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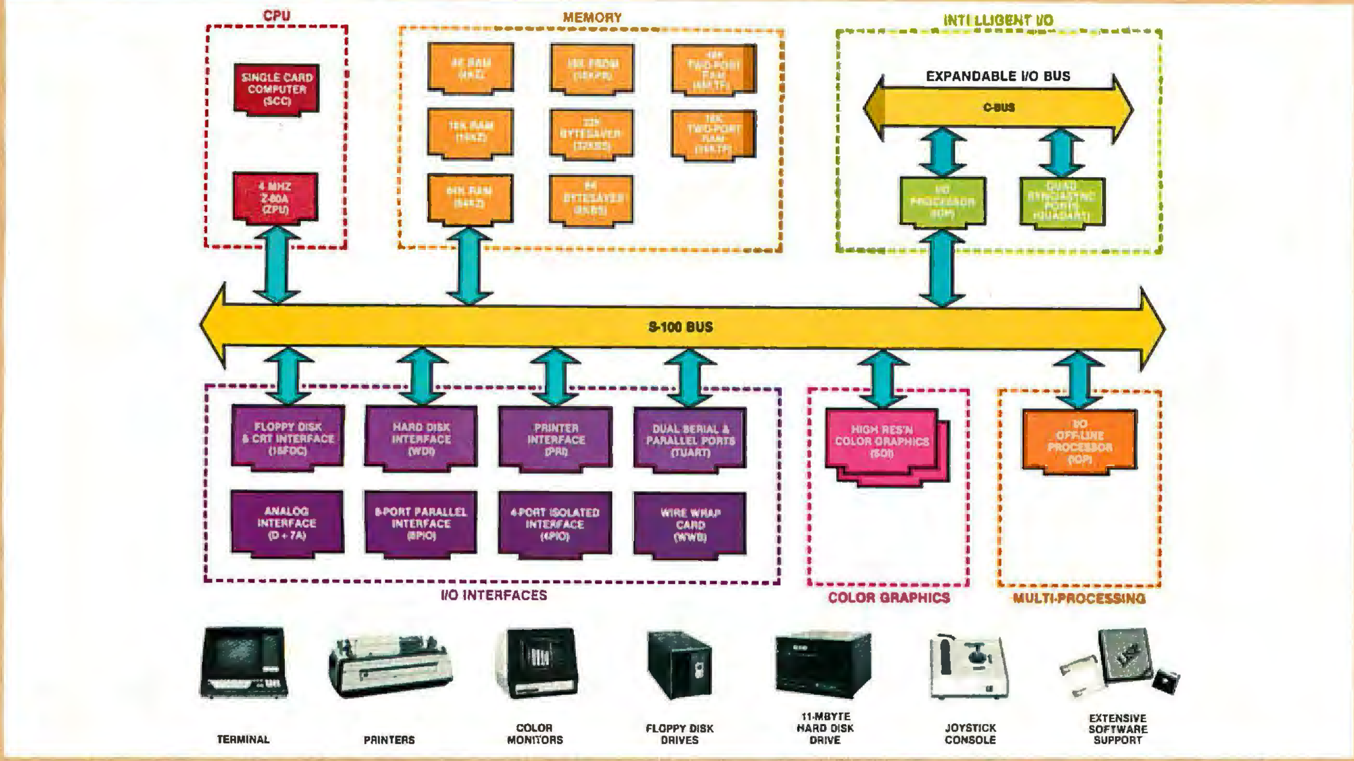
BYTE®

the small systems journal

ENERGY CONSERVATION



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To top it all off, you can draw from a substantial array of peripherals: terminals, printers, color monitors and disk drives.

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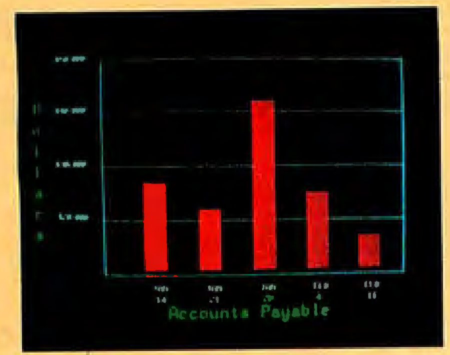
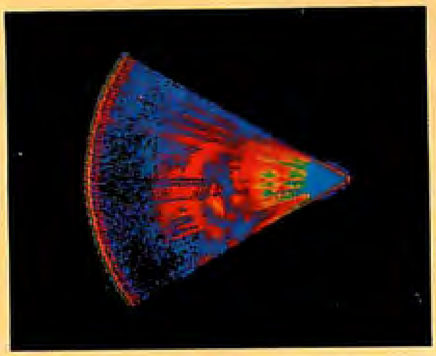


Management Information Display



Ultrasonic heart sector scan

High-resolution display with alphanumerics

Get the professional color display that has BASIC/FORTRAN simplicity

LOW-PRICED, TOO

Here's a color display that has everything: professional-level resolution, enormous color range, easy software, NTSC conformance, and low price.

Basically, this new Cromemco Model SDI* is a two-board interface that plugs into any Cromemco computer.

The SDI then maps computer display memory content onto a convenient color monitor to give high-quality, high-resolution displays (756 H x 482 V pixels).

When we say the SDI results in a high-quality professional display, we mean **you can't get higher resolution than this system offers in an** NTSC-conforming display.

The resolution surpasses that of a color TV picture.

BASIC/FORTRAN programming

Besides its high resolution and low price, the new SDI lets you control with optional Cromemco software packages that use simple BASIC- and FORTRAN-like commands.

Pick any of 16 colors (from a 4096-color palette) with instructions like DEFCLR (c, R, G, B). Or obtain a circle of specified size, location, and color with XCIRC (x, y, r, c).

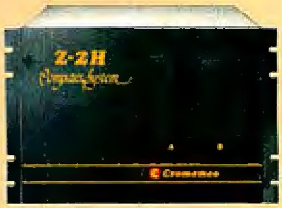
*U.S. Pat. No. 4121283

Model SDI High-Resolution Color Graphics Interface

HIGH RESOLUTION

The SDI's high resolution gives a professional-quality display that strictly meets NTSC requirements. You get 756 pixels on every visible line of the NTSC standard display of 482 image lines. Vertical line spacing is 1 pixel.

To achieve the high-quality display, a separate output signal is produced for each of the three component colors (red, green, blue). This yields a sharper image than is possible using an NTSC-composite video signal and color TV set. Full image quality is readily realized with our high-quality RGB Monitor or any conventional red/green/blue monitor common in TV work.



Model SDI plugs into Z-2H 11-megabyte hard disk computer or any Cromemco computer

DISPLAY MEMORY

Along with the SDI we also offer an optional fast and novel **two-port** memory that gives independent high-speed access to the computer memory. The two-port memory stores one full display, permitting fast computer operation even during display.

CONTACT YOUR REP NOW

The Model SDI has been used in scientific work, engineering, business, TV, color graphics, and other areas. It's a good example of how Cromemco keeps computers in the field up to date, since it turns any Cromemco computer into an up-to-date color display computer.

The SDI has still more features that you should be informed about. So contact your Cromemco representative now and see all that the SDI will do for you.

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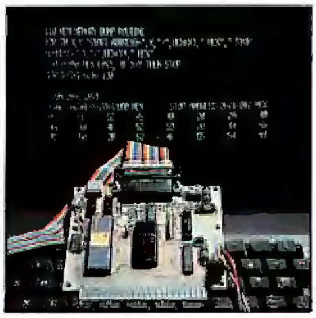
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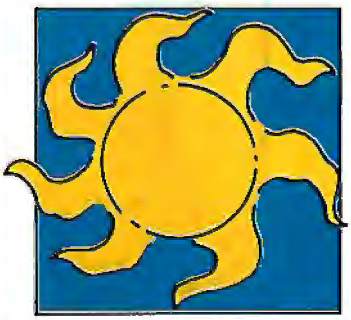
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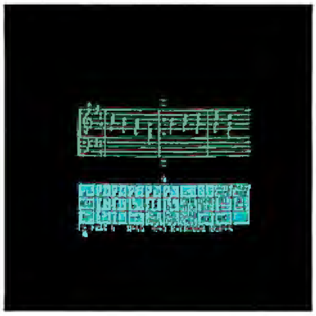
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In This Issue

This month's cover painting by Robert Tinney shows our own solution to the energy crunch: a computerized "solar system." To illustrate this month's theme of energy conservation, we present a variety of articles, including "Harvesting the Sun's Energy," "Computer Simulation of a Solar Energy System," "Energy Conservation With a Microcomputer," and "Energy Measurement With the Apple."

Also in this issue are a discussion of IBM's new personal computer; the first part of Steve Ciarcia's exciting new Z8 single-board computer project (about which there was much interest at the recent National Computer Conference); another solution to the traveling-salesman problem; Micromodem support in Apple Pascal; Kalman filters; hurricane tracking by computer; the Atari Assembler/Editor; a report on the Santa Cruz Computer Othello tournament; and much more, including all the regular BYTE features.

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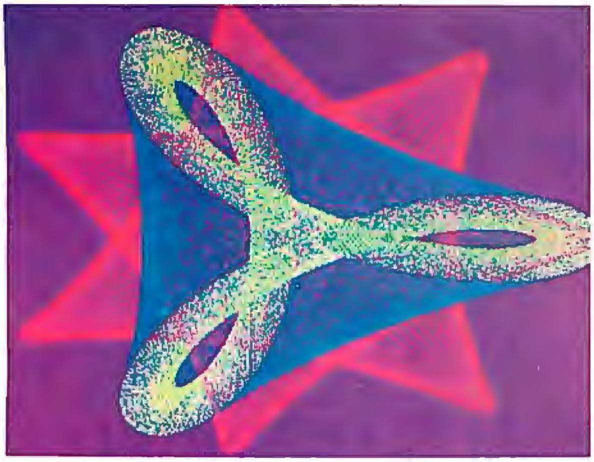
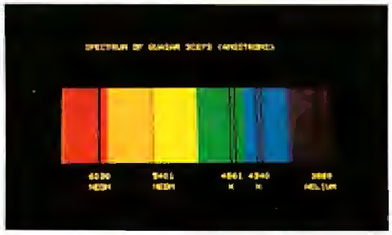


"...stands well above other S-100 graphics displays in its price and performance range."
BYTE, Product Review



"...better monochromatic ...display...."
ELECTRONIC DESIGN, 1981 Technology Forecast

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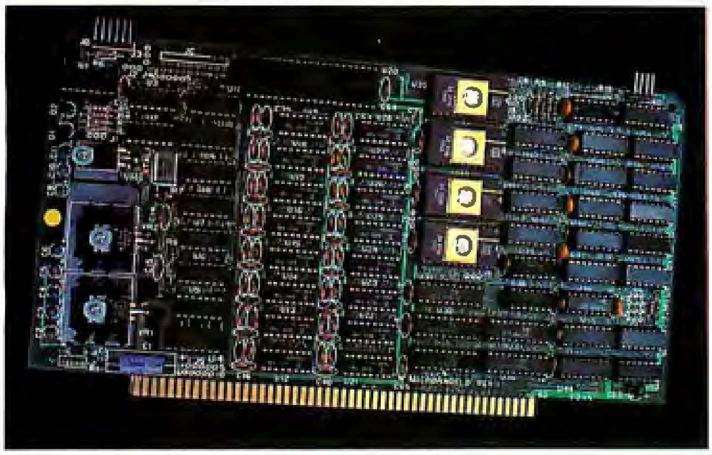

Light pen interface

Time multiplexed refresh

4K resident Screenware™ Pak I operating system

32K RAM isolated from host address space

High speed communications over parallel bus ports

Screenware™ Pak I

A 4K byte operating system resident in PROM on MicroAngelo™. Pak I emulates an 85 character by 40 line graphics terminal and provides over 40 graphics commands. Provisions exist for user defined character sets and directly callable user extensions to Screenware™ Pak I.

Screenware™ Pak II

An optional software superset of Pak I which adds circle generation, polygon flood, programmable split screen for separate graphics and terminal I/O, relative coordinates, faster vector and character plotting, a macro facility, full UCSD Pascal compatibility, and more.

And now...COLOR!!

The new MicroAngelo™ Palette board treats from 2 to 8 MicroAngelos as "bit planes" at a full 512 x 480 resolution. Up to 256 colors may be chosen from 16.8 million through the programmable color lookup table. Overlays, bit plane precedence, fade-in, fade-out, gray levels, blinking bit plane, and a highly visual color editor are standard.

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Editorial

IBM's Personal Computer

by Chris Morgan, Editor in Chief

The year 1981 will be important in the history of personal computing for two reasons: the "invasion" of Japanese personal computers, and the entry of major computer companies such as IBM into the market. Rumors abound about personal computers to come from giants such as Digital Equipment Corporation and the General Electric Company.

But there is no contest.

IBM's new personal computer (most likely to be officially announced this month) is far and away the media star, not because of its features, but because it exists at all. When the number eight company on the Fortune 500 list enters our field, that is news. And when you take a close look at the computer's design, that is news, too. Although the complete description of the computer is still subject to conjecture, sources close to IBM have given me an intriguing glimpse of the machine.

System Details

Seemingly contradictory rumors about IBM have raced along the personal computer grapevine for several months now. Part of the confusion stems from the fact that IBM has had not one but *two* projects going on simultaneously to develop a personal computer—one in Japan, the other in the United States. The Japanese project (code-named "Go") was jointly sponsored by IBM and Matsushita. The culmination of the project was to have been a *series* of personal computers produced in Japan bearing the IBM logo. That project now appears to have been either scrapped or indefinitely delayed.

That leaves us with the American design. The computer (code-named "Chess") looks like IBM's low-cost ASCII terminal, but with a few inches of extra height to accommodate two double-density, double-sided 5-inch floppy disk drives immediately beneath the black-and-white video display (with 640 by 400 resolution). The keyboard, designed as a separate module, has received high marks from people who have tested it. Internally, the computer uses an Intel 8088 microprocessor (a 16-bit processor with an 8-bit data bus) and an "IBM" bus. There are five slots on the motherboard—à la Apple II—to accommodate additional interface, memory, and peripheral boards.

The machine will probably be available in a low-cost version with entry-level BASIC in ROM and with program storage and retrieval via cassette recorder (the latter will be a separate module rather than built in). The more expensive version will have disk BASIC and a CP/M-like DOS (disk operating system) to be called, simply, "IBM Personal Computer DOS." Color will also be available in at least two modes: four out of a possible eight colors with 640 by 200 resolution, and eight colors with 320 by 200 resolution. A 6-megabyte

Percom Mini-Disk Drive Systems for TRS-80* Computers...

Now! Add-On *and* Add-In Mini-Disk Storage for your Model III.

The industry leader in microcomputer peripherals, Percom not only gives you better design, better quality and first-rate service, but you pay less to *boot*.

New for the TRS-80* Model III

Patterned after our fast-selling TFD Model I drives. And subjected to the same reliability controls. These new TFD mini-disk systems for the Model III provide more features than Tandy drives, yet cost far less.

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- **1.5 Mbyte On-line:** The Percom drive controller (included with the initial drive) handles up to four drives. With four 80-track mini-disk drives you can access over 1.5 million bytes of on-line file data.
  Moreover, the initial drive may be **either** an internal add-in drive or an external add-on drive. And whichever configuration you get, the initial drive kit comes complete with our advanced 4-drive controller, interconnecting cables, power supplies, installation hardware, a DOS and of course the drive mechanism itself.
- **First Drive Includes DOS:** OS-80™, Percom's fast extendable BASIC-language disk operating system, is included on diskette when you purchase an initial drive kit. Originally called MicroDOS, OS-80 was favorably reviewed in the June 1980 issue of Creative Computing magazine.
- **Works with Model III TRSDOS:** Besides being fully hardware compatible, Percom's Model III 40-track drive systems may be operated with Tandy's Model III TRSDOS — without any modifications whatsoever. And, TRSDOS may be easily upgraded with simple software patches for operating 80-track drives.

Percom TFD add-on drives start at only $399. Model III Drive kits start at only $749.95.

Quality Percom products are available at authorized dealers. Call *toll free 1-800-527-1592* for the address of your nearest dealer or to order direct from Percom.

Still #1 for Model I

As if greater storage capacities, exceptional quality control measures and lower prices aren't reasons enough to make Percom your first choice for Model I add-on drives, **all** Percom Model I drives are also rated for double-density operation.

Add our innovative DOUBLER™ adapter to your Model I Expansion Interface, and with Percom drive systems you can enjoy the same double-density storage capability as Model III owners.

The DOUBLER includes a TRSDOS*-like double-density disk operating system called DBLDOS™

We also offer a double-density Model I version of OS-80 as well as DOUBLEZAP programs for modifying NEWDOS/80 and VTOS 4.0† for DOUBLER compatibility.

Of course you don't have to upgrade your computer for double-density operation to use Percom mini-disk drive systems. In single-density operation, our TRS-80* Model I compatible 40-track drives store 102 Kbytes of formatted data on one side of a diskette, and our 80-track drives store 205 Kbytes. By comparison, Tandy's standard drive for the Model I stores just 86 Kbytes.

And like our Model III drives, Model I add-on drives are optionally available with "flippy" storage capability.

System Requirements:

Model III: 16-Kbyte system (min) and Model III BASIC. The second internal drive may be installed after the first internal drive kit is installed, and external drives #2, #3 and #4 may be added if either an internal or external first-drive kit has been installed. External drives #3 and #4 require an optional interconnecting cable.

Model I: 16-Kbyte system (min), Level II BASIC, Expansion Interface, disk operating system and an interconnecting cable. For double-density storage, a Percom DOUBLER must be installed in the Expansion Interface and DBLDOS (comes with the DOUBLER) or other double-density DOS must be used. For single-density operation, a Percom SEPARATOR™ adapter, installed in the Expansion Interface, will virtually eliminate "CRC ERROR — TRACK LOCKED OUT" read errors. Prices and specifications subject to change without notice.

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A simple algorithm

We work with the serious systems integrator ... on terms that make sense to you. That means giving you a set of products which expand your limits, not reduce them.

We manufacture the most complete family of high quality IEEE/696 S-100 mainframes on the market. Choices include three mainframes in rack-mount or table-top packages with complete board sets, to serve as the building blocks for your 8 or 16 bit system. We also provide other options ranging from complete floppy disk systems right up to our proven Pascal development system.

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No matter which option you choose, you get the benefit of working with completely integrated products ... fully assembled and tested ... under one warranty and one price structure ... leaving you free to concentrate on value-added application development and sales.

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Select from three packaging options: Rack-mount, table-top or front panel models. All three feature our 20 slot S-100 motherboard with 25 amp power supply and are delivered fully assembled and tested with our Series II™ board sets. Any board configuration you choose works with any DPS-1 version, allowing you to vary your package offering, or develop on one version and market another.

- Front Panel model — a powerful development and diagnostic tool for Z-80† systems, which can be used for prototyping, servicing, debugging, and software or hardware development. Use its features to set breakpoints, trigger scopes, single step, slow step and more.
- Front Panel less desk top model—a lower cost option for OEM or other turnkey operations which do not require the extra capability of our Front Panel.
- Rack Mount version — features a heavy gauge frame designed to fit into standard 19" racks. CVT power supply for brown out immunity is standard.

*In Calculus, a fundamental statement in the definition of limit; interpreted here to imply: "For your integration problem, Intersystems has a solution."

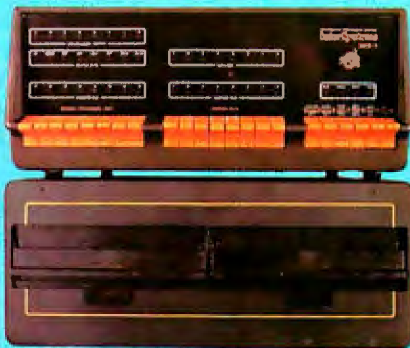
† Registered trademark of Zilog, Inc.

Board level options...

Intersystems mainframe packages, equipped with Series II boards, are operational in both 8 and 16 bit settings and support extended addressing in both I/O and memory space, recognizing 16 bit I/O addresses and 24 bit memory addresses. Just look at these individual features:

- MPU-80—uses a Z-80, 8 vectored interrupt lines and two 4K windows to address up to 1 Megabyte of RAM without bank select.
- 64KDR—sophisticated refresh circuitry allows unlimited DMA and absolutely reliable operation without wait states.
- 6 SI/O — six individually software-controllable serial I/O ports with optional interrupts. Each can run RS 232 at up to 19,200 BAUD, as can our VI/O board.
- VI/O—has two serial ports; two 8-bit parallel output and two 8-bit parallel input ports plus 8 individually controllable command lines and 16 levels of vectored interrupts.
- FDC II—can DMA up to a full track into 16 Megabytes of memory. Optionally generates interrupts and handles up to four 8" floppies.
- MPU-8000 — available with the non-segmented Z-8002†, which directly addresses 64K, or the segmented Z-8001†, which can directly address 8 Megabytes.

Extended systems options...



Interfacing disk drives is not a trivial matter, so when your objectives and resources dictate you spend your energy elsewhere, use our resources to perform the service for you. We can add our disk drive package to any Z-80 or Z-8000 configuration we provide ... again, fully assembled and tested and covered under one warranty.

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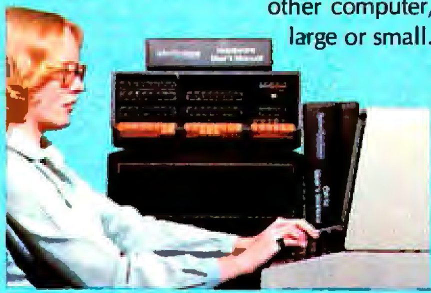
THIS SYSTEM IS FAST! Why? Because our ultra-fast Cache BIOS automatically buffers whole tracks, eliminating most disk accesses. This delivers up to three times the throughput of any other floppy-based system we know and is equal to many small hard disk systems.

The system is versatile, too. SET program allows you to change many BIOS parameters and specify control characters to enable special features such as diagnostic output to trace program execution. It can also provide remote I/O to link your system to almost any other computer, large or small.



And it's reliable. The Cache BIOS System runs continuous memory tests when idle, and verifies with a Read after Write and Read after Read.

And the system also includes our Pascal/Z, a true native compiler producing ROMable and Re-entrant code. It features a minimum of extensions chosen for the development of your scientific and business applications. And it's compatible with our native code Pascal for Z-8000, providing a graceful upward path to 16 bit applications. So what you write now is right later.

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We don't believe you should ever have to sacrifice good technical support to find a good product. We'll back you to the hilt with services like free technical consultation, board-swapping, diagnostic packages, and documentation that gives you all you need to integrate, operate and maintain your system ... right down to schematics of the boards.

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Winchester drive (manufactured by Tandon Magnetics) will eventually be available for the machine. IBM has signed agreements with Sears Roebuck and Co and Computerland to market the new machine; J C Penney is reportedly interested, too.

The price? That's a difficult question, but the more expensive version will probably retail in the $3000 to $4000 range. Pricing for the stripped-down version is harder to estimate.

To my mind, the new IBM computer is aimed squarely at the low-end word processing market. It will certainly give machines like the Apple III a run for their money.

The influence of a personal computer made by a company whose name has literally come to mean "computer" to most of the world is hard to contemplate. Its design is a mixture of the conventionally safe (some would say reactionary) coupled with a bit of daring-do (the 8088 holds up the possibility of further 16-bit development).

On the whole I am heartened by the news of IBM's computer. Some factions in our industry have looked upon IBM as the "enemy," the company that gave rise to the mainframe mentality and the coterie of high priests — the computer operators who ran the old behemoths and who formed the only link between the lowly user and the all-powerful computer. Elements of this syndrome are unfortunately still in evidence today. Yet where would we be in the personal computer world if IBM had not sunk millions of dollars into the development of such now commonplace inventions as the floppy disk? Besides, it may not be that easy for IBM to gain wide acceptance for its new computer. Competition is growing from all sides. Last year, for example, Fujitsu outsold IBM in the mainframe market in Japan. It is inconceivable that other American computer companies such as Xerox, Data General, Honeywell, and the like will remain on the sidelines for long. This competition can only further the state of the art. And today's successful microcomputer companies will most certainly not fold up and die in the presence of the giants. Good large companies don't always supplant good small companies. As an example from another field, many small specialty book publishing companies are flourishing today in the midst of a general publishing recession. Why? Low overhead, flexibility, unconventional solutions to problems, attention to customer service — the list goes on.

It would be burying my head in silicon, however, to deny the enormous marketing potential of IBM. But that's all right. I want to see personal computing take a giant step. I liked the recent jocular warning from Intel's Stan Masor to "never trust a computer you can't lift." Perhaps the warning's unnecessary: the way things are going, small computers may soon be the only game in town. ■

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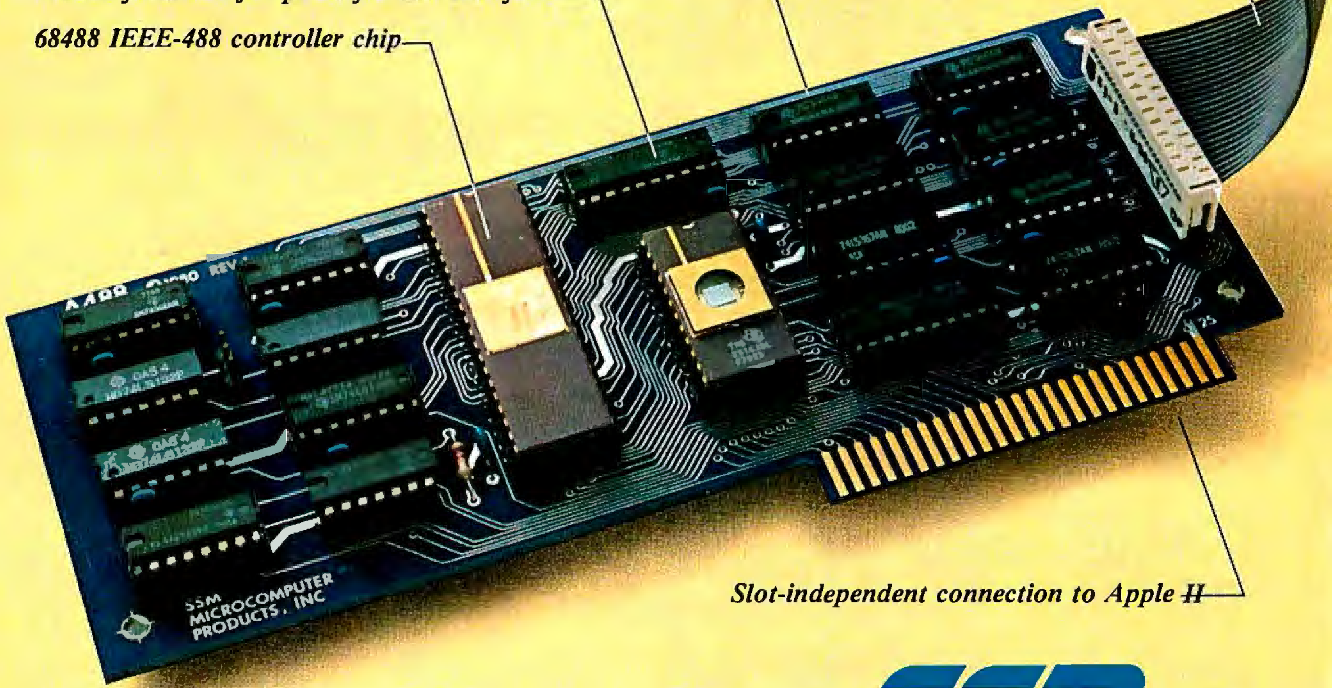

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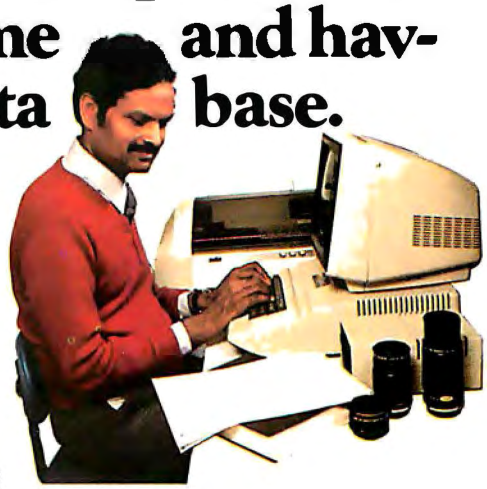

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Letters

"Bug" Takes Flak

In the January 1981 BYTE, W D Maurer reported on a "bug" that he had found in a number of BASIC interpreters on stack-oriented machines. (See "A Bug in BASIC," page 188.)

I ran Mr Maurer's test on the BASIC interpreter that I use. My BASIC is provided with the OASIS operating system by Phase One Systems. The bug doesn't appear to be present in this BASIC.

Donald M Dealy
EDP Director
Fuller Memorial Hospital
231 Washington St
South Attleboro MA 02703

W D Maurer has identified a vexing problem in some BASICs: the abnormal exit from a FOR . . . NEXT loop. Another problem with abnormal exits occurs when the interpreter is designed to stack, or nest, FOR . . . NEXT loops. A simple search algorithm such as

```
10  INPUT "MATCH?="; X
20  FOR I = 1 TO N
30    IF A(I) = X THEN 60
40  NEXT I
50  GO TO 10
60  PRINT "FOUND "; X
70  GO TO 10
```

can end abnormally if the number of matches in line 30 (ie: abnormal exits) exceeds the nesting level of the interpreter.

Ens G K Baird, SC, USN
USS Peleliu (LHA-5) Bx4
FPO San Francisco CA 96624

I enjoyed W D Maurer's article, but I beg to differ with his conclusion that the Atari 400 and 800 suffer from this problem.

In the *Atari BASIC Reference Manual*, the POP instruction is discussed. POP is a BASIC command that performs a PLA (Pull Accumulator) instruction on the 6502 processor. If line 135 is added to Maurer's program:

```
135 POP
```

the top location of the stack (which controls the number of loops to be executed) is cleared, and all test runs in listing 2, page 190 of the article, run without error.

Atari provides this instruction for use when an abnormal exit occurs from a FOR . . . NEXT loop or a GOSUB/RETURN sequence.

William Hanson
Kentron International
2508 W 22nd St
Yuma AZ 85364

The *PET Users Manual* warns not to use abnormal exits from loops. So is this really a bug or a design trade-off?

James E Borden
641 Adams Rd
Carlisle PA 17013

Surely the "elegant" solution to the BASIC bug problem is not to stack more information for each loop or to search stacks differently, but to clean up the programming by setting a flag if needed, resetting the counter variable to the end value, and executing the NEXT on the way out. The FOR . . . NEXT structure thus becomes a variant of a REPEAT . . . UNTIL structure, which, by coincidence, is more or less what David Carew was up to in his "Programming Quickie." (See "Change Your GOTOs to FOR . . . NEXT Loops," January 1981 BYTE, page 334.)

John C Miller
110 Riverside Dr #14C
New York NY 10024

Maurer's article "A Bug in Basic" was a bitter reminder of the many hours I've spent chasing down this particular problem in Applesoft BASIC. His solution—to replace a FOR . . . NEXT loop with an open-coded equivalent—is a practical one. However, there's an alternative solution that keeps the structure of the FOR . . . NEXT loop, but it requires a little more coding.

Recognizing that the problem arises from an abnormal exit from the loop, you can circumvent the difficulty by ensuring that all FOR . . . NEXT loops exit normally. This can be done by setting the index of the loop to its final value inside the loop at the point at which the abnormal exit would be made, then proceeding through one more cycle of the loop. The occurrence of abnormal termination can be stored in a flag. In terms of Maurer's example, this code could be used:

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```
75  FLAG = 0
80  FOR C = 1 TO N
90  IF T(C)< >0 THEN 100
92  C = N
94  FLAG = 1
100 NEXT C
110 IF FLAG = 1 THEN 130
120 PRINT "ZERO IS NOT PRESENT"
125 GOTO 140
130 PRINT "ZERO IS PRESENT"
140 ..........................
```

The key step here is line 92, in which the loop index is set to its final value when abnormal termination is required.

John Figueras
65 Steele Rd
Victor NY 14564

Mr Maurer's article was quite enlightening. As a Radio Shack TRS-80 Model I Level II owner (a machine that "bombed" on the tests), I too ran into the mysterious NEXT without FOR error. Maurer suggests changing the interpreter or the loop variable, but each of these solutions has problems: the first is either impossible (as with a BASIC in read-only memory) or impractical; the second can be cumbersome to patch into an existing program. There is an easier solution, one that presents few, if any, problems and is easy to implement into an incorrect program.

The problem, as Mr Maurer states, is the "illegal" exit from the loop. The correction I suggest is to "fool" the interpreter into thinking the loop is completed by changing the loop variable to a value greater than the end value of the loop.

Joe Sewell
6776 Sheridan Rd
Melbourne Village
Melbourne FL 32901

W D Maurer Replies:

I have received numerous communications from people who have tried out my "buggy" program on eight or ten versions of BASIC not covered in my article. The results are very much like those I reported: most do not have the bug, but a sizable minority do.

Mr Hanson exhibits a common confusion about bugs in programming-language systems. Just because there is a way to rewrite a program exhibiting a system bug in such a way that the new program does not manifest it, does not mean there is no bug. Mr Hanson's solution also has the drawback of reducing portability in a particularly essential way.

Mr Borden's comments on the PET can only be answered by noting that abnormal exits from loops are an essential part of programming. Also, when most people are faced with a system that discourages abnormal exits from FOR . . . NEXT loops, they will simply rewrite their programs to avoid the FOR and NEXT statements (usually with comments showing where the FOR and NEXT statements would have gone and what they would have been).

*Messrs Miller, Figueras, and Sewell have a higher-level confusion about structured programming that I have met with many times before. The fact is that changing the loop index value inside the loop is expressly forbidden in almost every algebraic language except BASIC (eg: FORTRAN, Pascal, PL/I). It should, therefore, not be considered as a technique dictated by structured programming, which is essentially a study of language-*independent *methods of improving the readability and provability of programs.*

I also want to respond specifically to Mr Sewell's contention that changing the interpreter is either impossible or impractical. The way to change interpreters, Mr Sewell, is for everyone who knows about the bugs in them to mention these bugs to computer-store salespeople when shopping for new equipment. It was partly for this reason that I intended my investigations of this particular bug to be published in a magazine with as large a circulation as BYTE's.

Structured Programming Clarifications

I agree 100% with the sentiments expressed by Gregg Williams in "Structured Programming and Structured Flowcharts." (See the March 1981 BYTE, page 20.) For too long, programmers have worried almost exclusively about program size, coding techniques, and execution speed. Logical simplicity, program reliability, and ease of modification (inevitable in every environment) have taken a back seat.

However, I want to point out the following:

- A design *notation* is not the same thing as a design *method*. A notation tells you *how to write down* something you have already structured mentally. A design method tells you *how to arrive* at the

structure and how to write it down. This is a very important distinction. I suggest that figuring out what the structure ought to be is the hardest part of programming.

I find that data-structured design produces programs that are simple, modifiable, and that accurately reflect the problem they are supposed to be solving. This method is explained in *Principles of Program Design*, by Michael Jackson (New York: Academic Press, 1975).

• Mr Williams's table-search program used as an example of structured flowcharting has some difficulties. The index of the largest element (MAXINDEX) is described in table 1 (page 22) as:

$$1 < \text{MAXINDEX} < \text{N}$$

This means that neither the first nor the last entry can be the largest, and that there must be at least three elements in the table.

$$1 \leq \text{MAXINDEX} \leq \text{N}$$

would have been better, and was probably intended.

Also, the initial setting of MAXVAL to -9×10^{20} is much too machine dependent. This number would have to be changed for each compiler/computer combination. Why should a programmer even have to know what the smallest possible number is? It would be much better to set MAXVAL to the contents of the first entry in the table, and MAXINDEX to 1. INDEX can then start at 2, since the first entry in the table does not have to be compared with MAXVAL—it *is* MAXVAL.

There is another weakness in the program. What if the table has no entries at all? I know this is outside the specification, but it really shouldn't be. As written, the program will print:

MAXINDEX = 0, MAXV = -9×10^{20}

Clearly, this is not true. The program

Listing 1

```
program FINDMAX
  if array is empty (N = 0)
    print "V ARRAY IS EMPTY"
  else array is not empty (N > 0)
    set first entry as largest (MAXINDEX = 1, MAXV = V(1))
    comparisons start at second entry (INDEX = 2)
    while INDEX ≤ N
      find value of current array element (CURRV = V(INDEX))
      if current array element > largest element so far (CURRV > MAXV)
        new maximum element = current element (MAXV = V(INDEX))
        new maximum index = current index (MAXINDEX = INDEX)
      endif
      increment index by 1 (INDEX = INDEX + 1)
    endwhile
    print MAXV, MAXINDEX
  endif
endprogram
```

should test explicitly for an empty table. The final pseudocode is shown in listing 1.

Listing 1 exhibits none of the problems I've mentioned, and it was patterned using data-structured design.

Mayer Wantman
3D Systems
17 Grange Rd
Elstree, Hertfordshire,
WD6 3LY, England

Gregg Williams Replies:

Mr Wantman's distinction between notation and *method is a particularly incisive one. Because it is one of those ideas that illuminates the mind and helps clarify its intended subject, I'm sure I will find it useful in the future.*

Also, his corrections concerning MAXINDEX, the initialization of MAXVAL, and the possibility of an empty V array are correct. The first was a typographical error, but the last two were, alas, design errors on my part. My thanks to Mr Wantman for pointing them out.

Praise from All Over

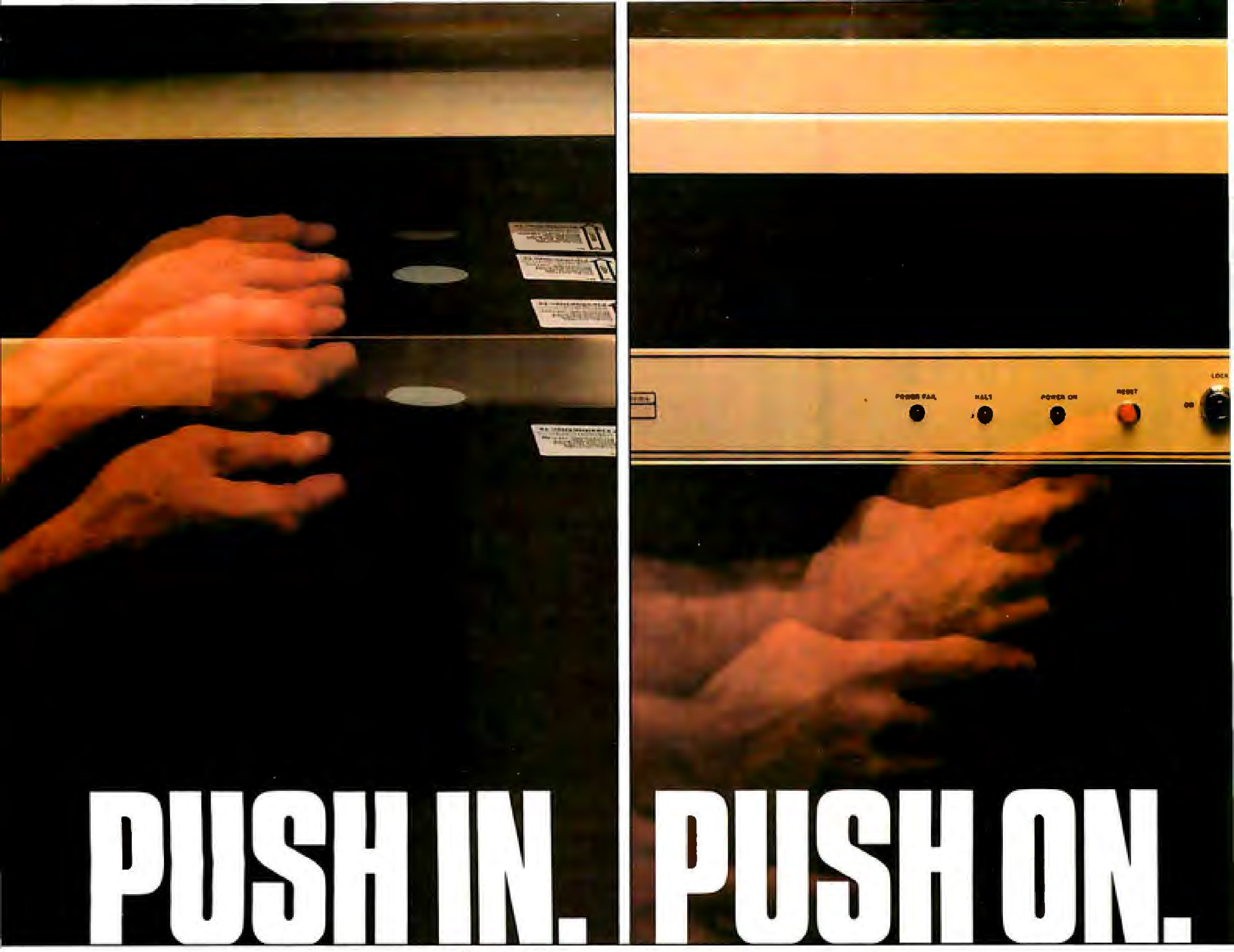
It would be nice if more software companies took a leaf from Versawriter's sales program and offered a sample of their products—perhaps a demonstration disk for a dollar plus your disk. Boy, that would certainly help in evaluating the stuff they're offering.

Evans M Harrel
342 Sequoia Dr
Marietta GA 30060

Southwestern Data Systems has recently introduced The Courier, a demonstration disk for dealers. It contains program samples from several manufacturers. While not as convenient as trying out programs in your home, you now have the opportunity to evaluate programs from several sources at your local computer store. . . . MH

In a day when companies charge you at the drop of a hat for an update to their software, here comes Tom Gibson providing an update to tiny-c, *without charge*. (See the letter from Tom, below.)

I've seen or heard of no other company doing this. Practices such as this will



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Tom Gibson
Tiny-c Associates
POB 269
Holmdel NJ 07733

When post-warranty service from a microcomputer manufacturer can be described only with superlatives such as "exemplary" and "outstanding," the time has come to bring it to BYTE readers' attention. In a field noted for its past lack of customer support, my experience with Dynabyte's civilized and decent way of treating consumers convinces me it is in a league with such legendary firms as Rolls-Royce (automobiles) and McIntosh (stereo equipment).

I called Dynabyte in Menlo Park, California, from London, Canada, about an intermittent disk problem with my Dynabyte 5200. Although the warranty period had expired, Roy Wheaton, Dynabyte's new national service manager, telephoned me. He not only spent some time on the phone "walking me through" the problem (I know nothing about the inside of a computer), but also arranged to rush me hundreds of dollars' worth of new parts without payment in advance. He called back several times to check whether they had arrived. The problem, an auxiliary disk controller, was sent back with the unneeded parts he sent, on an exchange basis for $65.

Dynabyte's policy of total customer satisfaction should be contrasted with an increasing number of firms in our society that become incommunicado after the sale. I have never experienced anything like the customer support given by Dynabyte.

Benjamin D Singer
Faculty of Social Science
Department of Sociology
University of Western Ontario
London, Ontario, N6A 5C2, Canada

Null Way To Run

William Sommerfeld's self-replicating program is an elegant one, but not quite the shortest. (See "Letters," March 1981 BYTE, page 16.) That honor goes to the "null" program:

which, if run, also prints exactly itself.

Here is, I think, the smallest self-replicating *and* self-modifying program. Notice that the program it *becomes* is also self-replicating (in fact, the one mentioned above):

```
1 LIST
2 NEW
```

Finally, if mere self-replication isn't enough, an *infinitely* self-replicating program:

