandy 600 version of Telecom features auto-dial/auto-answer capability, a wake-up command that allows automated telecommunications, a host mode, and XMODEM file transfer protocol. With proper programming, Telecom can activate itself at a designated time, call a remote host, upload or download files, save downloads to RAM or disk, and exit the remote host.
- Multiplan, the on-board spreadsheet, made its portable debut on the Tandy 200. In the 600, Multiplan is mounted in the optional RAM socket so you can replace it with a Basic ROM or other special applications ROMs.

Notes:

The Tandy 600's base price is $1,599 for the 32K version. Tandy left Basic out of the package in the belief that it's the ROM program users want least. The optional Basic ROM costs $129.95.

Printer cables, RS-232 cables, and telecommunications peripherals used on the Model 100 and Tandy 200 are compatible with the Tandy 600. However, the disk/video interface and Tandy's new portable disk drive aren't compatible with the new laptop.

At introduction time, Tandy had no plans to introduce an external drive for the 600, although the machine has a port designed for an external drive, or develop disk-based software or ROM firmware. Stewart Weinstock, buyer for the 600, says Tandy will look to third-party manufacturers to cater to users' needs. ■

Photograph supplied by Tandy Corp.

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Addenda

Several readers have modified programs to suit their needs and systems. Danny C. Mullen of Monterey, CA, found that he could get Joseph Gandreau's **custom character generator** ("Belles Lettres," December 1984, p. 87) to work on the **Gemini 10X printer using TRSDOS 1.3**. The solution is as simple as adding lines to two of the listings. First, change line 2510 of Standard/DVR to read: 02510 :LD C,0. Then insert a Call LPRINT line directly after it. Make the same changes between lines 3640 and 3650 of Double/DVR. You must also modify the Dump commands in the Basic listings to reflect the addition of the extra lines.

N.A. Douglas wrote from Ottawa, Ontario, saying that the **NovaCalc spreadsheet** ("NovaCalc," January 1985, p. 82), which runs under Model I/III Disk Basic, also works on **Model III Cassette Basic** if you rewrite the Load routine (lines 1670–1840) and Save routine (lines 2020–2230) using INPUT# – 1 and PRINT# – 1 commands. To effect Howard Potvin's decimal-point fix for NovaCalc (Reader Exchange, July 1985, p. 25), make the changes shown in Program Listing 1.

A.C. Baldwin, who currently resides in Madinat Al-Jubail Al-Sinaiyah, Saudi Arabia, used disk drive 1 to get what he wanted out of two programs. When he tried to follow directions for Doug Iford's **tape-to-disk transfer utility, Tapedisk/BAS** (Load 80, April 1985), Baldwin encountered a snag. The instructions specify that Tapedisk/BAS, Basic/CMD, and TPSRC/CMD must be on the same Model III TRSDOS disk. Unfortunately, TPSRC is on Radio Shack's EDT-ASM disk; you can't copy it because the disk is protected. To get around the problem, change line 670 in Tapedisk/BAS to read TPSRC:1, and put a back-up of EDT-ASM in drive 1. With Tapedisk/BAS and Basic/CMD in drive zero, and TPSRC in drive 1, the program works fine.

Baldwin also notes that David Williams' **disk zapper** for the Model 4 ("Zap Master," April 1985, p. 62) will **zap Model III disks** in drive 1. Put the zapper in drive zero and tell it you want drive 1, track 17, sector 00. Be patient; after a few seconds, the program reads the Model III disk. You can then use the semicolon key to find the part of the directory you want to view or change.

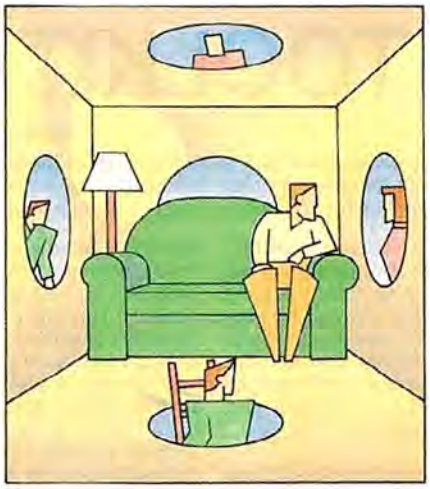

Illustration by Mark Fisher

Back Talk

Author Cameron Snyder reports that several people have expressed interest in **adapting Times2** ("The Great Divide," August 1985, p. 62) for use with **DOSes besides LDOS**. One reader, Kris Van Hoecke of Ertvelde, Belgium, suggested a patch for lines 260–280 of the source code (see Program Listing 2). His changes accommodate DOSes with an exit value of less than 52H.

However, as Snyder points out, you might also need to change the address 4300H in lines 2410 and 2450 to ensure that Times2 will function properly using your DOS. Because programs use the disk I/O buffer only during disk I/O, Snyder chose this area to perform screen transfer during a partition switch. In LDOS, the disk I/O buffer resides at 4300H–43FFH; certain DOSes—TRSDOS 1.3, for example—use a different area. Failure to modify lines 2410 and 2450 can cause destruction of part of the operating system during partition switching.

Postscript

The extra SuperScripsit text-storage space made available through Steve Woicik's modifications ("Storage to Spare," June 1985, p. 54) spurred Texan Patrick H. Larkin to add a couple of housekeeping refinements. To **reduce directory clutter**, insert (inv) in the back-up command in Scripsit/JCL, thus making /CTL SuperScripsit files invisible. Adding (inv,mod) to the back-up command in Exit/JCL lets you both back up invisible files and speed the exit process by restricting back-up to those files changed in the current session.

Larkin does have one question, though. In his experience, using the type-ahead feature of TRSDOS 6.X doesn't seem to improve keyboard response. He wonders whether there's a way to speed response using SuperScripsit 01.00.01 for the Model 4.

Drat

L.L. Millar's alternative to Raymond Boggs' scroll protection program for the Model 4 (Reader Forum, November 1985, p. 25) contains two errors. In the Forum's Program Listing 1, line 220 should read GOSUB 1020; the sequence PROTECT-VARPTR in line 1010 should be PROTECT = VARPTR.

Kris Van Hoecke has been busy. On discovering a minor bug in Stewart F. Hunter's compression program for the Models I/III ("Room Available," June 1985, p. 60), he fixed the error, added improvements, and wrote listings for the Model 4. In Hunter's Compress, a problem arises if one of the four most frequently used characters is lower than 10H (only 0DH, a carriage return, is likely to occur that often). Van Hoecke's fix switches any such value with the value of the fifth most used character.

The changes are too long to include here, but the revised listings for the Models I/III and the versions for the Model 4 are available on our BBS (603-924-6985) and this month's Load 80 (see p. 6).

Program Listing 1. Decimal-point fix for Model III Cassette Basic.

```
1960 IF$="D"THEN1975
1975 SS=12-LEN(D$(R,C)):SS$=STRING$(SS,32)+D$(R,C)
1980 LPRINTUSING$;SS$;:LPRINT" * ";
```

End

Program Listing 2. Patch for Times2.

```
260      LD      A,51H
270      CP      H
280      JR      NC,CONT
```

End

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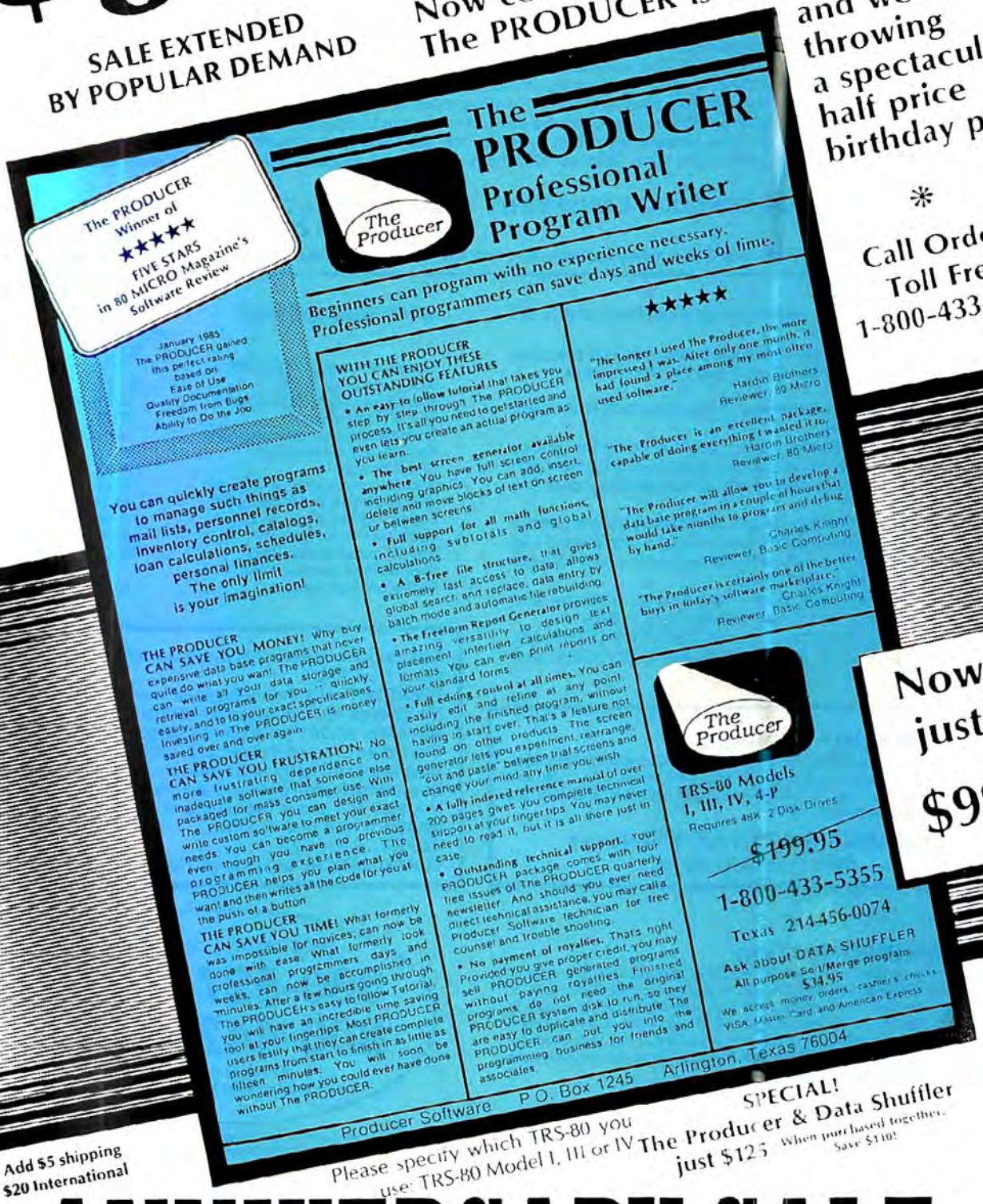

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The 4D and its predecessor share much in common: 64K base configuration (expandable to 128K), RS-232 port, Centronics-compatible parallel printer port, 12-inch green screen monitor, cassette port (500/1,500 baud), and a 70-key keyboard (with numeric keypad, three multipurpose function keys, and directional arrow keys).

Cosmetically, the differences between the two machines are minor. The Model 4D's disk drives, while occupying the same two slots to the right of the video monitor, are mounted slightly lower in each compartment and have a different type of twist latch handle. A new backspace key sits just above the enter key, about where you find the left-arrow key on the Model 4.

If you examine the rear of the computer, Tandy repositioned the RS-232 connector so that it points out toward the back instead of down toward the table top. A label on the bottom of the case clearly identifies the different connectors at the rear of the computer and the video contrast/brightness controls.

The real differences are inside the computer. The 4D has a redesigned main circuit board that uses fewer integrated circuits, and the disk drives, now from TEC, have a solid, meatier tone than the earlier Tandon drives. I prefer them.

Software Statistics

Tandy made some changes to the Model 4D's software, too. Not only do you get TRSDOS 6.2.1 (the 6.2 upgraded for double-sided drives), you also get the DeskMate integrated software that includes a word processor, spreadsheet, data base manager, telecommunications, calendar, and mail programs.

The DeskMate system lets you select information from any one module and move it into another. While DeskMate is easy to use, it is both large and slow. It's a good sampler package for beginners, but experienced computer users will probably want more sophisticated commercial packages (see the DeskMate review, January 1986, p. 31).

Tandy has also changed the 4D's Basic. Previous versions incorrectly rounded the decimal portion of a number when going to integer or displaying numbers with the Print Using command. This version of Basic (01.01.01) correctly rounds decimals of 0.5 or greater up, all others down.

The 4D maintains compatibility with the Model 4: it reads old Model 4 cassette tapes and runs Model III programs. (However, PFS: Report and PFS:File aren't recommended for upgrading to double-sided drives, because their copy-protection feature defeats that upgrade.) It also runs at the same speed (4 MHz) as the Model 4.

While the 4D comes with the new TRSDOS 6.2.1, you can still use the older DOS (6.2). The only penalty is that you can't use the second side of the drives without reconfiguring the DOS. The primary difference between the two is that Tandy has already configured 6.2.1 to use double-sided drives. The various filters, drivers, and utilities that came with TRSDOS 6.2 are on 6.2.1.

While you can switch from a 6.2 disk to a 6.2.1 disk without rebooting, you shouldn't switch the other way without a reset (6.2 will have great difficulty trying to use the double-sided disks and could crash them).

Optional Extras

The upgrade options are generally unchanged from the 4: You can add two external disk drives and a hard disk (the 4D includes a hard drive initialization disk with TRSDOS, as did the later versions of the Model 4). Tandy also offers an internal hard disk controller to run their 10-megabyte external hard disk.

Like its predecessors, the 4D has a slot for the internal high-resolution graphics board and room for memory expansion.

Conclusion

The Model 4D is a simple upgrade of the Model 4, which has been consistently refined since Tandy introduced it. The changes are minor, but are the result of Tandy's listening to their critics.

The original Model 4 underwent quite

Photograph supplied by Tandy Corp.

a few changes. It had the left-/right-arrow keys over the enter key, with the up-/down-arrow keys over on the left side. Each production run since then has added another refinement: Tandy rearranged the keyboard, putting the arrow keys in a cluster; changed the video monitor from black-and-white to an easier-on-the-eyes green screen; and revised the internal main circuit board several times, each time using fewer chips than previously.

And finally, Tandy upgraded the 4D to double-sided drives and bundled software. Through all, Tandy maintained compatibility with previous versions of the Model 4.

The Model 4D is for those who need an inexpensive and dependable desktop computer, but don't want the expense of hardware and software associated with an MS-DOS system. The $1,199 price is fairly competitive with other Z80 computers with bundled software, but is still a bit high. On the other hand, getting service for a Tandy computer is easier than it is for other machines. Personally, I would go for the 4D, even if it is more expensive. ■

COUNTERPOINT

Will the Model 4D be the last in Tandy's line of 8-bit computers? I certainly hope not. While the 4D offers only a few enhancements over the Model 4, it has great potential. But whether Tandy will recognize that potential or let the 4D twist slowly in the wind is another matter.

The 4D's double-sided drives are the best thing about the machine. With so much disk capacity, you needn't make any compromises as to which files you keep on-line and which you relegate to a data disk. But when you fill up a disk and need to scroll through eight or nine directory screens, you might wish for a directory manager of some sort.

The green screen is a sight for squinty eyes, with much brighter characters and a nice non-glare finish. It compares quite favorably with a monochrome monitor.

I could do without the realigned arrow keys. While I can see the need to cluster them, my particular word processor calls for clear/arrow-key combinations nearly impossible to perform on the 4D without severe digital contortions. However, my fingers had no problem hitting the backspace key, since they thought it was the left-arrow key anyway.

How long will the Model 4D last? Well, just as it looks darkest for the continuation of the Model 4 line, some exciting enhancements are available. Tandy has a Model 4 hard disk controller you can use with their external 10-megabyte drive. Someone will probably offer a 10- or 20-megabyte hard disk in the spacious full-size drive slots. And you can now install a third-party memory upgrade to get a fast RAM disk; applications currently available use that extra memory.

Over the next six months, the 4D will either live or die, based on its showing vis a vis the three A's (Atari, Amiga, and Apple), Tandy's support, and the marketplace.

—Ryan Davis-Wright

The Model 4D offers definitive, though unspectacular, improvements over the Model 4. I really like the double-sided drives, since each can hold 360K versus the Model 4's 180K. Considering the amount of disk space required for TRSDOS 6.2.1 and Basic, the additional disk space is almost essential.

The half-height drives use full-height faceplates, leaving a lot of empty space in there. Two double-sided, half-height drives and a hard disk or four double-sided, half-height drives would make the 4D a powerful computer.

On the positive side, the drives provide faster disk input/output.

The other changes, the green screen and clustered arrow keys, showed up on the last version of the Model 4 and are more aesthetic than practical. They're also subject to personal opinion. At least the 4D has the backspace key where it belongs.

The 4D manual is small and easy to handle, providing you have good eyesight or bifocals, as the print is smaller than that in the 4's reference manual. There are some changes, such as blue emphasized print and clarified statements. Otherwise, page for page it's the same manual.

The section explaining how to convert TRSDOS 6.X to 6.2.1 is easy to follow, as is the section on copying from single- to double-sided disks.

Lastly, I think third-party vendors could do well supporting this machine.

—Beve Woodbury

HIDRAW: Simple System for Detailed Drawings

by David Engelhardt

★★★½

HIDRAW runs on the Model 4 (64K) and requires the Radio Shack high-resolution graphics board, BasicG, and two disk drives. T. Soft, R.D. 5, Box 120, Kittaning, PA 16201. $49.95.

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

As the popularity of TRS-80 high-resolution (hi-res) boards increases, so does complementary software. HIDRAW, a Model 4 hi-res drafting and design program, sports a number of features useful in creating and manipulating detailed drawings. And since HIDRAW acts as interface between you and BasicG, you don't have to learn the BasicG system, only HIDRAW's simplified command structure.

HIDRAW lets you create line drawings, move pictures, draw to scale, and tint designs in 26 different monochrome shades. It also supports commands to draw straight lines, boxes, circles, arcs, and arrows. You can mix text and graphics on the same screen, and even magnify sections of a drawing.

While HIDRAW is versatile, moving its cursor manually is slow and it supports only the Radio Shack DMP-400 or -420 printers.

Function-Key Drawing

HIDRAW boots up with its drawing mode inactive. You move the cursor to any point on the screen and invoke the drawing commands to start work.

HIDRAW's cursor resembles a flashing cross hair, and it appears within a circle called the start mark. When you move the cursor, the start mark stays behind, denoting the outer extremity of the figure (or the center of a circle) you're about to draw. You can then draw lines, circles, and boxes between the start mark and the cursor using the appropriate keys. You can also swap the cursor with the start mark by pressing the space bar, or disable the cursor with the F key. If you disable it, all you'll see on-screen is a small reference dot.

Unfortunately, manual cursor movement occurs at one slow speed only. While this facilitates detail work, I found it exasperating when I wanted to draw something quickly over the entire screen.

Fortunately, HIDRAW is versatile in

cursor movement. You use the 4's keypad, in conjunction with the clear key, to quickly reposition the cursor on-screen. The number key you press determines where the cursor goes on-screen. For example, if you pressed clear/1, the cursor would go to your screen's lower left-hand corner. Clear/5 centers the cursor on-screen, and so on. With this system, you can quickly move the cursor to one of the screen's four corners, the left or right center, top or bottom middle, or screen center.

You determine the X,Y coordinates of the current cursor position on-screen by pressing the period key. You can quickly move the cursor to a different section of the screen by pressing the clear key and entering horizontal and vertical screen coordinates.

It's a Draw

HIDRAW uses all the 4's function keys to control drawing. F1 draws black on white (reverse video), F2 white on black, and F3 lets you move the cursor without drawing. You must press the appropriate function key before drawing boxes or circles. These keys make the cursor flash at different rates, indicating what mode you're in.

HIDRAW differs from other drawing packages in that you use the numeric keypad, rather than paired arrow keys, to move the cursor (with or without drawing) in 45-degree increments. For example, pressing the "9" key moves the cursor at an angle of 45 degrees from the horizontal, "4" moves it 180 degrees, and so on.

You can select one of 26 paint styles, or paint freehand, with a choice of eight brush sizes.

You can move without drawing, or draw lines and circles in a specified direction by pressing the shift key along with a keypad key. You specify the distance, in inches, of the figure; you can enter fractions of inches for highly detailed work.

The arrow keys draw arrow tips on-screen in the appropriate direction. You create the four types of box corner with the combination of shift/less-than, shift/greater-than, clear/less-than, and clear/greater-than keys. The box corners help anchor hand-drawn shapes.

Not only can you create standard boxes and circles, you can draw parts of circles, arcs, and other shapes by entering a radius value along with start and ending degree values with the advanced circle command.

Once you draw a circle or arc with the advanced circle command, you can use the arrow keys to change its shape. The down-arrow moves the top and bottom of the circle together while the up-arrow moves the left and right sides together.

The HIDRAW package includes a plastic grid in the shape of your screen, with reference numbers along the vertical and horizontal axes, and a water-soluble felt-tipped pen so you can plan a drawing before you start working with HIDRAW. HIDRAW displays a corresponding grid on-screen, which you can turn on or off, so you can easily transfer your design to the screen.

Other Features

Filling in enclosed designs is easy, too. You start automatic painting by selecting one of 26 paint styles. When you position the cursor over the area you want to paint, press the "P" key to display the available shades at the bottom of the screen. You can also paint freehand, with a choice of eight "brush" sizes.

HIDRAW produces drawings in a selected scale in inches or fraction of inches. You can change scales at any time. For example, if you specify a scale of ½, then a line drawn as one inch will actually measure ½ inch.

You can magnify areas of the drawing from one to four times. While the manual indicates this is primarily used for text, it seemed to work well with parts of the hi-res display. You can even magnify images at a slant. In any case, be prepared to wait as magnification takes some time to complete.

You enter text by hitting the "T" key,

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★★★ Good;
★★ Fair;
★ Poor.

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Easy to use: How easy is it for the new user to use the hardware/software/book?

Good docs: Is the documentation clear and helpful in explaining the product's use and anticipating user problems?

Bug free: Did the reviewer encounter any bugs while using the product?

Does the job: How well does the product do what it was designed for?

F1	Draw black	Shift-F1	Memkey (start/stop)
F2	Draw white	Shift-F2	Recall memkey
F3	Move without draw	Shift-F3	Grid overlay (on/off)
B	Draw box	Control-A	Put rectangle AND
C	Draw circle	Control-B	Move cursor back to start
D	Disk directory	Control-E	Erase screen
F	Flash cursor (on/off)	Control-G	Get rectangle area in memory
H	Help menu	Control-L	Select line and box style
L	Draw line	Control-O	Put rectangle overlay
P	Paint	Control-P	Put rectangle area
R	Recall drawing from disk	Control-R	Put rectangle reverse color
S	Start of line, box, or Get	Control-S	Select scale of drawing
T	Type text at cursor location	Control-X	Put rectangle XOR
W	Write drawing to disk	Control/.	Drawing to printer
0	Grid coordinate (on/off)	Space bar	Switch cursor and start mark

Clear/ # = Move cursor to selected position
Shift/ # = Draw direction specified length
Shift- 5 = Radius, start, end, shape
Clear- 0 = Go to grid coordinate
. = Show cursor location
M 1-4 = Magnify rectangle area
MS 1-4 = Magnify and slant rectangle area

Figure. HIDRAW help menu.

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and a box window offers four directions in which you can print text. You select the direction by entering a number from zero to 3 and start typing in your text at the current cursor position. You finish by hitting the enter key. The only problem with entering text is that if you make a mistake, you have to retype the entire line again.

HIDRAW supports Get and Put commands to move specified portions of the display to and from memory. Once the chosen section is obtained via the Get command, you may put it back anywhere on the screen with options of using logical operators, reverse video, and overlay. The maximum area allowed for the Get function is an area equal to one-fourth of the screen.

HIDRAW includes a help menu (see the Figure) that you can call by pressing the "H" key. It also supports disk functions such as displaying a drive directory and writing to or reading from disk.

You have six printout options, including the number of characters printed per inch, and a doubled Y axis with or without 90-degree rotation. If you're not satisfied with the results, the manual suggests trying the printer dump modules on the BasicG disk.

HIDRAW has a useful function, Memkey, for automating and saving commands. Memkey works like a command do-file, with each command executed in order. You can save the commands used to create pictures or symbols to disk and retrieve them later. You could also use this to draw complicated designs or symbols a number of times on the same display.

You get five Memkey files on disk that perform functions such as screen reversal, outlining text in a rectangle area, and moving your drawing in four directions in 1-inch increments. You can make the Memkey file as large as you want. The only disadvantage with Memkey is that you can't add or edit the files without the use of a line or screen editor.

Conclusion

HIDRAW's manual is clear and to the point, with many helpful examples. The package includes a plastic-laminated quick-reference card.

I have only a couple of complaints. First, the slow cursor movement is a drawback. It would be more convenient to have variable cursor speeds for moving and drawing around the screen. This would make it easier to create drawings without having to use the command keys.

The second problem is its printing ability. HIDRAW is only guaranteed to print on two of Radio Shack's printers. It should support many of the printers currently on the market. ■

Help Through the MS-DOS Maze

by Richard Ramella

★★★★½

Programmer runs on the Tandy 1000/1200 (256K) and requires one disk drive. T-System Software, P.O. Box 9449, Washington, DC 20016.

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

★★★★½

DOS-HELP runs on the Tandy 1000/1200 (128K) and requires one disk drive. Soft-Help Inc., 1550 Industrial Park Drive, Nederland, TX 77627, 409-724-0142.

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

You're on a roll, writing a great program. Some tenuously held concept is roosting in your mind and you're putting it on the screen at 200 characters a minute. But wait. What's the syntax for the Circle command? The reference manual is. . .somewhere under a pile of magazines. That's just the kind of situation that can break anybody's flow of creativity.

Programmer and DOS-HELP, two memory-resident programs for the Tandy 1000/1200, neatly remedy the problem of getting help quickly. They provide on-line information on GW-Basic and MS-DOS, respectively, at your beck and call.

Programmer

Programmer is a video version of a programmer's reference guide. With it resident in RAM, pressing alternate/1 brings up a window menu that coexists on-screen with your program listing. You can move the window around the screen using the arrow keys to better see program lines or, once you memorize Programmer's commands, make it invisible. Programmer offers a Basic Reference Guide, a DOS reference with 52 entries, an ASCII table, instructions on running Programmer, and a table of contents on Basic procedures (entering Basic, logical operators, special symbols, hexadecimal numbers, variables, and the like). The sixth option exits the program and takes you back to your listing.

The Basic Reference Guide offers 159 Basic words on-screen. You move among them with the arrow keys to highlight the command of interest and press the F4 key for more information. A new screen appears, providing the command's syntax, purpose, and the versions of Basic that support it, along with examples and remarks. If you need more information, you can press another key for supplemental data or cross-references.

Writing a program with a reference source so handy facilitates coding, and even experienced programmers will benefit from it. However, I found setting up Programmer tiresome. In fact, most of the seven pages of documentation deal with installation. If you have a single-drive system, the procedure is even more irksome; you have to make scores of disk exchanges. Thankfully, you have to do this only once and it results in a disk that boots DOS, accesses Programmer, and takes you into Basic.

DOS-HELP

DOS-HELP truly speeds up the process of learning MS-DOS. It's a compendium of easily accessible information on your MS-DOS 2.X system. If you're a novice computerist, you know that your DOS disk has a number of different programs on it. But unless you've diligently read through the DOS manual, you're probably still in the dark as to what some of these programs do. That's where DOS-HELP comes in.

The program displays three windows. The first lists 35 DOS commands. You scroll through the entries with the up- and down-arrow keys and press the return key for your selection.

Pressing the F2 or F3 keys activates the other two windows. Window 2 presents the command's syntax and purpose, and window 3 expands on this with examples and a few helpful hints. With any window active, you can use the up- and down-arrow keys to scroll through the information in it.

DOS-HELP's 13-page documentation is simple to understand. I especially liked the subject index, which briefly outlines the effects of commands. When you need answers, you want to know how to do something, not a command name. It's easy to read through DOS-HELP's subjects and see if a particular command fits your need. How to make a start-up disk? Use the Format command. How to see what's on a disk? DIR. How to check computer memory? CHKDSK.

Conclusion

As I used Programmer and DOS-HELP, I realized that GW-Basic and MS-DOS contain so much information that I grow hazy on certain aspects of them. Happening by chance onto a lucid explanation of some point serves not only as a reminder of the tool but as an inspiration to use it appropriately. I appreciate both programs. ■

Circle 85 on Reader Service card.

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FastPak: Mail to the Max

by Gary Ludwick

★★★★½

The FastPak Mailing List System runs on the Model 4 (64K) under Montezuma Micro CP/M 2.2 and the Models 1000/1200 (128K). It requires one disk drive. DHA Systems, 832 Jury Court, San Jose, CA 95112. $79.95.

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

You might find it hard to justify buying software that handles only a single, limited task, but if that package does its job better than anything else that's available, it's worth it. FastPak is such a product—it does the ho-hum chore of generating and printing mailing lists so well that I can give it an unqualified recommendation. In addition, FastPak can merge list names into form letters and sort lists according to criteria you set.

Set-Up and Go

If you're running an MS-DOS system, FastPak's ready to go when you get it; you just copy its files to a system disk.

CP/M owners (specifically Model 4 owners with Montezuma Micro's CP/M 2.2) have a little more work to do. Through a series of menus, you format FastPak's display for your system, then copy FastPak's files to your system disk.

FastPak's beauty lies in its simplicity. You type in MAIL from DOS Ready and FastPak asks for your mailing list file name. It then either opens an existing file or creates a new one. (For those of you with existing mailing lists, DHA's Convert utility makes converting data simple.)

Once FastPak finds or creates a file, you can choose to input new records, scan current records on-screen, delete records (FastPak ignores the record but doesn't erase it), condense all deleted records and update each record's number, print mailing labels, print a list of the entire file, correct individual fields within a record, or return to DOS.

FastPak greatly simplifies creating a mailing list by providing a predefined template with all the fields in place and ready for data. The fields comprise last name, first name, company name, address, city, state, zip code (five-digit), phone number (10-digit), and reference code. They should suit almost anyone.

Entering data into the template is straightforward, and pressing the enter or return key automatically takes you to the next field. In addition, a macro character at the end of each field automatically shunts you to the next field if you overwrite the character. Each record holds up to 128 bytes of information.

As you enter data in a record, FastPak automatically assigns it a number. When you delete a record, FastPak adjusts the record numbers accordingly.

You use FastPak's four-character reference code to sort files. You can also tag each name in the mailing list with a code to help select specific types of names for retrieval during sort and print operations.

Manipulating the Mail

The FastPak Mail System has a number of utilities that greatly enhance its use, including those to sort, combine, select, and merge records.

Sort manipulates your list by four different criteria: alphabetically by last name, alphabetically by company name, numerically by zip code, or alphabetically by reference code. And it is fast—if your file fits into available memory, FastPak sorts it in one pass.

Combine lets you merge mailing list files with each other. Because of FastPak's file structure, this is the only way you can merge files together.

Select pulls records by zip code, state, or by various combinations of reference codes. When used with Sort, your retrieval possibilities are almost endless.

Dupe Names scans your list for duplicate listings (based on the last-name field) and presents them to you for deletion.

Most impressive of all is Merge. It combines mailing list files with a form letter your word processor generates. All you have to do is insert special codes in the places where you want to put names, addresses, or phone numbers, and FastPak automatically does all the dirty work for you.

Merge lets you further customize form letters by inserting entire paragraphs at designated points in a form letter. You do so by creating different paragraphs and storing them as disk files. When you want to incorporate one, you include the name of the file in the letter and Merge retrieves and inserts the paragraph. In addition, you can have FastPak make a disk copy of each letter you send out. You can also pause the program during printout to input information on the fly.

FastPak prints mailing labels up to four across with a simple utility file to record your own particular tab settings and line lengths.

Conclusion

One aspect of the CP/M-based FastPak system that annoyed me was exiting to DOS to use FastPak's utilities.

I probably wouldn't have bought a mailing list system for personal use, but now that I have one, I wouldn't part with it.■

Keyed-In Basic

by Mark D. Goodwin

★★★★

Unikey runs on the Model 4 (64K) and requires one disk drive. The Alternate Source, 1806 Ada St., Lansing, MI 48910. $19.95.

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

As anyone who's ever typed in a Basic program listing knows, it's a tedious business. Many programmers use a shortcut, called a macro utility, to enter frequently used Basic key words (commands, for instance) with a single keystroke. Although TRSDOS 6.X provides such a utility, KSM/FLT, you have to define your own macros. And KSM stores only 26 macros at a time, offering minimal assistance. To overcome these shortcomings, Unikey provides 85 predefined Basic key word macros and three programmable macros in an easy-to-use system.

Installing Unikey

Like KSM, Unikey is a TRSDOS 6.X keyboard filter. You install it and execute Basic by running Unikey's JCL (job control language) file. During installation, Unikey asks if you want the optional help file installed. If you do install the help file, you can get a complete display of the Unikey macros by pressing shift-@.

After you execute the JCL file, Basic comes up in normal command mode; you toggle Unikey on or off by pressing control-B. With Unikey on, you have 85 Basic key word macros at your disposal (see the Table).

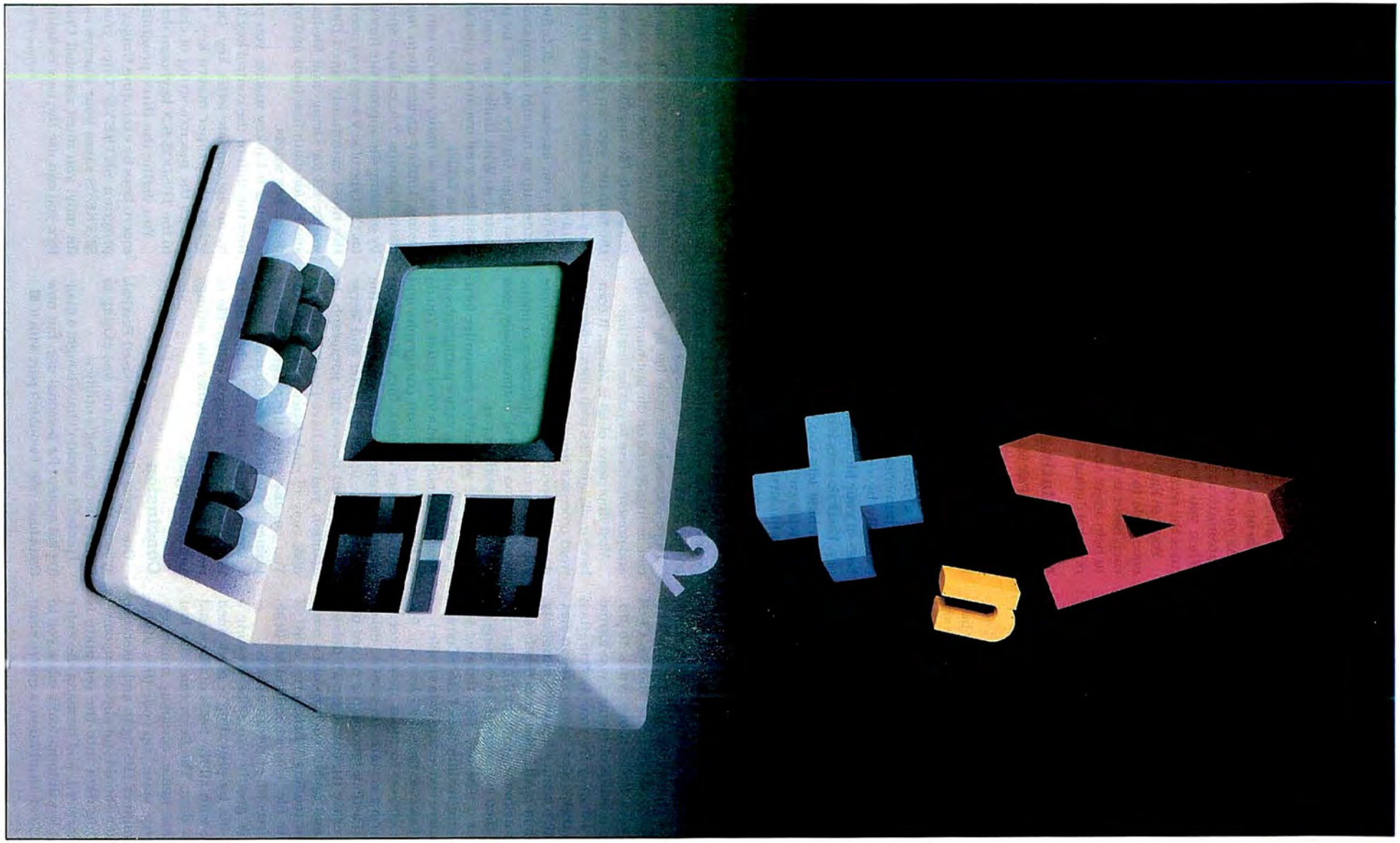
Because so many macros can be confusing, Unikey divides them into three distinct groups. You call up a specific set by pressing the appropriate function key for the type of key word you need: F1 for the most commonly used Basic key words; F2 for string- and file-handling; and F3 for math functions and miscellaneous key words.

To use a Unikey macro, you press either the shift or the control key followed by an appropriate letter key. Once you select the proper macro key, Unikey passes the macro's string of characters to the TRSDOS 6.X keyboard driver.

You define the three programmable macro keys by executing Unikey's Basic program SETKEYS. Once you do so, SETKEYS saves your macros as a disk file only; you must reinstall Unikey before you can use the new definitions.

Continued on p. 115

3-D illustration by Phil Geraci Photograph by Ed Judice



THE NUMBERS GAME

by Dave Rowell

See what Basic does to your numbers when you're not looking and find out how to get the precision you want.

What you don't know about numbers *can* hurt you. To design number-crunching routines that return accurate results, you need to know how Radio Shack Basic handles numbers. Unfortunately, that information is scattered throughout your Basic manual. Not that you shouldn't read the manual, but I'll tie it all together for you here. I'll also let you in on a few things the manual doesn't tell you.

I'll start easy with the basics of number types, then move into arithmetic operations and accuracy. If you're curious, you can learn how Basic stores numbers internally (your curiosity will reward you if you plan to write machine-language subroutines).

My explanations apply to the Microsoft Basic found in most Tandy machines: the Models I, III, and 4, and the newer MS-DOS computers, too. I'll detail the minor differences that affect program conversions among the different machines.

Type-Casting

TRS-80 Basic provides three number types—integer, single-precision, and double-precision—for different programming purposes (see the Table for examples). You can best use integers (whole numbers), the simplest number type, as counters in loops or indexes in arrays. Basic integers take little space (2 bytes), and process faster than the other number types. Small storage size, however, limits their range from −32,768 to 32,767. They're not suited for operations like division or trigonometric functions, where you'll get fractional results.

Single-precision numbers are floating-point numbers, those usually displayed with a decimal point. They have a much wider range than integers (-10^{38} to 10^{38}) and can express fractional values as minute as 10^{-38} (a 1 preceded by the decimal point and 37 zeros). Floating-point numbers can have normal decimal form (e.g., 1.34324), but Basic represents small and large numbers that would squander memory in exponential format (scientific notation): −1.2345E12 represents $-1.2345 * 10^{12}$, 1E−9 is $1 * 10^{-9}$, or 1 billionth.

Single-precision format, though it can represent numbers with many digits, is accurate to only six digits. The 4 bytes Basic uses to store a single-precision number is only enough to keep track of a number's sign (positive or negative), its exponent (the power of 10 to which it's multiplied), and seven decimal digits. Only the six most significant digits are accurate.

You can use single-precision numbers to represent integer values, but they take more space and more time to process than integers. They work best in noninteger calculations requiring speed but not high accuracy. Basic defaults to single-precision values for numbers and variables unless you specify otherwise. You do so by declaring variables' types in a program or by adding a type specifier to a number (more about this later).

Double-precision numbers are also floating-point numbers, with the same range as single-precision (-10^{38} to 10^{38}, fractions to 10^{-38}), but they're accurate to 16 digits. Higher precision comes at the price of larger storage size (8 bytes) and slower calculations. Basic represents double-precision numbers like single-precision numbers, but with more digits.

Double-precision exponential format uses a D (for double) instead of an E (for exponent) to mark the power of 10. Basic represents exactly 1,000,000,001 as 1.000000001D9. In this example, Basic displays only 10 digits, but keeps six more zeros after the last one in memory (plus a 17th digit that isn't accurate). If a number has no trailing zeros, then Basic displays 16 digits.

(If you need more than 16 digits of precision, you'll want to read "Higher Mathematics" [p. 42, this issue] to learn how you can store multidigit numbers as strings and perform arithmetic operations on them, maintaining up to 200 digits of precision.)

You can test the range of your computer's Basic by attempting to print out very large or very small numbers with a Print statement. If a number exceeds Basic's upper limit, Basic displays an overflow error message. A fraction too small to represent internally becomes zero. The Figure shows the limits I found, through trial and error, on the Tandy 1000.

The Models I, III, and 4 produce similar results for the upper limit (one less in the 17th and last digit entered). The 4's smallest fraction is similar to the 1000's, but the Models I and III recognize fractions no smaller than around 9.41D−39.

These limits vary among machines because of differences in the algorithms that translate between the base-10 format you use to work with numbers and the binary format your computer uses. The storage formats themselves are the same from computer to computer (I'll discuss details below).

Good Usage

Proper number programming begins with clearly specifying the types of variables and numbers with which you want to work. It's best to define program variable types right at the beginning of a program with DEFINT, DEFSNG, and DEFDBL (and DEFSTR for string variables) statements. The statement DEFINT I-N, for example, defines any variable starting with the letters I through N as an integer variable.

You could add the symbols %, !, #, and $ (for integer, single-precision, double-precision, and string variables) to the end of variable names to set or override any DEF statements. The variable IG# is a double-precision variable, even if you specified the

System Requirements

Models I, III, 4, 1000, 1200, and 2000
Basic

letter "I" as integer in a DEFINT statement. A! and A# represent two different variables, one single- and one double-precision. Basic assumes that undeclared or unlabeled variables are single-precision.

Setting the variable type is only half the story. If you're interested in accuracy, you must also specify numbers' types when assigning them to variables. Assigning a number to a double-precision variable without specifying its type can cause you grief. If you type in:

```
A# = 1.3
PRINT A#
```

Basic displays:

```
1.299999952316284
```

while typing in

```
A# = 1.3#       '(or A# = 1.3D)
PRINT A#
```

produces the correct result, 1.3.

Because most decimal fractions don't have exact binary equivalents, Basic approximates them as best it can. In the first instance above, Basic represents the unspecified 1.3 internally in single-precision format (the default) before storing it in the double-precision variable A#.

In the first instance, Basic approximates 1.3 to only six digits of accuracy. It then stores that 4-byte representation of 1.3 in the 8-byte space set aside for A#, filling the extra space with zeros. When you ask Basic to print A#, it interprets the whole 8 bytes into the misrepresentation of 1.3 you see above.

The more accurate representation produced in the second example, where 1.3 is clearly marked double-precision, happens to have no zeros in its internal storage form. Using "D" instead of the pound symbol also works. When numbers have more than seven digits, Basic assumes they're double-precision.

The same accuracy problem also arises when you transfer a value from a single- to a double-precision variable:

```
A! = 1.3
A# = A!
PRINT A#
  1.299999952316284
```

The Basic manual, however, reveals a clever way to get around this problem. Convert the value of single-precision A! to a string with the STR$ function, then use the VAL function to assign it to double-precision A#:

```
A# = VAL(STR$(A!))
PRINT A#
  1.3
```

The VAL function is well-behaved because it considers the type of the variable to which it's assigning a number when it decodes the string value. It does obey any type symbol occurring in the string, however.

The Input statement is also well-behaved. You can be confident that an Input routine with a double-precision variable will properly interpret numbers as double-precision, unless you specify otherwise.

Command:

?1.7014118346046923D38 (? is Basic shorthand for PRINT.)

Result:

1.701411834604692D+38 (The largest number on the Models III, 4, and 1000.)

Command:

?1.7014118346046924D38 (Just over the limit.)

Result:

Overflow
1.701411834604692D+38 (The Models 1000 and 4 indicate the upper limit in their error messages.)