```
1 LIST
2 RUN
```

Robert F Barnes
905 Delaware Ave
Bethlehem PA 18015

Expert Advice

On page 52 of the January 1981 BYTE, there is a photo showing a power-line filter in a video terminal. (See photo 2 in Steve Ciarcia's "Electromagnetic Interference.")

The label on the capacitor is 0.1 μF at 1000 V DC. BYTE readers should be warned that the selection of a DC-rated capacitor for use across the power line is a task for an expert. Nonexperts should use capacitors rated for the AC line voltage and recognized for this use by Underwriters Laboratories.

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Terminal Width Problems with the OSI Challenger

Shel Sacks, 2 Eldorado Blvd, Plainview NY 11803

If you use an OSI (Ohio Scientific) Challenger 1P computer with a video display having a line length or TW (terminal width) of less than 24 characters, you know that you cannot properly save programs on cassette. This is due to OSI's BASIC-in-ROM requiring a 72-character terminal width. In fact, 72 is the default value for the TW parameter, which is requested after the system is booted. But this problem of properly saving programs is easily solved.

The TW parameter is found in memory location 15 (decimal). The value of this parameter can be easily changed by a POKE, either given in immediate mode or from within a program. You might want to try a few different values and watch the changes in the display when listing a program.

Due to overscan on the television that I use for a video display, I program with TW set at 22 so that I can see all characters as they are entered. When I'm ready to save the program on tape, I begin with a POKE 15,72, which returns the TW parameter to 72 and ensures that the program is saved properly. I then SAVE the program as usual. ■

The Santa Cruz Open

Othello Tournament for Computers

Peter W Frey
Visiting Professor
University of California
421 Kerr Hall
Santa Cruz CA 95064

In mid January, when the Midwest and Northeast were weathering heavy snows and subzero temperatures, programmers from the US and abroad, laden with microcomputers or terminals and modems, traveled to the University of California in sunny Santa Cruz, for the Santa Cruz Open Othello Tournament. Each programming team had been preparing for months for decisive head-to-head competition in which only one program would triumph as champion. For individuals accustomed to solitary, cerebral pursuits, this tournament provided a public arena in which to demonstrate their skills.

The focus of this concentrated preparation was a complex strategy game, originally called Annexation, then renamed Reversi. It is now known as Othello, a trade name of CBS Inc. The rules of play and strategic ideas for this game have been discussed in earlier issues of BYTE (see references at the end of this article).

The University of California, Santa Cruz (UCSC), was an unconventional site for this electronic confrontation. The campus buildings are nestled among redwood trees on a hill overlooking Monterey Bay, an area of mostly undisturbed natural beauty. When the visitors arrived on campus for the weekend tournament, many must have thought they had been misdirected to a meeting of the Sierra Club.

The weekend was filled with many little surprises. Despite our careful plans, campus security forgot to open the fortress-like Applied Science building at the appointed hour. After traveling great distances at considerable expense, the competitors found themselves at a closed gate surrounded by dense forest. Members of the security force finally responded to our panicky telephone calls and opened the main gate, but then they promptly departed, leaving all of the rest rooms locked. The problems were eventually taken care of, however, and the Othello tournament gained a momentum of its own and proceeded in reasonable order.

Twenty teams were represented—more entries than in any computer-chess competition.

Tournament information was sent to potential participants last September. Later in the fall, most of the personal computing magazines carried announcements of the event. Even though Othello is a recent introduction to this country from Japan, it has gained a loyal following, and the organizers were surprised by the large number of individuals who responded enthusiastically. When tournament day arrived, 20 teams were represented—*more entries than in any computer-chess competition.*

The Santa Cruz Open was noteworthy also in respect to its budget. There wasn't any. Nevertheless, the event managed to take on the appearance of a big-time competition because of the enormous enthusiasm of the participants and the generous support from various segments of the computing community.

At the request of Dan and Kathe Spracklen, Fidelity Electronics and the Hayden Book Company provided air transportation from New York for the tournament director, Jonathan Cerf. Jonathan had recently returned from London where he had wrested the World Othello Championship from the Japanese. It was the first time that anyone outside Japan had held the title. For US Othello players, Jonathan's victory was akin to our hockey team's victory over the Russians at the 1980 Winter Olympics. We were extremely pleased to have Jonathan with us, and he turned in an absolutely superb job as tournament director. His efforts were aided by a computer program I had written to keep track of match outcomes,

Text continued on page 32

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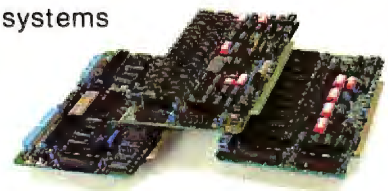

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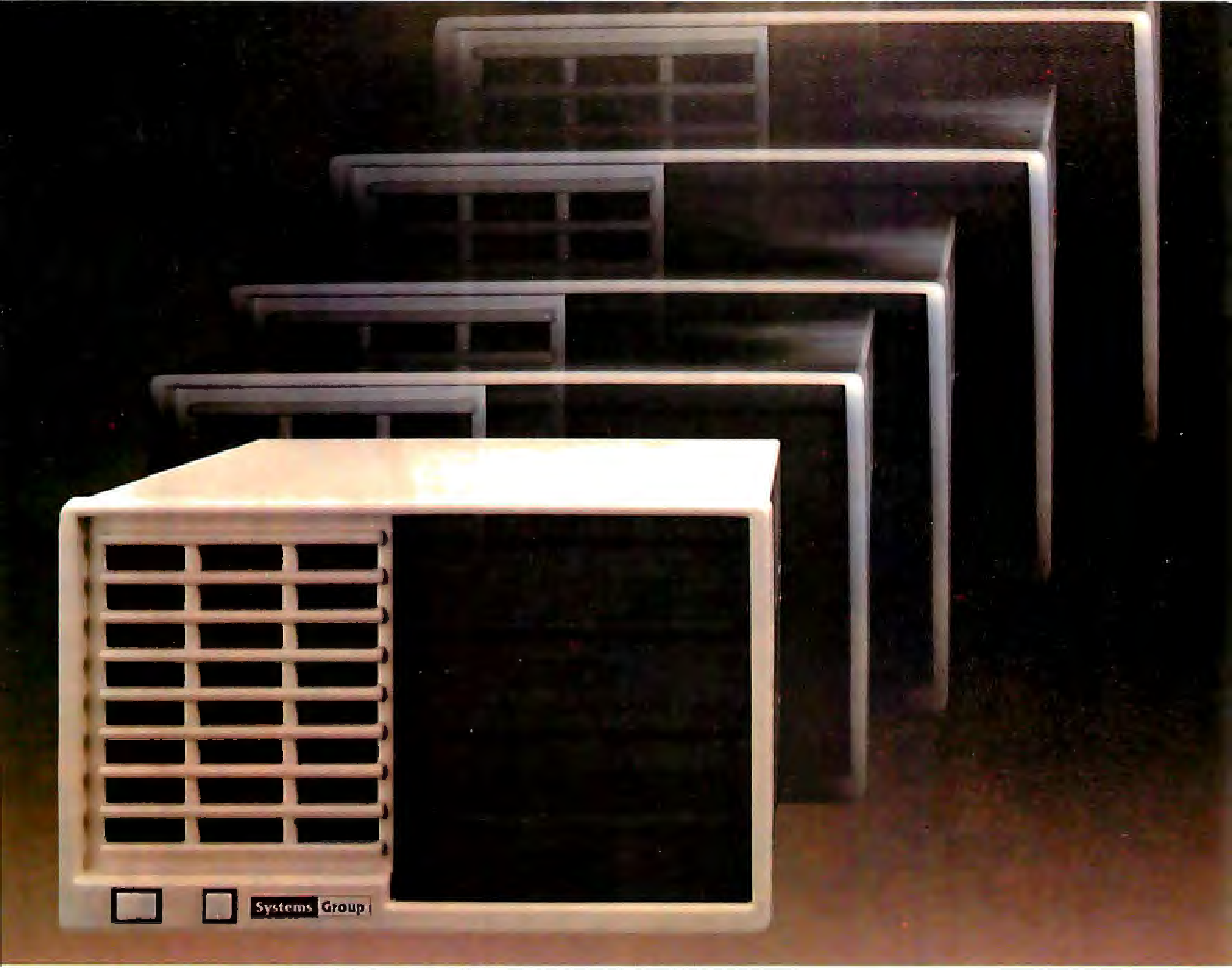

enhanced XIOS. The CP/M based System 2800 provides improved diagnostic reporting capability and increased sector sizes of 1024 bytes yielding disk performance throughput increases up to 400% over standard unblocked systems.

The enhanced multi-user, multi-tasking MP/M based System 2800 provides the same advanced features as CP/M. In addition, this interrupt driven implementation can offer performance throughput increases up to 2000% thru extensive disk buffering for applications requiring a large number of disk accesses.

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Text continued from page 26:
calculate standings, and make pairings for each new round. The program ran on a Radio Shack Model III TRS-80 lent to us by the local Radio Shack retailer.

We also received generous assistance from many others. BYTE Publications offered a prize of an autographed, bound set of its early volumes. The Computer Room, a retail establishment in nearby Scotts Valley, provided two Commodore PET computers for the weekend. One of these machines was used to run the program of our most distant entrant, Anders Kierulf, who was competing by proxy from the University of Zurich in Switzerland. Members of the local Apple and TRS-80 users' groups also volunteered their assistance. Several ran programs for entrants who could not be at the tournament site.

Photo 1: *Peter Frey, the author, waits patiently for his TRS-80 to calculate its next move.*

Photo 2: *Dan and Kathe Spracklen record the move of Larry Atkin's machine as he reaches for the chess clock.*

To accommodate individuals operating from large machines at distant locations, six of my colleagues at UCSC donated the use of their offices and telephones for the weekend. This arrangement avoided the considerable expense of installing telephones in the main tournament room and also provided some unexpected entertainment. Prior to the tournament, we had completed a university requisition to obtain keys for each office. On the first day of the tournament, I assigned office keys to each of the mainframe participants so that their terminals and modems would be secure. Imagine my chagrin when I learned that most of these keys did not work. The weekend was only a few hours old, and already some of the participants were starting to wonder if the tournament organizer had all of his marbles in the right place. A hastily discovered master key saved us.

Having six participants located in faculty offices away from the main tournament room also led to some logistical complications. When a microcomputer was paired with a mainframe, it was a simple matter to move the microcomputer into the proper office. When two mainframes were paired, the solution was not so easy since each was anchored to a telephone outlet. The problem was eventually solved by borrowing a few tricks from the ancient Greeks. Spectators who had dropped by to see this curious event were treated to a modern version of the marathon. Moves were relayed from one office to another, sometimes located on different floors, by messengers running as fast as possible. The spectators, I am sure, were impressed by our brilliant use of modern technology.

The tournament involved a David versus Goliath theme as well. Not only were lowly TRS-80s matched against large systems like the Control Data Cyber 170/730 and the Univac 11/40, but many first-time competitors found themselves sitting across the table from computer

Rank	Author(s)	Affiliation	Representative at Tournament Site	Hardware	Programming Language	Wins-Losses
1	Paul Rosenbloom	Carnegie-Mellon Univ Pittsburgh PA	Kate Rosenbloom	DEC KA10	SAIL	8-0
2	Charles Heath	Instant Software Peterborough NH	author	Model I TRS-80	Assembler	7-1
3	Dan and Kathe Spracklen	Fidelity Electronics Miami FL	authors	4 MHz 6502	Assembler	7-3
4a	Peter Frey	Northwestern Univ Evanston IL	author	Model I TRS-80	Assembler	7-4
4b	Larry Atkin Peter Frey	Applied Concepts Garland TX	Larry Atkin	2 MHz 6502	Assembler	5-4
6	Stephen Cheng	DataSoft Inc San Jose CA	author	Model I TRS-80	Assembler	4-4
7	Anders Kierulf	Univ of Zurich Zurich, Switzerland	Stuart Hastings	Commodore PET	Assembler	5-4
8	Rob Phillips	Univ of Maryland College Park MD	James Morgan	Univac 11/40	Pascal	5-4
9a	Douglas Larson Paul Gootherts	Hewlett-Packard San Jose CA	authors	HP-1000	FORTRAN	4-4
9b	Bill Tomlinson Mark Faron Chris Gates	California State Univ, Northridge	authors	CDC CYBER 170/730	BASIC	4-4
11	Richard Adams	Data General Dayton OH	author	C/330 Eclipse	Pascal	4-3
12	David Levy Kevin O'Connell	Philidor Software London, England	authors	2 MHz 6502	Assembler	4-4
13	Nick Jacobs	Univ of California Berkeley CA	author	MODCOMP	BCPL	3-5
14	Michael Riley	AB Computers Montgomeryville PA	Ernest Maharenke	Commodore PET	Assembler	3-4
15a	Gerhard Ringel Dan Jones	Qantel Corporation Hayward CA	authors	Qantel System 220	Assembler	3-5
15b	Ron Burke	Summit NJ	Philip Manoff	Model I TRS-80	Assembler	3-5
17	Bill Kemper	Hewlett-Packard Corvallis OR	John Sechrest	HP-85	BASIC	2-6
18	Brian Redman Lynn Aston	Bell Telephone Labs, Whippany NJ	Brian Redman	VAX 11/780	C	2-6
19	Peter Frey	Northwestern Univ Evanston IL	Kurt Inman	Model I TRS-80	BASIC	1-5
20	Jack Decker	The Alternate Source Lansing MI	Greg Vaughan	Model I TRS-80	BASIC	1-7

Table 1: *Final standings for the Othello Tournament held at UCSC on January 17 and 18, 1981.*

luminaries such as Dan and Kathe Spracklen, David Levy, or Larry Atkin. These tournament regulars had ten times as much experience as everyone else combined. Despite this, several of the newcomers turned in impressive performances.

Tournament Rules

The tournament rules closely followed those adopted for human competition by the United States Othello Association (USOA). Each contestant was allowed a maximum of 30 minutes for each game and moves were communicated using standard USOA notation. Pairings in the first round were determined by a random process. This was necessary because many programs had not been used in tournaments or they had been modified extensively since their last public performance.

A modified Swiss procedure was used to make the pairings for all subsequent rounds. At the end of each round, all of the contestants were ranked on the basis of their won-lost records and by cumulative piece differential when records were equivalent. Matches were then slated between the programs in first and second place, third and fourth place, fifth and sixth place, and so on. When this led to a pairing between contestants who had already met, a modified set of pairings was prepared which approximated the initial plan as closely as possible. The Model III TRS-80 performed these contestant-juggling acts quickly and accurately. This system of pairings insured that each contestant met an opponent of relatively similar strength. Although this decreased the number of lopsided outcomes, the won-lost records did not accurately reflect the relative playing strength of each program.

After the planned eight rounds had been completed, five programs were tied with records of five wins and three losses. Tournament director Cerf arranged several playoff matches between contestants who could stay a few extra hours. The addition of these extra matches, plus the cancellation of several others because of telephone problems, led to an unequal number of matches for the different programs. To arrive at final rankings, we used a Guttman scaling technique, instead of more conventional procedures. This is an iterative

TRS-80* COMPUTING EDITION

©1981 Percom Data Co., Inc. — The Percom Peripheral — 35 cents

Percom's DOUBLER II™ tolerates wide variations in media, drives

GARLAND, TEXAS — May 22, 1981 — Harold Mauch, president of Percom Data Company, announced here today that an improved version of the Company's innovative DOUBLER™ adapter, a double-density plug-in module for TRS-80* Model I computers, is now available.

Reflecting design refinements based on both theoretical analyses and field testing, the DOUBLER II™, so named, permits even greater tolerance in variations among media and drives than the previous design.

Like the original DOUBLER, the DOUBLER II plugs into the drive controller IC socket of a TRS-80 Model I Expansion Interface and permits a user to run either single- or double-density diskettes on a Model I.

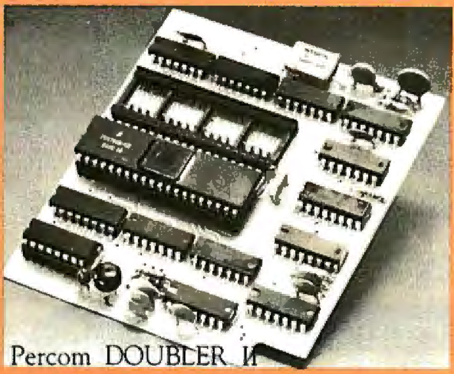
With a DOUBLER II installed, over four times more formatted data — as much as 364 Kbytes — can be stored on one side of a five-inch diskette than can be stored using a standard Tandy Model I drive system.

Moreover, a DOUBLER II equips a Model I with the hardware required to run Model III diskettes.

(*Ed. Note:* See "OS-80™: Bridging the TRS-80* software compatibility gap" elsewhere on this page.)

The critical clock-data separation circuitry of the DOUBLER II is a proprietary design called a ROM-programmed digital phase-lock loop data separator.

According to Mauch, this design is more tolerant of differences from diskette to diskette and drive to drive, and also provides immunity to performance degradation caused by circuit component aging.



Percom DOUBLER II

Mauch said "A DOUBLER II will operate just as reliably two years after it is installed as it will two days after installation."

The digital phase-lock loop also eliminates the need for trimmer adjustments typical of analog phase-lock loop circuits.

"You plug in a Percom DOUBLER II and then forget it," he said.

The DOUBLER II also features a refined Write Precompensation circuit that more effectively minimizes the phenomena of bit- and peak-shifting, a reliability-impairing characteristic of magnetic data recording.

The DOUBLER II, which is fully software compatible with the previous DOUBLER, is supplied with DBLDOS™, a TRSDOS*-compatible disk operating system.

The DOUBLER II sells for $2~~[illegible]~~95, including the DBLDOS diskette. NOW $169.95!

Owners of original DOUBLERs may purchase a DOUBLER II upgrade kit, without the disk controller IC, for $30.00. Proof of purchase of an original DOUBLER is required, and each DOUBLER owner may purchase only one DOUBLER II at the $30.00 price.

The Percom DOUBLER II is available from authorized Percom retailers, or may be ordered direct from the factory. The factory toll-free order number is 1-800-527-1592.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. **Circle 309 on inquiry card.**

All that glitters is not gold

OS-80™ Bridging the TRS-80* software compatibility gap

Compatibility between TRS-80* Model I diskettes and the new Model III is about as genuine as a gold-plated lead Krugerrand.

True, Model I TRSDOS* diskettes can be *read* on a Model III. But first they must be converted and re-recorded for Model III operation.

And you *cannot write* to a Model I TRSDOS* diskette. Not with a Model III. You cannot add a file. Delete a file. Or in any way modify a Model I TRSDOS diskette with a Model III computer.

Furthermore, your converted TRSDOS diskettes cannot be converted *back* for Model I operation.

TRSDOS is a one-way street. And there's no retreating. A point to consider before switching the company's payroll to your new Model III.

Real software compatibility should allow the *direct, immediate* interchangeability of Model I and Model III diskettes. No read-only limitations, no conversion/re-recording steps and no chance to be left high and dry with Model III diskettes that can't be run on a Model I.

What's the answer? The answer is Percom's OS-80™ family of TRS-80 disk operating systems.

OS-80 programs allow *direct, immediate* interchangeability of Model I and Model III diskettes.

You can run Model I single-density diskettes on a Model III; install Percom's plug-in DOUBLER™ adapter in your Model I, and you can run double-density Model III diskettes on a Model I.

There's no conversion, no re-recording.

Slip an OS-80 diskette out of your Model I and insert it directly in a Model III.

And vice-versa.

Just have the correct OS-80 disk operating system — OS-80, OS-80D or OS-80/III — in each computer.

Moreover, with OS-80 systems, you can add, delete, and update files. You can read *and write* diskettes regardless of the system of origin.

OS-80 is the original Percom TRS-80 DOS for BASIC programmers.

Even OS-80 utilities are written in BASIC.

OS-80 is the Percom system about which a user wrote, in Creative Computing magazine, ". . . the best $30.00 you will ever spend."†

Requiring only seven Kbytes of memory, OS-80 disk operating systems reside completely in RAM. There's no need to dedicate a drive exclusively for a system diskette.

And, unlike TRSDOS, you *can* work at the track sector level, defining and controlling data formats — in BASIC — to create simple or complex data structures that execute more quickly than TRSDOS files.

The Percom OS-80 DOS supports single-density operation of the Model I computer — price is $29.95; the OS-80D supports double-density operation of Model I computers equipped with a DOUBLER or DOUBLER II; and, OS-80/III — for the Model III of course — supports both single- and double-density operation. OS-80D and OS-80/III each sell for $49.95.

Circuit misapplication causes diskette read, format problems.

High resolution key to reliable data separation

GARLAND, TEXAS — The Percom SEPARATOR™ does very well for the Radio Shack TRS-80* Model I computer what the Tandy disk controller does poorly at best: *reliably* separates clock and data signals during disk-read operations.

Unreliable data-clock separation causes format verification failures and repeated read retries.

CRC ERROR–TRACK LOCKED OUT

The problem is most severe on high-number (high-density) inner file tracks.

As reported earlier, the clock-data separation problem was traced by Percom to misapplication of the internal separator of the 1771 drive controller IC used in the Model I.

The Percom Separator substitutes a *high-resolution* digital data separator circuit, one which operates at 16 megahertz, for the low-resolution one-megahertz circuit of the Tandy design.

Separator circuits that operate at lower frequencies — for example, two- or four-megahertz — were found by Percom to provide only marginally improved performance over the original Tandy circuit.

The Percom solution is a simple adapter that plugs into the drive controller of the Expansion Interface (EI).

Not a kit — some vendors supply an untested separator kit of resistors, ICs and other paraphernalia that may be installed by modifying the computer — the Percom SEPARATOR is a fully assembled, fully tested plug-in module.

Installation involves merely plugging the SEPARATOR into the Model I EI disk controller chip socket, and plugging the controller chip into a socket on the SEPARATOR.

The SEPARATOR, which sells for only $29.95, may be purchased from authorized Percom retailers or ordered directly from the factory. The factory toll-free order number is 1-800-527-1592.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. **Circle 310 on inquiry card.**

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process that attempts to order the contestants in a way that produces the greatest degree of transitivity. That is, each program should be able to defeat those below it in the standings and should lose to those above it. Our final standings, shown in table 1, closely approximate this goal in respect to the matches that were played in the tournament.

The Winners

The champion program was Iago, written by Paul Rosenbloom, a fifth-year graduate student in computer science at Carnegie-Mellon University in Pittsburgh. His DEC KA10 program performed remarkably well, defeating all opponents. In a tournament held six months earlier at Northwestern University, Paul's program placed third in the machine competition, finishing behind the Spracklens' program and my program. Since then, everyone had made major improvements. Paul had apparently learned more than the rest of us. Progress has been so substantial that any one of the top eight programs at Santa Cruz is probably strong enough to defeat the program that placed first at Northwestern. Paul could not be in Santa Cruz, so he vigilantly monitored the contests from Pittsburgh while his sister Kate, a professional programmer working in Mountain View, California, operated a terminal at UCSC.

Second place, and top microcomputer honors, was won by first-time competitor Charles Heath of Waltham, Massachusetts. After several playoff matches, the Spracklens placed third. Fourth place was shared by Larry Atkin and myself. Stephen Cheng from San Jose, another newcomer to the tournament circuit, came in sixth. Anders Kierulf, the Swiss entrant, finished seventh and Rob Phillips, who recently received his PhD from the University of Maryland, took eighth place.

One of the surprises of the tournament was the impressive showing of the microcomputers and hand-held electronic units. Devices based on the Zilog Z80 or the MOS Technology 6502 microprocessors finished in positions two through seven. The Cyber 170 entry tied for ninth place and the VAX 11/780 system came in 18th. All of the programs running on large machines were operated in time-sharing environments and this hindered their performance. In addition, these programs were compiled from high-level languages, while the microprocessor-based entries that placed well in the tournament were all written in assembly language. Some of the advantages of the larger machines, such as bigger word size or faster floating-point arithmetic, are not particularly important for Othello where most operations involve simple symbol manipulation.

Microprocessor-based units have also benefited from recent hardware improvements. For example, the 6502-based units entered by David Levy and Larry Atkin are designed to run at twice the speed of the Apple computer. The tournament version of the Spracklens' program used specially prepared hardware to run four times as fast as the Apple. At this speed, the 6502 generates so much heat that a special cooling unit is required. The two strongest TRS-80 programs were also run at clock rates faster than Tandy intended. The unit as it comes from the factory runs its Z80 processor at 1.8 MHz, less than half the speed for which it was designed. There are several speed-up kits available commercially for the TRS-80, and these may be useful options for the serious chess or Othello player. I have been especially pleased with the reasonable price and reliable operation of the kit from Archbold Electronics.

Learning and Playing

Machine Othello programs are becoming good enough to make useful contributions to human play. In the endgame, computers can play perfectly, selecting a final sequence of moves that guarantees them the maximum final disk count. In this respect, they are as good or better than any human. Cerf has played several of these programs and reports that his endgame play has improved noticeably. This may be the first case in which a machine has become sufficiently proficient at a complex strategy game to serve as a useful sparring partner for the world champion.

Tournaments like the Santa Cruz Open provide a rigorous test for new software and the occasion for information exchange. Few programmers are eager to reveal their most important secrets, but one must divulge some information in order to get ideas from others. Santa Cruz was a great learning experience. It was comforting to discover that other apparently sane persons had been working day and night for months on their creations. The enjoyable camaraderie reinforces each one's belief that the shared enterprise is reasonable and worthwhile.

Othello seems to be rapidly overtaking chess as the most popular strategy game for computer programming. Eighteen months ago few serious Othello programs existed. Today there are more than two dozen, and the number is increasing at a rapid pace.

The keen interest in machine Othello reflects the inherent fascination of the game and its logical structure that facilitates programming. The game is conceptually complex and yet the move-generation and evaluation routines can be compact and architecturally aesthetic. The challenge of chess is there with fewer programming headaches. I expect that the current love affair between Othello and microcomputers will produce a long and happy marriage. Long before the final match was played at Santa Cruz, one question was asked by many: "When is the next tournament?" ■

References

1. Frey, Peter W. "Simulating Human Decision-Making on a Personal Computer." July 1980 BYTE, page 56.
2. Maggs, Peter B. "Programming Strategies in the Game of Reversi." November 1979 BYTE, page 66.

Build a Z8-Based Control Computer with BASIC, Part 1

Steve Ciarcia
POB 582
Glastonbury CT 06033

I hope you believe me when I say that I have been waiting years to present this project. For what has seemed an eternity, I have wanted a microcomputer with a specific combination of capabilities. Ideally, it should be inexpensive enough to dedicate to a specific application, intelligent enough to be programmed directly in a high-level language, and efficient enough to be battery operated.

My reason for wanting this is purely selfish. The interfaces I present each month are the result of an overzealous desire to control the world. In lieu of that goal, and more in line with BYTE policy, I satisfy this urge by stringing wires all over my house and computerizing things like my wood stove.

There are many more places I'd like to apply computer monitoring and control. I want to modify my home-security system to use low-cost *distributed* control rather than central control. I want to try my hand at a little energy management, and, of course, I am still trying to find some reason to install a microcomputer in a car. (How about a talking dashboard?)

Generally, the projects I present each month are designed to be attached to many different commercially available microcomputers through existing I/O (input/output) ports. Most of my projects are applicable for use on the small (by IBM standards) computers owned by many readers, but, unfortunately, a typical home-computer system cannot be stuffed under a car seat.

The Z8-BASIC Microcomputer is a milestone in low-cost microcomputer capability.

The time has come to present a versatile "Circuit Cellar Controller" board for some of these more ambitious control projects. I decided not to adapt an existing single-board computer, which would be larger, more expensive, and generally limited to machine-language programming. Instead, I started from scratch and built exactly what I wanted.

The microcomputer/controller I developed is called the Z8-BASIC Microcomputer. Its design and application will be presented in a two-part article beginning this month. In my opinion, it is a milestone in low-cost microcomputer capability. It can be utilized as an inexpensive tiny-BASIC computer for a variety of changing applications, or it can be dedicated to specialized tasks, such as security control, energy management, solar-heating-system monitoring, or intelligent-peripheral control. [**Editor's Note:** *We are using the term "tiny BASIC" generically to denote a small, limited BASIC interpreter. The term has been used to refer to some specific commercially available products based on the Tiny BASIC concept promulgated by the People's Computer Company in 1975....* **RSS**]

The entire computer is slightly larger than a 3 by 5 file card, yet it includes a tiny-BASIC interpreter, 4 K bytes of program memory, one RS-232C serial port and two parallel I/O ports, plus a variety of other features. (A condensed functional specification is shown in the "At a Glance" text box.) Using a Zilog Z8 microcomputer integrated circuit and Z6132 4 K by 8-bit read/write memory device, the Z8-BASIC Microcomputer circuit board is completely self-contained and optimized for use as a dedicated controller.

To program it for a dedicated application, you merely attach a user terminal to the DB-25 RS-232C connector, turn the system on, and type in a BASIC program using keywords such as GOTO, IF, GOSUB, and LET. Execution of the program is started by typing RUN. If you need higher speed than BASIC provides, or if you just want to experiment with the Z8 instruction set, you can use the

GO@ and USR keywords to call machine-language subroutines.

Once the application program has been written and tested with the aid of the terminal, the finished program can be transferred to an EPROM (erasable programmable read-only memory) via a memory-dump program and the terminal disconnected. Next, the 28-pin Z6132 memory component is removed from its socket and either a type-2716 (2 K by 8-bit) or type-2732 (4 K by 8-bit) EPROM is plugged into the lower 24 pins. (The choice of EPROM depends upon the length of the program.) When the Z8 board is powered up, the stored program is immediately executed. *The EPROM devices and the Z6132 read/write memory device are pin-compatible.* Permanent program storage is simply a matter of plugging an EPROM into the Z6132's socket.

There is much more power on this board than is alluded to in this simple description. That is why I decided to use a two-part article to explain it. This month, I'll discuss the design of the system and the attributes of the Z8 and Z6132. Next month, I'll describe external interfacing techniques, a few applications, and the steps involved in transferring a program into an EPROM.

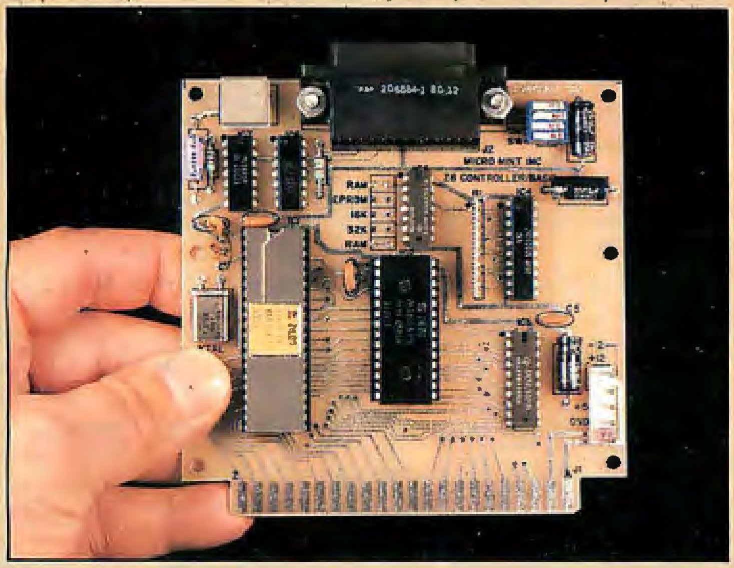


Photo 1: *A prototype of the versatile "Circuit Cellar Controller," formally called the Z8-BASIC Microcomputer. The printed-circuit board measures 4 by 4½ inches and has a 44-pin (two-sided 22-pin) edge connector with contacts on 0.156-inch centers. A 2716 or 2732 EPROM can be substituted for the Z6132 Quasi-Static memory, plugging into the same socket.*

Single-Chip Microcomputers

The central component in the Z8-BASIC Microcomputer is a member of the Zilog Z8 family of devices. The specific component used, the Z8671, is just one of them. Unlike a micro*processor*, such as the well-known Zilog Z80, the Z8 is a single-chip micro*computer*. It contains programmable (read/write) memory, read-only memory, and I/O-control circuits, as well as circuits to perform standard processor functions. Microprocessors such as the Z80 or the Intel 8080 require support circuitry to make a functional computer system. A single-chip microcomputer, on the other hand, can function solely on its own.

The concept is not new. Single-chip microcomputers have been around for quite a while, and millions of them are used in electronic games. The designers of the Z8, however, raised the capabilities of single-chip microcomputers to new heights and provided many powerful features usually found only in general-application microprocessors.

Typically, single-chip microcomputers have been designed for microcontroller applications and optimized for I/O processing. On a 40-pin dual-inline package, as many as 32 of the pins can be I/O related. A ROM-programmed single-chip microcomputer used in an electronic chess game might offer a thousand variations in game tactics, but it could not be reprogrammed as a word processor. The ability to reorient processing functions and reallocate memory has generally been the province of microprocessors, with their memory-intensive architecture.

The Z8 architecture (shown in figure 1a on page 40) allows it to serve in either memory- or I/O-intensive applications. Under program control, the Z8 can be configured as a stand-alone microcomputer using 2 K to 4 K bytes of internal ROM, as a traditional microprocessor with as much as 120 K to 124 K bytes of external memory, or as a parallel-processing unit working with other computers. The Z8 could be used as a controller in a microwave oven or as the processor in a stand-alone data-entry terminal complete with floppy-disk drives.

Getting Specific: The Z8671

The member of the Z8 family used in this project is the Z8671. This component differs from the garden-variety Z8601 chiefly in the contents of the ROM set at the factory. The pinout specification of the Z8671 is shown in figure 1b, and the package is shown in photo 2 on page 41. The Z8671 package contains the processor circuitry, 2 K bytes of ROM (preprogrammed with a tiny-BASIC interpreter and a debugging monitor), 32 I/O lines, and 144 bytes of programmable (read/write) memory.

The operational arrangement of memory-address space is shown in figure 1c. The internal read/write memory is actually a register file (illustrated in figure 2) composed of 124 general-purpose registers (R4 thru R127), 16 status-control registers (R240 thru R255), and 4 I/O-port registers (R0 thru R3). Any general-purpose register can be used as an accumulator, address pointer, index register, or as part of the internal stack area. The significance of these registers will be explained when I describe the tiny-BASIC/Debug interpreter/monitor.

The 32 I/O lines are grouped into four separate ports and treated internally as 4 registers. They can be configured by software for either input or output and are compatible with

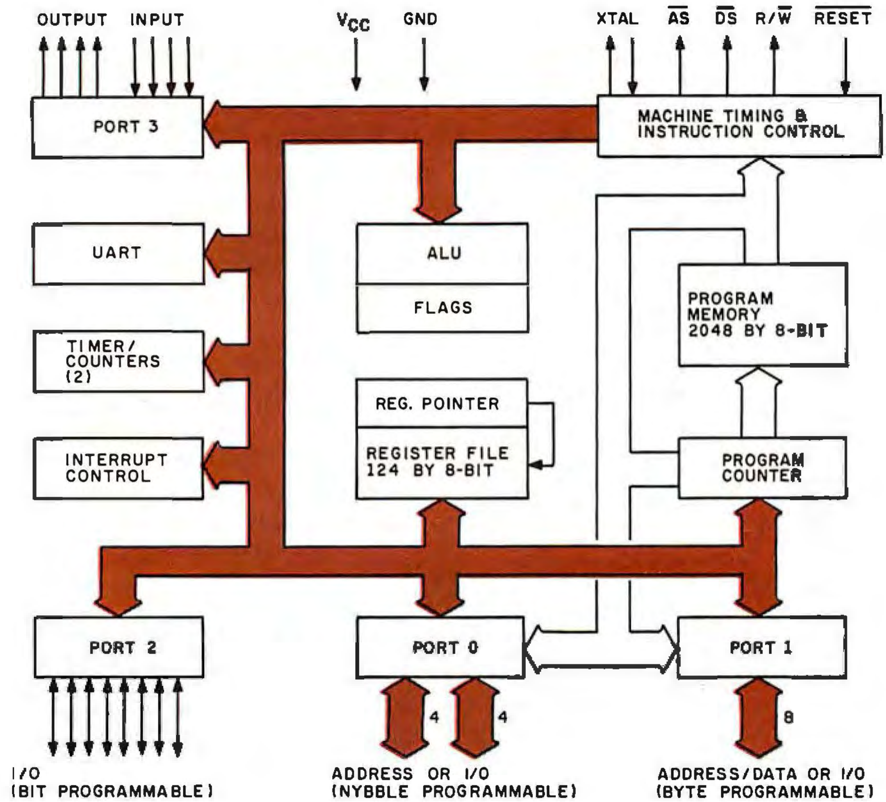


Figure 1a: *Block diagram of the Zilog Z8-family single-chip microcomputers. Their architecture allows these devices to serve in either memory- or I/O-intensive applications. This figure and figures 1b, 1c, 2, 3, and 4 were provided through the courtesy of Zilog Inc.*

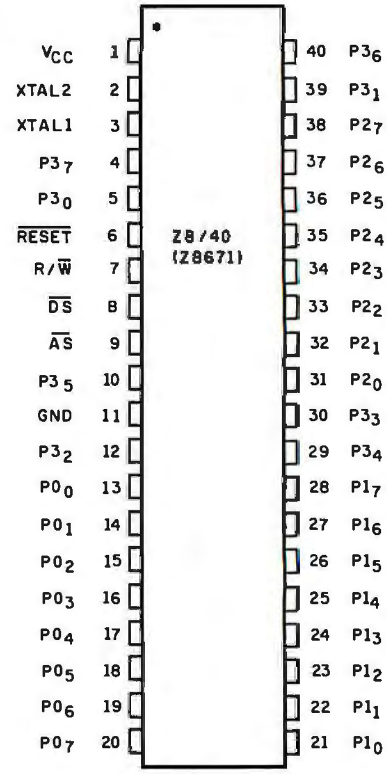


Figure 1b: *Pinout specification of the Zilog Z8671 microcomputer. The Z8671 is a variant of the basic Z8601 component of the Z8 family. The Z8671 is used in this project because it contains the BASIC/Debug interpreter/monitor in read-only memory. Other members of the Z8 family are supplied in different packages, chiefly to support system-development work.*

LSTTL (low-power Schottky transistor-transistor logic). In addition, port 1 and port 0 can serve as a multiplexed address/data bus for connection of external memory and peripheral devices.

In traditional nomenclature, port 1 transceives the data-bus lines D0 thru D7 and transmits the low-order address-bus signals A0 thru A7. Port 0 supplies the remaining high-order address lines A8 thru A15, for a total of 16 address bits. This allows 62 K bytes of *program* memory (plus 2 K bytes of ROM) to be directly addressed. If more memory is required, one bit in port 3 can be set to select another memory bank of 62 K bytes, which is referred to as *data* memory. In the Z8-BASIC Microcomputer presented here, a separate data-memory bank is not implemented, and program and data memory are considered to be the same.

The Z8 has forty-seven instructions, nine addressing modes, and six interrupts. Using a 7.3728 MHz crystal (producing a system clock rate of 3.6864 MHz) most instructions take about 1.5 to 2.5 μs to execute. Ordinarily, you would not be concerned about single-chip-microcomputer instruction sets and interrupt handling because the programs are mask-programmed into the ROM at the factory. In the Z8671, however, only the BASIC/Debug interpreter is preprogrammed. Using this interpreter, you can write machine-language programs that can be executed through subroutine calls written in BASIC. This feature greatly enhances the capabilities of this tiny computer and potentially allows the software to control high-speed peripheral devices. (A complete discussion of the Z8 instruction set and interrupt structure is beyond the scope of this article. The documentation accompanying the Z8-BASIC Microcomputer Board describes the instruction set in detail.)

The final area of concern is communication. The Z8 contains a full-duplex UART (universal asynchronous receiver/transmitter) and two counter/timers with prescalers. One of the counters divides the 7.3728 MHz crystal frequency to one of eight standard data rates. With the Z8671, these rates range between 110 and 9600 bps (bits per second) and are switch- or software-selectable.

A block diagram of the serial-I/O section is shown in figure 3. Serial data is received through bit 0 of port 3 and transmitted from bit 7 of port 3. While the Z8 can be set to transmit odd parity, the Z8671 is preset for 1 start bit, 8 data bits, no parity, and 2 stop bits. Received data must have 1 start bit, 8 data bits, at least 1 stop bit, and no parity (in this configuration).

Quasi-Static Memory

A limiting factor in small controller

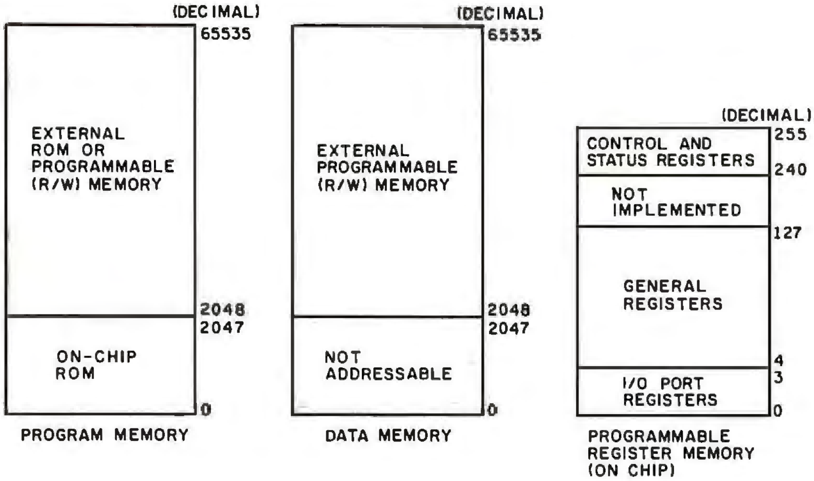


Figure 1c: *The operational arrangement of memory-address space in the Z8 family. The regions labeled "program memory" and "data memory" may map to the same physical memory, or two separate banks may be used, selected through one bit of I/O port 3. The internal programmable (read/write) memory is a register file containing 124 general-purpose registers, 16 status-control registers, and 4 I/O-port registers.*

designs has always been the trade-off between memory size and power consumption. To keep the number of components down and simplify construction, a designer generally selects a limited quantity of static memory. Frequently, the choice is to use two type-2114 1 K by 4 NMOS (negative-channel metal-oxide semiconductor) static-memory devices. In practice, however, the 1 K-byte memory size thereby provided is rather limited. It would be much better to expand this to at least 4 K bytes. Unfortunately, eight 2114 chips require considerably more circuit-board space and consume about 0.7 amps at +5 V. Not only would this make the design ill suited for battery power, it could never fit on my 4- by 4½-inch circuit board.

Another approach is to use dynamic memory, as in larger computers. Dynamic memory costs less, bit for bit, than static memory and consumes little power. Unfortunately, most dynamic-memory components require three separate operating voltages and special refresh circuitry. Adding 4 K bytes of dynamic memory would probably take about twelve chips. The advantages gained in reduced power consumption hardly justify the expense and effort.

The solution to this problem, surprisingly enough, also comes from Zilog, in the form of the Z6132 Quasi-Static Memory. The Z6132, shown in photo 4 on page 43, is a 32 K-bit dynamic-memory device, organized into 4 K 8-bit (byte-size) words. It uses single-transistor dynamic bit-storage cells, but the device performs and controls its own data-refresh operations in a manner that is completely invisible to the user and the rest of the system. This eliminates the need for external refresh circuitry. Also, the Z6132 requires only a +5 V power supply. The result is a combination of the design convenience of static memory and the low power consumption of dynamic memory. All 4 K bytes of memory fit in a single 28-pin dual-inline package, which typically draws about 30 milliamps.

An additional benefit in using the Z6132 is that it is pin-compatible with standard type-2716 (2 K by 8-bit) and type-2732 (4 K by 8-bit) EPROMs. This feature is extremely beneficial when you are configuring this Z8 board for use as a dedicated controller. As previously mentioned, the Z6132 can be removed and an EPROM inserted in the low-order 24 pins of the same socket. Thus, any program written and operating in the Z6132 memory can be placed in a

Text continued on page 44

LOCATION		IDENTIFIERS
255	STACK POINTER (BITS 7-0)	SPL
254	STACK POINTER (BITS 15-8)	SPH
253	REGISTER POINTER	RP
252	PROGRAM CONTROL FLAGS	FLAGS
251	INTERRUPT MASK REGISTER	IMR
250	INTERRUPT REQUEST REGISTER	IRQ
249	INTERRUPT PRIORITY REGISTER	IPR
248	PORTS 0-1 MODE	P01M
247	PORT 3 MODE	P3M
246	PORT 2 MODE	P2M
245	TO PRESCALER	PRE0
244	TIMER/COUNTER 0	T0
243	T1 PRESCALER	PRE1
242	TIMER/COUNTER 1	T1
241	TIMER MODE	TMR
240	SERIAL I/O	SIO
	NOT IMPLEMENTED	
127		
	GENERAL PURPOSE REGISTERS	
4		
3	PORT 3	P3
2	PORT 2	P2
1	PORT 1	P1
0	PORT 0	P0

Figure 2: *An expanded view of the register-memory section of figure 1c, showing the organization of the register file. Any general-purpose register can be used as an accumulator, address pointer, index register, or as part of the internal stack area.*

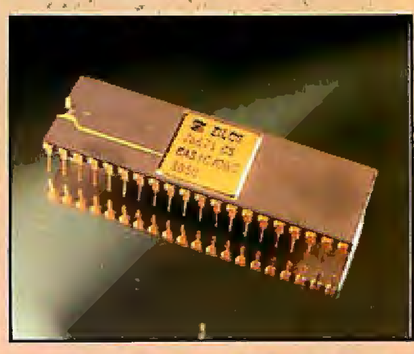


Photo 2: *The Zilog Z8671 single-chip microcomputer, a member of the Z8 family of devices. This dual-inline package contains the processor circuitry, 2 K bytes of ROM, 32 I/O lines, and 144 bytes of programmable memory.*

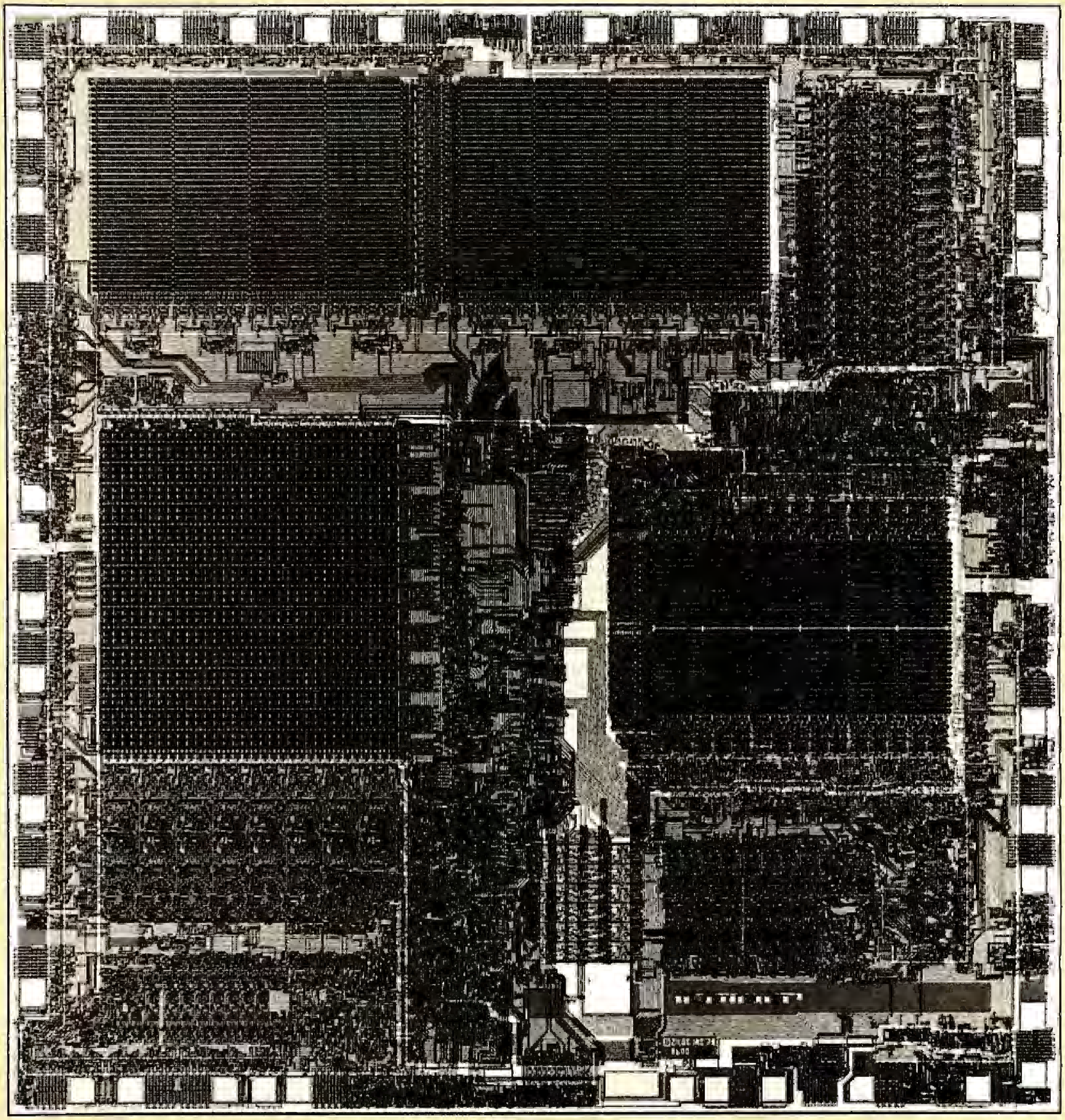


Photo 3: *A photomicrograph of the silicon chip containing the working parts of a Z8 microcomputer.*

The following items are available from:
The MicroMint Inc
917 Midway
Woodmere NY 11598
Telephone:
(800) 645-3479 (for orders)
(516) 374-6793 (for technical information)

Z8-BASIC Microcomputer
Documentation includes:
Z8 Technical Manual, Z8 Product Specification
Z6132 Product Specification
BASIC/Debug Manual
Z8-BASIC Microcomputer Construction/Operator's Manual
Assembled and tested....$170
Kit....$140

Z8-BASIC Microcomputer power supply
(Size: 2⅞ by 4½ inches)
Provides: +5 V, 300 mA
+12 V, 50 mA
−12 V, 50 mA
Assembled and tested....$35
Kit....$27

All printed-circuit boards are solder-masked and silk-screened.

The documentation supplied with the Z8 board includes approximately 200 pages of materials. It is available separately for $25. This charge will be credited toward any subsequent purchase of the Z8 board.

Please include $4 for shipping and handling. New York residents please include 7% sales tax.

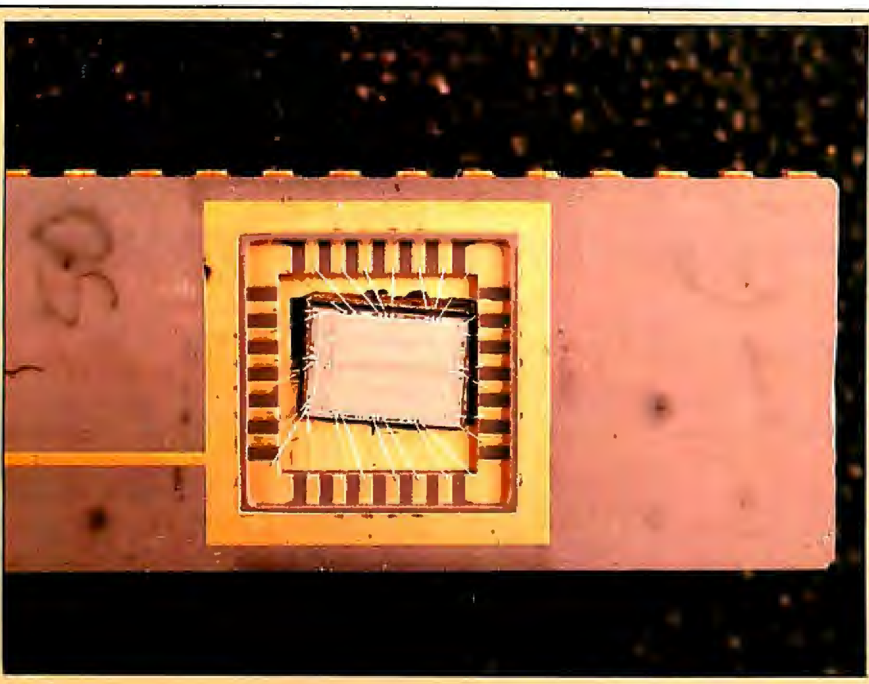


Photo 4: *The Zilog Z6132 Quasi-Static Memory device, shown with the hood up. This component stores 32 K bits in the form of 4 K bytes in invisibly refreshed dynamic-memory cells.*

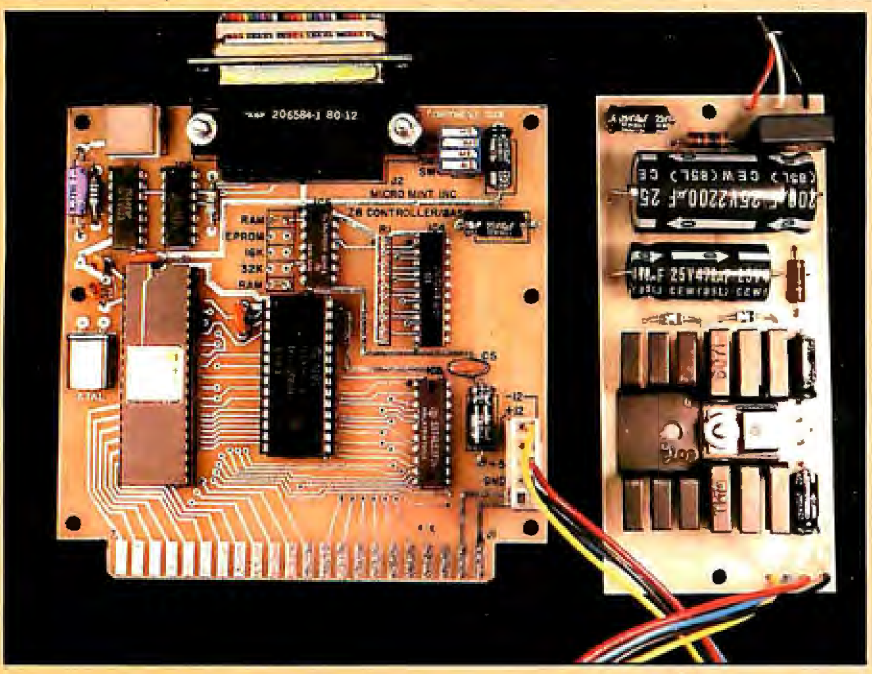


Photo 5: *The Z8-BASIC Microcomputer Board attached to a power supply. Power can be supplied either through the separate power connector, as shown, or through the edge connector.*

At a Glance

Name
Z8-BASIC Microcomputer

Processor
Zilog Z8-family Z8671 8-bit microcomputer with programmable (read/write) memory, read-only memory, and I/O in a single package. The Z8671 includes a 2 K-byte tiny-BASIC/Debug resident interpreter in ROM, 144 bytes of scratch-pad memory, and 32 I/O lines. System uses 7.3728 MHz crystal to establish clock rate. Two internal and four external interrupts.

Memory
Uses Z6132 4 K-byte Quasi-Static Memory (pin-compatible with 2716 and 2732 EPROMs); 2 K-byte ROM in Z8671. Memory externally expandable to 62 K bytes of program memory and 62 K bytes of data memory.

Input/Output
Serial port: RS-232C-compatible and switch-selectable to 110, 150, 300, 1200, 2400, 4800, and 9600 bps.
Parallel I/O: two parallel ports; one dedicated to input, the other bit-programmable as input or output; programmable interrupt and handshaking lines; LSTTL-compatible.
External I/O: 16-bit address and 8-bit bidirectional data bus brought out to expansion connector.

BASIC Keywords
GOTO, GO@, USR, GOSUB, IF...THEN, INPUT, LET, LIST, NEW, REM, RETURN, RUN, STOP, IN, PRINT, PRINT HEX. Integer arithmetic/logic/operators: +, −, /, *, and AND; BASIC can call machine-language subroutines for increased execution speed; allows complete memory and register interrogation and modification.

Power-Supply Requirements
+5 V ±5% at 250 mA
+12 V ±10% at 30 mA
−12 V ±10% at 30 mA
(The 12 V supplies are required only for RS-232C operation.)

Dimensions and Connections
4- by 4½-inch board; dual 22-pin (0.156-inch) edge connector. 25-pin RS-232C female D-subminiature (DB-25S) connector; 4-pole DIP-switch data-rate selector.

Operating Conditions
Temperature: 0 to 50°C (32 to 122°F)
Humidity: 10 to 90% relative humidity (noncondensing)

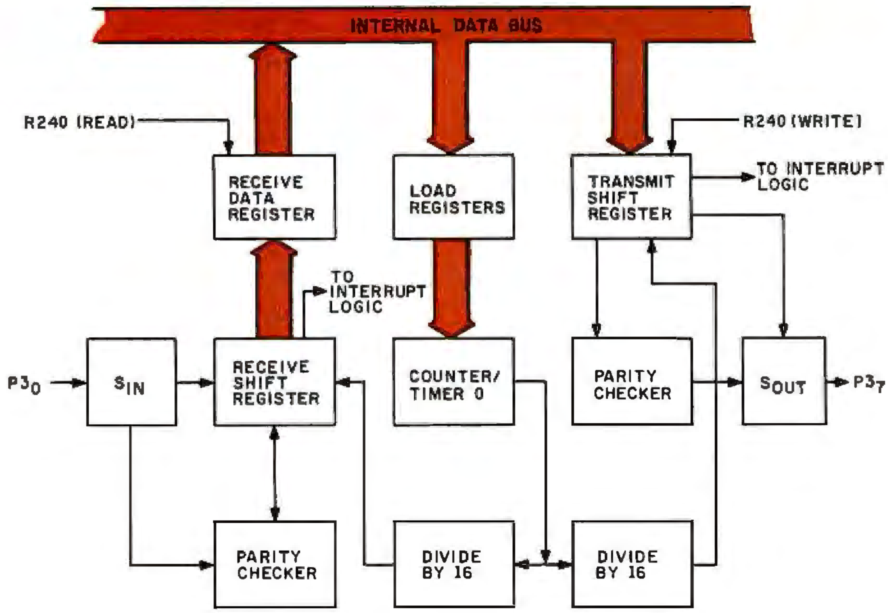


Figure 3: *Block diagram of the serial-I/O section of the Z8-family microcomputers. The Z8 contains a full-duplex UART (universal asynchronous receiver/transmitter). The data rates are derived from the clock-rate crystal frequency. Serial data is received through bit 0 of port 3 and is transmitted from bit 7 of port 3. An interrupt is generated within the Z8 whenever transmission or reception of a character has been completed.*

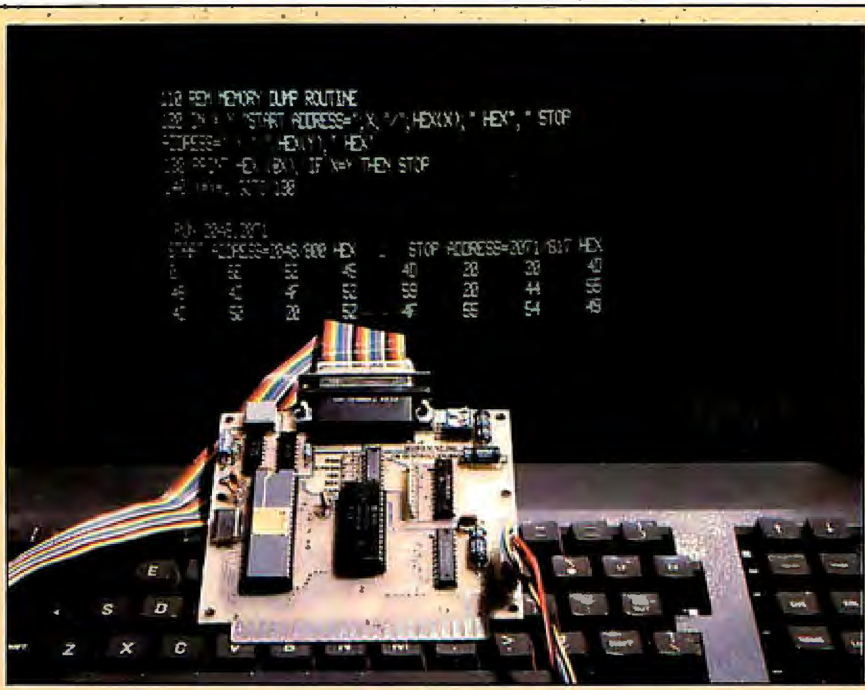


Photo 6: *The Z8-BASIC Microcomputer in operation, communicating with a video terminal (here, a Digital Equipment Corporation VT8E). A memory-dump routine, written using the BASIC/Debug interpreter, is shown on the display screen. The starting address of the dump is the beginning of the user-memory area; the hexadecimal values displayed are the ASCII (American Standard Code for Information Interchange) values of the characters that make up the first line of the memory-dump program.*

Text continued from page 41:
nonvolatile EPROM. (There are some limitations placed on the number of subroutine calls and variables allowed by this substitution because variable data and return addresses must be stored in the Z8's register area instead of in external read/write memory.)

Z8-BASIC Microcomputer

Figure 5 on pages 46 and 47 is the schematic diagram of the seven-integrated-circuit Z8-BASIC Microcomputer Board, shown in prototype form, with a power supply, in photo 5. IC1 is the Z8671 microcomputer, the member of the Z8 family that contains Zilog's 2 K-byte BASIC/Debug software in read-only memory. IC2 is the Z6132 Quasi-Static Memory, and IC3 is an 8-bit address latch. Under ordinary circumstances, the Z6132 is capable of latching its address internally, but IC3 is included to allow EPROM operation. IC4 and IC5 form a hard-wired memory-mapped input port used to read the data-rate-selection switches. IC6 and IC7 provide proper voltage-level conversion for RS-232C serial communication.

The seven-integrated-circuit computer typically takes about 200 milliamps at +5 V. The +12 V and −12 V supplies are required only for operating the RS-232C interface. Power required is typically about 25 milliamps on each.

The easiest way to check out the Z8-BASIC Microcomputer after assembly is to attach a user terminal to the RS-232C connector (J2) and set the data-rate-selector switches to a convenient rate. I generally select 1200 bps, with SW2 closed and SW1, SW3, and SW4 open. After applying power, simply press the RESET push button.

Pressing RESET starts the Z8's initialization procedure. The program reads location hexadecimal FFFD in memory-address space, to which the data-rate-selector switches are wired to respond. When it has acquired this information, it sets the appropriate data rate and transmits a colon to the terminal. At this point, the Z8 board is completely operational and programs can be entered in tiny BASIC.

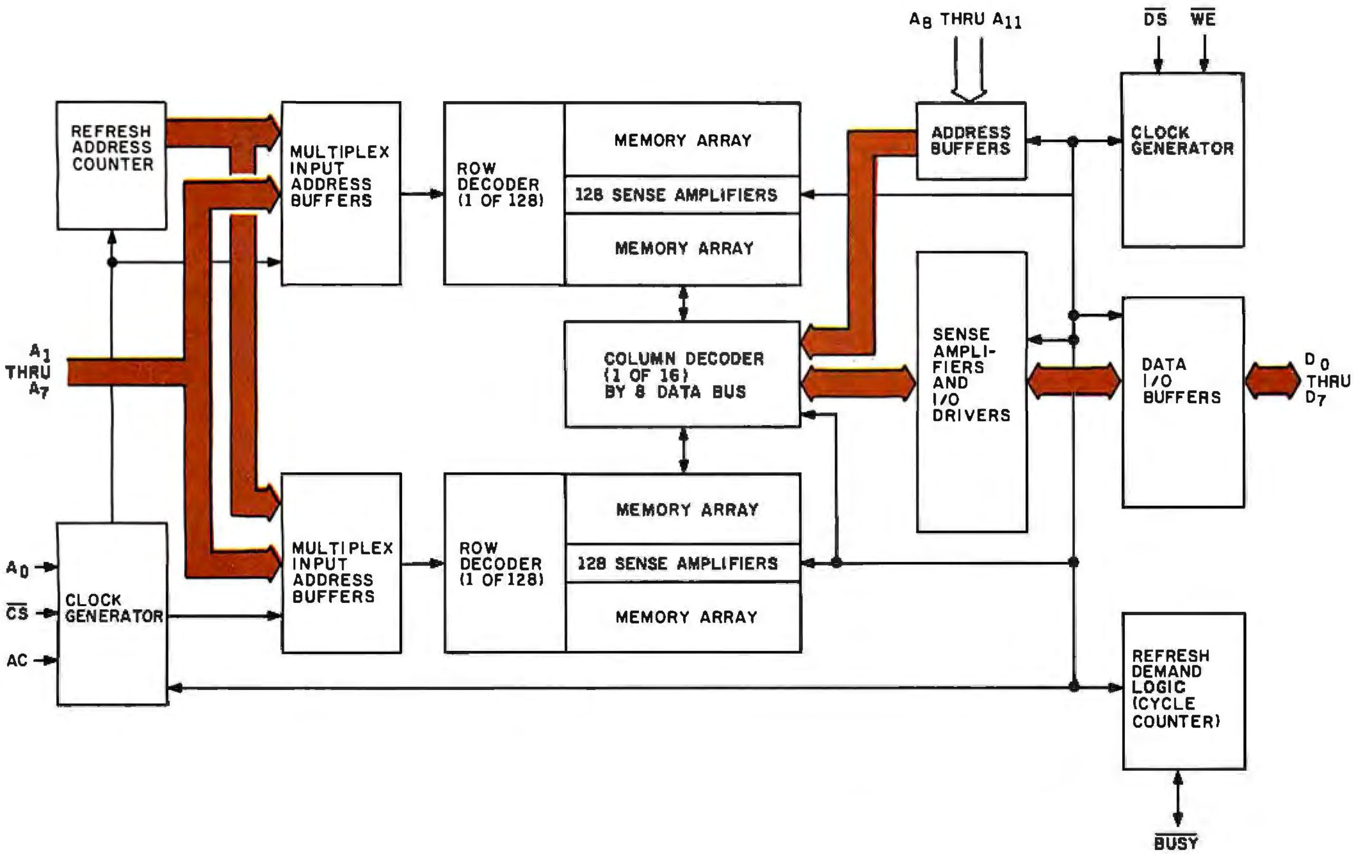


Figure 4: *Block diagram of the Zilog Z6132 Quasi-Static Memory component. This innovative part stores 32 K bits in the form of 4 K bytes, using single-transistor dynamic random-access bit-storage cells, but all refresh operations are controlled internally. The memory-refresh operation is completely invisible to the user and the other components in the system. The Z6132 draws about 30 milliamps from a single +5 V power supply.*

(With the simple address selection employed in this circuit, the data-rate switches will be read by an access to any location in the range hexadecimal C000 thru FFFF. This should not unduly restrict the versatility of the system in the type of application for which it was designed.)

BASIC/Debug Monitor

I'll go into the features of the tiny-BASIC interpreter in greater detail next month, but I'm sure you are curious about the capabilities present in a 2 K-byte BASIC system.

Essentially an integer-math dialect of BASIC, Zilog's BASIC/Debug software is specifically designed for process control. It allows examination and modification of any memory location, I/O port, or register. The interpreter processes data in both decimal and hexadecimal radices and accesses machine-language code as either a subroutine or a user-defined function.

BASIC/Debug recognizes sixteen keywords: GOTO, GO@, USR, GOSUB, IF...THEN, INPUT, IN, LET, LIST, NEW, REM, RUN, RETURN, STOP, PRINT, and PRINT HEX. Standard syntax and mathematical operators are used.

The Z8 board is not my idea of what should be available; it is available now.

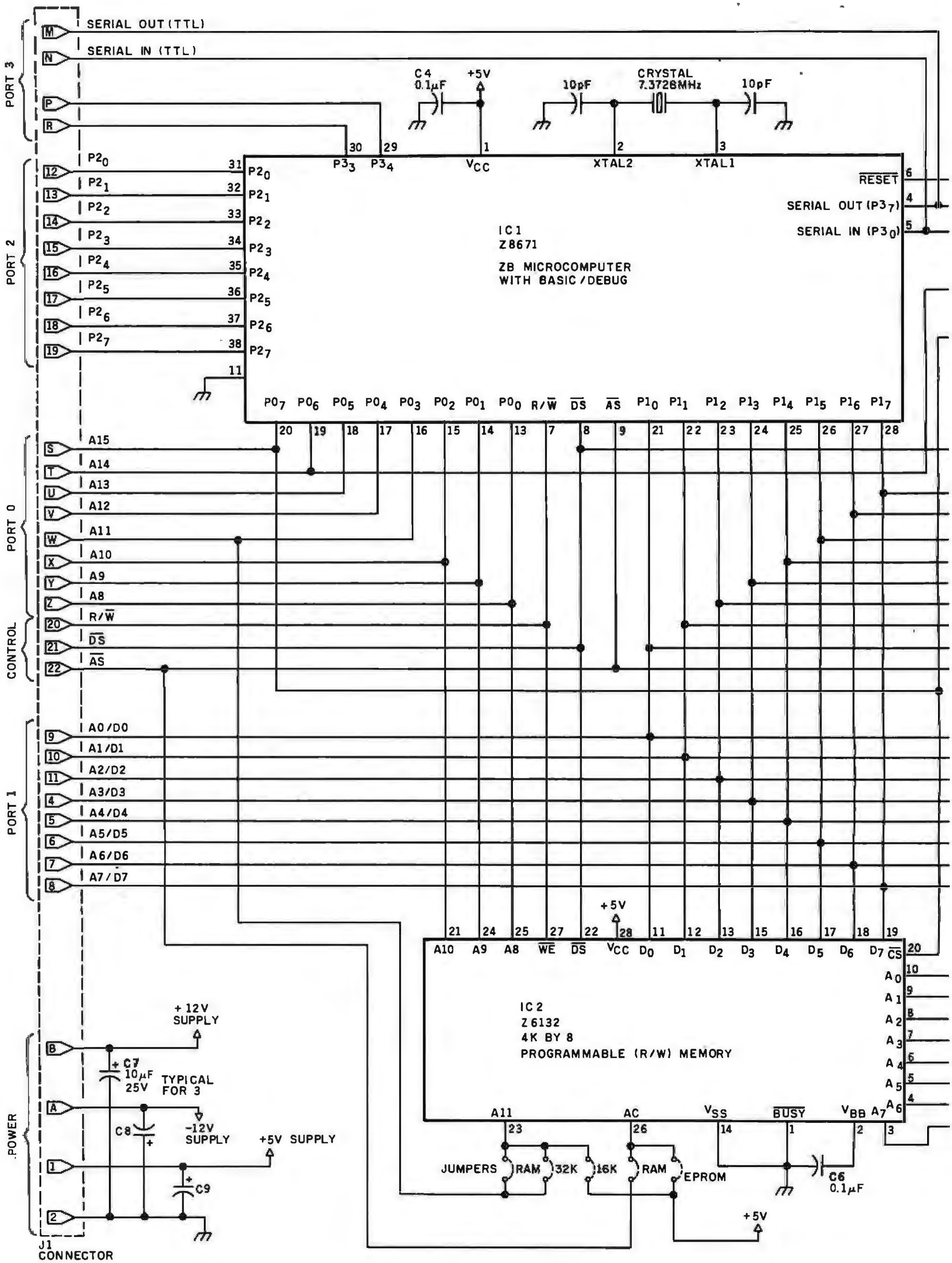
Twenty-six numeric variables, designated by the letters A thru Z, are supported. Variables can be used to designate program line numbers. For example, GOSUB B*100 and GOTO A*B*C are valid expressions.

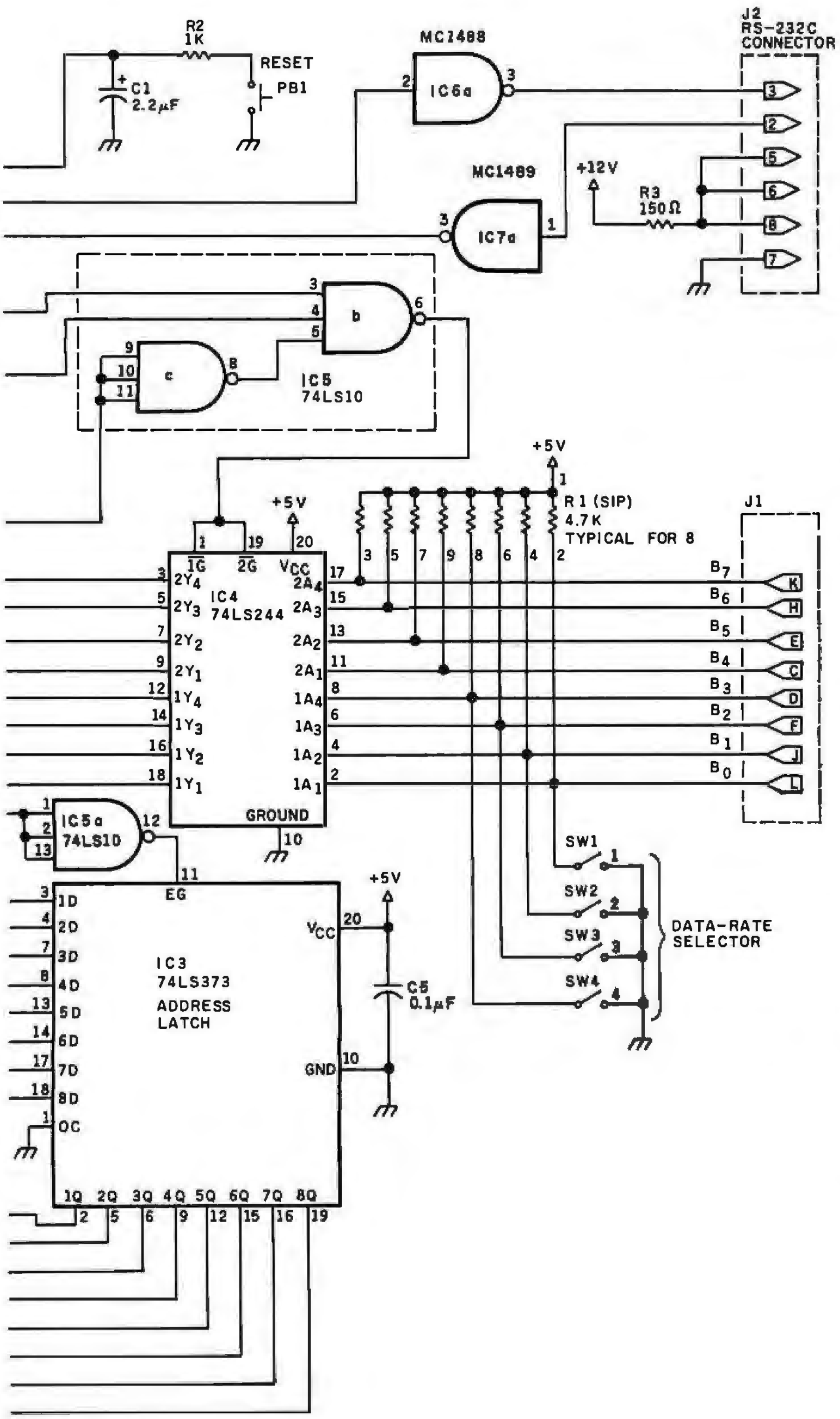
In my opinion, the 2 K-byte interpreter is extremely powerful. Because it operates easily on register and memory locations, arrays and blocks of data can be easily manipulated.

(Full appreciation of the Z8-BASIC Microcomputer comes after a complete review of the operating manuals and a little experience. Documentation approximately 200 pages long is supplied with the unit; the documentation is also available separately.)

In Conclusion

It's easy to get spoiled using a large computer as a simple control device. I have heard of many inexpensive interfaces that, when attached to any computer, supposedly perform control and monitoring miracles. Frequently overlooked, however, is the fact that implementation of these interfaces often requires the software-development tools and hardware-interfacing facilities of relatively large systems. The Z8-BASIC Microcomputer, with its interpretive language, virtually eliminates the need for costly development systems with memory-consuming text editors, assemblers, and debugging programs.


SERIAL OUT (TTL)
SERIAL IN (TTL)
PORT 3
C4
0.1µF
+5V
10pF
CRYSTAL
7.3728MHz
10pF
VCC
XTAL2
XTAL1
RESET
SERIAL OUT (P37)
SERIAL IN (P30)
PORT 2
IC1
Z8671
Z8 MICROCOMPUTER
WITH BASIC/DEBUG
PORT 0
A15
A14
A13
A12
A11
A10
A9
A8
R/W
DS
AS
CONTROL
PORT 1
A0/D0
A1/D1
A2/D2
A3/D3
A4/D4
A5/D5
A6/D6
A7/D7
+5V
IC2
Z6132
4K BY 8
PROGRAMMABLE (R/W) MEMORY
+12V
SUPPLY
C7
10µF
25V
TYPICAL
FOR 3
C8
-12V
SUPPLY
+5V SUPPLY
C9
POWER
JUMPERS
RAM
32K
16K
RAM
EPROM
BUSY
C6
0.1µF
J1
CONNECTOR



Number	Type	+5 V	GND	−12 V	+12 V
IC1	Z8671	1	11		
IC2	Z6132	28	14		
IC3	74LS373	20	10		
IC4	74LS244	20	10		
IC5	74LS10	14	7		
IC6	MC1488		7	14	1
IC7	MC1489	14	7		

If you need a proportional motor-speed control for your solar-heating system, you don't have to dedicate your Apple II or shut off your heating system when you balance your checkbook. From now on, there is a small, cost-effective microcomputer specifically designed for such applications. The Z8 board described in this article is not my idea of what *should be* available; it *is* available now.

Next Month:

I will elaborate on interfacing and applications for the Z8-BASIC Microcomputer. ■

Acknowledgment

Special thanks to Steve Walters and Peter Brown of Zilog Inc for help in production of this article.

Editor's Note: *Steve often refers to previous Circuit Cellar articles as reference material for the articles he presents each month. These articles are available in reprint books from BYTE Books, 70 Main St, Peterborough NH 03458.* Ciarcia's Circuit Cellar *covers articles appearing in BYTE from September 1977 thru November 1978.* Ciarcia's Circuit Cellar, Volume II *presents articles from December 1978 thru June 1980.*

Figure 5: *Schematic diagram of the Circuit Cellar Z8-BASIC Microcomputer. Five jumper connections are provided so different memory devices can be used. For general-purpose use and program development, the 4 K-byte Z6132 read/write memory device will be used; for dedicated applications, two kinds of EPROMs can be substituted in the same integrated-circuit socket. Standard 450 ns type-2716 or type-2732 EPROM chips can be used. The connection labeled "32 K" should be closed if a type-2732 EPROM is installed; the connection labeled "16 K" should be closed for use of a type-2716 EPROM.*

The pull-up resistors adjacent to IC4 (the 74LS244 buffer) are contained in a SIP (single-inline package).

Harvesting the Sun's Energy

George E Mobus
3984 60th St #30
San Diego CA 92115

As the cost of fuel continues to skyrocket, more people are looking toward the sun to meet their energy needs. The potential use of solar energy for both heating and electric power generation is tremendous. By some estimates, energy from the sun could account for more than one-third of the nation's total energy needs by the year 2000. There are even more optimistic estimates that are based on technological "breakthroughs" such as the much-publicized solar space station. If solar energy can be "harvested" in outer space by a station in geosynchronous orbit, it can be beamed down to the earth's surface as low-power microwaves. In such a scenario, as much as 80% of our energy may come from the sun.

No doubt such highly developed systems for exploiting this vast, nondepletable energy source will come into play as the economics of energy production make solar-conversion technology more competitive with conventional, nonrenewable forms of fuel such as oil, gas, and coal.

The Collector

For most of us, however, the immediate use of solar energy will be to heat our homes and hot water. Already the technology exists for the conversion of sunlight into thermal energy at convenient temperatures and affordable costs compared to the fossil fuel alternative. The solar-energy collector most commonly used involves a thin plate of metal (usually copper, stainless steel, or, sometimes, aluminum) sealed behind a glass panel. A working medium (water, air, or antifreeze) passes behind it to carry away the heat. The plate is coated with a black, light-absorbing substance such as flat black engine paint. The *flatplate* collectors are connected in parallel by some appropriate ducting or tubing, mounted facing, generally, in a southerly direction. The fluid is circulated through the collectors and then to a storage device, usually a bed of pebbles for air systems or a tank of water for water-based systems. The heat contained in the storage devices is removed and circulated to the point of use by a thermostatically controlled recovery system.

As the engineering details of systems designs are becoming better understood, the technology is gaining wider acceptance. In areas with very high fuel costs, such as the Northeast and Midwest, the price of the hardware may, indeed, be a worthwhile investment. Solar collector panels are showing up now on rooftops all over the country. The best and most efficient collectors, however, are still far from inexpensive.

Orientation

It is very important that the collector be properly oriented in order to maximize the heat gain during the peak of the heating season. Unfortunately, every location has varying constraints such as the position of the house, sun availability, and heating-load periods. All of these must be taken into consideration when designing the system. Detailed information on the timing and amount of solar energy available for a specific location is required when designing a collector. Since the design process involves trade-offs, it would be helpful to be able to predict the gains and losses of alternative strategies, particularly when it comes to the placement of the solar collector array. The governing factor in orienting collectors is that the actual light that can be absorbed falls off as the cosine of the angle of incidence increases between the light beam and the collector surface. When the beam of light is exactly normal (perpendicular) to this surface, as it would be when the collectors face the sun directly, the cosine of the angle (zero degrees) is 1.0 and all of the light is available for conversion into heat. At angles more than zero degrees, the available light falls off, slowly at first, then more rapidly as the angle of incidence increases. It can be seen from this that the proper orientation of the collectors (ie: the tilt angle with respect to the horizontal and the azimuth angle with respect to due south) is extremely important. Of course, there are many important design criteria in addition to collector placement and orientation that will affect the overall performance of the system. However, how and where the collectors are placed are the most important factors contributing to the success of the system.

The program described in listing 1 was developed to assess various placement strategies. It is one of a series of programs that can help a designer make the best use of the sun's energy. In fact, this program uses a simulation model of the theoretical maximum amount of collimated (ie: direct) sunlight striking a tilted flat surface facing southward. The units of output are in Btus (British thermal units) per square foot per solar hour. A solar hour is actually an arc of 15° thru which the sun moves across the sky (360°/24 hours = 15°/hour). This will not always correspond precisely to the local time. The variance, however, will not cause significant errors in the calculations.

A table of values is printed for each

Text continued on page 52

Listing 1: *Computer model that will calculate the daily solar flux on a flatplate solar-energy collector given the collector's latitude north or south, the tilt angle with respect to the ground, and azimuth angle with respect to true south. Written in BASIC-11 for use on a DEC PDP-11/V03 microcomputer, this program can be easily adapted to other versions of BASIC.*

```
SOLRA2                MU BASIC/RT-11 V01-01C

1 REM  ************ PROGRAM TO COMPUTE AND PRINT ***********
2 REM  ************   THE DAILY SOLAR FLUX ON A   ***********
3 REM  ************      FLAT PLATE COLLECTOR     ***********
5 Z=SYS(6,81)
10 RESTORE
20 PRINT CHR$(26);
30 DIM I(11) \ F=PI/180
40 PRINT ,"TABLE OF BEAM RADIATION"
50 PRINT ,"    SOLAR ENERGY"
60 PRINT  \ PRINT
70 PRINT "ENTER DATA IN DECIMAL VALUES AS REQUESTED."
80 PRINT  \ PRINT "LATITUDE"; \ INPUT L \ L=L*F
90 PRINT  \ PRINT "TILT ANGLE"; \ INPUT T \ T=T*F
100 PRINT  \ PRINT "AZIMUTH ANGLE"; \ INPUT A \ A=A*F
110 PRINT CHR$(26);TAB(28);"TABLE OF SOLAR RADIATION"
120 PRINT TAB(24)"BTU'S/SQ.FT.*HR. ON A FLAT SURFACE"
130 PRINT  \ PRINT "DAY";TAB(33);"SOLAR HOUR"
140 PRINT "OF";TAB(20);"AM";TAB(36);"NOON";TAB(56);"PM";TAB(74);"DAILY"
150 PRINT "YEAR";TAB(7);"7";TAB(13);"8";TAB(19);"9";TAB(25);"10";TAB(31)
;"11";
160 PRINT TAB(37);"12";TAB(43);"1";TAB(49);"2";TAB(55);"3";TAB(61);"4";T
AB(67);"5";TAB(74);"TOTAL"
165 FOR I=1 TO 79 \ PRINT "="; \ NEXT I \ PRINT "="
170 FOR Q=1 TO 12
180 READ N \ D$=STR$(Q)+"/21" \ H=75 \ P=0
190 FOR B=1 TO 11
200 H1=H*F \ GOSUB 500 \ I(B)=I \ H=H-15 \ P=P+I(B)
210 NEXT B
220 B=6
230 PRINT D$; \ FOR Z=1 TO 11 \ PRINT TAB(Z*B);I(Z); \ NEXT Z \ PRINT TA
B(74);P
260 NEXT Q
270 PRINT "END OF RUN" \ GO TO 1000
500 REM ****** SUBROUTINE TO COMPUTE **********
510 REM **** SOLAR INCIDENCE PER HOUR *********
520 I=429*(1+(.034*COS(360*N/365*F)))
530 D=23.45*SIN(360*(284+N)/365*F) \ D=D*F
540 S=SIN(L)*SIN(D)+(COS(L)*COS(D)*COS(H1))
550 M=SQR(1229+(614*S)^2)-(614*S)
560 IF M>94.976 THEN E1=0 \ GO TO 580
570 E1=EXP(-.65*M)
580 E2=EXP(-.095*M)
590 I=I*.56*(E1+E2)
600 C=SIN(D)*(SIN(L)*COS(T)-(COS(L)*SIN(T)*COS(A)))
610 C=C+COS(D)*COS(H1)*(COS(L)*COS(T)+(SIN(L)*SIN(T)*COS(A)))
620 C=C+COS(D)*SIN(T)*SIN(A)*SIN(H1)
630 I=I*C \ R=INT(I) \ O=I-R
640 IF O>.5 THEN I=R+1 \ GO TO 660
650 I=R
660 IF I<0 THEN I=0
670 RETURN
800 DATA 21,52,80,111,141,172,202,233,264,294,325,355
1000 END
```

IT WAS INEVITABLE

Sooner or later, someone had to take all this proven microcomputer hardware and software technology and wrap it up in a portable package at a price that shocks the industry. Adam Osborne decided to do it sooner.

The OSBORNE 1®, from Osborne Computer Corporation. You get full CP/M® disk computer capabilities— Z80A® CPU, 64K bytes of RAM memory, a full business keyboard, a built-in monitor, and two floppy drives with 100K bytes each of storage. You get two interfaces, the IEEE 488 and the RS-232C. Just connect a printer, via either interface.

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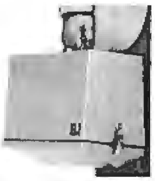

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Text continued from page 48:
daytime solar hour (7 am to 5 pm) when the light intensity is high enough to be collectible. Representative days for each month are used to print out an hour-by-hour averaged value. The daily amount is totaled and printed in the rightmost column. This allows the comparison of the expected variance between months.

Modeling a System

The program was written in BASIC-11, the DEC (Digital Equipment Corporation) implementation of BASIC. This particular version is running under the RT-11 operating system on a PDP-11/V03 microcomputer. DEC's BASIC is general enough so that you should have little difficulty adapting the program to your own computer's particular dialect. The SYS(n,n) command in line 5 is used to set the print buffer to 81 characters (normal default is 72). CHR$(26), which appears in lines 20 and 110, is the ASCII (American Standard Code for Information Interchange) code for *clear screen* to the ADM-3A terminal that I used. You will want to replace this code with the equivalent control code for your terminal.

All of the numbers in the DATA statement are the sequentially numbered days of the year for the 21st day of each month (January 1 = day 1). The program RUN samples were done on a DECWRITER terminal. If your system has an addressable printer, you may want to include provisions for an LPRINT type option. And for those hardy souls who might want to convert the program to another language, I've included the mathematical equations in table 1. The model was derived from work presented by Kreith and Kreider in *Principles of Solar Engineering* (McGraw-Hill, New York, 1978).

Three major features in the placement of collectors (in addition to making sure they aren't shaded) affect the amount of solar energy available for conversion. Two of these—the tilt angle (T) and the azimuth angle (A)—are controllable in the design (see figure 1). The third, latitude (L), simply depends on where you live.

An easy way to find your latitude is to call the nearest airport. They can tell you precisely where *they* are, which is close enough for this calculation. Tilt angle is measured relative to the horizontal. An upright wall has a tilt angle of 90°. The azimuth angle is measured with respect to true (not compass) south, with degrees east given positive signs and degrees west of south given negative signs by convention.

In addition to the above controllable factors, there are several more that contribute to the determination of the intensity of sunlight on a collector surface. Hourly varia-

1. Solar incidence outside the earth's atmosphere (the solar constant) — I_o
   $I_o = 429(1 + .034\cos(360N/365))$ where N = day number
2. Solar declination — D
   $D = 23.45\sin(360(284+N)/365)$ N as above
3. Mass of air along the path of light — M
   $M = (1229+(614 \sin\alpha)^2)^{1/2} - 614\sin\alpha$ where $\sin\alpha$(solar altitude) $= \sin L \sin D + \cos L \cos D \cos H$ where L = latitude, D as above, and H = solar hour angle
4. Solar incidence attenuated by the air mass — I_s
   $I_s = I_o \times 0.56(e^{-.65M} + e^{-.095M})$ where e = base of natural logarithm
5. Solar power on a tilted surface — I_p
   $I_p = I_s \cos i$ where i = angle of incidence
   where $\cos i = \sin D \sin L \cos T - \cos L \sin T \cos A$
   $+ \cos D \cos H \cos L \cos T$
   $+ \sin L \sin T \cos A$
   $+ \cos D \sin T \sin A \sin H$
   where T = tilt angle and A = azimuth (true south = 0)

Table 1: *These equations form the basis of the calculations performed in the author's computer model.*

tions are due, in part, to the distance of the light path through the atmosphere. The path is longer in the early morning and late afternoon, which is why we can watch sunsets and sunrises without burning our eyeballs. Even more important, however, is the fact that the amount of light reflected back from the flat surface increases as the angle of incidence increases. This results in the cosine factor mentioned previously. This fact has prompted some designers to develop special mounting systems for tracking the sun across the sky, thus keeping the collector surface always pointing directly toward the sun. While this will increase the solar power considerably, it also increases cost and mechanical complexity. These increased expenses must be considered carefully for home heating applications.

Monthly variation in daily totals is due to several factors. First, though of lesser importance, is the fact that the earth's orbit around the sun is elliptical; hence, the sun is farther away when the planet is at its apogee. But the major factor is the tilt of the planet with respect to the plane of its orbit. Viewed from the planet's surface, this is perceived as the difference in the sun's altitude between June 21 and December 21, the summer and winter solstices. The sun is lower in the winter sky and, since this is the heating season, the typical design strategy calls for tilting the collector array so that the beam radiation at solar noon on the coldest days of the year (usually January) is almost perpendicular to the surface of the collectors—if the array is used for space heating. If the system is to provide domestic hot water, the collectors must be tilted to split the difference between the two seasons.

The Weather

Finally, there is the age-old variable that can't be predicted, but that has a major impact on the light availability — the weather. The table of hourly radiation produced by this program cannot provide a prediction of how the local cloud cover will attenuate the sunshine. However, if the monthly cloud-cover factors for your area have been tracked for the past twenty years or so, then they can be used to modify the data in the table. The table provides the theoretical "clear day" values. The daily totals for the month can be multiplied by the percent of cloud cover averaged over the past years for that month and by the number of days in the month to get a fair picture of the probable light availability. (As it turns out, the values predicted by this model for clear-day radiation have been verified by empirical methods to within a very small deviation.)

Application

The model has several uses in designing a solar collector. Primarily, you will want to know how much sunlight your area could produce. Suppose your house is oriented such that the section of roof on which you want to mount the collectors faces

Text continued on page 58

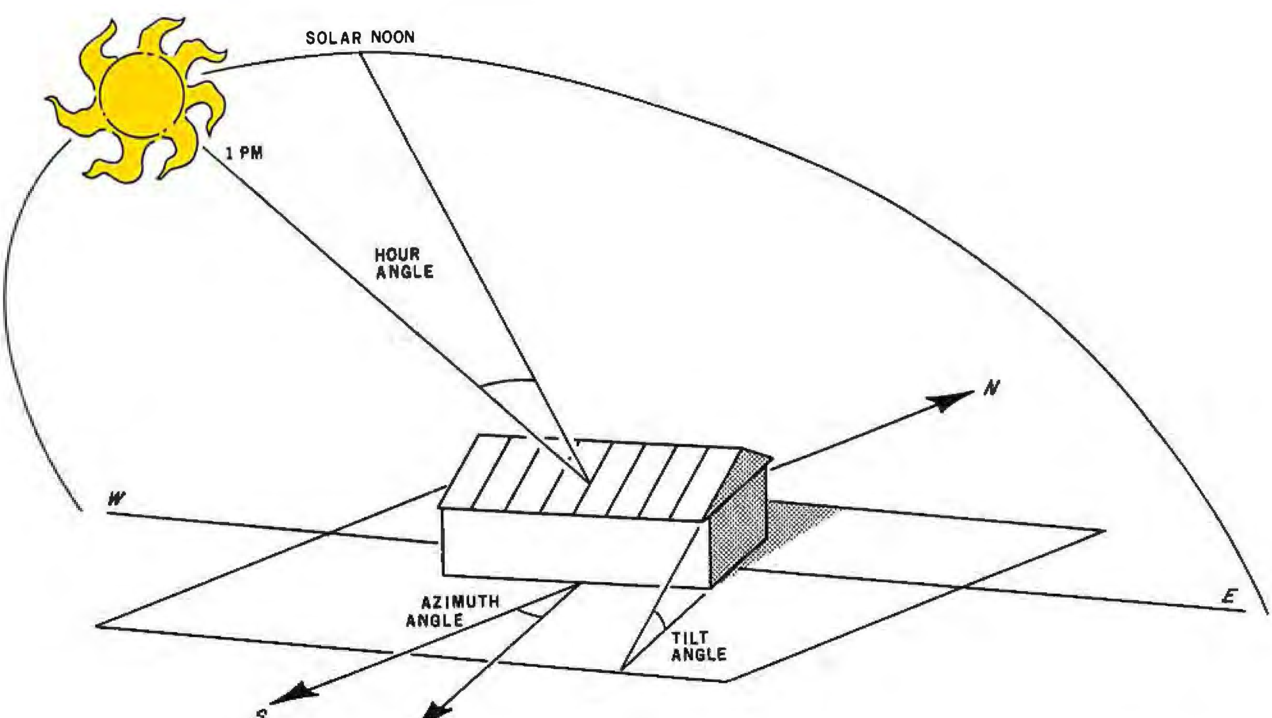

Figure 1: *Diagram of the various solar angles used in calculating the total beam energy striking a roof-mounted solar collector.*

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Listing 2: *Sample data obtained by running the program in listing 1. It shows the solar energy that would strike a collector mounted directly on the author's roof. In this case, the roof and the collector have an azimuth of 10°, a tilt with respect to the ground of 18°, and a latitude of 32.5° north. The energy, given in Btus per square foot per hour, is calculated for each daylight hour on the the 21st of each month.*

```
RUN

SOLRA2   13-OCT-80   MU BASIC/RT-11 V01-01C

                   TABLE OF BEAM RADIATION
                       SOLAR ENERGY


ENTER DATA IN DECIMAL VALUES AS REQUESTED.