Command:

?2.9387358770557187 5d-39

Result:

2.938735877055719D-39 (The smallest fraction on the 1000.)

Command:

?2.9387358770557187 4d-39

Result:

0 (Fraction too small; becomes zero.)

Figure. Sample output showing Basic's number limits.

Program Listing. FindOut routine, revealing contents of double-precision variables.

```
10 INPUT "Type double precision number";A#
20 B=VARPTR(A#)
30 FOR I = B+7 TO B STEP -1 : PRINT PEEK(I);" ";: NEXT I
40 PRINT
50 FOR I = B+7 TO B STEP -1 : PRINT HEX$(PEEK(I));"   ";: NEXT I
60 PRINT : GOTO 10
```

Mathology

Understanding Basic's mathematical operators and functions is also important in maintaining accuracy. The four basic operations—addition, subtraction, multiplication, and division—can all work with double-precision accuracy. The result's number type depends on the operands, since Basic converts all operands to the precision of the "most precise" operand. When you multiply a single-precision number by a double-precision number, Basic converts the less accurate number to double-precision format before performing the operation. Although Basic gives you a result in double-precision format, accuracy is reduced to single-precision. Whether you calculate by hand or

	Integer	Single-precision	Double-precision
Examples	1, 3276, -455	1.23, -345.67, 1.234E12	.00000032322, -1.23443222D6
Range	-32,768 to 32,767	-10^{38} to 10^{38}, fractions to 10^{-39}	-10^{38} to 10^{38}, fractions to 10^{-38}
Precision	---	6 decimal digits	16 decimal digits
Storage size	2 bytes	4 bytes	8 bytes
Basic symbols	DEFINT, %	DEFSNG, !	DEFDBL, #
Storage format	LSB/MSB with negative as two's complement.	3-byte mantissa (LSB/MSB) with leading 1 implied. 1-byte exponent (excess 128). Leading mantissa bit is sign.	7-byte mantissa (LSB/MSB) with leading 1 implied. 1-byte exponent (excess 128). Leading mantissa bit is sign.

Table. Basic's number types.

with a computer, a result's accuracy can't exceed that of the least accurate number you use.

The exponentiation operator ([or ^, depending on your computer) and the EXP, LOG, and trigonometric functions all give single-precision results only. If you need double-precision accuracy, you have to define your own functions using the four basic operations capable of double-precision calculations (+, −, *, and \). "Putting Things Precisely" (p. 44) uses mathematical series to do just this, giving you double-precision replacements for your Basic's single-precision functions.

The 1000 *Basic Reference Manual* doesn't tell you that exponentiation (^) is single-precision. In fact, the manual lumps it in with the double-precision operators (so does the IBM manual). The following sequence of commands and Basic's responses proves exponentiation is a single-precision operator on all Tandy/Radio Shack computers:

```
A# = 2.11111#*2.11111#   '(multiplication is
                           double-precision)
B# = 2.11111#^2#
PRINT A#
 4.4567854321              '(accurate square of
                           2.11111)
PRINT B#                   '(bogus beyond the
 4.456785202026367         sixth digit)
```

Even though the exponentiation involves two double-precision numbers, only the first six digits of the double-precision-format result are accurate.

Minding the Storage

If you want to pass variables in machine-language subroutines, or if you're just curious as to why the different number types have the limits they do, you need to know how Basic stores numbers in memory. Although Basic inputs and outputs numbers in the decimal format you're used to, it stores and manipulates numbers in binary format.

Integer storage is the most direct and easy to understand, a fairly direct translation between decimal and binary. The 2-byte integer format, in its 16 bits, can represent 65,536 possible values (2^{16}). Basic allots half of those values to positive and half to negative numbers, which explains the integer range from −32,768 to 32,767. The actual stored values for zero and the positive numbers are direct binary translations (e.g., 10 is 000A hexadecimal [hex]). Basic stores the 2 bytes with the least-significant byte (LSB) first in memory. Ten is actually stored as 0A00 hex.

Basic stores negative integers with values ranging from 32,768 (for −32,768) to 65,536 (for −1) using what's called two's complement representation. To find the two's complement of a binary number, you reverse the value of every bit and add one. Negative one (FFFF hex) is the two's complement of positive one (0001 hex). One side effect of Basic's integer storage system is that it sets all negative numbers' most-significant bit to 1.

Basic stores single- and double-precision numbers in binary exponential format, consisting of a binary fraction (called a mantissa) and exponent. The mantissa multiplied by 2 raised to the power of the exponent yields the stored value Basic uses (value = mantissa * (2 ^(exponent − 128)). Single-precision numbers have a 3-byte mantissa stored with the LSB first and the most-significant byte (MSB) third, followed by the 1-byte exponent. Double-precision has a 7-byte mantissa also stored with the bytes in reverse order and followed by a 1-byte exponent.

The mantissa is always a binary fraction with the binary point (not decimal) preceding the first binary digit (e.g., .1001011100). Because the most-significant digit of this form is always a 1, Basic assumes the first bit is 1 and so uses that bit to represent the sign of the mantissa (zero is positive, 1 negative). In other words, the leading 1 of the mantissa's most-significant byte is implied. The size of the mantissa limits the number of significant digits in a value.

Basic represents a number's exponent in 1 byte in excess 128 form: subtract 128 from the stored value to get the true exponent. It stores an exponent of zero as 128; it stores a binary exponent of −128 as zero. Because a byte can store 256 values (zero to 255), the value of binary ex-

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See our review in the January issue.

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ponents ranges from −128 to 127. This range determines the range of both single- and double-precision numbers that Basic accepts. Two raised to the 127th power approximates 10^{38}, the upper limit. The low limit for the smallest fraction is actually −127 because Basic represents zero with a stored exponent of zero (−128).

PEEK for Yourself

The Basic VARPTR function returns the address of the LSB for all three number types (LSB of the mantissa for the two floating-point number types). Knowing that address, you can PEEK into memory to see how Basic stores a given variable. FindOut (see the Program Listing) does just that for a double-precision variable. Line 10 stores your input in a double-precision variable (you don't have to specify the number you type in as double-precision with Input). Line 20 delivers the location of the variable's LSB. The two loops display the variable's contents.

This program displays the 8 bytes reversed from their order in memory so that the exponent appears first, followed by the mantissa bytes in decreasing order of significance. FindOut displays memory contents twice, first in decimal, then in hex format. (The second loop, which displays the memory contents in hex, works only on the Models 4 and 1000. For the Models I and III, delete lines 40 and 50).

The following sample program output demonstrates much of what I've discussed. I produced the examples on the Tandy 1000, but the other Tandy computers produce comparable results.

If I enter the highest number acceptable to Basic, all bytes should be at their highest value. Actually, the MSB (second byte displayed) has its first bit cleared to zero because the number is positive:

```
Type double-precision number?
1.70141183460469 23E38
 255  127  255  255  255  255  255  255
FF  7F   FF  FF  FF  FF  FF  FF
```

Entering the highest value as a negative number would set all possible bits.

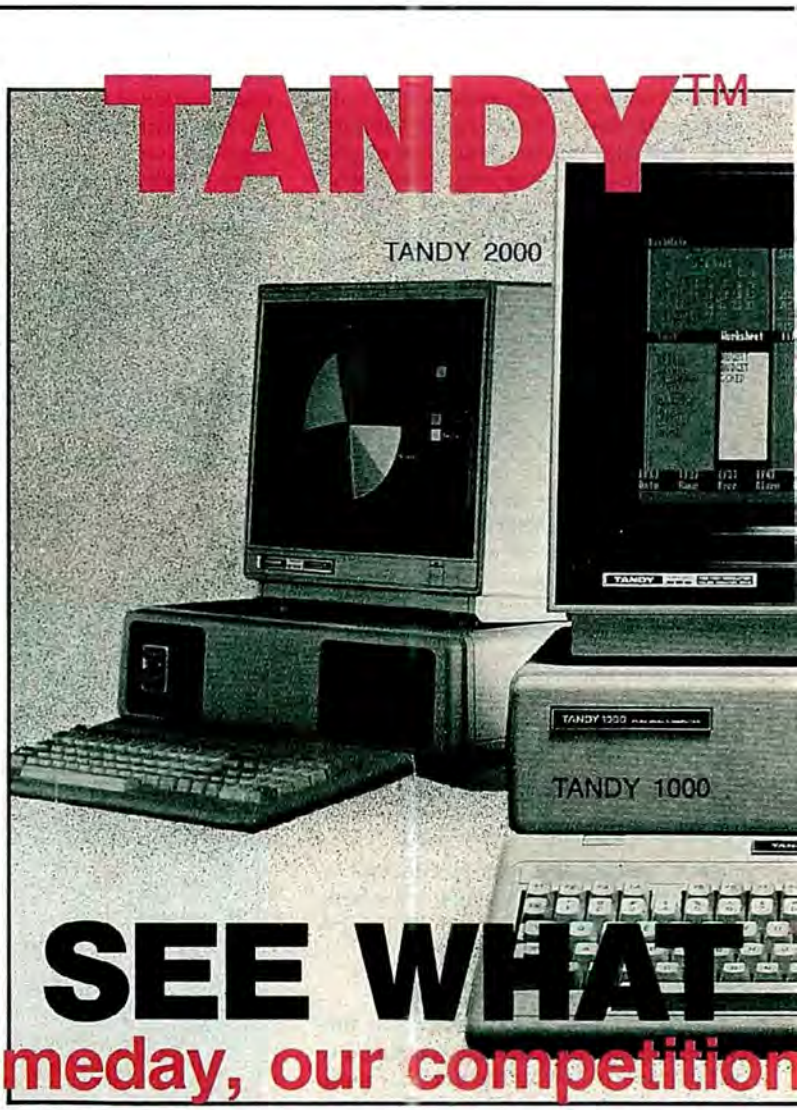
Entering the smallest fraction that Basic doesn't interpret as zero clears all mantissa bits, and creates the smallest exponent of 1 (−127). Basic recognizes that the mantissa's most-significant bit is actually 1, but the bit is cleared because the number is positive:

```
Type double-precision number?
2.938735877055718 75D-39
   1  0  0  0  0  0  0  0
  1  0  0  0  0  0  0  0
```

Basic stores zero with an exponent of zero (−128). Basic accepts "negative zero" as an input, stores it with the proper exponent, and sets the sign bit(!):

```
Type double-precision number? 0
   0  0  0  0  0  0  0  0
  0  0  0  0  0  0  0  0
Type double-precision number? -0
   0  128  0  0  0  0  0  0
  0  80   0  0  0  0  0  0
```

Entering a number with a simple frac-



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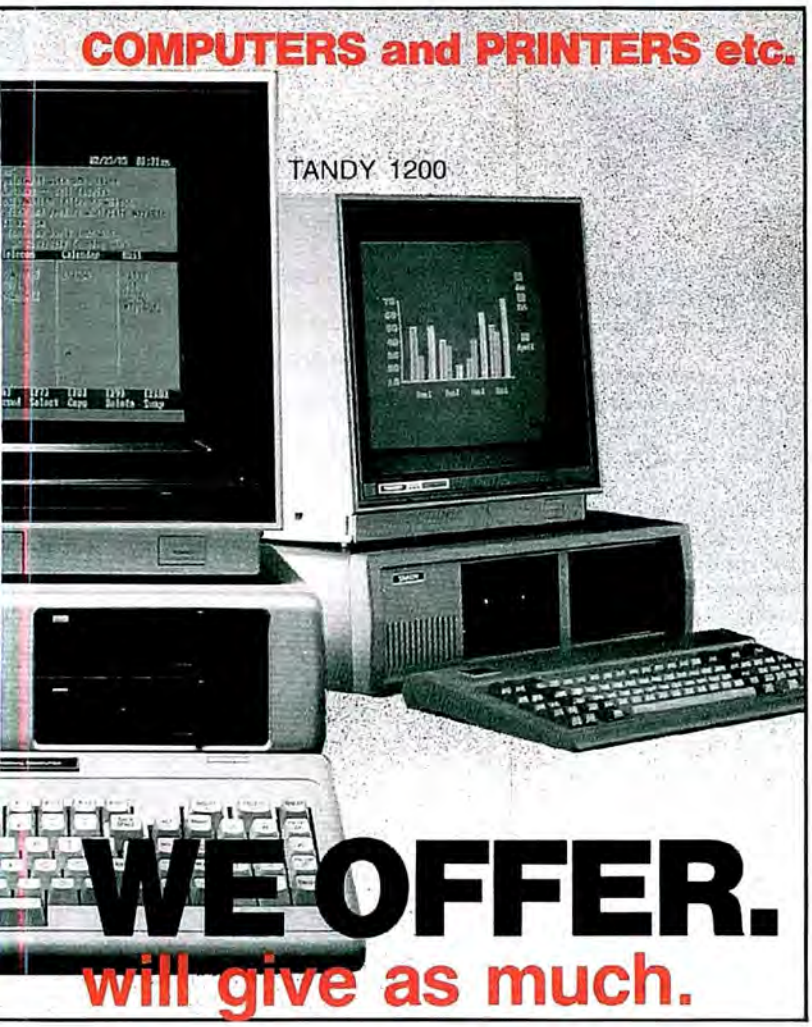

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ity, you can still format single-sided disks by specifying the sides parameter as 1.

The patch below makes your DOS access the two external drives. At TRSDOS Ready, type in:

```
PATCH BOOT/SYS.LSIDOS:O
(DO2,84 = C3:FO2,84 = C9) PATCH BOOT/
SYS.LSIDOS:O (DO2,8E = C3:FO2,8E = C9)
```

After you apply the two patches, reboot the system to test the accessibility of the two external disk drives. Notice that drives 2 and 3 are no longer illegal. When you're satisfied that the DOS behaves properly, label this disk as your master double-sided TRSDOS disk and write-protect it. Use it to make working copies and store your master in a safe place.

For the DOSPLUS IV alteration, you need a copy of your master DOSPLUS IV disk and a blank. Put the blank in drive 1 and the copy of DOSPLUS in drive zero. Format the blank by typing in FORMAT :1. Answer all prompts accordingly and use DOS + X2 as the new disk name. Make sure you specify two sides when prompted. After you format the disk, transfer the operating system over to it by SYSGENing it. Type in SYSGEN :1.

Finish everything off by copying all the remaining resident files. Type in:

```
COPY */*:0 :1
(INVIS,ECHO,SPW = 'PASSWORD')
```

DOSPLUS already recognizes the two external drives. All you need to do is label this disk as your new DOSPLUS master and write-protect it. Use it to make working copies and safely store your original master. ■

Tsun Tam is director of information systems for a national commercial real estate company. You can write to him at P.O. Box 655, Closter, NJ 07624.

HIGHER MATHEMATICS

by Merton L. Davis

Push the limits of precision with a calculator that handles up to 200 significant digits.

Microsoft Basic is a good all-around programming language, but it doesn't satisfy everyone's needs. The accuracy of Basic's double-precision, floating-point arithmetic is a case in point. While its available 16 digits suffice in most instances, it doesn't do for the engineer, mathematician, or scientist who needs far greater precision. To bridge the gap, I developed HiCalc, a program that reports results of standard arithmetic computations with an accuracy of up to 200 significant digits.

Making Calculations

When you type in and run HiCalc (see the Program Listing, p. 52), it first prompts you to enter the first number of your calculation. Numbers can contain a decimal point and up to 200 digits; you must precede negative numbers with a minus sign. The second prompt asks you for the mathematical operation you want to invoke. Enter a plus sign for addition, a minus sign for subtraction, an asterisk for multiplication, or a slash for division. Enter the second number at the next prompt. HiCalc computes the answer to the number of significant digits consistent with the entries and displays it with the appropriate sign and decimal point location.

After HiCalc displ-,s the result, it is ready to perform ar her operation. Unless you specify otherwise, HiCalc automatically uses the answer from the previous computation as the first number in the next calculation and jumps to the operation prompt.

If you want to enter a different first number, press C to clear the calculator and go back to the first-number prompt. If the previous operation was multiplication or division and you want to use the same operation again, tap the enter key. You can't do that for addition or subtraction because (depending on the signs and values of previous entries) the program may have changed the operation. When prompted, enter a second number if it differs from the previous second number; tap the enter key to use the same second number.

This repetition is a convenient way to raise numbers to a power. You enter the same value for the first and second numbers; multiply them; and after each display, tap the enter key twice for each power. Unfortunately, TRSDOS 6.X doesn't support this procedure; you must repeatedly enter the operation and the second number at the prompts.

Generally, the number of digits HiCalc displays in the result does not exceed the number of significant digits set by the first and second numbers. If you want to express the remainder of a quotient more precisely, you can add zeros (after the decimal point) to the divisor—the second number. For example, if 10/3 does not give you sufficient accuracy, try 10/3.0000.

Unfortunately, HiCalc works slowly. Dividing a 40-digit number by a 20-digit number, for instance, requires more than 10 minutes. HiCalc follows a procedure similar to the usual long-division method. It tries a digit in the quotient, multiplies it by the divisor, subtracts it from the dividend, and brings down the next digit. If the result is too large, HiCalc tries again with a smaller digit. Each trial HiCalc completes requires several Basic loops before the program reaches the correct value. To show you that the program is working, HiCalc displays a blinking asterisk in the upper right-hand corner of the screen as it determines each digit in the quotient. A blinking cursor also appears during multiplication.

If your numbers are long, they may exceed the dimensions specified by array L in line 10. When this happens during processing, HiCalc advises you to increase the value of L or shorten your entries. You may have to decrease the value of L if you use a 16K machine from Cassette Basic.

Another error could occur if a result exceeds the 255 characters the results string reserves. In this case, HiCalc doesn't save the result for a subsequent operation. It displays the answer, but you must clear the result from the program and enter a new first number before continuing.

Inner Workings

HiCalc is well suited to my needs, but your requirements may differ. To facilitate program modifications, I used remarks in HiCalc to document the four operations and describe the subroutines. The Table lists key variables that should prove useful in making changes.

HiCalc assigns your first and second numbers to F$ and S$, respectively. Lines 10–330 accept these strings; hack off any negative sign and leading zeros; and prepare them in arrays, in accordance with the chosen operation. The leading digit occupies the first index in the array; the final digit, the last index used. Lines 200–280 direct this preparation.

Lines 300–310 handle a subtraction detail. In order for you to subtract one number from another, you must have the numerically larger number in the first string. If it isn't, HiCalc switches the first and second strings and puts the proper sign for the answer in position R(0). Normally, the VAL function performs this task, but HiCalc's numbers might fall outside the range of E to the plus or minus 38, so I had to program this function myself. The remaining program lines (lines 340 on) operate on the first and second arrays and put the answer in the results array.

Addition and Subtraction

Lines 340–480 use the same loop to do addition and subtraction. HiCalc operates from right to left by adding (or subtracting) the digits in the second array to (or from) the corresponding digits in the first array. It adds in previous carries and subtracts previous borrows digit by digit.

Lines 340 and 350 determine the location of the starting digits. HiCalc computes an offset to describe the difference between the location of decimal points in the first and second arrays. RT holds the index of the last digit in the results array. It equals the index of the last digit in the first or second array, whichever is longer after HiCalc calculates the offset.

Multiplication

HiCalc performs multiplication (lines 530–620) from right to left—just as you would using a pencil and paper. It multiplies the last digit of the multiplier by each digit of the multiplicand, lining up the digits. The next line of individual products begins one place to the left; this process continues until the program has used the

LOAD 80

System Requirements

Models I, III, and 4
16K RAM (Cassette Basic)
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Variable	Definition
BO	Borrow for subtraction
CA	Carry for addition or multiplication
CF	Locates current digit in first array
CR	Locates current digit in result array
CS	Locates current digit in second array
D	Value of current digit in quotient
EF	Last erasure location for first array
ES	Last erasure location for second array
F$	String for first number entered
F( )	Array for first number
F	Loop index for F$
FF	Length F$
FP	Length F$ from first digit to decimal point
FL	Flags leading zeros for display of result
FG	Flags Model III or Model 4
HF$	First character of F$
HS$	First character of S$
J	For. . .Next loop index
K	Carry factor for multiplication requirements in division
KN	Knuth factor
L	Dimensions arrays
LF	Length F$ from decimal point to last digit
LR	Length result from decimal point to last digit
LS	Length S$ from decimal point to last digit
M1	Holds LSB of cursor position or row (Model 4)
M2	Holds MSB of cursor position or column (Model 4)
N	Index for quotient array
O$	Operation character
O	Offset loop index in multiplication
OF	Holds offset in operations other than multiplication
PR	Holds intermediate digital products in multiplication
R( )	Array holding result of operation
R	Loop index for result
RP	Length result from first digit to decimal point
RR	Length quotient with offset
RT	Locates last digit in result array
S$	String for second number entered
S1$	Working second number string
S( )	Array for second number
S	Loop index for S$
SP	Length S$ from first digit to decimal point
SS	Length S$
X	Value of current first digit in addition or subtraction
Y	Value of current second digit in addition or subtraction

Table. Summary of program variables.

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columns, now lined up vertically, to get the final product. To assure proper alignment of the columns of digital products (with no index lower than zero), line 540 offsets the multiplicand in its array by an amount equal to the length of the multiplier.

No decimal points appear in the arrays prepared for multiplication or division. When HiCalc completes a calculation, it positions the decimal point in the results array. Because multiplication proceeds from right to left, line 530 determines LR—the length of the result from decimal point to the last digit.

Division

Division (lines 650–1070) differs from the other operations in that it works from left to right, or first digit to last. The value of RP (line 650) determines the position of the decimal point in the answer; it is the sum of the length of the dividend from the first digit to a decimal point and the length of the divisor from decimal point to the last digit. The offset for division, also determined in line 650, sets the position for the first (leftmost) digit in the results array.

The next step in division removes any leading zeros from the divisor before division begins. As you enter a number, the program deletes head zeros, but some may remain after HiCalc removes the decimal point—a divisor like 0.0033 for example.

Next, HiCalc uses the expression "M" in line 690 to calculate the Knuth factor. If this factor is greater than one, the program multiplies the dividend and divisor by this figure before line 850 calculates the first trial digit in the quotient. D.E. Knuth discovered that by handling division this way the first trial digit is never more than two higher than nor less than the correct value. It is valuable here because it reduces the time HiCalc spends searching for the correct digit.

Lines 830–1040 perform the division; remarks in the Listing tell the function of each of the loops within the main loop. The second array, the divisor, remains unaltered during division, and the results array positions the correct digits as they occur. However, the first array, the dividend, changes continuously; it receives the result of the subtraction of the product of the trial digit and the divisor from the current dividend. HiCalc follows the usual long-division procedure, but the bring-down digit stays in the first array until the main loop uses it in the next search for a trial digit in the quotient.

Adding Advantage

HiCalc offers you a convenient tool for calculating sums, differences, products, and quotients with an accuracy of up to 200 digits. It has proved helpful in computing the terms of an expansion series for very accurate trigonometric values; I'm sure it will be equally useful in other applications requiring a high degree of precision. And if recreational mathematics is your cup of tea, you and your TRS-80 should get hours of enjoyment from such menial tasks as adding another digit or two to the accuracy of pi or the base of natural logarithms. ■

Merton L. Davis is a retired chemist and computer hobbyist. He is willing to supply a machine-language version of HiCalc for a 48K Model III or 64K Model 4 disk system. Write to him at 3A Palmetto Arms, Camden, SC 29020. Enclose a disk formatted in TRSDOS 1.3 or 6.X; a description of your system; and a self-addressed, stamped mailer for the program.

PUTTING THINGS PRECISELY

by D.Y. Barrer

Make your Basic programs more accurate with these routines that calculate values with up to 16 significant digits.

Accuracy to 10 or more significant digits may be overkill in a checkbook-balancing program, but in some complex financial or scientific calculations, you want all the precision you can get. The simplest way to ensure precise results is to use Basic's double-precision mode, which gives accuracy to 16 significant digits.

However, TRS-80 Basic's double precision is limited to simple arithmetic functions. You can't easily get double-precision values for exponentiation, or when computing logarithms, square roots, or trigonometric functions.

I've written six short Basic programs (Program Listings 1–6, p. 54) that return double-precision results for exponentiation and for the Basic functions LOG(X), EXP(X), SQR(X), ATN(X), SIN(X), COS(X), and TAN(X). The mathematical concept behind these programs is complex, but you don't have to understand the math to use the programs; the explanations provide background information only.

The Table lists the programs and their functions. Each program contains a central subroutine that you can incorporate into your own programs.

Getting Your Values Straight

To compute values for the functions listed above, you try to generate a sequence of numbers that continually gets closer to the value of the function and, with enough terms, differs by an arbitrarily small amount and remains so for all subsequent terms. Such a sequence is said to converge to the value of the function.

The first approach that comes to mind is to use a power series expansion; such series for these functions are well known. Unfortunately, however, some of them converge only for a limited range of values of the argument, or they converge very slowly.

The expansions I used for these functions are in the form of continued fractions, mathematical expressions so little known that it's possible to earn a doctorate in mathematics without being exposed to them.

A continued fraction is an expression of the form:

Equation 1

$$F = b_0 + a_1/(b_1 + a_2/(b_2 + a_3/(b_3 + \ldots$$

The fraction might continue infinitely, or

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Listing	Function	Corresponding Basic Function
1	Natural logarithm	LOG(X)
2	Natural exponent	EXP(X)
3	Exponentiation	
4	Trigonometric	SIN(X), COS(X), TAN(X)
5	Arctangent	ARN(X)
6	Square root	sqr(x)

Table. The Program Listings and their functions.

it might end after a finite number of terms. Associated with the fraction are sequences A_n and B_n, determined by the recursion equations:

Equation 2

$$A_{n+2} = b_{n+2}A_{n+1} + a_{n+2}A_n$$
$$B_{n+2} = b_{n+2}B_{n+1} + a_{n+2}B_n \quad n = 0,1,2,3\ldots$$

in which $A_0 = 1$, $A_1 = b_1$, $B_0 = 0$, and $B_1 = 1$. The numbers in the sequence A_n are called the partial numerators; the numbers B_n are called partial denominators. If, as n increases, the sequence A_n/B_n converges to a value F, then the sequence converges and its value is F.

Continued fraction expansions for many mathematical functions are known; you won't find them in your local public library, but any good university library should have several books on the subject. The expansions I used are from the book *Analytic Theory of Continued Fractions* by H.S. Wall (D. Van Nostrand Company, 1948).

The Programs in Action

Despite their complicated algorithms, the programs included here are easy to use. When you run Listing 1, for example, the program prompts you for a non-negative number and, a few seconds later, displays that number's natural logarithm in proper double-precision form. The Figure shows a sample screen output for Listing 1.

In each listing, the subroutine beginning at line 1000 is an independent module that you can incorporate into other programs.

In some calculations, A_n or B_n may become so large that you get an overflow error. Since you need only their quotient, you can multiply both A_n and B_n by the same small number to eliminate overflow errors yet preserve the same ratio.

The continued fraction for the LOG(X) function (Listing 1) converges faster for values of X from about 0.5 to 2. If X is less than 0.5, the routine takes X's reciprocal. The program then repeatedly divides by 2 until it has reduced the argument to a number between 1 and 2.

```
PROGRAM TO COMPUTE LOG(X) IN DOUBLE PRECISION

VALUE OF X? 10

LOG(X)= 2.302585092994046
Ready
```

Figure. Sample screen output of Program Listing 1.

The routine computes the continued fraction's value, and uses the identity $\log(X*Y) = \log(X) + \log(Y)$ to add log(2) the appropriate number of times. If the program took X's reciprocal, it uses the identity $\log(X) = -\log(1/X)$ to find the value of LOG(X).

This procedure not only shortens running time, but it keeps the partial numerators and denominators from becoming large enough to cause an overflow error. In line 1030, Q's value is the double-precision value of log(2) accurate to 16 significant digits.

To compute EXP(X), use Listing 2. Here, convergence is faster when X's value is between 2 and −2. The routine divides X by 2 enough times to reduce it to this range, evaluates the continued fraction, and then uses the identity $\exp(X*Y) = \exp(X)*\exp(Y)$ as often as necessary to reach the correct value.

I used similar techniques to speed up the exponentiation routine in Listing 3. Note that this routine also returns the correct result for negative values of the base if the exponent is an integer. As in Listing 1, these techniques ensure that A_n and B_n stay within range, i.e., less than 1D+38.

The routine for trigonometric functions, Listing 4, uses the continued fraction expansion for tan(X/2) and then the identities:

Equation 3

$$\tan(X) = 2*\tan(X/2)/(1 - \tan^2(X/2))$$
$$\sin(X) = 2*\tan(X/2)/(1 - \tan^2(X/2))$$

to compute SIN(X) and TAN(X). It doesn't compute COS(X); if you need the cosine, use the identity $\cos(X) = \sin(X)/\tan(X)$, provided that tan(X) is not zero. If the tangent is zero, COS(X) = 1 or −1, depending on the quadrant in which X lies. See lines 80 and 1060 of Listing 4.

Listing 5 computes the inverse tangent, ATN(X). In the interest of reducing execution time, this routine uses X's reciprocal if X is greater than 1. The routine then computes the continued fraction and, if it used X's reciprocal, applies the identity Arctan(X) = PI/2 − Arctan(1/X).

You could use Listing 3 with the exponent 0.5 to find double-precision square roots, but, because the continued fraction for the square root is particularly simple, Listing 6 is faster. In the continued fraction for the square root of X, the a_n are all equal to X − 1, b_0 is 1, and the remaining b_n are all equal to 2.

Listing 6 uses Equation 2, shown above. However, it might be even simpler to use the identity:

Equation 4

$$SQR(X) = 1 + (X - 1)/(1 + SQR(X))$$

If you repeatedly use the identity to substitute for the SQR(X) on the right-hand side of Equation 4, you arrive at the continued fraction expansion for SQR(X). Now, instead of using the recursion equations, substitute an approximate value for SQR(X) in the right-hand side of the equation; the single-precision value of SQR(X) isn't a bad choice. You can then compute a better approximation to SQR(X).

Substitute the improved approximation and compute SQR(X) again; each time, your result is more exact. Continue until two successive approximations differ by less than 1D−16.

Accuracy

The programs usually print results accurate to 16 significant digits. Remember that in double precision, the computer works internally with 17 significant digits and prints results rounded to 16 digits on the Model 4 and truncates on the Models I and III.

As a result, the 16th significant digit will occasionally be incorrect, but for most applications, accuracy to 15 significant digits should be ample. ■

D.Y. Barrer is a retired applied mathematician who divides his free time between fishing and developing programs for the mathematical analysis and design of fly-rod tapers. You can write to him at 7008 Old Stage Road, Rockville, MD 20852.

Related Articles

Douglass, Bruce Powel. Copernica Mathematica, February 1982, p. 362. This installment of Douglass' math column covers approximating a function's value using converging number series.

Shore, James R., "Dizzy Decimals," March 1982, p. 326. A discussion of round-off errors in Model I programs; includes a section on double-precision values.

Sinclair, I.R., "Into the 80's," Part V, January 1981, p. 100. A Model I math tutorial.

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FINDING YOUR √ROOTS

by Roxton Baker

Solve linear or nonlinear equations for their roots.

Solving equations for their roots is a common engineering and scientific problem. My Basic program, Solver, solves any single equation or set of equations, whether linear or nonlinear (see the Program Listing, p. 56). Solver has a significant advantage over other programs of this type because it easily accommodates multiple equations; you don't have to combine terms in order to reduce a problem to a single term.

Linear and Nonlinear Equations

Solving a linear equation, like $X - 4 = 0$, is simple, involving elementary algebra. Solving sets of simultaneous linear equations is more complex, but the techniques to do so are well known. Solver includes a routine to solve single linear equations and sets of linear equations.

Nonlinear equations, unlike linear equations, have more than one root and these roots may be real or complex (complex roots involve the term "i," the square root of -1). Solver is concerned only with real numbers; it doesn't handle complex roots.

A common way to solve single nonlinear equations is called the Newton method, and Solver incorporates an extension of the Newton method to solve sets of nonlinear equations.

The Newton Method

Finding the root of a single, nonlinear equation of the form $F(X) = 0$ entails finding a value for X that makes the equation true. For example, the nonlinear equation $X^3 - 2^X = 0$ has a value of $X = 2$ as one of its roots.

The Newton method (a numerical analysis technique discussed in most math theory books) is a kind of trial-and-error approach to solving nonlinear equations. According to the Newton method, you would solve the equation $F(X) = 0$ by first guessing the value of X and solving the equation with that randomly selected value to see how far the result is from zero (see the column labeled "Error" in Solver's printout). You then make a change to X, recevaluate the result, and continue to change X until you get an answer approaching zero.

Solver automates this process: You enter the initial estimate of X and Solver does the rest. The first time you run the program, Solver uses your value of X to solve the equation.

Solver then estimates what change in X brings the equation closer to zero, based on the result of the first calculation. After each comparison, the program automatically readjusts the value for X until it brings the equation acceptably close to zero.

In nonlinear equations (those that don't result in a straight line when you plot F(X) versus X), the new estimated value of X won't give you a result of exactly zero, but the amount of error around zero is acceptably small. While the root is never found exactly, any value of X that gives the equation a result acceptably close to zero (as defined by you) is considered to be a root.

Nonlinear equations often have more than one root; which root is found depends primarily on the value of X you choose as a starting guess. This points up a weakness in the Newton method: You have to provide a reasonably close guess of the root to begin with. In addition, the method may overlook one root that's very close to another.

Solver extends the Newton method to solve sets of up to 10 nonlinear equations. Because a set of equations has more than one unknown, Solver finds a value for each of these unknowns.

Using Solver

Before using Solver, you have to input the set of linear or nonlinear equations you want solved. To do this, arrange each equation so that zero appears on the left-hand side and then enter the equations as Basic statements at the end of Solver (see line 1730 of the Listing). A dummy variable, Y, then takes the place of zero in each equation as shown in the example below:

```
Y(N) = expression involving X(1), X(2). . .X(N)
```

Solver attempts to find values for X(1), X(2). . .X(N) that make Y(1), Y(2). . .Y(N) simultaneously zero. Solver calls the equation subroutine you've added to the end of the program whenever you run it, and as a consequence this is the only part of the program that changes for each new problem.

After you enter your equations and run the program, Solver presents you with a set of prompts to further define the problem. It first asks you how many equations you've added to Solver. Then it requests that you specify upper and lower bounds for each of the unknowns in the equations (the X variables).

This way, you can exclude ranges of the unknowns that aren't of interest, or those that produce undefined terms in the equations. If you don't want to exclude any values, set the bounds at very large negative and positive numbers.

You also have the option of setting individual bounds for each unknown.

Next you're asked if you have made any static terms U variables, i.e., values you can modify in subsequent program runs.

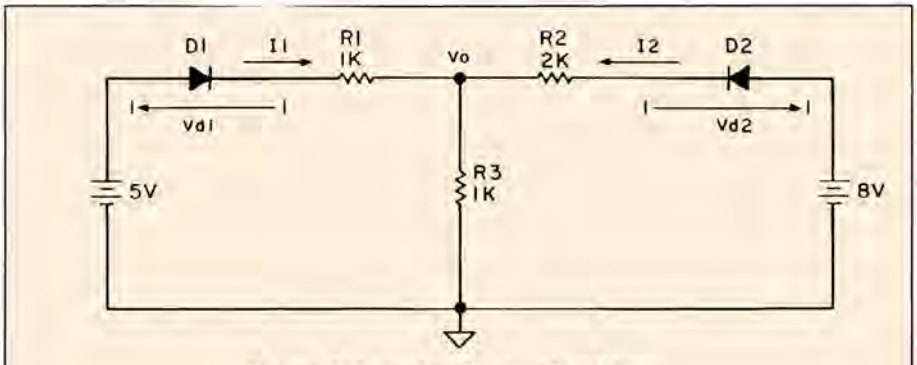

Figure. Schematic of example problem.

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System Requirements

Models I, III, 4, 1000, and 2000
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32K RAM Disk Basic
Printer (optional)

Circle 81 on Reader Service card.

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You're given the option to change the value of U variables before moving on.

Then you're prompted to enter a starting guess for each of the unknowns. You must enter these individually, although on the Models I and III you can duplicate the previous entry by pressing the enter key. It's best to make a close estimate, as this reduces solution time. For extremely complicated problems, Solver may not find a solution unless the starting guess is close to the actual solution. You can also change the starting guess of any unknown before continuing.

Solver is now ready to search for a solution by trying new values for the X variables and evaluating the given equations to see if they result in zero. Solver must know when it has found a solution that's acceptably close to zero. Solver arbitrarily uses a value for zero of ±0.0001. Thus, it keeps trying to improve its estimate of the solution until every equation solves to an error between −0.0001 and +0.0001. You can change the program to specify these tolerance values separately, or set them to exactly zero.

Each time Solver makes a new estimate, it displays the estimate (represented as X(1), X(2), and so on) as well as the resulting equation error (represented as Y(1), Y(2), and so on). The fact that Solver displays these two values side by side doesn't imply that each unknown X affects the error in only one equation. Rather, the unknown affects the error of every equation in which it appears.

If you interrupt the program by pressing a key after it begins execution, it calls a menu that lets you change starting guesses, bounds, and values. Solver follows up these options, including one for continuing the search with the current values, with appropriate prompts. The menu also lets you initiate or terminate output to a line printer.

Using this menu, you can designate new values for terms subject to modification. For example, you can use up to 10 U variables (U(1)–U(10)) to see the effect of different factors on the equation's solution, and I use it in my example problem (see below).

You can also insert U variables to solve a set of N equations that contain more than N unknowns. Yet, because Solver must have as many equations as unknowns, you'd have to manipulate the extra unknowns yourself by using the menu to change the U variables that represent the extra unknowns.

Solver's error-handling detects division-by-zero and illegal function call errors, displaying the relevant line number. You can correct these errors either by changing bounds or by changing the value of a U variable.

An Example

The electronic circuit in the Figure represents a typical problem for an electrical engineer. This problem illustrates both

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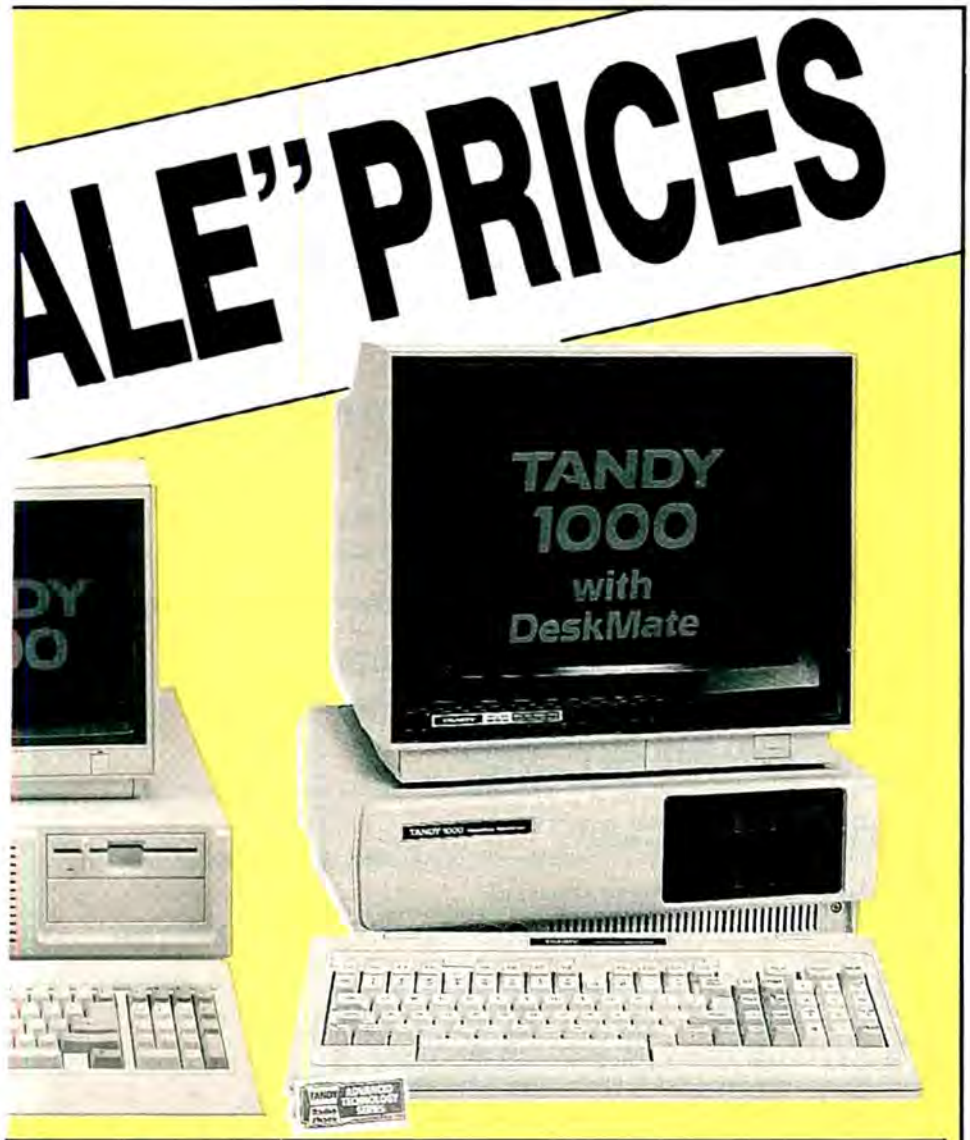

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the power and convenience of Solver. Briefly, Solver will calculate the output voltage (V_o) that results when the value of resistor R3 is 1,000 ohms (as shown). Since the diode forward voltage drops, V_{d1} and V_{d2} aren't known with accuracy; they're calculated from the diode equation you add to Solver. For this, reverse leakage currents are estimated from the appropriate diode data sheets. In addition, I'll discuss the effect of a ± 10 percent variation in the value of R3.

First, using both Kirchhoff's voltage and current laws and the diode equation, write five circuit equations in five unknowns, without eliminating or consolidating terms. For example:

Current through diode 1	$I1 = (5 - V_{d1} - V_o)/R1$
Current through diode 2	$I2 = (8 - V_{d2} - V_o)/R2$
Output voltage	$V_o = (I1 + I2) * R3$
Voltage across diode 1	$V_{d1} = (26mV) * Ln(I1/6.4E - 15)$
Voltage across diode 2	$V_{d2} = (26mV) * Ln(I2/6.4D - 15)$

Before adding these equations to Solver, you have to rewrite them in the format I discussed earlier, with a zero term on the left-hand side. Then replace the five unknowns, I1, I2, V_o, V_{d1}, and V_{d2}, with the following arbitrarily selected X variables:

```
I1 = X(1)
I2 = X(2)
Vo = X(3)
Vd1 = X(4)
Vd2 = X(5)
```

Because you want to observe the effect of variations in R3, the equations represent R3 with the U variable U(1) rather than with a fixed value. This way you can change the value of R3 at will.

The resulting Basic subroutine you'd insert at the end of Solver is:

```
5000 Y(1) = (5 - X(4) - X(3))/1000 - X(1)
5010 Y(2) = (8 - X(5) - X(3))/2000 - X(2)
5020 Y(3) = (X(1) + X(2)*U(1) - X(3))
5030 Y(5) = 0.026*LOG(X(1)/64.E - 15) - X(4)
5040 Y(5) = 0.026*LOG(X(2)/64.E - 15) - X(5)
5050 RETURN
```

I used 5000 as a line number because it's well above any line number used in the listing.

Once you insert the subroutine, delete lines 1750–1770 and run the program. Solver will now prompt you for more information; it assumes the default value (indicated by an asterisk) if you respond by pressing the enter key.

Answering the first prompt, you specify the number of equations (N) as five. When prompted for upper and lower bounds for each unknown, you decide to set all the bounds at once, rather than individually. As defined in the Figure, all the voltages and currents must be positive; thus, a lower common bound of zero is suitable and avoids an error message. The upper bound is entered as 10, as it's clear that no voltage is greater than 10 volts (V), and no current more than 10 amperes (A).

There's one U variable in the equations, R3, which I defined as U(1). I set the initial value of R3 at 1,000, but I'll vary the value later on.

Solver now prompts you for the variables' starting guesses; respond by entering 8 for all unknowns. Do this by typing in 8 for the first unknown, X(1), and then pressing the enter key for the remaining values. (This automatic-entry feature applies only to the Models I and III; you must enter each value on the Models 4, 1000, and 2000.) This means you're guessing that all voltages are 8 volts and that all currents are 8 amperes, which is exaggerated, but shows that practical problems like this are very tolerant of loose bounds and wild guesses.

Solver now estimates new values for the unknowns X(1)–X(5) in an attempt to bring all of the error terms to zero. Solver displays each new set of estimates, and the resulting error for each equation, on the screen. This takes about 15 seconds on the Models I and III, and slightly less time on the Models 4, 1000, and 2000. Solver requires only three iterations to reduce the errors to within ±0.0001 of zero, considered acceptably small. This is the value set within the program for the error tolerances YT(1)–YT(5). Here's the final solution:

X(1) = 0.001134
X(2) = 0.002059
X(3) = 3.193
X(4) = 3.193
X(4) = 0.6735
X(5) = 0.6889

You're particularly interested in the output voltage (V_o, X(3) here). With R3 set to 1,000 ohms, this voltage is observed as 3.193 volts. The diode currents are found to be I1 = .1134 mA and I2 = 2.059 mA, and the diode forward voltage drops are V_{d1} = 0.6735 volts and V_{d2} = 0.6889 volts.

Finally, consider the effect of an increase in the value of R3 to 1,100 ohms on V_o. Press U at the menu to change the value of a U variable.

The prompts allow you to set U(1) to 1,100; then you call the menu and press C to continue. Solver finds the new solution in two iterations, where V_o increases to 3.315V when R3 increases to 1,100 ohms. The solution is as follows:

X(1) = 0.001015
X(2) = 0.001999
X(3) = 3.315
X(4) = 0.6075
X(5) = 0.6881

Listing Changes

The Listing works as is on the Models I and III, yet for the Models 4, 1000, and 2000 you must change the end of line 540 to PP$ = "#. #### ^^^^ ". In addition, you must change line 1510 to PRINT,TR, " "; :PRINT if you're using the Models 1000 and 2000. ■

You can address your correspondence to Roxton Baker at Box 8272, APO San Francisco, CA 96555.

A word about the programs: HiCalc, pp. 52 and 53, is discussed in "Higher Mathematics," p. 42. The double-precision routines on pp. 54 and 55 are covered in "Putting Things Precisely," p. 44. Solver, pp. 56–58, is discussed in "Finding Your Roots," p. 48.

Program Listing. HiCalc.

```
1 CLS:PRINT TAB(24)"****HICALC****"
2 PRINT
3 PRINT"A high-precision calculator for Models I, III, 4 TRS-80 computer"
4 PRINT TAB(30)"BY"
5 PRINT TAB(23)"Merton L. Davis"
6 PRINT TAB(23)"3A Palmetto Arms"
7 PRINT TAB(23)"Camden SC 29020":PRINT
8 '
9 IF PEEK(457)=62 THEN CLEAR1500:DEFINTA-Z:FG=-1 ELSE DEFINT A-Z
10 L=200:DIM F(L*2),S(L+2),R(L*2):ON ERROR GOTO 10000
19 'Input data and remove head minus signs and zeroes--Lines 20 to 180
20 PRINT "INPUT FIRST NUMBER UP TO"L"DIGITS":INPUT F$
30 HF$=LEFT$(F$,1)
40 IF HF$<>"-" AND HF$<>"." AND (ASC(HF$)<48 OR ASC(HF$)>57 OR LEN(F$)>L) THEN 2
0
50 IF HF$="-" THEN F$=RIGHT$(F$,LEN(F$)-1)
60 IF LEFT$(F$,1)="0" THEN F$=RIGHT$(F$,LEN(F$)-1):GOTO 60
70 IF LEN(F$)>L*2 THEN PRINT "INCREASE L-VALUE OR DECREASE LENGTH OF FIRST NUMBE
R":END
80 INPUT "OPERATION (+ - * /) OR 'E' TO END OR 'C' TO CLEAR";O$:IF O$="E" THEN E
ND ELSE IF O$="C" THEN RUN 9
90 IF O$="+" THEN A$="SUM IS ":GOTO 130
100 IF O$="-" THEN A$="DIFFERENCE IS ":GOTO 130
110 IF O$="*" THEN A$="PRODUCT IS ":GOTO 130
120 IF O$="/" THEN A$="QUOTIENT IS " ELSE PRINT "OPERATION NOT UNDERSTOOD":GOTO
80
130 PRINT "INPUT SECOND NUMBER UP TO"L-1"DIGITS."
140 INPUT S$:HS$=LEFT$(S$,1):S1$=S$
150 IF HS$<>"-" AND HS$<>"." AND (ASC(HS$)<48 OR ASC(HS$)>57 OR LEN(S$)>L) THEN
130
160 IF HS$="-" THEN S1$=RIGHT$(S$,LEN(S$)-1)
170 IF LEFT$(S1$,1)="0" THEN S1$=RIGHT$(S1$,LEN(S1$)-1):GOTO 170
180 IF LEN(S1$)>L THEN PRINT "INCREASE L-VALUE OR DECREASE LENGTH OF SECOND NUMB
ER":END
190 BO=0:CA=0
199 'Lines 200 to 270 switch strings, change operation, and sign result accordin
g to signs of operands.
200 IF HF$="-" AND HS$<>"-" AND O$="+" THEN O$="-":GOSUB 4000:GOTO 280
210 IF HF$="-" AND HS$<>"-" AND O$="-" THEN O$="+":R(0)=-3:GOTO 280
220 IF HF$<>"-" AND HS$="-" AND O$="+" THEN O$="-":GOTO 280
230 IF HF$<>"-" AND HS$="-" AND O$="-" THEN O$="+":GOTO 280
240 IF HF$="-" AND HS$="-" AND O$="-" THEN GOSUB 4000:GOTO 280
250 IF HF$="-" AND HS$="-" AND O$="+" THEN R(0)=-3:GOTO 280
260 IF HF$="-" AND HS$<>"-" THEN R(0)=-3:GOTO 280
270 IF HF$<>"-" AND HS$="-" THEN R(0)=-3
279 'Use shortest string as multiplier for faster multiplication
280 FF=LEN(F$):SS=LEN(S1$):IF O$="*" AND SS>FF THEN GOSUB 4000:TT=SS:SS=FF:FF=TT
290 IF O$<>"-" THEN 320
295 IF FF>=SS THEN RT=FF:EF=RT:ES=RT ELSE RT=SS:EF=SS:ES=SS
299 'Lines 300-310 for subtraction.  Highest value number is placed in first num
ber array and proper sign placed in result.
300 GOSUB 5000:IF SP<FP THEN 340 ELSE IF FP<SP THEN 310
303 IF LF>LS THEN T=FF ELSE T=SS
306 T1=0:FOR J=1 TO T:IF F(J)<>S(J) THEN T1=J:J=T
308 NEXT:IF T1=0 THEN F$="0":GOSUB 2045:GOTO 80
309 IF F(T1)>S(T1) THEN 340
310 GOSUB 4000:GOSUB 2050:TT=SS:SS=FF:FF=TT:R(0)=-3
320 GOSUB 5000
330 IF O$="*" OR O$="/" THEN 490
339 'Lines 340-350 determine offset and locations in arrays to start addition an
d subtraction loop.
340 OF=ABS(LF-LS):IF OF=0 THEN 350 ELSE IF LF=0 THEN FF=FP ELSE IF LS=0 THEN SS=
SP
350 CF=FF-(LS>LF)*OF:EF=CF:CS=SS-(LF>LS)*OF:ES=CS:IF CF<CS THEN RT=CS ELSE RT=CF
359 'Addition and subtraction loop in Lines 360-440
360 FOR CR=RT TO 1 STEP -1
370 IF CF=FP THEN R(CR)=ASC(".")-48:GOTO 440
380 IF CF<1 THEN X=0 ELSE X=F(CF)
390 IF CS<1 THEN Y=0 ELSE Y=S(CS)
400 IF O$="+" THEN R(CR)=X+Y+CA ELSE R(CR)=X-Y-BO
410 IF O$="+" THEN 430
420 IF R(CR)<0 THEN R(CR)=R(CR)+10:BO=1:GOTO 440 ELSE BO=0:GOTO 440
430 IF R(CR)>9 THEN R(CR)=R(CR)-10:CA=1:ELSE CA=0
440 CF=CF-1:CS=CS-1:NEXT CR
450 IF CA=0 THEN 480
460 IF R(0)=0 THEN R(0)=1:GOTO 480:    'If addition had carry, R(0)=1
469 'If negative sign in R(0) then move array up 1.
470 FOR R=RT TO 1 STEP -1:R(R+1)=R(R):NEXT:RT=RT+1:R(1)=1
480 GOSUB 2000:GOTO 30
489 'Remove decimal points for multiplication or division
490 IF FP<F THEN FOR J=FP TO F-1:F(J)=F(J+1):NEXT:FF=FF-1
500 IF SP<S THEN FOR J=SP TO S-1:S(J)=S(J+1):NEXT:SS=SS-1
510 RT=SS+FF:IF O$="*" THEN 530
520 GOSUB 650:GOTO 30
529 'Multiplication in Lines 530-600
530 CR=RT:CF=CR:LR=LF+LS:IF FG THEN M1=PEEK(16416):M2=PEEK(16417) ELSE M1=ROW(0)
:M2=POS(0)
539 'Offset multiplicand in first array by length of multiplier.
```

Listing continued

Listing continued

```
540 FOR F=RT TO SS+1 STEP -1:F(F)=F(F+FF-RT):NEXT:FOR F=F TO 1 STEP -1:F(F)=0:NE
XT
559 'Loop summing products of offset digits--Lines 560-620
560 FOR O=0 TO RT-1:PR=CA:M=O/2:PRINT@ 63,CHR$(42+(M=O/2)*10);
570 FOR J=0 TO SS-1
580 CS=SS-J:CF=RT+J-O
590 PR=PR+(F(CF)*S(CS))
600 NEXT J
609 'Carry is the summed product MOD 10
610 CA=INT(PR/10):R(CR)=PR-CA*10:CR=CR-1
620 NEXT O
629 'Position decimal point in result array
630 IF LR>0 THEN FOR R=RT TO RT-LR+1 STEP -1:R(R+1)=R(R):NEXT:R(R+1)=-2:RT=RT+1
640 IF FG THEN POKE16416,M1:POKE16417,M2 ELSE PRINT@ (M1,M2),"";
645 GOSUB 2000:GOTO 30
649 'Find position of decimal point and array offset in quotient
650 RP=FP+LS:OF=RT-FP-LF:RR=RT+OF
659 'Remove lead zeroes from divisor--Lines 660-680
660 S=1
670 IF S(S)=0 THEN S=S+1:GOTO 670
680 IF S>1 THEN FOR J=S TO SS:S(J-S+1)=S(J):NEXT:ST=SS-S+1:FOR J=ST+1 TO SS:S(J)
=0:NEXT:SS=ST:RP=RP-1+S
689 'Find Knuth-Factor and multiply by dividend and divisor--Lines 690-800
690 KN=INT(10/(S(1)+1)):IF FG THEN M1=PEEK(16416):M2=PEEK(16417) ELSE M1=ROW(0):
M2=POS(0)
700 IF KN=1 THEN 830
710 FOR J=FF TO 0 STEP -1:PR=CA
730 PR=PR+(F(J)*KN)
740 CA=INT(PR/10):F(J)=PR-CA*10
750 NEXT J
760 IF F(0)>0 THEN FOR J=FF TO 0 STEP -1:F(J+1)=F(J):NEXT:F(0)=0:FF=FF+1:RP=RP+1
770 CA=0:FOR J=SS TO 0 STEP -1:PR=CA
780 PR=PR+(S(J)*KN)
790 CA=INT(PR/10):S(J)=PR-CA*10
800 NEXT J
820 'Lines 830-1040 start blinker and do the dividing
830 FOR N=1 TO RT:M=N/2:PRINT@ 63,CHR$(42+(M=N/2)*10);
840 IF F(N-1)=S(1) THEN D=9:GOTO 860
850 D=INT((F(N-1)*10+F(N))/S(1)):  'D = First trial digit
859 'Decrease if too large--Lines 860-870
860 IF D*S(2)<=(F(N-1)*10+F(N)-D*S(1))*10+F(N+1) THEN 890
870 D=D-1
889 'Multiply by trial digit, subtract, and place remainder in first array--Line
s 890-980
890 FOR J=SS-1 TO 0 STEP -1
900 F(N+J)=F(N+J)-D*S(J+1)
930 IF F(N+J)>=0 THEN 960
940 F(N+J-1)=F(N+J-1)+INT(F(N+J)/10)-1
950 F(N+J)=F(N+J)+(1-INT(F(N+J)/10))*10
960 K!=F(J+N)/10:K=INT(K!):F(N+J)=INT((K!-K+.05)*10)
970 F(N+J-1)=F(N+J-1)+K
980 NEXT J
990 IF F(N-1)=>0 THEN 1030
999 'Lines 1000-1020 correct remainder if trial digit is still one to large.
1000 FOR J=SS-1 TO 0 STEP -1:F(N+J)=F(N+J)+S(J+1)
1010 IF F(N+J)>9 THEN F(N+J-1)=F(N+J-1)+1:F(N+J)=F(N+J)-10
1020 NEXT J:D=D-1
1030 R(N+OF)=D
1040 NEXT N
1059 'Locate decimal in quotient and reset cursor.
1060 FOR R=RR TO RP STEP -1:R(R+1)=R(R):NEXT:R(RP)=-2:RT=RR+1
1070 IF FG THEN POKE16416,M1:POKE16417,M2 ELSE PRINT@ (M1,M2),"";
1999 'Subroutine to display result with no leading zeroes
2000 PRINT A$;:IF R(0)>0 THEN F$=RIGHT$(STR$(R(0)),1):FL=0:GOTO 2020
2010 FL=-1:IF R(0)=-3 THEN F$="-" ELSE F$=""
2020 FOR J=1 TO RT:IF FL AND R(J)=0 THEN 2042
2030 FL=0:IF R(J)>=0 THEN FT$=RIGHT$(STR$(R(J)),1) ELSE FT$="."
2040 F$=F$+FT$
2042 NEXT:IF FL AND R(J)=0 THEN F$="0"
2045 PRINT F$
2050 FOR J=0 TO RT:R(J)=0
2060 IF O$="*" OR O$="/" THEN 2100
2070 IF J=<ES THEN S(J)=0
2080 IF J=<EF THEN F(J)=0
2090 GOTO 2120
2100 IF J=<SS THEN S(J)=0
2110 F(J)=0
2120 NEXT J:RETURN
3999 'Exchanges first and second numbers
4000 T$=F$:F$=S1$:S1$=T$:RETURN
4999 'Subroutine to fill first and second arrays and determine position of decim
al point
5000 FP=0:SP=0:LF=0:LS=0:FOR F=1 TO FF:T$=MID$(F$,F,1)
5010 IF T$="." THEN FP=F:LF=FF-FP:GOTO 5030
5020 F(F)=VAL(T$)
5030 NEXT F:IF FP=0 THEN FP=F:LF=0
5040 FOR S=1 TO SS:T$=MID$(S1$,S,1)
5050 IF T$="." THEN SP=S:LS=SS-SP:GOTO 5070
5060 S(S)=VAL(T$)
5070 NEXT S:IF SP=0 THEN SP=S:LS=0
5080 RETURN
9999 'Error processing
10000 IF (FG AND ERR/2+1=9) OR (FG=0 AND ERR=9)THEN PRINT "OPERATION OVERSHOOTS
DIMENSIONED ARRAYS.":PRINT"Increase 'L' in Line 10 or shorten entry numbers":END
10010 IF ERL=2040 AND ((FG AND ERR/2+1=15) OR (FG=0 AND ERR=15)) THEN 10030
10020 IF FG THEN PRINT"ERROR CODE =";ERR/2+1;"IN LINE";ERL:STOP ELSE PRINT"ERROR
 CODE =";ERR;"IN LINE";ERL:STOP
10030 FL=-1:FOR J=0 TO RT:IF R(J)=-3 THEN 10050 ELSE IF FL AND R(J)=0 THEN 10055
10040 FL=0
10050 PRINT CHR$(R(J)+48);
10055 NEXT:PRINT
10060 PRINT "RESULT TOO LONG TO PRESERVE"
10070 PRINT "STRIKE 'I' TO INPUT NEW FIRST NUMBER OR 'E' TO END"
10080 A$=INKEY$:IF A$="" THEN 10080
10090 IF A$="I" THEN RUN ELSE IF A$="E" THEN END ELSE A$=INKEY$:GOTO 10080
```

End

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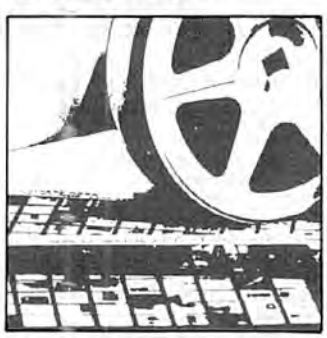

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Program Listing 1. Computes natural logarithms in double precision.

```
10 CLS:PRINT"PROGRAM TO COMPUTE LOG(X) IN DOUBLE PRECISION"
20 PRINT
30 PRINT
40 DEFDBL A-Z:DEFINT K,N
50 INPUT "VALUE OF X";X:PRINT
60 GOSUB 1000
70 PRINT "LOG(X)=";R
80 END
1000 'SUBROUTINE FOR LOG(X)
1010 QF=VAL(STR$(.693147))
1020 QL=VAL(STR$(1.80559945309D-07))
1030 Q=QF+QL
1040 KK=0:NN=0
1050 IF X<1 THEN X=1/X:NN=1
1060 IF X<2 THEN GOTO 1100
1070 X=X/2
1080 KK=KK+1
1090 GOTO 1060
1100 X=X-1:K=1:N=1
1110 B=0:C=1:E=1:F=0
1120 A=K*B+N*N*X*C
1130 D=K*E+N*N*X*F
1140 C=B:B=A:F=E:E=D
1150 R=B/E:RR=C/F:K=K+1
1160 N=FIX(K/2)
1170 IF R-RR<>0 THEN GOTO 1120
1180 IF KK=0 THEN GOTO 1200
1190 R=R+Q:KK=KK-1:GOTO 1180
1200 IF NN=0 THEN R=R+KK*Q ELSE R=-(R+KK*Q)
1210 RETURN
```

End

Program Listing 2. Computes natural exponents in double precision.

```
10 CLS:PRINT "PROGRAM TO COMPUTE EXP(X) IN DOUBLE PRECISION"
20 PRINT
30 PRINT
40 DEFDBL A-Z:DEFINT J,K,N
50 INPUT "VALUE OF X ";X:PRINT
60 GOSUB 1000
70 PRINT "EXP(X)=";R
80 END
1000 'SUBROUTINE FOR EXP(X)
1010 J=0
1020 IF ABS(X)<2 THEN GOTO 1040
1030 X=X/2:J=J+1:GOTO 1020
1040 B=1:C=0:E=1:F=1:N=1:K=2
1050 IF N=1 THEN KX=K-1 ELSE KX=2
1060 A=KX*B - C*X*SGN(N)
1070 D=KX*E - F*X*SGN(N)
1080 C=B:B=A:F=E:E=D
1090 K=K+1:N=-N
1100 IF E=0 OR F=0 THEN GOTO 1050
1110 R=B/E:RR=C/F
1120 IF R-RR<>0 THEN GOTO 1050
1130 IF J=0 THEN RETURN
1140 R=R*R:J=J-1:GOTO 1130
```

End

Program Listing 3. Computes exponentiation in double precision.

```
10 CLS:PRINT"PROGRAM TO DO DOUBLE PRECISION EXPONENTIATION"
20 PRINT:PRINT
30 DEFDBL A-Z:DEFINT J,K
40 INPUT "ENTER A POSITIVE BASE";X
50 INPUT "ENTER THE EXPONENT";N
60 BX=X
70 GOSUB 1000
80 PRINT:PRINT BX;"RAISED TO THE POWER ";M;" = ";Y
90 END
1000 'SUBROUTINE FOR EXPONENTIATION
1010 M=N:NX=0
1020 IF N<0 THEN N=-N:NX=1
1030 NN=FIX(N):N=N-NN
1040 NQ=0
1050 IF X<.5 THEN X=1/X:NQ=1
1060 X=X-1:K=1
1070 C=1:B=1:F=1:E=1-N*X
1080 A=B+K*(K+N)*X*C/(2*K*(2*K-1))
1090 AA=A+K*(K-N)*X*B/(2*K*(2*K+1))
1100 D=E+K*(K+N)*X*F/(2*K*(2*K-1))
```

Listing continued

Listing continued

```
1110 DD=D+K*(K-N)*X*E/(2*K*(2*K+1))
1120 B=AA:C=A:E=DD:F=D
1130 K=K+1
1140 IF E=0 OR F=0 THEN GOTO 1080
1150 R=B/E:RR=C/F
1160 IF R-RR<>0 THEN GOTO 1080
1170 NY=1:Y=R
1180 IF NN=0 THEN GOTO 1200
1190 NY=NY*(X+1):NN=NN-1:Y=NY*R:GOTO 1180
1200 IF NX=1 THEN Y=1/Y
1210 IF NQ=1 THEN Y=1/Y
1220 RETURN
```

End

Program Listing 4. Computes trigonometric functions in double precision.

```
10 CLS
20 PRINT"PROGRAM TO COMPUTE DOUBLE PRECISION
SIN(X),COS(X) & TAN(X)"
30 PRINT:PRINT
40 DEFDBL A-Z: DEFINT K
50 INPUT "ANGLE IN RADIANS";X
60 GOSUB 1000
70 PRINT "SIN(X)= ";SX:PRINT
80 IF R=0 THEN CX=KK ELSE CX=SX/TX
90 PRINT "COS(X)= ";CX:PRINT
100 IF CX<>0 THEN PRINT "TAN(X)= ";TX:END
110 PRINT CHR$(21);"TAN(X)=    ";CHR$(235);CHR
$(21):END
1000 'SUBROUTINE FOR SIN(X) & TAN(X)
1010 QF=VAL(STR$(3.14159))
1020 QL=VAL(STR$(2.653589793238D-06))
1030 PI=QF+QL
1040 IF X<0 THEN X=2*PI+X:GOTO 1040
1050 X=X-FIX(X/(2*PI))*2*PI
1060 IF X>PI THEN KK=-1 ELSE KK=1
1070 IF X>PI THEN X=X-PI
1080 X=X/2
1090 B=X:C=0:E=1:F=1:K=1
1100 A=(2*K+1)*B-X*X*C
1110 D=(2*K+1)*E-X*X*F
1120 C=B:B=A:F=E:E=D
1130 R=B/E:RR=C/F:K=K+1
1140 IF R-RR<>0 THEN GOTO 1100
1150 TX=2*R/(1-R*R)
1160 SX=KK*2*R/(1+R*R)
1170 RETURN
```

End

Program Listing 5. Computes arctangents in double precision.

```
10 CLS:PRINT "PROGRAM TO COMPUTE DOUBLE PRECISION ATN(X)"
20 PRINT:PRINT
30 DEFDBL A-Z:DEFINT K,N
40 INPUT "VALUE OF X=";X
50 GOSUB 1000
60 PRINT:PRINT "ATN(X)=";R
70 END
1000 'SUBROUTINE FOR ATN(X)
1010 QF=VAL(STR$(3.14159))
1020 QL=VAL(STR$(2.653589793238D-06))
1030 PI=QF+QL
1040 KK=SGN(X):NN=0
1050 X=ABS(X)
1060 IF X>1 THEN X=1/X:NN=1
1070 B=X:C=0:E=1:F=1:K=1
1080 A=(2*K+1)*B+K*K*X*X*C
1090 D=(2*K+1)*E+K*K*X*X*F
1100 C=B:B=A:F=E:E=D
1110 K=K+1
1120 R=C/F:RR=B/E
1130 IF R-RR<>0 THEN GOTO 1080
1140 IF NN=1 THEN R=PI/2-R
1150 R=R*KK
1160 RETURN
```

End

Program Listing 6. Computes square roots in double precision.

```
10 CLS:PRINT"PROGRAM TO COMPUTE SQR(X)"
20 PRINT
30 PRINT
```

Listing continued

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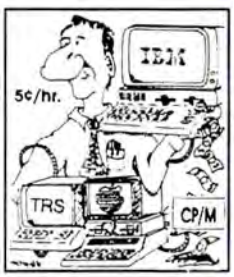

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Listing continued

```
40 DEFDBL A-Z:DEFINT J
50 INPUT "ENTER A NON-NEGATIVE NUMBER";X
60 GOSUB 1000
70 PRINT
80 PRINT "THE SQUARE ROOT OF";X;"=";R
90 END
1000 'SUB-ROUTINE FOR SQUARE ROOT
1010 IF X<1 THEN XX=1/X ELSE XX=X
1020 J=0
1030 IF XX<4 THEN GOTO 1060
1040 XX=XX/4:J=J+1
1050 GOTO 1030
1060 B=XX+1:C=1:E=2:F=1
1070 A=2*B+(XX-1)*C
1080 D=2*E+(XX-1)*F
1090 C=B:B=A:F=E:E=D
1100 R=B/E:RR=C/F
1110 IF R-RR=0 THEN GOTO 1120 ELSE GOTO 1070
1120 IF J=0 THEN GOTO 1140
1130 R=2*R:J=J-1:GOTO 1120
1140 IF X<1 THEN R=1/R
1150 RETURN
```

End

Program Listing. Solver/BAS.

```
10 ' SOLVER   by Roxton Baker
20 GOTO 490
30 ' (Kochenburger)- - - - - - - - - - - - - - - - - - -
40 IF(P)THEN 130
50 K=1
60 IF(ABS(Y(K))>YT(K)) THEN 90
70 IF(K=N)THEN 90
80 K=K+1:GOTO 60
90 IF(ABS(Y(K))>YT(K)) THEN 110
100 FI=T:GOTO 200
110 FOR I=1 TO N:DX(I)=-Y(I):NEXT I
120 J=1:TR=TR+1:P=T:GOSUB 220  :GOTO 200
130 FOR I=1 TO N:A(I,J)=Z*(DX(I)+Y(I)):NEXT I:X(J)=XS
140 IF(J=N)THEN 160
150 J=J+1:GOSUB 220  :GOTO 200
160 GOSUB 300  :FOR L=1 TO N
170 IF(X(L)+DX(L)>BU(L)) THEN DX(L)=(BU(L)-X(L))*RND(0)
180 IF(X(L)+DX(L)<BL(L)) THEN DX(L)=(BL(L)-X(L))*RND(0)
190 X(L)=X(L)+DX(L):NEXT L:P=F
200 RETURN
210 ' (Kochenburger)- - - - - - - - - - - - - - - - - - -
220 DE(J)=.01*X(J):IF ABS(DE(J))<.000001 THEN DE(J)=.001
230 IF(X(J)+DE(J)>BU(J)) THEN 270
240 IF(X(J)+DE(J)>=BL(J)) THEN 260
250 DE(J)=(BL(J)-.9999*X(J))
260 XS=X(J):Z=1/DE(J):X(J)=X(J)+DE(J):GOTO 280
270 DE(J)=BU(J)-1.0001*X(J):GOTO 260
280 RETURN
290 ' (Melsa) - - - - - - - - - - - - - - - - - - - - - -
300 G=1:FOR I=1 TO N:W=0:H=I
310 IF(ABS(A(H,I))<=ABS(W)) THEN 330
320 W=A(H,I):G=H
330 H=H+1
340 IF(H<=N)THEN 310
350 IF(G<I)THEN 390
360 IF(G=I)THEN 400
370 FOR M=1 TO N:Q=A(I,M):A(I,M)=A(G,M):A(G,M)=Q:NEXT M
380 Q=DX(I)
390 DX(I)=DX(G):DX(G)=Q
400 IF(ABS(A(I,I))<.000001)THEN A(I,I)=.01
410 DX(I)=DX(I)/A(I,I):Q=A(I,I)
420 FOR M=1 TO N:A(I,M)=A(I,M)/Q:NEXT M
430 FOR E=1 TO N:IF(E=I)THEN 470
440 IF(A(E,I)=0)THEN 470
450 DX(E)=DX(E)-A(E,I)*DX(I):Q=A(E,I)
460 FOR G=1 TO N:A(E,G)=A(E,G)-Q*A(I,G):NEXT G
470 NEXT E:NEXT I:RETURN
480 '- - - - - - - - - - - - - - - - - - - - - - - - - -
490 CLS:PRINT"SOLVER  -  by Roxton Baker":PRINT:CLEAR 500
500 DEFINT A-Z:DEFSNG A,B,D,Q,W,X,Y,Z
510 DIM I,J,E,G,N,L,H,M,Q,P,W,Z
520 DIM I$,K,F,T,XS,TR,FA,FI,PF,PP$,UN
530 SU$="Subscript too large - redo"
540 IB$="Improper bounds":PP$="#.####[[[["
550 DIM X(11),A(11,11),DX(11),DE(11)
560 DIM BL(11),BU(11),YT(11),Y(11)
570 T=-1:F=0:PF=F:ON ERROR GOTO 1020
580 PRINT:N=0:INPUT"How many equations (1-10)";N
```

Listing continued

Listing continued

```
590 IF N<=0 THEN 580
600 FOR I=1 TO N:YT(I)=.0001:NEXT I:PRINT
610 PRINT"Individual or common bounds (I/C*)?"
620 I$=INKEY$:IF I$="" THEN 620
630 IF I$<>"I" THEN 710
640 CLS:PRINT"Enter the bounds as:  lower,upper"
650 PRINT:PRINT"Bounds (*prev) for:"
660 BL(0)=0:BU(0)=0:FOR I=1 TO N
670 PRINT"X(";I;")";:BL(I)=BL(I-1):BU(I)=BU(I-1)
680 INPUT BL(I),BU(I)
690 IF(BL(I)>=BU(I)) THEN PRINT IB$: PRINT: GOTO 670
700 NEXT I:GOTO 750
710 CLS
720 PRINT"Enter common bounds as:  lower,upper ";
730 INPUT BV,BW:IF(BV>=BW)THEN PRINT IB$: PRINT: GOTO 720
740 FOR I=1 TO N:BL(I)=BV:BU(I)=BW:NEXT I
750 PRINT:PRINT"Change any individual bounds (Y/N*)?"
760 I$=INKEY$:IF I$="" THEN 760
770 IF I$="Y" THEN GOSUB 1290
780 CLS:UN=0:INPUT"How many U-variables (*none)";UN
790 PRINT:IF(UN=0)THEN 850
800 PRINT"Enter the value for:"
810 FOR I=1 TO UN:PRINT"U(";I;")";:INPUT U(I):NEXT I
820 PRINT:PRINT"Change a U-variable (Y/N*)?"
830 I$=INKEY$:IF I$="" THEN 830
840 IF I$="Y" THEN GOSUB 1370
850 CLS:PRINT"Enter value (*prev) for:":PRINT:X(0)=0
860 FOR I=1 TO N:PRINT"X(";I;")";:X(I)=X(I-1)
870 INPUT X(I):NEXT I
880 PRINT:PRINT"Change any value (Y/N*)?"
890 I$=INKEY$:IF I$="" THEN 890
900 IF I$="Y" THEN GOSUB 1440
910 FA=F:TR=1:FI=F:P=F
920 FOR I=1 TO N:IF(X(I)<BL(I)) THEN X(I)=BL(I)+.001
930 IF(X(I)>BU(I)) THEN X(I)=BU(I)-.001:NEXT I
940 GOSUB 1730 :IF INKEY$ <>"" THEN 1090
950 IF(P)THEN 990
960 CLS:IF(TR=1000)THEN TR=1
970 PRINT"The new estimates and resulting errors are:"
980 GOSUB 1510
990 GOSUB 40   :IF NOT(FI)THEN 920
1000 CLS:PRINT"A solution is:":GOSUB 1510 :GOTO 1090
1010 ' (Error handling)- - - - - - - - - - - - - - - - - -
1020 PRINT:IF(ERR=20)THEN 1060
1030 IF(ERR=8)THEN 1050
1040 PRINT"Error";ERR/2+1;:GOTO 1070
1050 PRINT"Illegal function call";:GOTO 1070
1060 PRINT"Division by zero";
1070 PRINT" in line";ERL:FA=T:RESUME 1090
1080 ' (Menu) - - - - - - - - - - - - - - - - - - - - - - -
1090 PRINT:PRINT"   V for new variable values";
1100 PRINT TAB(35)"B for new bounds"
1110 PRINT"   P to start printer output";
1120 PRINT TAB(35)"O to stop printer output"
1130 IF (FA) THEN 1150
1140 PRINT"  *C to continue";
1150 IF (UN<=0) THEN 1170
1160 PRINT TAB(35)"U for new U-var. values"
1170 I$=INKEY$:IF I$="" THEN 1170
1180 IF I$="P" THEN PF=T: GOTO 1170
1190 IF I$="O" THEN PF=F: GOTO 1170
1200 IF(FA)THEN 1220
1210 IF(I$=CHR$(13))OR(I$="C")THEN 1270
1220 IF(I$="V")THEN GOSUB 1440 : GOTO 1270
1230 IF(UN<=0)THEN 1250
1240 IF(I$="U")THEN GOSUB 1370 : GOTO 1270
1250 IF(I$<>"B")THEN 1170
1260 GOSUB 1290
1270 GOTO 910
1280 '- - - - - - - - - - - - - - - - - - - - - - - - - - -
1290 CLS
1300 PRINT"Specify variable bounds as:  subscript,lower,upper"
1310 PRINT"Enter 0,0,0 when done...":PRINT
1320 INPUT I,BL(I),BU(I):IF(I>N)THEN PRINT SU$
1330 IF(BL(I)>BU(I)) THEN PRINT IB$: GOTO 1320
1340 IF(I<>0)THEN 1320
1350 CLS:FA=F:RETURN
1360 '- - - - - - - - - - - - - - - - - - - - - - - - - - -
1370 CLS
1380 PRINT"Specify U-variable as:  subscript,value"
1390 PRINT"Enter 0,0 when done...":PRINT
1400 INPUT I,U(I):IF(I>UN)THEN PRINT SU$
1410 IF(I<>0)THEN 1400
1420 CLS:FA=F:RETURN
1430 '- - - - - - - - - - - - - - - - - - - - - - - - - - -
1440 CLS
```

Listing continued

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Listing continued

```
1450 PRINT"Specity variable values as:  subscript,value"
1460 PRINT"Enter 0,0 when done...":PRINT
1470 INPUT I,X(I):IF(I>N)THEN PRINT SU$
1480 IF(1<>0)THEN 1470
1490 CLS:FA=F:RETURN
1500 '- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1510 PRINT @ 59,TR," ";:PRINT
1520 PRINT TAB(1)"N";TAB(8)"X(N)";TAB(21)"ERROR";
1530 IF(N<=5)THEN PRINT: GOTO 1550
1540 PRINT TAB(35)"N";TAB(42)"X(N)";TAB(55)"ERROR"
1550 I=1
1560 IF(N>5)THEN 1590
1570 PRINT I; TAB(6)USING PP$; X(I);
1580 PRINT TAB(20)USING PP$; Y(I):GOTO 1650
1590 IF(N>=I+5)THEN 1610 :PRINT I; TAB(6)USING PP$; X(I);
1600 PRINT TAB(20)USING PP$; Y(N):GOTO 1650
1610 PRINT I; TAB(6)USING PP$; X(I);
1620 PRINT TAB(20)USING PP$; Y(I);
1630 PRINT TAB(34)I+5; TAB(40)USING PP$; X(I+5);
1640 PRINT TAB(54)USING PP$; Y(I+5);
1650 I=I+1:IF(I>N)OR(I=6)THEN 1670
1660 GOTO 1560
1670 IF NOT(PF)THEN 1710
1680 LPRINT" ":LPRINT TAB(1)"N";TAB(8)"X(N)";TAB(21)"ERROR"
1690 FOR I=1 TO N:LPRINT I; TAB(6)USING PP$; X(I);
1700 LPRINT TAB(20)USING PP$; Y(I):NEXT I
1710 RETURN
1720 '- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
1730 'This is where the system equations must be stated as
1740 'a subroutine, after deleting the following lines:
1750 '
1760 CLS:PRINT"Equations are missing at end of program!"
1770 STOP
```

End

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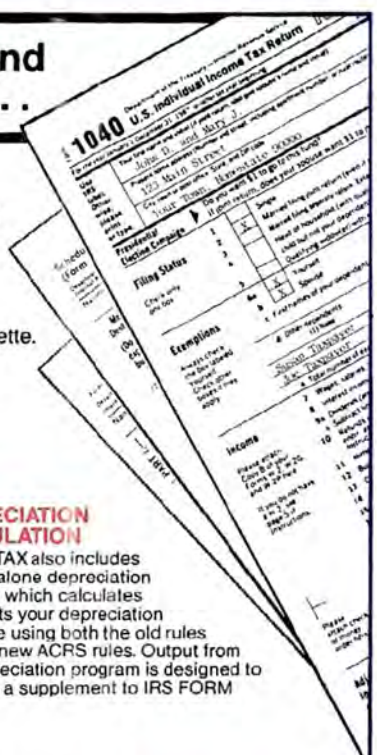

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Circle 215 on Reader Service card.

SOUNDS INCREDIBLE

by Robert Anderson

Blips, beeps, and all that jazz for the Model 4.

Trying to play a sonata on your Model 4 is like asking Liberace to write a data base manager by tickling the ivories: It's just not feasible. When I bought my Model 4, I was intrigued to learn that it had sound capability. After I brought the computer home, however, I found no reference to sound processing in the *Model 4 Disk System Owner's Manual*—except, that is, for the click filter that generates a sound whenever you press a key.

I found I could produce a variety of sounds using Basic's Sound command and arguments for tone and duration. Unfortunately, Sound supports only eight tones and 32 durations. Even more disappointing is the fact that the shortest duration is about .37 seconds; since the machine freezes during tone generation, using the Sound command slows program execution greatly.

The *Model 4 Technical Reference Manual* mentions a supervisor call named Sound. I thought this might solve my problem until I looked a little closer. Its limitations are identical to Basic's; in fact, it's the same routine. Stymied again.

New Routine

Not one to give up, I wrote an Assembly-language program that supports a wider range of arguments than Basic alone allows. My routine supports 2,000 possible tones, numbered from 1–2,000. I also pared the shortest tone duration to .04 seconds, thus minimizing processor interruption.

Because the Model 4 is an 8-bit machine, the number of possible durations varies according to the tone you generate. The formula for determining the possible durations for a given tone is:

1 < =Duration < =(65535*Tone/2000

You can use any duration for any of the 2,000 tones, but you'll get an overflow error if the duration doesn't fit in the above equation. In these cases, the computer generates a sound whose duration differs from the one requested.

Sounds Basic

Sound/BAS (see Program Listing 1) is a Basic program that uses data statements to load the sound routine into memory, starting at X'FF00' and ending at X'FF5F'. The first time you use the program, type in MEMORY (HIGH = X'FEFF') from TRSDOS Ready; then load Basic and execute the program. After storing the routine in high memory, Sound/BAS dumps Sound/CMD to your disk. Thereafter you can load the routine from TRSDOS Ready by typing in:

```
MEMORY (HIGH = X'FEFF')
LOAD SOUND/CMD
```

If you prefer to bypass this procedure and load the sound routine from a Basic program, load Sound/BAS into memory. At the Ready prompt, replace line 1120 with:

```
1120 RETURN
```

and delete lines 1130–1200. Then add the commands CLEAR,&HFF00:GOSUB 1000 to the first line of your program to reserve memory for the routine and load it into memory. (You can change the storage locations for Sound/BAS if they conflict with your Basic program, but be sure to change the addresses in Sound/BAS accordingly.) Your program must execute these memory-reserve commands only once. However, if the new program contains data statements, make sure that those statements for the sound routine precede the commands above.

Once you load the sound routine in Basic, you can generate sound by specifying tone and duration values via Basic's Call statement. You must define three integer variables for the routine's location, tone, and duration. The following program lines, for example, use the variables SND%, TON%, and DUR% to generate a tone of 12 with a duration of 25:

```
100 SND% = &HFF00
110 TON% = 12:DUR% = 25
120 CALL SND%(TON%,DUR%)
```

I included a demonstration program.

LOAD 80

System Requirements

Model 4/4P
64K RAM
Editor/assembler optional

Program Listing 1. Sound/BAS.

```
1000 'SOUND/BAS written by Robert Anderson, July 1985
1010 'LISTING 1
1020 'Stores advanced sound routine in high memory from &HFF00 to &HFF5F
1030 '
1040 CK=&H2C82:ML=&HFF00
1050 ML=&HFF00:FOR T=1 TO 6
1060 READ BY$
1065 'Convert 2-hex string bytes to single numeric decimal byte
1070 FOR R=1 TO 16:BT=VAL("&H"+MID$(BY$,R*2-1,2))
1080 POKE ML,BT:ML=ML+1
1090 CK=CK-BT
1100 NEXT R,T
1110 IF CK<>0 THEN PRINT"CHECKSUM ERROR--CHECK MACHINE CODE LINES":END
1120 '
1130 'Save routine
1140 '
1150 SYSTEM"DUMP SOUND/CMD (START=X'FF00',END=X'FF5F')"
1160 '
1170 'Sound test
1180 '
1190 SND%=&HFF00:TON%=0:DUR%=3
1200 FOR TON%=5 TO 20:CALL SND%(TON%,DUR%):NEXT TON%
1210 '
1220 'Data for routine
1230 '
1240 DATA F34E236669225EFFEB4E236669225CFF
1250 DATA 11D0072A5EFF7CD5C8EB01000003ED52
1260 DATA D21DFF0B78B1C81100002A5CFF7CB5C8
1270 DATA EB190B78B1C231FF444D3E00D3902A5E
1280 DATA FF2B7DB4C241FF3E01D3902A5EFF2B7D
1290 DATA B4C24EFF0B78B1C23AFFFEC901005000
```

End

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Program Listing 2. Music/BAS.

```
1 REM ***Demo program. Computer plays ASCII value of key struck.
2 REM     Duration defaults to five; hit control-A to change.
3 REM     Control-B exits program.
10 SND%=&HFF80
15 Y=5
20 WHILE A$<>CHR$(0)
30 A$=INKEY$
40 IF A$="" THEN GOTO 30
45 IF A$=CHR$(1) THEN GOSUB 200:GOTO 30
50 X=ASC(A$)
110 TON%=X:DUR%=Y
120 CALL SND%(TON%,DUR%)
125 IF X=2 THEN END ELSE PRINT X;
130 WEND
140 GOTO 15
200 PRINT:INPUT "duration";D$
210 Y=VAL(D$)
220 RETURN
```

End

Program Listing 3. Sound/ASM.

```
;SOUND/ASM WRITTEN BY ROBERT ANDERSON, JULY 1985
;LISTING 3
;ADVANCED SOUND ROUTINE FOR ASSEMBLY.
;
            ORG     0FF00H      ;CAN BE CHANGED IF NECESSARY
            DI
            LD      C,(HL)      ;THIS SECTION
            INC     HL          ;TAKES VALUES
            LD      B,(HL)      ;GIVEN BY
            LD      L,C         ;BASIC'S
            LD      (TONE),HL   ;CALL STATEMENT
            EX      DE,HL       ;AS ARGUMENTS
            LD      C,(HL)      ;FOR SOUND/CMD
            INC     HL          ;ON ENTRY:
            LD      B,(HL)      ;HL POINTS TO 16-BIT TONE
            LD      L,C         ;DE POINTS TO 16-BIT DURATION
            LD      (DURAT),HL  ;END OF PASSING ROUTINE
;
SOUND       LD      DE,2000     ;ENTRY POINT IF ARGUMENTS SAVED IN
            LD      HL,(TONE)   ;TONE AND DURAT
            LD      A,H
            OR      L
            RET     Z           ;IF TONE=0 THEN EXIT
            EX      DE,HL
            LD      BC,0
DIV1        INC     BC          ;DIVIDE 2000/TONE TO FIND
            SBC     HL,DE       ;NUMBER OF TIMES TO PASS
            JP      NC,DIV1     ;THROUGH GENERATION LOOP
            DEC     BC          ;IF DURAT EQUALED 1
            LD      A,B
            OR      C
            RET     Z           ;IF TONE>2000 THEN EXIT
            LD      DE,0
            LD      HL,(DURAT)
            LD      A,H
            OR      L
            RET     Z           ;IF DURAT=0 THEN EXIT
            EX      DE,HL
MLT1        ADD     HL,DE       ;MULTIPLY DURAT BY (2000/TONE)
            DEC     BC          ;TO FIND ACTUAL NUMBER TO
            LD      A,B         ;PASS THROUGH GENERATION LOOP
            OR      C
            JP      NZ,MLT1
ENTER       LD      B,H         ;SOUND GENERATION LOOP
            LD      C,L         ;BC=COUNT FOR LOOP
SL1         LD      A,0
            OUT     (99H),A     ;TURN OFF BIT 0 AT 99H
            LD      HL,(TONE)
SL2         DEC     HL          ;TONE DELAY
            LD      A,L
            OR      H
            JP      NZ,SL2
            LD      A,1
            OUT     (99H),A     ;TURN ON BIT 0 AT 99H
            LD      HL,(TONE)
SL3         DEC     HL          ;TONE DELAY
            LD      A,L
            OR      H
            JP      NZ,SL3
            DEC     BC          ;DECREMENT COUNT
            LD      A,B
            OR      C
            JP      NZ,SL1      ;DO IT AGAIN IF COUNT(BC)>0
            EI
            RET                 ;EXIT
DURAT       DEFW    1           ;DURATION
TONE        DEFW    59H         ;TONE
```

End

Music/BAS, to illustrate these principles (see Program Listing 2). With it, you can experiment with sounds on the Model 4 by pressing any key. The program sets a default-value duration of 5 and equates the tone it produces with the ASCII value of the key you press.