LATITUDE? 32.5

TILT ANGLE? 18

AZIMUTH ANGLE? 10
                         TABLE OF SOLAR RADIATION
                     BTU'S/SQ.FT.*HR. ON A FLAT SURFACE
```

DAY OF YEAR	7	8	AM 9	10	11	SOLAR HOUR NOON 12	1	2	PM 3	4	5	DAILY TOTAL
1/21	5	70	140	197	233	243	226	184	123	55	2	1478
2/21	27	99	174	235	273	283	264	220	155	80	16	1826
3/21	51	129	206	268	306	316	297	251	184	106	33	2147
4/21	72	152	227	286	323	332	314	270	205	127	51	2359
5/21	85	161	232	288	322	331	313	272	211	137	62	2414
6/21	88	163	232	286	318	327	310	270	211	139	66	2410
7/21	84	160	231	286	320	329	311	270	209	136	62	2398
8/21	72	150	225	284	319	329	311	267	203	126	51	2337
9/21	50	128	204	265	303	312	294	249	183	105	33	2126
10/21	25	97	171	231	268	278	260	216	151	78	15	1790
11/21	4	69	137	195	231	240	223	181	121	54	2	1457
12/21	1	58	125	181	216	226	209	168	109	45	0	1338

```
END OF RUN

READY
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Listing 3: *In this sample, the collector on the author's roof has been optimally mounted so that it faces directly south (zero azimuth) and is tilted at a more optimum angle (47.5°). Note that the solar energy striking the collector has increased about 27%.*

```
RUN

SOLRA2   13-OCT-80   MU BASIC/RT-11 V01-01C

                    TABLE OF BEAM RADIATION
                        SOLAR ENERGY


ENTER DATA IN DECIMAL VALUES AS REQUESTED.

LATITUDE? 32.5

TILT ANGLE? 47.5

AZIMUTH ANGLE? 0
                              TABLE OF SOLAR RADIATION
                         BTU'S/SQ.FT.*HR. ON A FLAT SURFACE
```

DAY OF YEAR	7	8	AM 9	10	11	SOLAR HOUR NOON 12	1	2	PM 3	4	5	DAILY TOTAL
1/21	8	93	173	239	281	296	281	239	173	93	8	1884
2/21	32	111	191	257	300	314	300	257	191	111	32	2096
3/21	42	118	196	261	303	317	303	261	196	118	42	2157
4/21	40	112	185	245	284	298	284	245	185	112	40	2030
5/21	33	100	168	223	260	272	260	223	168	100	33	1840
6/21	29	94	159	213	247	259	247	213	159	94	29	1743
7/21	33	99	166	221	257	269	257	221	166	99	33	1821
8/21	40	111	183	242	281	294	281	242	183	111	40	2008
9/21	42	117	194	258	299	313	299	258	194	117	42	2133
10/21	31	109	188	254	296	311	296	254	188	109	31	2067
11/21	7	92	171	237	279	293	279	237	171	92	7	1865
12/21	1	83	163	228	270	284	270	228	163	83	1	1774

```
END OF RUN

READY
```

Text continued from page 54:

10° east of due south. Furthermore, you would like to mount the collectors flush on the roof, to keep a low profile. Let's say the roof has an 18° tilt. If you should happen to live in San Diego, as I do, your latitude is approximately 32.5° (use decimal values for all minutes of arc). By plugging these values into the keyboard when requested, you should get an output such as listing 2.

If you can determine how much heat you need to keep warm during January, by doing heat-load calculations on your home, then you can estimate how much collector surface area you'll need. Incidentally, don't forget a factor for thermal efficiency. In many states, each collector manufacturer is required to state a standardized rating for its product. This factor modifies considerably the performance of the collectors in absorbing the available sunlight.

Now, if you want to determine how much more light you might get with a more "ideal" orientation, try plugging in some alternatives. One rule of thumb for the optimal tilt angle is to add 15° to the latitude—so let's try a tilt angle of 47.5° (32.5 + 15 = 47.5). Due south is 0° azimuth. And, of course, you can't change the latitude unless you move your house, so that remains 32.5°. The resulting output is shown in listing 3. Notice the difference in the values for January between the two mounting strategies. You've gained a whopping 406 Btus per square foot for the day; that's approximately a 27% increase. Now, you have to decide if it's worth forgoing the low profile to gain that much more heat. For one thing, it means you will be able to reduce the amount of collector surface by 27%. Since the collectors are the single largest cost factor in a typical installation, it might be worth it!

Play around with the model to generate various schemes. If nothing else, you can give your friends their very own, personalized printout of the solar energy they could be enjoying.

A final word of caution about this model. As with any model, simplifying assumptions have been made. The numbers represent theoretical maximums only and can in no way predict the actual performance of a particular solar system installation, so they must be interpreted with care. Use the program for comparing strategies. Who knows, it may help you find a way to beat the escalating cost of energy, or at the very least, you can snub your nose at OPEC! ■

System Review

Mountain Computer's MusicSystem

Robin B Moore, Warner Hill Rd, RFD 5, Derry NH 03038

You've probably heard them at computer shows or in the local computer store—the music synthesizer peripherals that, along with your Apple II computer, can help you "compose," "turn your Apple into a family music center," or offer "flash and crash sound effects." Six or seven music synthesizers are already available for the Apple II, and in this article we'll examine the most significant new entry into the marketplace—the Mountain Computer MusicSystem—and see how it compares with the competition.

Mountain Computer (formerly Mountain Hardware) is a well-known manufacturer of high-quality Apple peripheral products that have been well received by the Apple-user community. Mountain Computer's products have never been cheap, and the MusicSystem is no exception. At $545 it is one of the more expensive music synthesizers available for the Apple II, and yet, when its capabilities are considered, it costs less than some of the lower-priced units. No other Apple synthesizer on the market offers sixteen programmable waveforms, and the most popular "square-wave" unit, the ALF AMS (by ALF Products, of Denver, Colorado) can cost as much as $795 when expanded to its maximum (nine voices).

Unlike many of the less-expensive music boards that are available for the Apple II, the MusicSystem is a true synthesizer in the sense that a Moog or an ARP is a synthesizer. The user can not only specify the frequency and the amplitude envelope for each note, but also the waveform, waveform variation (within certain limits), and frequency variations during each note. This allows for a simulation of real instrument sounds that is impossible to achieve with a fixed-waveform music board.

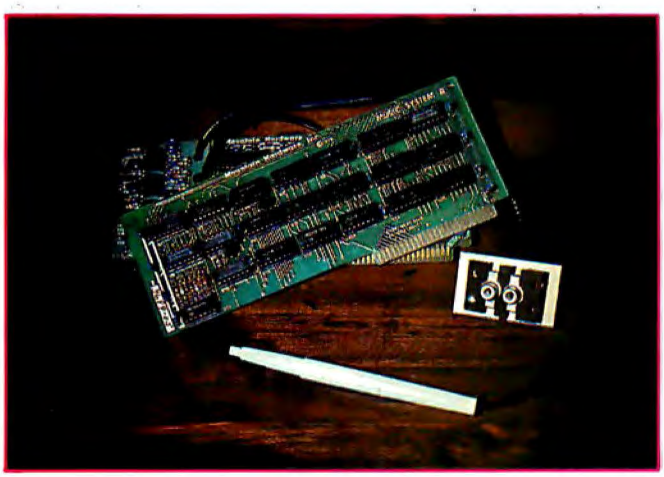

Photo 1: *The MusicSystem circuit boards with light pen and stereo outputs. The boards may occupy any two adjacent expansion slots, except slot 0, in the Apple II.*

The MusicSystem

The MusicSystem is a combined package of hardware and software that allows the user to enter and edit musical scores, to create and edit instrument definitions, and to combine both scores and instruments into PLAY files that produce the final musical output. Some of the pertinent MusicSystem features and specifications are:

- 16 programmable waveform generators (or oscillators)
- 31 KHz sample rate that gives a 13 KHz output frequency bandwidth
- Frequency resolution of 0.5 Hz
- Stereo audio outputs with up to eight waveforms (voices) per output
- Assignment of voices to either right, left, or both stereo speakers
- An integral light pen that is user-accessible for use with other programs
- Music entry and display on Apple high-resolution screen using the light pen, keyboard, or game paddles
- Use of *standard* music notation throughout the music editor portion of the system
- Multiple editing menus in high-resolution graphics to allow use of all the editing features without having to remember commands
- Part-by-part graphic printout of music scores on Apple's Silentype printer (other printers not yet supported)
- User definition of instrument waveforms, amplitude envelopes, and frequency histories
- Polyphony (chords) within a single part or through the use of multiple parts and multiple instruments
- Interrupt-driven software that allows foreground/background mode operation so that two programs can run concurrently
- The capability to merge COMP (composition) files with the Music Merger program so that extra-long scores can be created
- DMA (direct memory access) to waveform tables stored in the Apple's memory

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Many of the features incorporated into the MusicSystem can be found in existing products, but for the price the combination of features and capabilities is unique.

The MusicSystem package consists of two printed-circuit boards, two double-sided disks of software and demonstration files, and a comprehensive manual. The two circuit boards (see photo 1) are interconnected and designed to occupy any two adjacent Apple II expansion slots (except slot 0). The MusicSystem searches for them automatically wherever they are installed. A light pen and the stereo output jacks are preconnected to the boards, and their cables emerge through the slots in the back of the Apple's case.

At a Glance

Name
Mountain Computer MusicSystem

Type
Music composition/synthesis system

Manufacturer
Mountain Computer
300 Harvey West Blvd
Santa Cruz CA 95060
(408) 429-8600

Price
$545

Hardware
Two interconnected PC boards designed to occupy two adjacent expansion I/O slots in the Apple II; includes a light pen and stereo audio outputs suitable for external amplification or headphones with RCA phono plugs

Software
Four disk sides consisting of four main programs, various overlays, and four types of files; demonstration music and some predefined instruments are included

Language
Software is written in a combination of 6502 assembly language and XPLO (a block-structured, Pascal-like language); object code only is included

Software Format
Disks are provided in Apple's DOS 3.2 format; they are not protected, however, and may be converted to DOS 3.3 with Apple's Muffin program

Computer
Apple II or Apple II+ with 48 K bytes of programmable memory and at least one disk drive with Apple's DOS 3.2 or DOS 3.3 operating system

Documentation
Comprehensive manual that describes operations and provides many walk-through examples; additional sections describe installation, background theory, user interface and software file structures

Audience
Any Apple II owner who would like a flexible, high-quality music synthesis system

The Light Pen

At first glance, the most unusual feature of the MusicSystem is the light pen. The light pen is used to make menu selections, either from the main system menus or from the various editor menus. Due to its limited resolution, the pen is not used to enter music; this must be done with either the keyboard or the game paddles. The pen is very effective when used with the Music Editor, for it provides a quick means of selecting items from the various graphic editor menus. Mountain Computer has thoughtfully provided information that describes how to access the pen so that you can experiment and use it with other software.

The light pen is accessed by the software as a single bit in one of the MusicSystem hardware registers. The state of the pen bit simply indicates whether or not the pen is picking up light. The software recognizes use of the light pen by detecting the 60 Hz flicker from the monitor screen. Once the flicker is detected, the program blinks each allowable portion of the screen until the blink is recognized by the pen. (This is the same technique used by some of the very inexpensive light pens that plug into the Apple's game-paddle connector.)

Hardware Flexibility

It takes a while to really appreciate the extreme flexibility inherent in the hardware design. The MusicSystem boards can produce sixteen simultaneous waveforms, each with independent control of amplitude, frequency, and waveshape. A master volume control affects all sixteen waveform generators.

Each waveform is generated from a 256-byte waveform table stored in the Apple's memory. These tables can be created either with the Instrument Definer program or, as shown in the manual, with a user-written program. The MusicSystem boards read values out of the waveform tables by using DMA. When the system is playing music, the tables are accessed by the MusicSystem boards about 500,000 times per second, and so the Apple's 6502 microprocessor is effectively slowed from 1 MHz to 500 KHz (MusicSystem takes half of the available memory cycles). Even though the processor has been slowed down, it can still run normal software, and the speed difference is rarely noticeable. This use of DMA is the key to the MusicSystem's high performance: the technique is not used by any other Apple music synthesizers, although the Casheab synthesizer for the S-100 bus has similar capabilities. (See reference 1.)

Each waveform generator on the MusicSystem boards has software loadable registers that specify amplitude, waveform-table address, and frequency. There are also registers that control overall volume, access the light pen and random-number generator, and enable or disable the DMA and interrupts. Again, Mountain Computer provides all the information necessary to operate the boards with your own programs.

Frequency Histories

One unusual feature of the MusicSystem is the ability to specify note frequency histories. Most synthesizers

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allow you to specify amplitude envelopes, and some allow you to vary the waveform while the note is playing. The MusicSystem provides both of these features and also allows you to specify up to fifteen relative frequency changes *during* each note. This is done as part of the instrument definition process, and the feature may be used to create warble or vibrato, or to simulate tonguing effects. Unfortunately, frequency changes during each note are performed in steps, rather than following a smooth envelope. This makes it impossible to simulate an instrument like a steel guitar that uses long frequency glides. However, short glides can be simulated with a series of close frequency steps—the ear doesn't notice the difference. This limitation is a characteristic of the software, rather than the hardware, and could be improved in the future.

Sound Quality

The MusicSystem sound quality is excellent. Although there is a very slight background hiss—due to the limited signal-to-noise ratio of the 8-bit D/A (digital-to-analog) converters—it is not objectionable.

The system's 13-KHz frequency response is better than most home cassette tape decks, and it is almost as good as an FM receiver. If your record of *Switched-On Bach* has been played more than a few times on an average-quality turntable, it probably doesn't extend beyond 13 KHz either.

The separate individual and overall volume controls provide a wide dynamic range with no evidence of distortion at either high or low volumes.

Human Engineering

Mountain Computer has gone to a good deal of effort to make the MusicSystem as user-oriented as possible by providing detailed prompting, menu-driven operation, and operational feedback.

When an input is required, the choices are almost always spelled out on the screen. If an illegal command is entered, the system doesn't die a horrible death or misinterpret the command—it simply beeps, and usually informs you of your mistake. Any command that could cause loss of data requires a second, confirming command. Throughout the system, commands are kept as simple as possible, while still retaining their meaning. The user is not required to remember commands, for the system generally tells you what the choices are when the time comes to make them.

MusicSystem software is accessed through a series of nested menus (see photo 2) rather than direct commands. From the time the software is loaded, the system functions are controlled by selections from the menus. Each selection results in either a direct action, or it causes another menu to appear if further details are needed. The menus are clearly written and most selections consist of a single keystroke and a carriage return.

Visual feedback in the MusicSystem indicates proper operation and shows the results of your input. If the system is compiling a COMP file, it displays: WAIT

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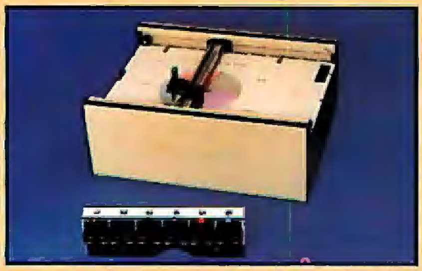

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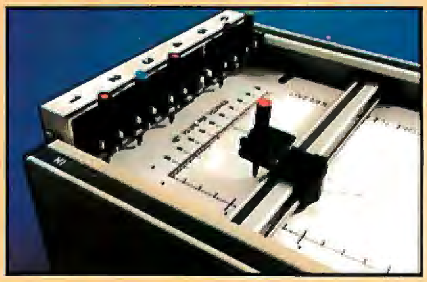

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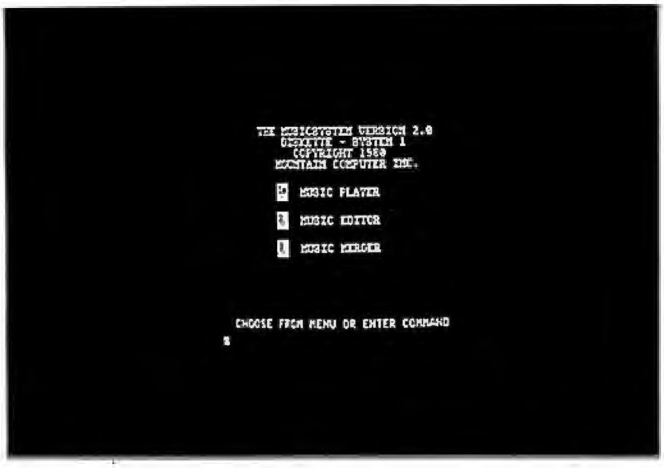

Photo 2: *The System 1 main menu. Selections can be made by touching the light pen to the block at the left of each item. The tiny square in the top block indicates the presence of the game-paddle cursor. If the button on paddle 0 is pressed, the Music Player is selected.*

--COMPILING. If you select a new instrument for a play file, the parameter display changes to show the results of your selection. Messages from the system are clearly spelled out, with no cryptic abbreviations.

The Software

The MusicSystem software is an integrated package of four main programs and four types of files (see figure 1), divided functionally and physically into two separate systems.

System 1 inputs and edits musical scores, and plays music. It includes the Music Editor, Music Merger, and Music Player programs, and comes with several demonstration COMP and PLAY files on the back side of the disk.

System 2 primarily creates waveforms and instruments (although it also includes a copy of the Music Player program). There are a number of predefined instruments and waveforms on the flip side of the System 2 disk.

System 1 and System 2 are tied together with the Music Player program. The Music Player compiles the COMP files produced by the Music Editor and binds in IDEF (instrument definition) files produced by the Instrument Definer, to produce the final PLAY files. Once a PLAY file is complete, it may be played at any time, and the original COMP and IDEF files may be discarded. The Music Player can also be used to alter instrument and speaker assignments in an existing PLAY file.

The System 1 and System 2 disks are received in Apple's DOS 3.2 format, and they are not copy protected. In fact, Mountain Computer recommends that you copy them as soon as possible to avoid inadvertent destruction of the master disks. If you have Apple's DOS 3.3, the MusicSystem software should be converted to sixteen-sector format rather than run in the thirteen-sector mode, because the system reloads from disk before returning to the main menus.

The system software is written in a combination of 6502 assembly language and XPLO (a block-structured Pascal-like language). The source program is not provided, but the manual contains detailed descriptions of all the file formats. All files and programs are in Apple DOS standard format, and may be copied with the DOS 3.3 FID utility or similar programs.

Interrupt Driven

Although the MusicSystem boards can run continuously under DMA once the appropriate registers have been initialized, playing real music requires changes in frequency and amplitude, while maintaining a specified tempo. MusicSystem accomplishes this with a constant-rate interrupt, which serves as a time-base reference for the *play* software. Every 8 ms (milliseconds), the MusicSystem interrupts the Apple's processor, and vectors to a

Text continued on page 70


Month
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160
New Product (P) / Monthly R.O.I. ($000)
NEC
NEC
I/O Unit
PC-8012A
NEC
PC-8001A

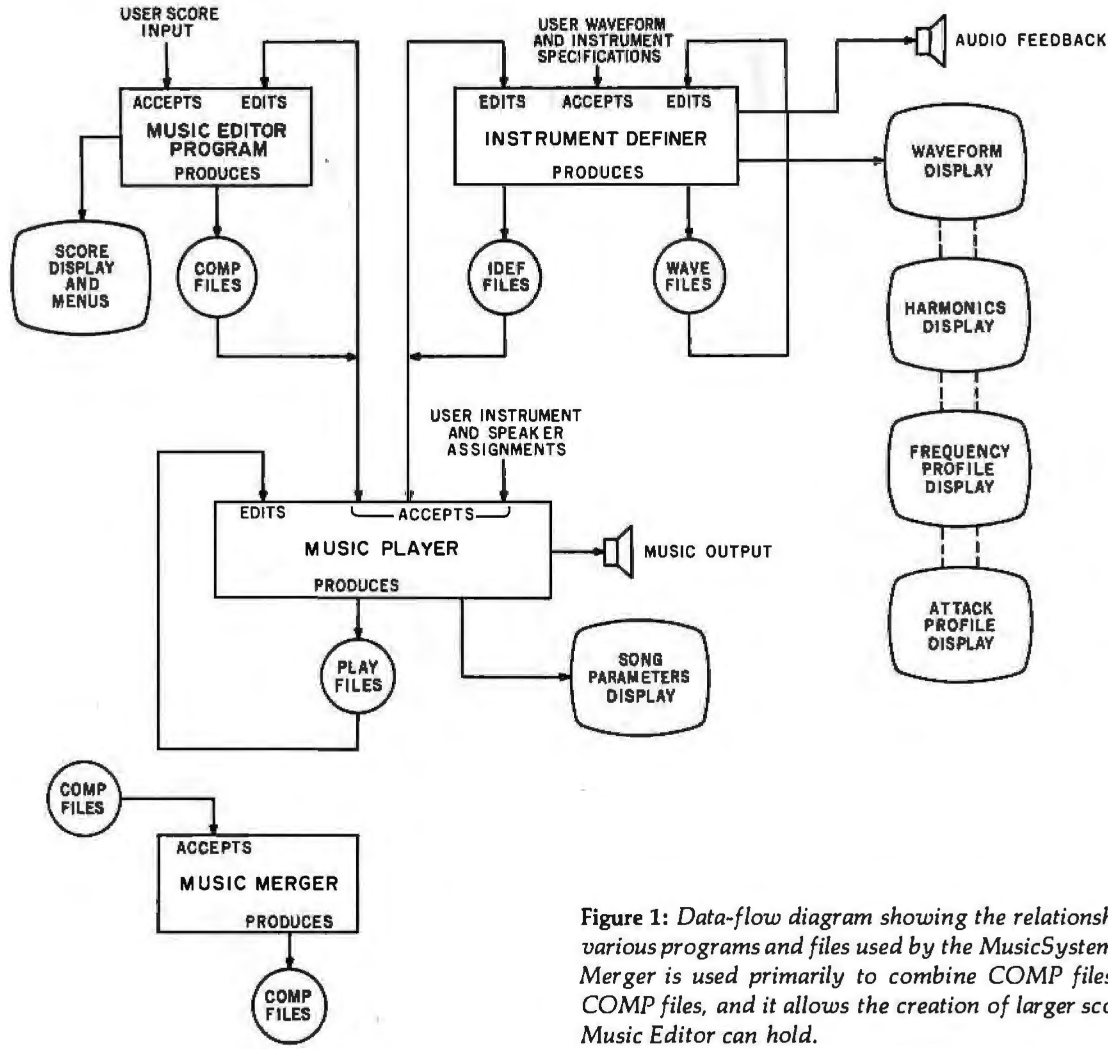

Figure 1: *Data-flow diagram showing the relationships between various programs and files used by the MusicSystem. The Music Merger is used primarily to combine COMP files into larger COMP files, and it allows the creation of larger scores than the Music Editor can hold.*

Text continued from page 66:

series of routines that update the registers in the MusicSystem boards. These routines vary the waveform amplitudes to create note envelopes, and update the frequency registers to change notes. They can also vary the overall volume. Once the updates are complete, execution returns to the program that was interrupted. This technique is called *foreground/background* operation.

Because the play software is interrupt-driven, the entire task of playing a song file can be accomplished during the time another program is running. A good example of this is the Instrument Definer program, in which the MusicSystem continuously plays a short PLAY file to provide audible feedback while the user is creating waveforms and defining instrument characteristics. In this case, the Instrument Definer program runs in the *foreground* while the MusicSystem plays and runs its interrupt routines in the *background*.

There is one main drawback to the use of interrupts (and DMA). The user manual cautions that no other device on the Apple's bus can generate interrupts or use DMA while the MusicSystem is playing. If this happens, both the MusicSystem and the conflicting device fail to work properly. This restriction would probably be encountered only with devices that interrupt continuously (eg: a real-time clock/home-control system combination). In any case, the problem can be avoided by temporarily stopping the conflicting device and then restarting it when you are finished with the MusicSystem.

The Music Editor

The Music Editor program is similar in format to a number of its competitors, but it offers a variety of additional features. The Music Editor divides the screen into two separate functional areas: the upper two thirds of the screen becomes a graphic music display, while the lower portion holds the various editor menus and the status and command lines.

The music display acts as a window on the score in memory. The display can be scrolled right and left through a given part, or up and down from part to part. The display staff formats include the treble, bass, alto, and tenor clefs, as well as the System Clef (ie: the combination of treble and bass clefs used in keyboard sheet music). You can change the clef at any time, and the score will be redisplayed correctly on the new clef. Photo 3 (the Music Editor main menu) shows an example of the system clef.

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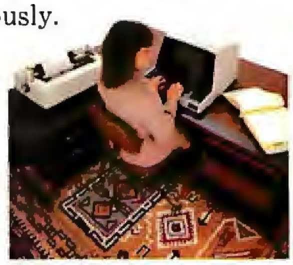

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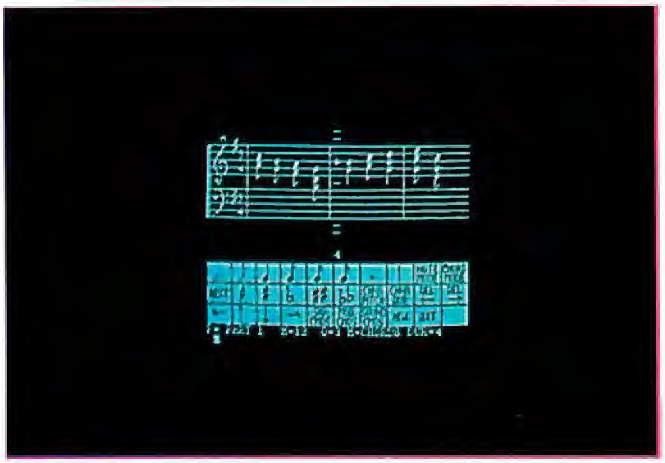

Photo 3: *The Music Editor main menu. In this example, the music cursor is at measure twelve of the song "America," the music staff is the system clef, and the editor is in the CHORD mode. Chords may be entered within a part, or through the use of multiple parts.*

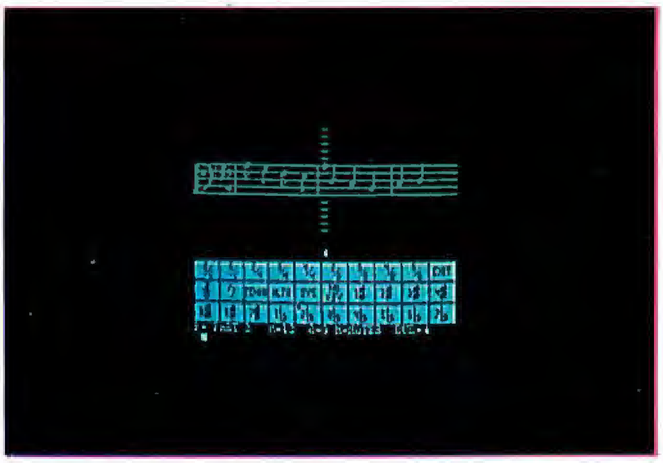

Photo 4: *The Music Editor Signature Commands menu displays part two on the bass clef in NOTES mode. This menu is used to select key, time signature, and clef.*

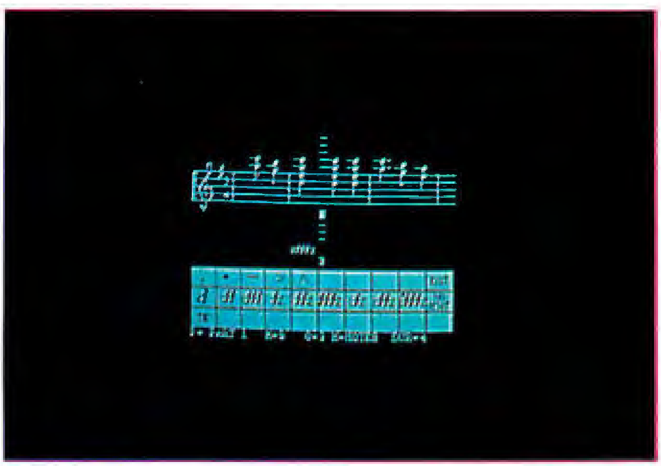

Photo 5: *The Note Modifier menu inserts dynamic or normal accents, and sets or removes ties between notes. The dynamic* sfffz *has just been inserted at the first note in measure nine. In this photo, part one is displayed on the treble clef.*

You can select items from any of the editor's four graphic menus, with either the light pen or with game paddle 1. Most of your time will be spent with the main menu: it is used to select note durations, rests, measure bars, and to handle all editing functions. The other three menus are selected from the main menu, and they all return to it. The commands are also available through the keyboard, and a few operations such as LOAD, SAVE, and PRINT can only be executed by typing the command. The various editor menus are shown in photos 3, 4, 5, and 6.

The Music Editor provides a large selection of accents and dynamics that add life and emphasis to your music. Overall loudness is controlled with the SOUND COMMANDS menu, and individual notes may be accented with the NOTE MODIFIER menu. Unfortunately, note dynamic accents, although provided for in the editor, are not fully functional in the Music Player program: they are played as normal accents. The MusicSystem manual states that this will be corrected in a later version of the software. Two other unimplemented commands are user SYNC (designed to synchronize external devices like a slide projector) and GRAD (specifies gradual volume changes to create crescendos and diminuendos). According to the manual, SYNC will be implemented in a later version. GRAD appears only in the SOUND COMMANDS menu; the manual doesn't mention it at all.

The editor's PRINT command allows you to print out part or all of a score in graphics on the Apple Computer Inc Silentype printer. The score is printed as it is shown on the screen, and may be printed in one of two sizes. Each part is printed separately on its own staff, and the printout can be cut and pasted to form a sort-of-orchestral score. I would have liked to have the ability to print out several parts simultaneously, on one set of staves, as this would have made the printout a more useful piece of sheet music. Other graphics printers, such as Integral Data Systems' Paper Tiger, are not supported in this version of the MusicSystem.

You can enter music in either NOTES or CHORDS mode. In CHORDS mode, the music cursor doesn't advance while you are entering notes of the same duration. Most synthesizers require that you use separate parts to enter chords, but the MusicSystem doesn't have this limitation. Multiple parts are only required to define the music played by *different* instruments.

Notes are placed on the screen with either game paddle 0 or with the keyboard. A small cursor is moved vertically through the staff when paddle 0 is turned, and the note appears when you press the button. You can enter music surprisingly fast through the keyboard. Once the duration and octave are selected, a string of notes may be entered as simply as typing C D E F G A B and pressing RETURN.

I was a little disappointed to find that the editor doesn't provide audio feedback during music entry. However, it

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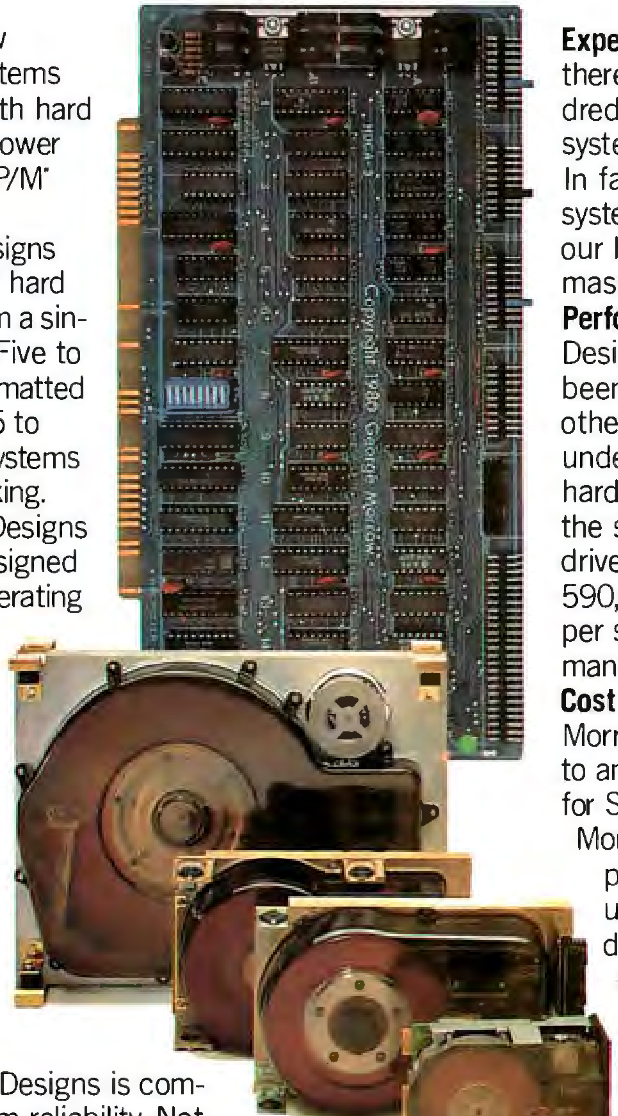

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does sharp and flat notes to match the key signature, so this potential source of errors is removed.

The size of the score that can be handled by the editor is somewhat limited. If you actually entered sixteen separate parts, there would not be room for many measures of music. Fortunately, the Music Merger program can be used to combine COMP files to produce a much larger final result. (There has been talk at Mountain Computer of designing a true "virtual score" capability into the MusicSystem by spooling the score on and off disk as the editor scrolls through it. Whether or not this will be implemented in the next version remains to be seen.)

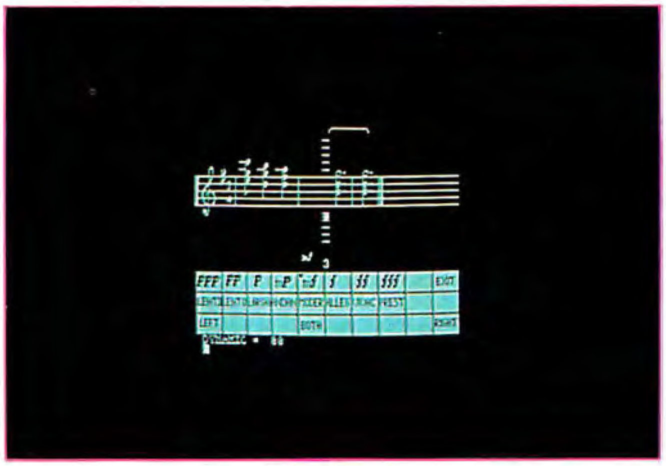

Photo 6: *The Sound Commands menu controls overall loadness, sets tempo, and assigns parts to speakers. Dynamic (loudness) may be specified as either absolute (with the menu) or relative (with the keyboard). The mf dynamic has just been inserted to the left of the music cursor.*

The editing functions provided by the editor are simple and effective. Unless otherwise specified, the editor is always in insert mode. Music events may be inserted at any time and at any place in the score. The editor provides commands to scroll right and left, delete right and left, and change note durations. You can jump to other locations in the score by using the keyboard GOTO command to access specific measures. I found the editor's responses to be a little slower than I liked, but it wasn't objectionable.

The editor has only two real weaknesses: it lacks both triplets and the capability to repeat musical phrases. The former makes it difficult to enter certain pieces of music, and the latter adds time and wastes space when repeated phrases are encountered. There is no reason why you should have to reenter the same section of music when the computer could do it for you. Also, the editor will not automatically place measure bars, but this drawback is not important because both measure bars and time signatures have no effect on the music played.

My overall reaction to the Music Editor is mixed. On the one hand it is an excellent piece of software with many features that are not found in most music editors. On the other hand there are the unimplemented features

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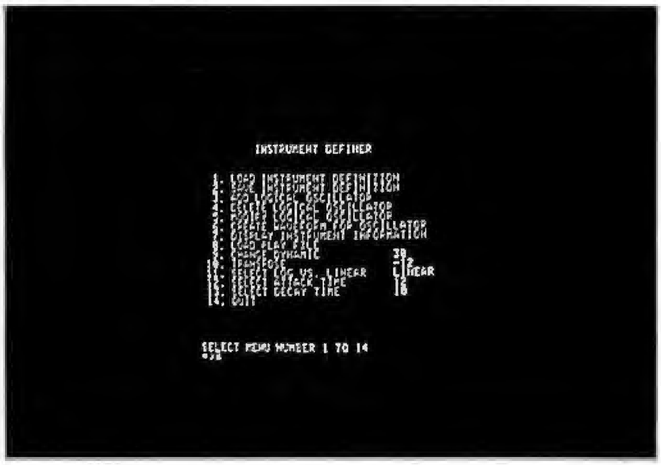

Photo 7: *The Instrument Definer main menu. The audio feedback level has been reduced and the pitch transposed down one octave by setting DYNAMIC to 30 and TRANSPOSE to −12.*

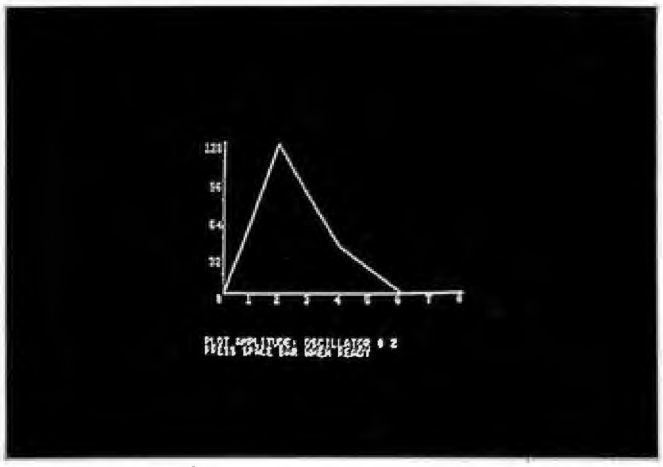

Photo 8: *An example of an Attack Profile plot from the Instrument Definer. The plot shown is for oscillator 2 from the instrument WOODDRUM. This example shows an alternate method of defining envelopes. In this case, the entire envelope is defined during the attack phase, so there is no sustain or release.*

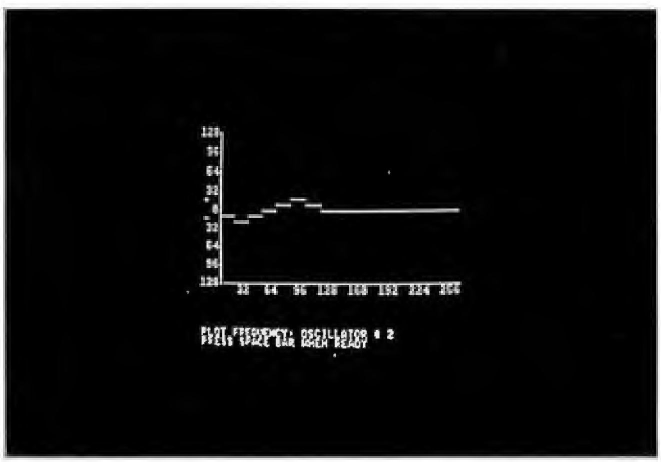

Photo 9: *A sample frequency-history plot. Note that rather than changing smoothly, the frequency changes in steps. In this example the steps are not audible, so it sounds like a smooth change.*

and the omissions previously mentioned. The current version of the software (2.0) is much improved from the original version 1.2. I look forward to the next version, and hope that the few remaining problems will be fixed. In any case, the editor is still very usable, and I enjoyed the time that I spent with it.

The Instrument Definer

The process of creating and playing different instruments is one of the more interesting aspects of the MusicSystem. Here the MusicSystem's unique capabilities clearly separate it from the rest of the synthesizers available for the Apple. Other synthesizers can define instruments, but their capabilities are limited compared with the MusicSystem (see the "Music Making" text box on page 84).

In the MusicSystem, each instrument definition (see figure 2) is composed of one or more logical oscillators, each with a defined waveform, relative amplitude, attack envelope, sustain-decay rate, and frequency profile. (The term "logical oscillator" is used because the actual physical waveform generator will not be chosen until play-time.) In addition, there are several global parameters that affect all of the oscillators used in an instrument definition (see photo 7). You can specify attack and decay times, and whether the amplitude scale should be logarithmic (to match the human ear's response) or linear.

During the instrument definition process (see photos 8 and 9), there is continuous audio feedback, so that you can hear the effect of your changes as you make them. The feedback is normally a C-major scale, but a short PLAY file can be loaded and used instead. The audio level of the feedback may be changed or transposed so that you can hear how your instrument sounds at different pitches. As previously described, the audio feedback runs under interrupts in the *background* while you define instruments and create waveforms with the Instrument Definer in the *foreground*.

A special subprogram of the Instrument Definer, called the Wavemaker, is used to create waveforms through a process called Fourier (or additive) synthesis. Just as *Fourier analysis* breaks down a waveform into its harmonic components, *Fourier synthesis* creates a waveform from a set of harmonic amplitudes. The process is also called additive synthesis because it is done by adding sine waves of various harmonic frequencies and amplitudes to produce the final result (see reference 6).

The Wavemaker allows you to specify the amplitudes of up to twenty-four harmonics, and you can switch to the waveform display to view the wave at any time during the process. The audio feedback responds to the harmonic changes as you make them, so you can literally design your waveform "by ear." The view of the waveform is interesting, but not really important: it is easier to relate the timbre of the sound to the harmonic mix than to the waveshape. Photos 10 and 11 show ex-

Text continued on page 82

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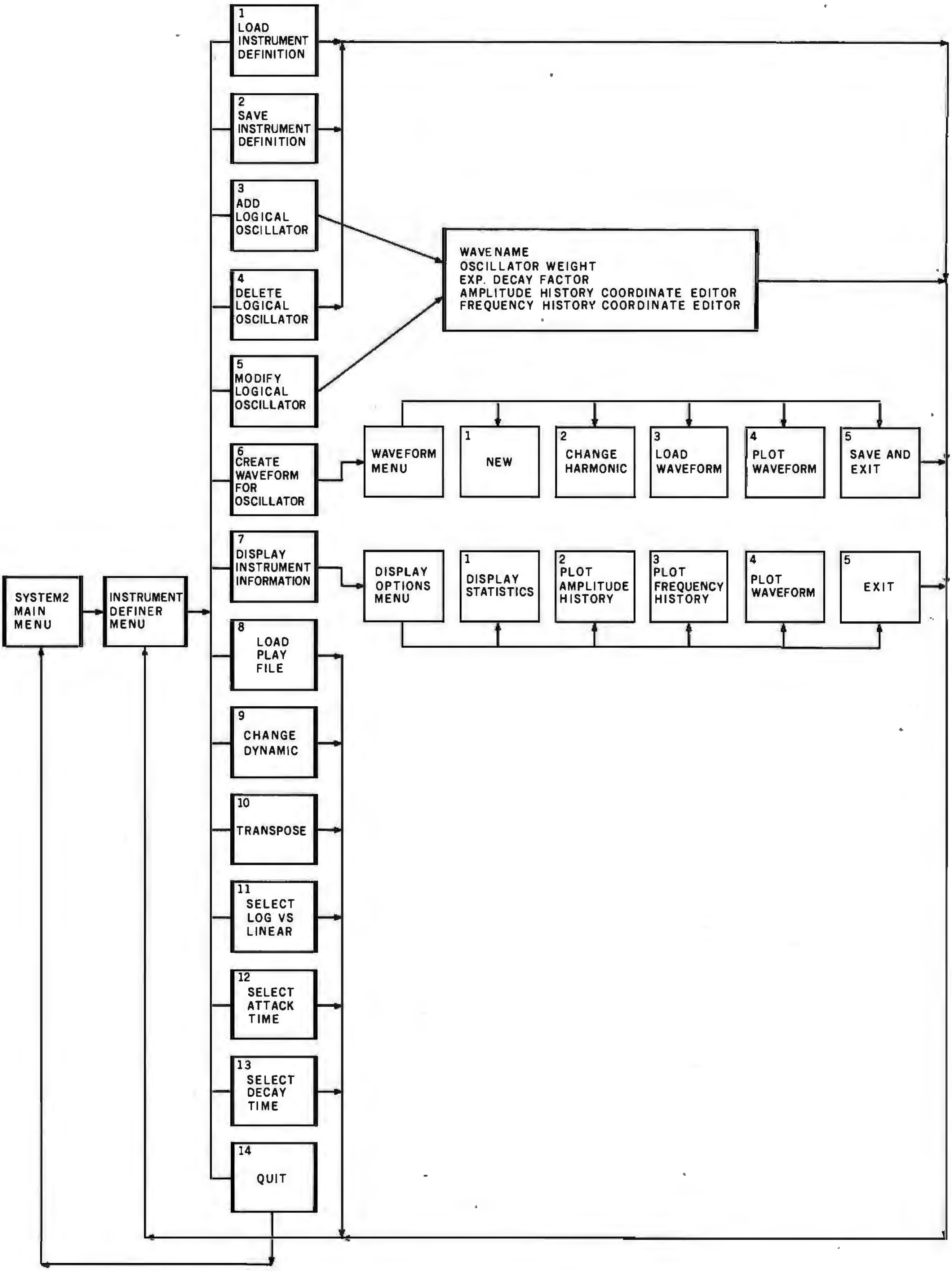
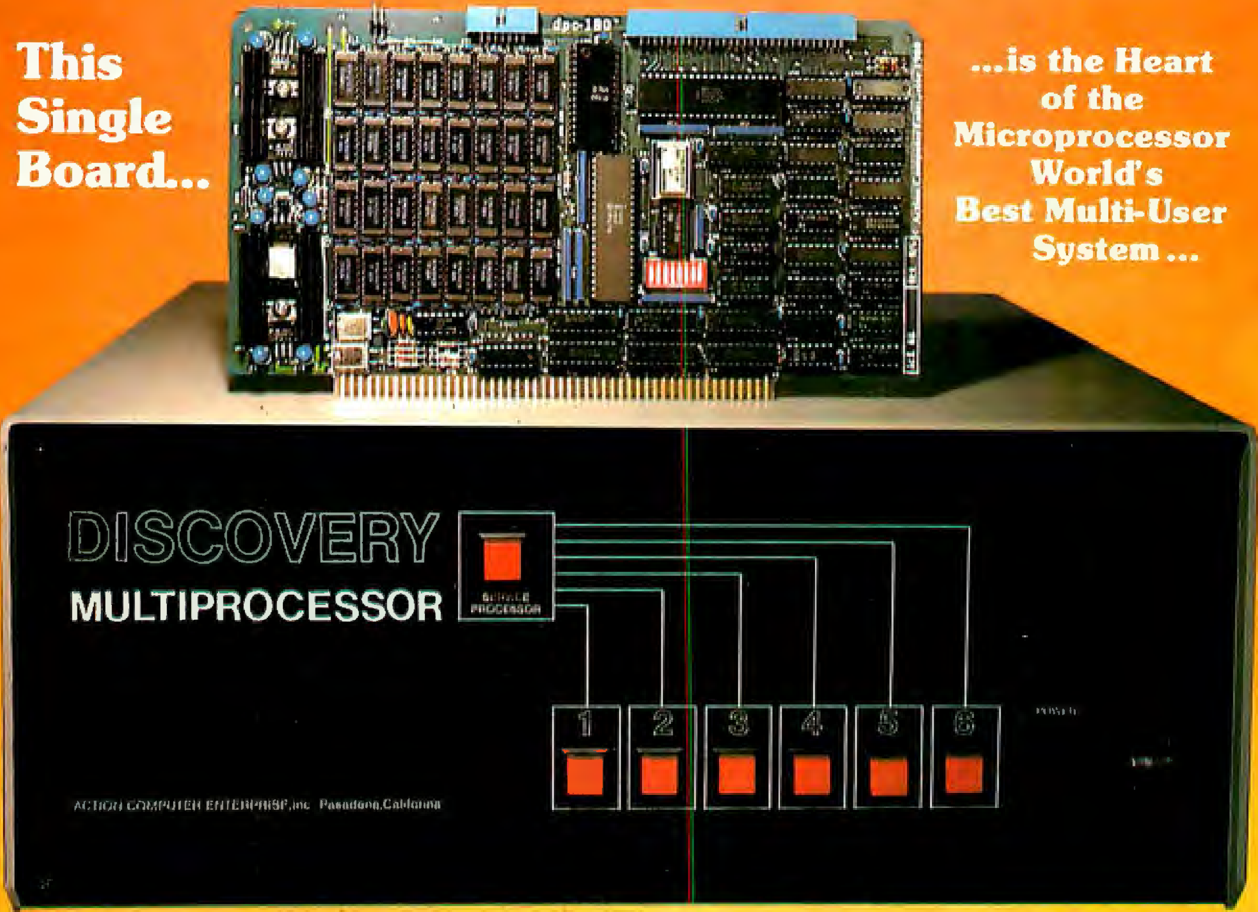


Figure 2: *Structural diagram of the Instrument Definer program, showing access paths to various menus and displays. The Instrument Definer is a large program that operates by loading program segments from disk as different functions are required.*

This Single Board...



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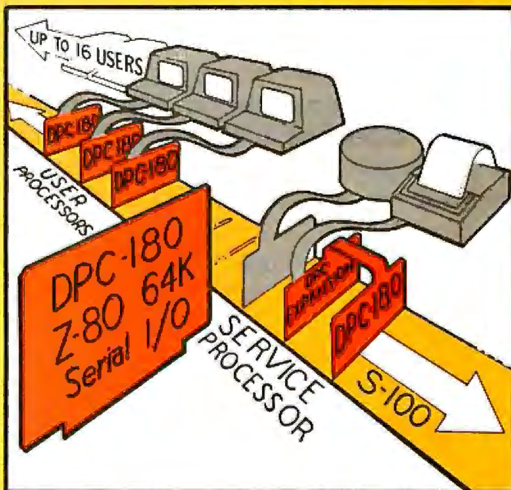

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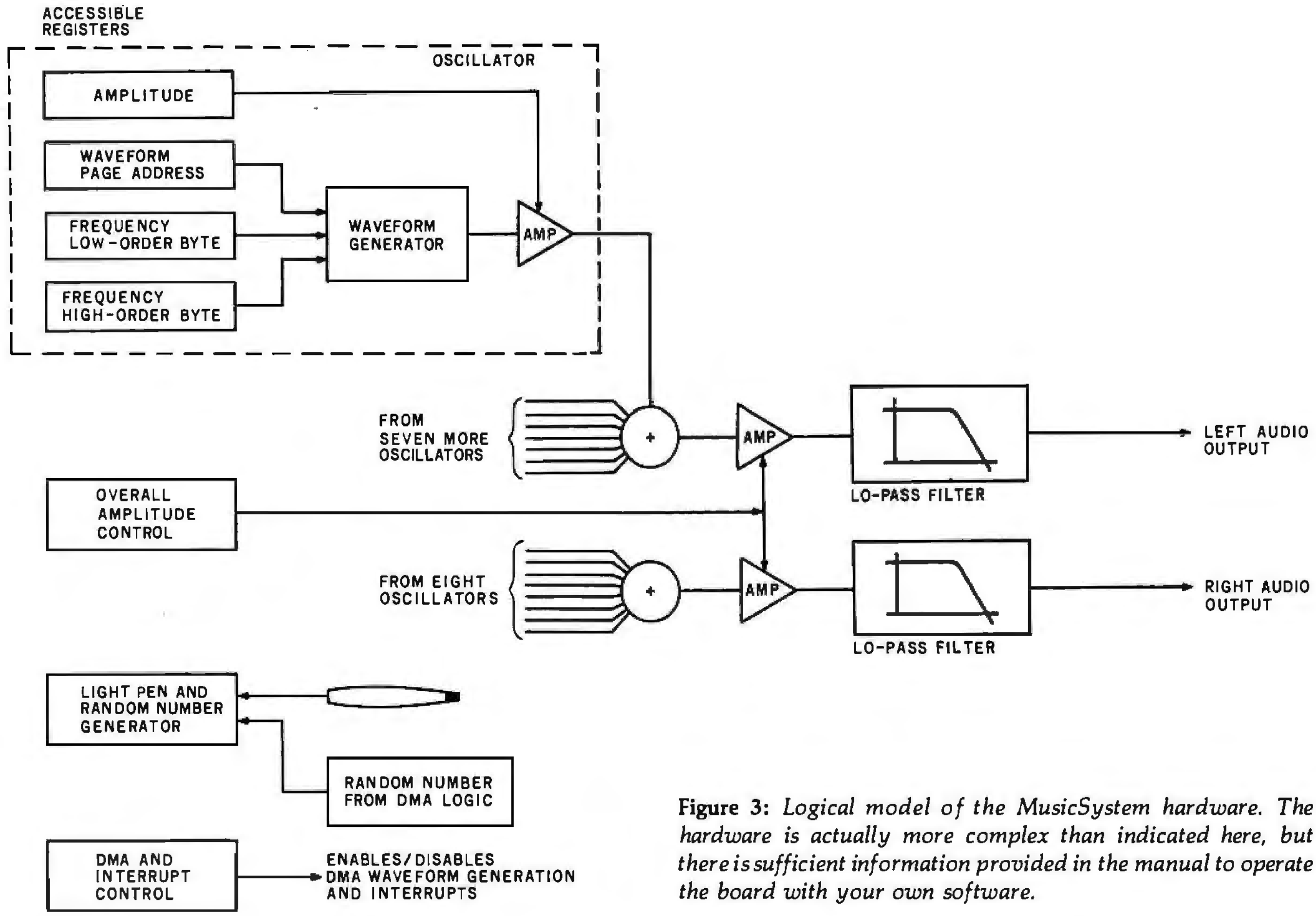

Figure 3: *Logical model of the MusicSystem hardware. The hardware is actually more complex than indicated here, but there is sufficient information provided in the manual to operate the board with your own software.*

Text continued from page 78:
amples of the waveform creation process.

Envelopes

In the Instrument Definer, the envelope is specified through a combination of oscillator and global parameters (see figure 3). Each oscillator in an instrument definition has five specified characteristics:

- Weight: its amplitude relative to any other oscillators used
- Attack profile: the pattern of volume changes during the attack portion of the envelope
- Frequency history: the pattern of frequency changes during the attack
- Sustain exponential: the sustain amplitude half-life in milliseconds
- Waveform

The attack and frequency profiles can each be specified with as many as fifteen segments to allow detailed instrument models. The global attack time defines the interval over which the oscillator attack and frequency profiles are spread.

Instruments whose timbre changes during each note

Text continued on page 88

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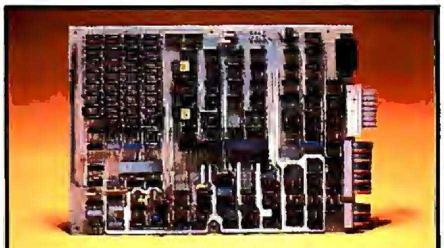

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*Some models require hardware/software modification.

Music Making

Two main music-synthesis techniques have been used on the Apple II computer. Each of these techniques has strong and weak points, and each presents features that the other does not. However, neither offers the power and flexibility of the MusicSystem which, in fact, uses a combination of the two techniques.

Square-Wave Music

The first widely available music synthesizer for the Apple II was produced by ALF Products Inc. The ALF synthesizer could generate three square-wave "voices" with note-envelope control and a wide frequency range. Up to three ALF circuit cards could be installed in an Apple II, which provided up to nine musical parts through three separate audio outputs. The ALF software was well written, and the same unit, the ALF Apple Music Synthesizer, is still quite popular today.

The technique used by ALF to generate tones is also used by a number of similar, but lower-quality and less-expensive, synthesizers currently on the market. This technique involves the use of several programmable hardware frequency dividers. Each divides a master frequency by a number that is provided by the controlling software. Different output frequencies are provided by varying the software-supplied divisor. The square-wave output of each frequency divider is then fed into a programmable attenuator, typically a D/A (digital-to-analog) converter, to vary the output level. Thus, the software simply supplies the frequency and output-level information to the card and the hardware does the rest.

One of the advantages of this technique is that the number of voices can be increased by simply adding more synthesizer cards. Even with nine-part music, the software has enough time left over to provide a real-time music display on the Apple's screen.

The main disadvantage of this technique is that it is not true music synthesis. It is impossible to reproduce a wide range of instrumental sounds with a waveform that is limited to a square wave. The control of each note's envelope allows a range of effects to be produced, but the high notes are invariably sharp and brilliant while the low notes have a buzzy sound.

Since the introduction of the ALF synthesizer, a number of similar units have appeared on the market. Most use the General Instrument AY-3-8910/8912 music synthesizer integrated circuit to produce tones. This is an inexpensive approach, but it offers limited frequency accuracy and only sixteen levels of output volume. The AY-3-8910 also includes a pseudo-white-noise generator that allows these units to offer (as one advertiser puts it) "flash and crash sound effects."

Software-Driven D/A Synthesis

Another popular approach to personal computer music synthesis utilizes a software-driven D/A converter. The D/A receives a constant stream of numbers from the computer and produces a correspondingly varying voltage at its output. With carefully written software, this technique is capable of producing surprisingly good-quality music.

The current state of the art was largely developed by Hal Chamberlin of Micro Technology Unlimited and his associates, Frank Covitz and Cliff Ashcraft. The software steps through precomputed waveform lookup tables, summing the values found and outputting the sum to the D/A at a constant rate. This allows complex waveforms to be computed and stored in advance, thus reducing the amount of computation required at play time. Note envelopes and timbre variations during each note are accomplished by storing a series of waveforms for each voice. Each stored waveform represents the waveshape and amplitude of the note at a given duration. The amplitude and timbre variations are generated by rapidly switching waveform tables.

Using the current software, the Apple's 1 MHz 6502 microprocessor can produce four-part music with realistic-sounding instruments and a 3.5 KHz frequency bandwidth. Faster processors can produce more parts and a greater frequency response. The technique is extremely flexible and can provide a wide range of instrument sounds. The hardware required is simple and inexpensive because the software does most of the work.

The main disadvantage of the system is that the software uses virtually all available processor time. The bandwidth or the number of musical parts cannot be increased without using a faster processor. Adding another D/A circuit board can provide stereo outputs but will not increase the music capacity of the system. Another disadvantage is that overall volume control and dynamic accents are difficult to implement due to time and memory-capacity limitations. It is not uncommon to fill 32 K bytes of memory with waveform tables without allowing for varying volumes for each instrument. This limitation could be removed by using a multiplying (variable gain) D/A to control the output level, which would also tend to effectively improve the limited signal-to-noise ratio of the 8-bit D/A.

Even with these limitations, the technique has a large number of avid users, and the quality of the music produced continues to improve as the software is refined. Examples of products using this method are devices built by Micro Music Inc (309 Beaufort St, Normal IL 61761, (309) 452-6991) for the Apple II, and products produced by Micro Technology Unlimited Inc (2606 Hillsborough St, POB 12106, Raleigh NC 27605, (919) 833-1458) for the Apple, PET, Aim, and other 6502-based computers.

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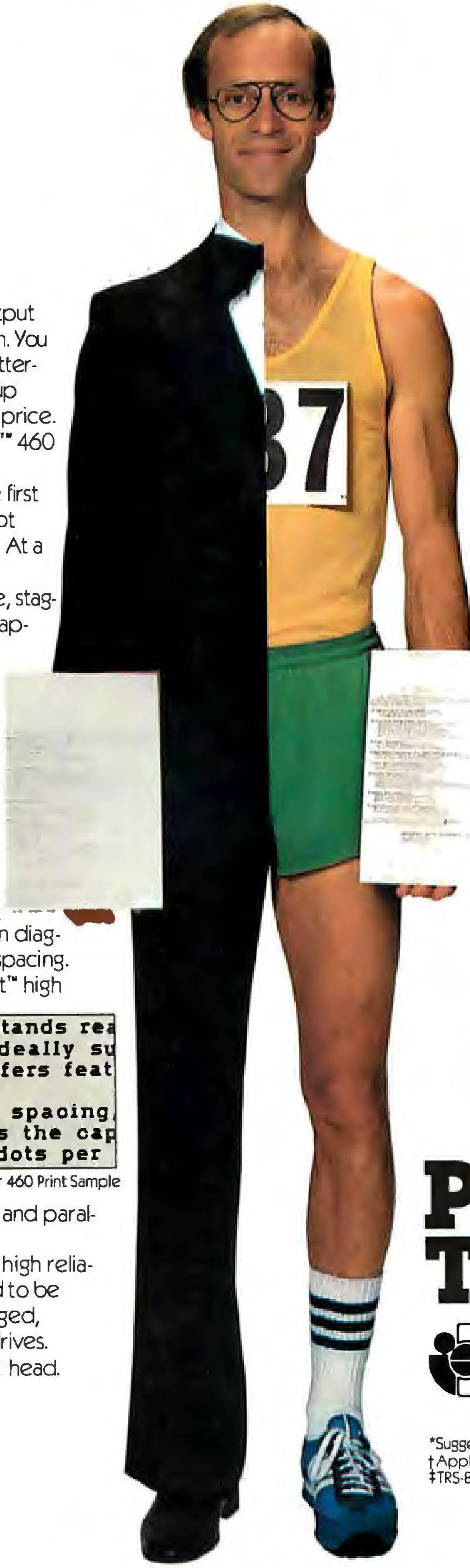

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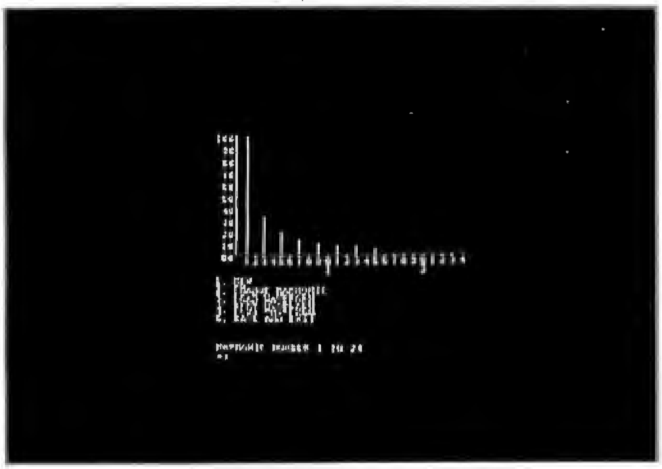

Photo 10: *A plot of the harmonic partials required to create an approximate square wave. For each odd harmonic specified, the amplitude is equal to 100/n, where n is the harmonic number.*

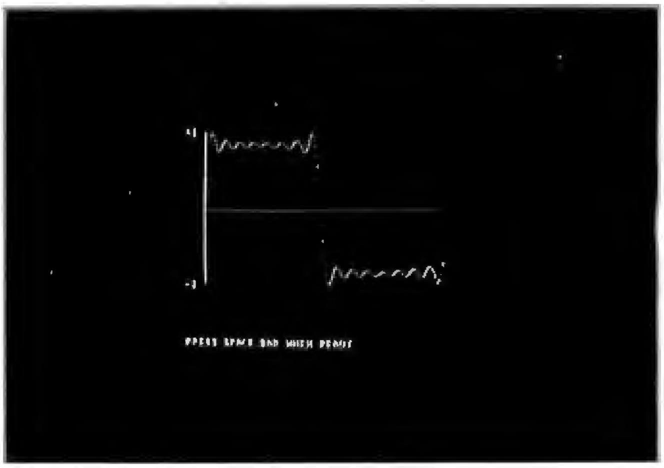

Photo 11: *The waveform resulting from the harmonic specifications in photo 10. A good approximation of a square wave could be used to simulate some of the less expensive music boards that are available for the Apple.*

Text continued from page 82:
may be simulated by using multiple oscillators. If you wish to decay the higher harmonics faster than the low ones in order to simulate a plucked or struck string instrument, you can use two or three oscillators with different harmonic contents and design them to decay at different rates.

In contrast to the MusicSystem, many synthesizers use the ADSR (attack-decay-sustain-release) method to specify envelopes. In the ALF synthesizer, for example, you specify the *attack* slope, the initial *decay* slope, the *sustain* level, and the *release* slope which ends the note. The sustain is always at a constant volume, so it is difficult to simulate instruments, like a piano, which decay

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gradually while the note is sustained, but drop off abruptly when the key is released. The ADSR method is a simple way of specifying envelopes, but it does not have the flexibility required to simulate real instruments accurately. Figure 4 shows a comparison of the ADSR and MusicSystem envelopes.

Documentation

Mountain Computer provides a comprehensive manual with the MusicSystem. Within its two hundred pages are chapters on system operations, descriptions of all the system programs, and a good section on background and theory.

The MusicSystem manual makes extensive use of walk-through examples to introduce you to each of the MusicSystem programs. You are taken step by step through the Music Editor (through the process of entering the song "America" in two parts), and then through the Instrument Definer, where you learn while creating the instrument ORGAN. The manual also includes a complete list of error messages and their causes, by program, as well as reference material that describes the hardware, the system file formats, and how to control the hardware with your own software.

The manual, and in particular the chapters on the Instrument Definer and MusicSystem theory, should be carefully read by any MusicSystem purchaser. A number of fine points and operational details will not be understood if you "don't read the instructions until all else fails."

Comments

According to Avery Dee, Vice President of Marketing, Mountain Computer considers the MusicSystem an evolving product, and plans to support and expand the system through future software releases. The first release of the MusicSystem was version 1.2, which did not include the Instrument Definer or the PRINT command. Since then, the current version 2.0 has been released and made available *at no charge* to all purchasers of version 1.2. By the time you read this article, another version may have been released. Certainly the unimplemented commands should be fixed, and hopefully, n-tuplets and repeats will be added.

Mountain Computer is currently compiling and providing MusicSystem information to several vendors who are either designing software or interfacing the system to other products. For example, The Alpha-Syntauri keyboard (Syntauri Ltd, 3506 Waverly, Palo Alto CA 94306) is now available interfaced to the MusicSystem as well as ALF's music boards.

In a way, the development of the MusicSystem can be compared to that of the Apple II three years ago. It has some limitations at the moment, but it is still entirely usable, and shows great potential. With the planned software enhancements, it should satisfy most needs for

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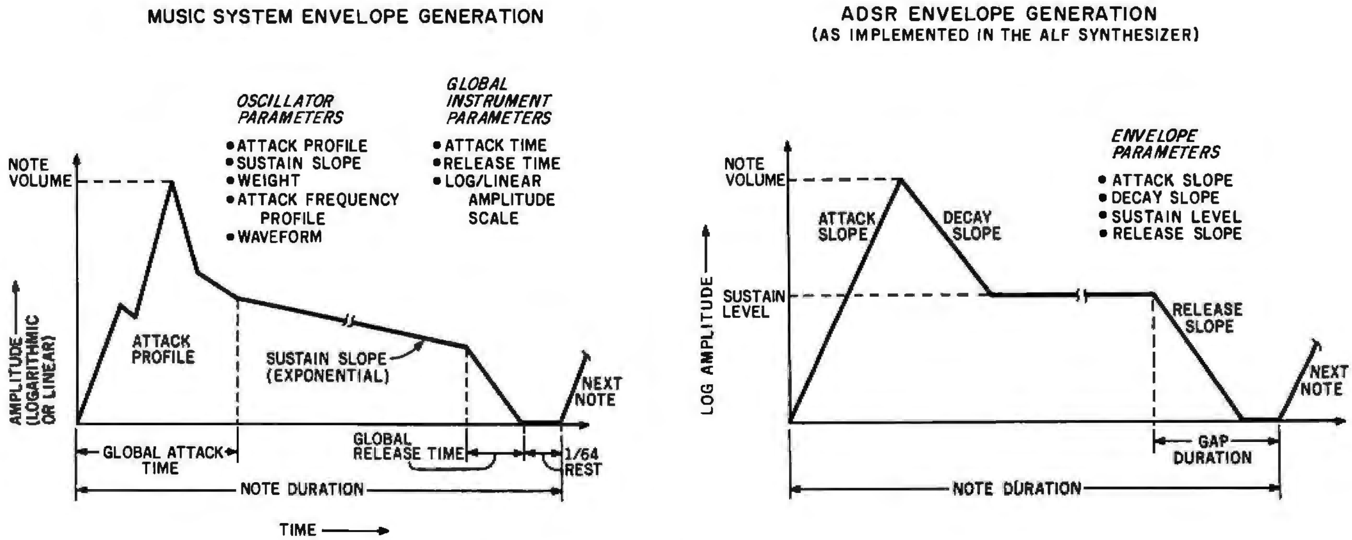

Figure 4: *Comparison envelopes produced by the MusicSystem and by the ADSR method. The MusicSystem allows a more detailed envelope specification than the ADSR method, and is better able to emulate the characteristics of real instruments. The overall MusicSystem envelope is a composite of the various oscillator envelopes in the instrument definition.*

years to come. In any case, it is the most powerful synthesizer available for the Apple II, and it is price-competitive with its closest rival, the ALF unit.

Conclusions

• The Mountain Computer MusicSystem is a flexible, well-designed music synthesizer that provides a combination of features and capabilities currently unmatched by any other Apple II music synthesizer.

• The MusicSystem boards alone provide an interesting avenue for experimentation in computer music for those users who wish to write their own programs.

• The documentation provided by Mountain Computer is complete and comprehensive. In addition to operating instructions, it provides tutorial and theory sections and numerous appendices that cover such categories as the hardware interface, error message causes, and conversion to DOS 3.3.

• The Instrument Definer is a unique program that adds a new dimension to the synthesis process. As much creative effort may be spent defining instruments as was previously spent entering music.

• The two main weaknesses of the MusicSystem are the lack of repeats (musical subroutines) and triplets, or n-tuplets. Hopefully this omission will be rectified in a future software release.

• Other features I'd like to see added are a Play Multiple Songs program, the ability to adjust tempo at play time, and audio feedback in the Music Editor program. ■

References and Further Reading

1. Bondy, Jon. "The Casheab Music Synthesizer." January 1981 *Creative Computing*, pages 30 thru 35.
2. Chamberlin, Hal. "A Sampling of Techniques for Computer Performance of Music." September 1977 BYTE, pages 62 thru 83.
3. Chamberlin, Hal. "Advanced Real-Time Music Synthesis Techniques." April 1980 BYTE, pages 70 thru 94, and 180 thru 196.
4. Newcomb, Steven R and Gooch, Sherwin. "Rise Up, Rachmaninoff." June 1980 *Creative Computing*, pages 66 thru 71. (A good explanation of D/A conversion and sampling theory as applied to music.)
5. Tubb, Phil. "Apple Music Synthesizer." June 1980 *Creative Computing*, pages 74 thru 83. (ALF as described by its designer.)
6. Stanley, W D and Peterson, S J. "Fast Fourier Transforms on Your Home Computer." December 1978 BYTE, pages 14 thru 25.

What Time Does the Sun Rise and Set?

Bruce Barkstrom
111 Pear Ave
Newport News VA 23607

Do you have to rise before the crack of dawn to go duck hunting? Do you need to know how many hours of sunlight to expect for your new solar collector? Do you want to know if you have enough time to jog ten miles before the sun sets? One way to answer these questions is to use your computer. All you need to know is your latitude, longitude, and the date. The program shown in listing 1 computes the time the sun rises or sets for any date and location on the earth. It uses a precise calculation of the sun's position in its apparent orbit around the earth and relates this to the time of sunrise and sunset by geometry.

The sun's orbital position is found with a general method that might be of use in your next space-war simulation. A general Julian-date calendar is also included, which might be useful in keeping track of days in an accounting program. The times of sunrise and sunset are computed with a method that also gives the amount of solar energy falling on the surface of the atmosphere for a given latitude and date. [*The amount of solar energy reaching the surface of the atmosphere is considerably different from the solar energy actually reaching the surface of the earth. Although the amount of energy actually radiating through the atmosphere can be calculated, it requires more complex mathematics than those used in this article. The solution involves solving a partial differential equation known as the* equation of radiative transfer....**SM**] For the twentieth century, the times computed are accurate to within two minutes.

The fact that the sun rises at different times during the year is not mysterious. It is caused by the tilt of the earth's axis with respect to its orbit around the sun. In the summer, the time between sunrise and sunset is longer than in the winter. The question is: "How much longer?"

Describing Celestial Objects

We first need to understand how astronomers describe where objects are in the sky. They start by assuming that all astronomical objects such as the sun, moon, and stars, can be painted on a large sphere around the earth. If you stand in an open field, your line of sight to the unobstructed horizon intersects this *celestial sphere* in a great circle. The point directly overhead is called the *zenith*, and the point near the North Star (Polaris) where the stars appear to rotate is known as the *north celestial pole*. A great circle running through the celestial poles and the local zenith is called the *local meridian*. These positions and circles are shown in figure 1. The position of the image on the sphere is described by a celestial "latitude" and "longitude," known as *declination* (δ) and *right ascension* (*RA*) (see figure 2).

The celestial sphere rotates once every 24 hours. By observing the angle between the meridian and a point on the celestial equator rotating with the celestial sphere,

Text continued on page 102

About the Author

Bruce R Barkstrom is a practicing scientist with a PhD in Astronomy from Northwestern University. Dr Barkstrom also has an active interest in word processing and computer-aided program design and development. He recently acquired a Cromemco System 3, on which this article andi ts associated software were written.


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Listing 1: *The Sunrise-Sunset program written in CBASIC Version 2.*

```
REM                         SUNRISE - SUNSET
REM       This program is intended to compute the time of sunrise and sunset,
REM       as well as the total solar energy incident on the top of the atmos-
REM       phere for a given latitude and longitude at a given time of year.
REM       Comments are welcome addressed to
REM               Bruce R. Barkstrom
REM               111 Pear Avenue
REM               Newport News, VA  23607.
REM       This program requires about 10k of text storage, and about 3.5k to run
REM       when compiled by the CBASIC Version 2 compiler.
          DIM First.Day.of.Month(12)
          FOR I=1 TO 12:READ First.Day.of.Month(I):NEXT I
          DATA 0,31,59,90,120,151,181,212,243,273,304,334
          Pi=3.1415926535898:TRUE%=-1:FALSE%=0:A=1:Debug%=TRUE%
REM ** Compute Julian Date  **********
          DEF FN.Julian.Date(Month,Day,Year)
          Yrs.since.0=Year+4712
          No.of.lp.yrs=INT((Yrs.since.0-1)/4)
          Julian.Date=365*Yrs.since.0 + No.of.lp.yrs
          IF Year>=1583 THEN \
                 Julian.Date=Julian.Date-10: \
                 No.of.cent.yrs.snc.1583=INT((Year-1501)/100):\
                 No.of.cent.lp.yrs.snc.1583=INT((Year-1201)/400):\
                 Julian.Date=Julian.Date-No.of.cent.yrs.snc.1583+\
                        No.of.cent.lp.yrs.snc.1583
              REM ** Deal with month and day **********
          Julian.Date = Julian.Date + First.Day.of.Month(Month) + Day
          IF 4*INT(Year/4)=Year AND Month>=3 THEN \
                 Julian.Date = Julian.Date + 1
          IF Year=1582 AND ((Month=10 AND Day>=15) OR Month>=11) THEN \
                 Julian.Date = Julian.Date - 10
          FN.Julian.Date = Julian.Date
          RETURN
          FEND
REM ** Compute Mean Anomaly **********
          DEF FN.M(T,D)
          M00 = -1.52417+(1.50E-4+3.E-6*T)*T*T+0.9856002670*D
          IF M00>360 THEN M00=M00-360*INT(M00/360)
          FN.M = M00*Pi/180
          RETURN
          FEND
REM ** Compute Obliquity of Ecliptic **********
          DEF FN.epsilon(T)=(23.452294-(1.30125E-2+ \
                 (1.64E-6 - 5.03E-7 * T)*T)*T)*Pi/180.
REM ** Compute Mean Longitude of Perigee **********
          DEF FN.omega(T,D)=(281.22083 + (4.53E-4 + 3.E-6 * T)*T*T \
                 + 4.70684E-5 * D)*Pi/180.
REM ** Compute Eccentricity **********
          DEF FN.eccentricity(T)=0.01675104 - (4.08E-5+1.26E-7*T)*T
REM ** Compute Longitude of Ascending Node of Lunar Oribt *****
          DEF FN.Lunar.Long(T,D)
          Lunar.Long = 259.183275 + (2.078E-3+2.E-6*T)*T*T
          Lunar.Long = Lunar.Long - .0529539222*D
          FN.Lunar.Long = Lunar.Long*Pi/180.
          RETURN
          FEND
REM ** Print time or angle in xx:xx:xx.xxx format
REM **    time.or.angle is assumed to be in radians
          DEF FN.Print.Angle(time.or.angle$,Y$,Angle)
          IF time.or.angle$="time" THEN factor=12: y0$="Hours" \
                  ELSE factor=180: y0$="Degrees"
          x1=factor*ABS(Angle)/Pi:x2=INT(x1):x3=60*(x1-x2):x4=INT(x3)
          x5=60*(x3-x4):x6=.001*INT(x5*1000)
          IF x2<>0 THEN x2=SGN(Angle)*x2
          IF x2=0 AND x4<>0 THEN x4=SGN(Angle)*x4
          IF x2=0 AND x4=0 THEN x6=SGN(Angle)*x6
```

Listing 1 continued on page 98

Circle 147 on inquiry card. ⟶

Listing 1 continued:

```
        PRINT Y$,x2;":";x4;":";x6;y0$
        RETURN
        FEND
REM ** Input Location Information
    Idne2=1
    WHILE Idne2
100     INPUT "Your latitude (Deg,Min,Sec), Pos for N, Neg for S";LatD,LatM,LatS
        Latitude=LatD+(LatM+(LatS/60))/60
        INPUT "E or W, Longitude (0 - 180 Deg,Min,Sec)";Dir$,LonD,LonM,LonS
        Longitude=LonD+(LonM+(LonS/60))/60
        INPUT "Your Standard Time Zone (1-24)";Std.Time.Zone
                Err=0
                IF Latitude<-90 OR Latitude>90 THEN \
                        PRINT "Latitude out of range":Err=Err+1
                IF Dir$<>"E" AND Dir$<>"W" THEN \
                        PRINT "You did not input E or W":Err=Err+1
                IF Longitude<0 OR Longitude>180 THEN \
                        PRINT "Longitude outside the range (0,180)":\
                        Err=Err+1
                IF Std.Time.Zone<1 OR Std.Time.Zone>24 THEN \
                        Print "Std Time Zone outside the range (1,24)":\
                        Err=Err+1
                IF Err<>0 THEN 100
REM ** Revise longitude and standard time zone to be consistent
        Latitude = Latitude*Pi/180.
        IF Latitude>=0 THEN x$="Arctic" ELSE x$="Antarctic"
        IF Dir$="E" THEN Longitude = 360 - Longitude
        Longitude = Longitude * Pi / 180
        Time.Diff=12*Longitude/Pi
        Tot.time.diff = Time.Diff - (Std.Time.Zone - 1)
REM ** Input Date and Check for Correctness **********
      Idne=1
      WHILE Idne
200     INPUT "Date (Month,Day,Year)";Month,Day,Year
                Err=0
                IF Month<0 OR Month>12 THEN \
                        PRINT "Month out of range, input again":\
                        Err=Err+1
                IF Day<0 OR Day>31 THEN \
                        PRINT "Day out of range, input again":\
                        Err=Err+1
                IF Err>0 THEN 200
        Day = Day - .5 + Time.Diff/24
REM ** Compute current Julian Date, and Time since 1900
        J.D.Current = FN.Julian.Date(Month,Day,Year)
        D = J.D.Current - FN.Julian.Date(1,0,1900):T = D/36525
REM ** Compute solar orbit
        ecc = FN.eccentricity(T):M0 = FN.M(T,D):E = M0
        FOR I=1 TO 3
                E = E + (M0 - (E-ecc*SIN(E)))/(1-ecc*COS(E))
                NEXT I
        V = 2*ATN(SQR((1+ecc)/(1-ecc))*TAN(0.5*E))
        IF V<0 THEN V=V+2*Pi
        r = A*(1-ecc*COS(E)):eps = FN.epsilon(T):omeg = FN.omega(T,D)
REM ** Nutation Terms are computed here ******************************
        L1 = FN.Lunar.Long(T,D)
        Nutation.of.Obliquity = (2.5583333E-3+2.5E-7*T)*COS(L1)*Pi/180.
        eps = eps + Nutation.of.Obliquity
        Nutation.of.Longitude = -(4.7872222E-3+4.72222222E-6*T)*SIN(L1)*\
                Pi/180.
REM ** Compute solar declination ****************************
        sine.del = SIN(eps)*SIN(V+omeg)
        cosine.del = SQR(1 - sine.del*sine.del)
        del = ATN(sine.del/cosine.del)
REM ** Compute Equation of Time ********************************
        mean.long=omeg+M0
        IF mean.long<0 THEN mean.long=mean.long+2*Pi
        IF mean.long>2*Pi THEN mean.long=mean.long-\
```

Listing 1 continued on page 100

Listing 1 continued:

```
           2*Pi*INT(mean.long/(2*Pi))
        y=TAN(0.5*eps)
        y=y*y
        y=(1-y)/(1+y)
        alpha0=omeg+V+Nutation.of.Longitude
        IF alpha0<0 THEN alpha0=alpha0+2*Pi
        IF alpha0>2*Pi THEN alpha0=alpha0-2*Pi*INT(alpha0/(2*Pi))
        alpha = ATN(y*TAN(alpha0))
        Eqn.of.time = alpha-mean.long
        Eqn.of.time = Eqn.of.time - Pi*INT(Eqn.of.time/Pi)
        IF ABS(Eqn.of.time)>.9*Pi THEN \
           Eqn.of.time=Eqn.of.time-SGN(Eqn.of.time)*Pi
        a0=Eqn.of.time+mean.long
        IF a0>2*Pi THEN a0=a0-2*Pi*INT(a0/(2*Pi))
REM ** Print various orbital related quantities if desired *******
        IF Debug%=TRUE% THEN \
        x0=FN.Print.Angle("angle","mean anomaly  ",M0):\
        x0=FN.Print.Angle("angle","eccentric anom",E):\
        x0=FN.Print.Angle("angle","true anomaly  ",V):\
        x0=FN.Print.Angle("angle","obliquity     ",eps):\
        x0=FN.Print.Angle("angle","nutation of ob",Nutation.of.Obliquity):\
        x0=FN.Print.Angle("angle","longitude     ",alpha0):\
        x0=FN.Print.Angle("angle","nutation of ln",Nutation.of.Longitude):\
        x0=FN.Print.Angle("angle","solar declin  ",del):\
        x0=FN.Print.Angle("time","solar R. A.   ",a0):\
        x0=FN.Print.Angle("time","equation of tm",Eqn.of.time):\
        PRINT "eccentricity  ";ecc:\
        PRINT "r             ";r
REM ** Length of Day
        mum = COS(Latitude - del):mun = -COS(Latitude + del):mua = 0
REM ** Refraction Effect computed here
        x0=FN.Print.Angle("time","Tot time diff",Tot.time.diff*Pi/12)
        IF -mum*mun>0 THEN Refrac.corr = 0.0555555556/SQR(-mum*mun) \
                ELSE Refrac.corr = 0:\
                PRINT "The sun's upper limb does not cross the horizon."
        IF Debug%=TRUE% THEN \
                x0=FN.Print.Angle("time","Refraction corr is  ",\
                   Refrac.corr*Pi/12)
        IF mun>mua THEN mua=mun
        IF mum>mua THEN \
                x = SQR((mua-mun)/(mum-mua)):\
                frac.of.day.sun.up = 1 - (2/Pi)*ATN(x):\
                basic.sunset = 12.*frac.of.day.sun.up:\
                basic.sunrise = basic.sunset:\
                basic.sunset = basic.sunset + Refrac.corr + Eqn.of.time*12/Pi:\
                basic.sunrise = basic.sunrise + Refrac.corr - Eqn.of.time*12/Pi:\
                time.basic.sunset = 12 + basic.sunset:\
                time.basic.sunrise = 12 - basic.sunrise:\
                time.sunrise = time.basic.sunrise + Tot.time.diff:\
                time.sunset = time.basic.sunset + Tot.time.diff:\
                fraction.avail.sun = 0.5*((mum+mun)*frac.of.day.sun.up\
                       + (mum-mun)*SIN(Pi*frac.of.day.sun.up)/Pi):\
                PRINT:PRINT:\
                x0=FN.Print.Angle("time","Sunrise occurs at  ",time.sunrise*Pi/12):\
                x0=FN.Print.Angle("time","Sunset occurs at   ",time.sunset*Pi/12)\
            ELSE \
                PRINT "you are in the ";x$;" winter - the sun doesn't rise":\
                fraction.avail.sun = 0.
        PRINT "Sunlight available at the top of the atmosphere is"
        PRINT 1.188864E8*fraction.avail.sun;" Joules per square meter"
        INPUT "If this is the last date, input 0";Idne
        IF Idne<>0 THEN Idne=1
        WEND
        INPUT "If you have no other locations, input 0";Idne2
        IF Idne2<>0 THEN Idne2=1
        WEND
        END
```

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Listing 2: *A sample run of Sunrise-Sunset.*

```
Your latitude (Deg,Min,Sec), Pos for N, Neg for S 37,0,0
E or W, Longitude (0 - 180 Deg,Min,Sec) W,75,0,0
Your Standard Time Zone (1-24) 6
Date (Month,Day,Year) 9,1,1980
mean anomaly          237 : 54 : 53.025 Degrees
eccentric anom        237 : 6 : 37.387 Degrees
true anomaly          236 : 18 : 34.682 Degrees
obliquity             23 : 26 : 23.519 Degrees
nutation of ob        0 : 0 :-6.947 Degrees
longitude             158 : 54 : 51.928 Degrees
nutation of ln        0 : 0 :-11.323 Degrees
solar declin          8 : 13 : 35.673 Degrees
solar R. A.           10 : 42 : 4.382 Hours
equation of tm        0 : 0 :-1.057 Hours
eccentricity    0.0167180457765
r               1.00907827086
Tot time diff         0 : 0 : 0 Hours
Refraction corr is    0 : 4 : 14.545 Hours


Sunrise occurs at     5 : 30 : 43.307 Hours
Sunset occurs at      18 : 29 : 14.577 Hours
Sunlight available at the top of the atmosphere is
 35208038.2944  Joules per square meter
If this is the last date, input 0 1
Date (Month,Day,Year) 12,1,1980
mean anomaly          327 : 36 : 15.675 Degrees
eccentric anom        327 : 5 : 1.817 Degrees
true anomaly          326 : 33 : 34.599 Degrees
obliquity             23 : 26 : 23.934 Degrees
nutation of ob        0 : 0 :-6.415 Degrees
longitude             249 : 10 : 6.219 Degrees
nutation of ln        0 : 0 :-12.376 Degrees
solar declin         -21 : 49 : 34.492 Degrees
solar R. A.           16 : 29 : 54.062 Hours
equation of tm        0 :-10 : 57.915 Hours
eccentricity    0.0167179436184
r               0.985965844479
Tot time diff         0 : 0 : 0 Hours
Refraction corr is    0 : 4 : 42.959 Hours


Sunrise occurs at     6 : 54 : 34.914 Hours
Sunset occurs at      16 : 43 : 29.255 Hours
Sunlight available at the top of the atmosphere is
 16043293.0622  Joules per square meter
If this is the last date, input 0 0
If you have no other locations, input 0 0
A.
```

Text continued from page 94:

you can keep track of the time. For example, if the sun were on the celestial equator, at noon it would be on the meridian. You could measure 90° along the celestial equator between the local meridian and the sun's location at 6 PM; it would be 180° from its starting position at midnight. At dawn, it would be 270° around, and at noon 360°—back to its starting position. The angle between the local meridian and a certain celestial longitude is called the *hour angle, H.*

At any given time, θ_0, the angle between the sun and the zenith of an observer at latitude ϕ, is related to the hour angle and declination of the sun, δ, by the equation

$$\cos(\theta_0) = \sin(\phi)\sin(\delta) + \cos(\phi)\cos(\delta)\cos(H) \quad (1)$$

When the sun sets, it is on the horizon 90° from the zenith, so $\cos(\theta_0)$ is 0. Thus, the sun sets when

$$\cos(H) = -\tan(\phi)\tan(\delta) \quad (2)$$

Computing the Amount of Solar Energy

The actual computation of the time of sunrise or sunset is more useful if, instead of solving equation (2), a method is used allowing you to estimate the amount of energy the sun radiates to the atmosphere during a day.

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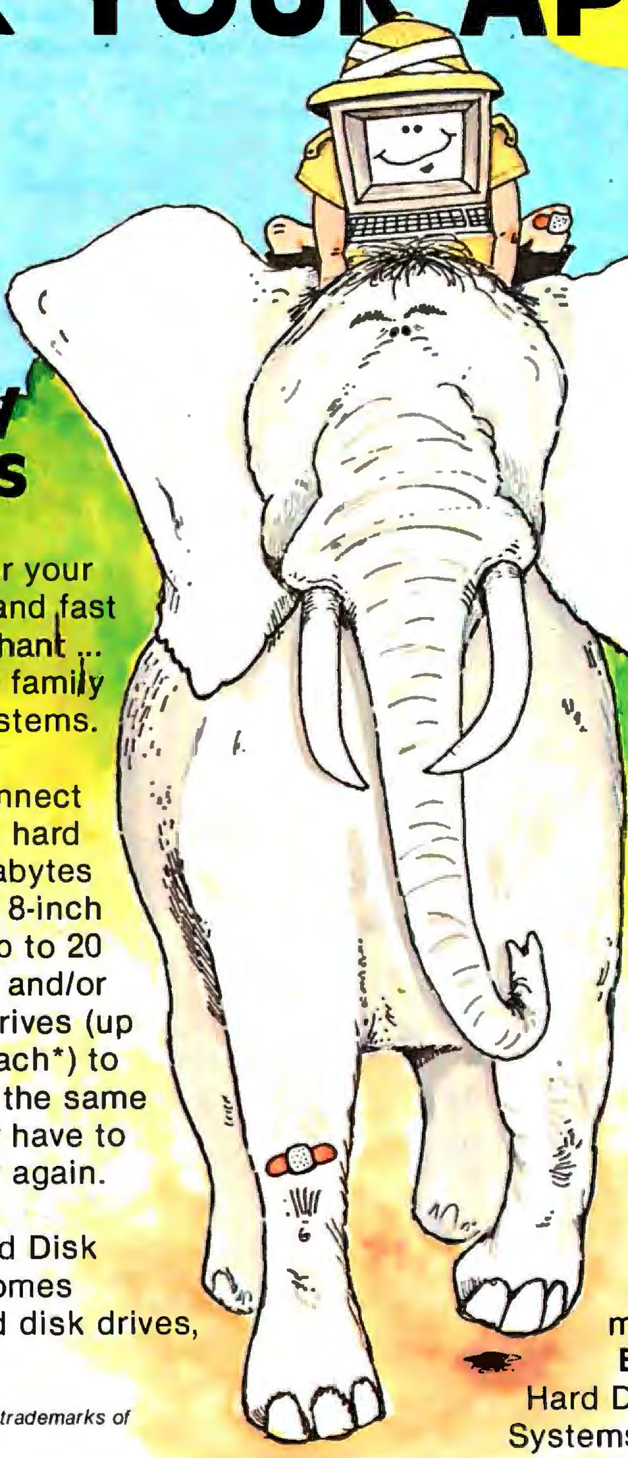

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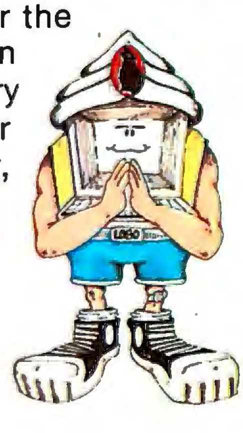

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The power input to a small portion of the top of the atmosphere is proportional to $\cos(\theta_0)$. For the time between sunrise and noon (or noon and sunset), θ_0 is a monotonically decreasing (or increasing) function of time. Thus, in a time increment dt,

$$d(\cos(\theta_0)) = -\cos(\phi)\cos(\delta)\sin(Ct)\,C\,dt \qquad (3)$$

where $C=2\pi/24$ hr. In this same time increment, the amount of energy per unit area that reaches the top of the atmosphere is

$$dP = E_0 \cos(\theta_0)\,dt \qquad (4)$$

E_0 is the *solar constant*, which is about 1370 watts per square meter. By converting to $\cos(\theta_0)$ as the variable of integration, you can compute both the time of sunrise (or sunset) and the amount of energy per unit area arriving during the hours of daylight.

The number of hours of sunlight is given by

$$LD = 24\left(1 - \frac{2}{\pi}\ \arctan\left(\sqrt{\frac{\mu_a - \mu_n}{\mu_m - \mu_a}}\right)\right) \qquad (5)$$

and the amount of energy is given by

$$AE = (1.184 \cdot 10^8)\left(\frac{a}{r}\right)^2 \left\{\frac{1}{2}(\mu_m + \mu_n)LD + \frac{(\mu_m - \mu_n)\sin(\pi LD/24)}{2\pi}\right\} \qquad (6)$$

where LD is the length of day in hours, AE is the amount of energy per unit area in joules per square meter (J/m^2), a is the mean distance from the earth to the sun in kilometers, and r is the actual distance from the earth to the sun in kilometers. (To convert this figure to Btu per square feet, multiply by $8.80598 \cdot 10^{-5}$. About half of this energy reaches the surface on a clear day.)

In these expressions, μ_m has been used for cos(max of θ_0 during the day), μ_n for cos(min of θ_0 during the night), and μ_a for max(0,μ_n). In terms of latitude and solar declination

$$\mu_m = \cos(\phi - \delta) \qquad (7)$$

while

$$\mu_n = -\cos(\phi + \delta) \qquad (8)$$

Observe that μ_m can be less than zero during the arctic winter (δ less than zero and ϕ close to 90°) and μ_n can be greater than zero during the arctic summer (δ greater than zero and ϕ close to 90°). These conditions prevent us from computing a negative square root in equation (5).

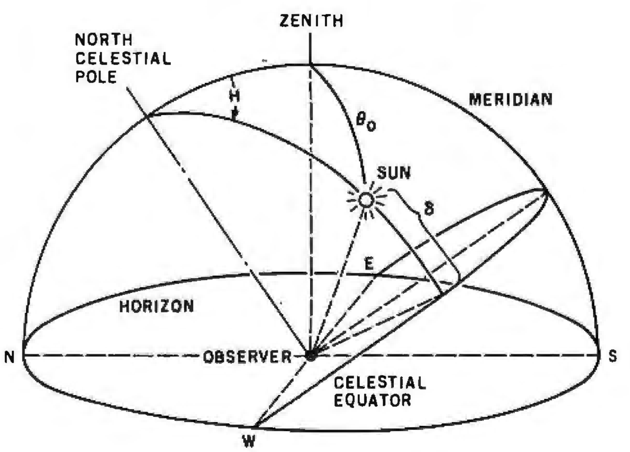

Figure 1: *Positions on the celestial sphere for an observer at latitude ϕ. For observation from the earth, the points of reference are the* horizon *and* zenith. *The horizon has attached to it the compass points N, S, E, and W. The zenith is always directly overhead. The* meridian *is the great circle extending from N on the horizon through the zenith to S on the horizon. The* celestial sphere *rotates from E to W about the* north celestial pole. *When the sun is on the meridian, it is local solar noon, and the hour angle H is 0. As time passes, rotation of the celestial sphere carries the sun toward the western horizon, and the hour angle increases. At the same time, the solar-zenith angle also increases. When the sun is on the horizon (at sunrise and sunset), $\theta_0=90°$.*

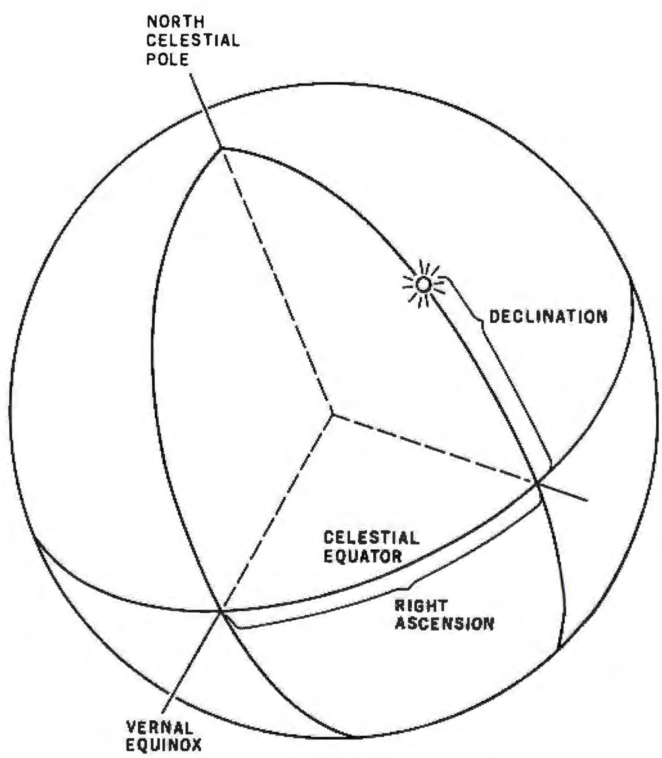

Figure 2: *The position of an object is described by its* declination *and* right ascension. *For a person located at the North Pole, the north celestial pole is directly overhead. A person located on the equator has the celestial equator directly overhead. The vernal equinox (March 21) is where the sun intersects the equator in its apparent orbit around the earth.*

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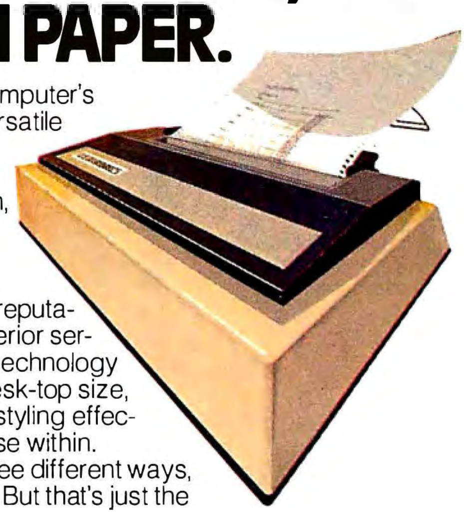

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Where's the Sun?

To use equations (5) and (6), you must know both your latitude, ϕ, and the solar declination, δ. Very roughly,

$$\delta = 22.5 \cdot \sin(360f - 90) \qquad (9)$$

where f is the number of days since January 1 divided by 365.25, δ is in degrees, and the argument of the sine function is also in degrees.

This might be satisfactory if you just wanted to know where the sun is. But if it is used to estimate the time of sunrise and sunset, you find large errors (about twenty minutes) in the local solar time of sunrise and sunset. There are basically two kinds of difficulty. The first is that the sun's apparent orbit around the earth doesn't fall on the celestial equator. Once this is recognized, you realize that time is kept by a fictitious *mean sun* moving steadily along the equator. As a result of the nonzero orbital inclination, the right ascension of the actual sun rarely agrees with that of the mean sun.

The second difficulty is that when the earth is closer to the sun in January, it moves faster in its orbit than it does in June, when it is farther away. The correction for these two effects is known as the *equation of time*.

The proper way to find the sun's location on the celestial sphere is to find its position in apparent orbit around the earth, then find its right ascension and declination. This is not as difficult as it sounds. The basic orbit description requires only the actual distance from the earth to the sun, r, and the angle between the sun and its orbital position at its closest approach to earth. This angle, V, is known as the *true anomaly*.

You can compute V (giving the true position of the sun) through calculations geometrically equivalent to the diagram in figure 3. The apparent orbit of the sun is given by the ellipse in this figure, with earth not at the center of the concentric circles but at one of the foci of the ellipse. (For purposes of illustration, the "flatness" of the ellipse has been exaggerated; in truth, the ellipse is almost a true circle, and the focus where the earth lies is much closer to the center of the concentric circles.) Taking the intersection of the axes of the ellipse as a center, the dotted circle (with radius $a \cdot \sqrt[4]{1 - e^2}$) is the path of the imaginary mean sun, traveling at a constant speed along its orbit. The larger, solid circle has the same center but with radius a, which is the length of the semimajor axis of the ellipse.

V can be found by calculating two other angles: the mean anomaly, M, and the eccentric anomaly, E. Although the calculations are involved, the result is this: the area traced out by the mean sun from perigee to its current location (the crosshatched area traced out by angle M) is equal to the area traced out by the real sun from perigee to its current location (the crosshatched area traced out by angle V). The eccentric anomaly, E, is calculated as an intermediate step from M to V.

(Actually, the angle M must be adjusted. Its true value, in degrees, for f days into the year is

$$M = 360f + \epsilon' - \Omega \qquad (10)$$

where ϵ' is the *mean longitude of the sun* and Ω is the *mean longitude at perigee*.)

An object with a position described by M can be geometrically related to another object moving at a con-

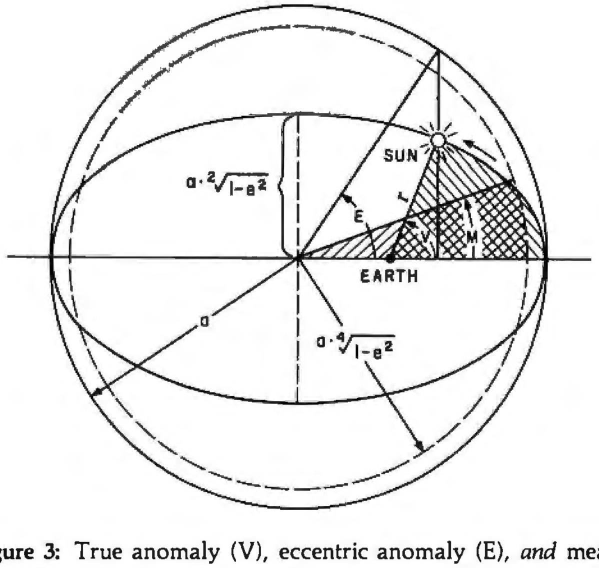

Figure 3: True anomaly (V), eccentric anomaly (E), *and* mean anomaly (M). *The position of an object in orbit is given by radius r and angle V. By using the properties of an ellipse and a circle with radius a, it can be shown that $r=a(1-e \cdot \cos(E))$, where e is the orbital eccentricity. The mean anomaly (M) is the angle swept out in a circle of radius $a \cdot \sqrt[4]{1-e^2}$ by a radius vector so that the area swept out by that radius (crosshatched area marked as M) increases at the same rate as that of r for the elliptical orbit (crosshatched area marked as V). See the text for more details.*

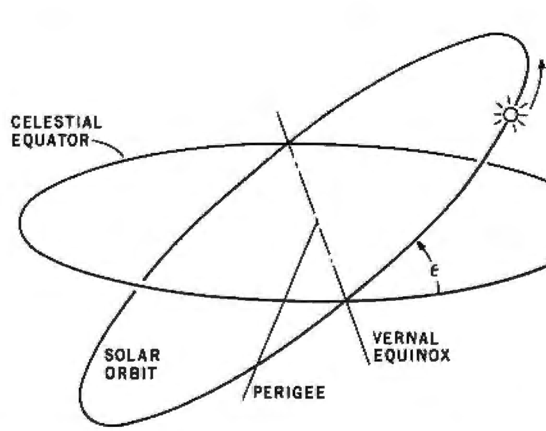

Figure 4: *Relation between the celestial equator and the apparent solar orbit. The sun's apparent orbit does not lie in the plane of the celestial equator. The angle between these two planes is the* obliquity of the ecliptic (ϵ). *The sun is closest to the earth at* perigee, *which occurs about January 20. Ω is the angle along the solar orbit from vernal equinox to perigee (about 280°).*

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stant rate around an elliptical orbit with the same semimajor axis. The angle between perigee and the position of this second object is known as the eccentric anomaly, E. It is related to M by the transcendental equation

$$E = M - e \sin(E) \tag{11}$$

where e is the *orbital eccentricity* (a dimensionless constant). For the earth, e is small, and Newton's method is sufficient for solving equation (11). You start by assuming that

$$E = M \tag{12}$$

and then iterate a few times with the equation

$$E = E + (M - (E - e \sin(E)))/(1 - e \cos(E)) \tag{13}$$

Once E is available, V can be found using the relationship

$$V = 2 \arctan (\sqrt{(1 + e)/(1 - e)} \cdot \tan(E/2)) \tag{14}$$

If you are interested in solar energy, the correction for the distance to the sun is available directly, since

$$r = a(1 - e \cos(E)) \tag{15}$$

and a is the semimajor axis of the orbit. Equations (10) and (12) through (15) are general and can be used for orbits other than the sun's apparent orbit around the earth. For a derivation, see sections 67 and 68 of *Textbook on Spherical Astronomy* by W M Smart (see reference 4). You might want to try these equations for simulating the orbital elements of comets and for spacecraft in spacewar games.

With the true anomaly available, you can find the solar declination from additional orbital geometry which relates Ω and the *obliquity of the ecliptic*, ϵ (ie: the angle between the earth-sun orbital plane and the celestial equator). The relationship is

$$\sin(\delta) = \sin(\epsilon) \cdot \sin(V + \Omega) \tag{16}$$

The Solar Ephemeris and the Julian Date

Equations (12) and (5) are not entirely accurate. For precise computation, you should use

$$M = -1.52417 - (1.5 \cdot 10^{-4} + 3 \cdot 10^{-6}\, T)\, T^2 + 0.9856002670\, D \tag{17}$$

where T is the *Universal Time* since January 1, 1900 in Julian years of 365.25 days, D is the number of Julian days since that date, and the mean anomaly M is in degrees. The longitude of perihelion is

$$\Omega = 281.22083 + (4.53 \cdot 10^{-4} + 3 \cdot 10^{-6}\, T)\, T^2 + 4.70684 \cdot 10^{-5} \cdot D \tag{18}$$

where Ω is in degrees.

You can also write the obliquity of the ecliptic, which is the angle between the celestial equator and the earth's orbital plane, as

$$\epsilon = 23.452294 - (1.30125 \cdot 10^{-2} \cdot T + (1.64 \cdot 10^{-6} - 5.03 \cdot 10^{-7} \cdot T) \cdot T^2) \qquad (19)$$

while the orbital eccentricity is

$$e = 0.01675104 - (4.18 \cdot 10^{-5} + 1.26 \cdot 10^{-7} \cdot T)\, T \qquad (20)$$

Anomalistic year: *The period of time (365.2596413 days) for the sun to increase the mean anomaly (M) by 360°.*
Celestial sphere: *An imaginary sphere around an observer positioned on the earth on which can be placed astronomical objects such as the sun, the moon, the planets, and the stars.*
Declination (δ): *The angular distance (north or south) from the celestial equator of an object located on the celestial sphere.*
Ecliptic: *The apparent annual path of the sun across the celestial sphere.*
Hour angle (H): *The angle between the local meridian and the right ascension (RA) of a celestial object.*
Local meridian: *A great circle running through the celestial poles and the local zenith.*
Mean anomaly (M): *The angle between perigee and a fictitious sun moving in a perfectly circular orbit at a constant speed.*
Mean sun: *A fictitious object used for calculating time because the real sun's apparent orbit around the earth does not fall on the celestial equator and the sun does not move at a constant speed in its apparent orbit.*
North celestial pole: *The point near the North Star (Polaris) around which all the other stars appear to rotate.*
Obliquity of the ecliptic: *The angle between the earth-sun orbital plane and the celestial equator.*
Orbital eccentricity: *An orbit of a celestial body deviating markedly from a circle.*
Perigee: *The point in the orbit of an object when it is closest to the earth.*
Perihelion: *The point at which the earth is closest to the sun.*
Precession of the equinoxes: *An effect caused by tidal friction which acts as a torque on the earth's rotation and causes the axis to precess like a top or gyroscope.*
Right ascension: *The east-west position of an object on the celestial sphere relative to a given reference point called the vernal equinox.*
True anomaly (V): *The angle between the sun and its orbital position at its closest approach to earth.*
Zenith: *The point directly overhead on the celestial sphere.*

It takes the sun 365.2596413 days to increase M by 360°, a period known as the *anomalistic year*. This is the time required for the sun to return to the same point in its orbit—perigee. However, as equation (18) shows, the zero-point for measuring the position of perigee moved 61.892 seconds of arc during the year. As a result, the time required for the sun to return to the same longitude is nearly 365.2422 days. You could repeat the position of the sun without correcting for this nonrational period only if the number were exactly 365 days.

The first-order correction is to add 0.25 days per year, one day every four years. This correction was instituted by Julius Caesar, resulting in the *Julian* calendar. However, 365.25 days is 0.0078 days per year too long. To improve the fit, Pope Gregory XIII decreed that October 5, 1582 was to be called the 15th and that, thereafter, three century leap years would be ignored every 400 years (ie: all leap years ending in 00 not divisible by 400). England did not adopt the change until 1752, when riots broke out because the rioters believed their lives were being shortened by twelve days.

Astronomers wish to be spared such complications, and they have agreed to keep track of the days continuously, beginning with January 1, 4713 BC. January 1, 4712 BC is day 366, January 1, 4711 BC is day 731, and so on. To compute the Julian date is not difficult. You start by taking 365 days times the number of years since 4713 BC. To this, add the number of leap years. In the years since 1581, the proper number of excess leap years must also be subtracted.

Some Physical Complications

In computing the time of sunrise or sunset, there are two major corrections to the procedure described so far: the *equation of time* and *refraction*. With the advent of accurate clocks, timekeepers have invented a fictitious *mean sun*, located on the celestial equator, which advances at the same rate as the mean solar longitude. The solar position in its apparent orbit must be put into right ascension to find how far ahead or behind the true sun is with respect to the fictitious mean sun. The difference in right ascension is known as the equation of time. To compute it, simply compute the solar right ascension, using the relation

$$\tan(SRA) = \frac{1 - \tan^2(\epsilon/2)}{1 + \tan^2(\epsilon/2)} \tan(SL) \qquad (21)$$

where SRA is the solar right ascension and SL is the solar longitude, both expressed in degrees. The equation of time is the difference between the solar right ascension and the right ascension of the fictitious mean sun.

The other significant factor is refraction. Although it has been assumed that the sun could be treated as a point mass for the orbital calculation, it subtends about one-

half degree in the sky. As the sun rises and sets, the rays from different portions of the disk are bent different amounts by refraction in the earth's atmosphere.

As a result, the center of the solar disk must be 51 seconds of arc below the horizon before the upper limb of the sun disappears. The first-order correction to the hour angle in equation (2) is provided by expanding the equation for a correction in H that depends upon having $\theta_0 = 90° + 51$ arc seconds. The number of minutes by which the sun's upper limb rises earlier or sets later is roughly given by

$$\Delta H = (51/15)\sec(\phi)\sec(\delta)\operatorname{cosec}(H) \qquad (22)$$

Changes in Orbital Elements

As we go forward or backward in time, the other planets and the moon act on the earth and its orbit to change the orbital elements. One sign of these changes is the *precession of the equinoxes,* which is the major cause of the 61 arc-second advance per year of the longitude of perihelion that has been noted.

Most of this effect is caused by the tidal friction, which acts as a torque on the earth's rotation and causes the earth's axis to precess like a top or gyroscope. In addition, because neither the moon nor the other planets lie exactly in the orbital plane and because their force is not uniform, the orbital elements reflect a change in the inclination of the earth's orbit. These changes appear in the equation for the ephemeris as terms in T and are known as *secular terms.*

Besides the secular terms, the earth wobbles in its motion in response to forces exerted by the moon on the mass distribution of the earth. The motion is not too large, but it is much faster than the motion accounted for by the secular terms. The largest element of the nutation (wobbling) is included in the program listing. The remaining terms are found in the *American Ephemeris and Nautical Almanac* (see reference 2) or in Smart's *Spherical Astronomy* (see reference 4).

Time Zone Correction

There is one more substantial correction to make. Most of us use standard time. The same time is kept for all points in a standard time zone. Standard time divides the world into twenty-four zones of longitude, each about 15° wide. The boundaries are not exactly longitude lines. They are arranged to miss centers of population.

In order to refer to the correct Julian date, you must have the time difference between the longitude of interest and both the Greenwich meridian and the standard time zone. The time difference between the standard meridian and the longitude of interest (LG) is

$$TD = \begin{cases} (24 \cdot LG)/360 & \text{if } LG \text{ is west of the Greenwich meridian} \\ \text{or} & \\ 24 - (24 \cdot LG)/360 & \text{if } LG \text{ is east of the Greenwich meridian} \end{cases} \qquad (23)$$

where *TD* is the time difference measured in hours. Then, you can refer back to the standard time zone, using the longitude of the standard time zone:

$$TTD = TD - LSZ \cdot \frac{24}{360} \qquad (24)$$

where *TTD* is the total time difference (in hours), *LSZ* is the longitude of the center of the standard time zone, and the ratio 24/360 relates 24 hours per day to the 360° in a circle.

To calculate daylight savings time in any zone, subtract 1 from the zone number. For example, Eastern Standard Time for the United States is centered at 75° 0′ 0″ W longitude and is time zone 6. For daylight savings time, use zone 5 in the program input.

The Sunrise-Sunset Algorithm

The program shown in listing 1 was written in CBASIC Version 2. The features of this language that will strike users of standard BASICs are the long variable names and lack of line numbers. Variable names, which may be up to 31 characters, may be concatenated from shorter phrases by interspersing periods; this allows you to write programs that are considerably more readable than versions of BASIC allowing only 2-character variable names.

The line numbers at the left of listing 1 were added during compilation. The only line numbers in the source code were those connected with error handling on the input. Line numbers are optional when using the IF...THEN...ELSE and similar control structures that enter so prominently into structured coding.

The second set of features that makes programming in CBASIC2 relatively easy is the structured-control features, such as the IF...THEN...ELSE and WHILE...WEND statements. (The WHILE statement executes the loop as long as the stated condition is not zero.) The implementation of these structures is such that no line numbers are required. Within a set of operations, several replacement statements can be strung together by the use of a colon (:) to denote continuation of the activity. Backslashes (\ ) allow comments at the end of statement lines, making it easy to write self-documenting code.

Beyond these features, CBASIC2 contains the ability to define functions that take arguments. Functions must be defined before they are used, as in Pascal, although there is no requirement for all function definitions to occur before the body of the program. CBASIC2 is a well-designed product that fits well with CP/M.

Final Comments

A sample calculation with some intermediate results is shown in listing 2. This program was checked against the *Nautical Almanac and Ephemeris for 1977*. Solar positions appear to be correct within about 10 seconds of arc, the error to be expected by neglecting the short-period terms in the nutation. The sunrise and sunset times agreed with those for 50° N latitude within two minutes at all times of year. The major inaccuracy is in the approximation used for the refraction effect.

There are some simple extensions to this work. With a bit more work, the times of moonrise and moonset could be derived. Beyond this, it should be relatively easy to extend the orbital calculation to other planets, so that a complete computation of the material in the *Ephemeris* would be available. Finally, the amount of sunlight getting through the atmosphere could be calculated. This last task, however, would require considerable extra work. ■

References

1. Abell, George. *Exploration of the Universe*. New York: Holt, Rinehart, and Winston, 1975.
2. *American Ephemeris and Nautical Almanac for the Year 1977, The*. Washington: US Government Printing Office, 1976.
3. *Explanatory Supplement to the Astronomical Ephemeris and to the American Ephemeris and Nautical Almanac, The*. Washington: US Government Printing Office, 1975.
4. Smart, W M. *Textbook on Spherical Astronomy*. New York: Cambridge University Press, 1965.
5. Wyatt, Stanley P. *Principles of Astronomy, Third Edition*. Boston: Allyn & Bacon, 1977.

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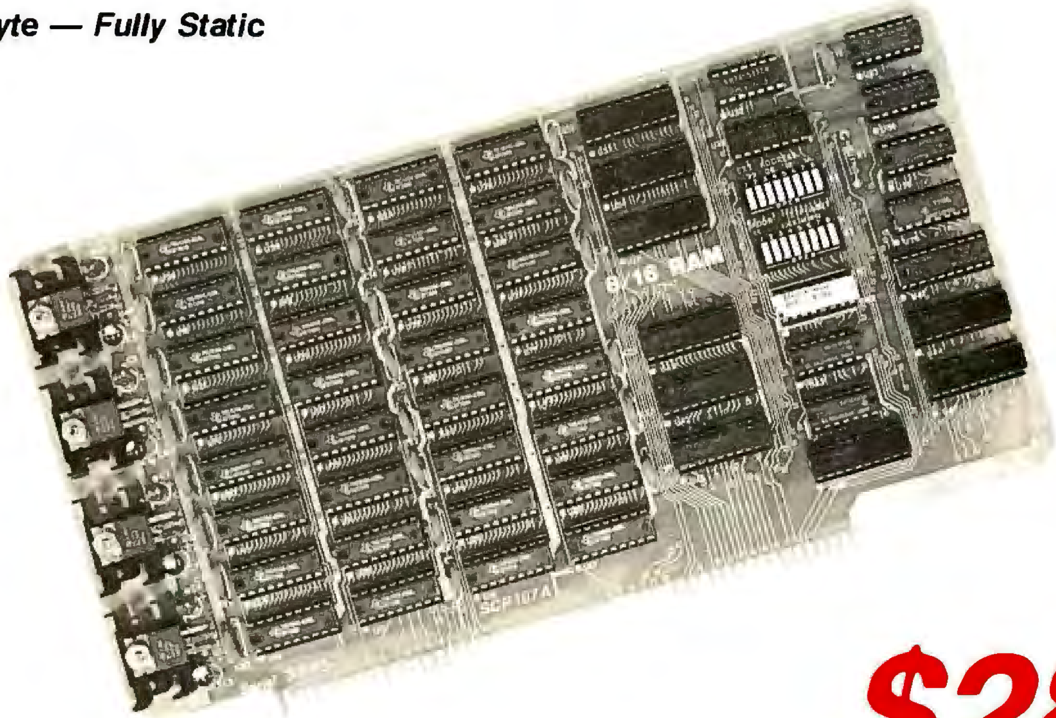

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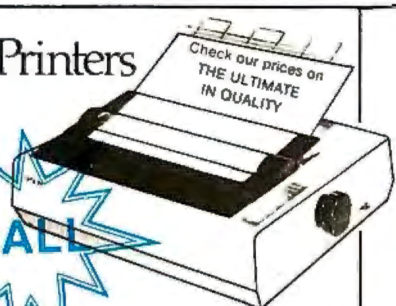

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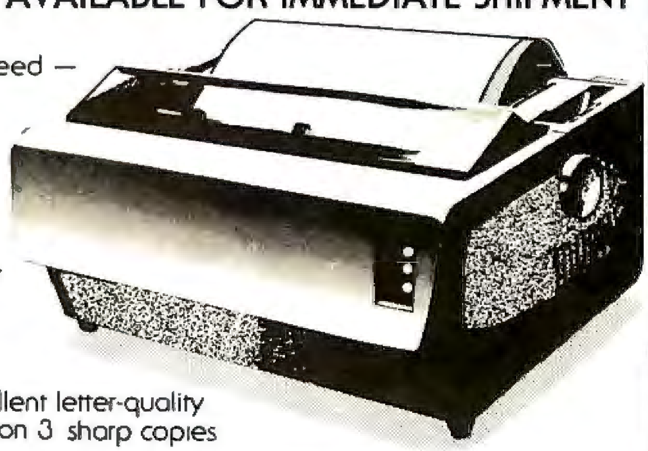

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A Character Fault

In a table comparison of five low-cost microcomputers (see "The Commodore VIC 20 Microcomputer: A Low-Cost, High-Performance Consumer Computer," by Gregg Williams, May 1981 BYTE, page 46), it is stated that the TRS-80 Color Computer has no graphics characters available, but that the unit's color block is one-quarter normal-character size. To clarify this a bit, the Color Computer (without Extended BASIC) *does* have low-resolution graphics on a 64 by 32 grid. Each of these blocks can be turned on or off individually by using the SET and RESET commands.

Corrupted Interpolation

There are several typographical errors in the second subroutine of "A General Interpolating Graphics Package for the TRS-80," by D K Cohen and D Crowe. (See the November 1980 BYTE, page 296.)

Refer to page 308 of that issue for comparison with these improved program statements:

```
20150 IF A1=Z2-X2/A
  THEN P1=64 ELSE
  P1=-64
20220 PRINT @
  Z5+P1+DU, AX$;
20265 J6=J6+64
20275 W5=J6+A1/2-
  (INT(W3/2)-1)*64
20290 L8=L8+1
20295 PRINT @
  M8+P2,F$(18);
```

In line 20150 the original has F1, which is an undefined variable. In line 20220, the entry ends with a comma, which would cause the screen to scroll up one line when this statement is at the bottom of the screen. Lines 20265 and 20275 have the undefined variable J8 in the original listing. Line 20290 had the undefined L6 as a variable, and 20295 had M6, also undefined.

Thanks to Philip F Jackisch of Royal Oak, Michigan, for pointing out these bugs.

Knight Errant

While attempting to run the FORTH program given in the article "KNIGHT: A Knight's Tour Problem in MMSFORTH," by Ulrich Frei (February 1981 BYTE, page 325), Marcel Kurtagic of Caracas, Venezuela, got the error message

DCONSTANT ? 28 3

running under Version 1.9 of MMSFORTH.

He corrected the problem by inserting the statement "25 LOAD" into block 80, just after ": TASK;" and before "28 LOAD". With this modification, the program ran perfectly. ■

Circle 385 on inquiry card. ➞

Hurricane Tracking

John E Bailey
24 Hibiscus St
Sulphur LA 70663

Tropical summer weather in Southwest Louisiana occasionally turns into vicious hurricanes. People in this part of the country, keenly aware of the destructive power of these storms, become very cautious when tropical depressions begin developing in the Caribbean or Gulf of Mexico. Local weather forecasters closely follow these weather patterns from their inception. Hurricane tracking charts appear everywhere. They are even printed on the back of the paper bags used at the local grocery stores.

In summer 1979, I began tracking hurricane David while it was far out in the Atlantic. I listened diligently to the daily weathercasts and recorded the storm's location on my grocery bag tracking chart. After several days of manually keeping track of David, I decided that this would be a perfect application for my computer. I wanted to give my program the ability to track different storms by name as they developed throughout the season, tell me the exact direction the storm was traveling, and the distance it had moved since its last recorded position.

At first, I decided to make the mathematics of the program simple by using plane trigonometry to compute storm direction and distance after I input latitude, longitude, date, and time. In fact, I tracked several storms during the 1979 season using this technique with reasonable accuracy. However, not being completely satisfied I checked out a library book that explained the development and use of spherical trigonometry. After several days of studying equations and trial-and-error testing on my computer, I was able to make my hurricane tracking program function more accurately.

Writing and rewriting this program was a great learning experience for me. I had never really worked with spherical trigonometry before. The equations are really quite simple. However, understanding how they work and making them work for you is not quite so simple.

There are two programs written in NorthStar BASIC: CSTORM and HURRICANE. Before running the

Listing 1: *Sample output of the hurricane tracking program as it monitored hurricanes David and Fred over a period of several days.*

```
  DAVID'S INITIAL POSITION WAS LAT - 16.9 , LONG - 67.4

DATE   TIME   LAT   LON   DISTANCE AND DIRECTION OF TRAVEL
08/31  12:00  17.7  70.0  181.3 MILES AT  18.2 DEG NORTH OF WEST
08/31  18:00  18.2  70.5   48.0 MILES AT  46.5 DEG NORTH OF WEST
08/31  22:00  18.8  70.7   43.8 MILES AT  72.5 DEG NORTH OF WEST
09/01  05:00  20.0  72.7  155.4 MILES AT  32.8 DEG NORTH OF WEST
09/01  11:00  20.0  74.5  117.6 MILES AT    .0 DEG DUE WEST
09/02  18:00  24.1  77.5  344.3 MILES AT  56.4 DEG NORTH OF WEST
09/02  22:00  24.7  78.4   70.6 MILES AT  36.4 DEG NORTH OF WEST
09/03  00:00  24.9  78.6   18.8 MILES AT  47.8 DEG NORTH OF WEST
09/03  18:00  27.9  80.8  249.4 MILES AT  57.2 DEG NORTH OF WEST
09/04  18:00  38.2  81.1  716.1 MILES AT  88.7 DEG NORTH OF WEST

ACTUAL MOVEMENT HAS BEEN  63.3 DEG NORTH OF WEST
DAVID IS  839.6 MILES AT  43.0 DEG NORTH OF EAST FROM LAKE CHARLES.

  FRED'S INITIAL POSITION WAS LAT - 14.1 , LONG - 54

DATE   TIME   LAT   LON   DISTANCE AND DIRECTION OF TRAVEL
09/01  22:00  17.0  60.6   485.6 MILES AT  25.4 DEG NORTH OF WEST
09/03  15:00  19.0  63.1   215.9 MILES AT  40.5 DEG NORTH OF WEST
09/03  22:00  18.3  64.0    76.7 MILES AT  39.2 DEG SOUTH OF WEST
09/04  18:00  18.1  68.0   264.5 MILES AT   2.4 DEG SOUTH OF WEST
09/09  18:00  22.3  83.7  1064.1 MILES AT  18.5 DEG NORTH OF WEST
09/10  18:00  23.5  83.7    83.4 MILES AT  90.0 DEG DUE NORTH
09/10  22:00  23.6  84.0    20.4 MILES AT  20.4 DEG NORTH OF WEST
09/11  05:00  24.1  84.4    43.1 MILES AT  53.9 DEG NORTH OF WEST
09/11  11:00  24.6  85.1    56.3 MILES AT  38.2 DEG NORTH OF WEST
09/11  14:00  25.0  85.5    37.5 MILES AT  47.9 DEG NORTH OF WEST
09/11  18:00  25.2  85.7    18.8 MILES AT  47.9 DEG NORTH OF WEST
09/11  20:00  25.6  85.8    28.5 MILES AT  77.3 DEG NORTH OF WEST
09/12  05:00  27.3  87.0   139.8 MILES AT  58.0 DEG NORTH OF WEST
09/12  07:00  27.6  87.3    27.8 MILES AT  48.4 DEG NORTH OF WEST
09/11  09:00  27.8  87.3    13.8 MILES AT  90.0 DEG DUE NORTH
09/12  13:00  28.2  87.3    27.8 MILES AT  90.0 DEG DUE NORTH
09/12  18:00  29.1  87.8    69.6 MILES AT  64.1 DEG NORTH OF WEST

ACTUAL MOVEMENT HAS BEEN  31.2 DEG NORTH OF WEST
FRED IS  320.5 MILES AT  10.0 DEG SOUTH OF EAST FROM LAKE CHARLES.
```

Listings 2 and 3 are on pages 126-132.

HURRICANE program, you must first initialize the storm file using the CSTORM program. CSTORM has to be run once for each new hurricane to be tracked. Then run the HURRICANE tracking program. It will ask if there are any new coordinates to add to the data file. If there are, the program will ask you to enter the date in the form (MM/DD), the time in the form (HH:MM), the latitude, and the longitude. You may enter all or as many new coordinates as you want to bring the file up to date. When all new coordinates are entered, type in END, to end the update phase. The program will then generate the latest tracking figures according to the data in the storm file. Listing 1 shows an example of its output. Listing 2 is the CSTORM program and listing 3 is the HURRICANE tracking program. Change lines 560 and 570 to reflect the longitude and latitude of your location and change line 600 to reflect the name of your city or location.

I can't say that I am anxiously awaiting the next hurricane season, but it will be fun and interesting to once again use this program to track the developing storms.■

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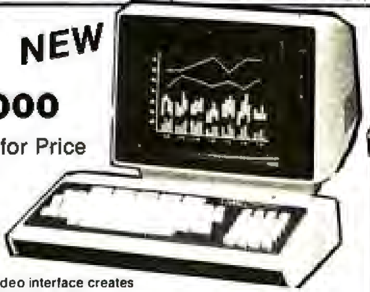

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Listing 2: *NorthStar BASIC program CSTORM initializes data in the disk file and must be run for each new hurricane tracked.*

```
10 !"      THIS PROGRAM CREATES AND INITIALIZES THE FILE"
20 !"      CONTAINING THE STORM DATA."
30 !
40 INPUT "      WHAT IS THE NAME OF THE STORM ? ",A$
50 CREATE A$,5
60 OPEN #1,A$
70 !\INPUT "      ENTER INITIAL DATE (99/99) ? ",D$
80 IF LEN(D$)<>5 THEN 70
90 INPUT "      ENTER INITIAL TIME (99:99) ? ",T$
100 IF LEN(T$)<>5 THEN 90
120 INPUT "      ENTER INITIAL LATITUDE ? ",Y
130 INPUT "      ENTER INITIAL LONGITUDE ? ",X
140 WRITE #1,D$,T$,X,Y
150 CLOSE #1
160 END
```

Listing 3: *HURRICANE performs the actual tracking functions using spherical trigonometry and produces the output shown in listing 1.*

```
10 DIM C$(15)
20 FOR I=1 TO 11\!\NEXT
30 !"      THIS PROGRAM GENERATES A HURRICANE TRACKING TABLE."
40 !\INPUT "      WHAT IS THE NAME OF THE STORM ? ",A$
50 INPUT "      ANY NEW COORDINATES TO ADD (Y OR N) ? ",Z$
60 IF Z$="" THEN 240
70 IF Z$="N" THEN 240
80 !\!\!
90 OPEN #1,A$
100 IF TYP(1)=0 THEN 130
110 READ #1,D$,T$,X,Y
120 GOTO 100
130 !\!"      ENTER NEW DATA"
140 INPUT "            ENTER DATE (99/99) ? ",D$
150 IF D$="END" THEN 230
160 IF LEN(D$)<>5 THEN 140
170 INPUT "            ENTER TIME (99:99) ? ",T$
180 IF LEN(T$)<>5 THEN 170
190 INPUT "            ENTER LATITUDE ? ",Y
200 INPUT "            ENTER LONGITUDE ? ",X
210 WRITE #1,D$,T$,X,Y
220 GOTO 130
230 CLOSE #1
240 !\!\INPUT "      DO YOU WANT A HARD COPY (Y OR N) ? ",Z$
250 IF Z$="Y" THEN H=1
260 IF H=1 THEN 280
270 !\!\!
280 OPEN #1,A$
290 P1=12
300 READ #1,D$,T$,X,Y
310 !#H"      ",A$,"'S INITIAL POSITION WAS LAT -",Y," , LONG -",X,
320 IF H=0 THEN INPUT " ",Z$
330 !#H\!#H
```

Listing 3 continued on page 128

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Listing 3 continued:

```
340 X0=X
350 Y0=Y
360 IF TYP(1)=0 THEN 510
370 READ #1,D1$,T1$,X1,Y1
380 GOSUB 830
390 IF P1<11 THEN 430
400 !#H"   DATE    TIME     LAT    LON    ",
410 !#H"DISTANCE AND DIRECTION OF TRAVEL"
420 P1=1
430 !#H"    ",D1$,"   ",T1$,"  ",%5F1,Y1,"  ",X1,"    ",
440 !#H%6F1,Q," MILES AT ",%5F1,D," DEG ",C$
450 IF H=0 THEN P1=P1+1 ELSE 480
460 IF P1<>11 THEN 480
470 INPUT "    PRESS RETURN TO CONTINUE",Z$
480 X=X1
490 Y=Y1
500 GOTO 360
510 X=X0
520 Y=Y0
530 GOSUB 830
540 T1=D
550 !#H\!#H"    ACTUAL MOVEMENT HAS BEEN ",%6F1,T1," DEG ",C$
560 X=93
570 Y=30
580 GOSUB 830
590 !#H"    ",A$," IS ",%6F1,Q," MILES AT ",D," DEG ",C$,
600 !#H" FROM LAKE CHARLES."
610 P1=P1+3
620 FOR I=P1 TO 10\!\NEXT
630 CLOSE #1
640 IF H=0 THEN INPUT "",Z$
650 IF Q>=100 THEN 720
660 !#H\!#H\!#H
670 !#H"    **************"
680 !#H"    *  W A R N I N G  -  HURRICANE IS LESS THAN 100 MILES AWAY."
690 !#H"    **************"
700 !CHR$(7)
```

Listing 3 continued on page 132

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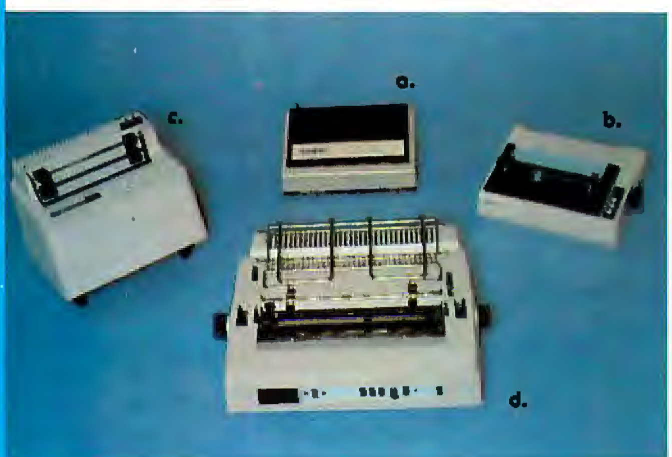

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Listing 3 continued:

```
710 FOR I=1 TO 6\!#H\NEXT
720 END
730 REM  THIS SUBROUTINE COMPUTES THE DIRECTION
740 REM  AND DISTANCE BETWEEN TWO POINTS ON THE
750 REM  GLOBE.  INPUT IS -, STARTING COORDINATE
760 REM  X,Y AND ENDING COORDINAGE X1,Y1.
770 REM  OUTPUT IS - C$ CONTAINS THE HEADING
780 REM  IN WORDS, IE, NORTH OF WEST, DUE SOUTH, ETC.
790 REM  D CONTAINS THE ANGULAR HEADING IN DEGREES.
800 REM  Q·CONTAINS THE DISTANCE BETWEEN THE 2 POINTS.
810 REM  USES VARIABLES A,B,Q,Q2,D,S,N,U
820 REM  X,X1,Y,Y1 ARE UNCHANGED.
830 IF X1=X AND Y1=Y THEN C$="NO MOVEMENT"
840 IF X1>X AND Y1=Y THEN C$="DUE WEST"
850 IF X1>X AND Y1>Y THEN C$="NORTH OF WEST"
860 IF X1=X AND Y1>Y THEN C$="DUE NORTH"
870 IF X1<X AND Y1>Y THEN C$="NORTH OF EAST"
880 IF X1<X AND Y1=Y THEN C$="DUE EAST"
890 IF X1<X AND Y1<Y THEN C$="SOUTH OF EAST"
900 IF X1=X AND Y1<Y THEN C$="DUE SOUTH"
910 IF X1>X AND Y1<Y THEN C$="SOUTH OF WEST"
920 REM
930 REM  SUBROUTINE MAY BE ENTERED HERE IF C$ IS NOT REQUIRED."
940 REM
950 U=57.29578
960 Q=0\D=0
970 N=ABS(X-X1)
980 B=90-Y
990 A=90-Y1
1000 S=COS(A/U)*COS(B/U)+SIN(A/U)*SIN(B/U)*COS(N/U)
1010 IF S*S>=1 THEN RETURN
1020 Q2=ATN(SQRT(1-S*S)/S)
1030 Q=Q2*U*69.5
1035 IF Y=Y1 THEN RETURN
1040 S=SIN(A/U)*SIN(N/U)/SIN(Q2)
1050 IF S*S>=1 THEN RETURN
1060 D=ATN(S/SQRT(1-S*S))*U
1070 D=90-D
1080 RETURN
```

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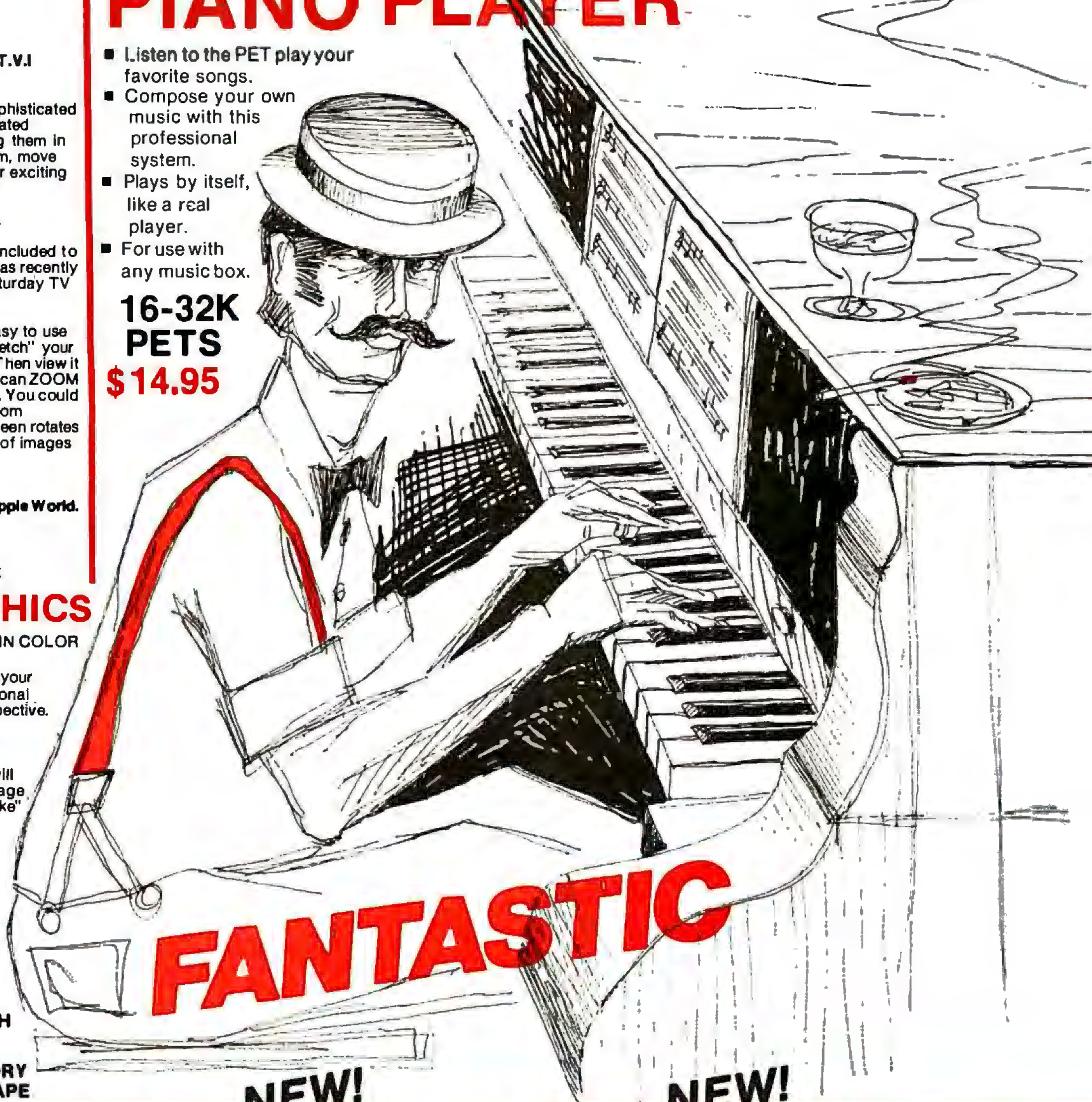
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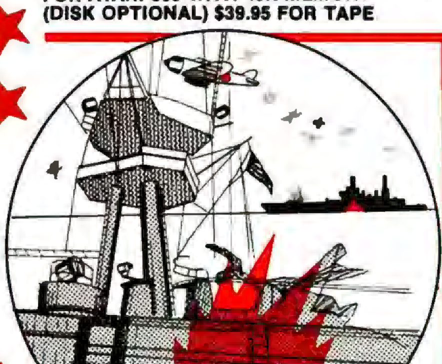

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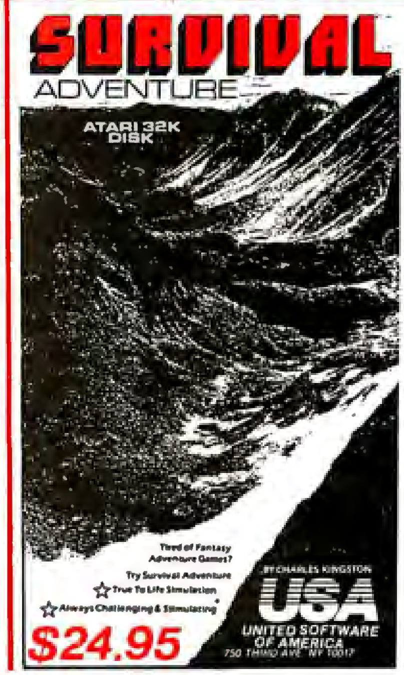

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Changes to FLOPTRAN-IV

George H Watson Jr, Physics Department
University of Delaware, Newark DE 19711

I thoroughly enjoyed Mark Zimmermann's article on compiled BASIC for the Commodore PET. (See "FLOPTRAN-IV: A Tiny Compiler," October 1980 BYTE, page 196.) His detailed documentation enabled me to translate FLOPTRAN-IV for use with version 3 PET ROMs (read-only memories). I would like to share with BYTE readers the changes needed for this translation.