Assembly Lines

Program Listing 3 contains the Assembly-language version of the sound routine. You can use it in your own Assembly programs, changing the locations for the routine if necessary. Simply move the ORG statement to the start of a free area of memory and reassemble it, but be sure to provide space for all 96 bytes. Also, delete lines 00160–00270; they pass variables from Basic that are unnecessary in Assembly language.

To call the sound routine, the calling program would first have to store tone and duration values in the 16-bit integers TONE and DURAT. The command CALL SOUND would then generate the tone. For instance, the Assembly-language sequence:

```
LD      (TONE),12
LD      (DURAT),25
CALL    SOUND
```

generates the same sound produced by the Basic example above.

Final Analysis

As I experimented with my Model 4's sound capabilities, I realized that its sound system imposes certain limits on musical creativity. You access the sound board through port 144; it is the on/off toggling of this port's first bit that creates sound. The delay between each toggle sets the tone. A shorter delay produces a higher tone; a longer delay, a lower tone.

With my routine, you can't hear tones with a value lower than 4. When tones get low (around 1,000), they start sounding "dirty," more like a quick series of clicks than a pure tone. Furthermore, the difference between tones decreases as their values increase. That means you can easily differentiate between 10 and 11, but 1800 and 1801 are virtually indistinguishable.

Unfortunately, you can't control the volume of the sound produced. Some tones sound naturally louder than others (e.g., tone 30 is much louder than tone 50) and you can't circumvent this limitation. Another unavoidable characteristic of the sound board is that some tones begin and end with a clicking sound.

Don't let these drawbacks discourage you. I'm sure you'll find my sound routine efficient and easy to use—not to mention entertaining. An added bonus is that you can use it with CP/M, since it has no disk operating system calls. ■

Write to Robert W. Anderson at 21105 Santos St., Hayward, CA 94541.

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2/86

Macro Economics

Commando builds macros that let you set program parameters with a single command and customize DOS commands.

Nobody wants to do more work than they have to, and computer users are no exception. When it comes to executing programs and command sequences, computerists—no matter how good their typing skills and memories—are always looking to save keystrokes. That's why software manufacturers put so much emphasis on macros, sequences of commands you can execute with just a single command.

TRSDOS 1.3, of course, provides a macro of sorts, the Build command. But I wanted something more specific to my needs, so I wrote Commando, an Assembly-language program that creates customized macros (see the Program Listing). With Commando, you can set up a single command to invoke complex program parameters; you can also rename or abbreviate DOS commands.

Although designed for use with TRSDOS 1.3, Commando should work with DOSes that support standard TRSDOS calls (you may have to make some minor modifications, however). Exercise care when typing in line 400—for the program to operate properly, the operand field must contain an apostrophe, 63 spaces, and a final apostrophe.

The Formula

After assembling Commando, execute it by typing in the file name. The program prompts you to name the customized command you want to create ("Enter logical name:"); you can't use a TRSDOS 1.3 library command name, though. Commando then asks you to provide the TRSDOS commands necessary to accomplish the task of interest.

When you're done, you can invoke the macro by typing in the name you assigned it at TRSDOS Ready, and Commando will automatically execute the commands you specified.

LOAD 80

System Requirements

Model III
TRSDOS 1.3
Assembly language
Editor/assembler

Program Listing. Commando.

```
                        00010 ;**  COMMANDO by Craig Chaiken
EE00                    00020 START   EQU     0EE00H
0040                    00030 INPUT   EQU     0040H
021B                    00040 PRINT   EQU     021BH
01C9                    00050 CLS     EQU     01C9H
0040                    00060 LINE    EQU     64
                        00070 ;
EE00                    00080         ORG     START
EE00 CDC901             00090         CALL    CLS
EE03 2139EE             00100         LD      HL,MESS1        ;GET LOGICAL NAME
EE06 CD1B02             00110         CALL    PRINT
EE09 2164EE             00120         LD      HL,LOGNAME
EE0C 0640               00130         LD      B,LINE
EE0E CD4000             00140         CALL    INPUT
EE11 214DEE             00150         LD      HL,MESS2        ;GET DEFINITION
EE14 CD1B02             00160         CALL    PRINT
EE17 2118EF             00170         LD      HL,COMMAND
EE1A 0640               00180         LD      B,LINE
EE1C CD4000             00190         CALL    INPUT
EE1F 2164EE             00200         LD      HL,LOGNAME      ;REPAIR BUFFER
EE22 0640               00210         LD      B,64
EE24 23                 00220 LOOP    INC     HL
EE25 7E                 00230         LD      A,(HL)
EE26 FE03               00240         CP      3
EE28 D8                 00250         RET     C
EE29 FE0D               00260         CP      13
EE2B 2803               00270         JR      Z,DONE
EE2D 10F5               00280         DJNZ    LOOP
EE2F C9                 00290         RET
                        00300 ;
EE30 3620               00310 DONE    LD      (HL),32
                        00320 ;
EE32 215FEE             00330         LD      HL,MESS3        ;DUMP FILE
EE35 CD9942             00340         CALL    4299H
EE38 C9                 00350         RET
                        00360 ;
EE39 45                 00370 MESS1   DEFM    'Enter Logical Name:',03
     6E 74 65 72 20 4C 6F 67
     69 63 61 6C 20 4E 61 6D
     65 3A 03
EE4D 45                 00380 MESS2   DEFM    'Enter Definition:',03
     6E 74 65 72 20 44 65 66
     69 6E 69 74 69 6F 6E 3A
     03
EE5F 44                 00390 MESS3   DEFM    'DUMP '
     55 4D 50 20
EE64 20                 00400 LOGNAME DEFM    '
     20 20 20 20 20 20 20
     20 20 20 20 20 20 20 20
     20 20 20 20 20 20 20 20
     20 20 20 20 20 20 20 20
     20 20 20 20 20 20 20 20
     20 20 20 20 20 20 20 20
     20 20 20 20 20 20 20 20
     20 20 20 20 20 20 20
EEA3 28                 00410 PARAM   DEFM    '(START=0EF00,TRA=0EF00,END=0EF60)',13
     53 54 41 52 54 3D 30 45
     46 30 30 2C 54 52 41 3D
     30 45 46 30 30 2C 45 4E
     44 3D 30 45 46 36 30 29
     0D
                        00420 ;
EF00                    00430         ORG     0EF00H          ;FILE TO BE DUMPED
                        00440 ;
EF00 1118EF             00450         LD      DE,COMMAND      ;FIND END OF COMMAND
EF03 1A                 00460 LOOP1   LD      A,(DE)
EF04 FE0D               00470         CP      13
EF06 2803               00480         JR      Z,ELOOP
EF08 13                 00490         INC     DE
EF09 18F8               00500         JR      LOOP1
                        00510 ;
EF0B 0640               00520 ELOOP   LD      B,LINE          ;MOVE PARAMETERS TO
EF0D 2B                 00530         DEC     HL
EF0E 3620               00540         LD      (HL),32
EF10 EDB0               00550         LDIR                    ;END OF COMMAND BUFFER
                        00560 ;
EF12 2118EF             00570         LD      HL,COMMAND
EF15 CD9942             00580         CALL    4299H           ;EXECUTE COMMAND AT HL
                        00590 ;
0040                    00600 COMMAND DEFS    LINE
                        00610 ;
EE00                    00620         END     START
```

End

Macro Specific

Some programs require that you set up parameters before you can run them. Imagine that for your favorite Basic program, called Favorite/BAS, you have to set the memory size and the number of files before program execution. Each time you run Favorite, you have to type in:

```
BASIC -M:60000 -F:2V FAVORITE/BAS
```

Instead of entering and remembering this sequence, you could write a macro that includes these parameters, like:

```
COMMANDO
FAVORITE
BASIC -M:60000 -F:2V FAVORITE/BAS
```

Thereafter, you can execute Favorite by simply typing in its file name. Commando will automatically set Basic's memory size to 60000 and allocate two files of variable record length.

Commando has other advantages. Unlike a Build file, a Commando file accepts additional parameters at run time. With the sequence below, you can execute any Basic program with the stated memory size and file-allocation needs by typing in RUN FILE NAME at TRSDOS Ready:

```
COMMANDO
RUN
BASIC -M:60000 -F:2V
```

Change of Command

Commando also lets you alter TRSDOS's command language. If, for example, you're a CP/M user who has to do some work on the Model III, you can avoid confusion by renaming TRSDOS commands in CP/M. You follow the same procedure used in establishing program parameters. Call up Commando; then set the logical name and its definition.

For example, to change TRSDOS's Kill command to ERA—its CP/M counterpart—type in:

```
COMMANDO
ERA
KILL
```

Shortening commands, thereby reducing keystrokes, is equally easy. Abbreviating the directory print command, DIR (PRT), to DP is a matter of specifying DP as the logical name and DIR(PRT) as the definition. ■

Write to Craig Chaiken at 32 Beverly Drive, Avon, CT 06001.

Related Articles

Risler, Keith E. "Extra-Strength DOS," June 1985, p. 48. Install advanced LDOS 5.X.X and TRSDOS 6.X.X options on your system disks.

Wilson, Raymond. "Command Performance," June 1984, p. 62. Create and edit job control language (JCL) files.

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by Robert L. Smith and Dave Rowell

Free the Tandy 14 (K)

Get up to 14K extra in Model 1000 RAM with these byte-liberating techniques.

Load Basic on a 128K Tandy 1000 and you'll find cramped quarters for coding. After you load DOS and RAM-based GW-Basic, you're left with a tad more than 21K of free space (21,661 bytes). If you've installed DOS device drivers (e.g., ANSI.SYS) or you've souped up drive input/output in CONFIG.SYS, you're down a few more K. You can increase your free memory allotment by up to 14K, however, by reducing the 1000's RAM requirements for video storage.

Like the PCjr, the Tandy 1000 sets aside high RAM as a video workspace; it maps out the display right in RAM. (The IBM PC uses separate memory on its video expansion board.) The amount of RAM used for video depends on the graphics mode; high-resolution color mode takes 32K, 40-column text mode only 2K. The default allotment for video space is 16K. If you're using only text mode in a program, you can free up unused video memory with Basic's Clear statement for more program storage.

Clear, besides initializing the values of all variables and arrays, has several memory allocation functions, including setting the size of video memory. There's more involved, however. Basic always uses video memory starting at the bottom. Before liberating video memory with Clear, you must first force Basic to store its display at a higher address.

Basic divides video memory into pages when it reserves more memory than required by a given screen mode. You can move the display to a higher page with Basic's Screen statement. The 80-column text mode, for example, requires only 4K, so you have room for four pages in the default 16K video area.

The trick, then, is to set the display to the highest page in memory with Screen (fourth page in 80-column mode, eighth page in 40-column mode), then free up the lower pages with Clear. You gain 12K of usable RAM in 80-column mode and 14K in 40-column mode.

System Requirements

Tandy 1000
128K RAM

Programmed Memory

Program Listings 1 and 2 show the actual lines you use in your programs to gain extra memory in 40- and 80-column modes. When first loaded, Basic comes up in 80-column text mode with 16K cleared for graphics, so the first few program lines are redundant in most situations. Video memory size is the last parameter in the Clear command; the three commas hold places for the other Clear parameters which, if not specified, remain unchanged.

The first four parameters for the Screen statement represent video mode (zero equals text), burst (1 means "color on"), active video page (zero is the first page), and display video page. The active page is the one Basic's Print and graphics commands currently write to, and the display page is the one Basic actually displays. For our purposes, the active and the display page are always the same. (They don't have to be the same, which has interesting possibilities, but the first version of 1000 Basic is buggy with paging.)

After line 120 sets the text width (40 or 80 columns), the Screen command switches the display to the last page, highest in memory (line 130). Page numbering starts at zero. Now you can regain video memory with a Clear command (line 140). Lines 135 and 145 are for demonstration purposes and you should remove them. The FRE(0) command returns the amount of free RAM before and then after you use this technique.

The sequence of the three Basic statements in the Listings is important. You can't switch to a more demanding screen mode if you haven't allotted enough video RAM with Clear. For example, you can't go directly from 40- to 80-column mode after reducing video memory to the minimum 2K. To switch back to 80-column mode you must use the full procedure outlined in Listing 2. Before using Width 80, you should restore 16K of video space with Clear and page zero with Screen. Then you can switch to the fourth 80-column video page (page 3) and free up memory again with Clear.

A few final notes: This technique works only on a 128K 1000. On a larger 1000, you should have the maximum 60K workspace for your Basic programs (unless you've loaded memory-resident programs before running Basic). Also, all graphics modes use at least 16K, and you can't gain anything in these modes. ■

You can reach Robert L. Smith at 601 S.W. 36th St., Lee's Summit, MO 64063. You can reach Dave Rowell c/o 80 Micro, *80 Pine St., Peterborough, NH 03458.*

Program Listing 1. Clears an extra 14K in 40-column text mode. Delete lines 135 and 145 when you use this listing within a program.

```
10 '      Technique by Robert L. Smith to
20 '   free up video memory on 128K Tandy 1000.
30 '      80-Column text mode releases 12K.
40 '
100 CLEAR ,,,16384
110 SCREEN 0,1,0,0
120 WIDTH 80
130 SCREEN 0,1,3,3
135 PRINT "Memory available before clear: "; FRE(0)
140 CLEAR ,,,4096
145 PRINT "Memory available after clear:  "; FRE(0)
```

Program Listing 2. Clears an extra 12K in 80-column text mode. Delete lines 135 and 145 when you use this listing within a program.

```
10 '   Smith's technique for 80-column
20 '   mode releases 12K of video RAM.
30 '
100 CLEAR ,,,16384
110 SCREEN 0,1,0,0
120 WIDTH 80
130 SCREEN 0,1,3,3
135 PRINT "Memory available before clear: "; FRE(0)
140 CLEAR ,,,4096
145 PRINT "Memory available after clear:  "; FRE(0)
```

End

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Making All the Pieces Fit

I have presented three printer projects over the last two years: a parallel printer buffer (September and October 1984, pp. 102 and 146, respectively); a two-computer, single-printer electronic switch (October 1985, p. 82); and a single-computer, two-printer electronic switch (November 1985, p. 88). The next two projects are also printer-related. This month's is a serial-to-parallel converter (see the Photo); next month, I'll describe a parallel-to-serial converter.

Overview

Figure 1 shows the block diagram of the serial-to-parallel converter. For this converter to work, the computer must recognize the board as a printer's RS-232C interface, and the printer must identify the board as a computer's Centronics parallel printer port.

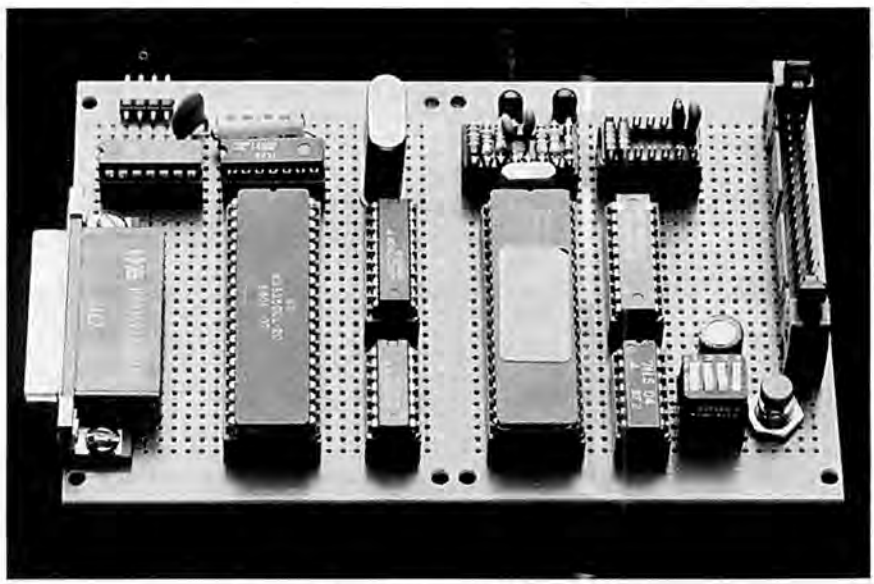

Photo. Serial-to-parallel converter.

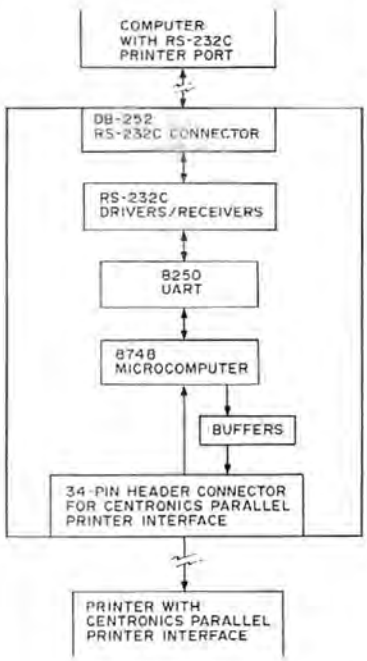

Figure 1. Block diagram of serial-to-parallel converter board.

The most obvious application of this project is to allow use of a parallel printer with a computer that has only an RS-232C port. But you can also run two parallel printers simultaneously on the same computer, connecting one printer to your computer's parallel printer port and the other to its RS-232C port through the serial-to-parallel converter.

A parallel printer interface usually limits the distance of the printer from the computer to about six feet, although you can extend it up to 10 feet. But you might find it difficult to concentrate with a printer rattling away close to your computer, especially if you use a printer buffer to run the printer while you use the computer.

The serial-to-parallel converter lets you locate your printer away from your computer. You can do this by using either an RS-232C port on your computer as the printer port or your computer's parallel printer interface in conjunction with next month's parallel-to-serial converter (see Figs. 2 a and b). While the RS-232C standard specifies a 50-foot distance limit, you can generally easily extend this to 100 feet or more.

Another possibility uses several printer-related projects presented here, and appears in Fig. 3. I do most of my work on my Model 4P (computer 2 in Fig. 3), which connects to my printer through my printer buffer. My Model I, however, is at a different location in my computer room, and is too far away to send information to the printer from its parallel port. The arrangement shown in Fig. 3 lets me use either computer with my printer, even though one computer is at a different location in the room. Also, since the printer buffer is at the output of the electronic switch, it stores characters regardless of which computer sends information. This set-up uses all of my printer-related projects except the two-printer switch.

About Interface

This project uses two standard interfaces, one an official standard (the RS-

LOAD 80

System Requirements

Models I, III, 4, and 1000
Assembly language
8748 Assembler

Photograph by Frank Cordelle

Circle 424 on Reader Service card.

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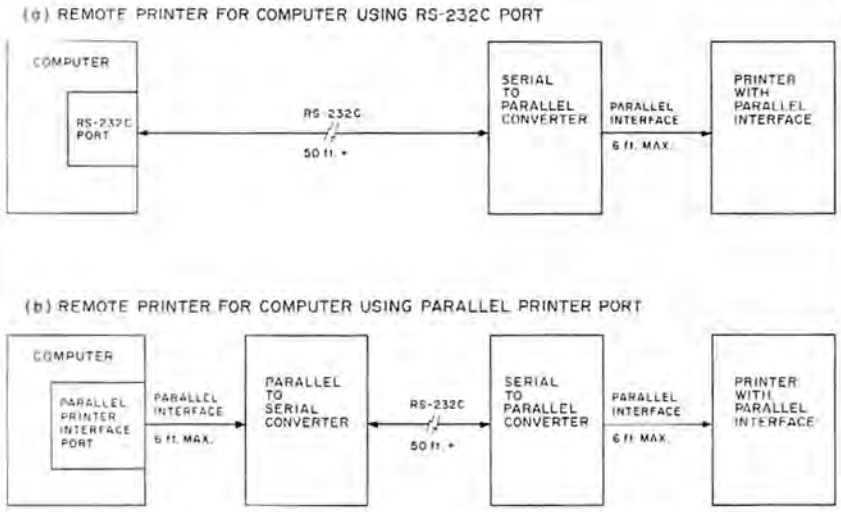

Figure 2. a) Using your computer's RS-232C port as a printer port. b) Using your computer's parallel printer interface with a parallel-to-serial converter (presented next month).

232C), the other a de facto standard (the Centronics parallel printer interface). The RS-232C is an EIA (Electronics Industries Assoc.) standard. The actual standard specification is available from the EIA.

Since I described the RS-232C serial and Centronics parallel interfaces in previous columns, I won't repeat the information here.

The 8250 UART

The 8250 asynchronous communications element, commonly referred to as a universal asynchronous receiver/transmitter (UART), handles the serial input/output (I/O) interface on the serial-to-parallel converter.

The 8250 UART is a 40-pin chip with a single serial channel, crystal oscillator, baud rate generator, and interrupt generator.

A block diagram of the 8250 UART appears in Fig. 4, and you can find a further description in the July 1985 Project 80 (p. 84).

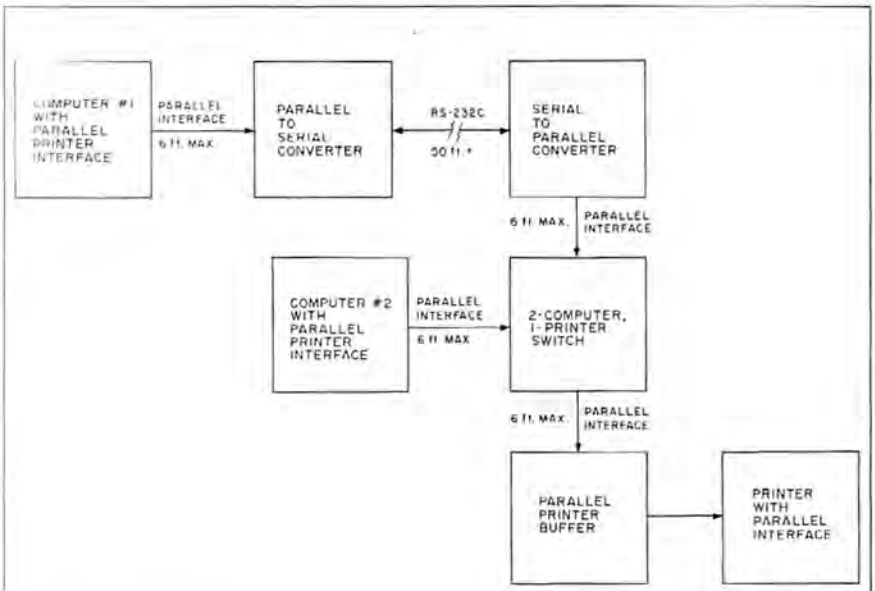

Figure 3. Possible computer-to-printer connections using various Project 80 hardware devices.

The 8748 Single-Chip Microcomputer

The 8748 single-chip microcomputer is a nifty 40-pin device with 1K of EPROM, 64 bytes of RAM, one counter/timer, 24 general-purpose I/O lines, three additional special input lines, an on-chip crystal oscillator, and interrupt control circuitry. While its instruction set and architecture are limited, the chip is certainly adequate for small control projects. A block diagram of the 8748 appears in Fig. 5. A further discussion of the 8748 microcomputer appears in the July 1985 Project 80 (p. 84).

Building the Serial-to-Parallel Converter Board

The schematic diagram of the serial-to-parallel converter appears in Fig. 6, with the parts list in Table 1. You will need two 40-pin sockets, two 20-pin sockets, and four 14-pin sockets (plus an 8-pin socket if you socket the DIP [dual in-line package] switch). If you use component carriers for resistors, diodes, and small capacitors, you also need two additional 14- or 16-pin sockets. For power, you need a +5-volt (at 400 milliamps) supply and ±12V to ±15V (at 100 milliamps) supply.

The board layout appears in Fig. 7. Note that the connector for the Centronics parallel printer interface is a 34-pin male header connector, not the standard 36-pin Centronics connector. I designed the header connector for a ribbon cable, which has a 34-pin female socket connector on one end that mates with the header and a male Centronics connector on the other. You should note the position of pin 1 of the header connector. To avoid confusion, I've provided the pin numbering of the header connector in Fig. 8. The cable assembly appears in Fig. 9, and is the same cable I used previously in both printer switch projects as well as the printer buffer.

Building the board is straightforward. Pay careful attention to the DB-25S pin numbers, which should be marked on the connector. Power and ground connections for the chips appear in the schematic (see Fig. 6).

A note concerning the DIP switch is in order. The switch numbers appear on the schematic. As indicated in Fig. 7, the left-most switch is switch 1, and the right-most is switch 4. If you wire the DIP switch properly, the right three switches will select the baud rate, with the right-most switch being the low-order baud rate select switch.

Handshaking

The DB-25S RS-232C connector is wired as a DTE (data terminal equip-

ment) device, the same as my printer (an Okidata Microline 92). Since most computers also have DTE-configured RS-232C ports, you will probably need a null modem cable between the computer and the serial-to-parallel converter (see Fig. 10).

In order to understand how all these pieces communicate with one another, a brief discussion of serial communication handshaking is in order.

Handshaking is a way to control information transferred among two or more systems. Many systems can't receive and process incoming information as rapidly as other systems can transmit it. For instance, a computer can usually send characters to a printer much faster than the printer can process them. The receiving system needs to indicate to the sending system when it is OK to send information and when it is not. This is called handshaking.

Generally, serial communication uses two types of handshaking, hardware and software. Hardware handshaking uses dedicated lines on the communications interface (the RS-232C port in this case), while software handshaking involves sending special characters to stop and start character transmissions.

The RS-232C standard specifies that you use several lines for handshaking. The most commonly used are RTS/ (request to send), CTS/ (clear to send), DTR/ (data terminal ready), and DSR/ (data set ready) lines. These signals work in pairs (RTS/-CTS/ and DTR/-DSR/), so that on any given interface connector, one of the signals in each pair acts as an output while the other serves as an input.

Serial communications provide several software handshaking methods, the most prevalent of which is XON/XOFF (transmission on/transmission off). This method uses two ASCII characters designated for XON and XOFF use. The ASCII DC1 character (11H or control-Q) represents the XON specifier, while the ASCII DC3 character (13H or control-S) provides the XOFF character. When DC3 goes to the transmitting system, the transmitting system responds by stopping its data transmission. It then resumes data transmission on receiving a DC1 character.

Transmitting systems can't always respond immediately to a change in handshaking status. This is important when telling the transmitting system to stop sending characters. If the receiving system has the ability to buffer up to 100 characters and waits until it receives the 100th character before telling the transmitting system to stop sending, the transmitting system may not be able to respond until it sends two or three more characters. It's important for the receiving system to tell the transmitting system to stop transmitting when there is still room in the receiver's buffer.

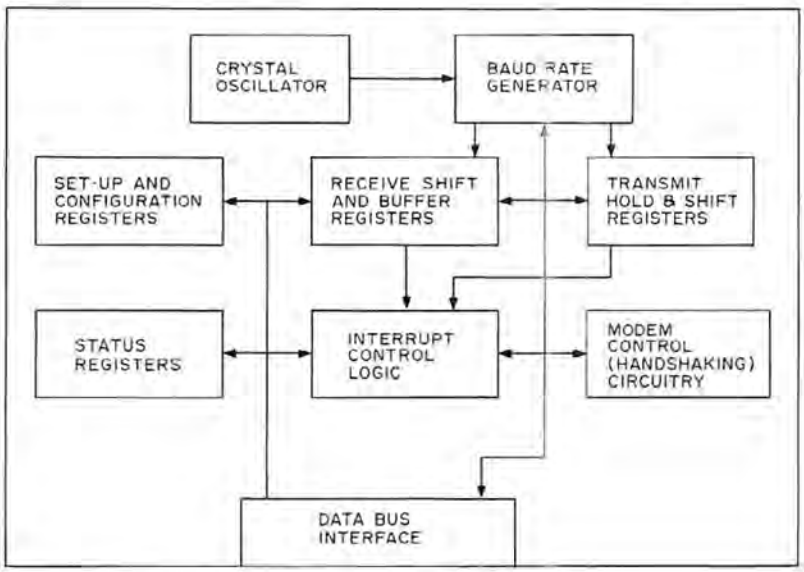

Figure 4. Block diagram of the 40-pin 8250 chip.

Most microcomputers that have RS-232C ports support hardware handshaking. Systems that have an RS-232C interface without hardware handshaking and systems that use an interface that doesn't support hardware handshaking resort to software handshaking, such as the XON/XOFF handshaking protocol.

The serial-to-parallel converter board described this month supports both RS-232C hardware handshaking and the XON/XOFF software handshaking protocol, which is DIP-switch selectable.

The cable between the serial-to-parallel converter board and your computer is probably a null modem cable. If your computer has a DCE interface (transmits on pin 3 and receives on pin 2), you need a straight-through cable, where lines 1–7 and 20 connect to the corresponding pins on each DB-25 connector on the cable.

You may not need all the lines, depending on your system's handshaking

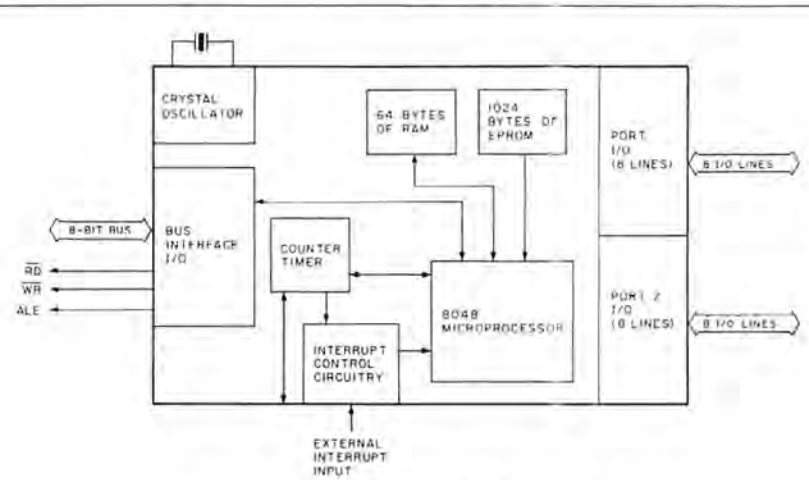

Figure 5. Block diagram of the 40-pin 8748.

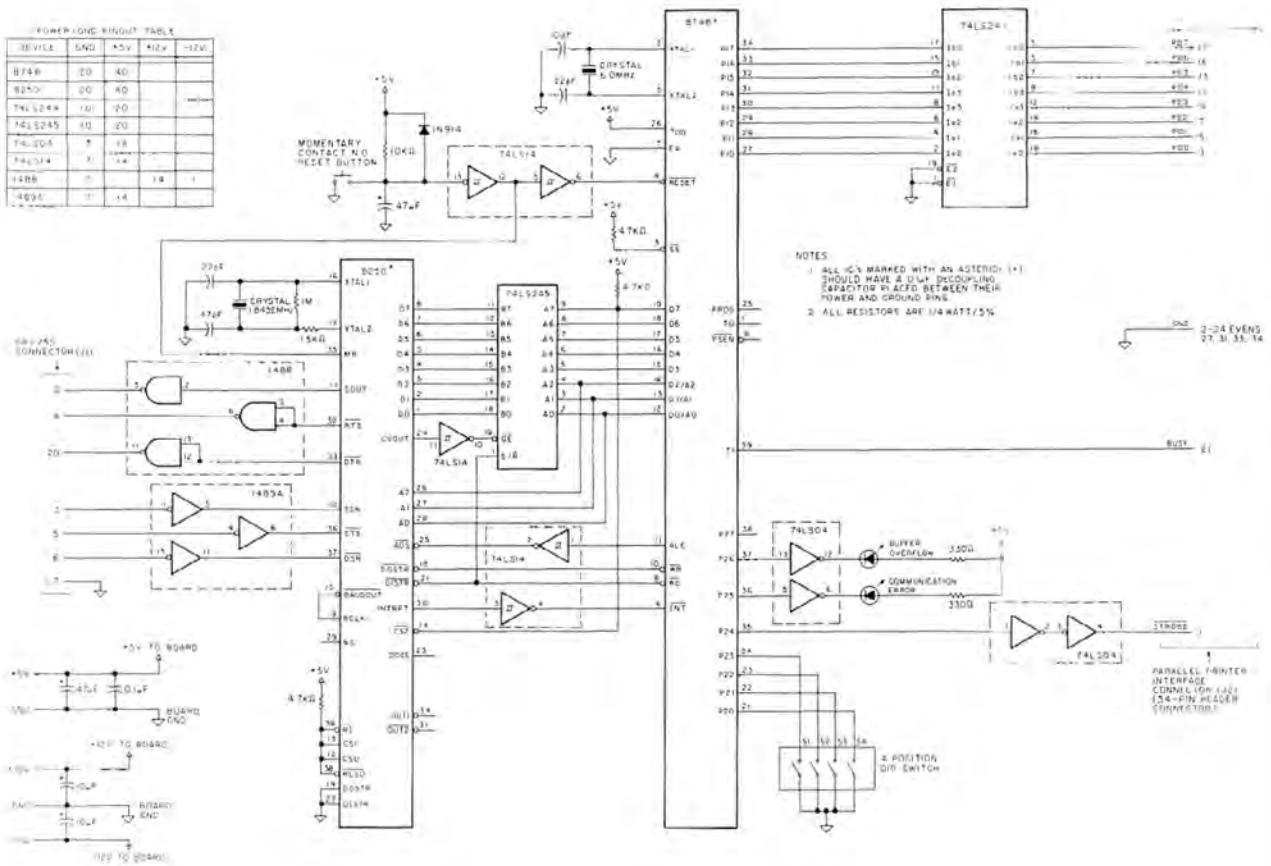

Figure 6. Schematic of the serial-to-parallel converter board.

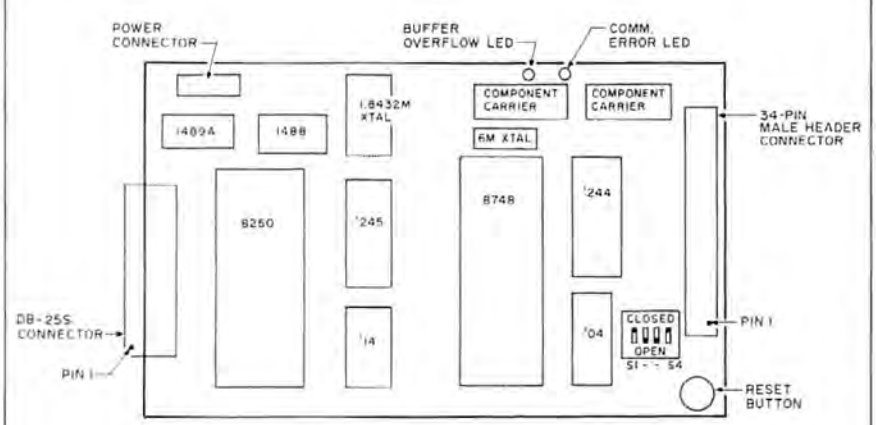

Figure 7. Layout of the serial-to-parallel converter board.

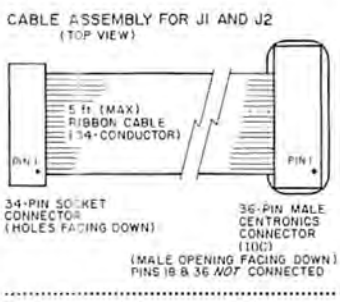

Figure 9. Cable assembly for the converter board.

Baud	S2	S3	S4
110	Off	Off	Off
300	Off	Off	On
600	Off	On	Off
1,200	Off	On	On
2,400	On	Off	Off
4,800	On	Off	On
9,600	On	On	Off
19,200	On	On	On

(On = closed, Off = open)

Table 2. DIP switch baud rate options.

Quantity	Description	Distributor	Part Number	Price (each)
1	8748 Single-chip microcomputer	JE	8748	7.95
1	8250 UART w/on-chip baud rate generator	JDR	8250	6.95
1	6.0 MHz Crystal	JDR		2.95
1	74LS04 Hex inverter (LS TTL) IC	JDR	74LS04	.24
1	74LS14 Hex Inverter/Schmitt trigger (LS TTL) IC	JDR	74LS14	.59
1	74LS245 Bidirectional bus buffer (LS TTL) IC	JDR	74LS245	1.49
1	74LS244 Octal tri-state buffer (LS TTL) IC	JDR	74LS244	1.29
1	LM1488 Quad RS-232C Driver IC	JDR	LM1488	.69
1	LM1489A Quad RS-232C Receiver IC	JDR	LM1489	.69
1	DB-25S/RA Right angle D-subminiature connector	JDR	DB25SR	4.42
1	34 pos. Cable header (w/w)	DK	R230-ND	1.90
1	4-pos. DIP switch (SPST)	RS	275-1304	1.49
1	Momentary contact SPST switch (mini)	RS	275-1571	.80
2	47 μF/35 V Electrolytic capacitors (PC mount)	RS	272-1027	.69
2	10 μF/16 V Tantalum capacitors	RS	272-1436	.69
3	.1 μF/50 V Disc capacitors	RS	272-135	.25
1	10 pF/500 V Disc capacitor	DK	P4000	.08
2	22 pF/500 V Disc capacitors	DK	P4004	.08
1	47 pF/50 V Disc capacitor	RS	272-121	.20
1	1N914 Small signal diode	RS	276-1122	.10
2	Red Light-emitting diodes	RS	276-041	.35
1	1 M ohm Resistor (¼watt)	DK		.05
1	10 Kohm Resistor (¼ watt)	RS	271-1335	.08
1	1.5 Kohm Resistor (¼ watt, 5%)	DK		.05
3	4.7 Kohm Resistors (¼ watt)	RS	271-1330	.08
2	330 ohm Resistors (¼ watt)	RS	271-1315	.08
1	36-position Centronics-type ribbon cable connector (male)	JE	CEN36M	8.69
1	34-position Ribbon cable socket connector	DK	R305-ND	2.24
6 feet	34-conductor Ribbon cable	DK	R026-NDx	

Parts Distributors

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JDR Microdevices, 1224 S. Bascom Ave., San Jose, CA 95128, 800-538-5000 or 408-995-5430 outside CA; 800-662-6279 inside CA.

Radio Shack National Parts Division (RS), 900 E. Northside Drive, Fort Worth, TX 76102, 817-870-5662.

Table 1. Parts list for serial-to-parallel converter.

34	+	+	33
32	+	+	31
30	+	+	29
28	+	+	27
26	+	+	25
24	+	+	23
22	+	+	21
20	+	+	19
18	+	+	17
16	+	+	15
14	+	+	13
12	+	+	11
10	+	+	9
8	+	+	7
6	+	+	5
4	+	+	3
2	+	+	1

(Top view)

Figure 8. Pin numbering for the converter board's 34-pin Centronics connector.

requirements. The serial-to-parallel converter transmits three RS-232C signals: the serial data output (pin 2), RTS/ (pin 4), and DTR/ (pin 20). Both RTS/ and DTR/ are handshaking lines toggled simultaneously by the 8748 controller software, so you need use only one of the two lines. Since most printers use pin 20 for handshaking (and/or pin 11), it is probably best to use pin 20 (DTR/) as the handshaking line to your computer's RS-232C port. If your computer has the standard DTE interface (transmits on pin 2 and receives on pin 3), then pin 20 from the serial-to-parallel converter should probably connect to pin 6 on your computer's RS-232C port. If your computer has a DCE port, however, connect pin 20 to pin 20 (straight through).

If you aren't using software handshaking, you don't have to include the serial data output line (pin 2) from the serial-to-parallel converter in your cable, since its only purpose is for the software handshaking option.

The DB-25S connector on the serial-to-parallel converter provides three RS-232C input lines: serial data input (pin 3), CTS/ (pin 5), and DSR/ (pin 6). Since the 8748 controller software never considers the input handshaking lines (CTS/ and DSR/),

these lines serve no useful purpose in this system and need not be connected. The serial data input line, however, sends characters from your computer to the serial-to-parallel converter.

The minimum cable configurations appear in Fig. 11 a and b for a computer with a DTE RS-232C port and a computer with a DCE RS-232C port. Be sure the DB-25 connector on the computer end of the cable mates with the DB-25 connector on your computer. If your computer uses a connector other than a DB-25 (such as the IBM PC-type 9-pin D-subminiature connector), use the signal names to configure your cable. In the case of the IBM PC, you can use a standard DTE IBM-type RS-232C cable (with a real DB-25 on the non-computer end) along with a null modem adapter.

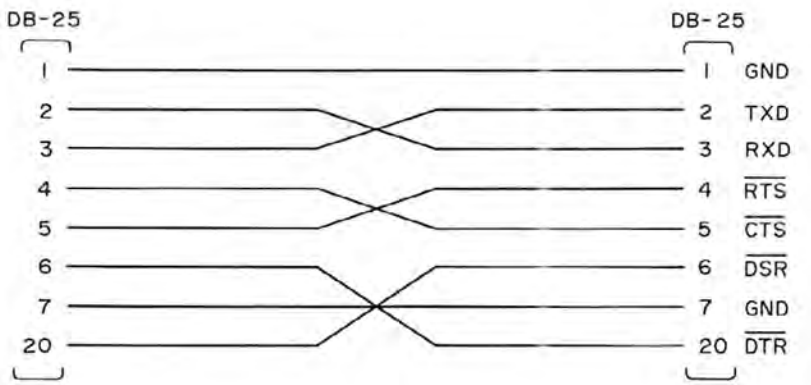

Figure 10. Null modem connection between the converter board and computer.

The DIP switch on the converter board selects both the serial port baud rate and the handshaking mode. Switches 2–4 select the baud rate, with switch 4 as the low-order switch (see Table 2). Switch 1 selects the handshaking mode. An open switch selects hardware handshaking, a closed switch software handshaking. Actually, the board uses hardware handshaking lines regardless of the switch setting. The switch merely determines if the board also uses XON/XOFF software handshaking protocol. Of course, a system using software handshaking may ignore the hardware handshaking lines.

The serial-to-parallel converter uses available 8748 RAM to buffer incoming characters, which is important because of the transmitting system's response delay after a change in the handshaking state.

The 8748 reserves 32 bytes to buffer incoming characters. If the buffer fills to the point where only 16 free buffer locations remain, it negates the handshaking lines (and sends XOFF, if appropri-

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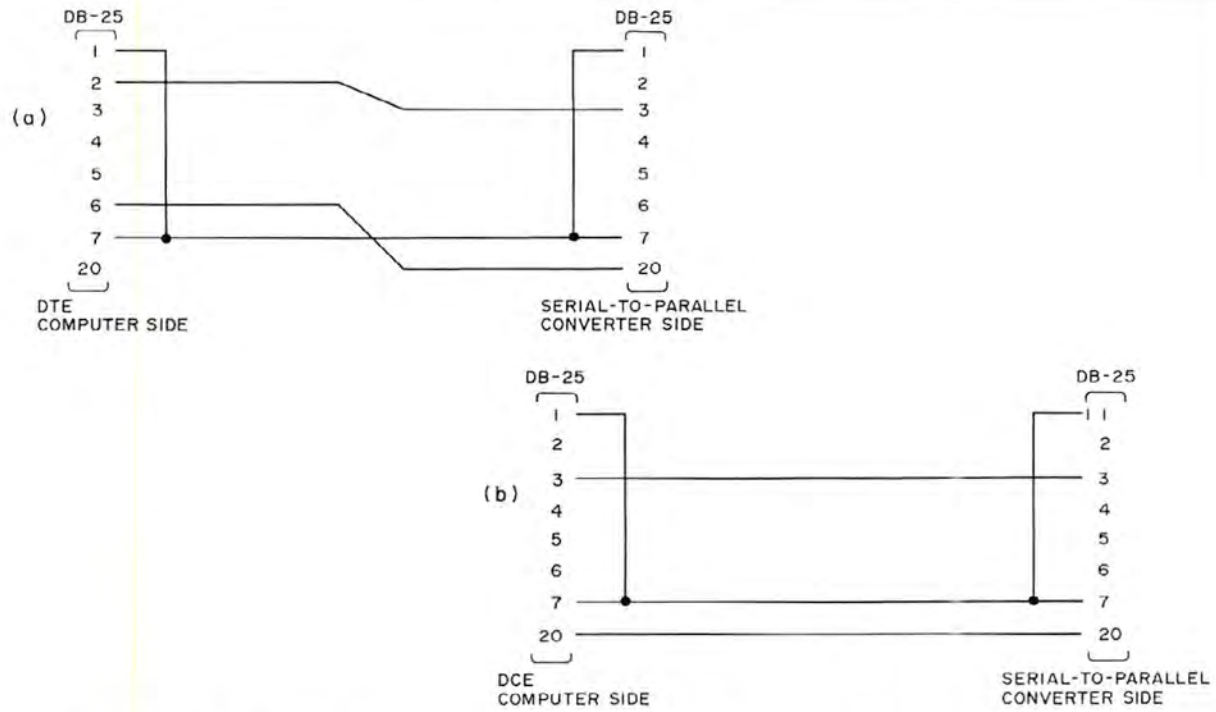

Figure 11. a)Minimum cable configuration for a computer with a DTE RS-232C port. b) Minimum cable configuration for a computer with a DCE RS-232C port.

* COMPUTERS USING SOFT HANDSHAKING SHOULD DROP THE HANDSHAKE LINE (PIN 20) AND ADD OTHER DATA LINE (PIN 2).

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TRS-80 Model IV. _____

Send Window-Comm to:
Name: _____
Company: _____
Address: _____
City, State, Zip _____

Program Listing. Control program for the serial-to-parallel converter.

```
                ;*************************************************************
                ;
                ;                       SERTOPAR/A48
                ;
                ; This program controls the Project 80 Serial to Parallel
                ; Converter, executing on an 8748-type microcomputer. The
                ; program allows either hardware "modem-control" handshaking
                ; or XON/XOFF handshaking.
                ;
                ;          *****  Written by Roger C. Alford  *****
                ;
                ;               Last modification: 11/02/85
                ;               Version: 1.0
                ;*************************************************************
                ;
                ; SYSTEM EQUATES:
0011            XON:    EQU     11H     ;ASCII XON CHARACTER (DC1)
0013            XOFF:   EQU     13H     ;ASCII XOFF CHARACTER (DC3)
0003            LCR:    EQU     03H     ;8250 UART "LINE CONTROL REGISTER"
0001            DLM:    EQU     01H     ;8250 UART "DIVISOR LATCH MSB" REG.
0005            LSR:    EQU     05H     ;8250 UART "LINE STATUS REGISTER"
0000            RBR:    EQU     00H     ;8250 UART "RECEIVER BUFFER REGISTER"
0000            THR:    EQU     00H     ;8250 UART "TRANSMITTER HOLDING REG."
0001            IER:    EQU     01H     ;8250 UART "INTERRUPT ENABLE REGISTER"
0004            MCR:    EQU     04H     ;8250 UART "MODEM CONTROL REGISTER"
0020            STRAM:  EQU     20H     ;START OF FREE RAM IN 8748
0020            CHRBFR: EQU     STRAM   ;INCOMING CHARACTER BUFFER
0020            BFRLEN: EQU     40H-CHRBFR ;LENGTH OF CHARACTER BUFFER
0040            BFREND: EQU     CHRBFR+BFRLEN ;END ADDR. + 1 OF CHAR. BUFFER
                ;
                ;*************************************************************
                ; THIS SECTION OF CODE CONTAINS THE RESET AND INTERRUPT
                ; VECTORS, AND THE RESET INITIALIZATION CODE.
                ;
0000                    ORG     00H
0000 0409       RESET:  JMP     INIT            ;SYSTEM RESET -- INIT. BELOW
0003                    ORG     03H
0003 0467       URTINT: JMP     PRCURT          ;UART INTERRUPT -- PROCESS IT
0009                    ORG     09H
0009 15         INIT:   DIS     I               ;MAKE SURE INT'S DSBLED
000A B800               MOV     R0,#00H         ;PREPARE R0 AND R1 FOR POWER-
000C B900               MOV     R1,#00H         ; UP STABILIZATION DELAY.
                                                ; (APPROX. 823 MS DELAY.)
000E F8         DLYLP:  MOV     A,R0            ;GET R0 (LOW DELAY BYTE) VALUE
000F 07                 DEC     A               ;DECREMENT THE LOW DELAY BYTE
0010 A8                 MOV     R0,A            ;STORE NEW DELAY BYTE VALUE
                                                ; BACK IN R0.
0011 960E               JNZ     DLYLP           ;IF R0 NOT ZERO, LOOP AGAIN
0013 F9                 MOV     A,R1            ;ELSE GET R1 (HI DLY BYTE) VLU
0014 07                 DEC     A               ;DECREMENT THE R1 DELAY BYTE
0015 A9                 MOV     R1,A            ;STORE NEW DELAY BYTE VALUE
                                                ; BACK IN R1.
0016 960E               JNZ     DLYLP           ;IF R1 NOT ALSO 0, LOOP AGAIN,
                                                ; ELSE DELAY COMPLETE.
0018 8A9F               ORL     P2,#9FH         ;MAKE SURE P2 BITS 0-4 AND 7
                                                ; ARE SET.
001A 9A9F               ANL     P2,#9FH         ;ALSO MAKE SURE BITS 4 AND 5
                                                ; ARE CLEAR, TO TURN OFF LEDS.
001C 14AE               CALL    SETURT          ;SET-UP THE UART
                ;
                ;*************************************************************
001E            MAIN:
                ;
                ; THIS SECTION OF CODE IS THE MAIN CONTROLLING LOOP, WHICH
                ; DETERMINES WHEN THE PRINTER CAN RECEIVE CHARACTERS AND
                ; HANDLES THE HANDSHAKING TO THE COMPUTER.
                ;
                ;       CERTAINS REGISTERS ARE DEDICATED AS FOLLOWS:
                ;               R1 -- BFRON: BUFFER ON POINTER
                ;               R2 -- BFROFF: BUFFER OFF POINTER
                ;               R3 -- BFRCNT: BUFFER CHARACTER COUNT
                ;               R4 -- HSFLAG: HANDSHAKE FLAG
                ;               R5 -- XFSNTF: XOFF SENT FLAG
                ;
001E B920               MOV     R1,#CHRBFR      ;INIT. R1 TO START OF BUFFER
0020 BA20               MOV     R2,#CHRBFR      ;INIT. R2 TO START OF BUFFER
0022 BB00               MOV     R3,#00H         ;BUFFER IS INIT. CLEAR
0024 BD00       SENXON: MOV     R5,#00H         ;CLEAR XOFF SENT FLAG
0026 B804               MOV     R0,#MCR         ;POINT AT UART MODEM CTRL REG.
0028 2303               MOV     A,#03H          ;SET RTS AND DTR OUTPUTS
002A 90                 MOVX    @R0,A           ;WRITE COMMAND TO MCR
002B FC                 MOV     A,R4            ;XON/XOFF HANDSHAKING?
002C 9632               JNZ     NOXX            ;IF NOT, WE'RE READY TO RUN
002E 2311               MOV     A,#XON          ;ELSE GET XON CHARACTER
0030 1450               CALL    SENCHR          ;SEND XON TO HOST SYSTEM
0032 05         NOXX:   EN      I               ;ENABLE INTERRUPTS FROM UART
0033 5633       WTFPRT: JT1     WTFPRT          ;WAIT UNTIL PRINTER IS READY
0035 FB                 MOV     A,R3            ;PRINTER READY, ANY CHAR'S.?
0036 C633               JZ      WTFPRT          ;IF NOT, JUST LOOP
0038 15                 DIS     I               ;ELSE DISABLE UART INT FOR NOW
0039 CB                 DEC     R3              ;DECREMENT BUFFER CHAR COUNT
003A FA                 MOV     A,R2            ;GET BUFFER OFF POINTER
003B A8                 MOV     R0,A            ;PUT INTO R0 AS POINTER
003C F0                 MOV     A,@R0           ;GET CHARACTER TO BE PRINTED
003D 39                 OUTL    P1,A            ;WRITE TO PRINTER DATA PORT
003E 9AEF               ANL     P2,#0EFH        ;DROP PRINTER STROBE LINE
0040 8A10               ORL     P2,#10H         ;RAISE PRINTER STROBE LINE
```

Listing continued

The serial-to-parallel converter uses available 8748 RAM to buffer incoming characters.

atel to tell the host to stop sending characters. This gives a 16-character response delay buffer, which should be sufficient for any system. If the buffer gets within four free locations of being full, it sends another XOFF (if software handshaking is enabled), assuming the transmitting system did not properly receive the first XOFF. This provides a back-up Stop command, with a four-character response delay buffer still available. The buffer reenables handshaking when it has 17 free locations available.

The 8748 controller software for the serial-to-parallel converter appears in the Program Listing. The first section provides a brief program description, followed by the "system equates" section that defines the XON/XOFF characters, the 8250 UART registers, and the input character buffer (storage) area. This is followed by the vector and initialization area. When an 8748 resets, execution always starts at location 000H. This location usually has a jump instruction to the start of the controller program (INIT). An interrupt generated by an external device (the 8250 UART) calls a subroutine (with automatically disabled interrupts) at location 003H. I also put a jump (to PRCURT) at the same location.

INIT starts the initialization code for the controller program. First, the program executes a delay loop of slightly less than a second to assure that power has stabilized to all board devices. After the power stabilization delay, the program sets P2 output to 9FH to allow proper reading of the DIP switches and to turn off the two LEDs. After it sets up port P2, it calls the SETURT subroutine to set up the 8250 UART.

The SETURT subroutine sets up the 8250 for 8-bit characters (standard for printers), no parity, and 1 stop bit. This will still allow the UART to properly receive characters having 2 stop bits. The routine then sets up the 8250 to generate an interrupt (to the 8748) whenever it receives a character and to disable the handshaking lines. The 8250 automati-

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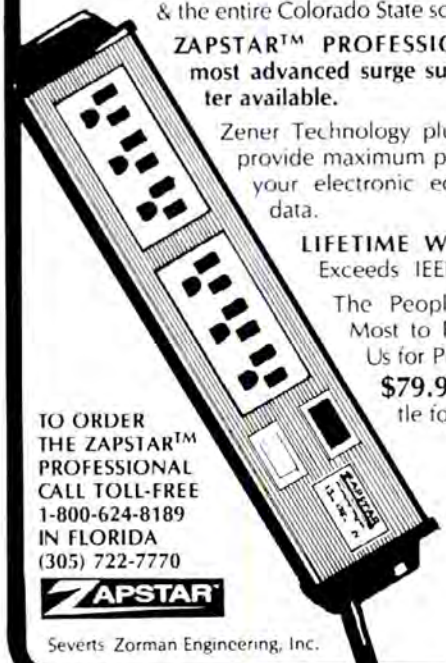

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The baud rate and handshaking modes are selected during system reset processing.

cally negates the handshaking lines during its reset operation, making this step redundant.

After disabling the handshaking lines, the routine sets the baud rate by reading in the DIP switch settings for switches 2–4 and using the complemented binary value (shifted left one bit position) as an offset to the baud rate divider table, BAUDTB. The program then sends the appropriate divider bytes to the 8250. As a final step before exiting the SETURT subroutine, the program reads in the value of switch 4 and puts it into a special flag register (R4), with all other bits in the byte cleared. If R4 is zero (switch closed), the program selects software handshaking. Otherwise, it selects hardware handshaking. The baud rate and handshaking modes are selected during system reset processing. If the program changes the DIP switch setting, the changes do not go into effect until the next board reset.

After the program completes reset initialization, execution enters the main controlling code section, MAIN. This section first initializes three pointers (R1, R2, and R3) used to maintain a circular buffer (queue) for incoming characters. It then enables the handshaking lines and, if appropriate, sends an XON character to the host system. Finally, the program enables external interrupts to permit the UART to notify the 8748 when it receives characters.

At WTFPRT, the 8748 keeps checking the busy bit from the printer (coming in on T1) until the printer is ready. If the busy bit is active (high), the program just loops continuously. During this time, the 8748 still receives and processes incoming characters from the computer since it handles them under interrupt control.

When the busy bit goes low, the program determines if any characters have been buffered and are ready to send to the printer. If so, it disables interrupts and sends the next character on the queue to the printer (port P1) and toggles the strobe line to the printer.

The program then checks to see if the handshaking is in a stop-transmitting state. If not, it goes back to NOXX to

Listing continued

```
0042  F8            MOV     A,R0            ;GET POINTER VALUE
0043  145D          CALL    UPDPTR          ;UPDATE CIRCULAR BUFFER
                                             ; POINTER VALUE.
0045  AA            MOV     R2,A            ;STORE UPDATED POINTER VALUE
0046  FD            MOV     A,R5            ;HAS COMM. STOP BEEN INITIATD?
0047  C632          JZ      NOXX            ;IF NOT, GO BACK AND RE-ENABLE
                                             ; INTERRUPTS AND PREPARE TO
                                             ; SEND NEXT CHAR. TO PRINTER.
0049  FB            MOV     A,R3            ;"STOP COMM." COMMAND SENT.
                                             ; GET BUFFER CHAR. COUNT.
004A  03F1          ADD     A,#0FFH-BFRLEN+17+1 ;DOES BUFFER HAVE 17 FREE
                                             ; SPACES NOW?
004C  C624          JZ      SENXON          ;IF YES, RE-ENABLE CHARACTER
                                             ; RECEIVING.
004E  0432          JMP     NOXX            ;ELSE CONTINUE WITHOUT RE-
                                             ; ENABLING CHAR. RECEIVING.
                ; END OF MAIN CONTROL ROUTINE: MAIN.
                ;
                ;*****************************************************
0050            SENCHR:
                ;
                ; THIS SUBROUTINE SENDS THE CHARACTER IN THE ACCUMULATOR OUT
                ; THE UART, AS SOON AS THE UART PERMITS A CHARACTER TO BE
                ; LOADED INTO ITS TRANSMITTER HOLDING REGISTER. REGISTERS A,
                ; R0 AND R6 ARE AFFECTED.
                ;
0050  AE            MOV     R6,A            ;STORE CHAR. TO BE SENT IN R6
0051  B805          MOV     R0,#LSR         ;POINT AT UART "LINE STATUS
                                             ; REGISTER".
0053  08          WTTX:  MOVX    A,@R0        ;GET UART STATUS REGISTER
0054  5320          ANL     A,#20H          ;IS THE TRANSMITTER FREE?
0056  C653          JZ      WTTX            ;IF NOT, JUST WAIT
0058  FE            MOV     A,R6            ;ELSE GET CHAR. BACK FROM R6
0059  B800          MOV     R0,#THR         ;POINT AT UART "TRANSMITTER
                                             ; HOLDING REGISTER".
005B  90            MOVX    @R0,A           ;SEND CHARACTER OUT UART
005C  83            RET                     ;ACC. CHARACTER SENT -- RETURN
                                             ; TO THE CALLING ROUTINE.
                ; END OF SUBROUTINE: SENCHR.
                ;
                ;*****************************************************
005D            UPDPTR:
                ;
                ; THIS SUBROUTINE UPDATES THE CHARACTER BUFFER POINTER PASSED
                ; IN THE ACCUMULATOR. SINCE THE CHARACTER BUFFER IS A CIRCULAR
                ; BUFFER (LOGICAL QUEUE), THE POINTER MUST BE RESET TO THE
                ; BEGINNING OF THE BUFFER IF IT IS INCREMENTED BEYOND THE END.
                ; REGISTERS A AND R0 ARE AFFECTED.
                ;
005D  17            INC     A               ;INCREMENT THE POINTER VALUE
005E  A8            MOV     R0,A            ;STORE TEMP. IN R0
005F  03C0          ADD     A,#0FFH-BFREND+1 ;POINTER EXCEEDED BUFFER END?
0061  9665          JNZ     PTROK           ;IF NOT, EXIT BELOW
0063  B820          MOV     R0,#CHRBFR      ;ELSE MOVE POINTER BACK TO
                                             ; START OF THE BUFFER.
0065  F8          PTROK: MOV     A,R0         ;PUT UPDATED POINTER VALUE
                                             ; BACK INTO ACC.
0066  83            RET                     ;ACC. POINTER UPDATED --
                                             ; RETURN TO THE CALLING
                                             ; ROUTINE.
                ; END OF SUBROUTINE: UPDPTR.
                ;
                ;*****************************************************
0067            PRCURT:
                ;
                ; THIS IS THE INTERRUPT SERVICE ROUTINE TO PROCESS RECEIVED-
                ; CHARACTER INTERRUPTS FROM THE 8250 UART. IF
                ; ROOM IS AVAILABLE, THE RECEIVED CHARACTER IS STORED ON THE
                ; CHARACTER BUFFER. IF THE BUFFER GETS DOWN TO 16 CHARACTERS
                ; OR 4 CHARACTERS, THE MODEM CONTROL LINES (AND XOFF, IF
                ; APPROPRIATE) ARE SET TO ASK THE HOST TO STOP SENDING
                ; CHARACTERS.
                ;
                ; IF AN ERROR IS DETECTED FOR A RECEIVED CHARACTER, THE
                ; COMM. ERROR LED IS TURNED ON. LIKEWISE, IF A CHARACTER IS
                ; RECEIVED WHEN THE BUFFER IS FULL, THE BUFFER OVERFLOW
                ; LED IS TURNED ON.
                ;
0067  D5            SEL     RB1             ;SELECT REG. BANK 1
0068  AA            MOV     R2,A            ;STORE THE CURRENT ACC. VALUE
0069  C5            SEL     RB0             ;SELECT REG. BANK 0 AGAIN
006A  F8            MOV     A,R0            ;GET CURRENT R0 VALUE
006B  D5            SEL     RB1             ;SELECT REG. BANK 1 AGAIN
006C  AB            MOV     R3,A            ;STORE CURRENT R0 VALUE HERE
006D  C5            SEL     RB0             ;GO BACK TO REG. BANK 0
006E  B805        GETNTR: MOV     R0,#LSR     ;POINT AT UART "LINE STATUS
                                             ; REGISTER".
0070  80            MOVX    A,@R0           ;GET UART STATUS REGISTER
0071  530A          ANL     A,#0AH          ;OVERRUN OR FRAMING ERROR?
0073  C677          JZ      NOERR           ;IF NOT, CONTINUE BELOW
0075  8A20          ORL     P2,#20H         ;ELSE SET THE "COMM. ERROR"
                                             ; LED.
0077  B800        NOERR:  MOV     R0,#RBR     ;POINT AT THE UART "RECEIVER
                                             ; BUFFER REGISTER".
0079  FB            MOV     A,R3            ;GET CURRENT BUFFER COUN VLU
007A  03E0          ADD     A,#0FFH-BFRLEN+1 ;IS THE BUFFER FULL?
007C  9683          JNZ     NOTFUL          ;IF NOT, CONTINUE BELOW
007E  80            MOVX    A,@R0           ;ELSE READ CHAR. FROM UART

007F  8A40          ORL     P2,#40H         ;TURN ON "BUFFER OVERFLOW" LED
0081  04A4          JMP     HSOK            ;CONTINUE PROCESSING BELOW
0083  80          NOTFUL: MOVX    A,@R0       ;GET RECVD CHARACTER FROM UART
```

Listing continued

Listing continued

```
00B4  A1              MOV     @R1,A           ;STORE CHARACTER IN BUFFER
00B5  F9              MOV     A,R1            ;GET BUFFER ON POINTER VALUE
00B6  145D            CALL    UPDPTR          ;UPDATE THE POINTER VALUE
00B8  A9              MOV     R1,A            ;STORE UPDATED POINTER VALUE
00B9  1B              INC     R3              ;UPDATE BUFFER COUNT VALUE
00BA  FB              MOV     A,R3            ;GET UPDATED COUNT VALUE
00BB  03F0            ADD     A,#0FFH-BFRLEN+16+1 ;DOWN TO 16 FREE SPACES IN
                                              ; BUFFER?
00BD  C694            JZ      RSOFF           ;IF YES, TURN HANDSHAKE OFF
00BF  FB              MOV     A,R3            ;GET UPDATED COUNT VALUE AGAIN
00C0  03E4            ADD     A,#0FFH-BFRLEN+4+1 ;DOWN TO 4 FREE SPACES IN
                                              ; BUFFER?
00C2  96A4            JNZ     RSOK            ;IF NOT, CONTINUE BELOW
00C4  BDFF      RSOFF:  MOV     R5,#0FFH        ;SET XOFF SENT FLAG
00C6  B804            MOV     R0,#MCR         ;POINT AT UART "MODEM CONTROL
                                              ; REGISTER".
00C8  2300            MOV     A,#00H          ;RESET RTS AND DTR LINES
00CA  90              MOVX    @R0,A           ;WRITE COMMAND TO MCR
00CB  FC              MOV     A,R4            ;GET HANDSHAKE FLAG
00CC  96A4            JNZ     RSOK            ;IF NOT XON/XOFF MODE, JUMP
00CE  D5              SEL     RB1             ;ELSE SWITCH TO REG. BANK 1
00CF  2313            MOV     A,#XOFF         ;GET ASCII XOFF CHARACTER
00D1  1450            CALL    SENCHR          ;SEND XOFF TO HOST SYSTEM
00D3  C5              SEL     RB0             ;SWITCH BACK TO REG. BANK 0
00D4  B66E      RSOK:   JNI     GETNTR          ;IF INTERRUPT INPUT IS STILL
                                              ; ACTIVE (LOW), PROCESS NEXT
                                              ; CHARACTER BEFORE EXITING.
00D6  D5              SEL     RB1             ;ELSE RESTORE ACC. AND R0
00D7  FB              MOV     A,R3            ;GET ORIG. R0 VALUE
00D8  C5              SEL     RB0             ;SELECT REG. BANK 0
00D9  A8              MOV     R0,A            ;STORE VALUE BACK INTO R0
00DA  D5              SEL     RB1             ;SELECT REG. BANK 1 AGAIN
00DB  FA              MOV     A,R2            ;GET ORIG. ACC. VALUE
00DC  C5              SEL     RB0             ;SELECT REG. BANK 0 AGAIN
00DD  93              RETR                    ;UART PROCESSING DONE --
                                              ; RETURN TO NORMAL PROGRAM
                                              ; CONTROL.
                ; END OF INTERRUPT SERVICE ROUTINE: PRCURT.
                ;
                ;*************************************************************
00DE            ;RETURT:
                ;
                ; THIS SUBROUTINE SETS UP THE 8250 UART. THE PARAMETERS
                ; INCLUDE 8 DATA BITS, NO PARITY, AND 1 STOP BIT. THE BAUD
                ; RATE IS SELECTED BY THE CONFIGURATION OF THE ON-BOARD DIP
                ; SWITCH, AS INDICATED BY THE BAUD RATE DIVIDER VALUE TABLE,
                ; "BAUDTB".
                ;
00DE  B803            MOV     R0,#LCR         ;GET THE ADDR. OF THE 8250
                                              ; "LINE CONTROL REGISTER".
00E0  2303            MOV     A,#03H          ;SELECT 8-BIT, NO PARITY,
                                              ; 1 STOP BIT CHARACTERS.
00E2  90              MOVX    @R0,A           ;WRITE VALUE TO THE 8250
                                              ; "LINE CONTROL REGISTER".
00E3  B901            MOV     R1,#IER         ;GET THE ADDR. OF THE 8250
                                              ; "INTERRUPT ENABLE REG.".
00E5  2301            MOV     A,#01H          ;SELECT INTERRUPT ENABLED FOR
                                              ; RECVD DATA AVAILABLE.
00E7  91              MOVX    @R1,A           ;WRITE VALUE TO THE 8250
                                              ; "INT. ENABLE REG.".
00E8  B904            MOV     R1,#MCR         ;GET THE ADDR. OF THE 8250
                                              ; "MODEM CONTROL REGISTER".
00EA  2300            MOV     A,#00H          ;CLEAR RTS AND DTR UNTIL
                                              ; SYSTEM INITIALIZED.
00EC  91              MOVX    @R1,A           ;WRITE VALUE TO THE 8250
                                              ; "MODEM CONTROL REGISTER".
00ED  2383            MOV     A,#83H          ;GET LINE CONTROL REGISTER
                                              ; VALUE AGAIN, BUT SET DLAB
                                              ; BIT.
00EF  90              MOVX    @R0,A           ;SET DLAB BIT IN THE "LINE
                                              ; CONTROL REGISTER".
00F0  0A              IN      A,P2            ;GET P2 BYTE CONTAINING BAUD
                                              ; RATE AND HANDSHAKING SWITCH
                                              ; SELECTIONS.
00F1  D3FF            XRL     A,#0FFH         ;COMPLEMENT THE BITS
00F3  5307            ANL     A,#07H          ;CLEAR ALL BUT VALID BAUD BITS
00F5  E7              RL      A               ;SHIFT THE VALUE LEFT ONE BIT
                                              ; POSITION TO CREATE AN OFFSET
                                              ; INTO THE BAUD RATE DIVIDER
                                              ; TABLE, "BAUDTB".
00F6  0300            ADD     A,#BAUDTB-300H  ;ADD THE BASE ADDRESS OF THE
                                              ; BAUD RATE DIVIDER TABLE TO
                                              ; POINT AT THE DESIRED ENTRY.
00F8  A9              MOV     R1,A            ;PLACE THE ADDRESS INTO R1 TO
                                              ; SAVE IT TEMPORARILY.
00F9  E3              MOVP3   A,@A            ;GET THE LOW-ORDER BAUD RATE
                                              ; DIVIDER BYTE.
00FA  AA              MOV     R2,A            ;SAVE IT TEMP. IN R2
00FB  F9              MOV     A,R1            ;GET THE BAUD RATE DIVIDER
                                              ; ADDRESS BACK.
00FC  17              INC     A               ;POINT AT THE HIGH-ORDER DIV.
                                              ; BYTE.
00FD  E3              MOVP3   A,@A            ;GET THE HIGH-ORDER BAUD RATE
                                              ; DIVIDER BYTE.
00FE  B901            MOV     R1,#DLM         ;POINT AT THE 8250 "DIVISOR
                                              ; LATCH MSB" REGISTER.
0100  91              MOVX    @R1,A           ;WRITE THE HIGH-ORDER BAUD
                                              ; RATE DIVIDER BYTE TO IT.
0101  C9              DEC     R1              ;POINT AT THE 8250 "DIVISOR
                                              ; LATCH LSB" REGISTER.
0102  FA              MOV     A,R2            ;GET THE LOW-ORDER BAUD RATE
```

Listing continued

reenable interrupts and again check for the printer to be ready. If the handshaking is in the stop-transmitting state (R5 non-zero), the program checks to see if 17 buffer locations are free. If so, control branches to SENXON to reenable transmitting, then reenables interrupts and resumes processing at WTFPRT. If 17 buffer locations are unavailable, control branches to NOXX to reenable interrupts and continue processing at WTFPRT.

PRCURT is the interrupt service routine to service serial characters the 8250 UART receives. After saving the A and R0 registers in the temporary register bank (bank 1), PRCURT reads the UART status register and checks for overrun and framing errors. If an error has occurred, it turns on the communications error LED.

Next, the program checks the buffer to see if it's full. If it is, it turns on the buffer overflow LED, and reads in the received character from the 8250 and discards it. If room exists in the buffer, the program reads in the character from the 8250 and stores it in the buffer. If the buffer now has 16 or four free locations remaining, the program sets the R5 stop-transmitting-initiated flag (to 0FFH) and negates the hardware handshaking lines to stop the host system from sending any more characters. If appropriate (R4 zero), it also sends an XOFF character.

Before exiting the PRCURT interrupt service routine, the program checks the interrupt input line to see if the 8250 has received another character. If so, it processes it as described above. After no more receive characters are available, the program restores the A and R0 registers from register bank 1 and exits the service routine (the RETR instruction automatically reenables interrupts).

Using the Serial-to-Parallel Converter Board

To use the serial-to-parallel converter board, connect the power supply, RS-232C, and parallel printer cables to the appropriate systems, and configure the DIP switch according to the handshaking protocol and baud rate desired. The power to the board may be applied before or along with the power to the computer and printer. The board will require 1.0 to 1.5 seconds for power-up initialization before it can accept characters from the host computer.

Acknowledgement

I would like express my appreciation to David Snearline for his help in constructing this month's project.■

Write to Roger C. Alford at P.O. Box 2014, Ann Arbor, MI 48106. Please enclose a self-addressed, stamped envelope for a reply.

Listing continued

```
                                                ; DIVIDER BYTE.
00D3  91                MOVX    @R1,A           ;WRITE THE LOW-ORDER BAUD RATE
                                                ; DIVIDER WORD TO THE 8250
                                                ; "DLL" REGISTER. THE BAUD
                                                ; RATE IS NOW SET.
00D4  2303              MOV     A,#03H          ;GET ORIGINAL "LCR" VALUE
                                                ; BACK, CLEARING THE HIGH-
                                                ; ORDER "DLAB" BIT, TO ALLOW
                                                ; ACCESS TO THE RECEIVE CHAR.
                                                ; REGISTER.
00D6  90                MOVX    @R0,A           ;WRITE THE NEW "LCR" VALUE TO
                                                ; THE 8250.
00D7  0A                IN      A,P2            ;GET DIP SWITCH BYTE AGAIN
00D8  5308              ANL     A,#08H          ;CLEAR ALL BUT THE "HAND-
                                                ; SHAKING" BIT (BIT 3).
00DA  AC                MOV     R4,A            ;STORE HANDSHAKE FLAG. IF 0,
                                                ; XON/XOFF H.S., OTHERWISE
                                                ; MODEM H.S.
00DB  83                RET                     ;8250 SET-UP DONE -- RETURN TO
                                                ; THE CALLING ROUTINE.
                ; END OF SUBROUTINE: SETURT.
                ;
0300                    ORG     300H
                ;*****************************************************
0300            BAUDTB:
                ;
                ; THIS TABLE HOLDS THE 2-BYTE 8250 TIMER DIVIDE VALUES FOR
                ; THE BAUD RATES PERMITTED BY THIS SYSTEM, AS SELECTED BY
                ; THE ON-BOARD DIP SWITCH.
                ;
0300  1704              DB      17H,04H         ;110 BAUD -- LOW/HIGH BYTES
0302  8001              DB      80H,01H         ;300 BAUD -- LOW/HIGH BYTES
0304  C000              DB      0C0H,00H        ;600 BAUD -- LOW/HIGH BYTES
0306  6000              DB      60H,00H         ;1200 BAUD -- LOW/HIGH BYTES
0308  3000              DB      30H,00H         ;2400 DAUD -- LOW/HIGH BYTES
030A  1800              DB      18H,00H         ;4800 BAUD -- LOW/HIGH BYTES
030C  0C00              DB      0CH,00H         ;9600 BAUD -- LOW/HIGH BYTES
030E  0600              DB      06H,00H         ;19,200 BAUD -- LOW/HIGH BYTES
                ;
                        END

Error total = 0
```

End

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Hard Wares: Comparing Two Megamemory Hard Drives

Cheap IBM PC hard drives are everywhere, but you can't just plug any IBM PC-compatible drive into your Tandy 1000. Fortunately, several companies now offer drives modified for the 1000. This month I'll report on 10-megabyte internal drives from Hard Drive Specialist ($549) and Osicom ($599).

I installed each half-height unit, in turn, on my 640K work machine with Tandy 1000 MS-DOS 2.11.00 (the original version). I loaded 2.8 megabytes' worth of programs and files onto each one, set up appropriate subdirectories and batch files (see last month's column, p. 96), and went about my daily work. Since then I've been smiling more, and days go by when I haven't had to put a floppy in drive A.

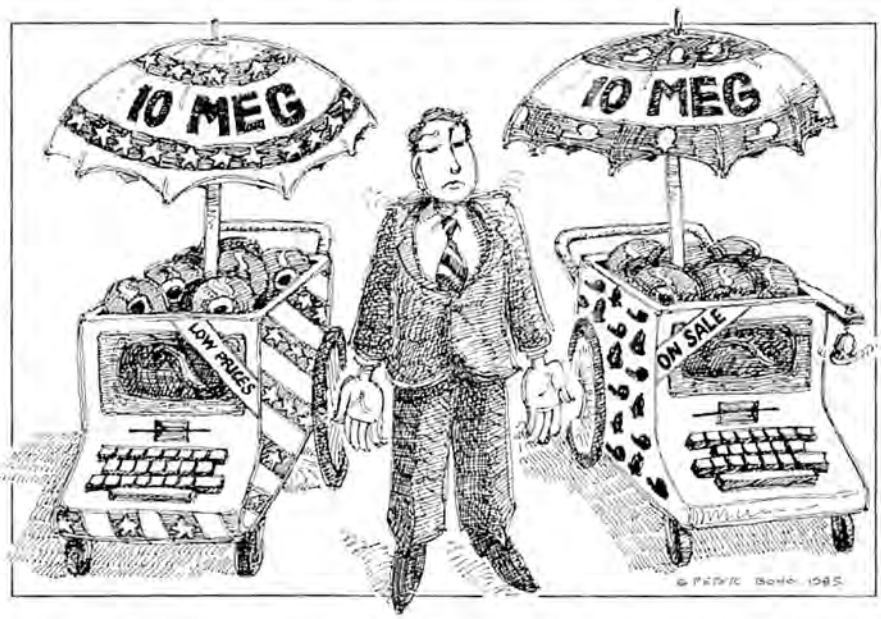

Illustration by Peter Bono

Hard Drive Specialist

Tandon makes the drive I tested from Hard Drive Specialist (HDS). This 5¼-inch unit is going out of production, and HDS is switching to Tandon 3½-inch drives (no price change). Their 20-megabyte drive ($749) has been a 3½-inch Tandon all along.

HDS uses a plated medium (comprising chromium and cobalt oxides) that's much tougher than cheaper iron oxide-coated platters. Head crashes, for instance, damage only the read/write heads, not the disk.

Three single-spaced typewritten pages make up the drive's documentation. The installation instructions barely suffice, but the formatting directions are fine. The drive slides in right above drive A. Three screws secure it in the drive enclosure. The third screw is tough to install without a screwdriver that grabs the screw. I taped the screw to a regular driver and carefully maneuvered it through the hole in the metal cage an inch or so until it reached the drive's chassis.

You might have to remove any expansion boards in the 1000 if your screwdriver has a long handle. If you're not dexterous, following the instructions might take awhile. I was lucky on my first try. It's too bad everybody doesn t supply a special long-headed screw like the one that comes with the Tandy floppy drive kit (the floppy drive screws aren't the right thread size for the hard drive).

The short Western Digital controller board comes with its support bracket tab trimmed to fit in the 1000. The two ribbon cables are already attached to the controller board, but you'll have to guess how to attach the other end of the 34-pin cable to the drive. The instructions tell you that if you guess wrong, the drive access light will stay on when you turn on the 1000. No damage is done; just reattach the cable properly. The 20-pin ribbon cable has a filled hole that corresponds with a missing pin on the drive connector. You can't go wrong there, and the three-wire power cable has a one-way-only connector.

Tandy Software

HDS supplies the Tandy Hard Disk Utilities (complete with Tandy label) with its drives, containing HSECT, FDISK, HFORMAT, Assign, Back-up, and Restore utilities. The drive comes physically formatted (with a report), but HDS suggests repeating the low-level format with HSECT. It takes only two and a half minutes (all four sides have 305 tracks). I used FDISK to set up one partition, then HFORMAT C:/s/v to set up the partition with MS-DOS system files and make it bootable. High-level formatting took two minutes and 10 seconds.

The HDS drive is quieter than the 1000's quiet fan. You can't hear it unless the drive is active, and that's a pleasant sound. The single red light flickers during drive access. A crude test of drive performance called the Doran test shows the HDS 10 megger as slightly faster (1.1 times) than an IBM PC XT's.

According to HDS, the 5¼-inch Tandon averages 8.5 watts (W) when running, not an unreasonable demand on the 1000's puny power supply. It does grab 19 W when you turn it on (necessary to get up to speed quickly). The smaller 3½-inch drive HDS is switching to has a starting power of fewer than 10 W and runs at around 6 W. It should be even quieter.

I noticed one problem with the HDS hard drive ROM software. I couldn't boot my 1000 with Sublogic's Jet flight simulator in drive A. Like Microsoft Flight Simulator, Jet doesn't use the operating system. Fortunately, you don't have to run Jet from a boot. You can boot MS-DOS disks from drive A.

Hey, Rosy

The Rose from Osicom is a 10-megabyte Rodime 3½-inch drive. Power consumption averages 10 W during drive access, but shuts down to 6 W after two seconds of non-use so it stays cool. Osicom's 10 megger also uses a plated medium rather than less durable iron oxide coating.

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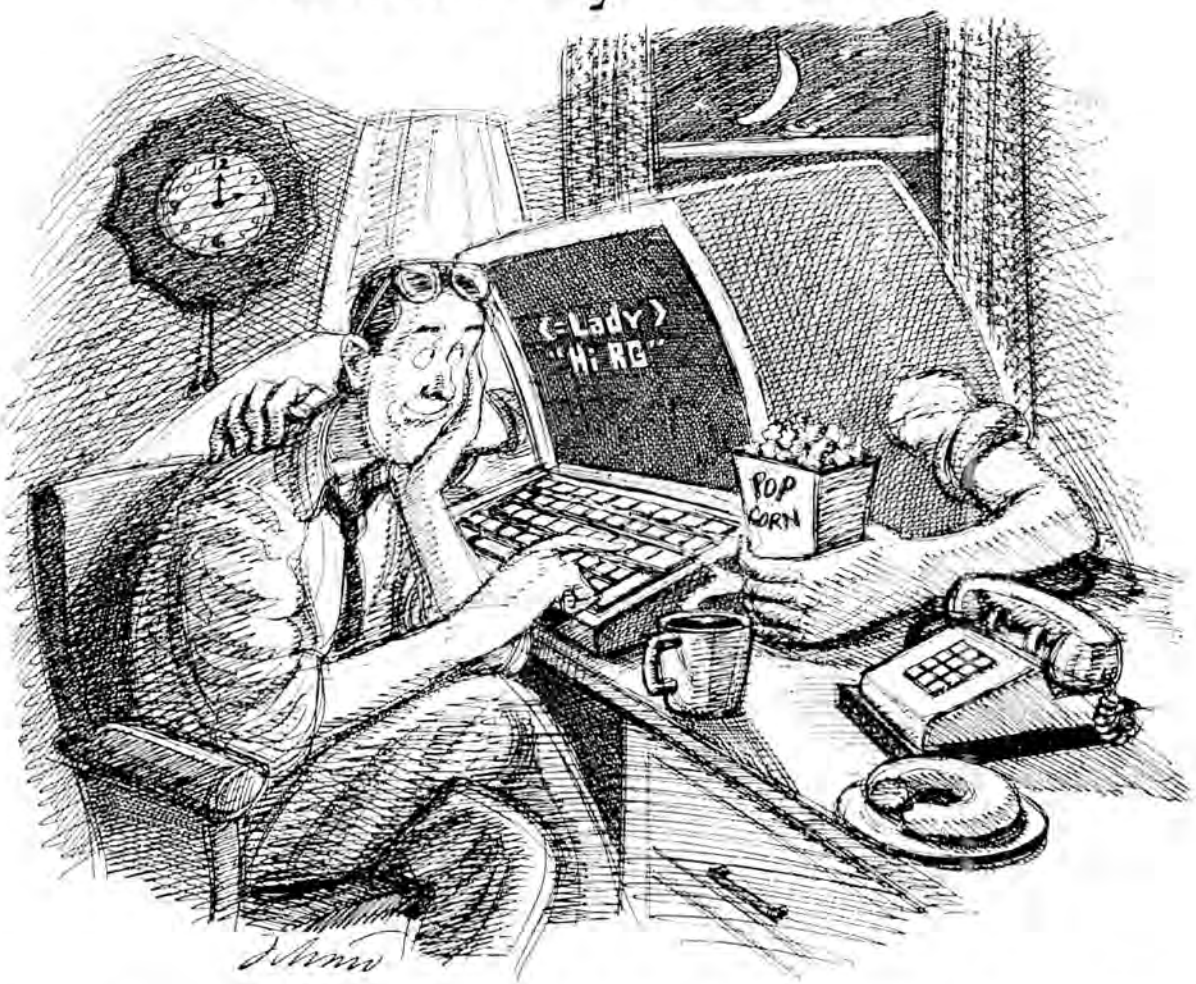

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DAVE'S MS-DOS COLUMN

Complete instructions for hardware installation leave you nothing to guess at. However, The Rose's formatting instructions are only adequate. Osicom takes a sound but difficult approach to installing the drive cables. You route them under the 1000's metal cage. It's a tight fit, but there's no chance of pinching the cables between the monitor-supporting plastic case and the edge of the metal partition beneath it. I had set up the HDS with the cables running over the metal divider.

You must attach the two ribbon cables to the drive and thread them through the 1000's drive enclosure before sliding the drive into place. The 3½-inch drive mechanism sits in a 5¼-inch frame that fits flush against the sides of the drive cage. I had to apply some force to move the unit into place and keep the holes aligned while inserting the mounting screws. The two screws on the outside face install easily enough, but again, I had to tape the last screw to my screwdriver to get it safely inside the metal cage.

The Western Digital controller board fits tightly, too. Its support bracket tab is shortened for the 1000, but you must still wedge it slightly between the motherboard and back plate. The directions for attaching the cables between drive and controller board are so explicit you can't go wrong.

Which DOS?

Osicom doesn't supply DOS hard drive utilities; you'll have to get your own. I used the Tandy utilities that come on the 1000HD MS-DOS system disk. You can also use PC-DOS 2.1 or 3.1.

The Rose arrives physically formatted so you don't need a low-level format program. I did it anyway with the Tandy HSECT. Low-level formatters like HSECT initialize the hard disk by writing sector headers on all tracks. The process defines track and sector locations as well as sector size.

PC-DOS 2.1 can't do this, but if you need it, the Osicom Basic input/output system has a low-level formatter built in. After installing the board, you can load Debug and type in G C800:5. Debug's Go command starts a format routine at that address. (When you turn the computer on, the board establishes its ROM at segment C800 hexadecimal, somewhere between the video window at B800 and the BIOS ROM at segment FC00.) Osicom warns that the 1200's low-level format program can cause problems.

To partition and format the Osicom you can use PC-DOS 2.1's FDISK and Format, or the FDISK and HFORMAT provided with the Tandy 1000HD or PC-DOS 3.1. As a safety feature, MS-DOS 2.11's Format won't touch a hard drive. Partitioning divides the disk for use by different operating systems and makes one partition active (the one from which you boot). Even if you're using the whole disk for MS-DOS (one partition), it's a formality you must go through before DOS will recognize the hard drive.

The high-level format utility adds a boot sector, file allocation table (FAT), and directory, and tests all sectors. If you want to boot from your hard drive, use the /S parameter to copy system files from a system floppy to your new hard drive, i.e., HFORMAT C:/S/V. The V parameter gives you the opportunity to add a volume name to the formatted drive.

After formatting, I ran the Norton Utilities' Disktest, finding one bad cluster. One out of 2,587 isn't unusual. (Ten-meg hard drives have eight 512-byte sectors per cluster.)

The Osicom Rose makes more noise than the 1000's fan, a whirring sound, but I don't find it obnoxious. It has two fairly bright red lights; one indicates that the power is on (and flashes if all is not right), and the other blinks during drive access. The only problem I ran into is that Super Utility won't run with the Osicom drive installed.