- GO% is replaced by G0% in lines 50000, 58760, 58840, and 60080 as shown:

```
50000 DIMX, LN%(255),G0%(127,1),ML%(19,1):P=1025:GC=0
58760 G0%(GC,0)=PC-32766:PRINT#1,0:PRINT#1,0
      :PC=PC+3:TL=0
58840 G0%(GC,1)=TL:GC=GC+1:GOTO50260
60080 FORX=0TOGC-1:PRINT#1,G0%(X,0)+32767
      :L=G0%(X,1):Z=LN%(L)+32767
```

- Change the DATA statements for the ROM subroutines in lines 49600, 49640, and 49680 as follows:

```
49600 DATA69,219,216,219,100,219,0,0,91,210,122,210
49640 DATA94,222,127,223,246,216,218,222,216,223,223,223
49680 DATA40,224,140,224,232,214,115,215,54,215,52,217,30,
      218,104,222
```

- The pointer to the start of the variables is at hexadecimal 2A,2B, so the PEEKs in line 58180 must be changed as follows:

```
58180 PRINT#1,24:PRINT#1,144:PRINT#1,5:PC=PC+3
      :VL=256*PEEK(43)+PEEK(42)+2
```

- The BASIC buffer is now in the second page of programmable memory, so lines 59620 thru 59780 should read:

```
59620 PRINT#1,157:PRINT#1,32:PRINT#1,2:PRINT#1,232
      :PRINT#1,201:PRINT#1,13
59660 PRINT#1,208:PRINT#1,245:GOSUB59300
59680 PRINT#1,169:PRINT#1,2:PRINT#1,133:PRINT#1,32
      :PRINT#1,169:PRINT#1,32
59700 PRINT#1,133:PRINT#1,31:PRINT#1,202:PRINT#1,138
      :PRINT#1,32:PRINT#1,143
59760 PRINT#1,214:PRINT#1,162:PRINT#1,ZL:PRINT#1,160
      :PRINT#1,ZH
59780 PRINT#1,32:PRINT#1,224:PRINT#1,218:PC=PC+46
      :GOTO59500
```

- Line 59780 above and lines 49420, 50720, 51520, 55660, and 59080 require changes, as follows, due to other alterations in subroutine locations:

```
49420 PRINT#1,32:PRINT#1,174:PRINT#1,218:PC=PC+7
      :RETURN
50720 PRINT#1,32:PRINT#1,152:PRINT#1,217:PC=PC+3
      :GOTO51080
51120 PRINT#1,32:PRINT#1,224:PRINT#1,218:PC=PC+7
      :GOTO50240
55660 PRINT#1,69:PRINT#1,99:PRINT#1,133:PRINT#1,99
      :PC=PC+6:GOTO51100
59080 GOSUB49190:GOSUB49400:PRINT#1,32:PRINT#1,233
      :PRINT#1,220
```

In the new ROMs, the array dimensions are limited by the amount of memory available. The number of possible lines in the source file can be increased by changing lines 49940, 50000, and 50200, replacing 255 with the number of lines desired. ■

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Multiprocessing with Motorola's MC6809E

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Recent years have seen microprocessors assuming applications previously targeted for minicomputers. Their cost and size advantages have spurred their inclusion in a variety of designs such as word processors, computer terminals, and cash registers. Where these functions were once implemented on minicomputers and timesharing terminals, microprocessors can now take on most of the burden in these jobs.

There are still many applications where microprocessors are too slow or are lacking in arithmetic power. However, microprocessors are so attractive from a cost standpoint that ways to use them in computation-bound problems are being intensively investigated. The sharing of resources by more than one processor spreads the cost of expensive programmable memory, mass storage, and peripheral devices. The percentage of utilization is increased, making these resources more efficient.

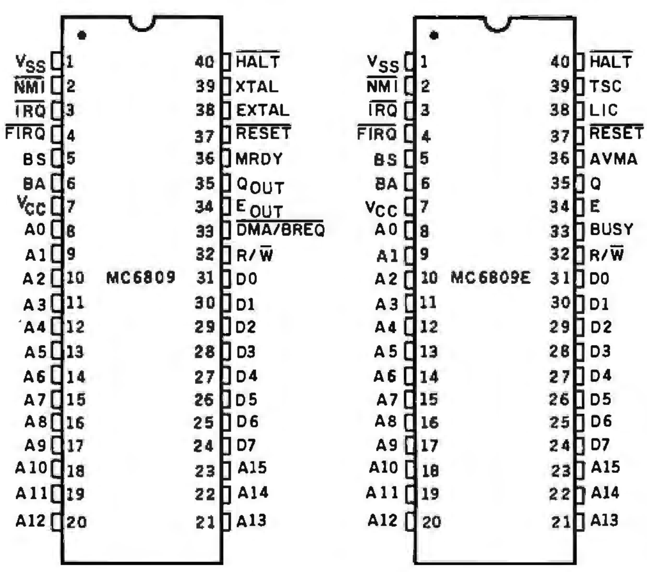

Figure 1: *Basic hardware changes made to develop the MC6809E. Comparing the pin assignments of the original MC6809 with the "E" version's reveals that 4 pins have new functions. The MC6809E does not have an on-board clock generator. It relies on external circuitry to perform this function. This allows the control of the bus accesses in a multiprocessor application.*

Multiprocessing (using more than one processor) is one way to accomplish this increase in use. The use of two or more microprocessors sharing common resources, each working on a portion of a problem, allows a microcomputer system to function where a minicomputer was needed previously—provided that the microprocessor can be used in a multiprocessor system. Motorola's new 8-bit microprocessor, the MC6809E, was designed with multiprocessing in mind.

Features of the MC6809E

While the MC6809E features the same instruction set as the MC6809, there are some basic hardware differences (see figure 1 for a pin description). The first difference is the clocks. The MC6809 has an on-board clock generator and inputs to control it: the MRDY (memory ready) pin causes the E and Q clocks to be stretched to allow for a longer access time (for slow memory circuits). The clock signals for the MC6809E, on the other hand, must be generated by an external circuit (see figure 2) that can also be used to stretch the clocks. On the MC6809, the DMA/BREQ input is used to stretch the clocks internally and force the address and data buses into the high-impedance state for DMA (direct memory access) operations. Since the clock generator is external to the MC6809E, this input is not present.

Figure 2 shows a simple clock-generator circuit for use with the MC6809E. The system clock is based on the signal from a crystal oscillator whose frequency is four times the desired clock frequency; the oscillator's output signal is called 4 X. The timing of the bus signals is shown in figure 3. The MRDY input is sampled on the rising edge of the 4 X signal before the falling edge of E. If MRDY is high, E falls with the next falling edge of 4 X, and Q rises one 4 X period later. If MRDY is low, E is *stretched* to remain high and Q is stretched low. Signals on the data and address buses remain valid until MRDY goes high again. E falls on the next falling edge of the 4 X signal, and E and Q continue normally from there. The MC6809E can have its clock stretched a maximum of 10 μs.

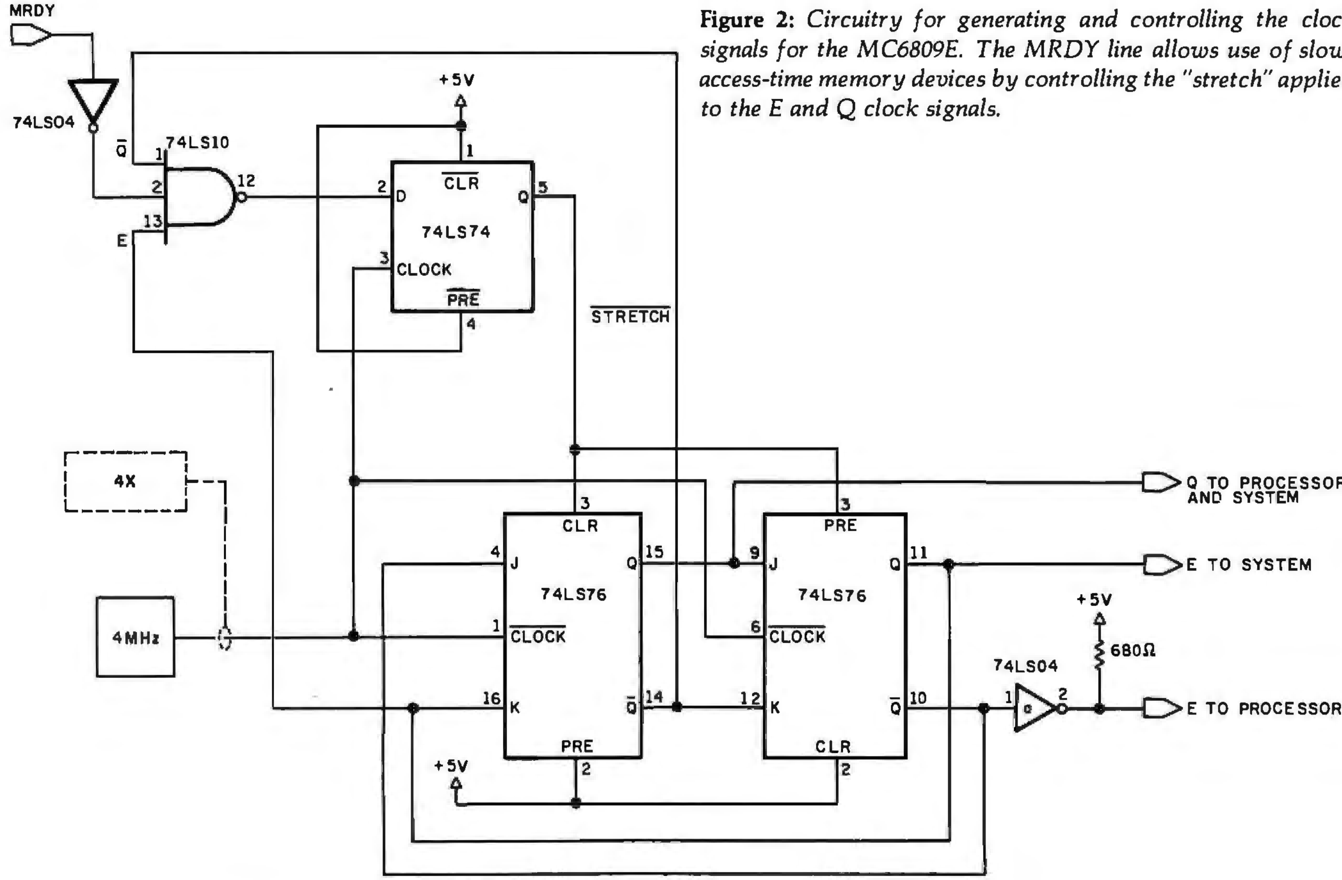

Figure 2: *Circuitry for generating and controlling the clock signals for the MC6809E. The MRDY line allows use of slow-access-time memory devices by controlling the "stretch" applied to the E and Q clock signals.*

In addition, the MC6809E has 4 pins dedicated to signals not used in the MC6809: TSC, AVMA, BUSY, and LIC. Asserting (placing a logical true signal on) the TSC (three-state control) pin forces the data bus, address bus, and R/$\overline{W}$ (read/write) line into a high-impedance state if the clocks are both held in the logic low state. This can be used to temporarily "remove" the processor from the bus so another bus master, such as a DMA controller, can take over.

The LIC (last instruction cycle) pin is high during the last cycle of an instruction. This signal, in conjunction with a bipolar PROM (programmable read-only memory), can be used to decode unimplemented opcodes and trigger an error condition. The error condition can be used to reset the processor to a known condition and recover. This helps to guarantee system integrity for applications needing fail-safe operation.

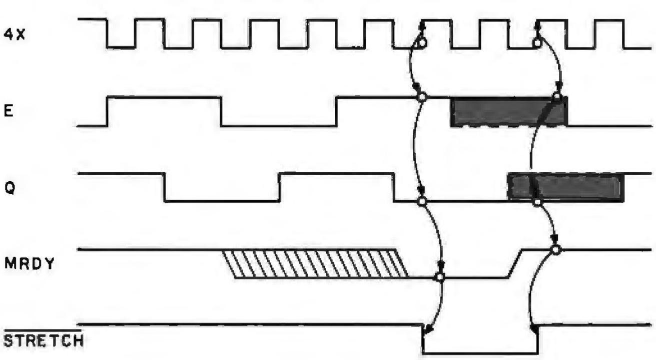

Figure 3: *Timing diagram for the circuit in figure 2. The MRDY and 4 X signals are used in combination to determine how long the E and Q clocks will be stretched (shaded areas).*

AVMA (advanced valid memory access) indicates that the processor will access the bus on the next cycle, whether an opcode or operand. Since the MC6809E sets all address and R/$\overline{W}$ lines high during cycles in which it is not accessing the bus, this signal is useful to a bus arbiter in deciding which processors are granted bus access and which have to wait. (This will be discussed in more detail later, in a multiprocessor system implementation.)

The BUSY signal indicates that an indivisible memory access is taking place. This occurs during double-byte operations (such as LDX), and also during the read-modify-write instructions (such as shifts and rotates) in which a byte is fetched from memory, modified, and returned. This is also useful in a multiprocessing environment, as will be shown later.

The timing relationship of these signals is shown in figure 4. The example given is the execution of an ASR (arithmetic shift-right) operation on a memory location using the extended (16-bit) addressing mode. AVMA is high for the first three cycles, indicating that the processor is using the bus. This is the opcode fetch (hexadecimal 77) and the operand fetch (hexadecimal 10 and 00) from locations hexadecimal 100, 101, and 102. AVMA then goes false to show that the next cycle is not a

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valid memory-access cycle; BUSY is then made true to identify the read-modify-write portion of the instruction. The value at address hexadecimal 1000 is read, shifted, and written back to memory. LIC is then made true to indicate the last cycle of the instruction. LIC, AVMA, and BUSY are all valid from the rising edge of the Q clock.

Software

The MC6809 and MC6809E have a powerful instruction set, including a variety of indexed addressing modes,

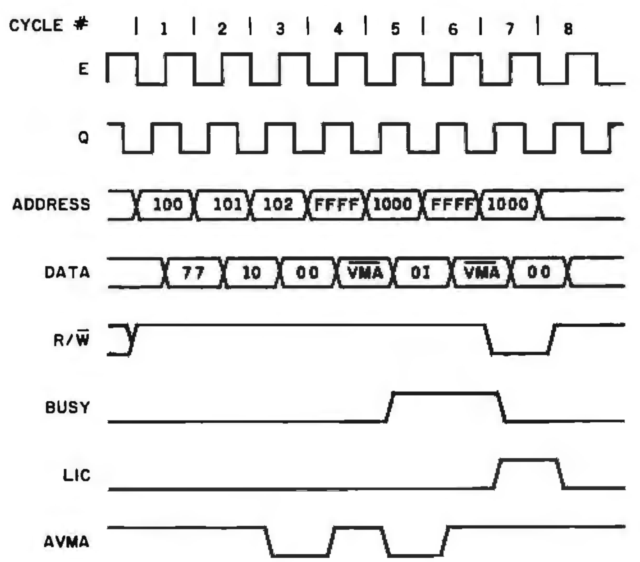


Figure 4: *Timing relationships of MC6809E signals during an ASR (arithmetic shift-right) instruction. All numbers shown are in hexadecimal.*

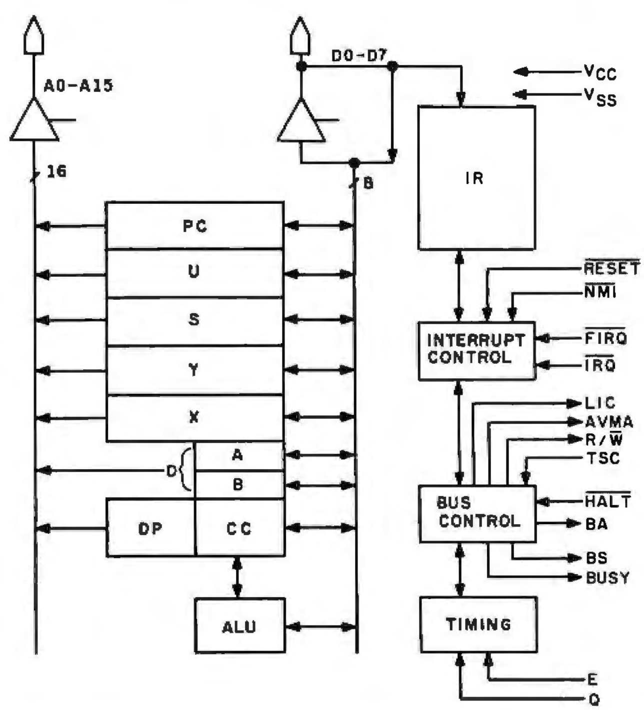
16-bit math functions, and versatile stack-manipulation instructions. They support position-independent reentrant code and the multiple-stack architecture required by many high-level languages, including Pascal.

The processor's architecture and programming model are shown in figure 5. There are two 16-bit stack pointers (S and U) and two 16-bit index registers (X and Y). Two 8-bit accumulators are provided, but they can be used as a single 16-bit accumulator (D) to perform double-precision additions and subtractions. The DP (direct-page register) allows a "floating" 256-byte page for direct (8-bit address) instructions. (This saves on the amount of code and time required to access frequently used variables.)

Both stack pointers also support all indexed addressing modes, and both index registers can be used as stack pointers:

```
PUSHAX  STA  0,-X  TO PUSH, PNTR IS DEC,
                   THEN STORE A
PULLAX  LDA  0,X+  TO PULL, LOAD THEN
                   INCR PNTR
```

This code implements stacks with the X and Y index registers. The X register is used as a stack pointer that always points to the last entry in the stack. The automatic "predecrement" indexed mode is used to implement a push to the stack. (The X register is first decremented by one, and the A accumulator is stored at the location pointed to by X.) In the same fashion, a pull is accomplished with the load-accumulator-indexed instruction with an automatic postincrement operation.



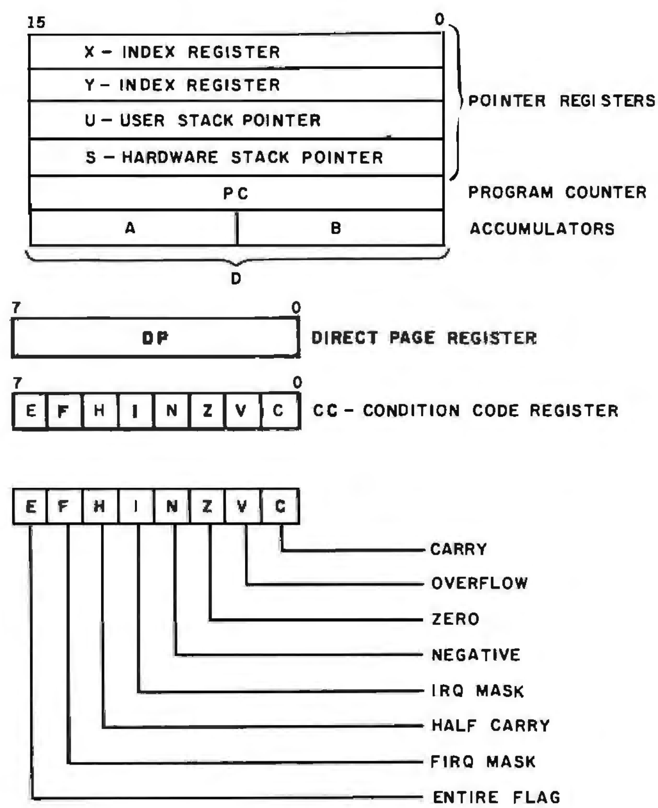


Figure 5: *Internal architecture and programming model of the MC6809E.*

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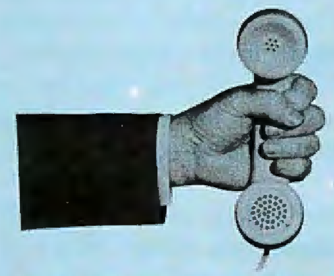

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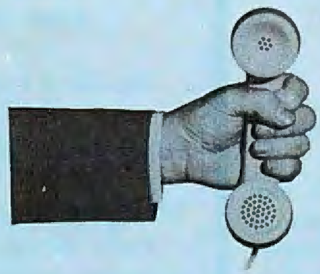

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Listing 1: *A completely reentrant search routine for the MC6809E. Each routine in a program passes parameters on a stack and returns them on the stack.*

```
******************CHARACTER SEARCH***************
*
*        SEARCH A TABLE OF LENGTH N STARTING AT
*        LOCATION TAB TO FIND CHAR. IF THE SEARCH
*        IS SUCCESSFUL, RETURN WITH ADDRESS ON
*        THE STACK AND C=1, IF NOT THEN CLEAN THE
*        STACK AND RETURN WITH C=0
*
*        ON ENTRY CHAR, N AND TAB ARE ON STACK
*
*        REGISTER VOLATILITY: A,B,X,Y,CC
*
*
CHAR     EQU     0        OFFSET ON STACK TO CHAR
TAB      EQU     1        2 BYTE ADDR OF TABLE
N        EQU     3        NUMBER CHARS IN TABLE
*
SEARCH   LDX     TAB,S    GET ADDR OF TABLE IN X
         LDB     N,S      GET N
         LDA     CHAR,S   GET CHAR TO FIND
S1       CMPA    ,X+      CHECK FOR MATCH, INC PNTR
         BEQ     FOUND    GOT IT
         DECB             DEC COUNT
         BNE     S1       NOT FINISHED YET
NOT      ANDCC   #$FE     CLEAR CARRY
         LEAS    4,S      CLEAN STACK
         RTS              RETURN
FOUND    ORCC    #$01     SET CARRY
         LEAS    4,S      CLEAN STACK
         LDY     0,S      GET RETURN ADDR IN Y
         STX     0,S      PUT CHAR ADDR ON STACK
         JMP     0,Y      RETURN TO CALLER
```


The A accumulator is loaded with the value pointed to by X, and the X register is incremented. In any case, the stack pointer points to the last byte on the stack.

The proper use of stacks in an MC6809 machine-language program allows completely reentrant code to be written, making recursive routines easy to implement. Each routine passes parameters on a stack and returns them on the stack, as well as keeping any temporary variables there. An example of this is shown in listing 1.

The MC6809E also supports position-independent code through its relative-addressing mode and LEA (load effective address) instruction. Two types of branches are provided—short and long. The short-branch instructions have a single-byte signed offset from the current location, allowing a branch within the 256-byte page centered on the branch opcode. The long-branch instructions have a 2-byte signed offset, allowing branches to anywhere in the 16-bit address map.

A particularly useful relative-address mode is the PCR (program counter relative) mode. This allows the use of the program counter itself as an index register. Using this mode in conjunction with the LEA instruction allows the calculation of absolute addresses at run time, even though the final execution address may not be known at assembly time.

The LEA instruction loads the effective address of an operand into an index register instead of the operand itself, allowing absolute addresses to be calculated in position-independent code:

```
TABLE RMB  20               START OF DATA TABLE


           LEAX TABLE,PCR   GET ADDRESS OF TABLE
           LDA  ,X+         GET A BYTE OF DATA
```

The LEAX instruction loads the absolute (effective) address of TABLE into the X register, even though this differs if the routine is executed at different addresses.

Multiprocessor Systems

There is considerable debate about what a multiprocessor system should do and how it should be implemented. On one hand are loosely coupled systems, in which several computers communicate with one another (over a serial link, for example), each processor doing part of a larger job. Local processors can preprocess raw data into a more manageable format to be used with more comprehensive algorithms on another computer. On the other hand are tightly coupled systems, in which several processors share a common bus (of a given bandwidth), using the same memory and I/O (input/output) interfaces in a timeshared fashion. The MC6809E was designed for this latter type of system.

Two types of systems are considered here, the local/global and the global-only. In the local/global system, each processor has a *local bus* with a block of program-

Text continued on page 146

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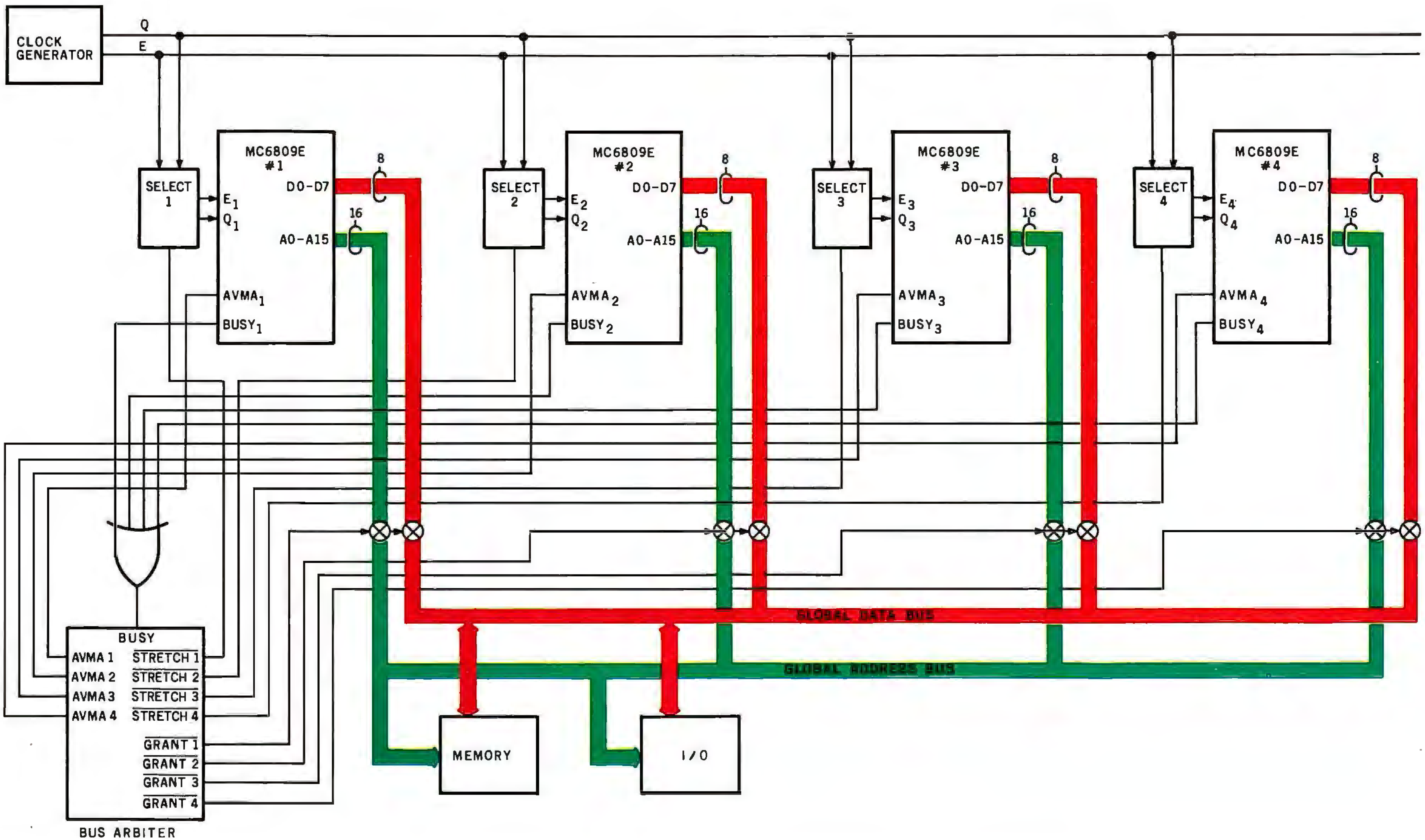

Figure 6: *Block diagram of a global-only multiprocessor system. Each of the four microprocessors shares the system's memory and I/O resources using a round-robin priority system.*

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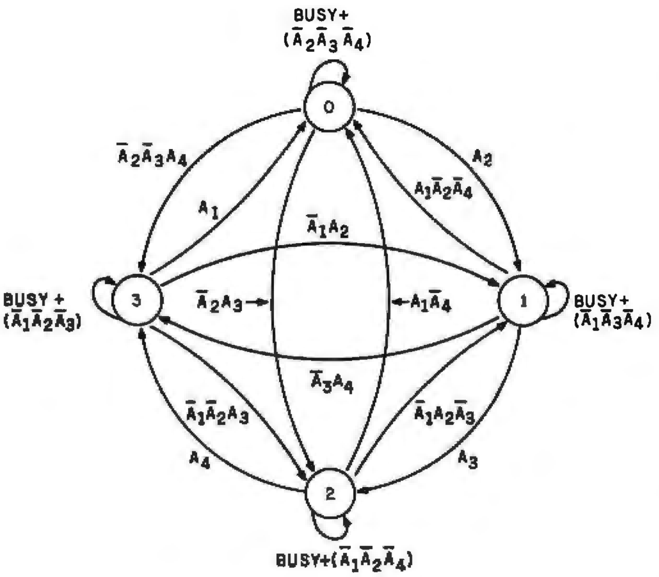

A_1 = AVMA1
A_2 = AVMA2
A_3 = AVMA3
A_4 = AVMA4
BUSY = BUSY 1+BUSY2+BUSY3+BUSY4

Figure 7: *State diagram of the bus arbiter used in a four-processor system. This resolves conflicts regarding which processor has access to the system resources.*

Text continued from page 142:
mable memory not shared by the others; a *global bus* makes available the memory and I/O that is shared. Arbitration takes place only when one processor wishes to use the global bus. In a global-only system, all processors share the same global bus and every cycle must be arbitrated.

The block diagram in figure 6 shows a global-only system in which four MC6809Es share a block of memory and some I/O interfaces. Each processor is connected to the bus via three-state bus buffers controlled by the bus arbiter. The AVMA lines of each processor are connected to the arbiter to indicate which processor is requesting access to the bus. The BUSY lines are logically ORed together to provide a single BUSY signal to the arbiter.

The arbiter's control outputs are four grant signals that control the three-state buffers of their respective processors, and four stretch signals that stretch the E and Q clocks of each processor, separately.

The function of the bus arbiter is to decide which processor will be granted access to the global bus during each cycle of the E clock. The arbiter determines access to the bus for each processor on a cycle-by-cycle basis. The clocks are stretched on the processors that are requesting the bus. Clocks are provided to the processor on the bus. This allows only one of the processors access during a given E cycle. During any given cycle, arbitration takes place for the next cycle unless BUSY is true, in which case arbitration is deferred until it becomes false. This is to ensure that data is not modified during instructions requiring indivisible accesses.

The state diagram in figure 7 shows the logical function of the arbiter. Each state represents the state of the grant outputs shown in table 1. For example, in state 1, GRANT1 is true and the remaining grant signals are false. If BUSY is true, the next state is the same as the present state and the bus continues to be granted to the same processor. BUSY remains true for a maximum of two cycles.

If no other processor requests the bus via its AVMA signal, the bus remains granted to the one currently having possession, even if it does not require it; this simplifies the logic of the arbiter.

If the processor next requesting the bus is next in line to have highest priority (ie: its number in the round-robin priority scheme is numerically next), it is granted the bus and the rest are denied access. If it does not request the bus and another processor does, the requesting unit with the highest priority is granted an access.

The stretch signals are also generated by the arbiter. If a processor requests the bus and is denied, its grant will be false and its clocks will be stretched with both E and Q held low until that unit is granted the bus and can complete its access. If a processor has not requested the bus, its grant will be false and its three-state bus buffers will be in the high-impedance state, but its clocks will *not* be stretched—to allow completion of its nonmemory access cycle. This improves system throughput markedly in programs where instructions having many internal cycles

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State	Outputs $\overline{\text{GRANT1}}$	$\overline{\text{GRANT2}}$	$\overline{\text{GRANT3}}$	$\overline{\text{GRANT4}}$
0 (00)	0	1	1	1
1 (01)	1	0	1	1
2 (10)	1	1	0	1
3 (11)	1	1	1	0

Table 1: *State of the $\overline{\text{GRANT}}$ outputs of the bus arbiter, as shown in figure 7. State numbers are those shown in figure 7. The binary output of the state-register flip-flop is shown in parentheses.*

AVMA_N	$\overline{\text{GRANT}_N}$	$\overline{\text{STRETCH}_N}$
1	1	1
0	1	0
0	0	1

Table 2: *Truth table of the $\overline{\text{STRETCH}}$ outputs of the bus arbiter, as shown in figure 7. N can have the values 1, 2, 3, or 4.*

(such as a multiply instruction) are used frequently. The truth table for the stretch signals is summarized in table 2.

If a processor, having the highest priority for that cycle, were to execute the fifth cycle of an ASR or similar instruction, the BUSY signal would prevent "rearbitration" and the other processors would be held off for three cycles. If all the processors did the same thing, each would have its clocks stretched for nine cycles. With a 1 MHz E clock, this is 9 µs. Since the maximum time a clock (E or Q) can be low is 9.5 µs, a maximum of four processors can be used in a system of this type. If MC68B09Es (rated at 2 MHz) are used, eight processors can be put on the same global bus.

A circuit implementing the bus arbiter is shown in figure 8. The state machine of figure 7 is implemented using a 74S287 256 by 4-bit PROM, and a 74LS273 octal latch as the next-state latch. Since the AVMA signals change with the rising edge of Q, these signals are latched by the falling edge of E, preventing the inputs to the PROM from changing during arbitration. The outputs of the arbiter are state bits that are decoded with a 74LS139 dual 2-bit to 4-line decoder. The separate grant lines control the enable signals of the three-state buffers, and the stretch signals send the E and Q clocks to the separate processors.

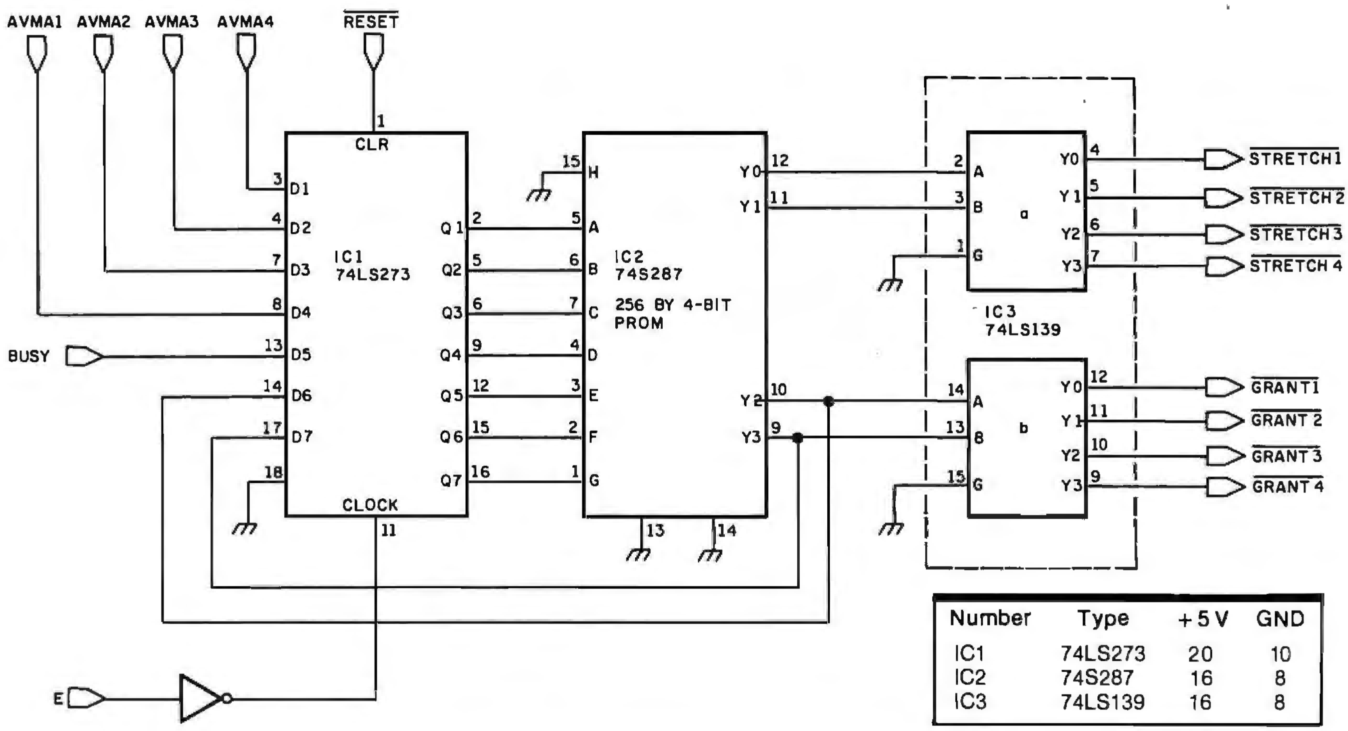
The reset state presents a special problem. When the $\overline{\text{RESET}}$ line is brought low and returned high, the processors fetch their restart vectors from locations hexadecimal FFFE and FFFF. This means that all the processors would execute the same code—hardly an improvement. One way to prevent this is to designate one processor, number 1, for example, as the master. The decoding for the restart vectors would then include $\overline{\text{GRANT1}}$, so processor 1 would restart into code that would perform the I/O and set up the operating system. The other three units would restart to another location containing a SYNC instruction.

Since the interrupt masks E and I are set during reset, the SYNC instruction causes the processor to wait until it receives an interrupt to continue execution. The master processor then writes a jump instruction to the code that each processor is to execute in the location following the SYNC instruction. A PIA (programmable interface adapter integrated circuit) can be used to toggle the IRQ (interrupt request) lines to each processor, in turn, to initiate the execution of the application program.

Semaphores

Now that the processors are all executing code, how do they communicate with one another? They will possibly need to pass data from one to the other. Perhaps one will need to pass a pointer to data that has been processed to another unit, or it might need to output data and will require an I/O device. How can a resource be *allocated* to one processor and its use be made known to the others? The answer is *semaphores*.

A semaphore, in this system, is a memory location set aside by the programmer to be a flag indicating the availability of a resource, memory, I/O, or whatever. The semaphore must show a resource as being allocated or



Number	Type	+5V	GND
IC1	74LS273	20	10
IC2	74S287	16	8
IC3	74LS139	16	8

Figure 8: *The circuitry used to implement the bus arbiter. Information based on table 1 and table 2 (stored in the PROM) is decoded to produce the states shown in figure 7.*

unallocated when read by a processor. If it was unallocated, it must show allocated the next time it is read.

Since bus accesses are performed on a cycle-by-cycle basis, there is the possibility that one processor might read the semaphore, finding it unallocated. Another processor might read it and find it still unallocated before the first processor has a chance to change the semaphore. At this point, the resource might (mistakenly) be allocated to both units.

To prevent this, the BUSY signal is used to defer bus "rearbitration." The shift instructions (which are of the read-modify-write type) can then be used to implement true semaphores:

```
CHECK  ASR  SEM     READ SEMAPHORE
       BCS  FREE    CAN NOW USE PRINTER
       BRA  CHECK   IN USE, TRY AGAIN
FREE   EQU  *       PRINTER ROUTINE HERE
```

The ASR instruction is used to allocate a printer to a processor. The location shown symbolically as SEM contains the value 0 if the printer is already in use or the value 1 if it is free. The ASR SEM instruction reads the location and shifts bit 0 into the carry bit of the processor. At the same time, a 0 is shifted into the high-order bit of the location and all other bits are shifted to the right one place. The result is the value 0. This is then written back into memory.

During the two cycles preceding the last write to memory, the BUSY line is high, preventing any other processor from accessing the bus. The BCS (branch-on-carry-set) instruction that follows will branch to FREE if the printer was free. If this is not the case, the program loops back to CHECK to try again. To reset the semaphore and make the resource available, store a 1 in the semaphore location.

The Local/Global System

One problem with the global-only type of system is that, since the processors must access the bus constantly to fetch opcodes, system efficiency suffers. One way to increase efficiency is to provide each processor with a separate, local bus with memory in which to store a program and a portion of the data as well. The only time a processor will be slowed is when it needs to access the global bus. This is called a *local/global system*.

A block diagram of a local/global system is given in figure 9. The top address bit (A15) is used to determine whether an access is local or global. Addresses hexadecimal 7FFF and below are global; 8000 and above are local. This places the restart and interrupt vectors in local address space, alleviating the restart problem mentioned earlier. The BUSY signal should also be gated with A15 to prevent the holding off of "rearbitration" when one of the processors is busy on the local bus. In the system shown, the processors are partitioned functionally. Processor 1 performs all I/O. Processor 2 executes the operating system and directs the operation of the others. Processor 3 and Processor 4 perform data manipulations.

Since it is not known whether an access as indicated by

Text continued on page 154

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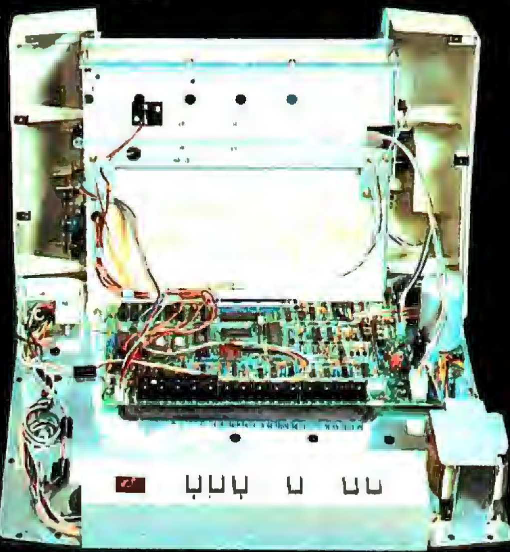

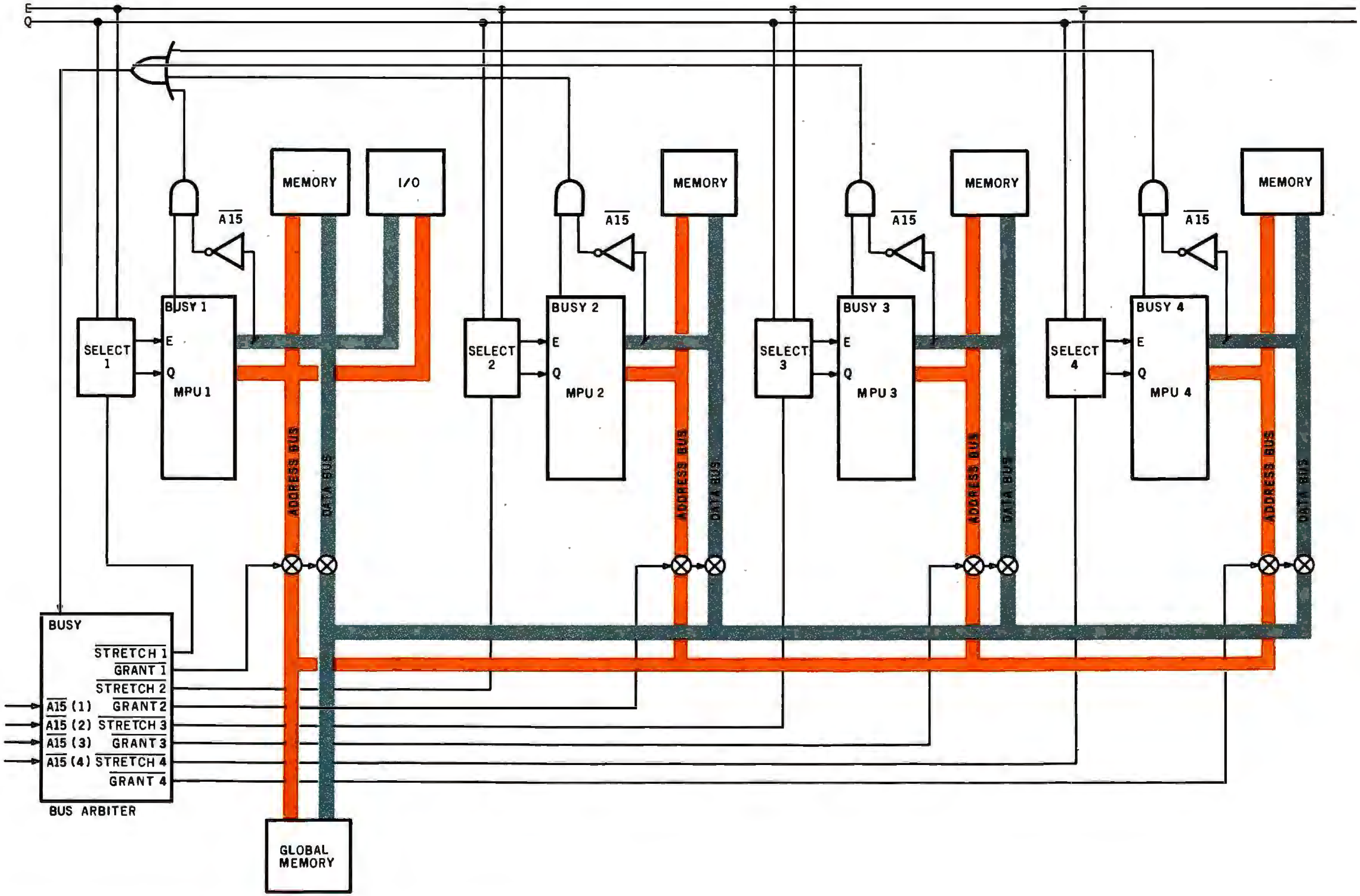

Figure 9: *Block diagram of a local/global multiprocessor system.*

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Text continued from page 150:

AVMA is going to be global or local, bus arbitration cannot be accomplished until addresses for the current cycle become valid. Addresses do not become valid until t_{AD} (200 ns in a processor rated at 1 MHz) after the rising edge of E, and arbitration must be complete before the rising edge of Q to prevent BUSY from switching to the valid state for the next cycle.

The E-low-to-Q-high time (t_{EQ}) is 250 ns at 1 MHz. Arbitration must be complete in $t_{EQ}-t_{AD}=$ 250 ns $-$ 200 ns $=$ 50 ns. Assuming Schottky buffers for the A15 line, there will be a 7 ns delay through the buffer, a 45 ns propagation delay through the 74S287 PROM, an 8 ns propagation delay through the 74S139, and a 22 ns delay for the bus buffers to release from high impedance. This is a total of 82 ns arbitration time. Clearly, this is not sufficiently fast. One solution is to redesign the arbiter using random logic to reduce the arbitration time. Another solution is to slow the system clock to less than 1 MHz, but this reduces throughput. A better solution is to use MC68A09Es. The address delay, t_{AD}, is only 140 ns in this part. With a 1 MHz clock, this requires 250 ns $-$140 ns $=$ 110 ns to arbitrate, leaving a 28 ns margin.

This type of system can use cost-effective 16 K-bit dynamic memory devices by applying the 6809's unique method of software refresh. In this method, an oscillator is connected to the $\overline{\text{NMI}}$ line, causing a nonmaskable interrupt to be generated periodically. The interrupt routine executed with each interrupt is used to refresh the dynamic memory, and the oscillator is set at a frequency allowing all the memory to be refreshed frequently enough to retain all its information. The interrupt routine is 128 page-2 "pre-byte" opcodes (hexadecimal 10), each of which increments the program counter and fetches the next byte (each instruction takes only one machine cycle). This routine quickly cycles through all possible

combinations of the 8 low-address lines (A0 thru A7), which is sufficient to refresh all the 16 K-bit memory devices being used. The memory used may be very slow because the entire cycle is available to access it (since there is no hidden refresh). However, the global memory must have hardware-refresh circuits because the stretched cycles caused by the shared bus preclude efficient refresh by the above method.

Applications

The systems described earlier provide a high concentration of processing power with the ability to communicate over a high-bandwidth medium, the global bus. Appropriate applications for this type of machine include problems that can be broken into subproblems not requiring access to the full block of data; mathematical operations on matrices are an example. Adding, subtracting, multiplying, finding the inverse, and finding the determinant of a matrix are all operations that can be partitioned successfully. If each processor can perform part of the operation and later combine the subproblem solutions, the speed of the system will be substantially increased over conventional serial methods.

A different way to use a multiprocessor system is to functionally partition a problem. Using a separate processor for each task allows simplified system software but retains the cost advantage over separate, loosely coupled systems. Several users can do different tasks simultaneously without a reduction in throughput or the complication of multiple-task operating systems. In any event, multiprocessing certainly has a place wherever concentrated computing power is needed with maximum utilization of resources. Multiprocessing is the wave of the future. ■

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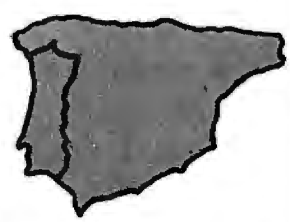

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Computer Simulation of a Solar-Energy System

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Energy consumption in the United States in 1979 exceeded 70 quadrillion Btus (British thermal units). That's a lot of energy. About 22% of that was consumed by residential space and water heating. If some of this energy could be supplied directly by the sun, the savings would be considerable.

This goal could be attained in part by thermal-solar-energy heating systems, but their design presents some problems. For example, what collector area would be most cost-effective? Does the building need more insulation? Can a storage tank hold enough energy to supply the building with heat thru a cold spell? A simulator program can help answer these and other important questions.

A computer program using heat-transfer equations can use numerical approximation to effectively simulate a solar-energy system. Program users can begin simulation with the parameters of their home and learn the effect of changes in these parameters on the efficiency of a hypothetical energy system. In this way, an economical system can be engineered for a particular building and location without costly experimentation.

A typical solar-heating system (figure 1) consists of a collector, storage tank, and pipes connecting these and the building. In this article, I consider only a circulating-water system, keeping in mind that the concepts are similar for a hot air system.

The flow, storage, and exchange of heat are governed by several thermodynamic equations. Heat flow in any homogeneous material is given by the equation:

$$H_f = (T_h - T_c)/R_f \qquad (1)$$

where H_f = heat flow in kilojoules per hour (kJ/hr), T_h = temperature on hot side of material, in degrees Celsius, T_c = temperature on cool side of material in °C, and R_f = resistance to heat flow in the material, with units of degree-hours per kilojoule (degree-hrs/kJ). The resistance to heat flow is a constant, characteristic of the material thru which the heat transfer takes place. This equation will be used to calculate the amount of heat lost from the building. We can also calculate the amount of heat lost from the storage tank and that lost from the collector to the outside air.

The thermodynamic equation for heat storage is:

$$H_s = m\ C_v\ T_a \qquad (2)$$

where H_s = heat stored in the material, in kJ, m = mass of the material in kilograms, C_v = specific heat of the material, in kJ/kg-degree, and T_a = absolute temperature of the material, in kelvins (K). (Kelvins are equivalent to degrees Celsius plus 273.15.) In this equation, H_s is the amount of absolute heat in the material. Any change in T_a will result in a storage or loss of energy.

When water is between 0° and 100°C, its specific heat, or C_v, is about 4.18 kJ/kg-degree. Since one liter of water has a mass of about 1 kilogram in this temperature range, a tank of 1900 liters (about 500 gallons) can store 7942 kilojoules of energy for each degree it is heated, according to equation (2).

Heat exchange, in this case thru water pumped in pipes, is given by the equation:

$$H_x = m_f C_v (T_s - T_d) \qquad (3)$$

where H_x = amount of heat exchanged, in kJ/hr, m_f = mass flow rate of water in liters/hr, C_v = specific heat of water, T_s = temperature of heat source, and T_d = temperature of the heat's destination.

This can be restated as:

$$H_x = (T_s - T_d)/R_x$$

where $R_x = 1/(m_f \times C_v)$. In this way the piping system can be modeled as a resistance to heat flow, and our simulation will take advantage of this fact.

To increase our understanding of the simulation, we can make an analogy between a thermal system and an electrical circuit. Basically, electrical and thermodynamic systems have much in common, according to their dynamics. If we suppose that heat is analogous to electric charge, then heat flow is analogous to current. Thermal

About the Author

Daniel Doan graduated from the Massachusetts Institute of Technology in 1980 with a bachelor's degree in electrical engineering. He is continuing his education at MIT in a master of science program. During the last four years, Dan has done research on a simulation system for power electronic circuits, in which an IMSAI 8080 computer was used.

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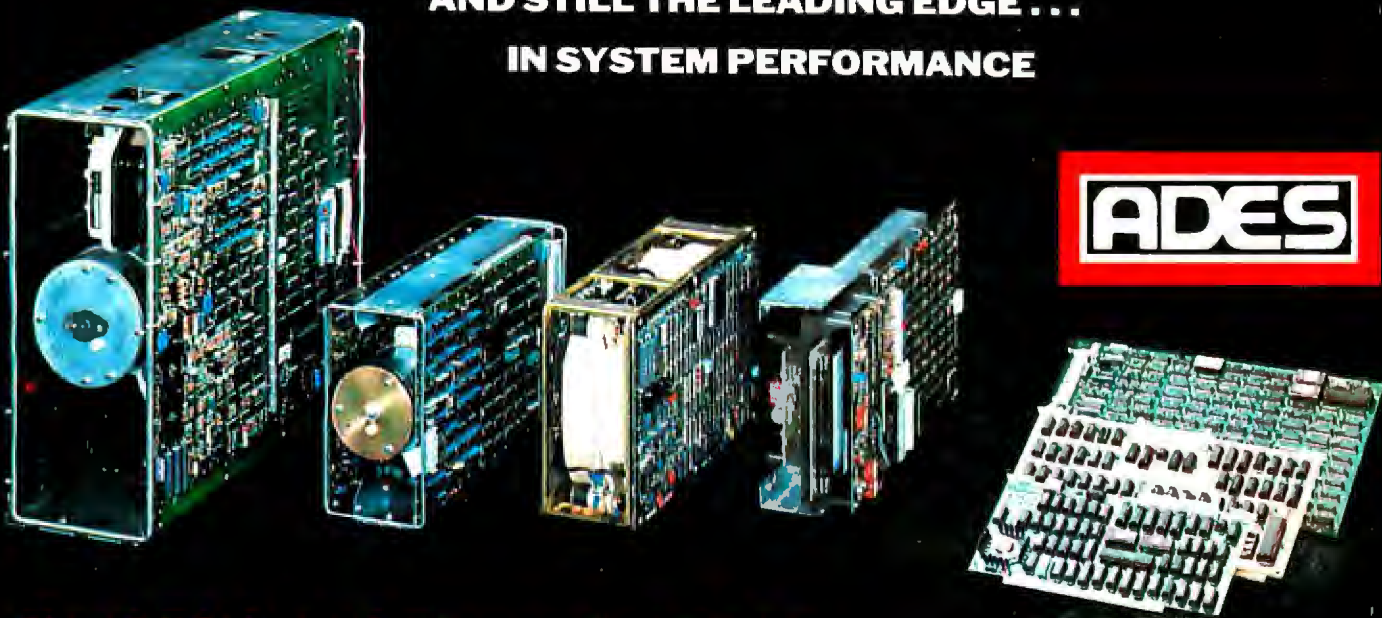

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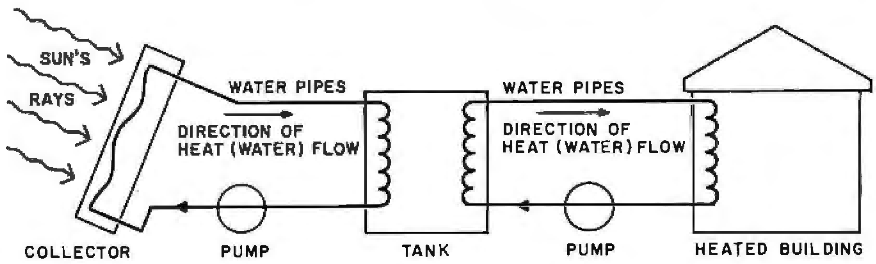

Figure 1: *Diagram of a water-based thermal-energy system that will provide home heat using solar energy as a source. The water tank serves as a temporary energy-storage area, which can provide heat on cloudy days.*

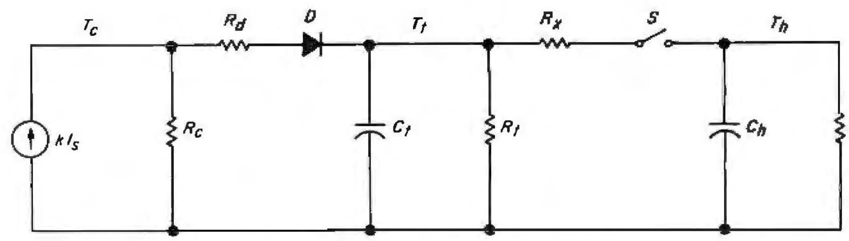

Figure 2: *Electrical simulation of heat flow in the solar-heating system shown in figure 1. Current source I_s simulates the solar collector. Resistors R_d and R_x represent the water-piping system connecting the collector, the storage tank, and the house. Resistors R_c, R_t, and R_h represent paths of heat loss to the environment from the three main system components. The capacitances of C_t and C_h simulate the heat-storage capacity of the water tank and the house, respectively. The switch S symbolizes the house thermostat, closing when the house temperature goes below the thermostat setting. Diode D shows that heat will be transferred to the water tank only when the collector's temperature is greater than that of the tank.*

resistance can be compared with electrical capacitance. Compare equation (1) with Ohm's law:

$$I = (V_h - V_l)/R$$

If the above analogies hold, we can see that the voltage in a circuit corresponds to the temperature in a thermal system.

For a clear illustration that capacitance is the counterpart of heat storage in our analogy, compare equation (2) with the fundamental equation for charge on a capacitor:

$$Q = CV$$

Here C is the capacitance, and V is the voltage across the dielectric. If voltage is analogous to temperature, then in our simulation, heat storage can be modeled as capacitance.

Our thermal system (figure 1) can now be described as an electrical circuit, as shown in figure 2. The piping systems from the collector to the tank and from the tank to the building are modeled by the resistances R_d and R_x, respectively. The switch S symbolizes the building thermostat, closed when building temperature is below the thermostat setting. The diode shows that heat will be transferred from the collector to the tank only when the temperature of the collector is higher than that of the tank. These heat-flow controls will be implemented in our computer simulation by IF statements and a flag in the program.

The heat-storage capacity of the building is symbolized by C_h, and R_h shows the path of heat loss to the environment. The heat-storage capacity of the water tank is shown by C_t, and R_t shows the path of heat loss from the tank. Operation of the collector is defined by the values of k and R_c. The current source at the left of the circuit is a model of the sun's energy that strikes the collector and turns into heat.

The amount of heat actually absorbed by the collector is less than the amount striking it. This is due to reflection from the cover plates and incomplete absorption by the collector surface. The ratio of heat absorbed to heat striking is referred to as k, and is given by the equation:

$$k = at^n$$

where a = absorptivity of surface (about 0.9 for most black paints), t = transmissivity of cover plate (about 0.8 for glass), and n = the number of cover plates.

Some of the absorbed heat will be lost to the environment. This heat flows thru R_c, the value of which is a parameter of the collector. The amount of heat gained from any solar collector can be described by an equation:

$$I_{out} = k\,I_s - (T_c - T_a)/R_c$$

where T_c = temperature of the collector, T_a = temperature of environment, I_{out} = amount of heat actually sent to the storage tank, and k and R_c given as parameters. Commercially built collectors will list the values of k and R_c on data sheets accompanying the units. Occasionally, this data will be given in the form of an efficiency equation:

$$\text{efficiency} = k - U(T_c - T_a)/I_s$$

with k and U given. U is merely $1/R_c$.

The hot-water-storage tank is modeled in our circuit by an RC (resistor/capacitor) network. The time constant of this RC network is R_tC_t. If the tank is large and well in-

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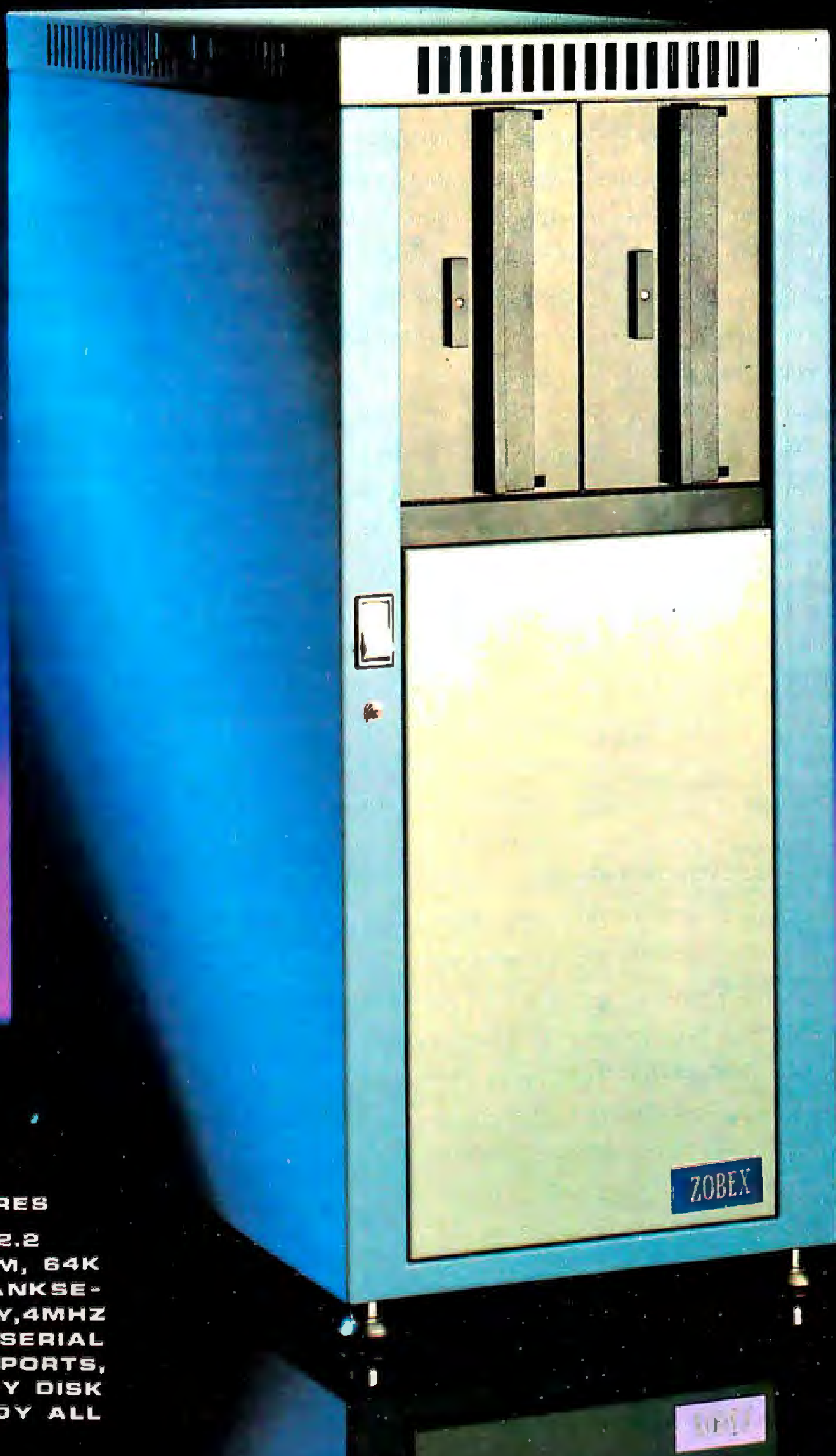

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Listing 1: *The solar-energy system simulator written in CBASIC. The author attempted to use only those BASIC statements available in other versions of BASIC, to facilitate translation.*

```
10  REM             SOLAR ENERGY
20  REM           SYSTEM SIMULATOR
30  REM     BY DANIEL DOAN     JUNE,1980
40  REM
50  REM  DEFINE FUNCTIONS
60  PI = 3.14159
70  REM  ARCCOS(X)
80  DEF FNA(X)=PI/2-ATN(X/SQR(1-X*X))
90  REM  DEGREES TO RADIANS
100 DEF FNR(Y)=Y*PI/180
110 REM
120 REM  DAYS IN MONTH
130 DATA 31,28,31,30,31,30,31,31,30,31,30,31
140 DIM M(12)
150 FOR I=1 TO 12
160 READ M(I)
170 NEXT I
180 REM
190 REM  GET PARAMETERS
200 FOR CD=1 TO 8
210 GOSUB 3260
220 NEXT CD
230 REM
240 REM  REVISE?
250 GOTO 3000
260 REM
270 REM  INPUT DATA
280 GOSUB 2000
290 IF IT<0 THEN 2500
300 REM  SETUP SUN
310 GOSUB 2200
320 REM
330 REM  LOOP ONE HOUR
340 FOR MI=DT TO 60.0 STEP DT
350 T=HR+MI/60
360 IS=B*SIN((T-(12-WS))*PI/(2*WS))
370 IS=IS*DT/60
380 IF T<12-WS OR T>12+WS THEN IS=0
390 REM  ADD TO SUM1
400 FT=FT+IS
410 IF TC<TT THEN 470
420 TC=RD*RC/(RC+RD)*(K*IS+TA/RC+TT/RD)
430 IF TC>100 THEN TC=100
440 II=(TC-TT)/RD
450 II=II*DT/60
460 GOTO 490
470 TC=K*IS*RC*60/DT+TA
480 II=0
490 REM  ADD TO SUM2
500 ST=ST+II
510 REM  CALCULATE TANK,HOUSE
520 IF TH<TS THEN F=1
530 IH=(TT-TH)/RX
540 IH=IH*DT/60
550 IL=(TT-TA)/RT
560 IL=IL*DT/60
570 REM  TANK
580 SI=II-F*IH-IL
590 TT=TT+SI/CT
600 IF TT>100 THEN TT=100
610 REM  HOUSE
620 SI=F*IH-DT*(TH-TA)/(RH*60)
630 TH=TH+SI/CH
640 REM  ADD TO SUM3
650 HT=HT+IH*F
660 F=0
670 IF OP$="S" THEN GOSUB 2400
680 NEXT MI
690 REM  SUM4
700 UT=UT+(TS-TA)/RH
710 IF TH<TS THEN 880
720 HR=HR+1
```

Listing 1 continued on page 164

sulated, it will cool off very slowly. This means that its RC time constant is large. From equation (2):

$$C_t = m\ C_v$$

Since the specific heat C_v is 4.18 kJ/kg-degree, C_t is equal to 4.18 kJ/degree multiplied by the number of liters of water in the tank. A good time constant is a week, or 168 hours, and that requires R_t to be about 0.021 degree-hrs/kJ for the 1900-liter tank.