The Doran test for drive performance puts the Osicom in the same class as the HDS (1.1 times as fast as an XT). Some of this speed might be due to differences between 1000 and IBM PC rather than between the drives themselves. The test uses the Norton Utilities' Disktest, which tests all sectors of a disk, as a rough indication of drive speed. You divide the number of kilobytes of storage on a disk by how long it takes Disktest to run and get an index. The IBM PC XT yields 44K per second. The batch file in Fig. 1 also uses Norton's stopwatch program (Timemark) to time Disktest, and DOS's CHKDSK to get the amount of storage space on the specified drive. You can print out the resulting one-screen display with the print-screen function (shift/print). It works on floppy and RAM disks as well.

Drive Carefully

If you use PC-DOS 2.1, the Format command is a threat to hard drives. Intending to format a floppy in drive A, you can easily clean out your hard drive by not specifying the drive letter (with drive C as default). Or someone else using the machine could do it for you. The batch file in Fig. 2 can provide some protection by giving you fair warning. It short-circuits the Format command by checking for a drive parameter after the command. If it doesn't find a parameter, it tells you so and stops. If you specify drive C, it asks you to reconsider and offers an out. Otherwise, Format.BAT for-

```
echo off
cls
echo          Doran Test for Drive Performance
rem    Developed by Joseph Doran, and uses Norton Utilities to
rem    provide crude test of drive performance.
timemark start /n
disktest %1/d
timemark stop /n
chkdsk %1
echo  44 Kbytes/sec is standard for XT. 1000 may affect speed.
```

Figure 1. Batch file that tests for drive performance.

```
echo off
rem -- File to prevent formatting of hard drive by PC-DOS 2.1
rem -- Rename FORMAT.COM to SFORMAT.COM
if "%1" == "" goto nodrive
if %1 == c: goto harddisk
goto doit
:nodrive
echo Please use drive spec with FORMAT command.
goto end
:harddisk
echo Do you really want to format your hard drive?
echo If not, press CTRL-C to return to DOS.
pause
:doit
sformat %1
:end
```

Figure 2. Batch file to prevent formatting hard drive.

Hard Drive Specialist
16208 Hickory Knoll
Houston, TX 77059
713-480-6000

Osicom
18 Bank St.
Morristown, NJ 07960
800-922-0881

Figure 3. Manufacturers' information.

mats the disk in the specified drive.

You must rename the real format program (Format.COM) because the DOS command processor (Command.COM) looks for .COM files before .BAT files when you fail to provide an extension and two files have the same name. (The DOS's order of priorities is internal commands first, .COM, .EXE, and .BAT files.) In this case I renamed Format.COM SFORMAT.COM. Notice how this ersatz format command tests for no parameter, using empty quotation marks to represent nothing (see last month for another method).

Next month: some hardware basics, or how hardware devices get the 8088 CPU's attention; Basic graphics; another ANSI trick. ■

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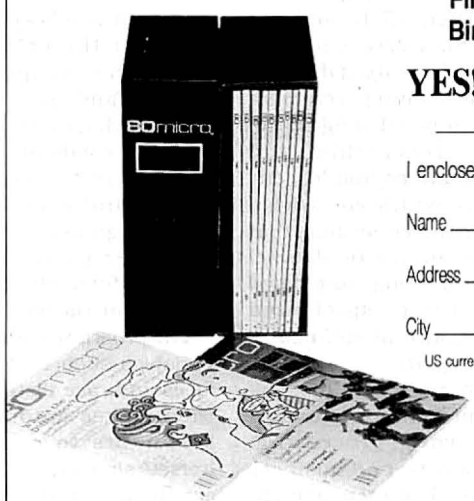

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Cat and Mouse

Torrington's Manager Mouse uses an independent suspension system, an on-board microprocessor, and a self-contained drive mechanism that gives you skip-free performance on virtually any surface at any angle.

The Manager Mouse works with the Tandy 1000, 1200HD, and 2000. It plugs directly into your computer without any external power supply and works without a special pad or tablet. The included TMouse software provides compatibility with a wide range of popular windowing, computer-aided design, graphics, project management, and word processing applications like Auto CAD, GEM, DesQ, Framework, Microsoft Word, and PC Paintbrush.

The Manager Mouse costs $198 and comes with TMouse software, user's manual, technical reference data, and a protective travel pouch. For more information, contact The Torrington Co., 59 Field St., Torrington, CT 06790, 203-482-9511.

Circle 577 on Reader Service card.

The Manager Mouse has a self-contained drive mechanism.

Pay Day

Joe Lynn's Payroll System for MS-DOS computers gives you payroll accounting for your business for $49.95. The system was created with the small business in mind (10–25 employees) but can handle up to 999 employees.

It calculates the standard federal, state, and FICA deductions as well as four miscellaneous deductions you define. It prints your paychecks, posts the totals, prints a journal record, and prints W2 forms or the data for your 941 form. Paystubs include year-to-date totals for all deductions as well as year-to-date net totals.

You need MS-DOS, 128K, and one 5¼-inch floppy disk drive to run the system for up to 50 employees. For further details or a sample program, contact Joe Lynn, 23501 W. Gagne Lane, Plainfield, IL 60544, 815-436-4477.

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Business Tools

BPI Business Builder is an integrated software system that gives you four accounting and four management tools in one product. The package requires an IBM PC or compatible using MS-DOS 2.0 or later, 256K, and two floppy disk drives (or one floppy and one fixed drive).

The accounting section includes general ledger, accounts receivable and payable, and payroll ledgers. It also provides you with a comprehensive system that includes automatic double-entry accounting, automated check-writing, specialized journals, and predefined financial reports.

The management tools include information management, word processing, spreadsheets, and business graphics. The management programs interface with Lotus 1-2-3, dBase II, WordStar, DIF, and ASCII files. You can also integrate them with a BPI communications module.

The package is $795. For more information, contact BPI Systems Inc., 3001 Bee Cave Road, Austin, TX 78746, 512-328-5400.

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Horse Racing

Winning at the Track from Liberty Publishing is a thoroughbred handicapping program for the IBM PC and compatible computers (including Tandy's).

The package compares current race conditions with the abilities of the competing horses and compares the horses against each other. The horses' past performance records form the basis for both comparisons.

The program evaluates key variables such as track surfaces and race distances and then makes automatic adjustments to equate the horses' statistics. The results are then held up to the conditions of the current race to yield the top three or four choices. The program is menu-driven with 12 screens, including a help screen.

Winning at the Track is based on a book of the same name. The package is $49.95 and includes a disk and a 160-page book. For more information, contact Liberty Publishing Co., 50 Scott Adam Road, Cockeysville, MD 21030, 301-667-4094.

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Trading Places

Sunburst offers Trading Post, a two-player strategy game for the Model 1000. Aimed at students in grades 3–7, it teaches you to make decisions based on a set of rules, to sharpen visual perception, and to encourage planning and strategy.

The object of the game is to be the first to match a set of five to eight objects selected by the computer. You take turns exchanging the objects according to a given set of exchange rules, or you can request a shape at random from the computer. The game never gets dull because starting shapes, goals, and exchange rules differ each time you play.

For more information, contact Sunburst Communications Inc., 39 Washington Ave., Pleasantville, NY 10570, 800-431-1934.

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Organize Yourself

Synthesis II from SSI, a $99 MS-DOS data base manager, lets you create files, record information, and review information on-line or in printed reports. It also includes utilities that let you create a system library and transfer files between disks.

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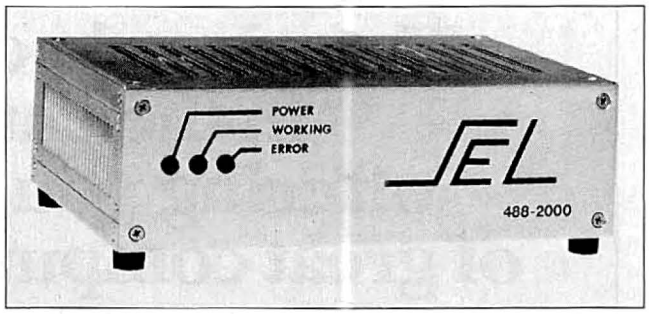

You can use the 488-2000 interface with Tandy computers.

on numeric fields, and it also lets you custom-design report formats for maximum clarity and effectiveness.

For more information, contact SourceView Software International, 835 Castro St., Martinez, CA 94553, 415-228-6220.

Circle 572 on Reader Service card.

Universal Interface

A new universal GPIB-488 interface is available from Scientific Engineering Laboratories for use with any computer that sports an RS-232 port. It's the Model 488-2000, for use with the IBM PC, XT, AT; the Tandy 1000, 1200HD, 2000; and the Macintosh. You can use the same software on all computers. It's not language- or operating system-dependent.

The price is $675. For more details, contact Scientific Engineering Laboratories, 11 Neil Drive, Old Bethpage, NY 11804, 516-694-3370.

Circle 571 on Reader Service card.

Switch Box

Any MS-DOS system can use this code-activated printer switch from Via West. The switch comes with software that lets you specify which printer you want to use from the keyboard or your program.

The electronic switch allows greater distance between your computer and printers. You can remotely locate a printer up to 30 feet away to reduce noise. All of the switch's connectors are female DB 25S and mating male connectors are DB 25P. The printer switch measures 5.8 inches by 3.8 inches by 1 inch, and it costs $89.

For more information, contact Via West Inc., 534 N. Stone Ave., Tucson, AZ 85705, 602-623-5716.

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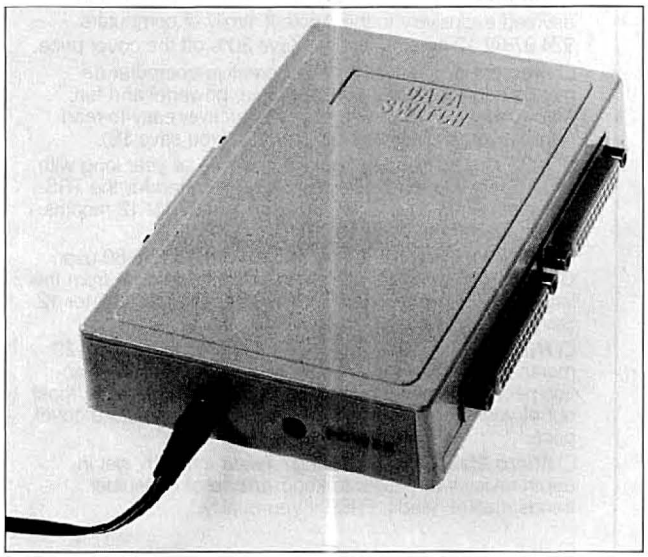
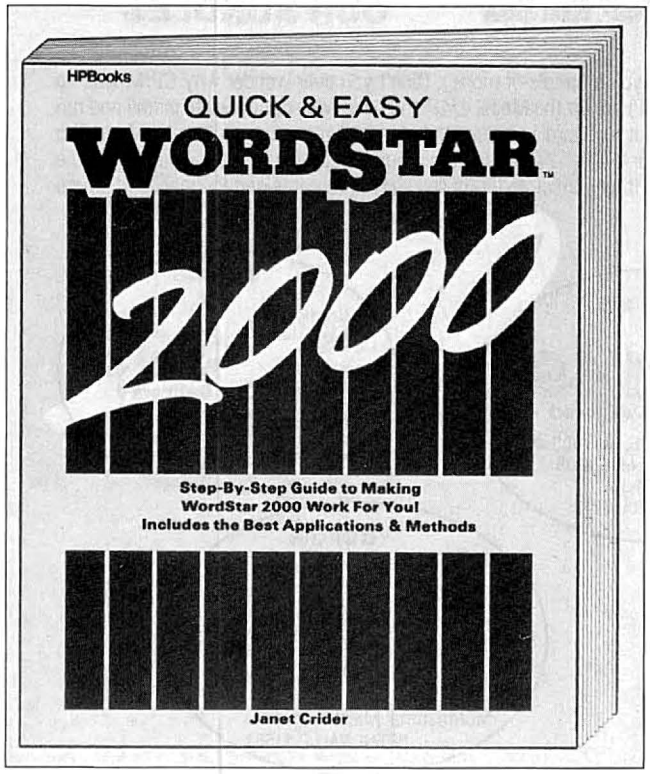


This code-activated data switch comes with software.

MS-DOS NEW PRODUCTS



Learn WordStar 2000 with a step-by-step guide from HPBooks.

Bookings

HPBooks' *Quick & Easy WordStar 2000* ($14.95 plus $1.95 handling) by Janet Crider helps you master WordStar 2000 features and applications. You'll learn to prepare better correspondence, outlines, and reports. *Quick & Easy* also teaches you how to write a book or newsletter, create preprinted forms and accounting reports, and merge and telecommunicate documents.

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MS-DOS New Products Index

Reader Service Number	Company	Page
578	BPI Systems Inc.	88
570	HPBooks Inc.	91
576	Liberty Publishing Co.	88
575	Lynn, Joe	88
571	Scientific Engineering Laboratories	90
572	SourceView Software International	88
573	Sunburst Communications Inc.	88
577	Torrington Co., The	88
574	Via West Inc.	90

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26-1178 DCM-3 300 Baud Modem	51
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26-3010 Model 1200 VM-3 Monochrome Monitor	186
26-0511 Genuine RS Pantyhose Anti-Glare Device	14
26-1085 Model 4P Carrying Case	21
26-1133 Model 3 15MB Hard Disk Inst. Kit	85
26-1134 Model 4 15MB Hard Disk Inst. Kit	68
26-1183 Model 100 Bar Code Reader	85
26-1185 Color Computer Koala Pad	51
26-1197 Mouse for Model 1000/1200/2000	85
26-1198 Serial to Parallel Converter	85
26-1208 CCR-81 Cassette Tape Recorder	51
26-1209 CCR-82 Cassette Tape Recorder	42
26-1244 Power Strip/Line Filter	42
26-1326 Anti-Glare Panel, Model 2/12/16	42
26-1342 Clear Keycover for Model 3/4	11
26-1410 Model 100 Modem Cable	17
26-1429 Automatic Power Strip/Surge Protector	89
26-1451 Non-Automatic Power Strip/Filter	42
26-1457 Anti-Glare Panel, Model 1/3/4	42
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26-3008 Color Computer Joysticks, Per Pair	17
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26-3212 Model 1000/1200 CM-2 Color Monitor	391
26-3503 PC 1 Cassette Interface	9
26-3508 PC 1 Carrying Case	13
26-3608 PC 2 Carrying Case	25
26-3612 PC 2 RS-232C Interface	36
26-3651 PC 4 Cassette Interface	33
26-3653 PC 4 1K Ram Module	16
26-3654 PC 4 Carrying Case	6
26-3804 Model 100 AC Adapter	5
26-3805 Model 100 Acoustic Coupler	34
26-3809 Model 100 Carrying Case	42
26-3811 Model 100 Soft Carrying Case	34
26-3812 Model 100 Legs (pair)	4
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26-4156 Model 2/3/4/12/16 15Mb Secondary Drive	1100
26-4157 Model 2/12/16 Installation Kit for 26-4155	297
26-5111 Model 2000 VM-1 Monochrome Monitor	169
26-5112 Model 2000 CM-1 Color Monitor	509

FURNITURE

26-1324 Computer Table	68
26-1354 Computer Stand	42
26-1355 Printer Stand	42
26-1356 System Desk	102
26-1357 Printer Stand	85
26-1358 Corner for 1356/57 Desk/Stand	34
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26-4565 Menu Generator 33
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A-3 # 73185

Pixels! Program! Action!

Want to learn some simple, impressive ways to add zip to that concrete stress software you're writing? I'll show you how to enliven your programs with computer animation. I'm not talking about the artistic complexities of Donald Duck throwing a two-minute tantrum. I just want to demonstrate ways to create movement. It can help others use your programs more easily and enhance the appearance of your work.

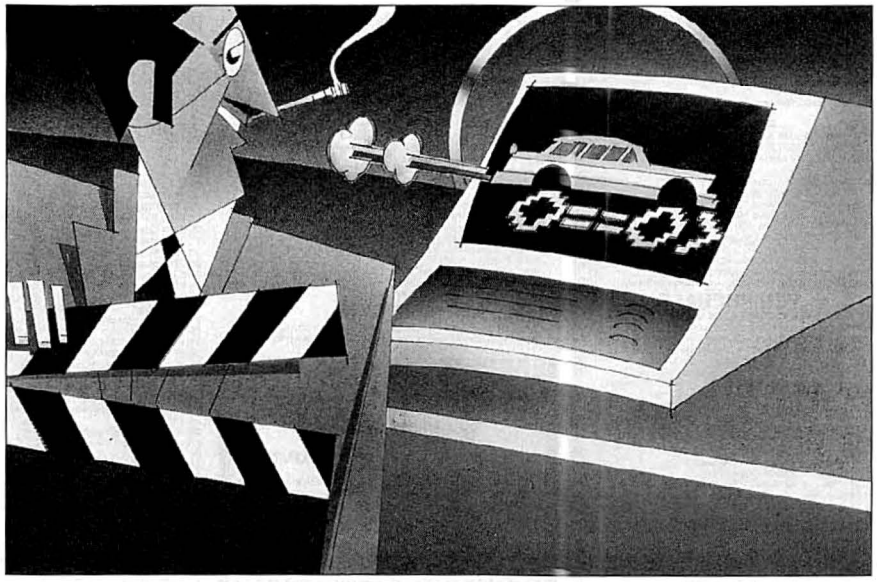

Illustration by Phil Geraci

Fantasyland

In fundamental theory, the following listing gives you computer animation:

```
100 CLS: CLEAR
110 PRINT @ 1000,"A";
120 PRINT @ 1000,"X";
130 GOTO 110
```

The program alternately prints an "A" and an "X" quickly at the same screen position. Now for a revelation: This animation is a long shot of Donald Duck throwing a tantrum. And that's the fundamental secret of computer animation on a machine like the 4/4P, which admittedly has limitations. You're working with little sparks of fantasy, so tell the viewer what's happening and leave the rest to his imagination.

For other animation examples, type in the Program Listing. It contains five small menu-driven programs that progressively illustrate levels of animation you can adapt to your own needs.

Rapidly printing one character over another gets viewer attention. In the Listing, try Look Here (lines 200–300). The program randomly selects a screen position in line 220 at which to print "LOOK HERE!". The For. . .Next loop in lines 240–290 alternately prints a block of light (CHR$(191)) and a blank (CHR$(128)) at a position just before the message.

Because the 4/4P carries out instructions quickly, a GOSUB switches to a timer loop after the program prints each character. This sets the flicker rate slow enough so you can see it.

System Requirements

Models 4 and 4P
Basic

Program Listing. Five examples of animation.

```
100 REM * Basic Takes *
110 REM * TRS-80 MODEL 4/4P
120 CLS: CLEAR
130 PRINT "MENU": PRINT "-----"
140 PRINT "1 - Look Here": PRINT "2 - '57 Chevy"
150 PRINT "3 - Candlelight": PRINT "4 - Excitement"
160 PRINT "5 - Dancer": PRINT: PRINT
170 INPUT "Pick a number";N: N=INT(N)
180 IF N<1 OR N>5 THEN RUN ELSE CLS: PRINT CHR$(15)
190 ON  N GOTO 200,400,500,700,900
199 REM ---------------------------
200 REM * Look here
210 A$=CHR$(191)
220 Z=RND(20)*80+RND(60)
230 PRINT @ Z,"Look here"
240 FOR X=1 TO 10
250 PRINT @ Z-2,CHR$(191);
260 GOSUB 300
270 PRINT @ Z-2,CHR$(128);
280 GOSUB 300
290 NEXT: PRINT CHR$(14): END
300 FOR T=1 TO 100: NEXT T: RETURN
399 REM ---------------------------
400 REM * '57 Chevy
410 CLS: CLEAR
420 PRINT CHR$(15)
430 A$=CHR$(32)+"o==o>"
440 FOR X=0 TO 74
450 PRINT @ X,A$;
460 PRINT @ 160+RND(1000),"beep!"
470 FOR T=1 TO 50
480 NEXT T,X
490 PRINT CHR$(14): END
499 REM ---------------------------
500 REM * Candlelight *
510 FOR X=1860 TO 420 STEP -80
520 PRINT @ X,STRING$(8,191);: NEXT
530 PRINT @ 680,"VACATION PLANNER";
540 PRINT @ 840,"A Candlelight Production";
550 PRINT @ 1000,"by Alicia Burns";
560 PRINT @ 1320,"Press a key for main menu.";
570 X$=INKEY$: IF X$<>"" THEN PRINT CHR$(14): GOTO 610
580 FOR G=264 TO 344 STEP 80
590 PRINT @ G,CHR$(128+RND(63));
600 NEXT G: GOTO 570
610 CLS: PRINT "Program begins": END
```

Listing continued

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Listing continued

```
699 REM ----------------------------
700 REM * Excitement *
710 Z$="EXCITEMENT! FUN! THRILLS! CHILLS! READ BASIC TAKES! EXCITEMENT!"
720 X=1000: A$=CHR$(191): P=1
730 A=RND(35): B=RND(10)
740 V$=INKEY$: IF V$<>"" THEN PRINT CHR$(14): END
750 CLS: PRINT @ 995,MID$(Z$,P,10)
760 P=P+1: IF P=53 THEN P=1
770 PRINT @ X-A-(B*80),A$;
780 PRINT @ X+A+(B*80),A$;
790 PRINT @ X-A+(B*80),A$;
800 PRINT @ X+A-(B*80),A$;
810 FOR T=1 TO 100: NEXT T
820 GOTO 730
899 REM ----------------------------
900 REM * Dancer
910 DEFSTR B: B=CHR$(128): N=0
920 T$(1)=B+CHR$(168)+CHR$(188)+CHR$(191)+CHR$(188)+CHR$(148)+B
930 M$(1)=B+CHR$(138)+CHR$(170)+CHR$(191)+CHR$(149)+CHR$(133)+B
940 B$(1)=B+CHR$(128)+CHR$(186)+CHR$(128)+CHR$(181)+CHR$(128)+B
950 T$(2)=T$(1)
960 M$(2)=B+CHR$(133)+CHR$(186)+CHR$(191)+CHR$(181)+CHR$(138)+B
970 B$(2)=B+CHR$(166)+STRING$(3,128)+CHR$(153)+B
980 L=1000
990 N=N+1: IF N=3 THEN N=1
1000 PRINT @ L,T$(N);
1010 PRINT @ L+80,M$(N);
1020 PRINT @ L+160,B$(N);
1030 V$=INKEY$: IF V$<>"" THEN PRINT CHR$(14): END
1040 R=RND(2): IF R=2 THEN L=L-1 ELSE L=L+1
1050 FOR T=1 TO 200: NEXT T: GOTO 990
1060 REM * END OF LISTING
```

End

You don't need line 210; I put it there as a reminder that you can assign CHR$ values to variables. Line 250 could read PRINT @ Z-2,A$; and still work.

The second program, '57 Chevy, is a little frippery. I represented the "car" with a blank space and five characters: o= =o>. The loop starting at line 440 changes the PRINT @ position from zero to 74, interspersed with a brief timing loop. This illustrates how you simulate movement of a graphic from one place to another. The beginning blank serves to erase the left-hand edge of the car as the current PRINT @ positions move rightward. I threw in the beeps to enhance the fantasy.

A title screen is a good place to incorporate some animation. The third program, Candlelight, is a brief but effective title screen for software from that famous nonexistent company, Candlelight Productions. A string of CHR$(191) characters draws the candle shape at decremented positions up the screen. The flicker occurs in the For. . .Next loop in lines 580–600. It prints random graphics in the range CHR$(129) to CHR$(191) at screen positions 264 and 344. These overprint each other quickly and pass for a flame.

Whatever kind of program you're writing, you can probably incorporate some clever movement in the title screen. The fourth program, Excitement, is an example of a "nervous sign," one of those infuriating, rippling light systems that call attention to Joe's Drive-In. The listing, in lines 700–820, is a real attention-grabber. It is both kaleidoscopic and stroboscopic in the way it prints four CHR$(191) graphics characters in each quadrant of the screen, equidistant from the center. The formula for determining these four PRINT @ positions appears in lines 770–800.

More interesting, Excitement contains an exhortation to read a certain computer magazine column, and it presents the advertisement in the form of a moving line of type. Here's how it works: Line 710 gives variable Z$ the value of the message you want presented. Notice that I repeated the word "Excitement!" at the end of the line.

Variable P, standing for the first string character position the program prints, gets a starting value of 1. In line 750, the program prints 10 characters of the message, starting from the current value of P, which it increments by 1 after each printing. This way, the message seems to flow from right to left. In line 760, P's value returns to 1 if it exceeds 52; the program prints the two "Excitement!" statements smoothly over each other, one ending, the other beginning the routine. If you use this method with longer or shorter repeating messages, you'll have to figure out the P value at which the printing of the midstring values begins again. Line 740 ends the program if you tap a key.

And We Danced

Now we come to some true animation using Basic's 64 graphics characters ranging from CHR$(128) to CHR$(191). Each character has six pixel positions within it, two across by three down. The 64 different shapes include every combination of pixel-on, pixel-off in two- by six-pixel cells. To prove it, draw a two- by six-pixel shape; then shade in any combination of pixels. If you refer to page A-57 in the *Model 4/4P Disk System Owner's Manual*, somewhere on that page you'll find the shape.

In Dancer, the fifth program, I've animated a little man who dances from one side of the screen to the other. I did it by stringing character graphics, overprinting three lines each of two versions of the figure, and moving the whole arrangement randomly from side to side.

The tough part is figuring out the jigsaw puzzle of fitting character graphics together in sensible ways. One logical approach is to draw a work grid made of vertical rectangles subdivided by dashed lines into two- by three-pixel cells. The solid lines indicate the space covered by one PRINT @ graphic. The dashed lines indicate the pixel divisions within each PRINT @ graphic.

Draw any shape you want, as long as you don't go off any line, dashed or solid. Then systematically check the shapes within the solid lines against the shapes on page A-57 of the manual. To the right of the work grid, record the CHR$ number of each shape, from left to right. You can turn each line into a string of graphics. You'll understand better as we dissect Dancer's listing.

In line 910, I defined B as a string and gave it the value of a blank space. Lines 920–970 form the strings defining the two poses of the dancing body. The T$ array values stand for top, M$ for middle, and B$ for bottom. A small array creates two of each classification, T$(1), T$(2), and so on. As an example, the top of the first figure comprises the CHR$ figures numbered 168, 188, 191, 188, and 148. You can see any of these by typing in PRINT CHR$(168) and so on. In line 980, I gave L a starting value of 1000. That's the screen position where the figure will begin dancing.

Trust me: Line 990 is a little routine that ensures that N always has a value of 1 or 2. In lines 1000–1020, the program prints the current top string at L, the middle just below it, the bottom below that. Line 1040 sets a random value to determine if the figure will shift left or right on its next printing. With blank spaces beginning and ending each line of characters, the dancer moves without leaving traces of himself behind. Line 1030 is a routine that ends the program if you tap a key.

If this explanation gives you any trouble, try the program and watch the figure dance. The result might send you back through the explanation again.

With this method and the 4/4P's speed, you can create fairly large animations without noticeable flicker. Experiment, be imaginative, and you might surprise yourself!■

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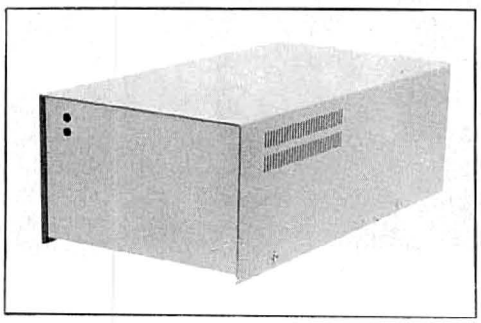

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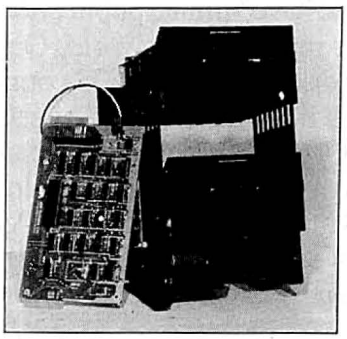

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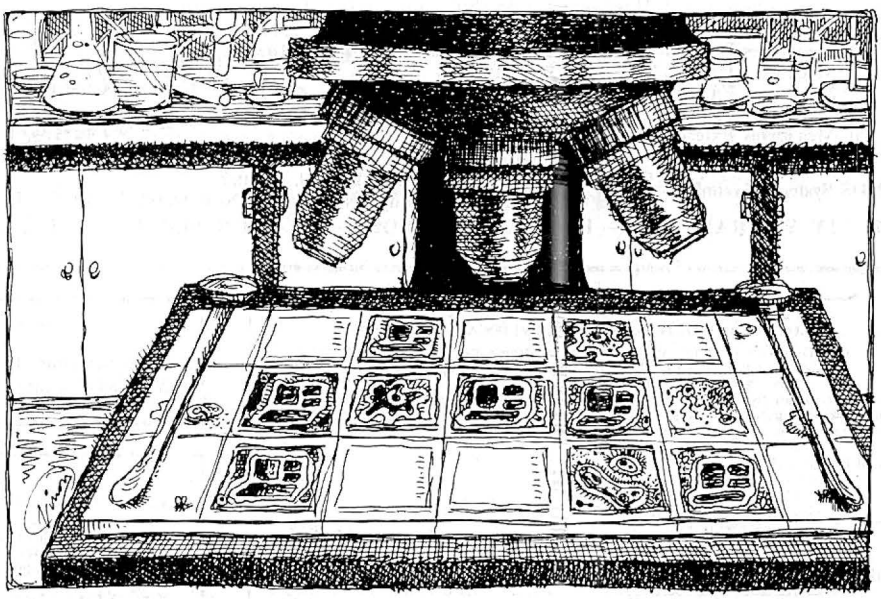
Life with the Model 4



The seeds for this month's column were planted in 1970, seven years before the first Model I came out. In the October 1970 issue of *Scientific American*, Martin Gardner wrote the first of several Mathematical Games columns about John Conway's biology simulator, The Game of Life.

I bought a Model I almost 10 years later and wrote a Basic program to simulate Life. I was so disappointed by its slowness that I learned Assembly language so I could write a faster version.

In the August 1981 issue of *80 Micro* (p. 52), Dennis Kitsz presented a new, faster algorithm for Life. I put his ideas into my original program, added several bells and whistles, and ended up with a version I enjoyed.

Recently, I was making one of my periodic futile attempts to sort out my piles of disks and came across the source code for my Model I program. I rewrote it for the Model 4 following the rules of TRSDOS 6.X, and was pleasantly surprised at how fast it ran, even without addressing the screen directly.

What Life Is All About

Life is not a competitive game, but a simulation of a small universe with rigorous rules of life and death. The universe is a plane divided into a square grid like a checker board. Each cell of the grid can hold a single "individual." During each "generation" of this universe, individuals are born, die, or continue to live according to the following rules:

►Each cell has eight adjacent "neighbor" cells. The number of individuals in the neighboring cells determines the fate of the cell under question.

►If an individual has fewer than two neighbors, it will die of "loneliness."

►If an individual has exactly two or three neighbors, it will continue to exist into the next generation.

LOAD 80

System Requirements

Model 4
TRSDOS 6.2
Assembly language
Editor/assembler

Program Listing. The Game of Life.

```
00100 ;************************************************
00110 ;
00120 ;      "Game of Life" by John Conway
00130 ;      Model 4, TRSDOS 6.2 version
00140 ;          by Hardin Brothers
00150 ;      Assembled with PRO-Create
00160 ;
00170 ;************************************************
00180 ;  SVC List
00190 @KEY     EQU     01H
00200 @DSP     EQU     02H
00210 @KBD     EQU     08H
00220 @DSPLY   EQU     0AH
00230 @VDCTL   EQU     0FH
00240 @EXIT    EQU     16H
00250 @CLS     EQU     69H
00260 ;
00270 ENTER    EQU     0DH             ;Enter key
00280 CLEAR    EQU     1FH             ;<Shift> <Clear>
00290 SPACE    EQU     ' '             ;Space key
00300 BREAK    EQU     80H             ;Break key
00310 NOCRS    EQU     0FH             ;Cursor off character
00320 LF       EQU     0AH             ;Line feed character
00330 CR       EQU     0DH             ;Carriage return char.
00340 ;
00350 SCRLEN   EQU     24*80           ;Screen length
00360 ;
00370 ;************************************************
00380 ;  Macro commands
00390 ;
00400 SVC      MACRO   #NUM
00410          LD      A,#NUM
00420          RST     28H
00430          ENDM
00440 ;
00450 PRINT    MACRO   #ADDR
00460          LD      HL,#ADDR
00470          SVC     @DSPLY
00480          ENDM
00490 ;
00500 GETSCR   MACRO
00510          LD      HL,SBUFF
00520          LD      B,6             ;function - screen to memory
00530          SVC     @VDCTL
00540          ENDM
00550 ;
```

Listing continued

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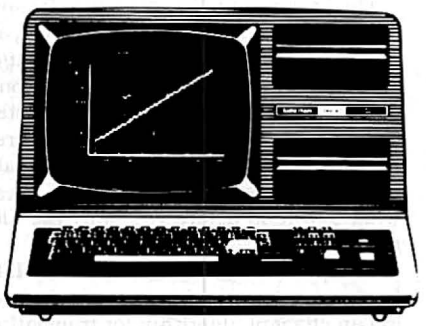

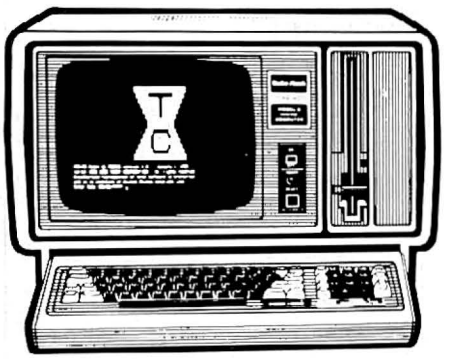

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Listing continued

```
00560 PUTSCR   MACRO
00570          LD      HL,SBUFF
00580          LD      B,5             ;function -- memory to screen
00590          SVC     @VDCTL
00600          ENDM
00610 ;
00620 RANGE    MACRO   #LOW,#HIGH,#NO
00630          CP      #LOW            ;Below bottom of range?
00640          JR      C,#NO           ;Yes -- go
00650          CP      #HIGH+1         ;Above top?
00660          JR      NC,#NO          ;Yes -- go
00670          ENDM
00680 ;
00690 ;***********************************************
00700 ;
00710          ORG     3000H
00720 START    LD      C,NOCRS         ;Turn off cursor
00730          SVC     @DSP            ;Send to display
00740          SVC     @CLS
00750          PRINT   OPENING         ;display opening screen
00760 ;
00770          GETSCR                  ;Copy screen to buffer
00780          LD      HL,CBUFF        ;HL==> beginning of calculation buffer
00790          LD      DE,CBUFF+1      ;DE==> next byte
00800          LD      BC,SCRLEN-1     ;Bytes to clear
00810          LD      (HL),-1         ;Set calc. buffer to -1
00820          LDIR                    ;Clear whole buffer
00830 ;
00840          SVC     @KEY            ;Wait for a key
00850          CP      BREAK           ;Is it the <break> key?
00860          JR      NZ,MAINLP       ;No -- start program
00870          SVC     @CLS            ;  Else clear screen
00880          LD      HL,0            ;No error
00890          SVC     @EXIT           ;And leave
00900 ;
00910 ;  Main program loop
00920 ;
00930 ;
00940 MAINLP   RANGE   '0','9',ML10    ;Is key between 0 & 9 ?
00950          CALL    COMPLEX         ;Yes -- display complex pattern
00960          JR      ML60            ;Go to end of block
00970 ;
00980 ML10     CP      ENTER           ;<ENTER> key?
```

Listing continued

►If an individual has more than three neighbors, it will die of "overcrowding."
►If an empty cell has exactly three neighbors, a new individual will be born in that cell.
►The status of the next generation of every cell in the universe is based on the distribution of individuals in the previous generation in order to avoid problems of recursion.

What's fascinating is that these simple rules can create complex results, even in the Model 4's 24-column by 80-row universe. Some starting patterns fall into infinite loops, others end with a static display of a stable universe, and still others end with the extinction of all individuals and an empty universe.

The Program Listing generates 24 special starting patterns for the universe, all described in various issues of *Scientific American*, as well as 10 different complex, pseudorandom starting positions. Once you understand how the universe works, you can amuse yourself by calling up a new pattern and trying to guess what it will do before you start the Life generator.

The problem with The Game of Life from a programmer's viewpoint is finding an efficient algorithm for translating the rules of Life into a computer pro-

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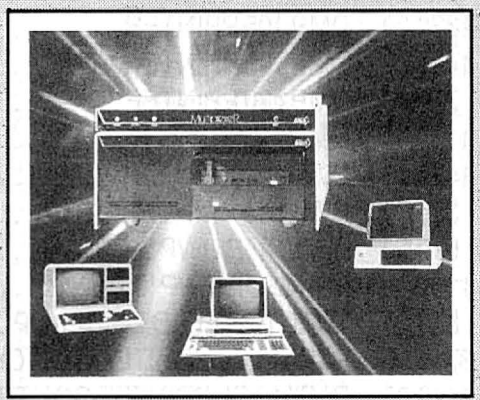
The Bi-Tech Star Network



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gram. The Listing uses an algorithm that works like this:

1. Copy the screen to a memory buffer.
2. Create a second buffer to count neighbors for each cell.
3. Scan through the screen buffer to find living individuals (inhabited cells).
4. Each time a living cell is found in the screen buffer, update the neighbor count in the second buffer for each of its neighboring cells.
5. When all the living individuals in the screen buffer have been found, use the counts in the second buffer to determine the next-generation status of each screen buffer cell. If any cell has fewer than two or more than three living neighbors, make it blank. If any cell has two living neighbors, don't change it. If any cell has three living neighbors, put an individual in it.
6. Copy the screen buffer to the computer's screen and start again.

The program implements this algorithm in the subroutine called Onelife (lines 1410–1850), which calculates and displays the next generation of the Life universe.

The remainder of the program provides a user interface that allows several options. The program begins by displaying a screen of instructions explaining the program's options. Once you start the Life generator, you must stop it by pressing the spacebar before it will accept any other commands. The Life gen-

Listing continued

```
00990           JR      NZ,ML20         ;No -- go
01000           CALL    RUN             ;Run Life generator
01010           JR      ML60            ;Skip to end of loop
01020 ;
01030 ML20      CP      CLEAR           ;<Shift> <Clear> ?
01040           JR      NZ,ML30         ;No -- go
01050           SVC     @CLS            ;Clear screen
01060           LD      C,NOCRS         ;Turn off cursor
01070           SVC     @DSP            ;Send to display
01080           GETSCR                  ;Copy screen to buffer
01090           JR      ML60            ;Jump to end of loop
01100 ;
01110 ML30      CP      SPACE           ;Space bar?
01120           JR      NZ,ML40         ;No -- go
01130           CALL    ONELIFE         ;Update screen once
01140           JR      ML60            ;Jump to end of loop
01150 ;
01160 ML40      CP      BREAK           ;Break key?
01170           JR      NZ,ML50         ;No -- go
01180           JP      START           ;Yes -- start over
01190 ;
01200 ML50      AND     0DFH            ;Force to upper case
01210           RANGE   'A','X',ML60    ;Is key between A & X ?
01220           CALL    PATTERN         ;Yes -- display pattern
01230 ;
01240 ML60      SVC     @KEY            ;Wait for key before another loop
01250           JR      MAINLP          ;Go around again
01260 ;
01270 ;*********************************************
01280 ;           Subroutines
01290 ;*********************************************
01300 ;
01310 ;Run continuously until SPACE is pressed
01320 ;
01330 RUN       CALL    ONELIFE         ;Do one generation
01340           SVC     @KBD            ;Scan keyboard
01350           CP      SPACE           ;Space pressed?
01360           JR      NZ,RUN          ;No -- loop back
01370           RET                     ;Else return
01380 ;
01390 ;Perform one generation
01400 ;
01410 ONELIFE LD        HL,SBUFF        ;HL==> screen image
```

Listing continued

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Listing continued

```
01420           LD      IX,CBUFF        ;IX==> calculation buffer
01430           LD      BC,24*80        ;BC = characters on screen
01440 OL10      LD      A,(HL)          ;Get byte from screen buffer
01450           CP      ' '             ;A space?
01460           JP      Z,OL20          ;Yes -- go
01470           INC     (IX-81)         ;Not a space:
01480           INC     (IX-80)         ;  Increment
01490           INC     (IX-79)         ;  all of its
01500           INC     (IX-1)          ;  neighbors
01510           INC     (IX+1)
01520           INC     (IX+79)
01530           INC     (IX+80)
01540           INC     (IX+81)
01550 OL20      INC     HL              ;HL==> next screen buffer location
01560           INC     IX              ;IX==> next location in CBUFF
01570           DEC     C               ;Fast way to go back
01580           JP      NZ,OL10         ;Loop back
01590           DEC     B               ;If C = 0
01600           JP      NZ,OL10         ;Loop until BC = 0
01610 ;
01620 ;Now set living and dead cells
01630 ;
01640           LD      HL,SBUFF        ;HL==> Screen buffer again
01650           LD      DE,CBUFF        ;DE==> Calculation results
01660           LD      BC,24*80        ;BC = characters on screen
01670 OL30      LD      A,(DE)          ;Get byte from CBUFF
01680           DEC     A               ;Were there 2 neighbors?
01690           JP      Z,OL50          ;Yes -- no change if 2 neighbors
01700           DEC     A               ;Was it 3 ?
01710           JP      NZ,OL40         ;No -- then cell dies
01720           LD      (HL),'*'        ;Give birth to cell
01730           JP      OL50            ;And go
01740 ;Set dead cell
01750 OL40      LD      (HL),' '        ;Turn off cell
01760 OL50      LD      A,-1            ;For next generation
01770           LD      (DE),A          ;  clear CBUFF
01780           INC     HL              ;HL==> next SBUFF location
01790           INC     DE              ;DE==> next CBUFF location
01800           DEC     C               ;Fast BC decrement
01810           JP      NZ,OL30         ;Loop back until C = 0
01820           DEC     B               ;Finish BC decrement
01830           JP      NZ,OL30         ;Loop until done
```

Listing continued

erator has no way to determine if the screen has reached a stable configuration or an empty one, so if you can't get any command keys to respond, try pressing the spacebar first.

Once you stop the display, the break key will return you to the opening screen. If you press the break key again, the program will stop and return you to TRSDOS. If you press shift/clear, the screen (and screen buffer) will clear so you can set a new pattern.

You can use the spacebar to single-step from one generation to another to watch closely how a pattern of individuals changes. And, if you press the enter key, the computer displays one generation after another as quickly as it can.

You also need a way to put new patterns on the screen. If you press a numeric key when the program is waiting for a command, the program displays a complex semirandom pattern. If you press any alphabetic key from A through X, the program displays a special set pattern instead.

The Code of Life

Life begins by defining labels for a handful of supervisory calls (SVCs) and for the special keys the program uses. Next follows definitions of five macro in-

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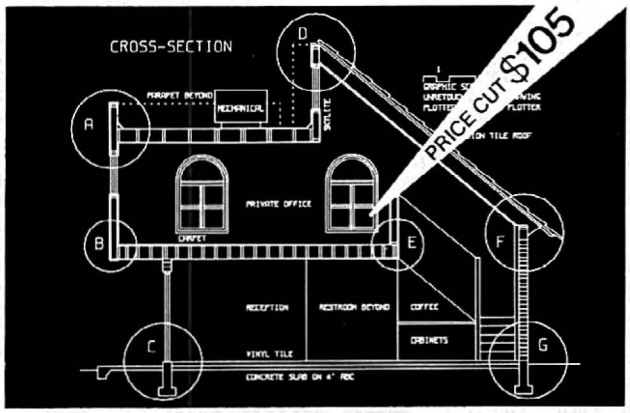

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You can use the spacebar to single-step from one generation to another to watch changes.

structions. As I explained last month, if your assembler doesn't support macros, you can expand these by hand each time the program uses them.