A 1-inch thickness of common fiberglass insulation has a thermal resistance value of about 1.95 degree-m²-hrs/kJ. To convert this metric R-value or R-number to R_t, it must be divided by the area insulated. The result is in units of degree-hrs/kJ. If the 1900-liter tank has an outside area of 20 square meters, 1 inch of insulation will give $R_t = 1.95/20 = 0.098$ degree-hrs/kJ. This would be sufficient to insulate the tank, but more insulation is recommended and will decrease the amount of heat wasted.

The thermal-resistance coefficient of the building must also be calculated. This can be derived from the amount of insulation, heat loss thru windows and doors, and the heating of infiltrating air. This is complicated and beyond the scope of this article, but a guide to this calculation can be found in *Sound Control and Thermal Insulation of Buildings* by Paul Close (see reference 1). An easier way to determine R_h is to divide the number of degree-days in a year by the number of kilojoules of energy burned by the building's heating plant during that year. In this manner:

$$R_h = 24 \times N/(H_u \times eff) \times 5/9$$

where N = number of degree-Fahrenheit-days in a year, H_u = number of kilojoules burned by heating system in that year, and eff = efficiency of the furnace. The factor 5/9 converts degrees Fahrenheit to degrees Celsius.

To find H_u, the amount of fuel burned must be multiplied by its energy content. Coal contains about 6.2×10^6 kJ/metric ton, #2 heating oil contains about 39,100 kJ/liter (148,000 kJ/gallon), and natural gas contains about 19,950 kJ/m³ (565 kJ/ft³). The efficiency of a typical furnace is between 70% and 80%, but it should be measured for each individual furnace. The number of degree-days in a year for a specific geographic region can be obtained from local weather or radio stations.

The heat capacity of the building C_h cannot be easily determined from the design of the building. But the building cools down to the temperature of its environment exponentially as a function of time, with no heat source, by the equation:

$$T = (T_i - T_e)\exp(-t/R_hC_h) + T_e$$

Here, T_i = initial inside temperature, and T_e = temperature of the environment. The time it takes

Text continued on page 168

Listing 1 continued:

```
730  IF HR=24 THEN 770
740  IF OP$="H" THEN GOSUB 2400
750  IF IP$="H" THEN 260
760  GOTO 320
770  HR=0
780  DA=DA+1
790  IF DA>M(MO) THEN 830
800  IF OP$="D" OR OP$="H" THEN GOSUB 2400
810  IF IP$="D" OR IP$="H" THEN 260
820  GOTO 300
830  DA=1
840  MO=MO+1
850  IF MO=13 THEN MO=1
860  GOSUB 2400
870  GOTO 260
880  REM  AUX HEAT
890  IF TH>=TS-5 THEN 720
900  SA=SA+(TS-5-TH)*CH
910  TH=TS-5
920  GOTO 720
930  REM
940  REM
950  REM
960  REM  SUBROUTINES
970  REM
980  REM
990  REM
1000 REM GET LOCATION
1010 PRINT
1020 INPUT"LATITUDE(D,M,S)";LD,LM,LS
1030 LA=((LD*60+LM)*60+LS)/3600
1040 LA=FNR(LA)
1050 RETURN
1100 REM
1110 REM  GET DT
1120 PRINT
1130 PRINT"STEP SIZE, IN MINUTES"
1140 INPUT DT
1150 IF 60/DT=INT(60/DT) THEN RETURN
1160 PRINT
1170 PRINT"DT MUST BE A FACTOR OF 60."
1180 GOTO 1120
1200 REM
1210 REM  COLLECTOR DATA
1220 PRINT
1230 PRINT"COLLECTOR AREA"
1240 INPUT"(SQR. METERS)";AR
1250 PRINT
1260 INPUT"ANGLE FROM HORIZONTAL";AN
1270 AN=FNR(AN)
1280 PRINT
1290 PRINT"COLLECTOR LOSS"
1300 INPUT"COEFFICIENT";RC
1310 PRINT
1320 INPUT"# OF COVER PLATES";NP
1330 AL=0.9
1340 TR=0.8
1350 K=AL*TR^NP
1360 RETURN
1400 REM   TANK DATA
1410 PRINT
1420 INPUT"TANK VOLUME(LITERS)";CT
1430 CT=CT*4.187
1440 PRINT
1450 INPUT"TANK LOSS COEFF.";RT
1460 PRINT
1470 INPUT"FLOW TO TANK(L/MIN)";ML
1480 RD=1/(ML*4.187*60)
1490 RETURN
1500 REM  HOUSE DATA
1510 PRINT
1520 INPUT"HOUSE LOSS COEFF.";RH
1530 PRINT
1540 INPUT"HOUSE TIME CONSTANT(HRS)";HC
1550 CH=HC/RH
1560 PRINT
```

Listing 1 continued on page 166

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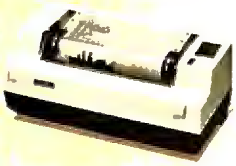

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Listing 1 continued:

```
1570 INPUT"FLOW TO HOUSE(L/MIN)";ML
1580 RX=1/(ML*4.187*60)
1590 PRINT
1600 INPUT"THERMOSTAT SETTING";TS
1610 RETURN
1620 REM
1630 REM  INITIAL TEMPS
1640 PRINT
1650 PRINT"    INITIAL"
1660 INPUT"COLLECTOR TEMP";CI
1670 INPUT"TANK      TEMP";TI
1680 INPUT"HOUSE     TEMP";HI
1690 RETURN
1700 REM
1710 REM  I/O
1720 PRINT
1730 PRINT"OUTPUT EACH MONTH, DAY,"
1740 INPUT"HOUR, OR STEP (M/D/H/S)";OP$
1750 PRINT
1760 PRINT"INPUT EACH MONTH, DAY,"
1770 INPUT"OR HOUR (M/D/H)";IP$
1780 RETURN
1800 REM
1810 REM  INIT DATE,HOUR
1820 PRINT
1830 PRINT"STARTING DATE, TIME"
1840 INPUT"MONTH(1-12)";MS
1850 INPUT"DAY  (1-21)";DS
1860 INPUT"HOUR (0-23)";HS
1870 RETURN
1900 REM
1910 REM  OUTPUT DATE,TIME
1920 PRINT
1930 PRINT"MO   DA   HR"
1940 PRINT MO;" ";DA;" ";HR
1950 RETURN
2000 REM
2010 REM  GET TEMP, INSOLATION
2020 PRINT
2030 PRINT"MEAN OUTDOOR TEMP"
2040 PRINT"FOR PERIOD BEGINNING"
2050 GOSUB 1900
2060 INPUT"(DEGREES F)";TA
2070 TA=(TA-32)*5/9
2080 PRINT
2090 PRINT"MEAN DAILY INSOLATION"
2100 PRINT"FOR SAME PERIOD"
2110 INPUT"(KJ/SQR.METER)";IT
2120 RETURN
2200 REM
2210 REM  NEW DAY OR NEW DATA
2220 REM
2230 N=MO*30+DA
2240 DE=0.40928*SIN((284+N)*2*PI/365)
2250 FA=-1*TAN(LA)*TAN(DE)
2260 WS=FNA(FA)
2270 AC=COS(LA-AN)*COS(DE)+SIN(LA-AN)*SIN(DE)
2280 AT=COS(LA)*COS(DE)+SIN(LA)*SIN(DE)
2290 IU=IT*AR*AC/AT
2300 IU=ABS(IU)
2310 WS=WS*12/PI
2320 B=(IU*PI)/(4*WS)
2330 RETURN
2400 REM
2410 REM  OUTPUT TEMPS
2420 GOSUB 1900
2430 PRINT
2440 PRINT"TH ";TH
2450 PRINT"TT ";TT
2460 PRINT"TC ";TC
2470 RETURN
2500 REM
2510 REM  OUTPUT SUMS
2520 PRINT
2530 PRINT"KJ INCIDENT  ";FT
2540 PRINT"KJ COLLECTED ";ST
2550 PRINT"KJ DELIVERED ";HT
```

Listing 1 continued on page 168

Listing 1 continued:

```
2560 PRINT"KJ REQUIRED  ";UT
2570 PRINT"AUX KJ USED  ";SA
2580 PRINT
2590 PRINT HT/UT*100;" PERCENT SOLAR"
3000 REM
3010 REM
3020 REM  MENU OF COMMANDS
3030 REM
3040 PRINT
3050 PRINT"1 - CHANGE LOCATION"
3060 PRINT"2 - CHANGE DT"
3070 PRINT"3 - CHANGE COLLECTOR DATA"
3080 PRINT"4 - CHANGE TANK DATA"
3090 PRINT"5 - CHANGE HOUSE DATA"
3100 PRINT"6 - CHANGE INITIAL TEMPS"
3110 PRINT"7 - CHANGE I/O"
3120 PRINT"8 - CHANGE DATE, HOUR"
3130 PRINT"9 - RUN"
3140 PRINT"10- CONTINUE"
3150 PRINT"11- QUIT"
3160 PRINT
3170 PRINT"TYPE THE # CORRESPONDING"
3180 PRINT"TO YOUR WISH."
3190 INPUT CD
3200 IF CD>11 OR CD<1 THEN 3000
3210 IF CD = 11 THEN STOP
3220 IF CD = 10 THEN 260
3230 IF CD = 9 THEN 3300
3240 GOSUB 3260
3250 GOTO 3000
3260 REM
3270 REM  DISPATCH
3280 ON CD GOTO 1000,1100,1200,1400,1500,1620,1700,1800
3300 REM
3310 REM  RESET INITS AND RUN
3320 TC=CI
3330 TT=TI
3340 TH=HI
3350 HT=0
3360 ST=0
3370 FT=0
3380 UT=0
3390 SA=0
3400 MO=MS
3410 DA=DS
3420 HR=HS
3430 GOTO 260
```

Text continued from page 162:

to cool down to $1/e$ or about 37% of its original temperature is one time constant R_hC_h.

If one wishes to find this time constant for a particular occupied house, certain approximations must be made. In practice all houses have many heat sources: people, appliances, lights, and pets. These can be ignored because they produce much less heat than the building's main heating system. To measure t_h (which is R_hC_h), turn off the main heating system for a few hours and fit the resulting temperatures over a period of time to the exponential equation shown above. The time constant required (in units of hours) can be divided by R_h to get C_h. For example, the R_h of a typical building might be 10^{-3} degree-hrs/kJ, and t_h might be two days, or 48 hours, so that C_h would be 48,000 kJ/degree.

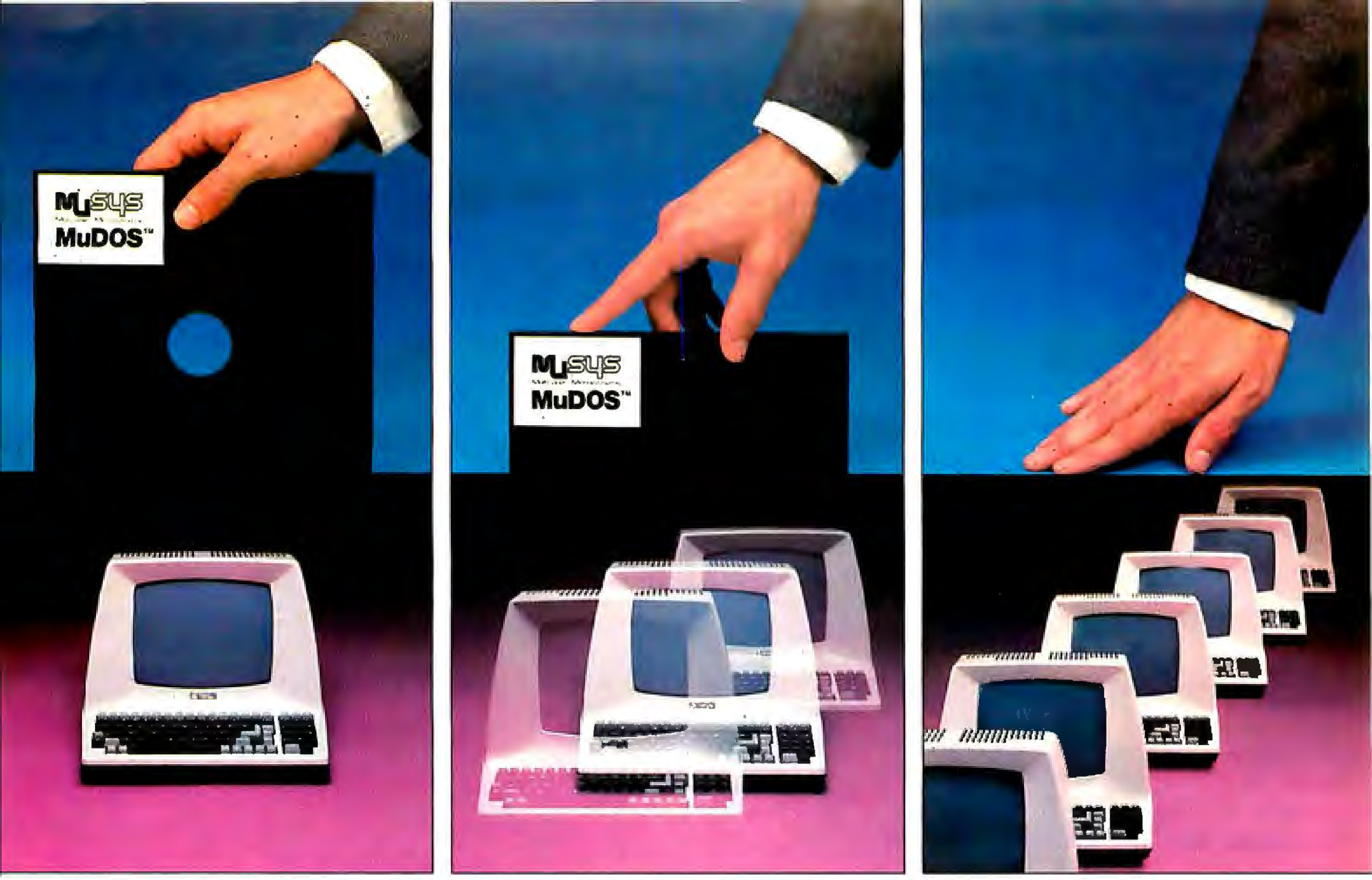
About the Program

Understanding all the preceding parameters is important for understanding the simulator program. This program is designed to work easily on the data from the reference book *Input Data for Solar Systems*, distributed by the United States Department of Energy (see reference 2). This publication contains information in tables for 248 weather stations in the United States. It includes average temperature and standard degree-days (heating and cooling) in degrees Fahrenheit and mean daily solar radiation on a horizontal surface for every station each month of the year.

The simulation program (shown in listing 1) will fit in 8 K bytes of memory with lots of room for expansion. The program was written for an Ohio Scientific C1P, but only those BASIC statements available on most BASIC machines were used.

The first loop, in lines 200 to 220, calls the different subroutines to obtain values for the various heating-system parameters. The initial conditions of the system

Text continued on page 172



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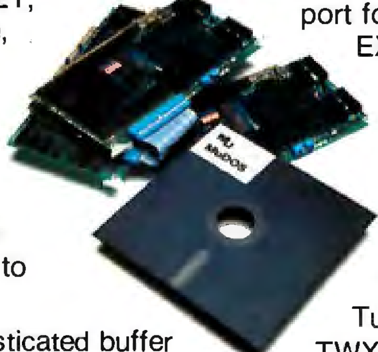

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Listing 2: *Sample run of the solar-system simulator using actual data obtained from the author's parents' home.*

```
CRUN VER 2.03

LATITUDE(D,M,S) 41,20,0

STEP SIZE, IN MINUTES
? 60

COLLECTOR AREA
(SQR. METERS) 40

ANGLE FROM HORIZONTAL 35

COLLECTOR LOSS
COEFFICIENT .0022

# OF COVER PLATES 1

TANK VOLUME(LITERS) 1900

TANK LOSS COEFF. .098

FLOW TO TANK(L/MIN) 5

HOUSE LOSS COEFF. .00213

HOUSE TIME CONSTANT(HRS) 24

FLOW TO HOUSE(L/MIN) 5

THERMOSTAT SETTING 20

    INITIAL
COLLECTOR TEMP 10
TANK      TEMP 50
HOUSE     TEMP 20

OUTPUT EACH MONTH, DAY,
HOUR, OR STEP (M/D/H/S) m

INPUT EACH MONTH, DAY,
OR HOUR (M/D/H) m

STARTING DATE, TIME
MONTH(1-12) 1
DAY  (1-21) 1
HOUR (0-23) 0

1 - CHANGE LOCATION
2 - CHANGE DT
3 - CHANGE COLLECTOR DATA
4 - CHANGE TANK DATA
5 - CHANGE HOUSE DATA
6 - CHANGE INITIAL TEMPS
7 - CHANGE I/O
8 - CHANGE DATE, HOUR
9 - RUN
10- CONTINUE
11- QUIT

TYPE THE # CORRESPONDING
TO YOUR WISH.
? 9


MEAN OUTDOOR TEMP
FOR PERIOD BEGINNING

MO   DA   HR
 1    1    0
(DEGREES F) 26

MEAN DAILY INSOLATION
FOR SAME PERIOD
(KJ/SQR.METER) 5165

MO   DA   HR
 2    1    0

TH  15
TT  16.1120664067
TC -3.33333333333

MEAN OUTDOOR TEMP
FOR PERIOD BEGINNING

MO   DA   HR
 2    1    0
(DEGREES F) 0

MEAN DAILY INSOLATION
FOR SAME PERIOD
(KJ/SQR.METER) -1

KJ INCIDENT    10416572.1067
KJ COLLECTED   2929020.83061
KJ DELIVERED   3030684.47692
KJ REQUIRED    8150234.74177
AUX KJ USED    3404717.54754

 37.1852415659  PERCENT SOLAR

1 - CHANGE LOCATION
2 - CHANGE DT
3 - CHANGE COLLECTOR DATA
4 - CHANGE TANK DATA
5 - CHANGE HOUSE DATA
6 - CHANGE INITIAL TEMPS
7 - CHANGE I/O
8 - CHANGE DATE, HOUR
9 - RUN
10- CONTINUE
11- QUIT

TYPE THE # CORRESPONDING
TO YOUR WISH.
? 10

MEAN OUTDOOR TEMP
FOR PERIOD BEGINNING

MO   DA   HR
 2    1    0
(DEGREES F) 27.3

MEAN DAILY INSOLATION
FOR SAME PERIOD
(KJ/SQR.METER) 7815


MO   DA   HR
 3    1    0

TH  15
TT  17.1636489361
TC -2.61111111111

MEAN OUTDOOR TEMP
FOR PERIOD BEGINNING

MO   DA   HR
 3    1    0
(DEGREES F) 36

MEAN DAILY INSOLATION
FOR SAME PERIOD
(KJ/SQR.METER) 11250

MO   DA   HR
 4    1    0

TH  18.1455114873
TT  21.1256652165
TC  2.22222222222

MEAN OUTDOOR TEMP
FOR PERIOD BEGINNING

MO   DA   HR
 4    1    0
(DEGREES F) 0

MEAN DAILY INSOLATION
FOR SAME PERIOD
(KJ/SQR.METER) -1

KJ INCIDENT    38853164.0338
KJ COLLECTED   12498479.6857
KJ DELIVERED   12236803.5069
KJ REQUIRED    21493583.7251
AUX KJ USED '  5478230.30262

 56.9323555505  PERCENT SOLAR

1 - CHANGE LOCATION
2 - CHANGE DT
3 - CHANGE COLLECTOR DATA
4 - CHANGE TANK DATA
5 - CHANGE HOUSE DATA
6 - CHANGE INITIAL TEMPS
7 - CHANGE I/O
8 - CHANGE DATE, HOUR
9 - RUN
10- CONTINUE
11- QUIT


TYPE THE # CORRESPONDING
TO YOUR WISH.
? 11
```

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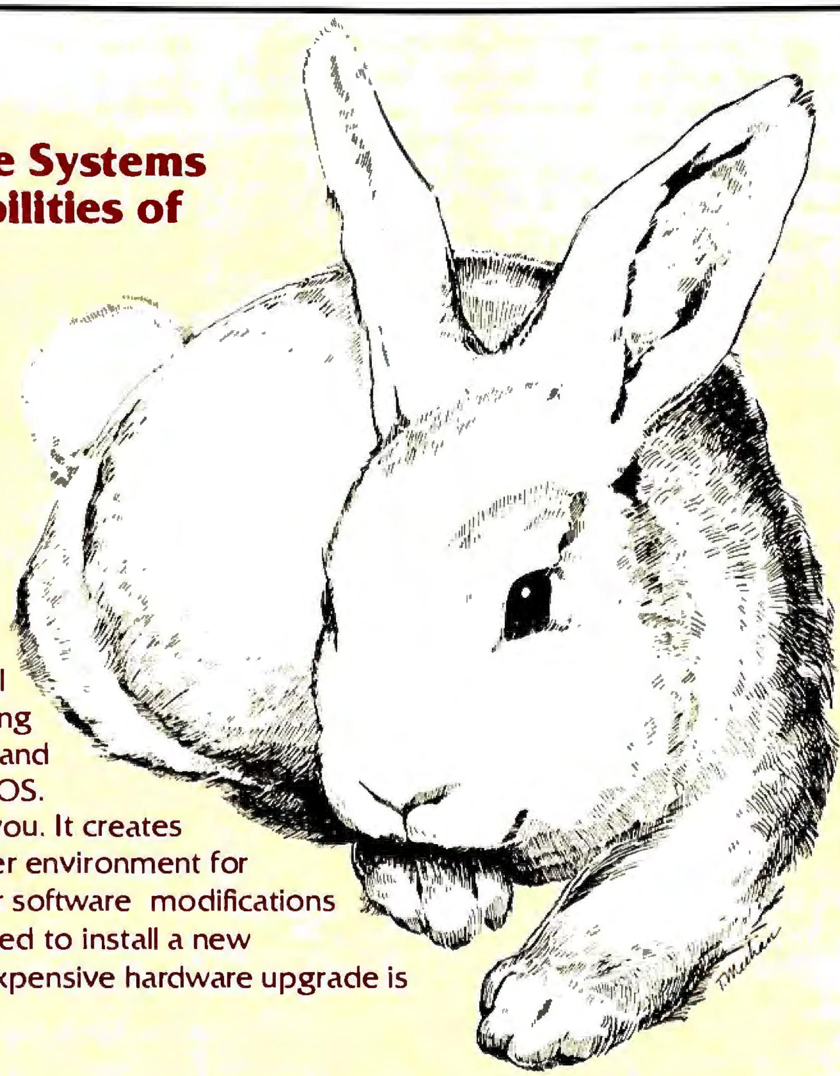

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Text continued from page 168:
are set up. These include the initial temperatures of the tank, collector, and building in degrees C. The time increment for the numerical approximation is set to a value between 1 minute and 60 minutes. This allows a very accurate simulation, if 1-minute steps are used, or a fast simulation, if 30- or 60-minute steps are used. The program is quite accurate even with long steps. Short steps could be effectively used with parameter changes to simulate how a partly cloudy day affects the system.

The subroutine beginning at line 2200 changes daily solar radiation in kilojoules to a half-wave sine approximation of the energy falling during that day. As the simulation proceeds thru the current day, the sun rises at a point in time WS hours before noon and sets WS hours after noon. WS is the hour angle of the sun, calculated from the location's latitude and the declination of the sun (lines 2230 to 2260). The sine wave is implemented in the main loop in lines 360 to 380, as the simulator time proceeds.

The user is asked if he wants output each *dt* (step size), hour, day, or month. He is also asked if changing data (outside temperature and solar radiation) should be input each hour, day, or month. The program asks the user for the initial date and hour of simulation, to calculate the angle of incidence of solar radiation. Control is then transferred to lines 3000 thru 3300, where the user is given a menu of different commands that allow him to change any parameters or run the simulation.

As the program is running, it will output the temperatures of the collector, tank, and building until data is required. When data is input, the simulation will continue. If a negative value is input for the solar radiation, the program will stop simulation and output five sums of energy:

- the amount of heat striking the collector
- the amount of heat transferred to the tank from the collector
- the amount of heat delivered to the building from the tank
- the amount of heat that would have been used by the building had its temperature stayed at 20 °C (68 °F)
- the amount of heat delivered by an auxiliary source

These sums can be compared for different parameter values to find the most efficient and effective heating system. After this output, control returns to line 3000, allowing the user to alter parameters and run the simulation again, or quit the program.

As many will note, this program is far from ideal. Much could be added. If you wish to simulate a system employing a collector with selective surfaces, lines 1320 to 1350 could be changed to allow input of different transmissivities of glass and absorptivities of the surface. If a south-facing wall of the building has many windows, a current source could be added to the electric circuit to model the heat gain from this passive source.

As an example, I calculated the t_h and R_h of my parents' home in Pennsylvania. R_h was 0.00213 degree-hrs/kJ, and t_h was 24 hours. A tank of 500 gallons with 1 inch of insulation was modeled, and the flow rates of typical water pumps were used (5 liters/minute). Other parameters were 40 square meters of collector area, a single cover plate, and an R_c of 0.0022 degree-hrs/kJ. The simulator was run for these conditions, giving the output shown in listing 2. The results were significant, since a total of 1.2×10^7 kilojoules of energy would be supplied by this system, and the house uses 2.1×10^7 kilojoules without any solar heating during January, February, and March in a typical year.

I hope that some readers will be inspired to develop further some of these ideas, which show the power of computers in engineering alternative energy sources. ■

References

1. Close, Paul D, *Sound Control and Thermal Insulation of Buildings*, New York: Van Nostrand Reinhold, 1966.
2. National Climatic Center. *Input Data for Solar Systems*. U.S. Department of Energy, 1979. Available for $3 from:

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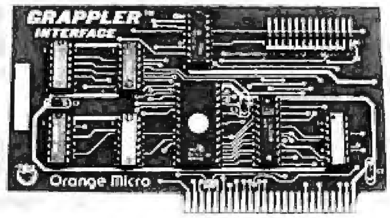

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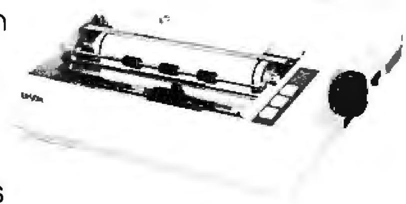

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The Atari Assembler/Editor

Mark Pelczarski
1206 Kings Circle
West Chicago IL 60185

The Atari Assembler/Editor plug-in ROM (read-only memory) cartridge is finally available. Anyone who plans to use or learn 6502 assembly language on the Atari 400 or 800 computers will find it a convenient tool. It is especially nice for beginners, since some of the editing and programming features of Atari BASIC are available. The Atari people point out that this assembler is not designed for professional programmers, although they do use it for much of their in-house programming. They describe it as an experimenter's assembler designed for those people writing machine-language subroutines to supplement their BASIC programs when speed, sound, or graphics are factors.

Overview

The Assembler/Editor package includes the cartridge and a user's manual. The cartridge actually contains three programs: the Writer/Editor, the Assembler, and the Debugger/Mini-Assembler. The cartridge will operate with either a cassette-tape drive or a floppy-disk system, but the disk gives more versatility. The cartridge plugs into the left slot in the Atari 800, and it occupies the upper 8 K bytes of user-accessible memory-address space.

Although it does not make any attempt to teach the fundamental concepts of assembly-language programming, the manual does include an overview of 6502 assembly language (command format, addressing modes, types of operands, etc)—something I've not seen in other assembler/editor packages. The beginner will still want to find a good book about 6502 assembly language, however. A large part of the manual contains information explaining the use of each program and the options and procedures available. It seems complete and easy to follow and contains helpful information in the appendices, including sample programs showing how to use machine-language subroutines from BASIC.

This assembler will be used mostly for writing short subroutines that will be called from BASIC programs. Those who decide to write straight machine-language code will need more information about the Atari I/O (input/output) structure, which may be found in the *Atari Technical Manual*, now available. They will also have to consider the memory capacity of their machine. Atari estimates that the amount of object code that can be "comfortably developed" with the cartridge is about one-tenth of the memory space available. Thus a 40 K-byte system would allow about 4 K bytes of object code to be developed. (Remember that other use of the top 8 K bytes is precluded by the cartridge, so 40 K bytes is the maximum.)

Those who want to write long machine-language segments to attach to BASIC programs may find some other problems. There are only 256 bytes in memory that are guaranteed untouched by BASIC or the operating system. If you want to write a longer machine-language routine, you must incorporate it into the actual BASIC program through the use of strings. This is not an unknown practice. Programmers of Radio Shack's TRS-80 have been using this method for quite some time. The only drawback is that the code must be fully relocatable. That means the subroutine can have no JMP or JSR commands to itself, and no data tables. Some non-relocatable material may be put in the one 256-byte block that is always available, but some headaches may persist. These procedures are well documented in the appendix,

At a Glance

Product
Atari Assembler/Editor Cartridge

Manufacturer
Atari Inc,
Computer Products Division
1346 Bordeaux Dr
Sunnyvale CA 94086

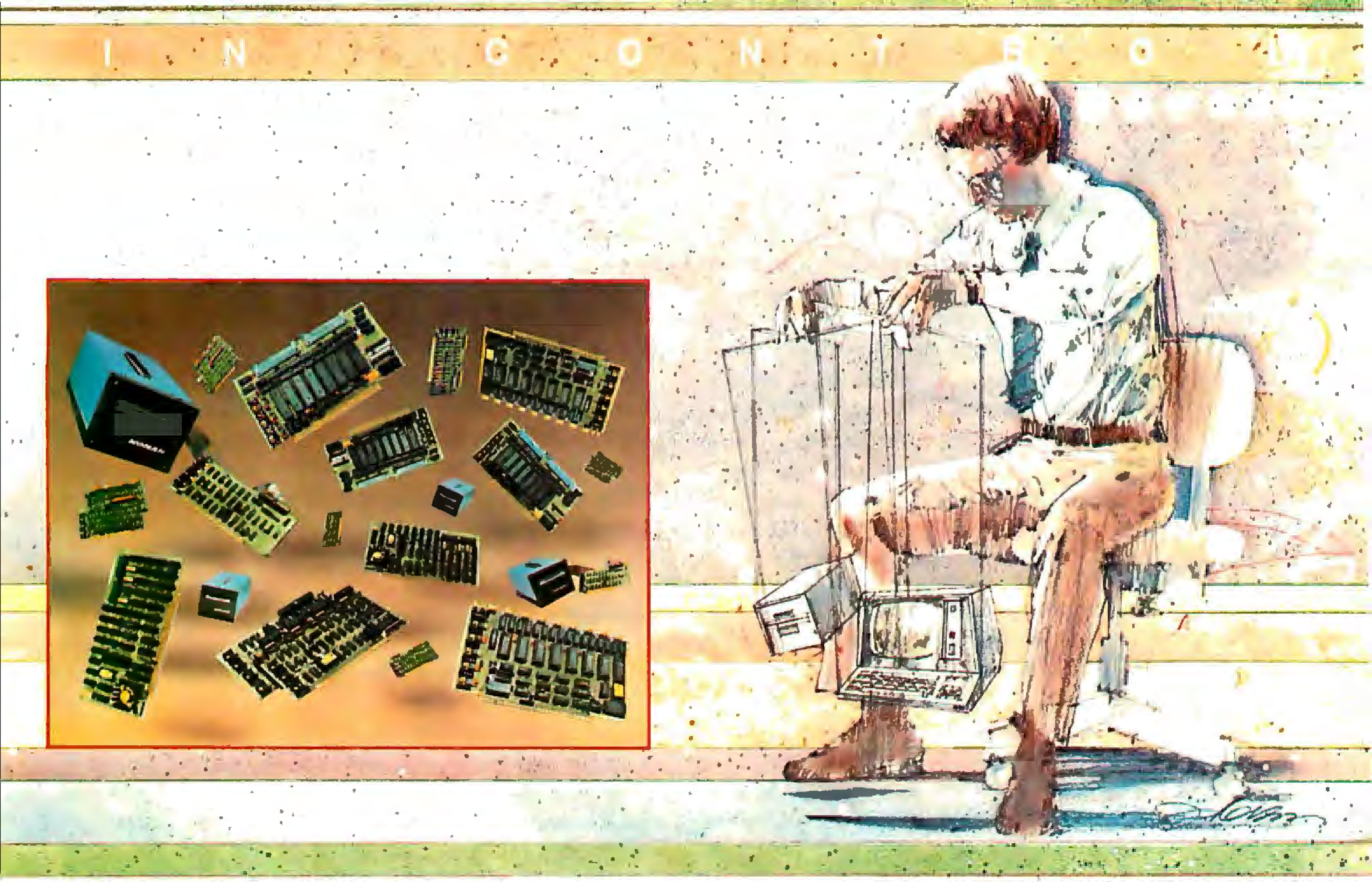
Price
$59.95

Format
Plug-in ROM cartridge

Computer requirements
Atari 400 or 800, floppy-disk drive, and more than 16 K bytes of memory recommended, but not necessary

Documentation
User's manual describing operating features is included. Atari technical information and 6502 assembly-language programming information available separately

Audience
Those who want to write machine-language programs and subroutines on the Atari computers



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by the way, with sample programs using calculations, sound, and graphics (a demonstration of putting 128 colors on the screen at once).

Writer/Editor

The Writer/Editor allows you to enter and edit assembly-language programs. Each line of a program is numbered, as in BASIC, and contains an optional label, an instruction, an operand, and an optional comment. These are located in predesignated fields across the line, and pressing either Tab or the space bar moves the cursor to the next field. The Editor also uses the same screen editing that Atari BASIC uses: you may move the cursor to a line, insert, delete, or change characters, then press Return and the new line is entered. The line numbering allows other BASIC-like commands, such as:

- LIST—to list all or part of a program
- DEL—to delete a line or a range of lines
- NUM—for automatic line numbering
- REN—to renumber lines

(Strangely, most of these were left out of Atari BASIC.) The Editor also has FIND and REPLACE commands, plus SAVE and LOAD commands that let you move parts of programs, allowing you to create your own library of subroutines on disk.

The Assembler

The Writer/Editor puts your program into a text buffer in memory. The Assembler takes the source program from the buffer, or from disk or cassette tape, and assembles it into an object program (true 6502 machine language) stored in a specified range of memory, on disk, or on tape. During assembly you can also specify an assembly listing to be displayed on the screen, written to disk or tape, or printed on a printer. Assembly requires two passes, which is standard. Directives to the assembler may be included in your program to control paging and titles in the assembly listing, and to insert values and character strings into the machine code. One feature not provided that would have been helpful is a symbol table that shows the values assigned to labels you've used.

Debugger/Mini-Assembler

The Debugger allows you to trace through your program step by step as it runs and make minor changes in conditions or in the code. Options provided allow for single-stepping through your program, displaying and changing register or memory values, and moving and comparing contents of memory locations. There is also the Disassembler, which will display the instruction mnemonics for any range of memory, and the Mini-Assembler, which lets you assemble single lines of code at specified locations.

Conclusions

Although there are three programs in the cartridge, transferring control back and forth between them is simple, thus creating the effect of a nicely integrated system. When you turn the power on, you are in the Editor mode. Typing ASM assembles whatever source code is in the buffer and returns you to the Editor. Typing BUG puts you in the Debugger. Typing X returns you to the Editor again. With a disk, typing DOS gives you access to the disk operating system, and you can access the Atari's built-in Memo-Pad by typing BYE.

There's nothing easier than using a cartridge-based system, even if we did have to wait for it. The designers of the Assembler/Editor programs have taken advantage of the cartridge system, and have made a nice, easy-to-use tool for both beginners and assembly-language experts. It was not designed for large-scale machine-language code development, but that shouldn't bother most people. It is much easier to write the bulk of a program in a higher-level language such as BASIC, leaving machine language for the subroutines that have requirements BASIC cannot satisfy. ■

The Atari Technical Manual *is available from Atari for $27 plus $3 shipping. A documented operating-system source-code listing is also available for $17 plus $3 shipping. Contact Atari Inc, Customer Service Division, 1346 Bordeaux Dr, Sunnyvale CA 94086.*

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Energy Conservation with a Microcomputer

David R Jackson and John M Callahan
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Many aspects of the present energy situation are beyond the control of the individual. There are, however, a few notable actions that you can take to lessen the impact: one is to conserve conventional fuels; the other is to find economical alternatives. In this article we will present several tools that can be used in conjunction with your personal computer—tools that will allow you to understand energy-use patterns, and change these patterns with sound technical and economic decisions.

We will begin by providing a background on heat transfer and how it governs the energy consumed in a building. After this information is presented, we will outline an example that demonstrates the calculation that you must perform to determine your yearly energy requirements for space conditioning. Included in this example will be a program that you can use to simplify these calculations. We will also discuss energy conservation options available to you and how to determine the economic payback to implement these measures.

About the Authors

David R Jackson is Director of the Solar Energy Division of the University of Connecticut Energy Center and a lecturer in the School of Engineering. John M Callahan is a staff member at the Solar Energy Division and is working toward a degree in Electrical Engineering/Computer Science at the University. Both have been involved in a variety of research projects dealing with energy-systems performance analysis, as well as solar energy system design.

Basic Principles of Heat Transfer

Heat, of course, tends to flow from hot places to cold places. This observation fits right in with such other examples as water running downhill, electrical current flowing from high electrical potential (voltage) to low, and fluids moving from high-pressure areas to low-pressure areas. In these and similar phenomena there is a *flux* of something—thermal energy, matter, or electrical charge—in response to a favorable gradient in some *potential*. In the case of thermal energy in transit, which is referred to as heat, the potential is a *gradient*, or difference in temperature. The engineering discipline that attempts to quantitatively relate the flow of heat to temperature differences is called *heat transfer*.

Why do we care about this? Because the comfortable temperature of our living and work environments is often very different from the outdoor temperatures which surround these spaces. These temperature differences result in an unwanted flow of heat, either into our spaces or out of them. In the former case, which occurs in hot weather, we often "pump" the unwanted heat back outdoors with a type of heat pump called an air conditioner. In cold weather, we usually replace the escaping heat by burning some form of fuel or by operating an electrical resistance heater or a backwards air conditioner, called a heat pump.

The methods by which we cope with unwanted heat transfer all have one fact in common: they cost money to implement and operate. Alarming increases in the price of fuel and electricity have caused the energy portion of our cost of living to challenge rent and mortgage payments for the lead item in the family budget.

Types of Heat Transfer

There are three basic types of heat transfer which must be recognized in order to understand and calculate the heating and cooling energy requirements of a building. These are *conduction, convection,* and *radiation.* A fourth contributor to the heating and cooling load related to outside air entering the structure will be dealt with separately as *infiltration.*

Conduction

The movement of thermal energy by conduction is the only mode of heat transfer that is possible within solid materials. However, it is also present and important in liquids and gases. Thermal energy can be visualized in terms of randomly directed motion among the atoms or molecules of a material. In solids, the atoms are bound together by forces so that the only possible atomic motions are various types of vibrations, as opposed to the relative freedom of motion present in liquids and gases. Picture a three-dimensional arrangement of billiard balls, all held in a regular geometrical pattern by springs. If one of the billiard balls is hit with a hammer and caused to vibrate, the vibrations will be transmitted through the springs until all of the balls are shaking. This example is a crude but easy-to-visualize model of the propagation of thermal energy through a solid by conduction.

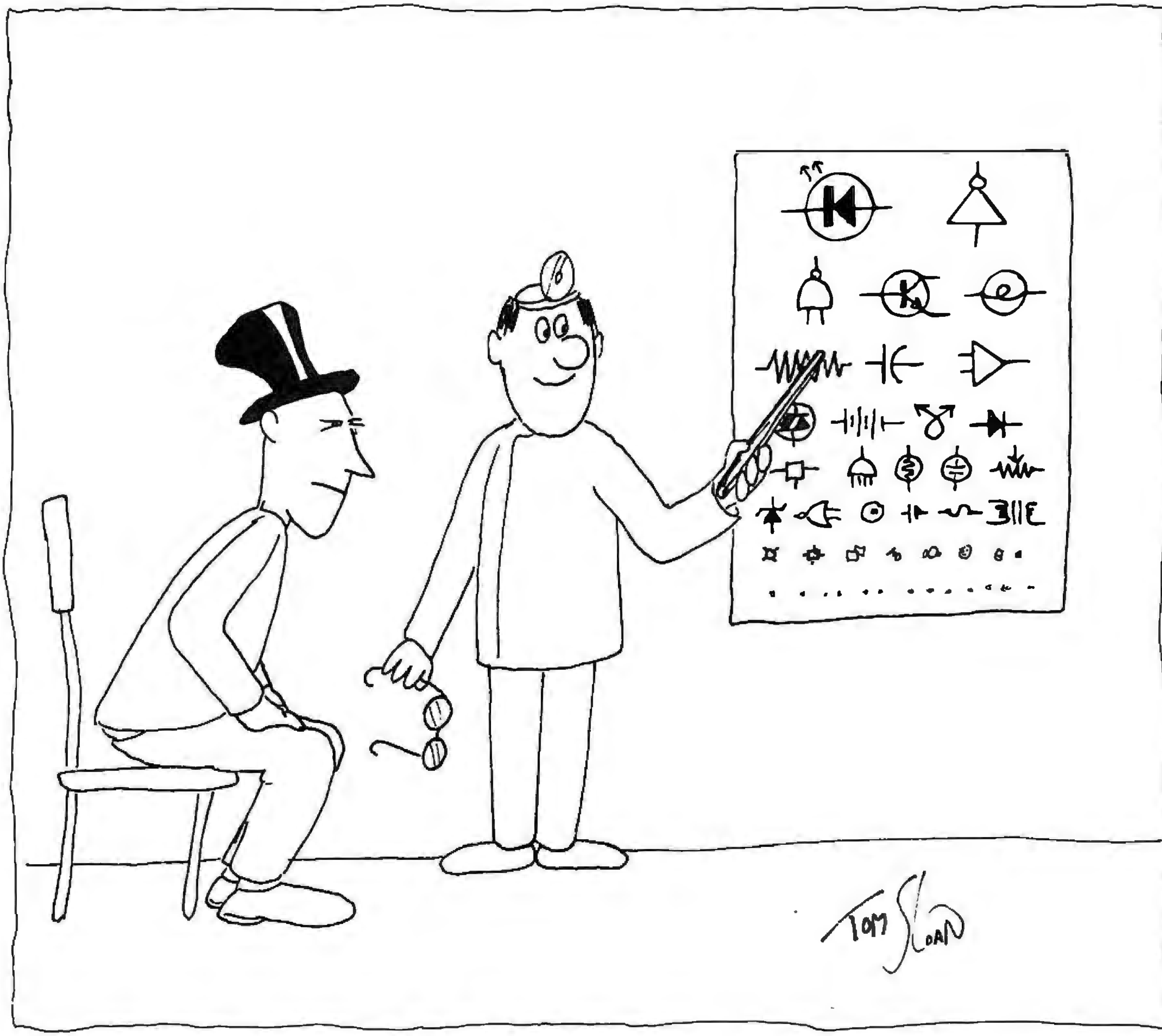
Now that we have a conceptual idea of conduction heat transfer, we would like to be able to numerically calculate the rate of heat transfer by conduction in various materials for a given, imposed, temperature difference. This calculation is readily performed using Fourier's law of heat conduction, which states for simple steady-state one-dimensional conduction:

$$Q = KA\frac{\Delta T}{\Delta X} \qquad (1)$$

where:

Q = the heat transfer rate in Btu/hr
A = the cross-sectional area in square feet of the material perpendicular to the direction of heat flow
ΔT = the temperature difference across the material in degrees Fahrenheit
ΔX = the thickness of the material in the direction of heat flow in feet
K = the thermal conductivity of the material in units consistent with the rest of the equation (eg: in Btu/hr ft °F)

The use of this equation is best demonstrated by an example. Suppose we have a 14½-inch-wide by 8-foot-long by 3½-inch-thick piece of fiberglass insulation, and we wish to calculate the rate of heat transfer through the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thickness. The warm side is at a temperature of 60°F, the cool side is at a temperature of 30°F, and the thermal conductivity of fiberglass insulation is 0.0265 Btu/hr ft °F. For this case:

$$A = \text{length} \times \text{width} = \frac{14.5 \text{ in}}{12 \text{ in/ft}} \times 8 \text{ ft} = 9.67 \text{ ft}^2$$

$$\Delta X = \frac{3.5 \text{ in}}{12 \text{ in/ft}} = 0.292 \text{ ft}$$

then:

$$Q = 0.0265 \times 9.67 \times \frac{(60 - 30)}{0.292} = 26.3 \frac{\text{Btu}}{\text{hr}}$$

Now that we have arrived at this number, how do we interpret it? Officially, a Btu is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit. But this fact isn't much help unless we can relate heat requirements to fuel purchases. Roughly speaking, one gallon of number two fuel oil burned in a furnace of average efficiency contains about 100,000 Btu. One kilowatt-hour of electricity contains 3413 Btu. So, if we lost 26.3 Btu per hour through our piece of fiberglass insulation for a period of one month, the total amount of thermal energy lost would be:

$$26.3 \frac{\text{Btu}}{\text{hr}} \times 24 \frac{\text{hrs}}{\text{day}} \times 30 \frac{\text{days}}{\text{month}} = 18{,}936 \text{ Btu}$$

If fuel oil costs $1.35/gal, and electricity $.07/kWh, this corresponds to:

$$\frac{18{,}936 \text{ Btu}}{100{,}000 \text{ Btu/gal}} \times \$1.35/\text{gal} = \$0.26 \text{ for oil}$$

and:

$$\frac{18{,}936 \text{ Btu}}{3413 \text{ Btu/kWh}} \times \$.07/\text{kWh} = \$0.39 \text{ for electricity}$$

The example used for fiberglass insulation closely resembles the case of a normal American residential wall which is framed by 2-inch by 4-inch (nominal) studs placed on 16-inch centers and insulated with fiberglass batting between the studs. But how do we arrive at the thermal conductivity value used in the example? And what is the so-called "*R*-value" that is used in reference to insulation?

Actually, the *R*-value is another way of describing the thermal conductivity of insulation. Often we hear of a given thickness of insulation having a certain *R*-value. The lumber yards usually stock "R11" or "R19" fiberglass, which refers to 3½-inch thickness or 5½-inch thickness, respectively. Insulating materials also have a certain "*R*-value per inch." For instance, rigid urethane foam is frequently assigned an *R*-value of 6.5 per inch of thickness. The R11 fiberglass which is 3½ inches thick therefore has an *R*-value per inch of 11/3.5 = 3.1 per inch.

But we seem to be going in circles. Let's relate the *R*-value to the thermal conductivity. People in the building trade find the *R*-value of materials easier to deal with than thermal conductivity. The equation they use for heat transfer is:

$$Q = A \frac{\Delta T}{R} \tag{2}$$

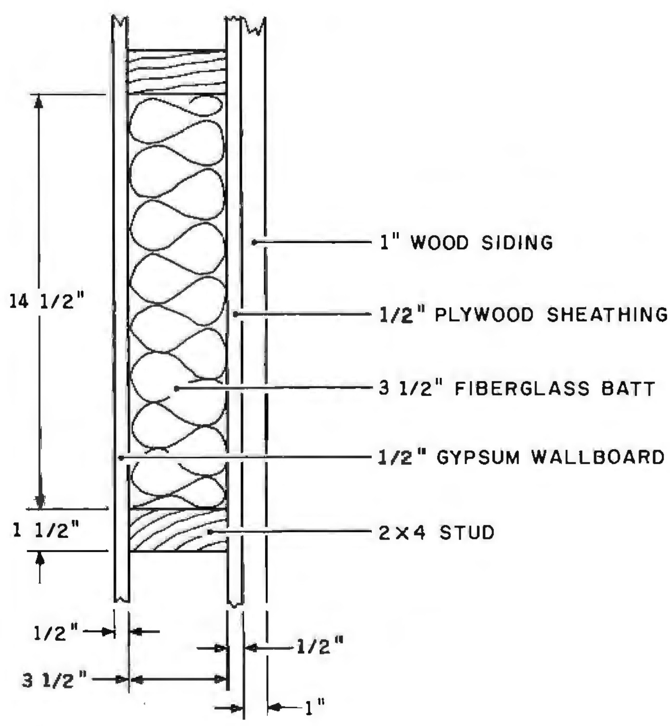

Figure 1: *Cross section of an insulation combination that is used to demonstrate heat-loss calculations.*

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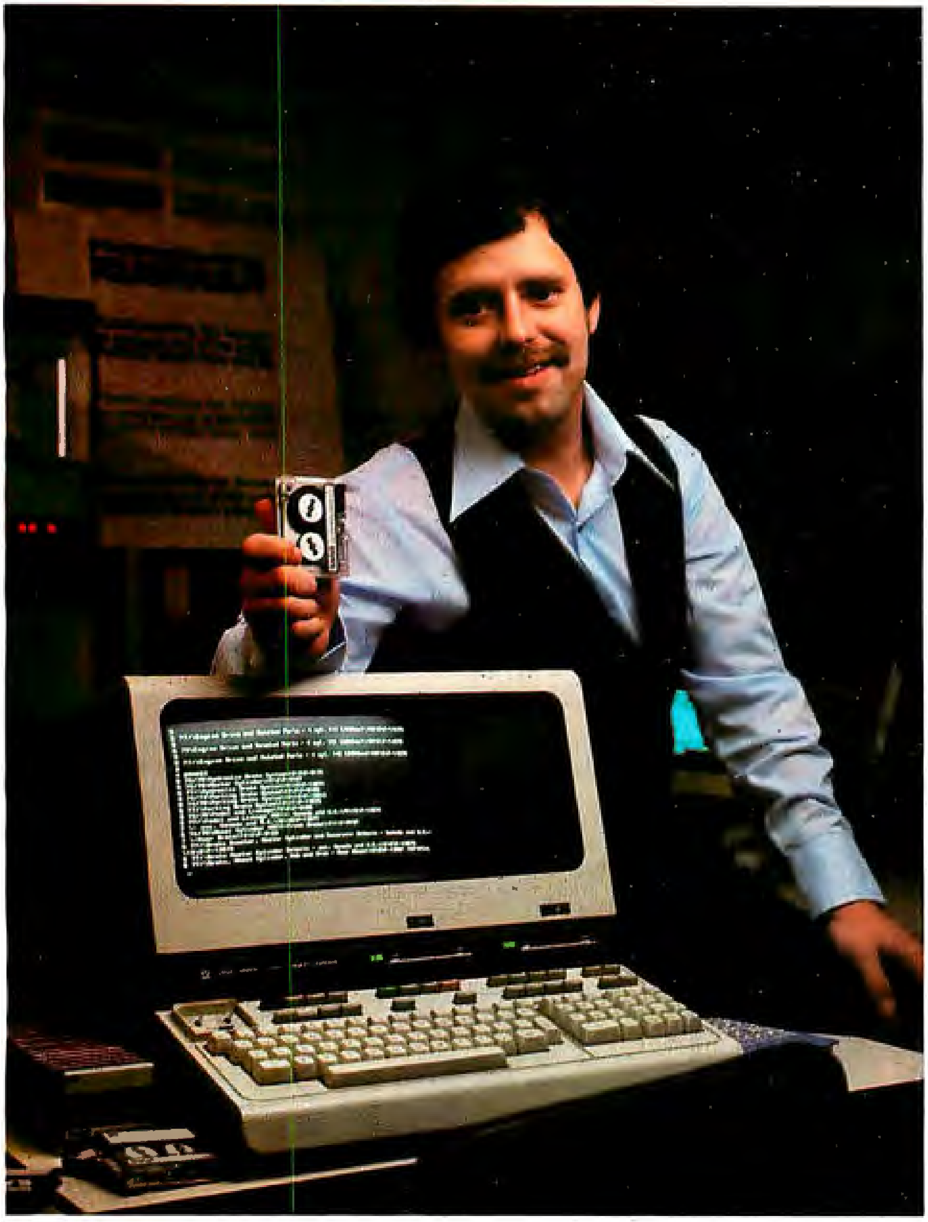

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where R is the R-value. Quite often it appears in this form:

$$\frac{Q}{A} = \frac{\Delta T}{R}$$

which gives the heat-transfer rate per area of surface. If we compare equations 1 and 2, we see that $R = \Delta X/K$ for a given thickness, and the R-value per inch $= 1/12K$. The number twelve is left over from converting ΔX from feet to inches. Thermal conductivities tabulated in various reference sources may be listed in any of these three forms. References 1, 2, and 3 (given at the end of this article) are good sources for this data.

If we examine the version of Fourier's law of heat conduction that contains the R-value and compare it to Ohm's law for electrical conduction, we have the following:

$$Q = \frac{A\,\Delta T}{R} \qquad \text{(Fourier's law)}$$

$$I = \frac{V}{R_{\text{electrical}}} \qquad \text{(Ohm's law)}$$

The similarity between these laws is striking. Apparently, temperature difference and electrical potential difference are analogous, as is the R-value to electrical resistance and the heat transfer rate to electrical current. Thus, we can conceptually consider thermal circuits of various heat paths with characteristic thermal resistances. This analogy is extremely useful, as it provides the rules for dealing with complicated heat-path systems and leads to some of the more straightforward numerical schemes for solving problems involving complicated thermal networks. For our purposes, we need only the rules for combining series and parallel thermal resistances.

Looking once again at our example of the 3½-inch-thick fiberglass insulation, let's calculate the R-value:

$$R = \frac{\Delta X}{K} = \frac{3.5/12}{0.0265} = 11.0$$

R11 is, of course, much easier to remember to characterize 3½-inch fiberglass insulation than are thermal conductivity and thickness.

What happens if we sandwich our fiberglass between sheets of ½-inch-thick gypsum board and ½-inch asphalt-impregnated plywood, both having the same width and height as the piece of fiberglass? We know that the heat must pass sequentially through each of the three materials. This suggests that we should add the R-values

Material		R-Value (or Thermal Resistance) in $\frac{\text{hr ft}^2\ ^\circ\text{F}}{\text{Btu}}$
Plywood	¼ in	0.31
	⅜ in	0.47
	½ in	0.62
Particle board ⅝ in		0.82
Insulating sheathing ½ in		1.32
Softwood	1 in	1.24
Hardwood	1 in	1.00
Gypsum board ⅜ in		0.32
	½ in	0.45
Plaster	1 in	0.20
Brick	1 in	0.15
Concrete blocks		
Three oval core	4 in	0.70
	8 in	1.12
	12 in	1.28
Poured concrete 1 in		0.25
Asbestos siding shingles		0.21
Wooden siding shingles		0.81
Asphalt roof shingles		0.44
Slate roof shingles		0.05
Wood roof shingles		0.94
Fiberglass batts	3½ in	11.00
	6 in	19.00
Urea formaldehyde	1 in	5.60
Polyurethane	1 in	6.25
Polystyrene	1 in	3.57
Inside vertical air film		0.68
Outside vertical air film (15 mph wind)		0.17
Inside horizontal air film		0.60
Dead air space attic		1.14
Air space between studs 3½ in		0.97
Single-pane glass		0.91
Double glass		1.67
Triple glass		2.50
Storm window (4 in air space)		1.78
Wooden door	1¼ in	1.56
Insulated steel door	1¾ in	1.69

Table 1: *Thermal resistances of several typical building materials.*

in the same manner that we would add the values of electrical resistances in series:

$$R_{total} = R_{gypsum} + R_{fiberglass} + R_{plywood}$$

The thermal resistances for gypsum and plywood sheathing (see table 1) are found to be 0.45 for ½ inch of gypsum and 1.32 for ½ inch of sheathing. The total R-value becomes:

$$R_{total} = 0.45 + 11.0 + 1.32 = 12.77$$

We must also consider parallel heat paths. The heat transfer through the wooden studs that form the walls of the cavities occupied by our fiberglass insulation (see figure 1) follows a parallel path to the heat passing through the fiberglass. In parallel electrical circuits, we merely add the currents. Here we add the heat transfer rates:

$$Q_{total} = \frac{A_1 \Delta T}{R_1} + \frac{A_2 \Delta T}{R_2} = \left(\frac{A_1}{R_1} + \frac{A_2}{R_2}\right)\Delta T \quad (3)$$

where the subscripts 1 and 2 refer to the wall areas associated with the studs and bays between them, respectively.

For each stud that is 1½ inches wide by 8 feet long, $A_2 = 1.0$ square feet, and the total resistance through the studs, which are also sandwiched between gypsum and plywood, is:

$$R_2 = R_{gypsum} + R_{stud} + R_{plywood} = 0.45 + 4.35 + 1.32 = 6.12$$

where R_{stud} (pine or other softwood 3½ inches thick) = 4.35. (See table 1 for the thermal resistances of several common building materials.) If the inside surface of the wall is at 62°F and the plywood is at 28°F, the heat transfer rate through the wall will be given by equation 3 as:

$$Q = \left(\frac{9.67}{12.77} + \frac{1.0}{6.12}\right)(62 - 28) = (.921)(34) = 33.3 \text{ Btu/hr}$$

An effective R-value for the stud/fiberglass parallel combination can also be determined. (This will be useful later.) Generalizing the parallel resistance analogy we have:

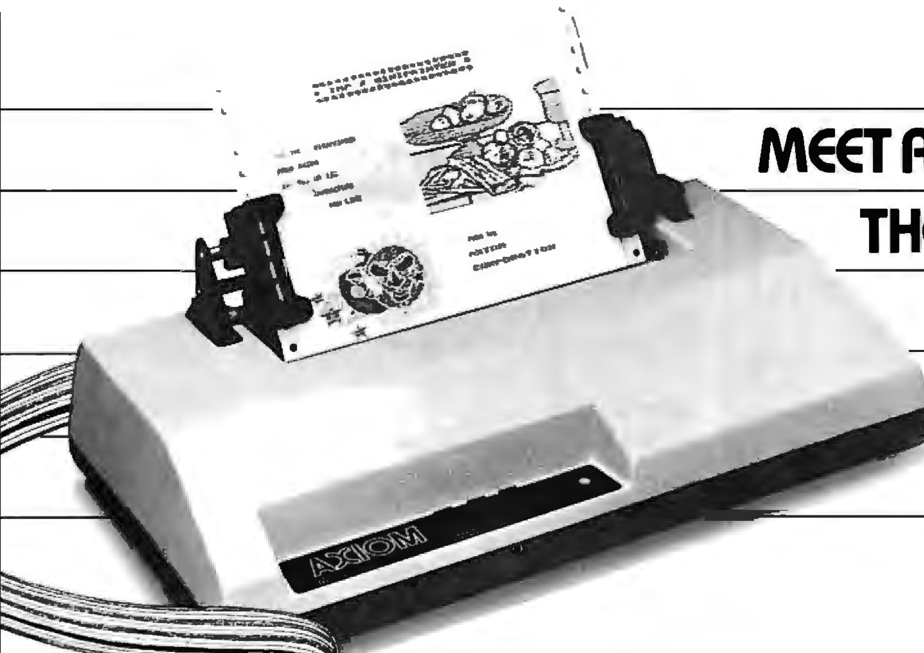
$$\frac{A_1 + A_2}{R_{eq}} = \left[\frac{A_1}{R_1} + \frac{A_2}{R_2}\right]$$

For our example (considering just the wood studs and fiberglass), we get the equation:

$$\frac{9.67 + 1.0}{R_{eq}} = \left[\frac{9.67}{11} + \frac{1}{4.35}\right]$$

which gives us a value of:

$$R_{eq} = 9.62$$



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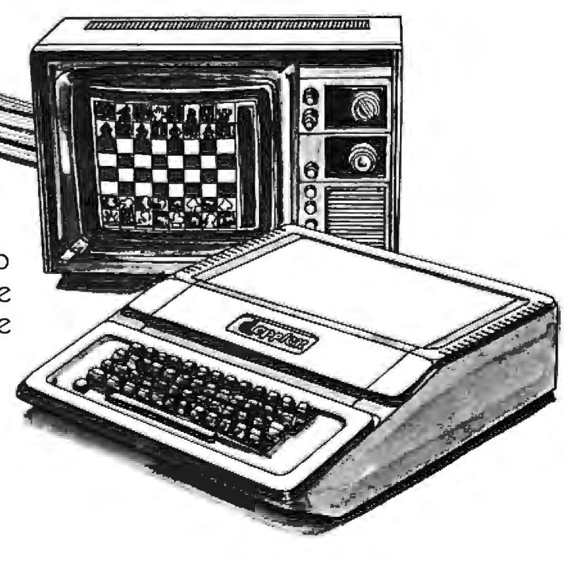

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The method outlined thus far allows us to compute conductive heat loss through walls (or ceilings) of arbitrary construction, provided we know the temperature of the inner and outermost surfaces. Unfortunately, we almost never know these temperatures, but we do have values for inside and outside *air* temperatures. If we can add additional thermal resistances to our network to account for the temperature drops across the air films separating the air temperature from the material surface temperatures, we will have a more complete picture.

Convection

Why can't we simply look up the thermal conductivity of air and add it in as a thermal resistance? There are two reasons:

- We have no way of determining a film thickness ΔX to use in the equation $R = \Delta X/12K$.
- The film of air adjacent to the wall may be mixing with air at a different temperature from outside the film as a result of turbulence.

Convection problems are classified as either *free* or *forced*, depending on whether the gas or liquid motion involved is caused by buoyancy effects (eg: cold air streaming down the interior surface of a large picture window on a cold night) or induced by wind (or mechanically by fans or blowers). We understand that raising the velocity of a gas over a solid surface improves heat transfer between the gas and solid—that's why we blow on hot food. However, determining the actual relationship between the flow characteristics and convective heat-transfer rate is a science unto itself, and amateurs are forced to use simple, empirically derived coefficients to describe convective heat transfer. The convective heat-transfer coefficient (h) relates the heat-transfer rate to the difference in temperature as follows:

$$Q_{convective} = hA(T_{air} - T_{surface})$$

The R-values given in table 1 are equivalent to the reciprocal of h; reference 1 gives the R-values of a large number of building materials.

Since we can consider $1/h$ to be an R-value, we are now in a position to add it to the resistance chain on the inside and outside walls.

Radiation

Before we conclude our discussion of heat transfer through an insulated wall, we should discuss radiation, the last of the three principal types of heat transfer. While conduction and convection involve matter as the medium of heat transfer, radiation does not. Radiative heat transfer proceeds unimpeded in a vacuum, where convection and conduction would be precluded. A type of electromagnetic radiation is emitted by all surfaces whose temperatures are above absolute zero. The amount of

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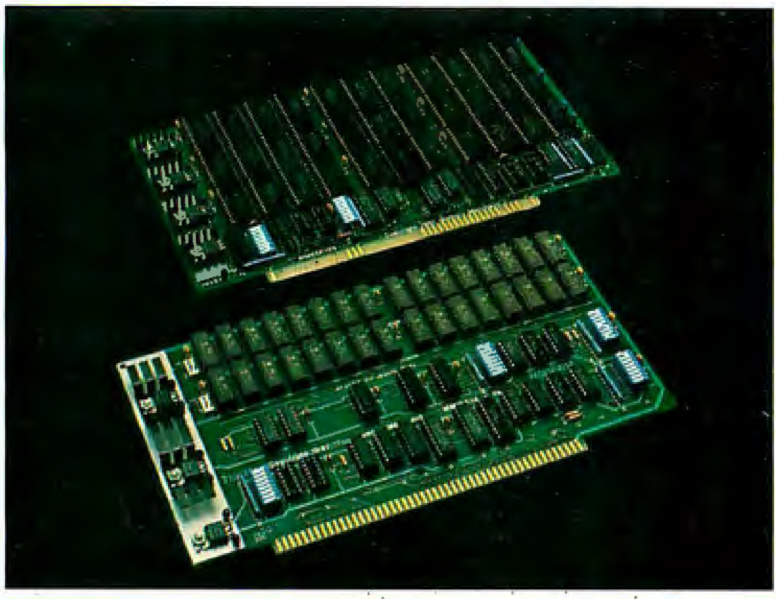

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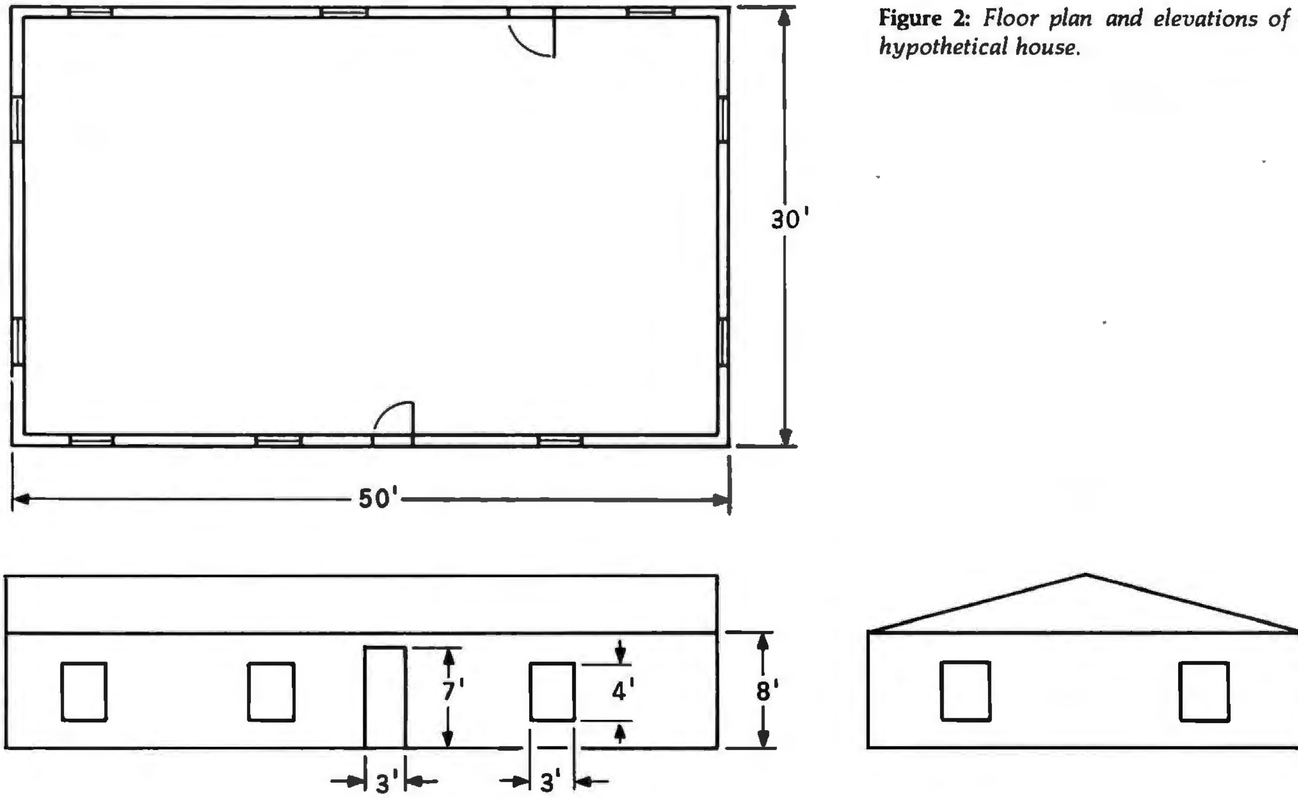

Figure 2: *Floor plan and elevations of a hypothetical house.*

radiation emitted per unit time is proportional to the fourth power of the absolute temperature of the emitting surface. Those surfaces which are separated by a vacuum or other transparent medium experience net heat transfer according to the following:

$$Q_{radiation} = \epsilon A \sigma (T_1^4 - T_2^4) \quad (4)$$

The emissivity, ϵ, is a number between zero and one, and it is a measure of the ability of a surface to emit (or absorb) radiant heat. The area, A, plays the usual role, and σ is a constant of proportionality. The nonlinearity exhibited by equation 4 would ruin our thermal resistance model if we attempted to explicitly include a radiation term.