The program itself starts in line 680 by turning off the TRSDOS cursor, clearing the screen, and displaying the opening message. While the message is on the screen, Life copies the screen to the screen buffer and clears each position in the calculation buffer to 0FF hexadecimal (hex). Then Life waits for you to press a key and, if you press something other than the break key, Life uses that key as the first command when it enters

Listing continued

```
01840           PUTSCR
01850           RET                     ;Done with one generation
01860 ;
01870 ; Generate a complex, semi-random pattern
01880 ;
01890 COMPLEX LD        D,A             ;Save key in D
01900         LD        A,R             ;Get current refresh value
01910         AND       7FH             ;Turn off high bit
01920         RLCA                      ;Multiply by 2
01930         LD        E,A             ;And save in E
01940         LD        A,D             ;Get original key in A
01950         LD        D,0             ;Zero D register
01960         LD        HL,SBUFF        ;HL==> screen buffer
01970         ADD       HL,DE           ;Add value in E
01980         SUB       20H             ;Subtract from key
01990         RLCA                      ;Multiply by 2
02000         RLCA                      ;Multiply by 4
02010         RLCA                      ;Multiply by 8
02020         LD        B,A             ;Into B for looping
02030 C10     LD        (HL),'*'        ;Put character on screen
02040         INC       HL              ;Point to next position
02050         DJNZ      C10             ;Loop back
02060         PUTSCR                    ;Put on screen
02070         RET
02080 ;
02090 ;  Pattern Generating Routine
02100 ;
02110 PATTERN SUB       'A'             ;A = 0 to 25
02120         SLA       A               ;A = A * 2
02130         LD        E,A             ;Save in E
02140         LD        D,0             ;DE has offset into table
02150         LD        HL,PTRNS        ;HL==> Pattern table
02160         ADD       HL,DE           ;HL==> address of pattern
02170         LD        E,(HL)          ;Get LSB of address
02180         INC       HL              ;HL==> MSB
02190         LD        D,(HL)          ;DE==> pattern
02200         PUSH      DE              ;Move pointer
02210         POP       IX              ;To IX register
02220         LD        E,(IX+0)        ;Get cursor offset
02230         LD        D,(IX+1)        ;  into DE
02240         INC       IX              ;Move twice to next
02250         INC       IX              ;  offset
```

Listing continued

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Listing continued

```
02260           LD      HL,SBUFF        ;HL==> Screen buffer
02270           ADD     HL,DE           ;HL==> first character location
02280           LD      D,0             ;Zero D for calculations
02290 ;
02300 P10       LD      (HL),'*'        ;Put char. in place
02310           LD      A,(IX)          ;Get next offset
02320           OR      A               ;Is it 0?
02330           JR      Z,P20           ;Yes -- exit
02340           LD      E,A             ;No -- add to HL
02350           ADD     HL,DE           ;HL==> next location
02360           INC     IX              ;IX==> next offset
02370           JR      P10             ;Loop back
02380 ;
02390 P20       PUTSCR                  ;Display new screen
02400           RET                     ;and return
02410 ;
02420 ;  Pointers to patterns
02430 ;
02440 PTRNS     DW      PA,PB,PC,PD,PTE,PF,PG,PH,PI,PJ
02450           DW      PK,PL,PM,PN,PTO,PP,PQ,PR,PS,PT
02460           DW      PU,PV,PW,PX
02470 ;
02480 ; Patterns for display
02490 PA        DW      120
02500           DB      81,78,1,1,0
02510 PB        DW      120
02520           DB      81,76,4,77,1,1,1,0
02530 PC        DW      120
02540           DB      81,75,5,76,1,1,1,1,0
02550 PD        DW      120
02560           DB      81,74,6,75,1,1,1,1,1,0
02570 PTE       DW      120
02580           DB      80,2,78,1,0
02590 PF        DW      120
02600           DB      81,1,77,1,81,0
02610 PG        DW      120
02620           DB      1,79,1,77,1,79,1,0
02630 PH        DW      757
02640           DB      1,1,78,1,1,78,1,1,81,1,1,78,1,1,78,1,1,0
02650 PI        DW      836
02660           DB      1,1,1,1,1,1,0
02670 PJ        DW      837
02680           DB      1,1,1,1,76,4,0
```

Listing continued

the main program loop in line 940.

Life's main loop checks for each possible key and takes appropriate action when it finds a match. Then, in line 1240, it uses the @KEY SVC to wait for another command and loops back. You break the loop only if the program encounters the break key, which starts the entire program over from the top.

The subroutines do the real work in this program, starting in line 1270. The most complex routine, Onelife (lines 1410–1850), calculates and displays the next generation of the Life universe and represents the Assembly-language implementation of the algorithm described above. The short Run routine (beginning in line 1330) simply makes repeated calls to Onelife and checks, after each, to see if you've pressed the spacebar.

The subroutine Complex (lines 1890–2070) uses a numeric keystroke to generate a line of individuals near the top of the screen. Life determines the beginning of the line randomly by using the current value in the Z80's refresh register, a technique that needs some explanation.

The dynamic memory chips in modern computers need to be constantly refreshed to hold valid data. The Z80 central processor maintains a special register that it uses to address each bit

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Circle 150 on Reader Service card.

of memory and simulate a read instruction to keep the memory alive. The Z80 implements the refresh as it decodes each machine-language instruction, so it doesn't hamper processing.

The refresh register, like most Z80 registers, is 8 bits wide. However, the processor actually uses only the bottom 7 bits during refresh operations. A program may set the top bit if necessary and it will stay set.

Life uses the value in the refresh register to determine where to start printing individuals when you press a numeric key. It then uses the actual key pressed to determine how many individuals to print. The result is a string of asterisks that is predictable in length (depending on which key you pressed) but not in location, so each time you press a numeric key, the computer will provide you with a slightly different starting universe.

The final subroutine, Pattern (lines 2110–2400), prints a particular pattern of individuals on the screen if you press an alphabetic key. It first finds the pattern by looking up its address in a table (PTRNS in line 2440) and then using the data at that address to generate a special set of individuals. This method of using a look-up table to find a data set is fairly common and you'll find it useful for a variety of programs.

Each piece of pattern data (lines 2490–2990) begins with a 2-byte word and ends with a single zero byte. The program uses the 2-byte word to determine the location of the first character in the pattern. Each byte that follows indicates how far Life should move the cursor before printing another character. When it finds a zero byte, the program transfers the new pattern to the screen and returns to its main loop to await a new command.

Listing continued

```
02690 PK        DW      277
02700           DB      3,77,1,1,1,76,5,75,2,1,2,75,5,76,1,1,1,0
02710 PL        DW      441
02720           DB      1,79,1,157,1,1,1,73,1,2,5,72,1,2,1,4
02730           DB      75,3,2,2,1,72,2,3,2,1,73,1,1,1,157,1,79,1,0
02740 PM        DW      600
02750           DB      79,2,77,3,78,1,78,3,77,2,79,0
02760 PN        DW      516
02770           DB      1,1,1,155,1,1,1,1,1,1,1,151,1,1,1,1,1,1,1,1,1,1,1
02780           DB      151,1,1,1,1,1,1,1,1,155,1,1,1,0
02790 PTO       DW      272
02800           DB      1,79,2,160,2,160,2,160,2,160,2,160,2,79,1,0
02810 PP        DW      998
02820           DB      1,1,78,2,78,2,0
02830 PQ        DW      437
02840           DB      1,79,1,154,1,4,1,1,1,4,1,67,2,2,5,2,2,69,2,1
02850           DB      4,2,69,2,2,5,2,2,67,1,4,1,1,1,4,1,152,1,79,1,0
02860 PR        DW      759
02870           DB      1,78,1,80,0
02880 PS        DW      757
02890           DB      1,2,1,76,1,2,1,77,2,76,2,2,2,74,2,2,2,74,1,4,1,0
02900 PT        DW      838
02910           DB      1,1,77,1,1,0
02920 PU        DW      838
02930           DB      1,1,80,77,0
02940 PV        DW      677
02950           DB      1,1,1,1,79,79,79,79,1,1,1,1,0
02960 PW        DW      26
02970           DB      27,54,25,53,1,1,25,1,1,0
02980 PX        DW      825
02990           DB      1,1,1,1,2,1,1,1,1,2,1,1,1,1,2,1,1,1,2,1,1,1,1,0
03000 ;
03010 ; Buffer space
03020 ;
03030 SBUFF     DS      SCRLEN          ;Buffer same length as screen
03040 ;
03050           DS      81              ;Phantom first line
03060 CBUFF     DS      SCRLEN          ;Calculation buffer
03070           DS      81              ;Phantom last line
03080 ;
03090 ; Opening Screen
03100 ;
03110 OPENING   DB      LF,LF           ;Line feeds
03120           DB      '          The Game of Life -- Originated by John Conway'
03130           DB      LF,'                    Model 4, TRSDOS 6.2 version'
03140           DB      LF,LF
03150           DB      '  To create patterns, press'
03160           DB      LF,'     A - X for set patterns'
03170           DB      LF,'     0 - 9 for complex, pseudo-random patterns'
03180           DB      LF
03190           DB      LF,'     <ENTER> starts generator'
03200           DB      LF,'     <SPACE> halts generator and allows input'
03210           DB      LF,'     <SHIFT><CLEAR> clears screen'
03220           DB      LF,'     <BREAK> ends program'
03230           DB      CR                              ;End of screen
03240 ;
03250           END     START
```

End

A Better Life

You can play with the program in several ways. First, you might want to allow a user to specify some display character other than an asterisk. You could do so by prompting for a new character at the beginning of the program and then storing that character at OL40-4, C10+1, and P10+1, the only three places where an individual is actually added to the Life universe.

The Game of Life is most fun if you can experiment with new patterns yourself. It isn't too hard to add a new subroutine that will allow you to move a cursor around the screen and add or erase individuals at will. You could even save several user-created patterns in a memory buffer or on disk to recall or modify.

One of the important lessons you can draw from looking at the Listing is that the video and keyboard SVCs are fast enough to meet the needs of almost any application. Several readers have asked me why I don't publicize the addresses of various TRSDOS 6.X variables and routines. The problem with doing so is that such addresses will only be valid for one specific version of LDOS/TRSDOS 6.X running on one specific machine.

If your programs follow the rules of TRSDOS and use SVCs instead of direct hardware input/output, you can be assured that they will run correctly on any Model 4, 4P, II, 12, or Max-80 running your version of the DOS or any later version. If you use absolute addresses, your program will be limited to running on one version of the DOS on only one machine. If you upgrade your DOS, you will have to rewrite your programs.

This Game of Life program is written specifically to run on TRSDOS 6.2 or later. However, if for some reason you're using an earlier version of TRSDOS 6.X, all you'll need to do is change every use of the @CLS SVC (first introduced in version 6.2). To clear the screen with earlier versions, you must send ASCII characters 1C hex and 1F hex to the display with the @DSP SVC. You could also easily modify the Listing to run on a Model III by using the screen directly as a screen buffer, setting SCRLEN to 1,024, and using calls to ROM routines instead of TRSDOS 6.X SVCs. Almost everything else in the program should work the same regardless of which machine you use.■

You can contact Hardin Brothers through CompuServe. Go PCS-117 to the Writers' and Editors' SIG (WESIG) and leave your message. You can also write to Hardin at 280 N. Campus Ave., Upland, CA 91786. Enclose a stamped, self-addressed envelope if you want a reply.

A Matter of Records: Your Spreadsheet as Data Base

This month's spreadsheet was submitted by Glenn T. Stratton of Canaan, ME.

If you've always thought of VisiCalc as simply a spreadsheet, you might be surprised to learn that you can also use it as a data base. Creating print files—one of VisiCalc's least-recognized options—provides the key. After preparing a VisiCalc worksheet, you "print" the information to disk by invoking the /PF command. You can then write a small Basic program to access and manipulate the data. In most cases, this approach is far easier than mastering the ins and outs of VisiCalc's data interchange format (DIF) files.

Setting an Example

I'll illustrate VisiCalc's data base capability with a voting list for the town of Hannibal's Crossing and the unincorporated village of Scipio's Landing. The registered voters include Whigs (W), Tories (T), and Libertarians (L) (see Table 1).

Each row in the spreadsheet represents one data record, each column a field. A spreadsheet is ideal for compiling and maintaining such a list because you can easily make insertions and deletions. Unfortunately, VisiCalc is useless if you need to sort the list by a particular criterion, such as party affiliation. That's where a print file and a Basic program become useful.

To create the desired print file and print reports from the data base, position the cursor on the cell containing the name of the first voter (A3 in my example). Type in /PF; after the file-name prompt appears, name your print file (HANNIB in my example). VisiCalc automatically appends /PRF as an extender.

The next prompt asks you to identify

LOAD 80

System Requirements

Model 4/4P
VisiCalc
Multiplan with changes

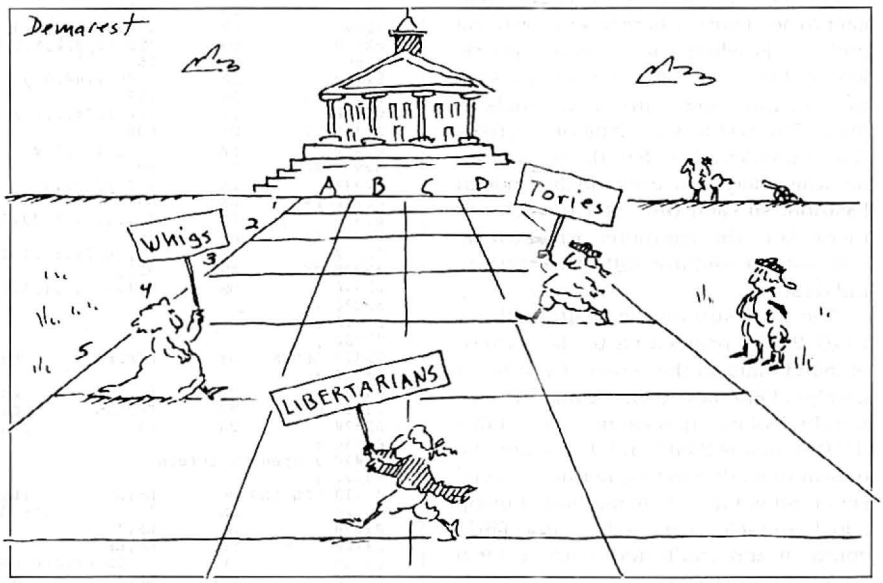

Illustration by Chris Demarest

	A	B	C	D	E
1	Name	Street Address	City	Zip	Party
2					
3	Abbot, Justin	432 Western Ave.	Hannibal's Crossing	16666	T
4	Able, Arthur	132 Golden Ave.	Hannibal's Crossing	16666	W
5	Baker, Mary	RFD2 Box 2232	Scipio's Landing	16668	T
6	Clarke, John Jr.	456 North Ave.	Hannibal's Crossing	16666	T
7	Clarke, John Sr.	456 North Ave.	Hannibal's Crossing	16666	L
8	Dougals, Jane P.	RFD2 Box 2239	Scipio's Landing	16668	W

Table 1. Voting list worksheet.

Able, Arthur	132 Golden Ave.	Hannibal's Crossing	16666	W
Dougals, Jane P.	RFD2 Box 2239	Scipio's Landing	16668	W
Abbot, Justin	432 Western Ave.	Hannibal's Crossing	16666	T
Baker, Mary	RFD2 Box 2232	Scipio's Landing	16668	T
Clarke, John Jr.	456 North Ave.	Hannibal's Crossing	16666	T
Clarke, John Sr.	456 North Ave.	Hannibal's Crossing	16666	L

Table 2. Voting list after sorting with Reader/BAS.

Program Listing 1. Reader/BAS.

```
10 GOTO 100
15 'READER/BAS
20 ' THIS PROGRAM READS A PRINT FILE GENERATED BY VISICALC.
```

Listing continued

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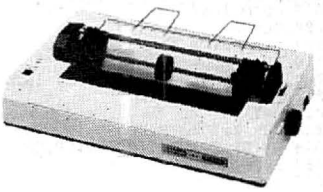

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Listing continued

```
30 ' IT BREAKS THE STRINGS INTO SUBSTRINGS, BY FIELDS AND STRIPS
40 ' LEADING BLANKS.
50 ' SUBROUTINE 5000 SELECTS AND LPRINTS CERTAIN RECORDS
100 DIM A$(100)
110 GOSUB 1000
120 GOSUB 2000
130 GOSUB 3000
140 GOSUB 4000
150 GOSUB 5000
160 GOSUB 6000
170 END
1000 'GOSUB 1000 GETS FILENAME AND RELATED DATA.
1010 ' THIS GOSUB FIXES PARAMETERS USED TO READ "HANNIB/PRF
1020 'IT COULD BE MODIFIED TO A SERIES OF INPUT STATEMENTS
1030 'IN A PROGRAM FOR MORE GENERAL USE
1040 CLS
1050 FILE$="HANNIB/PRF"
1060 CW=20 'COLUMN WIDTH USED TO CREATE THE WORKSHEET
1070 FIELDS = 5 ' THE NUMBER OF COLUMNS USED
1080 RETURN
2000 'GOSUB 2000 READ THE RECORDS
2010 CLS
2020 PRINT@(12,30),"<<< WORKING >>>"
2030 OPEN "I",1,FILE$
2040 C2=0
2050 IF EOF(1), THEN 2090
2060 C2=C2+1
2070 LINE INPUT #1, A$(C2)
2080 GOTO 2050
2090 CLOSE
2100 DIM F$(C2,FIELDS)
2110 RETURN
3000 'GOSUB 3000, BREAKS A$ INTO RECORDS
3010 FOR C1=1 TO C2
3020 P=1
3030 FOR X=1 TO FIELDS
3040 F$(C1,X)=MID$(A$(C1),P,CW)
3050 P=P+CW
3060 NEXT
3070 NEXT
3080 RETURN
4000 'GOSUB 4000 STRIPS EACH FIELD OF LEADING BLANKS
4010 FOR C1 =1 TO C2
4020 FOR X=1 TO FIELDS
4030 TEMP$=F$(C1,X)
4040 GOSUB 4500
4050 F$(C1,X)=TEMP$
4060 NEXT
4070 TEMP$=""
4080 NEXT
4090 RETURN
4500 'GOSUB 4500 STRIPS LEADING BLANKS FROM A STRING
4510 Q=LEN(TEMP$)
4520 XX=0
4530 XX=XX+1
4540 IF MID$(TEMP$,XX,1)=" " THEN :Q=Q-1 : GOTO 4530
4550 B$=RIGHT$(TEMP$,Q)
4560 TEMP$=B$
4570 RETURN
5000 'LPRINTS SELECTED RECORDS
5010 CLS
5020 INPUT "WHICH PARTY AFFILIATION (W,T,or,L)";I$
5030 IF I$="W" OR I$="w" THEN PARTY$="W":GOSUB 5500
5040 IF I$="T" OR I$="t" THEN PARTY$="T" : GOSUB 5500
5050 IF I$="L" OR I$="l" THEN PARTY$="L" : GOSUB 5500
5060 INPUT "DO YOU WISH TO CONTINUE ? <Y/N>";I$
5070 IF I$="N" OR I$="n" THEN RETURN
5080 GOTO 5010
5500 ' PRINTS SELECTED RECORDS
5510 FOR C1=1 TO C2
5520 IF F$(C1,5)<>PARTY$ THEN 5580
5530 LPRINT TAB(5)F$(C1,1);
5540 LPRINT TAB(25)F$(C1,2);
5550 LPRINT TAB(45)F$(C1,3);
5560 LPRINT TAB(65)F$(C1,4);
5570 LPRINT TAB(75) F$(C1,5)
5580 NEXT
5590 RETURN
6000 'GOSUB 6000 PRINTS DONE MESSAGE
6010 CLS
6020 PRINT@(12,30),"<<< DONE >>>"
6030 RETURN
```

End

Program Listing 2. Reader2/BAS. Modifications for Multiplan.

```
4540 IF X < LEN(TEMP$) THEN IF MID$(TEMP$,XX,1)=" " THEN :Q=Q-1
: GOTO 4530
4550 TEMP$=RIGHT$(TEMP$,Q)
4570 Q = LEN(TEMP$)
4580 IF Q <= 1 THEN RETURN
4590 XX = Q+1
4600 XX = XX - 1
4610 IF XX > 1 THEN IF MID$(TEMP$,XX,1)=" " THEN Q=Q-1: GOTO 460
0
4620 TEMP$=LEFT$(TEMP$,Q)
4630 RETURN
```

End

Using VisiCalc worksheets as data bases invites much creative tinkering.

the lower right-hand corner of the print area. When you set the cursor on the cell containing the party affiliation of the last voter (cell E8 in my example) and press the enter key, VisiCalc generates the print output file HANNIB/PRF.

Program Listing 1 contains the Basic program Reader/BAS. It reads the print file and converts it into records and fields, allowing you to sort the voting list by party affiliation and print the corresponding records (see Table 2).

Program Structure

Reader/BAS uses six subroutines. The first (beginning at line 1000) initializes the file name, field length, and fields per record. The subroutine at line 2000 opens the file indicated and reads each data base record from the spreadsheet output file into a string array, A$.

The heart of the program lies in the subroutines beginning at lines 3000 and 4000. I set each column in the spreadsheet to a width of 20 characters, so the subroutine at line 3000 divides the data records into 20-character substrings. It then stores them in a two-dimensional array, F$.

Because this example uses VisiCalc's right-justified global format, /GFR, all fields of fewer than 20 characters contain leading blanks. The subroutine at line 4000 removes all leading blanks from each data field so that the printed output fits onto a standard 80-column printer.

The subroutine at line 5000 is a data base query routine. It asks you which records you want to print out and sends them to the printer. This routine doesn't do any sophisticated data manipulation—it's a simple loop that searches the array created from the input data for all matching records in the identical order produced by the spreadsheet.

Creative Process

The transformation of a VisiCalc worksheet into a data base invites a lot of creative tinkering. You could, for example, create a program that would let you search according to a variety of fields. Or you could output the sorted list to disk, read the file using a word processor, and incorporate the data into a larger report. The versatility of the technique expands VisiCalc's utility beyond number-crunching. ■

Beyond VisiCalc

You can apply Glenn Stratton's techniques to other spreadsheets. For example, you may find times when you can use it with Lotus 1-2-3: I've used this approach to produce reports when I felt Lotus' data base functions were too limited. And although Multiplan lets you sort records, it can also use this technique if you find it easier to read and manipulate data in a separate program. However, you need to keep in mind some basic differences between Multiplan and VisiCalc to use Stratton's template.

In the example given, Stratton formatted all columns at 20 characters. If you use Multiplan, be sure you meet this criteria or the accompanying Basic program won't read the data base fields correctly. Of course, you can extend the Basic program in Listing 1 to read data base fields of different widths.

Multiplan allows better control over the printer than VisiCalc. If you don't change the top and bottom margins with the Print Margins command, you'll get additional blank lines in the disk output file. For example, a standard formatted sheet printed with Multiplan has six blank lines at the top, a print area of 54 lines, and six blank lines at the bottom. If your printed output doesn't fill the entire 54 allowed lines, Multiplan creates blank lines to compensate. The solution is to set the top margin to zero and set the last print line and the page length to the number of records in the data base.

Also, make sure you set the left margin to zero or you'll get additional blank lines to the left of each record. Similarly, make sure that you properly set the right margin; otherwise Multiplan automatically divides the "printed" records into two pages, just as it does on the printer when the spreadsheet is too wide.

Finally, Multiplan left-justifies its default text storage within each cell. Program Listing 2 contains the lines necessary to accommodate leading and/or trailing blanks in a data cell. Use them in place of lines 4540–4570 of Listing 1. You don't have to use the right-aligned text format illustrated in the example.

—*John B. Harrell III*

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TIDBIT #33

I often set up a dedicated system disk for a specific task. This disk contains only the system files, DOS utilities, and/or Basic that the task requires. To make it easier to see what I've got on the disk, I change the invisible files—most DOS utilities and Basics—to visible files. I use a disk-zapping utility to change byte zero of the file primary directory entry (FPDE) for each file. The table shows the visible and invisible FPDE zero bytes for each DOS I have altered (all numbers are in hexadecimal):

DOS type	Visible FPDE	Invisible FPDE
DOSPLUS	10	18
MULTIDOS	10	18
NEWDOS/80	10	1E
LDOS	10	1E
TRSDOS	10	18

Below is an example FPDE indicating visible files:

```
1000 009A 0045 4454 4153 4D20 2043 4D44  .....EDTASM..CMD
9642 9642 2000 0D24 1A01 FFFF FFFF FFFF  .B.B...$.....
```

Below is an example FPDE with invisible files:

```
1800 009A 0045 4454 4153 4D20 2043 4D44  .....EDTASM..CMD
9642 9642 2000 0D24 1A01 FFFF FFFF FFFF  .B.B...$.....
```

You can do the reverse of the above—make a visible file invisible by changing byte zero of its FPDE. DOS and Basic use the changed file normally, but it is invisible to a standard Directory command.

Wes Fritschle
Clarksville, TN

TIDBIT #34

Model III TRSDOS handles files with short logical records inefficiently. Ervan Darnell gave a dramatic example with the following program ("Model III Bugs," September 1981, p.12). Remember to answer 1V to the "How many files?" prompt when you enter Basic.

```
10 OPEN "R",1,"TEMP",1
20 FIELD 1,1 AS A$
30 FOR N = 1 TO 256
40 LSET A$ = "A"
50 PUT 1,N
60 NEXT N:CLOSE
```

Darnell commented that this program took 160 seconds at a baud rate of 12.8. You can reduce execution time to fewer than five seconds by changing line 50 to:

```
50 PUT 1
```

When the Get and Put statements don't carry an explicit record number, TRSDOS foregoes unnecessary disk accesses. When TRSDOS reads a random file sequentially, it reduces execution time drastically.

The same concept applies to reading a record. The simple loop below takes 50 seconds:

```
30 FOR N = 1 to 256
40 GET 1,N
50 NEXT N
```

The change below cuts run time to three seconds:

```
40 IF N = 1 THEN GET 1,1 ELSE GET 1
```

Thomas P. Eggarter
San Luis, Argentina

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45	Cornucopia Software	7
539	Desert Sound Inc.	83
282	DFW Computer Center	50, 51
536	DHA Systems	111
204	DiskCount Data	45
439	Donald Ady	83
91	Dotwriter	9
452	Dresselhaus Computer	90
85	Educational Micro Systems	34
	80 Micro	
	Back Issues	58
	Classified	128
549	Classified Ads	127
	CW Museum	113
	CW Newstand	89
	CW Inc.	97
	Dealer Sell	126
	Foreign Dealers	86
	Jessie Jones	87
	Load 80 Subscription	64, 65
	Mailing List	126
	Subscription	32, 95
	Toll Free	128
	University Micro	53
349	80 Northwest Publishing	117
45	Electric Webster	7

Reader Service Number		Page
181	Envision Design	90
178	EZWare Corp.	76
461	Frank Software	125
214	Ft. Worth Computers	40, 41
	G.E. Information Services	85
185	Gooth Software	79
9	H & E Computronics	CIV
455	Hard Drive Specialist	69
355	H.D.P.	114
175	Howe Software	47
46	Hypersoft	76
109	Instant Software	121
401	Intellitech Corp. (ITC)	43
101	J & M Systems, Ltd.	CIII
126	JMG Software International	2, 3
534	Jameco Electronics	79
331	K Soft	122
*	Langley-St. Clair	87
372	Lindbergh Systems	123
251	Logical Systems	57
250	Marymac Industries Inc.	123
505	Microcomputer Tools	122
299	Microdex Corp.	104
464	Micro Labs Inc.	126
488	Micro-Link	39
137	Miller Microcomputer Services	54
411	Montezuma Micro	26, 27
416	Montezuma Micro	92, 93
424	Montezuma Micro	71
232	Nocona Electronics	101
*	NRI Schools	114
200	Pacific Software Consultants	77
470	P.G. Design Electronics	63
124	Perry Computers	24
176	Personal Computer Products	56
440	Personal Integrated Computers	67
108	Powersoft	18, 19
308	Powersoft	4
249	Press A Software	114
76	Producer, The	28
174	Professional Tax Software	83

Reader Service Number		Page
449	Professor Jones/Frogg House	124
30	Prosoft	11
75	Radio Shack	CII, 1
512	Rockware Data Corp.	58
453	Rocky Mountain Electronic Sales	20
371	Seatronics	91
503	Severts-Zorman Engineering	79
*	Software Support	98, 99
427	SOTA Computing Systems Ltd.	62
386	Statewide Microelectronics/ Digital Disks	105
150	Summit Software Technology Inc.	106
456	Sunlock Systems	83
347	Talley Communications Co.	124
81	Total Access	49
198	Traveling Software	80
441	Trionix	117
227	Trisoft	104

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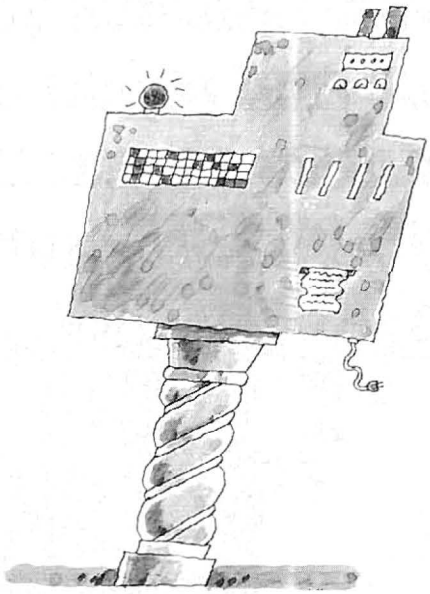

CW Communications, ComputerLand and The Computer Museum invite you to send in your early personal computers, software, and memorabilia — you could win a free trip to The Computer Museum in Boston

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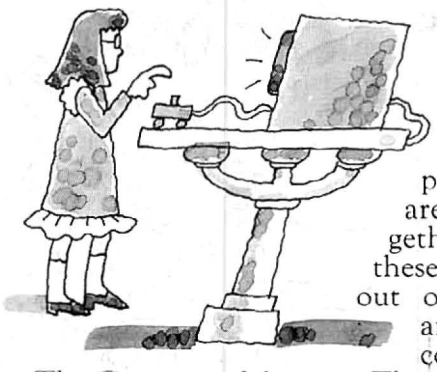

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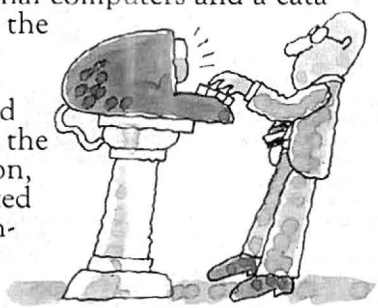

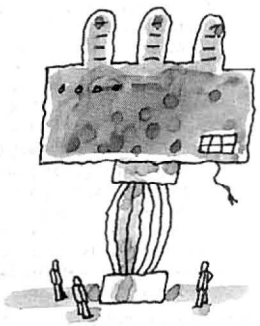

So, get up to the attic, down to the cellar and into your closets, and tell us what you find! Call or write the Museum for an official entry form, or send a photo and description of your items by March 1, 1986 to: The Computer Museum, Personal Computer Competition, 300 Congress St., Museum Wharf, Boston, Massachusetts USA 02110, (617) 426-2800, Telex: 62792318.

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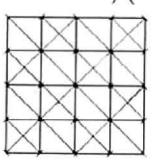

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Entries will be judged on significance, rarity, date, completness and condition. Items particularly sought include pre-1980 machines, early serial numbers (get those number 1's out), machines made for purchase outside of North America (even modern machines are sought in this category); first releases of software such as first releases of operating systems, languages and mass-marketed and original applications; and pre-1980 photographs, newsletters, manuals and other records. The Computer Museum is a private non-profit educational institution. All donations are tax-deductible according to the provisions of the Internal Revenue Service. Thinker Toys is a registered trademark of George Murrow & Murrow Designs, Inc.

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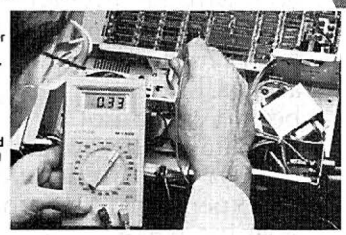

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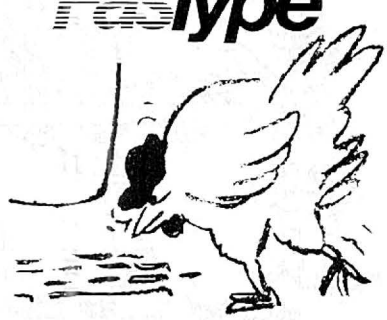

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See Our 4★ Review Nov. 85 *80 Micro*

Continued from p. 35

Documentation

Besides the optional help screen, the Unikey documentation consists of a 10-page manual. It adequately covers such topics as defining, installing, and using the three programmable macro keys. It also provides a complete list of the Basic key word macros and appropriate illustrations for the three distinct sets of keyboard macros.

Although all this material explains the Unikey system, it doesn't provide information on related TRSDOS topics. Novices don't even get the information necessary to perform such simple tasks as copying the Unikey files to a TRSDOS system disk. Although you can find the answers in the Model 4 *Disk System Owner's Manual*, beginning computer users would benefit from more comprehensive documentation.

Conclusion

Unikey is an excellent tool for faster entry of Basic programs. Once you memorize the macro keys most commonly used, you'll notice an increase in program entry speed. While the Unikey manual is a bit weak, the optional help screen provides a lot of assistance while you're learning the macro definitions.■

ABS(	GOSUB	POKE
ASC(	GOTO	POS(0)
ATN(	$H	PUT
CDBL(	HEX$(	RANDOM
CHR$(	IMP	READ
CLEAR	INKEY$	RESUME
CLOSE	INPUT	RETURN
CLS:	INT	RIGHT$(
COS(	LEFT$(	RND
CSNG(	LEN(	ROW(0)
CVD(	LINE	RESET
CVI(	LIST	SAVE "
CVS(	LOC(	SGN(
DATA	LOF(	SIN(
DATE$	LOG(	SOUND
DEF	LPRINT	STR
EDIT	LSET	STRING$(
ELSE	MEM	SYSTEM "
EOF(	MID$(	TAB(
EQV	MKD$(	TAN(
ERL	MKI$(	THEN
ERRS$	MKS$(	USING "
EXP(	MOD	USR
FIELD	NEXT	VAL
FIX(	OCT$(	VARPTR(
FN	ON ERROR	WEND
FOR	GOTO	WHILE
GET	OPEN "	WRITE #
	PEEK(	XOR

Table. Unikey's Basic key words.

PRO-ZShell Maps TRSDOS 6.X I/O

by Thomas L. Quindry

★★★½

PRO-ZShell runs on the Model 4 (64K) and requires one disk drive. Misosys Inc., P.O. Box 239, Sterling, VA 22170, 703-450-4181. $24.95

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

PRO-ZShell is a Model 4 utility that improves on TRSDOS 6.X's Route command by letting you redirect device input/output by task rather than by computer session. PRO-ZShell also supports piping and multiple and wildcard commands from TRSDOS.

Unfortunately, PRO-ZShell's documentation doesn't adequately explain its functions, making it difficult to use and understand. I found PRO-ZShell best suited to the knowledgeable DOS user.

A Better Route

TRSDOS 6.X is a device-controlled disk operating system and its routing program lets you redirect input or output from one device to another. If your Basic program displays information on-screen that you want printed out, you could use the Route command to redirect output to your printer. The problem with TRSDOS's Route command is that it reroutes everything until you invoke the Reset command.

PRO-ZShell takes TRSDOS's Route command a couple of steps further. It lets you temporarily redirect input/output devices until you return to TRSDOS. In the example above, PRO-ZShell would automatically stop routing data to the printer once the Basic program finishes executing.

PRO-ZShell also offers more routing flexibility than the TRSDOS Route command. It can redirect video or printer output to a disk file, either appending output to a certain file or overwriting a file. You can also substitute a text file for keyboard input (such as in response to the Basic Input command) and when PRO-ZShell finishes reading the file, it transfers input responsibility to the keyboard once again.

When commercial programs determine the end of program input, they transfer input control. PRO-ZShell has to mimic this function and, because different programs transfer input control in different ways, it does so in three ways, any one of which you can select. (PRO-ZShell recognizes the end of input by a file's end-of-file marker).

Since some programs expect you to send a break character at the end of input, PRO-ZShell can send one when it encounters an end-of-file marker. However, because the break character ends some Basic programs, PRO-ZShell can also transfer input control to the keyboard device driver. A third way PRO-ZShell transfers input control is with TRSDOS's @ABORT vector, which aborts your current operation. You use this method when a program doesn't read to the end of a file, and would be in error if it did so.

Other Utilities

The most difficult PRO-ZShell application to understand is the concept of piping the output of one program to the input of another. Large computer systems pipe data by executing interconnected programs simultaneously (a process called multiprocessing). The TRS-80 doesn't support anything as complex as multiprocessing, so piping in TRSDOS comprises chaining one program's output so that it becomes a second program's input. Shunting the output of the Directory command into the text buffer of a word processor is an example.

One caveat in using the piping command: The program that receives input must use the standard keyboard driver for it to work. A word processor that has a proprietary keyboard driver will simply ignore the piping command from PRO-ZShell.

Other PRO-ZShell utilities let you enter multiple commands from TRSDOS and use wildcard commands. For example, you could use the multiple command feature to give you a directory of all your files, purge selected ones, show the resulting free space, and then enter your word processor.

The wildcard command is a form of PRO-ZShell's multiple command that executes a specific command on all files that meet a wildcard specification. For example, REMOVE */TXT:1 deletes all files with the extension /TXT. You can use the wildcard command with the DOS commands Append, Attribute, List, Load, Remove, Rename, Reset, and Run.

Conclusion

The only problem I have with PRO-ZShell is its unclear documentation. While the manual explains the different commands, you have to experiment to understand what PRO-ZShell can and can't do. Otherwise, PRO-ZShell adds useful versatility to TRSDOS 6.X's Route command.■

TRSDOS 6.2 Utilities

★★★★

TRSDOS 6.2 Utilities run on the Model 4 (64K) and require TRSDOS 6.2.X and one disk drive. Tandy/Radio Shack, One Tandy Center, Fort Worth, TX 76102. $39.95.

TRSDOS 6.2 Utilities is a fine collection of six diverse programs for the Model 4 operating system. The package provides a speedy disk format and back-up utility, a disk and file comparison utility, a Basic sort utility, a Model III Basic-to-Model 4 Basic program converter, a utility that restores deleted disk files, and a structured Basic program processor.

Making mirror-image backups with 6.2 is slow and cumbersome because you have to format a disk before you back one up. QFB6 combines the format and back-up procedures. While you can save a lot of time with QFB6 (30–50 percent), it has a few limitations: The destination disk is always formatted with the same format as the source disk, only mirror-image back-ups are allowed, and you can't make a back-up with a one-drive system.

COMP6 can compare two disks or files and dutifully displays any inconsistencies between them. Unless you have a three-drive Model 4, many types of comparison require that you have various TRSDOS 6.2 system overlays in memory for successful completion. COMP6 is difficult to use and too limited.

BSORT is a high-speed Basic sort utility that sorts integer, single-precision, double-precision, or string arrays with either one or two dimensions. BSORT also supports ascending or descending sorts, multilevel sorting, tag arrays, mid-string sort keys, and generation of index arrays. It's the most versatile sorting utility I've seen.

MOD324 converts Model III Basic programs to Model 4 format. It adds spaces to a Model III Basic program, removes any values specified in Clear statements, optionally modifies PRINT@ values, and provides a complete list of truncated lines or those with potentially incorrect Basic program statements. MOD324 is fast and should be of considerable assistance in converting programs to Model 4 Basic.

Unkill permits possible restoration of removed and purged disk files. However, it can't restore a file that has lost either its directory entry or file space to another file. Unkill is most effective for restoring files immediately after you delete them. Otherwise, successful restoration is questionable at best.

TBA generates Basic programs from structured Basic text files, which the Basic interpreter then executes. Since TBA doesn't come with an editor, you can use either a word processor, a text editor, or the Model 4 Basic editor. TBA writes a structured Basic program as a collection of procedures. Procedures use line labels instead of line numbers and local and global variables.

Although TBA supports structured programming to a limited degree, it pales beside the new generation of Basic compilers that can transform Basic into a truly structured programming language. TBA doesn't quite offer enough features to make me want to use it.

The TRSDOS 6.2 Utilities come with a comprehensive 144-page manual. Perhaps the only problem with it is that certain features of TBA are explained to death.

However, TRSDOS 6.2 Utilities is an excellent package. While most of the utilities are useful, QFB6 and BSORT are the stars of the package. Even if the other four utilities were dropped from the package, TRSDOS 6.2 Utilities would still be an excellent purchase.

—Mark D. Goodwin

MicroZap

★★

MicroZap runs on the Model 4 (64K) and requires one disk drive. SOTA Computing Systems Ltd., 213-1080 Broughton St., Vancouver, British Columbia, Canada V6G 2A8, 604-688-5009. $49.95.

MicroZap is a disk sector- and file-zapping utility of limited usefulness and flexibility. Its main drawback is its configuration requirements—you have to answer configuration prompts every time you use it. Even with microZap's menu, the process is tedious: You have to answer or re-answer questions about single-sided or double-sided disks, single or double-density, the drive to read from, the drive to write to, DOS type (Model III or 4 including CP/M), user-defined format, the action you want to take, and so on. MicroZap saves your responses in a default file, but you still have to hit the enter key a half-dozen times in response to microZap's incessant questions.

If you elect to define a disk format from the main menu, microZap asks you for sector length, number of tracks, number of sectors, and whether the sectors are numbered from zero, 1, or higher. The manual states that microZap supports 256-, 512-, and 1,024-byte sector lengths, but since it accepts only three digits, you can't specify a 1,024-byte sector.

You can do relatively few operations with microZap. You can zap disk and file sectors, and copy, fill, and verify sectors. You can't read a directory, copy files, store information in memory, or read from memory. Also, microZap doesn't indicate what track and sector you're reading in the file-zapping mode. Talk about flying blind. If you really want to do some serious disk zapping, you need to know exactly where those files appear on the disk.

Some microZap features didn't work. When changing the sector you want to read, you use the right- and left-arrow keys. The manual states you can also use the plus and minus keys, but I couldn't get them to work on my Model 4P. And the file-zapping command writes to the read disk only.

MicroZap includes two other utilities, Fastback and PasFix. Fastback is touted as a fast back-up utility that can back up a disk in 38 seconds. But it loses its usefulness on two points: You still have to format the disk with your DOS, and Fastback doesn't recognize double-sided drives.

PasFix changes the file attributes on your disk so you can remove passwords and make files visible or invisible. However, you have to cycle through the whole list of files on your disk to make any changes. PasFix does have a Quit command so you can exit to DOS without implementing any of the changes.

The functions Fastback and PasFix perform should be part of microZap, making it a more complete program. As it is, microZap just doesn't have the functions or ease of use needed in a disk zapper.

—Thomas L. Quindry

Lovejoy's Preparation for The SAT

★★★½

Lovejoy's Preparation for the SAT runs on the Tandy 1000/1200 and requires 128K and one disk drive. Simon & Schuster Inc., Computer Software Division, 1230 Avenue of the Americas, New York, NY 10020. $69.95.

Like the book of the same name, Lovejoy's Preparation for the SAT is designed to help high school students prepare for the scholastic aptitude test (SAT). Since good SAT scores can be a heavy factor in gaining admission to college, many students want to prepare as much as possible.

Lovejoy's method of improving SAT performance involves practice drills and sample exams. Both the disk and book versions follow this tack, and also use special strategies keyed to the test's verbal and mathematics sections.

The most glaring difference between the book and the disk is the price tag: $8.95 versus $69.95. How does the elec-

tronic rendition justify a seven-fold increase in price? The answer, like the difference between a Volkswagen and a Porsche, lies with the extras. The computer version uses its environment to the fullest. For example, a windowed screen keeps handy reference information available as each multiple-choice question flashes on the display. After a student answers questions, explanations appear in the window detailing the differences between right and wrong responses.

Another window serves as a scratchpad. It records user notes with a text editor and emulates a four-function calculator. Like any responsible proctor, the software disables the calculator during sample exams.

Once a student completes a practice drill or sample exam, he/she needn't worry about looking up the answers. The program automatically checks the student's choices and displays the incorrect ones. It even draws bar charts comparing results for each session.

For many individuals, these bells and whistles may not justify a $70 investment. But group purchasers, such as school libraries, would find the electronic Lovejoy offering a distinct advantage. Since test scores are maintained on work disks, the software can effectively handle an unlimited number of students. And unlike a book, it never gets dog-eared.

—Ed Joyce

Monte's Toolkit

★★★★½

Monte's Toolkit runs on the Model 4 (64K) and requires Montezuma Micro's CP/M 2.2 (version 2.2X) and one disk drive. Montezuma Micro, P.O. Box 32027, Dallas, TX. $49.

Monte's Toolkit is a collection of six sophisticated utilities for Montezuma Micro's CP/M 2.2.X. The utilities are easy to use and provide some needed features that CP/M lacks.

The Auto utility lets you specify more than one command on a command line, which you can't normally do in CP/M. It creates a file similar to a Submit intermediate file from the CP/M commands you enter as Auto parameters. Auto saves you disk space and quickly executes auto command sequences.

One of CP/M's most annoying requirements is keeping a system disk in disk drive A. SYS2M copies CP/M system files to the RAM disk Montezuma CP/M automatically establishes in a 128K Model 4. It also patches the BIOS code to perform system reloads from the RAM disk instead of the drive-A disk. The operating system code takes up only about 8K.

After running SYS2M, you can put any CP/M-formatted disk in drive A. You still need a disk in the drive (CP/M always reads the disk directory of drive A on a warm boot), but it can be of any format.

SYS2M also copies your files or programs to the RAM disk, which CP/M will search first, regardless of the current disk drive.

WSPR is an enhancement for WordStar's deficient printer controls. It uses printer definition files with appropriate control codes to print out WordStar output files. You can also design more than one printer definition file and print the same document on multiple printers. WSPR overcomes another WordStar deficiency: It prints more than one copy of a document.

The other three utilities (DBLCROSS, FREEFORM, and FILEFIX) form a powerful data-transfer capability between CP/M, TRSDOS, and MS-DOS.

DBLCROSS lets you read the directory of any disk in these formats. It combines Montezuma's extensive CP/M disk format coverage with the ability to read TRSDOS 1.3, TRSDOS 6.X, and MS-DOS directories. You can assign any physical disk drive in the system to one of these formats.

Once you select the drive formats, you can display the directory of the source drive and tag the files you want to transfer. When you make your selections, press the M key to initiate the file transfer. You then pick the target drive from the menu of assigned formats. Transferring each tagged file occurs quickly, and DBLCROSS presents a running status of the operation.

You can use FREEFORM to format and create blank disks in an alien disk format or to copy an alien disk. FREEFORM also has a clone option that analyzes a disk track by track and copies it. This is great if you want to copy a disk and don't exactly know its format. The clone command will do its best but won't always work with strangely protected disk formats.

FREEFORM also has a disk analysis program, which uses the same scanning routine the clone option uses to scan disk tracks and print out its format, the actual track contents, or the track's data records. You can direct this output to the screen or printer.

FIXFILE can fix some of the incompatibilities between text files under the different operating systems, such as cleaning up WordStar or Scripsit files so you can transfer them back and forth.

Monte's Toolkit comes with a 17-page user's manual on disk, ready for you to print out with WSPR. Instructions on the disk sleeve get you started.

—John B. Harrell III

Circle 441 on Reader Service card.

TANDY 1000

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$777 5 MEG HARD DRIVE

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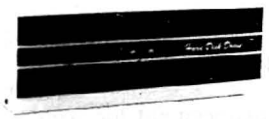

Comes complete with cable and choice of software driver* (CPM, LDOS, TRSDOS)

10 Megabyte Hard Drive	$899
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SYSTEM FEATURES

- For TRS-80 Model 3-4-4P
- One Year Parts & Labor Warranty
- Size Rated After Format
- Continuous Duty Power Supply
- Error Checking & Correcting
- Continuous Duty Fan
- Size 11.5" x 12.5" x 5.0"
- All Contacts Gold Plated

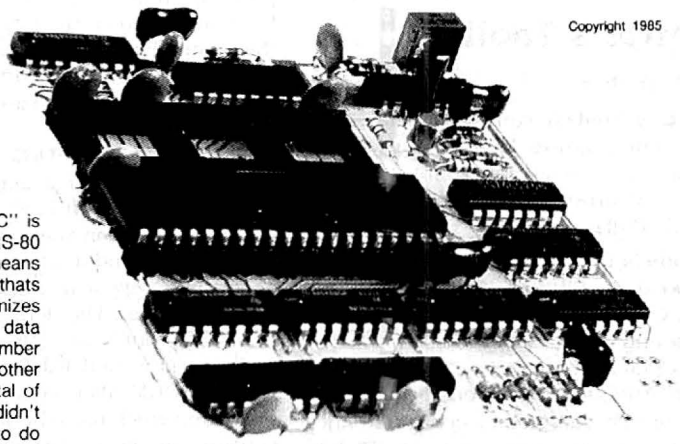
*Model 3 requires LDOS
Model 4 requires TRSDOS 6.2 or Montezuma Micro CP/M 2.2

There are firms which offer benefits, experience or products seemingly too good to be true. Now why would you want to expose yourself to unhappiness when Aerocomp has a proven record of thousands of happy, satisfied TRS-80 customers. Just take a minute to look through back issues of this magazine. You won't find many companies that have been around as long as Aerocomp. We fully support TRS-80 computers and most all operating systems including CP/M 2.2. Aerocomp leads the way to low hard disk prices so you can afford to enjoy the benefits of increased storage and faster disk I/O. These units are precision engineered, tested and delivered complete and ready to use, right from our stock. Each unit is guaranteed for one year parts and labor. You can count on us to be here if you should ever need us. As always, your satisfaction is assured with our 14 day free trial offer. If, for some reason, you are dissatified with our drive merely return it for a full refund (less shipping). How can you go wrong? Specify the software driver of your choice and start enjoying your computer's real capability. Do it today! Call our toll-free number now!

See opposite page ▶▶▶▶▶▶

MODEL I DOUBLE DENSITY BOARD

Add 80% more capacity to your disk system with the Double Density Controller (DDC) from Aerocomp.



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The Story

Some products have what it takes to seem to last forever. Our "DDC" is one of those products. What it does is allow you to operate your TRS-80 Model 1 disk system in double density. In this case double density means almost doubling the storage capacity of your diskettes. Single density, thats the way Radio Shack designed your Model I expansion interface, organizes your disk into 10 sectors per track. Each sector contains 256 bytes of data for a total storage capacity of 2,560 bytes or 2.5K per track times the number of tracks your drive is capable of adressing. Double density, on the other hand, writes 18 sectors per track each containing 256 bytes for a total of 4,608 bytes or 4.5K. That is 80% more data in the same space. Why didn't Radio Shack do that in the beginning, you ask? Well it costs money to do double density because it is more difficult to do than single density and the data is harder to capture reliably. That means more cost and the Model I was meant to be a low-cost computer for the masses. Therefore, no double density for the original Model I.

The Facts

Other companies introduced double density controllers for the Model I but they were not so good. We waited and waited but, even new models failed to correct problems with data separation that kept cropping up. So we went to work and came up with a new design to cure the old problem. At last! A double density controller for the Model I with a higher probability of data recovery than with any other double density controller on the market then or since. Our analog design phase lock loop data separator has a wider capture window than the digital types the others use. This allows high resolution data centering. Our "DDC" analog circuit allows infinately variable tuning. The attack and settling times are optimum for 5.25" diskettes. The oft-stated fears of adjustment problems rumored by digital dilettantes have been proved groundless by thousands of satisfied users the world over. The bottom line here is state-of-the-art performance and reliability.

ORDER YOURS TODAY

TRS-80 Model I disk system owners who are ready for reliable double density operation will get 80% more storage per diskette; single and double density data separation with far fewer disk I/O errors; single density compatibility; simple plug-in operation. You will need a disk operating system that has the necessary double density software. All the popular DOS's (except TRSDOS) have the drivers. We have put together two special packages in the event you don't already have one of the more popular DOS's.

Please add $4 handling & shipping

"DDC" by itself	$ 99
"DDC" and LDOS	159
"DDC" and NEWDOS 80 2.0	179

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BARE DRIVES

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These drives are completely burned-in and tested for your ultimate satisfaction. Add that extra drive today! These are new factory drives. No blems, seconds, closeouts or defunct manufacturers surplus (MPI, Shugart, etc). Instruction manual included at no extra cost. Service manuals are also available. See "Miscellaneous Goodies" for information.

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40tk DS half high TEAC FD35-B	109
80tk DS half high TEAC FD35-F	129
40tk SS full size Tandon TM100-1	119
40tk DS full size Tandon TM100-2	119
40tk SS half high TEAC FD55-A	89
40tk DS half high TEAC FD55-B	99
80tk DS half high TEAC FD55-F	119
8" SS Thinline Tandon TM848-1E	260
8" DS Thinline Tandon TM848-2E	335

8" FLOPPY DRIVES

Add $12 S&H

These 8" Thinline drives work with the Model 2 and 16 plus others that use standard drives. The rugged all-steel cabinet has an extra heavy duty power supply rated for continuous operation. A removeable air filter allows only clean air to circulate. Cabinets with single drives are supplied with a blank panel to cover the unused space. A second drive can be added at any time. Service manuals are available. See "Miscellaneous Goodies" for info.

1-8" SS Tandon TM848-1E & case	$ 389
2-8" SS Tandon TM848-1E's & case	649
1-8" DS Tandon TM848-1E & case	439
2-8" DS Tandon TM848-2E's & case	699

MISCELLANEOUS GOODIES

$2 S&H

Model 1 TRSDOS 2.3 disk & manual	$ 25
Model 3 TRSDOS 1.3 disk & manual	25
Model 4 TRSDOS 6.2.x disk & manual	20
LDOS (specify Model I or III)	69
NEWDOS 80 v2.0 (specify Model I or III)	99
Montezuma Micro Model 4 CP/M 2.2	169
Tandon TM100-1/2 Service Manual	20
Tandon TM848-1/2 Service Manual	20
TEAC FD55A/B/F Service Manual	20
10 SSDD disks in library box, Lifetime Guar	12
10 DSDD disks in likrary box, Lifetime Guar	15
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5.25" 1-drive cable, a nice length	19
5.25" 2-drive cable, a 44 incher	24
5.25" 3-drive cable, just the right size	29
5.25" 4-drive cable, the top dog	34
5.25" Extender cable with gold contacts	10

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1-40tk DS 3.5" FD-35B in dual case	$ 159
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40tk Single Side full size TM100-1	149
40tk Double Side full size TM100-2	159

1-40tk SS half-high FD-55A in dual case	129
2-40tk SS half-high FD-55A's in dual case	219
1-40tk DS half-high FD-55B in dual case	139
2-40tk DS half-high FD-55B's in dual case	259
1-80tk DS half-high FD-55F in dual case	159
2-80tk DS half-high FD-55F's in dual case	279

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Use your Aerocomp hardware product for up to 14 days. If you are not satisfied for **ANY REASON** (except misuse, damage or improper handling), return it (insured) in the orginal shipping container for a full purchase price refund, less shipping. **Sorry, this offer does not apply to software. Defective software will be replaced.** Any hardware/software specials will be prorated and the software will be charged at the regular unbundled price. We have confidence in our products and we know you will be satisfied.

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Convert your cassette Model III or 4 to disk operation with one of our complete kits. You receive our own advanced disk controller board with gold plated edge contacts capable of 4-drive operation; our own power supply; plated steel mounting towers complete with RFI shield plus all the cables and hardware necessary. Detailed instructions are included. All you need is a screwdriver and a pair of pliers. System kits come with 40 track single-side drives or just order the basic kit and pick the drives you want from the selection in the next column.

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Model 4 TRSDOS 6.2.x disk/manual	20
LDOS 5.1.4disk/manual	69
NEWDOS 80 version 2.0disk/manual	99
CP/M 2.2 by Montezuma Micro	169

No S & H charge when ordered with kit

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If you have a Model I and an Expansion Interface this is what you need to get started with disks. Included is one 40 track single-side disk drive complete with matching silver case and power supply, a 2-drive cable, a TRSDOS 2.3 disk operating system and TRSDOS manual plus all insurance and delivery charges to your door (lower 48 states).

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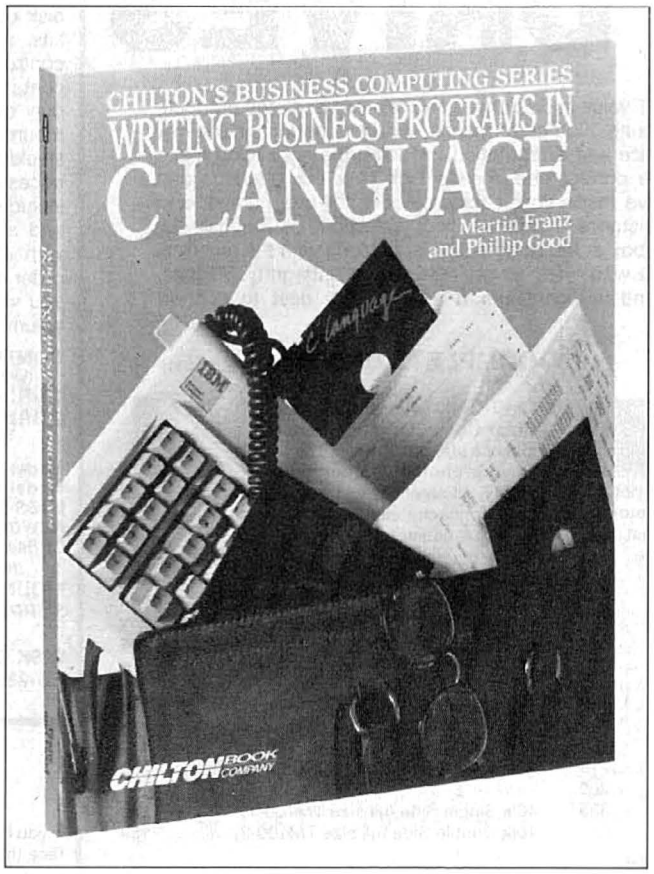
Chilton Books' *Writing Business Programs in C Language* ($16.95 plus $1.75 for handling), by Martin Franz and Philip Good, lets managers, analysts, consultants, and anyone who programs use C to write business software.

The book has practical, easy-to-understand models to run, modify, and adapt to individual needs for business applications. It teaches you the calculations, character manipulation, and file management you need to develop programs and build extensive applications and functions libraries.

The book also provides information on compilers and interpreters and how to selectively choose among them. For more information, contact Chilton Book Co., Radnor, PA 19089, 215-964-4758.

Circle 558 on Reader Service card.



Learn to use C to fulfill your business needs.

Shuffle Around

Blue Ridge Software offers PROfix*IV for the Model 4. It's a restructure and transfer utility for TRSDOS 6.2 Profile 4 users. This is an addition to the PROfix family including PROfix*III for the Profile III Plus users and Profile Plus Model II/12 users.

PROfix lets you reorganize a data base any way you want, then moves the data from all or selected fields and/or records of the existing data base into the newly defined file structure without disturbing the existing data. You can increase or reduce field lengths, drop unused fields, or add new fields. Other unique features include building the new file in sorted order, dropping deleted records, spinning off new subsidiary files, and inserting literal values in selected fields.

PROfix has the same equipment requirements as Profile and works with hard as well as floppy disks. The Models III and 4 versions cost $49.95 and the Model II/12 version sells for $89.95. Add $2.50 for postage and handling. For more details, contact Blue Ridge Software, 230 Chesterfield Road, Lynchburg, VA 24502, 804-239-0574.

Circle 562 on Reader Service card.

Time Keeper

BUSS.BA for the 24K and 32K Model 100 is a program primarily for billing and timekeeping but you can use it to keep track of expenses (like travel costs) and to keep a simple journal and ledger.

The program also includes a section for keeping notes on multiple accounts and a label printer.

The billing process is fast and accurate. You can use the program with the TRP 100 printer from Radio Shack and print a bill on the job. BUSS.BA comes on a cassette tape and includes a 24-page instruction manual. It retails for $89.95 plus $3 for shipping. For more information, contact Ron Burkart, Route 3, Box 883, Hillsborough, NC 27278, 919-967-4604.

Circle 566 on Reader Service card.

Tax Fever

TRY-O-TAX from TRY-O-BYTE helps you prepare your federal tax return on a Model III or 4/4P. It calculates schedules A–G, SE, and W, as well as forms 1040, 2106, and 2441. With the exception of form 1040, the program prints the schedules as a computer-generated substitute form. It prints form 1040 by line number in an easy-to-transfer format.

TRY-O-TAX prompts you through the tax preparation process. It also includes a stand-alone program, Estimate, that estimates the federal tax liability based on 1985 tax law and tables.

The package costs $29.95. Updates of TAXAID and any other commercial tax preparation programs are $15. Add $3 for shipping and handling. For more information, contact TRY-O-BYTE, 1008 Alton Circle, Florence, SC 29501, 803-662-9500.

Circle 556 on Reader Service card.

Antenna Project

HF Antenna Design software from Cynwyn calculates the data necessary for radio hobbyists to build three popular types of antennas—the dipole, Yagi, and quad—for frequencies of 1.8–30 MHz. The program displays the calculations in an easy-to-read tabular format. Antenna Design optimizes the dimensions for the Yagi and quad antennas for maximum gain.

The program requires a Model I, III, or 4 with 16K. HF Antenna Design comes on cassette only for $14.95 plus $2 for shipping. For more information, contact Cynwyn, 4791 Broadway Suite 2F, New York, NY 10034, 212-567-8493.

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Fun with Math

Recreational Mathemagical Software offers Magic Math Plus, a new collection of MS-DOS and TRSDOS (Models III and 4/4P) math programs for advanced junior high through college-level students.

Magic Math Plus includes Base Two, Prime Number Generator, Self-Listing Program Challenge, Additive Sequences, Super-Blackjack, and Super-Trick.

Magic Math Plus provides 20 programs for MS-DOS computers ($27.50) and 40 programs (in a special double volume with a self-booting disk) for the Models III and 4/4P ($37.50). Schools can license the programs for $50 extra.

For further information, contact Recreational Mathemagical Software, 129 Carol Drive, Clarks Summit, PA 18411, 717-586-2784.

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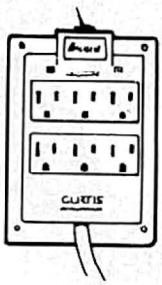

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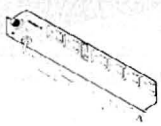

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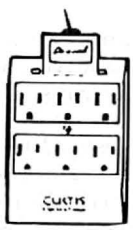

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SUPERLOG 4	for Models 4 and 4P	TRSDOS 6	$119.95
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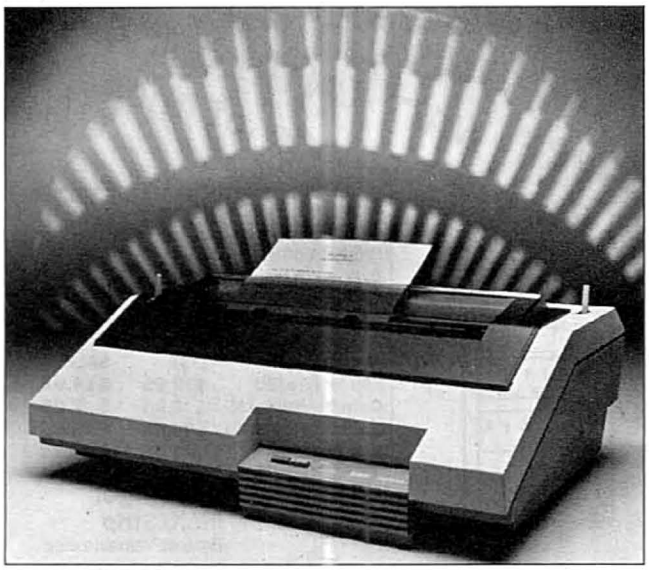


The Xerox 635 Diablo daisy-wheel printer is fast, light, and quiet.

Good Quality Print

Xerox offers the 635 Diablo daisy-wheel printer for correspondence, word processing, and personal computing in large and small businesses.

The 635 prints 55 characters per second, weighs 30 pounds, and has a noise level of only 56 decibels. It offers a two-switch operating panel, a semiautomatic paper-loading feature, and a drop-in printwheel.

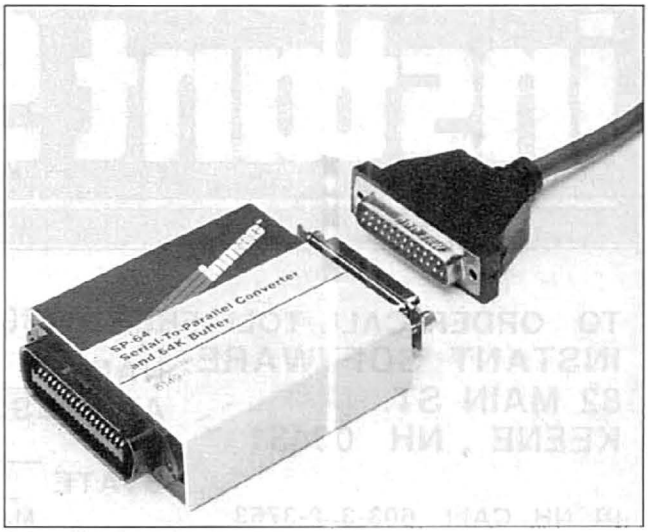
The printer offers 255 different printwheels, including worldwide type styles for word processing, accounting, engineering, foreign languages, science, and math. It also supports functions like boldface type, underlining, sub- and superscripts, and shadow fonts.

The printer costs $1,485. For more information, contact Xerox Corp., Xerox Square 006, Rochester, NY 14644, 716-423-5078.

Circle 561 on Reader Service card.

Parallel or Serial

Inmac offers serial-to-parallel or parallel-to-serial one-way converters with EIA RS-232 25-pin female and Centronics-type 36-pin male connectors. They support XON/XOFF, ETX/ACK, and DTR/DSR flow control handshak-



Inmac's converters let you convert serial to parallel or vice versa.

Tandy's portable disk drive weighs 1¾ pounds.

ing, and transmit at speeds of 50 to 38,400 bits per second.

The 16K buffer model costs $149 and the 64K model is $229. For more information, contact Inmac, 2465 Augustine Drive, Santa Clara, CA 95054, 408-727-1970.

Circle 553 on Reader Service card.

Portable Disk Drive

Tandy/Radio Shack has introduced a battery-powered portable disk drive for the Models 100 and 200. The unit stores 100K of data on 3½-inch disks and weighs 1¾ pounds.

The drive operates from a menu that lets you list the files on the disk. It also lets you format disks, and save and load files. Data transfer occurs at 19,200 baud. The disk drive uses four AA batteries or an optional ac adapter. It's available from Radio Shack Computer Centers (catalog number 26-3808) for $199.95. For more information, contact Tandy/Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102.

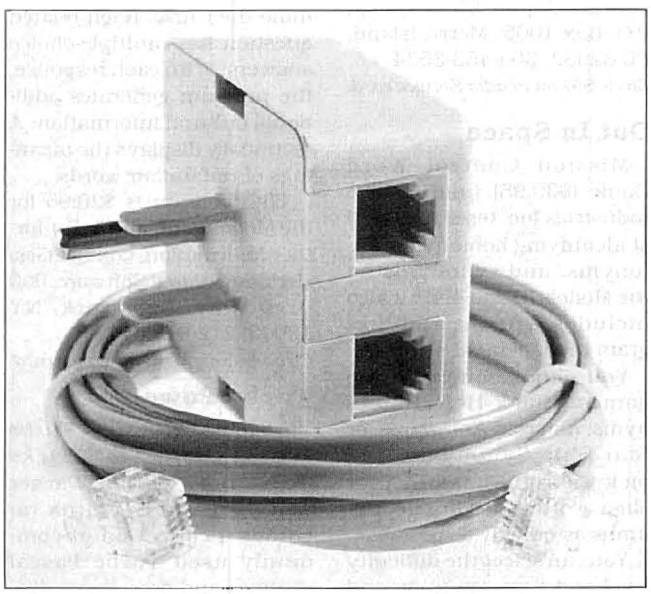
Circle 564 on Reader Service card.

Phone Line Protection

The TLP-1 ($34.95) from Kalglo Electronics protects modems, CPUs, and other sensitive electronic equipment from telephone line spikes and surges.

The TLP-1 plugs into any standard three-prong grounded wall receptacle and provides phone jacks for inserting the phone line and modem cord. It comes with a six-foot telephone connector cord. For details, contact Kalglo Electronics Co. Inc., 6584 Ruch Road, Bethlehem, PA 18017, 215-837-0700.

Circle 559 on Reader Service card.



Prevent telephone line spikes and surges with the TLP-1.

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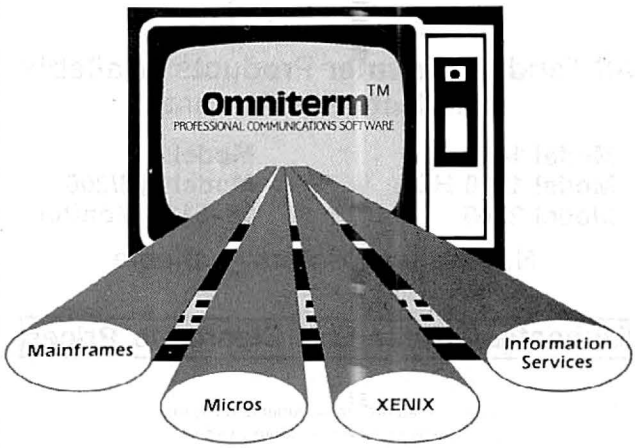

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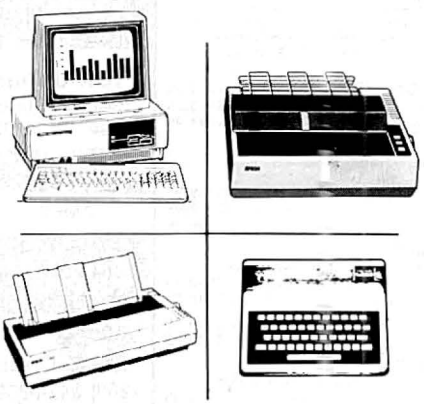

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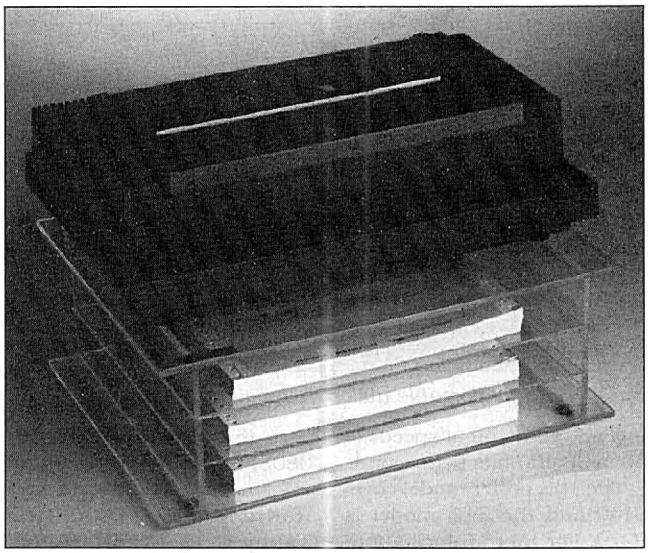


The Ultimate Printer Stand lets you use up to three different papers and forms.

Printer Stand

Alpha Electronics' Ultimate Printer Stand eliminates the time and hassle involved in removing one pack of paper and replacing it with another when you change the printer's task. It has two removable shelves that store up to three different paper types and forms.

The stand, made of clear Plexiglas, measures 15 inches wide by 11 inches deep by 5 inches high. It weighs five pounds and requires some assembly.

The Ultimate Printer Stand sells for $69 plus $6 for shipping. For further information, contact Alpha Electronics, P.O. Box 1005, Merrit Island, FL 32952, 305-453-3534.

Circle 557 on Reader Service card.

Out in Space

Mission Control Word Game ($39.95) from Gamco Industries Inc. tests your skill at identifying homonyms, antonyms, and synonyms on the Models III and 4/4P. It also includes student and program management systems.

You choose one of three games: Black Hole Homonyms, Asteroid Antonyms, or Star Ship Synonyms. You pick the right homonym or align word pairs in two columns as quickly as possible.

You can select the difficulty level and turn sound on and off. Each game contains a bank of approximately 100 pairs of words. You can add eight lists of up to 50 words each. For more information, contact Gamco Industries Inc., Box 1911, Big Spring, TX 79721, 800-351-1404.

Circle 560 on Reader Service card.

Culture Shock

Mesaventures Culturelles from Gessler Educational Software is a French reading program that reveals the cultural differences and similarities between Americans and the French.

Through a series of 12 minidramas set in various locations, misunderstandings arise and you have to determine the cause. Each related question has multiple-choice answers. With each response, the program generates additional cultural information. A dictionary displays the meanings of unfamiliar words.

The program is $29.95 for the Models I, III, and 4. For further information, contact Gessler Educational Software, 900 Broadway, New York, NY 10003, 212-673-3113.

Circle 565 on Reader Service card.

Turbo Power

Abacus Software's *Turbo Pascal Tips & Tricks* ($19.95) by Adrian Warner and Joachim Sgomina includes a collection of commonly used Turbo Pascal routines and procedures, like sort routines, binary trees, B-

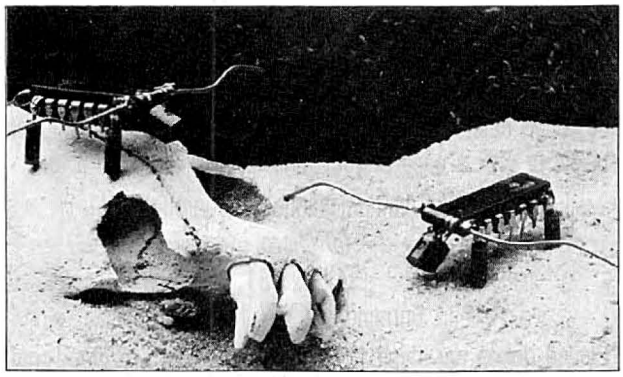
NEW PRODUCTS

trees, balanced trees, MS-DOS screen output, screen mask generator for MS-DOS and CP/M-80, disk management, a program lister, a cross-referencer, and a tracer utility for easy debugging.

For more information about this product, contact Abacus Software, 2201 Kalamazoo S.E., P.O. Box 7211, Grand Rapids, MI 49510, 616-241-5510.

Circle 551 on Reader Service card.

DIFFERENT TRACK



The Texas Cow Chip.

The Ultimate Cow Chip

The I-P-E Group's Texas Cow Chip ($5.95) is a cross between a Texas Longhorn and a high-tech hobby shop. The Cow Chip is made entirely of electronic components. You can train it to perform dozens of semi-useful tasks around the house or the office.

For example, you can stick jalapenos or strips of grilled fajitas on the horns for unique hors d'oeuvres. If you're a software nerd, you can use it as proof that hardware bugs really exist. Put one under your kitchen sink to frighten cockroaches or connect one to a fishing line as a can't-miss lure for catfish. For more information, contact I-P-E Group, 1906 Rampart Circle, Austin, TX 78758, 512-339-8136.

Circle 563 on Reader Service card.

New Products Index

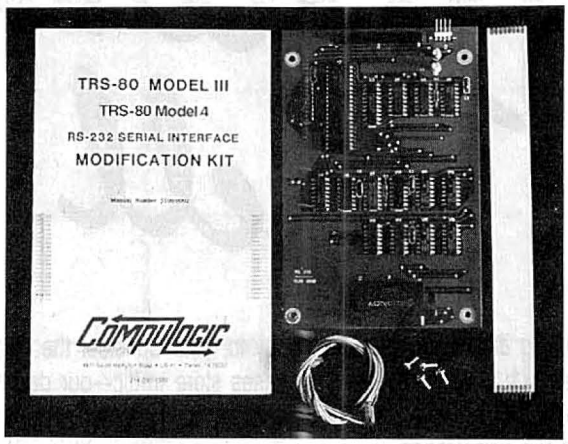
Reader Service Number	Company	Page
551	Abacus Software	124, 125
557	ALPHA Electronics	124
562	Blue Ridge Software	120
566	Burkart, Ron	120
558	Chilton Book Co.	120
555	Cynwyn	120
560	Gamco Industries Inc.	124
565	Gessler Education Software	124
553	Inmac	123
563	I-P-E Group	125
559	Kalglo Electronics Co. Inc.	123
552	Recreational Mathemagical Software	120
564	Tandy Corp./Radio Shack	123
556	TRY-O-BYTE	120
561	Xerox Corp.	122

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.

Circle 86 on Reader Service card.

THE RS-232

MODEL III MODEL 4



State of the art technology in board design, our direct replacement of Radio Shack's* internal RS 232 board, mounts inside the Model III or 4 on the existing brackets. All cables, screws and complete mounting instructions are included. Non-technical people will find that installation is quick, straight forward and simple requiring less than 15 minutes to complete.

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Circle 461 on Reader Service card.

Z-EDIT

A Powerful new ASSEMBLER EDITOR For the Model 4 Series

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True full screen capabilities. Arrow keys take you directly where you want to go. Just begin typing where you wish.
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Add and repeat lines.
Page up or down a whole page or a specified number of lines using function keys.
Tab key. Tab positions may be user-defined.
Copy all or part of another file into the file currently edited.
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Circle 464 on Reader Service card.

Graphics Solutions

High-Resolution Software and Hardware

GBASIC 3.0 - Radio Shack Model 4/4P/III hi-res board owners take note of an enhanced graphics Basic; GBASIC 3.0 not only has an equivalent for each of the BASICG commands but adds a number of important new commands while using less memory. The hi-res screen can be printed on any of 20 popular printers or saved to or loaded from disk without leaving Basic. The software works with TRSDOS 1.3, 6.1.2, 6.2, LDOS, NEWDOS80, and DOSPLUS. The disk contains 40 graphics programs/files. Also included is a detailed manual which includes assembly language entry addresses. $49.95. (Specify Model 4 or III mode or add $10 for both.)

The following nine programs run on a Model 4/4P/III equipped with a Radio Shack graphics board and GBASIC 3.0 or a Micro-Labs Grafyx Solution board:

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BIZGRAPH Create business graphs from hand-entered or VisiCalc data. $98.00.

xT.CAD - Professional drafting aid which outputs to a printer or plotter. $449.95.

CHESS - A very powerful program with 10 skill levels, 40 play options. $49.95.

REVERSI - Play Othello with 10 skill levels, 20 execution options. $39.95.

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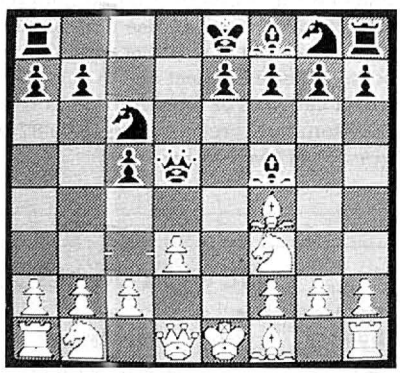
3D-PLOT - View three-dimensional data from any perspective or angle. $39.95.

MATHPLOT - Plot equations of the form Y=F(x) with auto scaling. $39.95.

SURFACE PLOT - Plot three-dimensional equations of the form Z=F(x,y). $39.95.

GRAFYX SOLUTION. Plug-in, clip-on board enhances any Model 4/4P/III to provide 640 × 240 / 512 × 192 dot graphics. Comes with over 40 programs and files including GBASIC 3.0 which adds over 20 new commands. $199.95.

JOY-MOUSE. Allows a Radio Shack CoCo joystick, mouse, or touch pad to be connected to any Model 4/4P/III. Hardware provides X, Y position values from 0 to 255. A built-in speaker produces sound from the cassette port. $129.95.



G.I.N.A. Software program for the Model 4/4P/III/I which uses the standard block graphics screen to display a window to a larger 65536 × 65536 dot tablet. The arrow keys are used to draw two or three-dimensional figures. The display can be scaled, shifted, or rotated in any dimension. The final picture is printed in hi-res on Radio Shack, Epson, Gemini, NEC 8023, or Prowriter printers. $75.00.

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Model I/III: Geography with maps; NBA Basketball; Casino card game. 52 Pine Avenue, Randolph, MA 02368.

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Show Us What Life Means to You

What is Life? On computers it's a simulation; creatures in a two-dimensional world (your video display) reproduce or die depending on the density of fellow creatures around them. The rules are simple. Any blank space surrounded by exactly three creatures gives birth to a new creature. One creature can have zero to eight neighbors. Fewer than three isn't enough, and more than four is overcrowding. Either condition causes immediate extinction for the creature in question.

Watching the patterns produced by one of these simulations is entertaining in itself (see The Next Step, p. 100). Trying to predict the outcome from a given starting pattern is difficult. *80 Micro*'s editors wrote a crude Game of Life in only two lines of Basic. It's Life on Ice (glacially slow, even after reducing the screen area), and you must set up your starter colony on-screen before running the Life routine, but it works. We won't show you what we came up with here because we think you can do better, especially with three lines to work with.

Send in your efforts. If you change the rules at all, send in a few interesting patterns with your program. As always, those who please us get their due reward. Besides putting your name in print, we'll provide *80 Micro* bumper stickers and *80 Micro* T-shirts for the real gems. *80 Micro* also rewards good ideas used in future contests. Here are the rules:

1. Owners of all TRS-80 and Tandy systems with the exception of the pocket computers are eligible. We'll consider degree of difficulty when comparing solutions created on different machines.
2. The deadline will always be the 21st of the issue month. Thus, this month's deadline is Feb. 21, 1986. We realize that this doesn't give everyone the same amount of time to come up with their entries (we apologize to our overseas readers especially), but postponing the deadline any longer would add another month to publishing the answers.
3. Speaking of the answers, they'll appear three issues from the issue in which the problem appears. Thus, this month's winners will make their appearance in the May 1986 issue.
4. Employees of CW Communications are not eligible.
5. We will not, unfortunately, be able to return entries.
6. Specify your T-shirt size. Bumper size not required. ■

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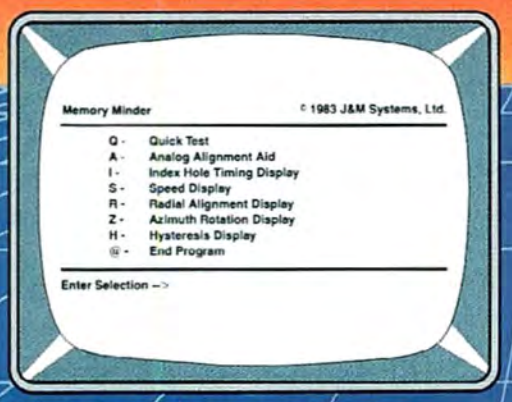
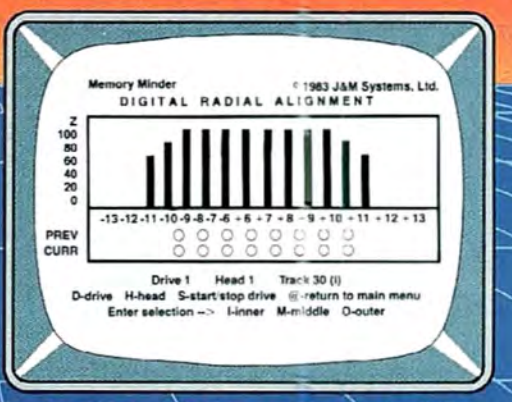
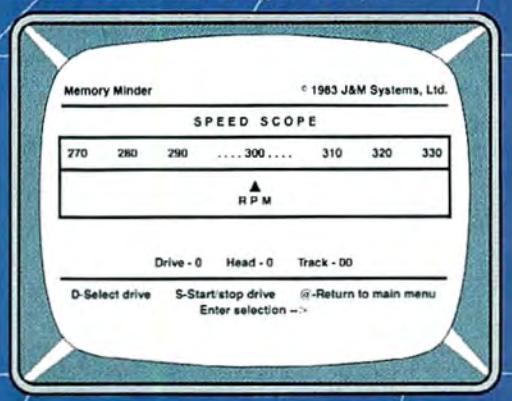


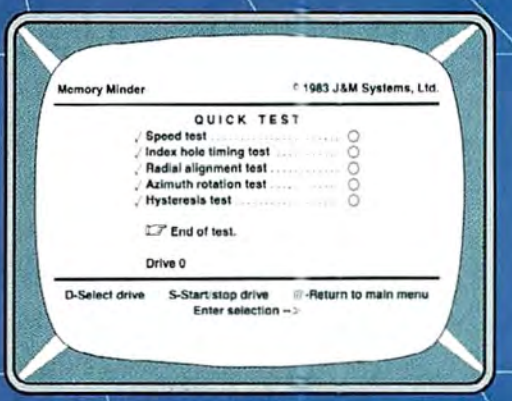
Select any one of seven tests to perform preventive maintenance or to isolate problems. Simple, single-letter commands make MM easy to use! Use MM to align the head, adjust the index hole detector, or adjust the speed.



Use the MM Radial Alignment Test to check the head alignment of your drives. No need for an oscilloscope or other expensive test equipment!



Check the motor speed of your drives. Or, you can even use the Speed Test to adjust the drive speed. No need for any test equipment!



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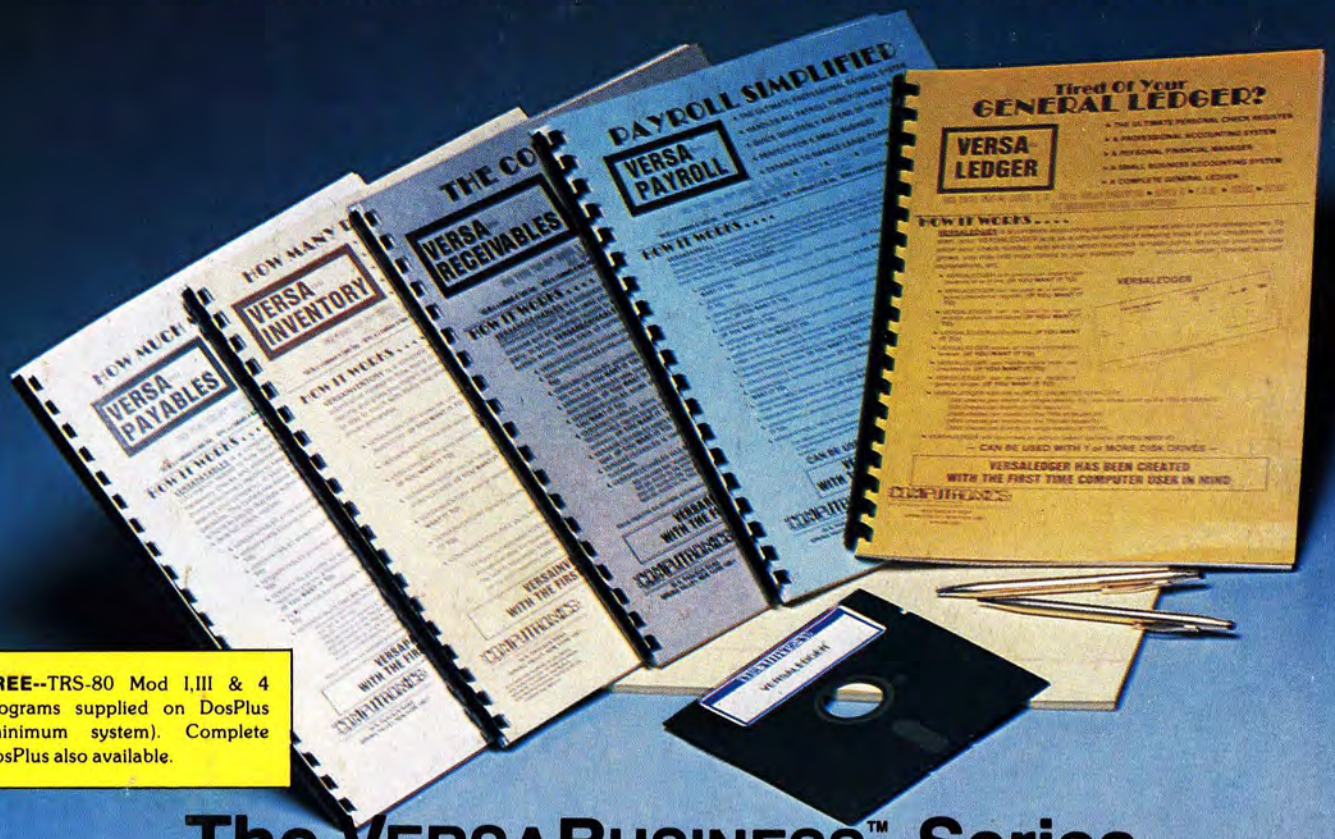

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