Fortunately, in cases where radiation plays a significant role in building-heat transfer, convection is also present so that the radiation effect may be added into the convective R-value. For example, in the case of double-pane (insulated glass) windows, the panes may radiate to one another but this effect is taken into account in the overall window R-value listed in table 1. Similarly, radiation is included in tabulated R-values in other cases involving air gaps. Of course, when a gap between surfaces is stuffed with insulation, radiation is eliminated through the elimination of the transparency of the gap (so that we don't have to worry about it in those cases either).

Armed with some knowledge of the other two forms of heat transfer, we can complete our analysis of the insulated wall. Figure 1 gives a wall cross section showing the materials already discussed and the addition of exterior siding. Using table 1, reference 1, and our previous calculation, we add the R-values for the entire heat path from inside and to outside air:

Item	R-value
Inside surface (air film)	0.68
Gypsum wallboard	0.45
Insulation plus studs equivalent	9.62
Plywood sheathing	1.32
Wood siding	0.81
Outside surface, 15 mph wind	0.17

$$\text{Total } R\text{-value} = 13.05 \ \frac{°F\ hr}{Btu}$$

If a building had 1000 square feet of wall area constructed in this manner, the total heat loss for an interior temperature of 65 °F and an exterior temperature of 25 °F would be:

$$Q_{wall\ total} = \frac{A \Delta T}{R} = 1000\ ft^2 \times \left(\frac{(65 - 25)°F}{13.05\ °F\ hr/Btu}\right)$$
$$= 3065\ Btu/hr$$

If we extend this calculation to include other heat paths (doors, ceiling, windows, etc), we would add the resulting heat-transfer rates to get the total:

$$Q_{total} = \left(\sum_{paths} \frac{A}{R}\right) \Delta T \quad (5)$$

People who perform these calculations for a living have found it worthwhile to replace the R-value with its reciprocal, U, the conductance, so that equation 5 becomes:

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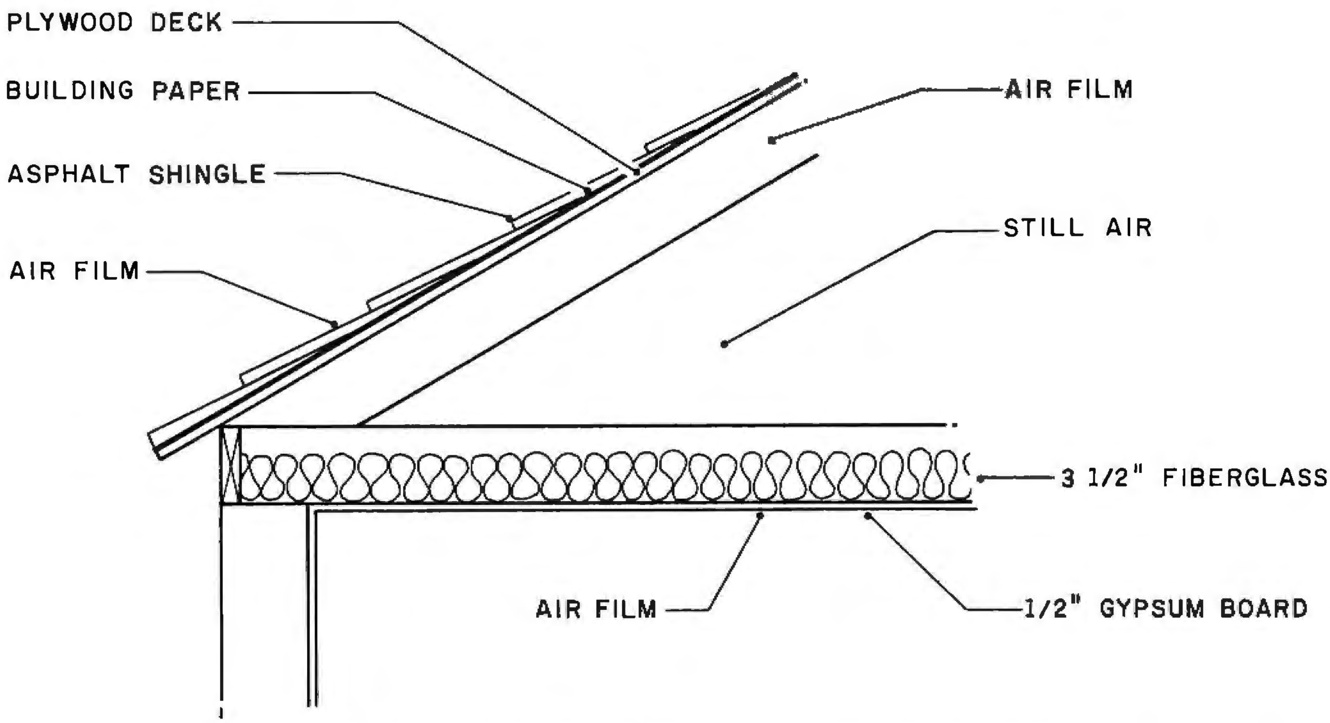

Figure 3: *Construction of the ceiling and roof of the house shown in figure 2.*

$$Q_{total} = (\sum_{paths} UA)\Delta T \qquad (6)$$

where:

$$U = 1/R$$

The units of U are Btu/ft^2 hr °F, which are easier to remember than those of the R-value.

Infiltration

Remember that unconditioned air entering our building can impose an additional cooling or heating load. If a cubic foot of air at outdoor temperature enters a conditioned space, the heating or cooling system must adjust the temperature of that air to the conditioned temperature. The thermal energy, Q, required to accomplish this is given by:

$$Q = \text{vol of air in ft}^3 \times \text{density} \times \text{specific heat} \times (T_{inside} - T_{outside})$$

$$= \text{vol of air in ft}^3 \times 0.074 \frac{\text{lb}}{\text{ft}^3} \times 0.24 \frac{\text{Btu}}{\text{lb °F}} \times \Delta T \text{°F}$$

If the volume of infiltration air is given in cubic feet per minute (CFM), we have:

$$Q = (\text{CFM}) \times 60 \frac{\text{min}}{\text{hr}} \times 0.74 \frac{\text{lb}}{\text{ft}^3} \times 0.24 \frac{\text{Btu}}{\text{lb°F}} \times \Delta T \text{°F}$$

$$= 1.07 \times (\text{CFM}) \times \Delta T \qquad (7)$$

Meteorology

We have seen that in calculation of heating or cooling energy requirements in Btu/hr, we multiply our *UA* values by a temperature difference. Here our principal interest is to determine seasonal heating and cooling costs from these calculations. To this end, we need a way to modify our calculations to get this information.

The *degree-day* is a measure of the average temperature difference between our conditioned space and the outside for a given period of time. Heating degree-days are usually based on an inside temperature of 65°F. For example, if the average daily temperature on a day in February were 35°F, we would accumulate 65 − 35 = 30 degree-days on that day. Adding up all the heating and cooling degree-days for a month or an entire season provides a measure of the severity of the climate. We use degree-days in our calculations as shown in the following:

$$Q_{season} = \{\Sigma UA + \text{infiltration load}\} \times \text{degree-days} \times 24$$

Degree-day data is available for various US cities from the US Weather Service (see also references 1 thru 4).

Example Problem

To reinforce understanding of the relationship between the basic principles of heat transfer and different building components, we will present an example that outlines the calculations needed to determine the energy requirements for a residential building in Austin, Texas. If you live in the northeast, heating is the major energy consideration, and cooling is usually considered unnecessary, whereas if you live in the southwest, this situation may be reversed. Therefore, we have chosen Austin as a location where both heating and cooling functions are necessary.

First, we will outline the characteristics of the building that will serve as our example. Then we will proceed to show how to calculate the heat loss in the winter and the

heat gain in the summer. Finally, we will explain how to automate these calculations by using an interactive BASIC program that runs on a personal computer.

Two major factors determine heat loss and heat gain in any building: the climatological conditions and the building components. In Austin there are approximately 1980 heating degree-days and 2908 cooling degree-days. For the purpose of illustration, we will consider a single-story ranch-style house with 1500 square feet of floor area and a ceiling height of 8 feet. Figure 2 shows the floor plan and two elevations for our example house.

Building Description	Air Changes per Hour
House under 5 years old; new storm windows and doors; caulking and weatherstripping used around doors, windows, foundation.	0.5
House is 5 to 10 years old; old storm windows and doors; deteriorating caulking and weatherstripping.	1.0
House is 10 to 25 years old; no storm windows; no weatherstripping and caulking.	1.5
House is older than 25 years; drafty; windows rattle on windy day.	2.0

Table 2: *Guidelines for the air-changes-per-hour value of a house. Because this figure is difficult to calculate, the guidelines provide only a rough estimate.*

To simplify our calculations, we will assume no heat loss through the floor. We will also say that the walls have no insulation and the ceiling has 3½-inch fiberglass. The front and back doors are 1¼-inch-thick solid wood. There are ten windows, each measuring 3 feet by 4 feet. We will also assume that there are no storm doors or storm windows and that there are two exhaust fans, one in the kitchen and one in the bathroom. We will use the wall section shown in figure 1, but without the fiberglass insulation, and the ceiling/roof combination shown in figure 3. Based on the given configuration of our example building and the climatological conditions in Austin, we can now calculate the heat loss and heat gain. The procedure is very simple if it is approached in a logical step-by-step fashion.

First we should calculate or look up all the R-values for the different building elements (see reference 1). Table 1 is a fairly comprehensive list of the R-values of typical building materials; it can be used to determine the R-values for your own home if you are not able to obtain a copy of a standard reference.

We have already calculated the R-value for the wall with insulation and found it to be $R = 13.05$. To get the R-value without the insulation, we substitute the R-value of a 3½-inch air space from table 1 for the R11 fiberglass, and get an effective R-value of 4.4 for the wall.

We will now calculate the R-value for the ceiling on a one-square-foot basis. Referring to figure 3 and table 1, we list the ceiling and roof materials and individual R-values. The R-values for the ceiling are:

Inside still air	0.60
Gypsum board, ½ in	0.44
Fiberglass insulation, 3½ in	11.00
Still air in attic	1.14
Ceiling total	13.18

The R-values for the roof are:

Outside air	0.17
Asphalt single roof	0.44
Building paper	0.06
Plywood deck, 5/8 in	0.78
Air film	0.60
Roof total	2.05

We will assume that the resistances of the ceiling and roof are additive. This is not quite correct because there is more area associated with the roof, but the answer you obtain by simply adding the two resistances is fairly close, so we get $R_{ceiling/roof} = 15.23$. Single-pane windows are very poor insulators; therefore, they have a low R-value, which is approximately $R = 0.91$. The R-value for a 1¼-inch wooden door is $R = 1.56$ (see table 1).

Second, we must determine the total surface area for each building element. Using figure 2, we find the total wall area is 1118 ft^2, total glass area is 120 ft^2, total door

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Building Element	Area (ft^2)	R-Value $\left(\frac{hr\ °F\ ft}{Btu}\right)$	U = 1/R $\left(\frac{Btu}{hr\ °F\ ft}\right)$	UA $\left(\frac{Btu}{hr\ °F}\right)$	Air Infiltration Load $\left(\frac{Btu}{hr\ °F}\right)$	Percent of Total Load
Ceiling/Roof	1500	15.23	0.066	98.5		13
Walls	1118	4.40	0.23	257.1		35
Windows	120	0.91	1.10	132.0		18
Doors	42	1.56	0.64	26.9		4
Air infiltration					213.1	29
Forced ventilation					6.6	< 1
			Total conduction and infiltration:	514.5 +	219.7	
			Grand total:	734.2		100%

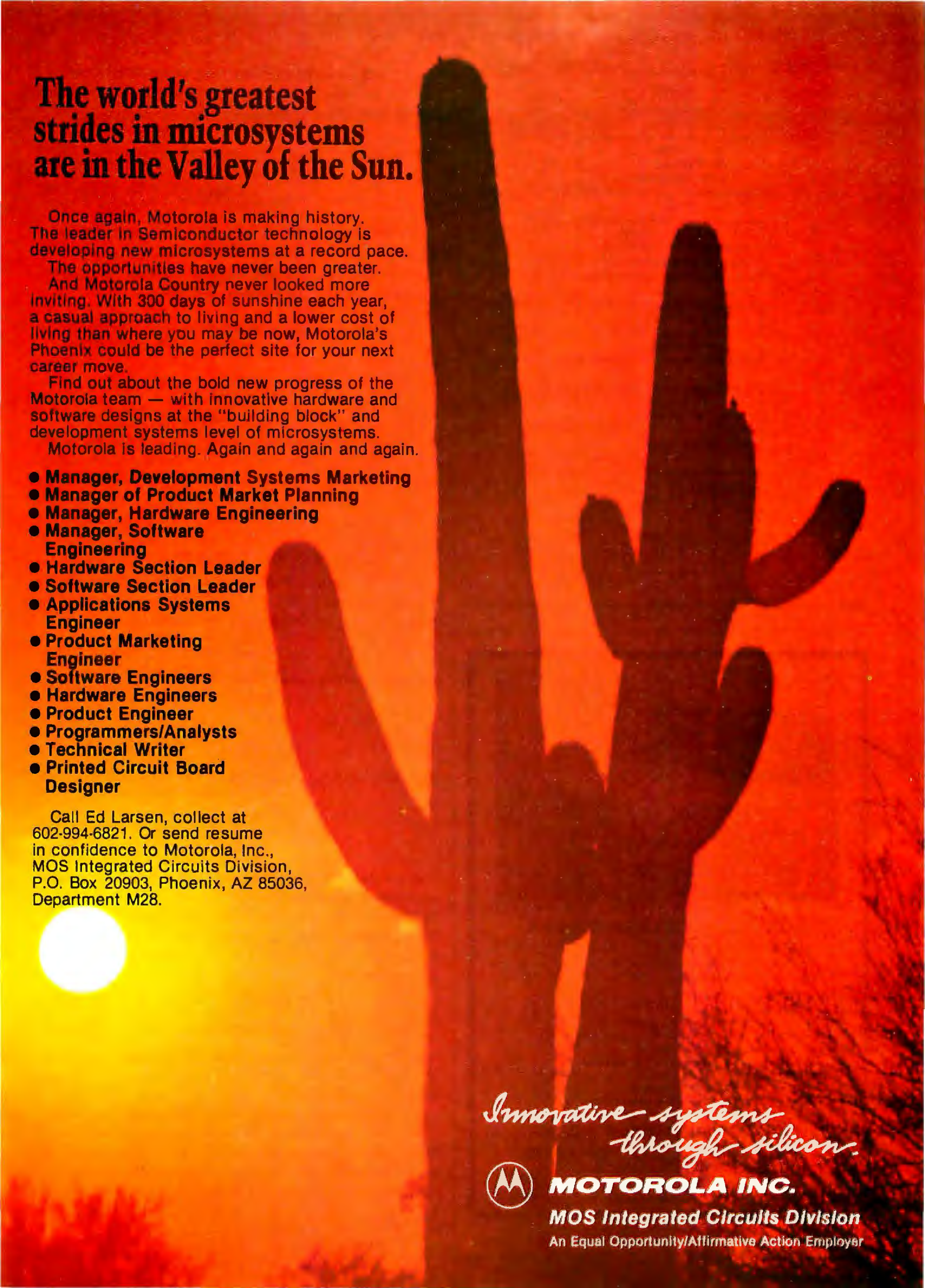
Table 3: *Summary of heat-transfer characteristics of a ranch-style house.*

area is 42 ft^2, and the ceiling area is 1500 ft^2. The volume of the conditioned space is 1500 ft^2 × 8 ft = 12,000 ft^3.

Finally, we must consider the load imposed by air infiltration. All buildings have some unwanted infiltration, and often have some forced ventilation. A simple way to quantify unwanted infiltration is to speak of it in terms of the number of total air changes per hour (AC/hr). A well-constructed building with tight-fitting windows and doors can have an air-change rate as low as 0.5 AC/hr. On the other hand, a badly constructed building with poorly fitted doors and windows can have an air-change rate as high as 2.0 AC/hr. It is difficult to measure infiltration or to make reasonably accurate estimates, so for our example, we will assign 1.0 AC/hr. We suggest that when you perform your own calculation, you assign a number between 0.5 and 2.0 AC/hr, using the guidelines given in table 2.

We must change the number of air changes per hour to cubic feet per hour to use in our energy calculations. This is done by taking the air changes per hour and multiplying by the total volume of the house. In our example, we get 1 AC/hr × 12,000 ft^3 = 12,000 ft^3/hr.

Forced ventilation from exhaust fans must now be considered. We estimate the number of minutes each fan is on each day, along with its rated capacity, to determine how much air is exhausted by the fans. Remember that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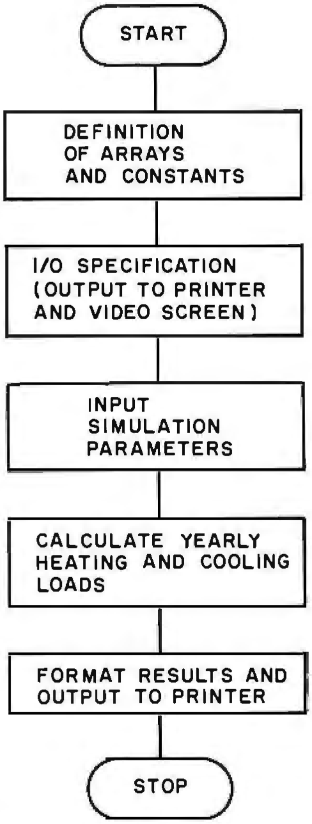

Figure 4: *Flowchart for the energy-usage program of listing 1.*

any air exhausted by the fans must be replaced by outside air that is heated or cooled. The equation that governs forced ventilation is shown below:

$$\text{Air ventilation rate (ft}^3\text{/hr)} = \Big[\text{estimated on-time}\left(\frac{\text{min}}{\text{day}}\right) \times \text{fan rating}\left(\frac{\text{ft}^3}{\text{min}}\right)\Big]/24 \qquad (8)$$

For our example house we will say that each fan has a rated capacity of 100 ft³/min, and each runs about 45 minutes per day. Substituting our numbers, we get the air-change rate for both fans combined:

$$\text{Air ventilation rate} = 90\,\frac{\text{min}}{\text{day}} \times \frac{1\text{ day}}{24\text{ hr}} \times 100\,\frac{\text{ft}^3}{\text{min}} = 375\,\frac{\text{ft}^3}{\text{hr}}$$

Now that we have determined the volume of air that is exchanged every hour and subsequently replaced by air that is unconditioned, we must determine the amount of energy needed to heat or cool this outside air. This must be calculated in two steps. The *infiltration energy load* is the amount of energy needed to bring to room temperature the air that inadvertently enters the house from outside, while the *ventilation energy load* is the amount of energy needed to bring to room temperature the air that enters the house to replace air deliberately pumped out by a house fan. These can be calculated as follows:

$$\text{Infiltration energy load} = 12{,}000\,\frac{\text{ft}^3}{\text{hr}} \times 0.24\,\frac{\text{Btu}}{\text{lbm}\,^\circ\text{F}} \times 0.074\,\frac{\text{lbm}}{\text{ft}^3} = 213.23\,\frac{\text{Btu}}{\text{hr}\,^\circ\text{F}}$$

$$\text{Ventilation energy load} = 375\,\frac{\text{ft}^3}{\text{hr}} \times 0.24\,\frac{\text{Btu}}{\text{lbm}\,^\circ\text{F}} \times 0.074\,\frac{\text{lbm}}{\text{ft}^3} = 6.66\,\frac{\text{Btu}}{\text{hr}\,^\circ\text{F}}$$

The notation "lbm" stands for pound-mass, and is a more accurate description of what we normally call one pound of weight. The constant 0.24 Btu/lbm °F is the number of Btu needed to heat one pound-mass of air one degree Fahrenheit. The constant 0.074 lbm/ft³ is the number of pound-masses in one cubic foot of air.

So far, the calculations presented have been simplified. If you would like to try a more rigorous approach, we refer you to the references at the end of this article. You will find a number of procedures for calculating heat loss through basements, roof/ceiling combinations, solar-heat gain through windows, and you will also find a more elaborate description of air infiltration.

We have determined the *R*-value and surface area of each building component, as well as the energy load imposed by air infiltration. This information is summarized in table 3. We can proceed to calculate the yearly energy requirements for our example building. The total yearly

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Listing 1: *Program to produce a table of conduction and ventilation loads and the yearly energy requirements for a given house. Written in PET BASIC, this program, when slightly modified, will also run on any computer that uses Microsoft BASIC. The PET-dependent features are the opening of logical files to the printer, and the printing of formatted results to the printer. Line 2030 creates logical device 2 as unformatted output to the printer. Line 2035 creates logical device 3 as formatted output to the printer (see, for example, line 8000). Line 2040 creates logical device 3 as the format that later influences formatted output (see lines 2045 and 5090).*

```
100 REM  TITLE "YEARLY ENERGY LOAD"
101 REM
105 REM
110 REM
115 REM THIS PROGRAM ALLOWS YOU TO DETERMINE YOUR YEARLY ENERGY CONSUMPTION.
120 REM YOU INPUT BUILDING INFORMATION AND WEATHER CONDITIONS.
125 REM THE PROGRAM GENERATES A SUMMARY OF BUILDING CHARACTERISTICS AND ENERGY
130 REM REQUIRERMENTS FOR EACH SEASON
465 REM
466 REM
467 REM
1000 REM
1001 REM
1005 REM DATA DEFINITION
1010 REM
1150 DIM S$(25)    :REM SURFACE NAME
1160 DIM A(25)     :REM SURFACE AREA
1165 DIM R(25)     :REM R-VALUE OF SURFACE
1170 DIM UA(25)    :REM UA FOR SURFACE
1180 T$=""         :REM TITLE
1185 AC=0          :REM INFILTRATION RATE
1190 V1=0          :REM FORCED VENTILATION
1195 RT=0          :REM ON TIME OF FANS
1200 DD(1)=0       :REM HEATING DD
1205 DD(2)=0       :REM COOLING DD
1220 V=0           :REM BUILDING VOLUME
1225 SU=0          :REM UA ACCUMULATOR
2000 REM
2005 REM
2010 REM  I/O SPECIFICATION
2020 REM
2025 REM
2030 OPEN 2,4,0  :REM UNFORMATTED DATA
2035 OPEN 3,4,1  :REM FORMATTED DATA
2040 OPEN 4,4,2  :REM FORMAT CHANNEL
2041 REM FORMAT STRINGS
2045 F1$="AAAAAAAAAAAAAAAAA   99999.9      99.99       9999.9    999.9"
2046 F2$="AAAAAAAAAAAAAAAAAAA   9.99       99999       9999.9       999.9"
2049 F4$="      999.99   AAAAAAAAAAAAAAAAAAAA"
2050 REM FORMAT DELIMITER
2055 B$=CHR$(29)
2057 REM STRING CONSTANTS USED IN OUTPUT TABLE
2060 A$="AIR INFILTRATION"
2065 V$="FORCED VENTILATION"
3000 REM
3005 REM
3010 REM INPUT SECTION
3020 REM
3024 PRINT"TYPE IN TITLE OF OUTPUT TABLE"
3025 INPUT T$
3029 PRINT"WHAT IS AIR INFILTRATION RATE(A.C./HR)"
3030 INPUT AC
3034 PRINT"WHAT IS  INSTALLED FAN CAPACITY(CFM)"
3035 INPUT V1
3039 PRINT"WHAT IS ESTIMATED RUN TIME OF FANS(MIN/DAY)"
3040 INPUT RT
3044 PRINT"WHAT IS THE TOTAL # OF HEATING DEGREE DAYS "
3045 INPUT DD(1)
3049 PRINT"WHAT IS THE TOTAL # OF COOLING DEGREE DAYS "
3050 INPUT DD(2)
3064 PRINT"WHAT IS THE VOLUME OF YOUR BUILDING "
3065 INPUT V
3069 PRINT"ENTER THE NUMBER OF BUILDING ELEMENTS TO BE CONSIDERED"
3070 INPUT N
3075 FOR I=1 TO N
3080 INPUT"TYPE IN SURFACE NAME";S$(I)
3085 INPUT"WHAT IS SURFACE AREA";A(I)
3090 INPUT"WHAT IS THE R-VALUE";R(I)
3092 REM CALCULATE UA AND SUM UP
3095 UA(I)=(1/R(I))*A(I)
4000 SU=SU+UA(I)                  :REM ACCUMULATE HOURLY CONDUCTION LOADS
4010 NEXT I
4500 REM
4510 REM
4520 REM CALCULATION SECTION
4525 REM
4530 REM
4550 IL=.24*.074*V*AC             :REM HOURLY INFILTRATION LOAD
4555 V1=V1*RT/24                   REM ADJUST VENTILATION TO FT↑3/HR
4560 VL=.24*.074*V1               :REM HOURLY VENTILATION LOAD
4575 IN=IL+VL                     :REM COMBINED  HOURLY LOAD DUE TO AIR EXCHANGES
4580 TL=SU+IN                     :REM TOTAL HOURLY LOAD
4585 HL=(SU+IN)*24*DD(1)/10↑6     :REM YEARLY HEATING LOAD IN 10↑6 BTU
4600 CL=(SU+IN)*24*DD(2)/10↑6     :REM YEARLY COOLING LOAD IN 10↑6 BTU
5000 REM
5010 REM
5020 REM OUTPUT SECTION
5025 REM
5030 REM
5035 PRINT#2,T$
5040 PRINT#2,"":PRINT#2,""
5042 PRINT#2,"                        UA TABLE "
5045 PRINT#2,"":PRINT#2,""
5060 PRINT#2,"     SURFACE              AREA        R          UA      LOAD %"
5070 PRINT#2,"      NAME               (FT↑2)              BTU/HR DEG F "
5080 PRINT#2,"-------------------+------------+-----------+-----------+--------"
5090 PRINT#4,F1$    REM SET UP FORMAT
6000 FOR I=1 TO N
6005 PRINT#3,S$(I),B$,A(I),R(I),UA(I),UA(I)/TL*100
6010 NEXT I
7040 PRINT#2,"":PRINT#2,""
7042 PRINT#2,"                         VENTILATION TABLE"
7045 PRINT#2,"":PRINT#2,""
7060 PRINT#2,"   AIR EXCHANGE SOURCE  AC RATE  VENT RATE  ENERGY LOAD   LOAD %"
7070 PRINT#2,"                         AC/HR    FT↑3/HR   BTU/HR DEG F "
7080 PRINT#2,"---------------------+----------+----------+------------+--------"
7090 PRINT#4,F2$   :REM SET UP NEW FORMAT
8000 PRINT#3,A$,B$,AC,AC*V,IL,IL/TL*100
8010 PRINT#3,V$,B$,V1/V,V1,VL,VL/TL*100
8045 PRINT#2,"":PRINT#2,"":PRINT#2,""
8050 PRINT#4,F4$
8105 PRINT#2,"YEARLY HEATING REQUIRERMENT FOR";DD(1);"HEATING DEGREE DAYS"
8110 PRINT#3,HL,"MILLION BTU"
8120 PRINT#2,"":PRINT#2,"":PRINT#2,""
8125 PRI T#2,"YEARLY COOLING REQUIRERMENT FOR";DD(2);"COOLING DEGREE DAYS"
8130 PRINT#3,CL,"MILLION BTU"
9000 CLOSE 4,4
9005 CLOSE 3,4
9010 CLOSE 2,4
READY.
```

Listing 2: *Output of listing 1, based on an example that uses 3½ inches of insulation in the ceiling.*

```
EXAMPLE HOUSE IN AUSTIN TEXAS 3.5

                       UA TABLE

     SURFACE           AREA         R          UA       LOAD %
      NAME            (FT↑2)               BTU/HR DEG F
-------------------+-----------+----------+-----------+--------
CEILING/ROOF         1500.0      15.23        98.4      13.4
WALLS                1118.0       4.40       254.0      34.7
WINDOWS               120.0        .91       131.8      18.0
DOORS                  42.0       1.56        26.9       3.6

                       VENTILATION TABLE

   AIR EXCHANGE SOURCE  AC RATE  VENT RATE  ENERGY LOAD   LOAD %
                         AC/HR    FT↑3/HR   BTU/HR DEG F
---------------------+----------+----------+------------+--------
AIR INFILTRATION        1.00      12000       213.1         29.1
FORCED VENTILATION       .03        375         6.6           .9


YEARLY HEATING REQUIREMENT FOR 1980 HEATING DEGREE DAYS
      34.74   MILLION BTU


YEARLY COOLING REQUIRERMENT FOR 2908 COOLING DEGREE DAYS
      51.02   MILLION BTU
```

Listing 3: *Output of listing 1, based on an example that uses 9½ inches of insulation in the ceiling.*

```
EXAMPLE HOUSE IN AUSTIN TEXAS 9.5

                       UA TABLE

     SURFACE           AREA         R          UA       LOAD %
      NAME            (FT↑2)               BTU/HR DEG F
-------------------+-----------+----------+-----------+--------
CEILING/ROOF         1500.0      34.28        43.7       6.4
WALLS                1118.0       4.40       254.0      37.5
WINDOWS               120.0        .91       131.8      19.4
DOORS                  42.0       1.56        26.9       3.9

                       VENTILATION TABLE

   AIR EXCHANGE SOURCE  AC RATE  VENT RATE  ENERGY LOAD   LOAD %
                         AC/HR    FT↑3/HR   BTU/HR DEG F
---------------------+----------+----------+------------+--------
AIR INFILTRATION        1.00      12000       213.1         31.5
FORCED VENTILATION       .03        375         6.6           .9


YEARLY HEATING REQUIREMENT FOR 1980 HEATING DEGREE DAYS
      32.14   MILLION BTU


YEARLY COOLING REQUIRERMENT FOR 2908 COOLING DEGREE DAYS
      47.20   MILLION BTU
```

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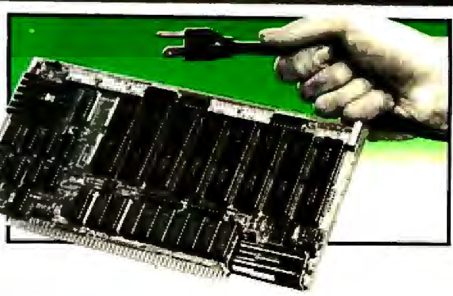

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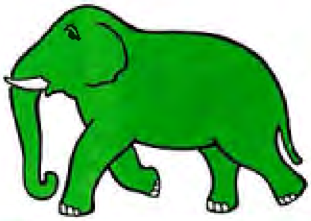

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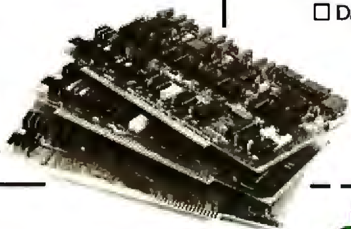

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energy requirement for space conditioning is the sum of the heating and cooling loads. The governing equation is:

$$Q_{\text{total}} = Q_{\text{heating}} + Q_{\text{cooling}}$$

Heating and Cooling Requirements

The yearly heating requirement for our example house can be easily determined from the combined conduction and infiltration load shown in table 3, and the yearly heating degree-day value of 1980 °F day/year:

$$Q_{\text{heating}} = 734.2 \frac{\text{Btu}}{\text{hr}\,°\text{F}} \times 24 \frac{\text{hr}}{\text{day}} \times 1980 \frac{°\text{F day}}{\text{year}}$$

$$= 34.89 \times 10^6 \text{ Btu/year}$$

We calculate the cooling energy requirements in a similar fashion:

$$Q_{\text{cooling}} = 734.2 \frac{\text{Btu}}{\text{hr}\,°\text{F}} \times 24 \frac{\text{hr}}{\text{day}} \times 2908 \frac{°\text{F day}}{\text{year}}$$

$$= 51.24 \times 10^6 \text{ Btu/year}$$

We have presented these calculations in considerable detail so that the reader will understand the mechanism of heat transfer. Now we would like to outline and demonstrate how to obtain these results using your personal computer. Figure 4 is a flowchart for a simple interactive program that accepts building and climate input and generates a printout (similar to table 3) and a summary of yearly energy consumption.

The program is written in Commodore (Microsoft) BASIC, and it runs on any PET with a Commodore 2022 printer. Listing 1 is the source code and listing 2 is a copy of the output from this program. Readers who are fortunate enough to have Personal Software's VisiCalc will find that the procedures performed by this program can be followed very easily. We will not go into details of the program because it simply carries out the procedures outlined earlier. We suggest that you first try these calculations by hand, then write the BASIC program after you are comfortable with the method.

Listing 4: *Program for calculating dollar savings based on proposed home improvements. This program uses the discounted payback method to determine when the home improvement pays for itself in decreased energy use.*

```
100 REM  TITLE "DISCOUNTED PAYBACK"
101 REM
102 REM
900 REM I/O SPECIFICATION
905 REM
1000 OPEN 2,4,0
1010 OPEN 3,4,1
1020 OPEN 4,4,2
1030 REM
1035 REM FORMAT STRING
1050 F1$="99      99999.99            99999.99            S99999.99"
1190 REM
1195 REM INPUT SECTION
1197 REM
1200 INPUT"GENERAL INFLATION(FRAC)";I
1250 INPUT"INVESTMENT YIELD(FRAC)";Y
1275 INPUT"FUEL ESCALATION RATE(FRAC)";E
1400 INPUT"RETROFIT COST($)";C
1500 INPUT"WINTER SAVINGS(10↑6BTU)";WS
1505 INPUT"COST OF HEATING ($/10↑6 BTU)";HC
1510 INPUT"SUMMER SAVINGS(10↑6BTU)";SS
1520 INPUT"COST OF COOLING ($/10↑6 BTU)";CC
1521 REM
1522 REM ECHO INPUT INFORMATION
1523 REM
1525 PRINT#2,"                    DISCOUNTED PAYBACK"
1527 PRINT#2,"":PRINT#2,""
1530 PRINT#2,"GENERAL INFLATION(FRAC)";I
1531 PRINT#2,"FUEL ESCALATION RATE(FRAC)";E
1532 PRINT#2,"INVESTMENT YIELD(FRAC)";Y
1534 PRINT#2,"RETROFIT COST($)";C
1536 PRINT#2,"WINTER SAVINGS(10↑6BTU)";WS
1538 PRINT#2,"COST OF HEATING ($/10↑6 BTU)";HC
1540 PRINT#2,"SUMMER SAVINGS(10↑6BTU)";SS
1542 PRINT#2,"COST OF COOLING ($/10↑6 BTU)";CC
1545 REM
1546 REM PRINT TABLE HEADER
1547 REM
1548 REM
1555 PRINT#2,"":PRINT#2,""
1560 PRINT#2,"       WITH RETROFIT       WITHOUT RETROFIT"
1565 PRINT#2,""
1570 PRINT#2,"       PRESENT VALUE OF   PRESENT VALUE OF      PRESENT VALUE OF"
1575 PRINT#2,"YEAR     CUMULATIVE           CAPITAL            NET SAVINGS"
1580 PRINT#2,"        ENERGY SAVING        INVESTMENT "
1695 REM
1700 PRINT#4,F1$    :REM SETUP FORMAT
1705 REM
1950 REM
1960 REM  CALCULATION SECTION
1965 REM
2000 A=WS*HC+SS*CC
2010 FOR N=1TO10
2050 S=A*(1+E)/(I-E)*(1-((1+E)/(1+I))↑N)
2070 CI=C*((1+Y)/(1+I))↑N
2080 PV=S-CI
2090 PRINT#3,N,S,CI,PV   :REM PRINT TABLE ENTRIES
3000 NEXT N
5000 CLOSE4,4
5005 CLOSE3,4
5007 CLOSE2,4
READY.
```

Listing 5: *Sample output of listing 4.*

```
                  DISCOUNTED PAYBACK

GENERAL INFLATION(FRAC) .1
FUEL ESCALATION RATE(FRAC) .15
INVESTMENT YIELD(FRAC) .08
RETROFIT COST($) 450
WINTER SAVINGS(10↑6BTU) 2.6
COST OF HEATING ($/10↑6 BTU) 20.51
SUMMER SAVINGS(10↑6BTU) 3.81
COST OF COOLING ($/10↑6 BTU) 6.83

       WITH RETROFIT       WITHOUT RETROFIT

       PRESENT VALUE OF    PRESENT VALUE OF       PRESENT VALUE OF
YEAR     CUMULATIVE            CAPITAL              NET SAVINGS
        ENERGY SAVING        INVESTMENT
 1          82.95              441.81              -  358.86
 2         169.68              433.78              -  264.10
 3         260.34              425.89              -  165.54
 4         355.13              418.15              -   63.01
 5         454.23              410.55              +   43.68
 6         557.83              403.08              +  154.75
 7         666.14              395.75              +  270.39
 8         779.38              388.56              +  390.82
 9         897.76              381.49              +  516.26
10        1021.52              374.56              +  646.96
```

Energy Conservation

At this point, you can see *how* to get your microcomputer to predict energy consumption in buildings, but you may be wondering whether you should go to the trouble.

The advantage of having a program is that it will allow you to rapidly evaluate the energy savings of such hypothetical changes as adding storm windows or insulation. To serve as an example, we have used our program to evaluate the effect of adding 6 inches of insulation to the ceiling of the example house. This change raises the *R*-value in the ceiling from 15.23 to 34.23. Listing 3 shows that the new annual ênergy consumption is 79.35×10^6 Btu/year, a savings of 6.41×10^6 Btu/year.

By themselves, annual energy savings numbers tell us very little. We still need an indicator that will help us choose from among energy conservation alternatives.

Energy Conservation Economics

Armed with our program and a "hit list" of potential conservation measures, we can compile energy savings figures for each measure or for any combination of the measures. But there are two other key pieces of information that we must stir into the recipe: the cost of material and labor for adopting the conservation scheme, and the fuel cost information required to turn Btu saved into dollars.

Getting a cost estimate for material and labor for residential retrofit work is as easy as calling a contractor. If the labor will be your own, then you should call a local lumber yard to get material cost figures. Once we know how much the proposed modifications to the building will cost, we can turn our attention to the dollar savings associated with the energy savings.

If a fuel is burned to produce heat, we have to know the efficiency of the furnace and the heating value of the fuel. Let's assume we are burning number two fuel oil in a furnace that has an efficiency of 70%. Using 138,000 Btu per gallon as the heating value for this oil and assuming a cost of \$1.30 per gallon, we can compute:

$$\text{Cost per million Btu} = \frac{\$1.30 \text{ per gallon}}{0.7 \times 138{,}000 \text{ Btu/gallon}} \times 10^6 = \$13.46$$

All fossil fuels can be calculated in this manner.

For electric heating, we have a cost of \$0.07 per kilowatt-hour and an efficiency of 100%. We can compute:

$$\text{Cost per million Btu} = \frac{\$0.07 \text{ per kWh}}{3413 \text{ Btu/kWh}} \times 10^6 = \$20.51$$

Electric air-conditioning cost estimates require knowledge of the coefficient of performance of the air-conditioning system—a measure of the ratio of the cooling effect in Btu to the electrical energy purchased. The coefficient of performance of a good air-conditioning system is around 3.0. The cost for cooling then becomes:

$$\text{Cost per million Btu} = \frac{\$0.07 \text{ per kWh}}{3.0 \times 3413 \text{ Btu/kWh}} \times 10^6 = \$6.83$$

A time-honored method for putting all of this information together is the calculation of *simple payback*. In this easy method, we merely calculate how long it will take for the money saved each year on energy costs to "pay back" the capital we invested to carry out the building modification. We then have a simple way to rank our energy conservation options.

Let's return to the example of adding ceiling insulation. The current cost of material for R19 fiberglass is \$0.30 per square foot, which amounts to a material cost of \$450. Let's assume you install the insulation yourself. Comparing listings 2 and 3, we see an annual energy savings of 2.6 million Btu for heating and 3.81 million Btu for cooling. Using the electricity values estimated previously, our heating and cooling savings are:

$$\text{Annual heating savings} = 2.6 \text{ million Btu} \times \$20.51 = \$53.33$$

$$\text{Annual cooling savings} = 3.81 \text{ million Btu} \times 6.83 = \$26.02$$

$$\text{Total savings} = \$79.35\text{/year}$$

The simple payback period is therefore:

$$\frac{\$450}{\$79.35} = 5.67 \text{ years}$$

You probably noticed from listings 2 and 3 that the ceiling heating and cooling load is not, by any means, the predominant load. You might, for example, be tempted to assume that insulating the walls is a better approach. However, don't forget that retrofitting wall insulation is a grim proposition that, in some cases, involves drastic dismantling of the walls. Even when it is blown in loose, wall insulation will still involve a greater initial cost than do-it-yourself ceiling insulation.

Improving the Economic Model

What if we want a more sophisticated economic model to rate our conservation measures? The shortcomings of the simple payback model are that it ignores the effects of:

- Income derived from investing the capital instead of using it for energy conservation
- Escalation of fuel costs with time
- Inflation on the real value of money saved or spent in the future

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We will present a method here called *discounted payback*, which takes these things into account without becoming terribly complicated. We will also discuss a BASIC program that uses these concepts and gives results for our example house.

Let's assume that a quantity of capital, C, is invested at an annual yield rate, Y, with an annual inflation rate of I. In 1981 dollars, the present value of this investment after n years is given by:

$$P = C\left(\frac{1+Y}{1+I}\right)^n$$

The *accumulated* present value of energy saved from now to year n, while energy costs escalate at rate E and general inflation is I, is given by:

$$S = A\frac{(1+E)}{(1+I)}\left[1 - \left(\frac{1+E}{1+I}\right)^n\right]$$

where A represents the initial annual energy savings based on 1981 fuel costs.

If we compare by subtraction the accumulated present value of the energy savings for each year with the present value of the invested money, payback occurs when the difference changes sign. Using this method, the financial gains made in the years beyond payback are tangible and easy to interpret because we have discounted everything back to 1981. Reference 4 describes several more elaborate economic models.

Listing 4 shows a program written for a Commodore PET with printer. Listing 5 shows program output for our attic insulation example using an annual energy cost escalation rate of 15%, a general inflation rate of 10%, and a rate of return on investment of 8%. The program accepts input of these three rates, plus heating and cooling energy costs in year zero (1981) and the capital cost of the energy conservation measure.

Conclusions

Some readers may question the simplicity of our methodology. Please remember that we only wish to provide the basics to get you started. The material we have presented must be expanded to be truly useful, but the references cited and the vast body of available literature on the subject should help you develop the material presented here. ■

References

1. *ASHRAE Handbook, 1977 Fundamentals.* The American Society of Heating, Refrigeration, and Air Conditioning Engineers, 345 E 47th St, New York, 1971.
2. Gay, L (editor). *The Complete Book of Insulating.* Brattleboro VT: The Stephen Greene Press, 1980.
3. McQuistion F and J Parker. *Heating, Ventilating, and Air Conditioning.* New York: John Wiley & Sons, 1977.
4. Marshall H and R Ruegg (editors). *Simplified Energy Design Economics.* Washington DC: Superintendent of Documents, US Government Printing Office.

Ask BYTE

Conducted by Steve Ciarcia

The VTR Blues

Dear Steve,

I want to use my Radio Shack TRS-80 for generating screen titles for videocassette training tapes, including graphs, etc. My problem is that when I plug the TRS-80's cable into the video recorder (instead of the monitor), I can't get a good recording.

I replaced the TRS-80's monitor with an industrial monitor, and modified the cassette recorder's cable to plug into the video monitor and the VTR (videotape recorder).

As long as I keep the amount of writing on the screen to a few lines, the videotape comes out fine. But if I try to put many lines on the screen, the result is sparkling, rippling letters, etc. Any more than four lines seems to drive the VTR crazy. Also, it seems that the writing has to be kept away from the right edge of the screen.

The VTR I use is a Panasonic reel-to-reel unit that has selectable video-level control. In the automatic mode, the recorder doesn't work so well. I have to keep it on a low manual setting. Even on good recordings, the playback gives a light gray background with black smears running to the right of the letters.

I use this equipment for my work, but many TRS-80 users must own VTRs. This idea is useful in schools for educational tape titling, etc, so solving this problem would benefit a lot of people.

Paul Bendorius
New York NY

The more lines of text on a screen, the greater the bandwidth required to store the information.

It sounds like you have two problems. First, using the cassette cable as you have provides no shielding and is probably very capacitive. Excess capacitance will cause high-frequency loss and probably accounts for the sparkling and rippling letters. Second, apparently your VTR needs a better signal with more defined synchronization levels. The problem is due to the difference between the standard 1- to 1½-volt peak-to-peak video signal that the recorder expects and the almost 4 V output from the TRS-80.

The video signal in this circumstance is either black or white—there are no gray tones. The synchronization level is correct, but the high white level can be confusing your VTR. The white level should be at +1.5 V, the black level at +0.5 V, and the synchronization level at 0 V.

I see no problem in directly recording this signal. My Magnavox VHS VTR has no problems even with a screen full of text. Other than opening your TRS-80 and changing the values of R23, R27, and R28, there isn't much I can suggest to you. Better cabling should help. . . . **Steve**

Chip Off the Old Program

Dear Steve,

I have some questions about PROM (programmable read-only memory) programming. Like many homebrewers, I'm strong on digital, but weak on analog. I have successfully built a 2708 EPROM programmer, but I encountered a problem when attempting to program Intel 2716s and 8755As under complete computer control. The +26/+5 V programming/verifying voltages complicated the control circuit. My circuitry came up with only +26/+4.4 V. The circuit did manage to program the PROMs and verify correctly, but obviously doesn't meet Intel specifications. The

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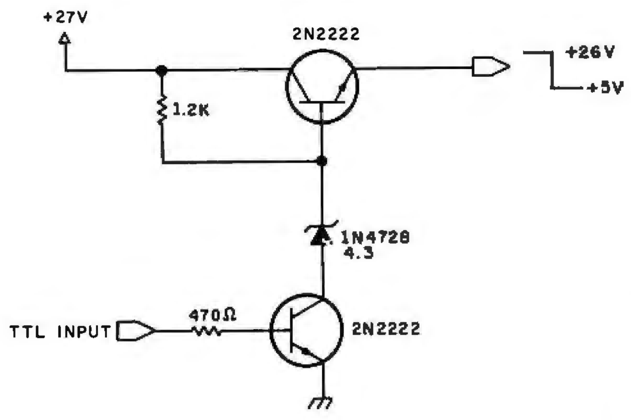

Figure 1

question is: given power-supply voltages of +5, ±12, and +26 V, can a transistor circuit be designed to come within the Intel specifications?

I've wanted to use Texas Instruments' 74S-series fuse-like (transistor-transistor logic) PROMs in circuits, but had no way of programming them. I have never seen any designs for a programmer for TTL PROMs. As I see it, there are two problems. First, a controllable power-supply voltage like the one I attempted would be required (except with different voltages). Second, what kind of drive requirements are necessary to program the output bits of the PROMs? Would TTL open-collector outputs (eg: from a decoder) be sufficient, or would an active circuit with transistors be necessary?

Robert A Servis
Ann Arbor MI

I'm not exactly an analog "wizard" myself, but I have designed a few EPROM programmers. Perhaps you should look at the article I wrote in the March 1978 BYTE for examples of voltage-level switching. (See "Program Your Next EPROM in BASIC," page 84.)

Concerning your initial problem, there is nothing inherent in transistors that would preclude them from being set at +5.0 V, and it doesn't require much to do the level shifting you need. The circuit of figure 1 switches between +26 and +5 V as you require. A logic 0 input produces +26 V, and a logic 1 produces +5 V.

Finally, as you've noted, there are few fuse-link programmer schematics around. Perhaps a reader will send me one that I can forward to you. . . . **Steve**

Incomplete Interface?

Dear Steve,

I enjoy reading your interesting projects in BYTE. Your May 1980 project appeared at the right time; however, I am having some trouble adapting it to my system. (See "I/O Expansion for the Radio Shack TRS-80, Part 1," May 1980 BYTE, page 22.)

I have the Heath H-89 all-in-one computer, which has a serial interface, and a Radio

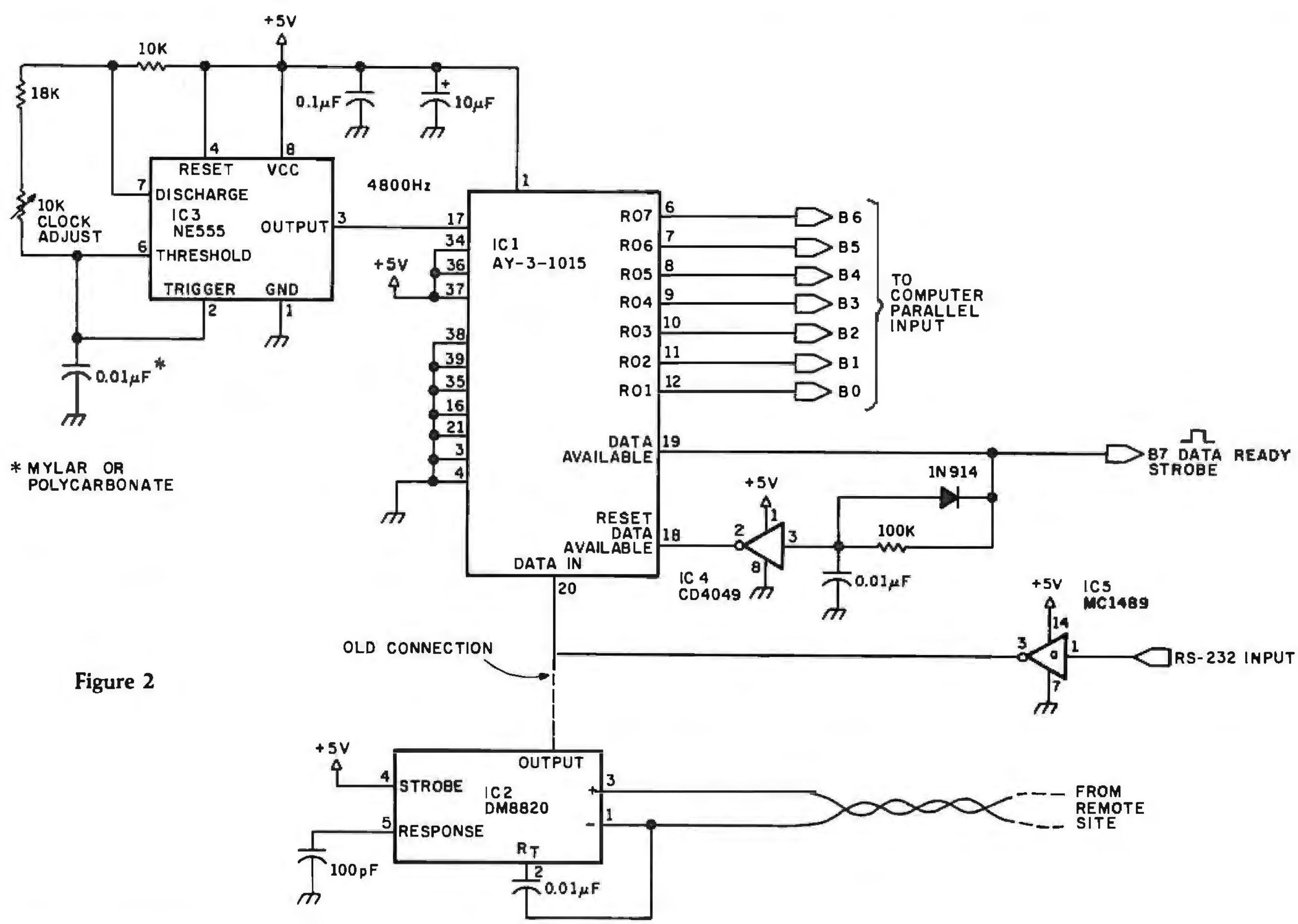

Figure 2

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Circle 113 on inquiry card.

Shack Daisy Wheel Printer II, with a letter-quality print wheel and a parallel input (eight data lines and one strobe). I need a parallel interface from my H-89 to my printer. I have tried building the parallel interface explained in your article, but can't get it to work.

I can't afford to lose the money invested in my printer, and I don't want to part with my beloved H-89. So, what can I do to complete this interface? I don't mind buying an interface off the shelf, if it's available.

Olu O Ajala
Madison TN

There are two ways to approach your problem. One is to convert the H-89 to parallel output, and the other is to enable the printer to accept serial input. Given the equipment involved, your best bet is to attach a serial-to-parallel converter to the input of the printer.

Figure 2 is a schematic of a 300 bps (bits per second) serial-to-parallel converter that should solve your problem. Set for 300 bps, no parity, and one stop bit, this circuit will allow communication between the machines. It should not be necessary to tie the printer handshaking lines back to the H-89 for the printer to operate. If you do this, however, use the input portion of the UART (universal asynchronous receiver/transmitter) IC1 to convert the parallel printer-status bits to serial.

This circuit and other variations on the subject of serial-to-parallel and parallel-to-serial conversion were covered in an article I wrote in the May 1977 BYTE entitled, "Come Upstairs and Be Respectable" (page 50). . . . **Steve**

Slow Memory Signals

Dear Steve,

The Intel 8080 microprocessor has an input intended to force the processor to wait for memory devices that have slow access times. Can you give me an example of a memory device that produces this signal?

Irv Barditch
Baltimore MD

Generally speaking, memory devices do not have output pins specifically designed to control microprocessor WAIT states. The WAIT input is controlled by separate circuitry. The usual method is to trigger a one-shot *(a circuit that produces a pulse of adjustable duration) from the device-select strobe (called CS) of the memory bank in use. The one-shot holds the WAIT line low for a specific period so that the memory has time to produce valid data.*

If you had a PROM (programmable read-only memory) with a 1 µs access time installed at location 0000 (to bootstrap load a system, for example), you would wire it as you would any other memory device (200 ns access time). However, the CS input on the PROM would have a one-shot attached to it that produced a 1 µs pulse. The $\overline{Q}$ output of the one-shot is, in turn, attached to the WAIT input of the processor. Whenever data is read from this PROM, the processor is automatically delayed by the one-shot. This delay would appear essentially transparent to the user, unless it is

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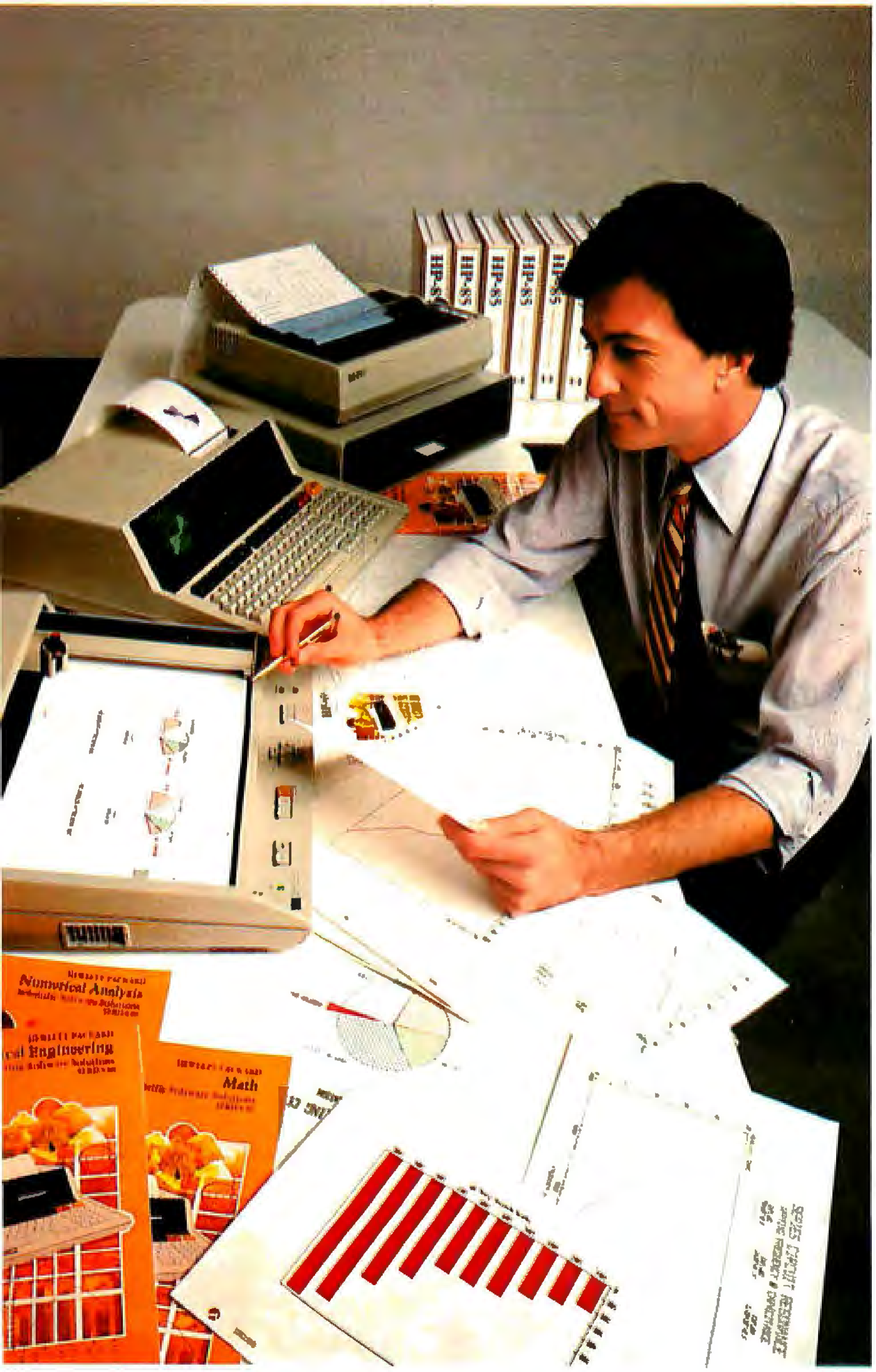

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Circle 172 on inquiry card.

set for a long period. . . . **Steve**

'Scope Trials

Dear Steve,

I'm faced with the decision to buy an oscilloscope or to continue using a homemade logic probe. What bandwidth 'scope would you recommend: 30 MHz or 50 MHz? (The 16-bit micrprocessors are getting into the 10 MHz range, and I want my investment to last.) The problem is that the 50 MHz 'scope is twice the price of the 30 MHz one.

I'd prefer a logic analyzer, but most are designed for specific microprocessors and are just too expensive.

Mel K Schmuldt
San Jose CA

The choice of a 'scope must be a trade-off between required operating needs and price. Rarely will you have to deal with the 20 MHz clock frequencies of the new microprocessors. Most likely you will just check to see if the clock is present. A frequency counter is the better instrument to measure period.

In general, most of the signals you will be trying to observe will be at far lower frequencies. You would find very little difference between a 30 and 50 MHz 'scope when displaying a 1 MHz signal.

More important factors to be concerned about when buying a 'scope that will be used primarily on digital circuitry are the precision of the trigger *and* sweep *electronics and a dual-trace (not dual-beam) display. Frequently, 'scopes are used to compare two signals while being triggered by a third. If the trigger circuitry is not particularly stable, the comparison of the signals is invalid and misleading (unfortunately, detecting these errors is very difficult). Also, it is often desirable to view the actual trigger signal or wait a specific time interval before starting the sweep.* Trigger view *and* delayed sweep *are expensive options.*

In my opinion, the most economical choice for a computer hobbyist is a 15 to 25 MHz dual-trace 'scope that has a time-base range between 200 ns and 0.5 s (without the time-base magnifier). Vertical sensitivity should be at least 10 mV per division. Delayed sweep and trigger view are not necessary. This type of 'scope probably costs about $1200.

If you are planning to do digital design, then you must be more particular about your needs. The market is wide open, and it is not unusual to pay $5000 to $15,000 for some 'scopes. My biggest complaint about top-end 'scopes is that they have so many bells and whistles that you need a road map to find the on/off switch.

Finally, if you are determined to buy a 50 MHz 'scope, I suggest the Tektronix Model 455 (about $2200). A comprehensive list of the 'scopes on the market is available in the September 1980 Electronic Products *magazine.* . . . **Steve**

Dual-Purpose Modems

Dear Steve,

I read with interest your article "A Build-It-Yourself Modem for Under $50." (See the August 1980 BYTE page 22.) I'd like to try to adapt

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Compute Magazine, November/December 1980

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"Underground Guide to Buying a Computer"
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Creative Computing Magazine, June 1980

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Circle 34 on inquiry card.

either your circuit or a commercial modem so that I can use my Apple II both for computer communication and as a deaf-communication device.

I am planning to use older model teletypewriters or special-purpose units, such as the Magsat, for the deaf communication project. From what I've been able to determine, they apparently operate at a lower transmission rate (45.5 bits per second?), and they have no carrier frequency.

What changes would be required to make a modem serve this dual purpose? Also, where can I get more information on this subject?

Jerry Black
Oshkosh WI

Remember that a modem is merely a tone generator connected to a serial-data stream. The common data rates are 110 or 300 bits per second (ie: the bit rate of the data stream). If you transmit at 45.5 bps (bits per second), the modem will operate at 45.5 bps. The modem in my article is rated to work properly from 0 to 300 bps.

If the older units you mentioned have no carrier frequency, they are probably 20 mA current-loop devices. The modem output can be converted to 20 mA with a single-transistor circuit. Such a circuit was given in my June 1980 "Circuit Cellar" article. (See "An Answer/Originate Modem," page 24.)

Finally, 45.5 bps is a function of the clock rate provided to the transmitting UART (universal asynchronous receiver/transmitter). A serial interface designed for 110 bps can be converted to 45.5 bps by lowering the clock from 1760 to 728 Hz. At 45.5 bps you would probably use 2 stop bits. . . . Steve

A Loaded Question

Dear Steve,

I got into computing a few months ago with a 16 K-byte Level II TRS-80, and I love it. So far I only have one problem: loading programs.

How do I load two or more programs at once? For example, I would like to combine a number of game programs into one program for my four-year-old daughter, along with a menu so I won't have

to keep loading the tape. Could you recommend a SYSTEM tape that could do this?

I tried a Radio Shack renumbering program to set the lines of each program far apart, but when I execute a CLOAD, it wipes out everything previously stored.

Dave Bower
Virginia Beach VA

CLOAD on a TRS-80 clears any previous program before it starts loading (except the memory area reserved when you answer the MEM SIZE? prompt). Every BASIC program, regardless of the line numbers, starts loading at the same point.

On a 16 K-byte Level II, you only have two alternatives. The first (what most people do) is to load the program each time you want it to run. A separate tape is required for each program. The second approach is to rewrite all the game programs to fit within 16 K bytes.

To do this, you would type in the first game to have the line numbers from 2000 to 3000, for example, the second from 3010 to 4000, the third from 4010 to 5000, and so on. Lines 0 thru 1999 would be reserved for a menu that allows you to select which of the games you want to run. If you select Game 2, for example, a GOTO statement would send the interpreter to line 3010 to start execution.

The only way to get the flexibility you want without rewriting all the programs is to add a disk system. With a disk, you can write a short menu program that loads the games you want to play exactly as you have described. If you feel adventurous, my March 1981 "Circuit Cellar" article is on how to build an Expansion Interface for the TRS-80 Model I. (See "Build the Disk-80: Memory Expansion and Floppy-Disk Control," page 36.) . . . Steve

Bus Transfers

Dear Steve,

I may buy a Compucolor II computer system because this integrated color system has most of the requirements that I am seeking. Most important is its resolution and color capability; however, its bus structure concerns me. My question is this: are there any products available that allow peripherals designed for the S-100 bus to be used on the Compucolor's S-50 bus?

For other projects that I have in mind, I have looked into boards designed for the S-100, but they, of course, would make the S-50 a liability. I can see that the same signals would not be readily available from the 8080A as from a Z80 microprocessor. For example, take the signal MWRITE: aside from the fact that this particular signal is not available from an 8080A pin, I'm not sure that it could be emulated. Has anyone accomplished this, or at least managed to change an 8080A system to a Z80-based system?

Daniel W McAndrew
Bel Air MD

I haven't seen an S-50-to S-100 bus converter, but that doesn't mean there isn't one. If that is your main consideration for buying the Compucolor II, you might want to look around.

As for the 8080, Z80, and S-100 incompatibility: there are a variety of interfaces available, and the MWRITE Z80 signal is easily synthesized with a few gates. A good book that covers all these buses (and conversions between some of them) is The S-100 and Other Micro Buses, *by Elmer C Poe and James C Goodwin (Indianapolis IN: Howard W Sams & Company). I paid $5.95 for it.* . . . Steve ■

Books Received

The Architecture of Pipelined Computers, Peter M Kogge. New York: McGraw-Hill, 1981; 16 by 24.5 cm, 334 pages, hardcover, ISBN 0-07-035237-2, $27.95.

The Art of Computer Programming, Volume Two, Second Edition, Donald E Knuth. Reading MA: Addison-Wesley, 1981; 16.5 by 24.5 cm, 688 pages, hardcover, ISBN 0-201-03822-6, $25.95.

Basic Computer Logic, John R Scott. Lexington MA: D C Heath & Company, 1981; 16.5 by 23.5 cm, 233 pages, hardcover, ISBN 0-669-03706-0, $21.95.

Computer Systems Performance Modeling, C H Sauer and K M Chandy. Englewood Cliffs NJ: Prentice-Hall, 1981; 18.5 by 24.5 cm, 352 pages, hardcover, ISBN 0-13-165175-7, $18.95.

Data File Programming in BASIC: A Self-Teaching Guide, L Finkel and J R Brown. New York: John Wiley & Sons, 1981; 17.5 by 25.5 cm, 338 pages, softcover, ISBN 0-471-08333-X, $9.95.

8080/Z80 Assembly Language: Techniques for Improved Programming, Alan R Miller. New York: John Wiley & Sons, 1981; 17.5 by 25.5 cm, 318 pages, softcover, ISBN 0-471-08124-8, $9.95.

Essentials of Project Management, Clifford F Gray. Princeton NJ: Petrocelli Books, 1981; 16.5 by 24.5 cm, 241 pages, hardcover, ISBN 0-89433-101-9, $17.50.

Formal Specification of Programming Languages: A Panoramic Primer, Frank G Pagan. Englewood Cliffs NJ: Prentice-Hall, 1981; 16 by 23.5 cm, 245 pages, hardcover, ISBN 0-13-329052-2, $19.95.

How to Get the Most from Your Chess Computer, Julio Kaplan. Great Neck NY: RHM Press, 1980; 13.5 by 20.5 cm, 138 pages, softcover, ISBN 0-89058-046-4, $8.95.

Information Processing Systems, Second Edition, William S Davis. Reading MA: Addison-Wesley, 1981; 20 by 24.5 cm, 504 pages, hardcover, ISBN 0-201-03183-3, $18.95.

Inside BASIC Games, Richard Mateosian. Berkeley CA: Sybex, 1981; 18 by 23 cm, 325 pages, softcover, ISBN 089588-055-5, $13.95.

Interactive Videotex: The Domesticated Computer, Dimitris N Chorafas. Princeton NJ: Petrocelli Books, 1981; 16.5 by 24.5 cm, 263 pages, hardcover, ISBN 0-89433-127-2, $21.95.

Karel the Robot, A Gentle Introduction to the Art of Programming, Richard E Pattis. Somerset NJ: John Wiley & Sons, 1981; 16.5 by 23 cm, 106 pages, softcover, ISBN 0-471-08928-1, $5.95.

Man-Machine Systems: Information, Control, and Decision Models of Human Performance, T B Sheridan and W R Ferrell. Cambridge MA: MIT Press, 1981; 15.5 by 23 cm, 452 pages, softcover, ISBN 0-262-69072-1, $12.50.

MICRO/Apple, Ford Cavallari. Chelmsford MA: Micro Ink Inc, 1981; 16 by 23 cm, 216 pages, softcover, ISBN 0-938222-05-8, $24.95. All the programs introduced in *MICRO/Apple* are on a 5-inch floppy disk (DOS 3.2 format), which accompanies the book.

Oscilloscopes, S Prentiss. Reston VA: Reston Publishing, 1981; 16 by 23.5 cm, 161 pages, hardcover, ISBN 0-8359-5354-8, $16.95.

Pascal Primer, D Fox and M Waite. Indianapolis IN: Howard W Sams & Company, 1981; 22 by 28 cm, 208 pages; softcover, ISBN 0-672-21793-7, $16.95.

6809 Assembly Language

Programming, Lance A Leventhal. Berkeley CA: Osborne/McGraw-Hill, 1981; 16.6 by 23.5 cm, 553 pages, softcover, ISBN 0-931988-35-7, $16.99.

68000 Microprocessor Handbook, Gerry Kane. Berkeley CA: Osborne/McGraw-Hill, 1981; 18 by 23.5 cm, 113 pages, softcover, ISBN 0-931988-41-1, $6.99.

Software Maintenance Guidebook, R L Glass and R A Noiseux. Englewood Cliffs NJ: Prentice-Hall, 1981; 15.5 by 23.5 cm, 193 pages; hardcover, ISBN 0-13-821728-9, $21.95.

Stalib, A Statistical Computing Library, W M Brelsford and D A Relles. Englewood Cliffs NJ: Prentice-Hall, 1981; 21 by 28 cm, 427 pages; softcover, ISBN 0-13-846220-8, $17.50.

Structured Requirements Definition, Ken Orr. Topeka KS: Ken Orr & Associates, 1981; 24.5 by 28 cm, 236 pages, softcover, ISBN 0-9605884-0-X, $25.

Understanding FORTRAN, Second Edition, M Boillot. St Paul MN: West Publishing, 1981; 18.5 by 25 cm, 505 pages, softcover, ISBN 0-8299-0355-0, $14.95.

Using BASIC, R Didday and R Page. St Paul MN: West Publishing, 1981; 18.5 by 25 cm, 525 pages, softcover, ISBN 0-8299-0357-7, $15.95.

When People Use Computers, Marilyn Mehlmann. Englewood Cliffs NJ: Prentice-Hall, 1981; 16 by 23.5 cm, 142 pages, hardcover, ISBN 0-13-956219-2, $15.

Why Do You Need a Personal Computer?, Lance A Leventhal and Irvin Stafford. New York: John Wiley & Sons, 1981: 17.5 by 25.5 cm, 278 pages, softcover, ISBN 0-471-04784-8, $8.95.■

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John Whitney is on the Faculty in the Department of Art at the University of California, Los Angeles.

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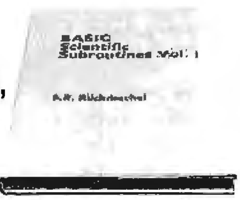

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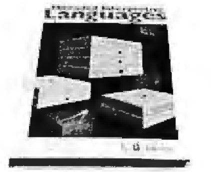

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Ron Loeliger is a Senior Analyst with Intermetrics, Inc.

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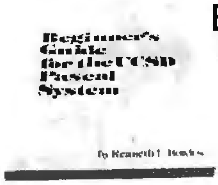

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Kenneth Skier is a Systems Programmer for Wang Laboratories, Inc., and a Lecturer at MIT.

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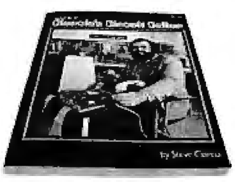

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Dr. Henry D'Angelo is the Associate Dean of the College of Engineering and Professor of Manufacturing Engineering at Boston University.

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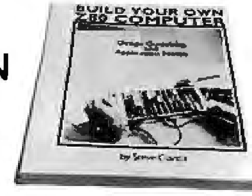

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Steve Ciarcia is a Computer Consultant, Electrical Engineer, and author of "Ask Byte" and "Ciarcia's Circuit Cellar" columns in BYTE magazine.

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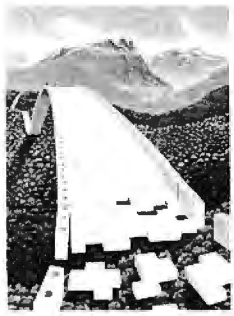

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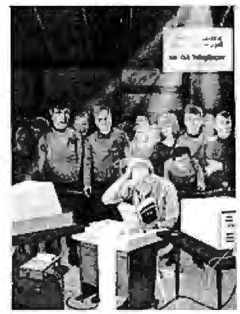

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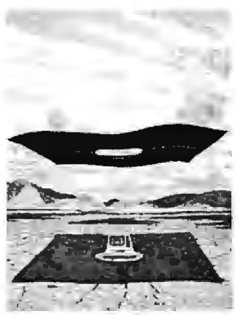

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This program is unmatched in its ability to store a maximum number of addresses on one diskette (minimum of 1100 per diskette, more than 2200 for "double density" systems!). Its many features include alphabetic and zip code sorting, label printing, merging of files and a unique keyword seeking routine which retrieves entries by a virtually limitless selection of user defined codes. Mail List 2.2 will even find and delete duplicate entries. A very valuable program!

FORM LETTER SYSTEM (FLS) (Apple and North Star diskette only) Price: $21.95
Use FLS to create and edit form letters and address lists. Form letters are produced by automatically inserting each address into a predetermined portion of your letter. FLS is completely compatible with MAIL LIST 2.2, which may be used to manage your address files.

FLS and MAIL LIST 2.2 are available as a combined package for $49.95.

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SORTIT is a general purpose sort program written in 8080 assembly language. This program will sort sequential data files generated by NORTH STAR BASIC. Primary and optional secondary keys may be numeric or one to nine character strings. SORTIT is easily used with files generated by DYNACOMP's MAIL LIST program and is very versatile in its capabilities for all other BASIC data file sorting.

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PFS is a single disk menu oriented system composed of 10 programs designed to organize and simplify your personal finances. Features include a 300 transaction capacity; fast access; 26 optional user codes; data retrieval by month, code or payee; optional printing of reports; checkbook balancing; bar graph plotting and more. Also provided on the Atari diskette is ATARI DOS 2.

THE COMMUNICATOR (Atari only) Price: 49.95 Diskette
This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., The SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "uploaded" to another computer, making the Atari a *very* smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

DYNACOMP also supplies THE COMMUNICATOR with an Atari 830 modem for a combined price of $219.95. The modem is available separately for $189.95.

TEXT EDITOR II (CP/M) Price: $29.95 Diskette/$33.45 Disk
This is the second release version of DYNACOMP's popular TEXTEDITOR I and contains many new features. With TEXT EDITOR II you may build text files in chunks and assemble them for later display. Blocks of text may be appended, inserted or deleted. Files may be saved on disk/diskette in right justified/centered format to be later printed by either TEXT EDITOR II or the CP/M ED facility. Futher, ASCII CP/M files (including BASIC and assembly language programs) may be read by the editor and processed. In fact, text files can be built using ED and later formatted using TEXT EDITOR II. All in all, TEXT EDITOR II is an inexpensive, easy to use, but very flexible editing system.

COMPRESS (North Star only) Price: $12.95
COMPRESS is a single-disk utility program which removes all unnecessary spaces and (optionally) REMark statements from North Star BASIC programs. The source file is processed one line at a time, thus permitting very large programs to be compressed using only a small amount of computer memory. File compressions of 20-50% are commonly achieved.

DFILE (North Star only) Price: $19.95
This handy program allows North Star users to maintain a specialized data base of all files and programs in the stack of disks which invariably accumulates. DFILE is easy to set up and use. It will organize your disks to provide efficient locating of the desired file or program.

FINDIT (North Star only) Price: $19.95
This is a three-in-one program which maintains information accessible by keywords of three types: Persona (eg: last name), Commercial (eg: plumbers) and Reference (eg: magazine articles, record albums, etc). In addition to keyword searches, there are birthday, anniversary and appointment searches for the personal records and appointment searches for the commercial records. Reference records are accessed by a single keyword or by cross-referencing two or three keywords.

GRAFIX (TRS-80 only) Price: $14.95 Cassette/$18.95 Diskette
This unique program allows you to easily create graphics directly from the keyboard. You "draw" your figure using the program's extensive cursor controls. Once the figure is made, it is automatically appended to your BASIC program as a string variable. Draw a "happy face", call it H$ and then print it from your program using PRINT H$! This is a very easy way to create and save graphics.

EDUCATION

HODGE PODGE (Apple only, 48K Applesoft or Integer BASIC) Price: $19.95 Cassette/$23.95 Diskette
Let HODGE PODGE be your child's baby sitter. Pressing any key on your Apple will result in a different and intriguing "happening" related to the letter or number of the chosen key. The program's graphics, color and sound are a delight for children from ages 1½ to 9. HODGE PODGE is a non-intimidating teaching device which brings a new dimension to the use of computers in education.

TEACHER'S PET I (Available for all computers) Price: $11.95 Cassette/$15.95 Diskette
This is the first of DYNACOMP's educational packages. Primarily intended for pre-school to grade 3, TEACHER'S PET provides the young student with counting practice, letter-word recognition and three levels of math skill exercises.

MORSE CODE TRAINER (TRS-80 only) Price: $12.95 Cassette/$16.95 Diskette
MORSE CODE TRAINER is designed to develop and improve your speed and accuracy in deciphering Morse Code. As such, MCT is an ideal software package for FCC test practice. The code sound is obtained through the earphone jack of any standard cassette recorder. You may choose the pitch of the tones as well as the word rate. Also, various modes of operation are available including number, punctuation and alphabet tests, as well as the keying of your own message. A very effective way to learn code!

MISCELLANEOUS

CRYSTALS (Atari only) Price: $ 9.95 Cassette/$13.95 Diskette
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari.

NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY
DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.

Price: $9.95 each/$7.95 each (4 or more)
The complete collection may be purchased for $149.95

AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, *all* programs will run within 16K program memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (Applesoft) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM format) 8" CP/M floppy disks for systems running under MBASIC.

STATISTICS and ENGINEERING

DIGITAL FILTER (Available for all computers) Price: $29.95 Cassette/$33.95 Diskette
DIGITAL FILTER is a comprehensive data processing program which permits the user to design his own filter function or choose from a menu of filter forms. The filter forms are subsequently converted into non-recursive convolution coefficients which permit rapid data processing. In the explicit design mode the shape of the frequency transfer function is specified by directly entering points along the desired filter curve. In the menu mode, ideal low pass, high pass and bandpass filters may be approximated to varying degrees according to the number of points used in the calculation. These filters may optionally also be smoothed with a Hanning function. In addition, multi-stage Butterworth filters may be selected. Features of DIGITAL FILTER include plotting of the data before and after filtering, as well as display of the chosen filter functions. Also included are convenient data storage, retrieval and editing procedures.

DATA SMOOTHER (Not available for Atari) Price: $14.95 Cassette/$18.95 Diskette
This special data smoothing program may be used to rapidly derive useful information from noisy business and engineering data which are equally spaced. The software features choice in degree and range of fit, as well as smoothed first and second derivative calculation. Also included is automatic plotting of the input data and smoothed results.

FOURIER ANALYZER (Available for all computers) Price: $16.95 Cassette/$20.95 Diskette
Use this program to examine the frequency spectra of limited duration signals. The program features automatic scaling and plotting of the input data and results. Practical applications include the analysis of complicated patterns in such fields as electronics, communications and business.

TFA (Transfer Function Analyzer) Price: $19.95 Cassette/$23.95 Diskette
This is a special software package which may be used to evaluate the transfer functions of systems such as hi-fi amplifiers and filters by examining their response to pulsed inputs. TFA is a major modification of FOURIER ANALYZER and contains an engineering-oriented decibel versus log-frequency plot as well as data editing features. Whereas FOURIER ANALYZER is designed for educational and scientific use, TFA is an engineering tool. Available for all computers.

HARMONIC ANALYZER (Available for all computers) Price: $24.95 Cassette/$28.95 Diskette
HARMONIC ANALYZER was designed for the spectrum analysis of repetitive waveforms. Features include data file generation, editing and storage/retrieval as well as data and spectrum plotting. One particularly unique facility is that the input data need not be equally spaced or in order. The original data is sorted and a cubic spline interpolation is used to create the data file required by the FFT algorithm.

FOURIER ANALYZER, TFA and HARMONIC ANALYZER may be purchased together for a combined price of $49.95 (three cassettes) and $59.95 (three diskettes).

REGRESSION I (Available for all computers) Price: $19.95 Cassette/$23.95 Diskette
REGRESSION I is a unique and exceptionally versatile one-dimensional least squares "polynomial" curve fitting program. Features include very high accuracy; an automatic degree determination option; an extensive internal library of fitting functions; data editing; automatic data and curve plotting; a statistical analysis (eg: standard deviation, correlation coefficient, etc.) and much more. In addition, new fits may be tried without reentering the data. REGRESSION I is certainly the cornerstone program in any data analysis software library.

REGRESSION II (PARAFIT) (Available for all computers) Price: $19.95 Cassette/$23.95 Diskette
PARAFIT is designed to handle those cases in which the parameters are imbedded (possibly nonlinearly) in the fitting function. The user simply inserts the functional form, including the parameters (A(1), A(2), etc.) as one or more BASIC statement lines. Data and results may be manipulated and plotted as with REGRESSION I. Use REGRESSION I for polynomial fitting, and PARAFIT for those complicated functions.

MULTILINEAR REGRESSION (MLR) (Available for all computers) Price: $24.95 Cassette/$28.95 Diskette
MLR is a professional software package for analyzing data sets containing two or more linearly independent variables. Besides performing the basic regression calculation, this program also provides easy to use data entry, storage, retrieval and editing functions. In addition, the user may interrogate the solution by supplying values for the independent variables. The number of variables and data size is limited only by the available memory.

REGRESSION I, II and MULTILINEAR REGRESSION may be purchased together for $51.95 (three cassettes) or $63.95 (three diskettes).

ANOVA (Available for all computers) Price: $39.95 Cassette/$43.95 Diskette
In the past the ANOVA (analysis of variance) procedure has been limited to the large mainframe computers. Now DYNACOMP has brought the power of this method to small systems. For those conversant with ANOVA, the DYNACOMP software package includes the 1-way, 2-way and N-way procedures. Also provided are the Yates 2^{K-P} factorial designs. For those unfamiliar with ANOVA, do not worry. The accompanying documentation was written in a tutorial fashion (by a professor in the subject) and serves as an excellent introduction to the subject. Accompanying ANOVA is a support program for building the data base. Included are several convenient features including data editing, deleting and appending.

BASIC SCIENTIFIC SUBROUTINES, Volume I (Not available for Atari)
DYNACOMP is the exclusive distributor for the software keyed to the popular text *BASIC Scientific Subroutines, Volume I* by F. Ruckdeschel (see the BYTE/McGraw-Hill advertisement in BYTE magazine, January 1981). These subroutines have been assembled according to chapter. Included with each collection is a menu program which selects and demonstrates each subroutine.

Collection #1: Chapters 2 and 3: Data and function plotting, complex variables
Collection #2: Chapter 4: Matrix and vector operations
Collection #3: Chapters 5 and 6: Random number generators, series approximations

Price per collection: $14.95 Cassette/$18.95 Diskette
All three collections are available for $39.95 (three cassettes) and $49.95 (three diskettes).

Because the text is a vital part of the documentation, *BASIC Scientific Subroutines, Volume I* is available from DYNACOMP for $19.95 plus 75¢ postage and handling.

ROOTS (Available for all computers) Price $10.95 Cassette/$14.95 Diskette
In a nutshell, ROOTS simultaneously determines all the zeroes of a polynomial having real coefficients. There is no limit on the degree of the polynomial, and because the procedure is iterative, the accuracy is generally very good. No initial guesses are required as input, and the calculated roots are substituted back into the polynomial and the residuals displayed.

LOGIC SIMULATOR (Apple only; 48K RAM) Price: $24.95 Cassette/$28.95 Diskette
With LOGIC SIMULATOR you may easily test your complicated digital logic design with respect to given set of inputs to determine how well the circuit will operate. The elements which may be simulated include multiple input AND, OR, NOR, EXOR, EXNOR and NAND gates, as well as inverters, J-K and D flip-flops, and one-shots. The response of the system is available every clock cycle. Inputs may be clocked in with varying clock cycle lengths/displacements and delays may be introduced to probe for glitches and race conditions. At the user's option, a timing diagram for any given set of nodes may be plotted using HIRES graphics. Save your breadboarding until the circuit is checked by LOGIC SIMULATOR.

LOGIC DESIGNER (North Star and CP/M only) Price: $34.95 Diskette
LOGIC DESIGNER is an exceptional Computer Aided Design (CAD) program. With it you may convert a large and complicated digitial truth table (the functional specification) into an optimized Boolean logic equation. This equation may then be *easily* converted into a circuit design using either NAND or AND/OR gates. Operationally, LOGIC DESIGNER is composed of a BASIC program which calls in a machine language routine to reduce execution time. Example: For a 7 variable by 127 line table, the processing time is only two minutes. LOGIC DESIGNER is clearly a fast and powerful tool for building digital circuitry.

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Jerry Lobdill
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Have you ever wondered how a heat-seeking missile homes in on its prey? How lunar landings are accomplished without dashing the lunar module to bits? Or how satellite orbits are predicted and adjusted? These and other complex problems have been solved through the powerful techniques of optimal estimation theory.

The roots of this discipline can be traced back to Karl F Gauss, who first used the technique of deterministic least squares in an orbit-measurement problem—circa 1800. Although Gauss recognized and discussed many aspects of the general problem of estimating the state of a dynamic system based on "noisy" measurements of observable quantities, it remained impractical to address the real-time statistical problem until 1960 when R E Kalman proposed optimal *recursive* techniques which can be easily implemented on digital computers. Today "Kalman filtering" problems involving ten to twenty variables are routinely solved in real time using microprocessor-based systems.

A complete understanding of the theory of Kalman filtering requires considerable familiarity with the theory of random processes, but the intuitive concept can be easily grasped by any interested person with some background in university-level mathematics. This article provides insight into the workings of a Kalman filter and at the same time it presents a useful algorithm that can be implemented on any personal computer. The problem addressed is simple to solve with Kalman techniques in that only one variable is involved—the gasoline mileage of your automobile.

A Practical Application

As the price of gasoline spirals, it becomes increasingly important to conserve fuel. Certain driving habits result in poor fuel economy; consequently more of us are suppressing our desire to experience the thrill of acceleration. The EPA ratings have made us aware that even the gas mileage of a properly tuned car will vary substantially depending upon whether it is driven in town or on the highway. This variation tends to obscure the inevitable aspect of gradual deterioration in performance due to aging spark plugs and points, a clogging air filter, and slowly deflating tires. Early detection of this downward trend in the average mileage can save a considerable amount of fuel and money if promptly followed by maintenance.

The problem is that even if we buy an expensive special-purpose onboard computer to monitor and display instantaneous and average mileage, or simply compute and plot mileage on a tank-to-tank basis, we still have to decide when this gradual deterioration is occurring. Although a record of the mileage the car is getting at any instant contains too much random variation (noise), a plot of average mileage versus time can be eyed judiciously or subjected to regression analysis in order to extract the required information. This is comforting to know, of course, but the idea of studying a graph is aesthetically revolting to a personal computer enthusiast, and to store all previous data for display or regression analysis seems like a brute-force approach. Isn't there an elegant recursive algorithm that will monitor the fuel economy performance? The answer is yes.

This article presents an algorithm for the recursive optimal estimation of a car's mileage performance, a flow chart for implementing the algorithm, a program written for the Hewlett-Packard HP-67/97, and an example that illustrates the program's use. I have monitored the performances of a 1973 MGB and a 1971 Mercury Monterey for several months and have found the program to be convenient and useful.

The program, based on optimal estimation theory, implements a single-state linear Kalman filter which recursively predicts the gasoline mileage at each successive fill-up, compares the measured mileage with the prediction, monitors the trend of the data, and sums the miles traveled and cost of the gasoline used since initializing the Kalman filter. The HP-67/97 program also provides alerts when the difference between the predicted and measured mileage exceeds a given threshold, when a trend toward degraded (or improved) performance is established, and when it is time to change the oil. The program and the data for the next update (fill-up) can be stored on just one of the calculator's magnetic cards.

Optimal Estimation

Optimal estimation theory is

About the Author

Jerry Lobdill is a sonar systems scientist at Tracor Inc in Austin, Texas. As a personal computer hobbyist he has written numerous programs for the HP 67/97, with applications that range from accounting to music.

applied to navigation systems, satellite orbit estimation, and rocket guidance. Most of the mechanizations are based on Kalman filtering theory (see references).

An overview of the Kalman filter is shown in figure 1. The Kalman filter recursively estimates a parameter (or set of parameters), x, called a state vector, based on discrete samples of a noisy measurement vector, z, and gives a prediction of the state vector, $\hat{x}_k(+)$, based on previous measurements. The measurement vector is considered to be linearly related to the state vector, although it need not contain the same number of elements as the state vector. If it contains fewer elements, the system is underdetermined; if it contains more, the system is overdetermined. (In the case at hand, both the measurement vector and the state vector are one dimensional.) The Kalman filter is designed to produce an estimate of the state vector which is optimum in a least-squares sense. Theoretically, no other estimator can produce a better estimate if the actual process and the model of the process incorporated into the filter are in accord. The Kalman filter provides not only an estimate of the current state vector, $\hat{x}_k(+)$, but also a prediction of the next state vector, $\hat{x}_{k+1}(-)$.

System and Measurement Models

In the Kalman mileage predictor-monitor, we assume that when the car is operating properly the true mileage is a constant perturbed by additive zero-mean Gaussian noise. Thus, our system model is defined by a single state with the following simple- state transition equation:

$$x_{k+1} = x_k + w_k \qquad (1)$$

where x_k is the mileage on the kth fill-up, and w_k is a sample from a zero-mean Gaussian process with variance given by q. Changes in the mileage due to different driving conditions encountered on different tanks (not errors in our measurements) are represented by *plant noise*, w_k.

Our kth measurement of the mileage, which we denote by z_k, is corrupted by another zero-mean Gaussian noise process, v_k, so that in the Kalman filter we assume that the measurement is related to the actual mileage, x_k, by the equation:

$$z_k = x_k + v_k \qquad (2)$$

where v_k has a variance denoted by r. The quantity v_k is called *measurement noise*, and it represents the uncertainty in our measurement procedure.

The program computes the mileage measurement, z_k, using the total cost of the fill-up, C_k, and the price per gallon, CG_k. This yields a more accurate measure of the number of

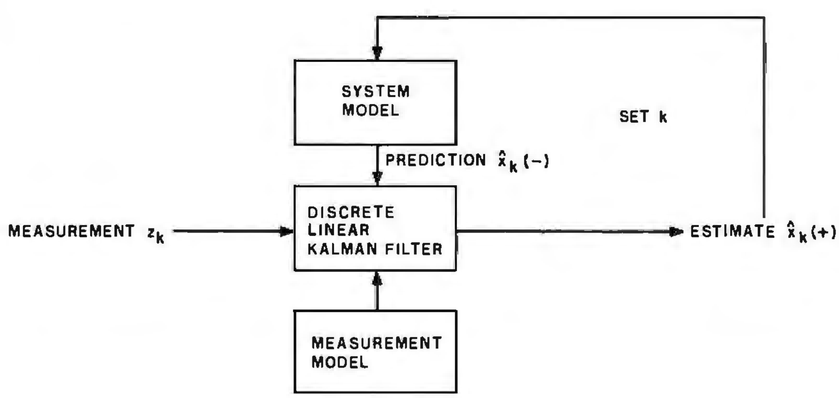

Figure 1: *The discrete linear Kalman filter computes the optimal estimate of the state vector, x, from a noisy measurement vector, z, and a prediction of the state vector, $\hat{x}_{k+1}(-)$, based on the available k previous measurements. After the kth measurement, the optimal estimate of the state vector is $\hat{x}_k(+)$. The system and measurement model boxes represent mathematical descriptions of the filter designer's concept of the processes which produce the observables, z_k. To the extent that these models coincide with reality, the filter is optimal.*

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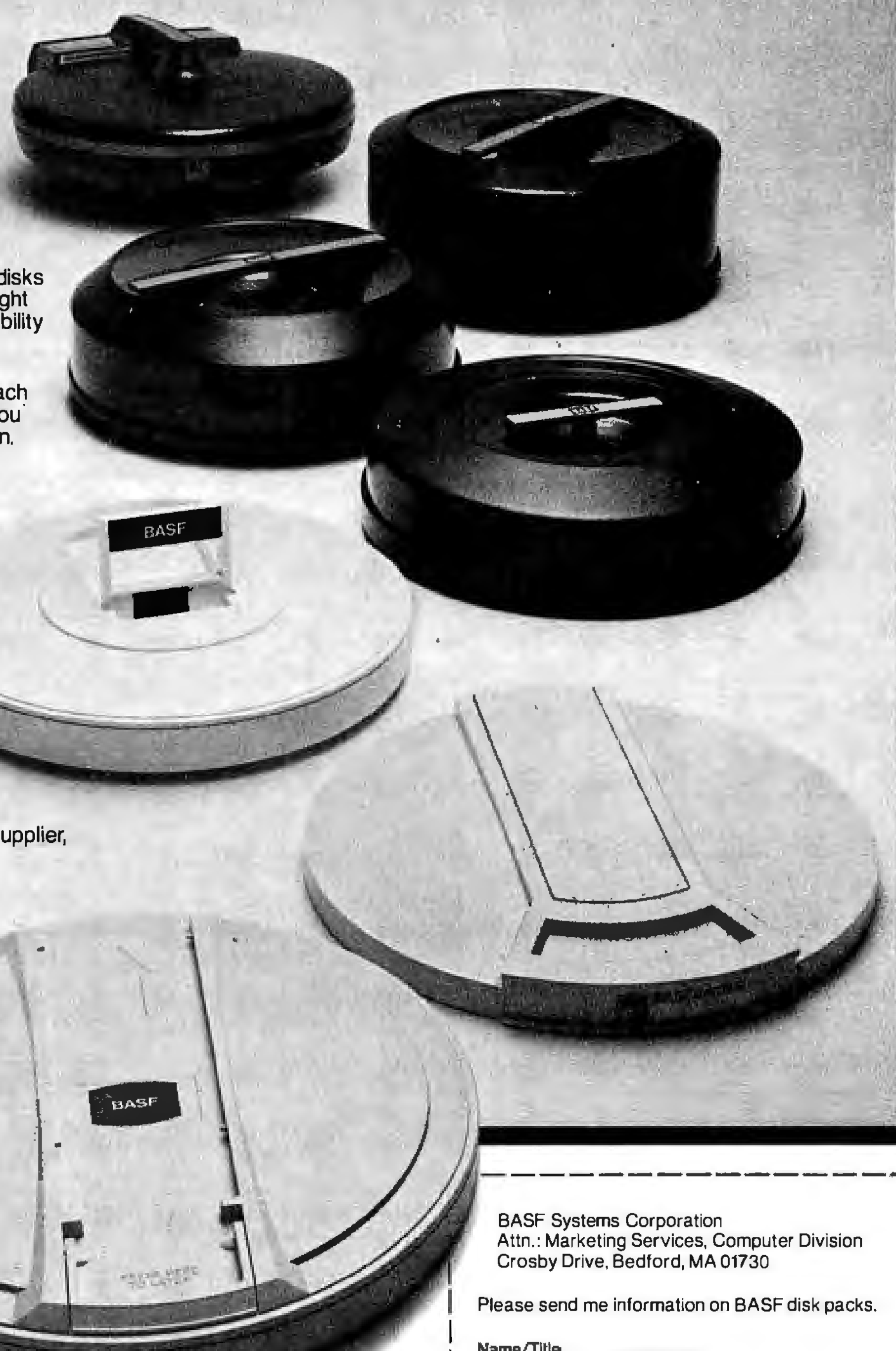

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gallons used than that obtained by using the gas pump reading. Thus:

$$z_k = \frac{(O_k - O_{k-1})\,(CG_k)}{C_k} \quad (3)$$

where $O_k - O_{k-1}$ is the difference between odometer readings on the $(k-1)$th and the kth fill-up.

Recursive Estimation

The optimal estimate of x after the kth fill-up is given by the following equation:

$$\hat{x}_k(+) = \hat{x}_k(-) + K_k(z_k - \hat{x}_k(-)) \quad (4)$$

where the ∧ caret denotes an estimate of the state, and the $(-)$ or $(+)$ denotes the estimate before or after the kth fill-up, respectively. A prediction of the kth value of x based on the $k-1$ previous measurements (but not including the kth measurement) is expressed as $\hat{x}_k(-)$. K_k is called the *Kalman gain,* and the quantity $(z_k - \hat{x}_k(-))$ is called the *residual,* denoted hereafter by R_k.

The Kalman gain is a measure of the confidence the filter places in the current measurement. It is related to the *error covariance,* $P_k(-)$, by the equation:

$$K_k = \frac{P_k(-)}{P_k(-) + r} \quad (5)$$

The error covariance is an estimate of

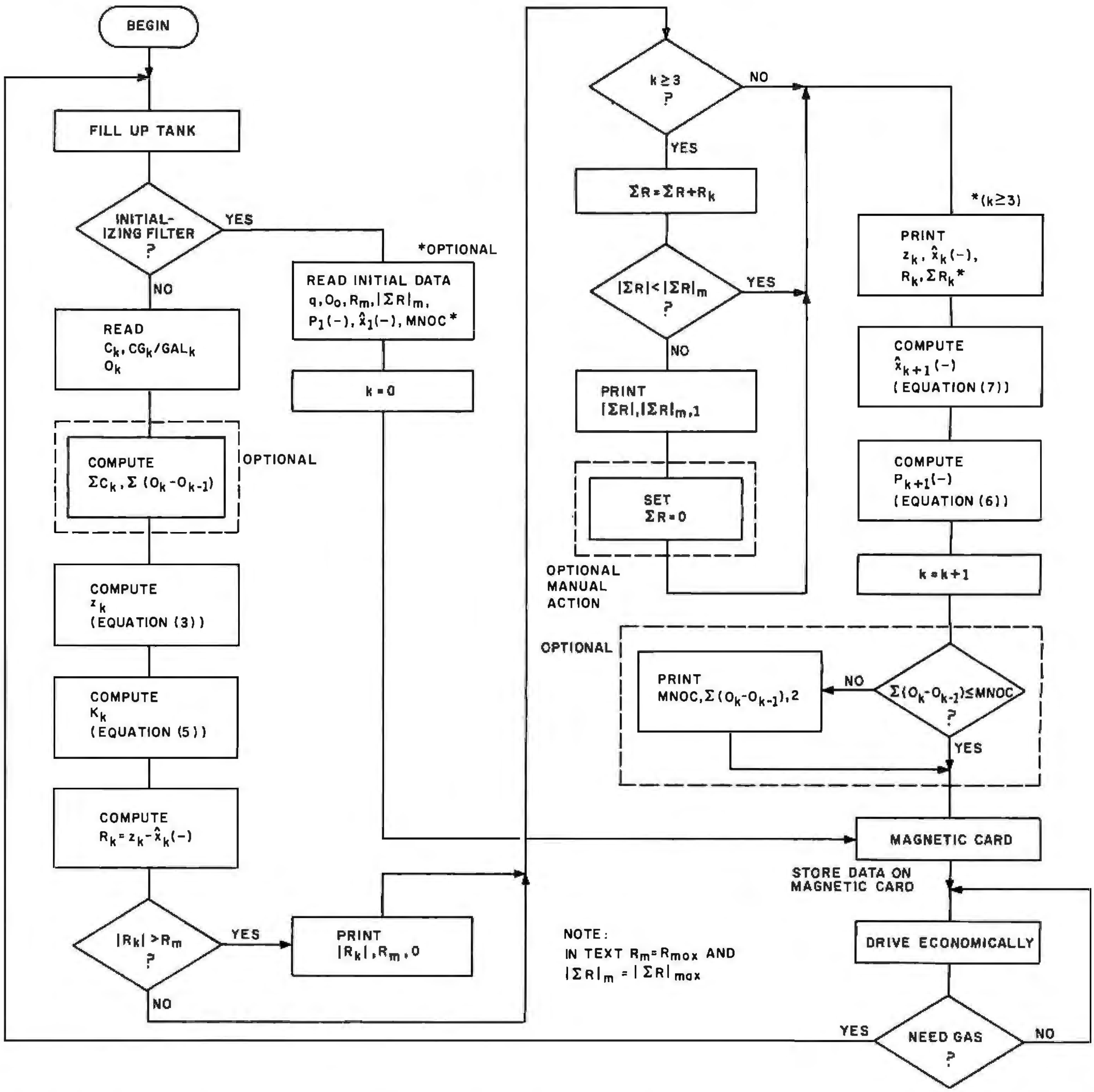

Figure 2: *Flowchart of the Kalman mileage-predictor program. MNOC is a constant with a value that means "miles since filter initialization."*

```
001  *LBLE    21 15
002  CLRG     16-53
003  STO4     35 04
004  R↓         -31
005  STOA     35 11
006  R↓         -31
007  STOB     35 12
008  R↓         -31
009  STOD     35 14
010  0           00
011  STOI     35 46
012  R/S         51
013  STOC     35 13
014  R↓         -31
015  STO3     35 03
016  R↓         -31
017  STO5     35 05
018  WDTA     16-61
019  RTN         24
020  *LBLA    21 11
021  R↓         -31
022  STO2     35 02
023  R↓         -31
024  STO0     35 00
025  ST+8  35-55 08
026  R↑       16-31
027  ÷          -24
028  RCLB     36 12
029  R↑       16-31
030  STOB     35 12
031  X⇄Y        -41
032  -          -45
033  ST+7  35-55 07
034  X⇄Y        -41
035  ENT↑       -21
036  R↓         -31
037  ÷          -24
038  STO1     35 01
039  .          -62
040  4           04
041  RCL5     36 05
042  +          -55
043  1/X         52
044  RCL5     36 05
045  x          -35
046  STO6     35 06
047  0           00
048  RCLA     36 11
049  RCL1     36 01
050  RCL3     36 03
051  -          -45
052  STOE     35 15
053  ABS      16 31
054  X>Y?     16-34
055  GSB0     23 00
056  RCLI     36 46
057  3           03
058  X≤Y?     16-35
059  GSB1     23 01
060  GSBC     23 13
061  RTN         24
062  *LBL1    21 01
063  RCLE     36 15
064  ST+9  35-55 09
065  1           01
066  RCL4     36 04
067  RCL9     36 09
068  ABS      16 31
069  X>Y?     16-34
070  GSB0     23 00
071  RTN         24
072  *LBL0    21 00
073  SPC      16-11
074  PRTX       -14
075  R↓         -31
076  PRTX       -14
077  R↓         -31
078  PRTX       -14
079  RTN         24
080  *LBLC    21 13
081  RCL9     36 09
082  RCLE     36 15
083  RCL3     36 03
084  RCL1     36 01
085  GSB0     23 00
086  R↓         -31
087  PRTX       -14
088  R↑       16-31
089  RCL6     36 06
090  x          -35
091  RCL3     36 03
092  +          -55
093  STO3     35 03
094  ISZI  16 26 46
095  1           01
096  RCL6     36 06
097  -          -45
098  RCL5     36 05
099  x          -35
100  RCLD     36 14
101  +          -55
102  STO5     35 05
103  2           02
104  RCLC     36 13
105  RCL7     36 07
106  X≤Y?     16-35
107  GTO2     22 02
108  GSB0     23 00
109  *LBL2    21 02
110  WDTA     16-61
111  RTN         24
```

Listing 1: *Program to predict automobile mileage using the Kalman filtering technique. Written for the Hewlett-Packard HP-67 (or HP-97), the program uses a recursive routine that compares the actual fuel economy with the predicted economy and provides a warning if the discrepancy is above a threshold level.*

the variance of the error in the filter's estimate of x. When the filter is updated, the error covariance is updated according to the equation:

$$P_{k+1}(-) = (1-K_k)P_k(-) + q \quad (6)$$

By virtue of our state transition model, equation 1, we have:

$$\hat{x}_{k+1}(-) = \hat{x}_k(+) \quad (7)$$

because the Gaussian noise term, w_k, has a zero-mean value. Note in equation 5 that the Kalman gain cannot exceed unity since r, the measurement noise variance, is non-negative. (If r were zero, our measurements would be error free.) When the gain is small, the filter places more confidence in the prediction than in the new data; when the gain is large, the filter is less skeptical of the new data. After the filter is initialized, the Kalman gain decreases monotonically from the initial value to a steady-state value as the filter is updated. This decrease in the gain is a result of the fact that as more data is accumulated, the error in the estimate of the state decreases (ie: P_k decreases). If r is small, the Kalman gain approaches unity, in which case it disregards new data. In this instance, the error in the estimate of the state would be entirely due to the plant noise, as can be seen by examination of equation 6 with $K_k = 1$. Plant noise prevents the filter from deciding that it knows everything, in a sense causing it to behave like a finite memory filter that always responds to new data. The recursive feature of the Kalman filter is evident in that only the present measurement value, z_k, is required in equations 4 thru 7.

Filter Design Considerations

It is desirable that the filter respond slowly to changes in the mean value

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of the mileage data. This allows the residuals to be monitored for the purpose of detecting changes in mileage that exceed the expected variation for a properly operating automobile. We generate an alarm if the residual exceeds twice the expected standard deviation of the steady-state estimation error (the alarm detects sudden changes in mileage). We also sum the residuals and generate an alarm if the magnitude of the sum exceeds four times the expected standard deviation of the steady-state estimation error (this alarm detects a gradual trend, either upward or downward). In order to allow the filter to converge, we do not begin to sum the residuals until the third update after initialization.

Flow Diagram

The flow diagram for the Kalman mileage predictor-monitor is shown in figure 2. Note that a number of inputs are required upon initialization. The following guidelines and the example contain a discussion of how to select values for these inputs.

Figure 2 shows optional computations that aid in monitoring automobile performance and assure timely maintenance. Specifically, sums of all gasoline costs and total miles traveled since filter initialization are computed and a test is performed to determine whether or not the total miles traveled exceeds the desired oil change interval. If it is time for an oil change, the program outputs an alarm. The user can compute gasoline cost per mile traveled at any time by recalling the summed data and computing the ratio of costs to miles traveled. Other optional computations can be added if you are willing to use more than one HP-67/97 magnetic card for program and data storage or if the program is implemented on a larger machine.

The optional manual action, set $\Sigma R = 0$, has been shown in figure 2 to emphasize a point about ΣR, the sum of the residuals computed for $k \geq 3$. Since the mean value of the residuals is zero, you might expect that the sum of the residuals will remain near zero. However, there is a theorem in probability theory (the theorem of long leads) that states, in effect, that the farther this sum departs from zero, the longer it will be before it returns to zero. This is a result of the fact that a significant departure from zero requires an improbable sequence of events—the occurrence of residuals of improbably large magnitude and/or a sequence of residuals of the same sign. Once such an improbable event occurs, an equally improbable event must occur to return the sum to zero. Therefore, the user may wish to set $\Sigma R = 0$ whenever $|\Sigma R|$ reaches or crosses the threshold, $|\Sigma R|_{max}$, in order to prevent this alarm from repeating erroneously after the car has been repaired. The flow diagram shows that the program does not output the filter's estimate of the mileage based on all k measurements, $\hat{x}_k(+)$.

Register	Contents	Units
P0	Cost of current fill-up, C_k	$
P1	Measured miles per gallon at current fill-up, z_k	mpg
P2	Cost per gallon, CG_k	$
P3	Predicted miles per gallon for next fill-up, $\hat{x}_{k+1}(-)$	mpg
P4	Threshold for magnitude of the sum of residuals, $\lvert\Sigma R\rvert_{max}$	mpg
P5	Error covariance for next fill-up, $P_{k+1}(-)$	$(mpg)^2$
P6	Kalman gain for current fill-up, K_k	none
P7	Total miles traveled since initialization, $\Sigma(O_k - O_{k-1})$	mi
P8	Total cost of gasoline since initialization, ΣC_k	$
P9	Sum of the residuals, ΣR_k $(k \geq 3)$	mpg
A	Threshold for magnitude of a residual, R_{max}	mpg
B	Odometer reading at current fill-up, O_k	mi
C	Total miles between initialization and next oil change, MNOC	mi
D	Variance of plant noise, q	$(mpg)^2$
E	Residual, current fill-up, R_k	mpg
I	Number of fill-ups since initialization, including current fill-up, k	none

Table 1: *Data-register contents for the mileage-predictor program. P0 thru P9 represent primary registers.*

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Instead, the filter's prediction is based on $k-1$ measurements, $\hat{x}_k(-)$. This quantity is more useful because the user is interested in what the mileage *should* have been on the kth fill-up.

Alarms are indicated by a code number on the printer. A zero indicates that the magnitude of the residual has exceeded the threshold, a one indicates that the magnitude of the sum of the residuals has exceeded the threshold, and a two indicates that it is time for an oil change.

HP-67/97 Program Listing

The HP-67/97 program listing is shown in listing 1. Since it requires 111 steps, the program can be recorded on side 1 of a magnetic card. A value of $r = 0.4$ has been incorporated in the program at steps 039 and 040. This choice is explained in the next section and in the example. Data storage requires primary registers 0 thru 9 and registers A, B, C, D, E, and I. The contents of these data registers can be recorded on side 2 of the card. Table 1 identifies data register contents, and table 2 gives instructions for the use of the program.

Program Calibration

When the filter is initialized, it is necessary to specify the initial values of the error covariance, $P_1(-)$, an estimate of your car's mileage, $\hat{x}_1(-)$, the plant noise variance, q, and the measurement noise variance, r. A reasonable initial guess at the quantities will cause the filter to converge to a good estimate within three updates. The two parameters which affect the filter's steady-state performance are r and q. It is recommended that you select $q = 0.02$ and $r = 0.4$ when you first begin to use the program. These values work well for both of my cars (which perform quite differently). The procedure used to select these quantities requires that you keep a record of mileage data for a number of updates. Try plotting z_k versus O_k for a few fill-ups. By virtue of equation 2, the variance of the measurements, σ_z^2, is r, provided the data does not contain a trend. If the plot appears to contain a trend, try

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Step	Instructions	Input Data/Units	Keys	Output Data/Units
1	Load side 1, magnetic card			
2	If updating GO TO 5, otherwise continue			
3	INITIALIZE: Enter plant noise, q	$q/(\text{mpg})^2$	ENT	
	Beginning odometer reading, O_o	O_o/mi	ENT	
	Threshold for residual alarm, R_m	R_m/mpg	ENT	
	Threshold for sum of residuals alarm, $\lvert\Sigma R\rvert_m$	$\lvert\Sigma R\rvert$/mpg	E	
	Initial guess at the error covariance, $P_1(-)$	$P_1(-)/(\text{mpg})^2$	ENT	
	Initial guess at the mileage, $\hat{x}_1(-)$	$\hat{x}_1(-)$/mpg	ENT	
	Value of $\Sigma(O_k - O_{k-1})$ at next oil change	MNOC/mi	R/S	Crd
4	Record data on side 2 of card END			
5	Load side 2 of card			
6	Enter total price of gasoline at fill-up	C_k/\$	ENT	
	Enter price per gallon	CG_k/\$	ENT	
	Enter odometer reading	O_k/mi	A	
	OUTPUTS: If $\lvert R_k\rvert > R_m$:			$\lvert R_k\rvert$/mpg
				R_m/mpg
				0.0000
	If $\lvert\Sigma R_k\rvert > \lvert\Sigma R\rvert_m$:			$\lvert\Sigma R_k\rvert$/mpg
				$\lvert\Sigma R\rvert_m$/mpg
				1.0000
	Actual mileage measured, z_k			z_k/mpg
	Predicted mileage, $\hat{x}_k(-)$			$x_k(-)$/mpg
	Residual, $R_k = z_k - \hat{x}_k(-)$			R_k/mpg
	Sum of residuals for $k \geq 3$			ΣR_k/mpg
	If time for oil change:			
	Elapsed mileage since initialization			$\Sigma(O_k - O_{k-1})$/mi
	Elapsed mileage at oil change interval			MNOC/mi
	(When this happens, change the oil, add the desired oil change interval to the contents of register P7 to get the new value of MNOC, and DO:	MNOC/mi	STO C	2.0000
7	Record data on side 2 of card END OPTIONAL:		f WDTA	Crd
8	When something causes $\lvert\Sigma R_k\rvert > \lvert\Sigma R\rvert_m$ to occur it is best to set P9 = 0 before recording data for next update: 0		STO 9	
9	You can compute your gasoline costs per mile traveled over the total miles traveled by:		RCL 8 RCL 7 ÷	\$/mile

Table 2: *Instructions and keypresses necessary for use with the mileage-predictor program.*

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Alarm Type	k	C_k	CG_k	O_k	z_k	$\hat{x}_k(-)$
—	0	9.91	0.889	77406.6*	—	—
0	1	8.77	0.889	77645.2	24.1865	28.0000*
—	2	5.06	0.879	77784.0	24.1117	24.4690
—	3	9.45	0.879	78045.0	24.2771	24.2925
—	4	8.40	0.899	78273.1	24.4121	24.2871
—	5	9.25	0.899	78519.6	23.9571	24.3230
—	6	8.10	0.899	78742.6	24.7502	24.2308
0,1**	7	9.00	0.919	78942.6	20.4222	24.3513
0	8	10.20	0.919	79182.8	21.6415	23.4871
—	9	8.26	0.929	79389.0	23.1913	23.0948
1,2**	10	10.35	0.949	79627.0	21.8224	23.1149
0,1**	11	11.32	0.949	79866.1	20.0447	22.8449
—	12	10.42	0.969	80108.4	22.5325	22.2798
0	13	9.89	0.979	80352.5	24.1632	22.3308
—	14	10.30	0.999	80580.4	22.1041	22.6997
—	15	10.70	0.999	80820.5	22.4168	22.5801
—	16	9.25	1.05	81021.3	22.7935	22.5473
0,1**	17	5.05	1.05	81098.3	16.0099	22.5967
0	18	11.80	1.07	81367.0	24.3652	21.2779

* Initialization values. Since the $\hat{x}_1(-)$ guess was wrong, a type-0 alarm occurred on the first fill-up ($k=1$). Other initialization data were: $q=0.02$, $P_1(-)=5$, $R_{max}=1.26$, $|\Sigma R|_{max}=2.53$, MNOC = 2000.

** When type-1 alarms occurred, ΣR_k was set to zero as suggested in the text.

Table 3: *Program input data and results (also see figure 3).*

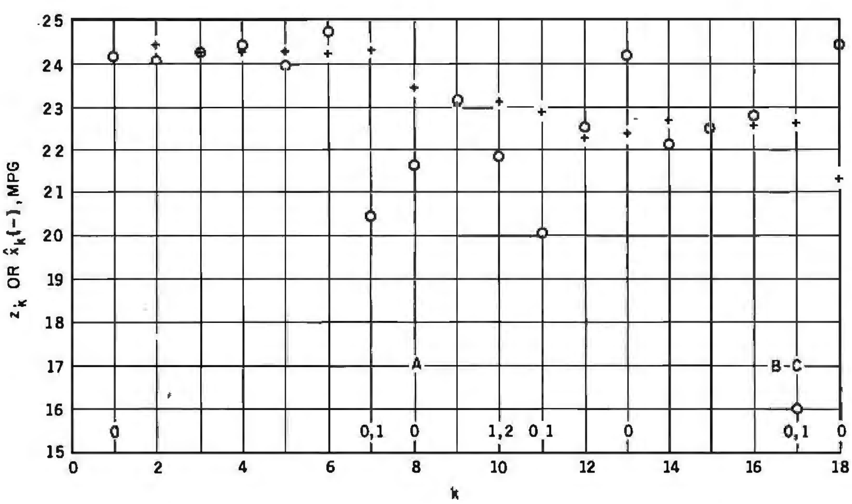

Figure 3: *Plots of actual data provided to Kalman mileage predictor (see table 3) and the resulting mileage estimates. The filter program provided alarms that resulted in the following repairs:*

A: faulty vacuum hose replaced on carburetor
B: valve job
C: loose spark plug wire

Other interesting points on these plots are marked as follows:

0: indicates that the residual magnitude exceeds the alarm threshold
1: indicates that the magnitude of the sum of the residuals exceeds the alarm threshold
2: indicates that oil-change mileage has been reached or exceeded

Mileage measurements are indicated by a circle; mileage predictions are indicated by a cross.

linear regression to obtain a proper value of r.

Once a value of r is obtained, you must make a choice of q. The choice can be made either analytically or heuristically, but remember that the function of plant noise in the Kalman mileage predictor-monitor is to keep the filter from ignoring new data. At steady state (the value of k large) the effect of q on the error covariance and Kalman gain are given by the relations:

$$\lim_{k\to\infty} P_k(\pm) = \sqrt{rq} \tag{8}$$

and:

$$\lim_{k\to\infty} K_k = \sqrt{q/r} \tag{9}$$

respectively. The variance of the residuals is given by:

$$\sigma^2_{R_k} = \sqrt{rq} + r \tag{10}$$

Equations 4 and 9 demonstrate that the larger the value of q, the more responsive the filter is to new data. However, equations 1 and 10 imply that the predictions, $\hat{x}_k(-)$, also become noisier as q increases. In addition, the ability of the filter to detect trends in the mileage data decreases, as indicated in equation 8.

Obviously, an optimization problem could be defined here. An elaborate simulation experiment could be designed to select a value of q that would cause the filter to adapt its estimate to track a step function change in the mean value of the measurements within so many updates while still producing an alarm on measurements containing a trend of so many miles per gallon per fill-up.

I prefer the heuristic approach. The idea is to select a sufficiently small q so that $\hat{x}_k(-)$ varies slowly with k when the car is operating properly and when driving conditions are similar. A value of $q = 0.02$ works well for both of my cars and my driving pattern. If I took my car on an extended trip where highway driving would predominate I would probably increase the value of q by, say, a factor of 10 for one or two fill-ups in

Glossary

The following glossary of terms is provided to clarify the meaning of some of the specialized terms used in this article. Definitions have been simplified to avoid the introduction of additional terms.

Convergence: *A Kalman filter may be said to converge when the magnitude of the envelope of the residuals is a monotonically decreasing function of the number of filter updates.*

Error covariance: *In intuitive terms, a statistical estimate of the error in the state vector.*

Gaussian noise: *Random errors that add algebraically to quantities of interest, such as measurements (z_k), are frequently considered to have a Gaussian probability density with a zero-mean value. For example, the expression:*

$$f(v_k) = \frac{1}{\sqrt{2\pi r}} \exp\left(\frac{-v_k^2}{2r}\right)$$

is the probability density for v_k, the measurement noise term of equation 2, which has a variance of r and a mean value of zero. Zero-mean random variables are said to be unbiased. A probability density equation gives the probability that a random variable (v_k in the above equation) assumes a particular value.

Kalman gain: *A function of the error covariance (the measurement matrix which relates the measurement vector to the state vector) and the measurement noise covariance (or variance in the case of a filter with a single element measurement vector). It is a measure of the confidence the filter places in the current measurement. The smaller the gain, the less confidence the filter has in the measurement.*

Least-squares sense optimum estimator: *An algorithm that produces estimates for which the sum of the squares of the errors in the estimates is minimum.*

Linear Kalman filter: *A filter in which the equations expressing the measurements in terms of the elements of the state vector are linear equations.*

Measurement noise: *A random unbiased error which corrupts the measurements.*

Overdetermination/underdetermination: *If there are more elements in the measurement vector than in the state vector, the Kalman filter is overdetermined. If there are fewer elements in the measurement vector than in the state vector, the Kalman filter is underdetermined.*

Plant noise: *An additive unbiased random quantity representing some actual physical process which causes the state vector to have statistical variability. Plant noise has the effect of preventing the Kalman gain from approaching zero as the number of updates increases. Kalman filter designers sometimes use this effect to implement an adaptive filter. In such filters, the sequence of residuals is tested for bias. When bias is detected, artificial plant noise is introduced into the filter. This increases the Kalman gain, which in turn causes the filter to increase its confidence in the incoming measurements when compared to its predictions. When the residuals are again unbiased, the plant noise is reduced.*

Regression analysis: *A process by which a least-squares optimum curve is fit to a set of data points. When the curve is a straight line, the process is called linear regression analysis.*

Residual: *A Kalman filtering term that denotes the difference between the actual measurement vector and the predicted measurement vector.*

Standard deviation: *A statistical term that is a measure of the expected or observed spread of data points about the mean value. Quantitatively, two thirds of the data points are within one standard deviation, plus or minus, of the mean value.*

State vector: *Any set of quantities sufficient to completely specify the unforced motion of a dynamic system.*

Variance: *The variance of a set of n measurements, x_i (i = 1 to n), is given by the formula:*

$$\text{variance} = \sum_{i=1}^{n} \frac{[(x_i - \bar{x})^2]}{(n-1)!}$$

where $\bar{x}$ is the mean value of the set. The *square root of the variance is called the standard deviation.*

**Though the filter's output is based upon all data entered since initialization, and data is not saved. Thus, the amount of memory required to produce successive estimates is minimal and constant — an essential feature of algorithms implemented on the HP67/97.*

order to allow the filter to adapt its estimate to the anticipated improvement in gasoline mileage.

Example

Figure 3 shows the measurement data, z_k, as a function of k for my 1973 MGB. Also shown are significant maintenance events during the time period covered by the data. Until the thirteenth fill-up, I did not rely on the Kalman mileage predictor-monitor because all initialization data was based on speculation. On the twelfth fill-up, I calibrated the filter using the data from $k = 5$ through $k = 12$. Since this data contains a trend, I used linear regression to obtain a value of $r = 0.4$ mpg². I then reprocessed the data using $r = 0.4$, $q = 0.02$, $P_1(-) = 5$ mpg², $x_1(-) = 28$ mpg, $R_{max} = 2\sqrt{0.4}$, and $|\Sigma R|_{max} = 4\sqrt{0.4}$.

Figure 3 indicates the occurrence of each type of alarm and superimposes the predictions, $x_k(-)$, on the plot of z_k versus k. The filter alarms will indicate the need for maintenance at the proper time. The history of input and output data for the MGB are given in table 3.

One powerful feature of the Kalman filtering technique lies in its use of a recursive algorithm. Though the filter's output is based upon all data entered since initialization, the data is not saved. Thus, the amount of memory required to produce successive estimates is minimal and constant—an essential feature of algorithms implemented on the HP-67/97. The filter program monitors gradual degradation of fuel economy, despite the action of noise and variations due to external sources. While other methods (plotting a graph or regression analysis) could be used, the Kalman technique is elegantly simple. ■

References

1. Kalman, R E. "A New Approach to Linear Filtering and Prediction Problems." *J Basic Engineering*, March 1960, pages 35 thru 46.
2. Gelb, Arthur et al. *Applied Optimal Estimation*. Cambridge MA: MIT Press, 1974. (This text is recommended as a practical introduction to Kalman filtering theory.)

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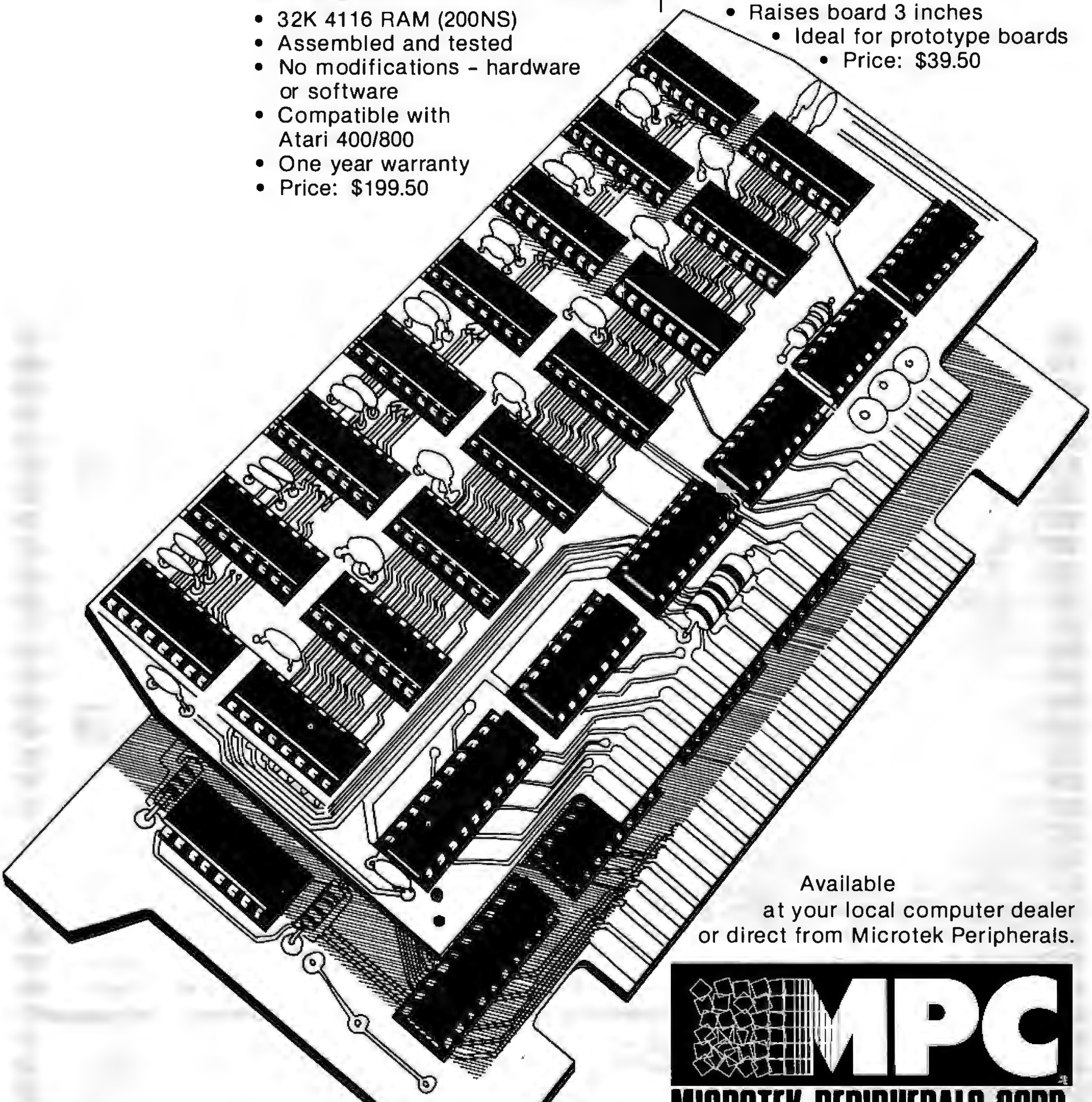

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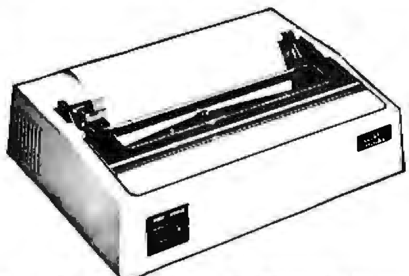

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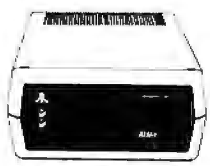

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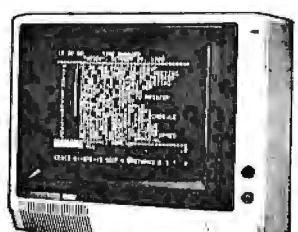

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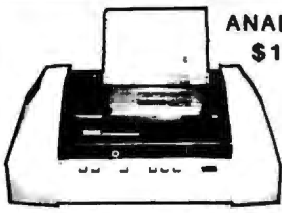

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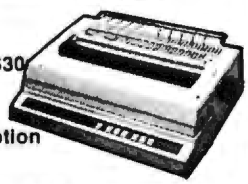

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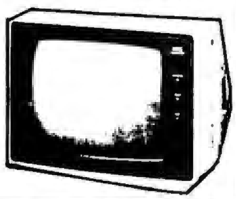

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The Infamous Traveling-Salesman Problem

A Practical Approach

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You may not need a computer to tell you the shortest distance between two points, but you may need one if you are trying to find the shortest route from city to city when many are involved.

This problem is commonly known as the traveling-salesman problem and is referred to by mathematicians and computer scientists as an NP-complete (nondeterministic polynomial) problem.

The difficulty lies in the number of different routes a salesman can take from city to city. If only five cities are involved, the number of different routes is a manageable 4! (4 factorial or 24). But the number of routes increases exponentially. So with nine cities, for example, the number of routes jumps to 8! (5040). And with 12 cities, the number of possibilities for the trip reaches a staggering 40 million. That's a lot of calculations—even for a computer. In fact, it is not too hard to imagine a traveling-salesman problem that would take the world's most powerful computer centuries to solve.

The fact that NP-complete problems take so long to solve is both a burden and a blessing. The obvious disadvantage is that it is difficult or impossible to solve some very useful problems. But it is a blessing as well since it lends itself to the design of systems to encode information for security purposes. This fact comes at a time when computer fraud is increasing.

Interestingly, the traveling-salesman problem was discussed in an article entitled, "What Computers Cannot Do " (BYTE, January 1980, page 100). Indeed, there is no known way, at present, to solve all traveling-salesman problems in a simple and elegant manner or in a relatively short time. Even the recent breakthrough by the Russian mathematician Leonid G Khachiyan, which solves the linear-programming class of problems, leaves the traveling-salesman problem unsolved. (See "Khachiyan's Algorithm, Part 1: A New Solution to Linear Programming Problems," BYTE, August 1980, page 198, and "Khachiyan's Algorithm, Part 2: Problems with the Algorithm," BYTE, September 1980, page 242, by G C Berresford, A M Rockett, and J C Stevenson.) However, with a limited number of towns, the traveling-salesman problem is most certainly solvable.

In this article, we discuss a BASIC program that can solve a 12-city problem in less than an hour—not bad, considering that there are 40 million possibilities and that the program was written in BASIC on an 8-bit microcomputer. (Unless otherwise noted, execution times stated are based on a SwTPC [Southwest Technical Products Corporation] 6800 computer system with a 1 MHz system clock using TSC [Technical Systems Consultants] BASIC.)

We loaded the program into a Control Data Cyber 175 large-scale computer to see what it could do with the traveling-salesman problem. The 12-city problem, which requires 47 minutes on the microcomputer, was solved by the Cyber in less than four seconds. When a 16-city problem was given to the Cyber, the execution time was 41 seconds. This is truly astounding, considering that there are 1.3 trillion possibilities for this trip.

Several characteristics of the Cyber account for its speed. Perhaps the greatest gain comes from the fact that it uses a BASIC *compiler* instead of an interpreter. Its 60-bit word length, hardware arithmetic manipulation,

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and faster cycle rate are other factors that increase its speed. But such a powerful computer is not the ultimate answer to solving NP-complete problems. Even the Cyber would be hard-pressed to solve a 50-city problem in our lifetime.

About the Program

We wanted to develop a program that would be useful in many ordinary situations. For example, while it's possible that you might have to visit 100 or more points in one trip, it's not very likely. It seemed that if we could develop a program that would compute the shortest trip for an 11- or 12-city problem in less than an hour, then the program could solve a large number of real-life situations. Also, we wanted to write a program that could be used on virtually every computer system. (This meant that we had to use BASIC.) But this hampered our goal of fast execution time because BASIC is ordinarily interpreted and, therefore, slow. As previously noted, execution time would be much faster if the program could be compiled.

We first tried to solve the traveling-salesman problem by using a sampling technique in which only a few of the possibilities are calculated. From this sample, the best route for the trip is the answer. Sampling seemed a viable solution; it would certainly reduce the total execution time because all possibilities are not evaluated. The technique does not yield the best route for a trip (at least not normally), but we hoped it would give a good solution.

We were disappointed by the results of this approach, however. Looking back, it is easy to see why: if only a small percentage of the possibilities are examined, on the average, the probability of finding the best route is also very small. In addition, even if only 1% of the possibilities of a 12-city trip are examined, the total that must be tried is still very large (400,000). The weaknesses of sampling were further illustrated by a simple experiment with friends, which showed that a

dBASE™ II vs. the Bilge Pumps.

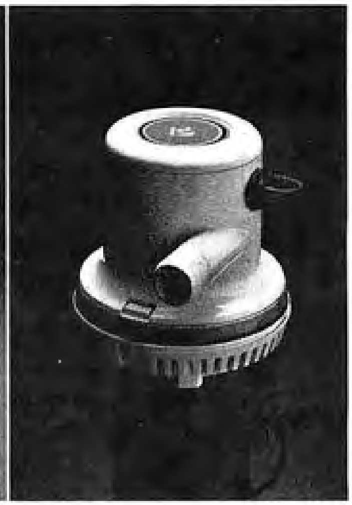
by Hal Pawluk

We all know that bilge pumps suck.

And by now, we've found out—the hard way—that a lot of software seems to work the same way.

So I got pretty excited when I ran across **dBASE II**, an assembly-language relational Database Management System for CP/M. It works! And even a rank beginner like myself got it up and running the first time I sat down with it.

If you're looking for software to deal with your data, too, here are some tips that will help:



Tip #1: Database Management vs. File Handling:

Any list or collection of data is, loosely, a data base, but most of those "data base management" articles in the buzzbooks are really about file handling programs for specific applications. A real Database Management System gives you data and program independence (no reprogramming when data changes), eliminates data duplication and makes it easy to turn data into information.

Tip #2: Assembly Language vs. BASIC:

This one's easy: if you're setting up a DBMS, you're going to be doing a lot of sorting, and Basic sorts are s-l-o-w. Run a benchmark on a Basic system like S*-IV against a relational DBMS like **dBASE II** and you'll see what I mean. (But watch it: I've also seen one extremely slow assembly-language file management system.)

Tip #3: Relational vs. Hierarchal & Network DBMS.

CODASYL-like hierarchal and network systems, around since the 1960's, are being phased out on the big machines so why get stuck with an old-fashioned system for your micro? A relational DBMS like **dBASE II** eliminates the predefined sets, pointers and complex data structures of a CODASYL-type DBMS. And you don't need to be a programmer to use it.

dBASE II vs. everything else.

dBASE II really impressed me.

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And if all this makes your mouth water, but you've already got all your data on a disk, that's okay: **dBASE II** reads your ASCII files and adds the data to its own database.

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Ashton-Tate

person could easily outperform the computer.

We were convinced that an exhaustive search of all possible routes was necessary. This meant that in the 12-city problem all 40 million routes would have to be evaluated. Extrapolation from a simple 5-city problem that was run using an exhaustive-search program indicated that the SwTPC computer would require 40 days to solve the 12-city problem. This falls far short of our original goal of solving it in less than an hour.

The solution to reducing the execution time lies in a technique similar to that used in computer chess programs. It is basically a *decision-tree-pruning* method. In the case of the traveling-salesman problem, the idea is to skip over newly examined routes that are poorer than the best route found up to that point.

For example, assume a 6-city problem, with city 1 the starting and ending point. Also, assume that the path thru cities 1, 2, 3, 4, 5, 6, and back to 1 has been calculated to require 400 miles. (This may or may not be the shortest route; it merely represents the shortest path found thus far.) The program must now generate another path and evaluate it.

Assume the new path is 1, 4, 2, 3, 5, 6, 1. If after evaluating the distance from 1 to 4 to 2 to 3, the accumulated distance is found to be greater than 400 miles, there is no need to continue the evaluation. Continuing would only prove what we already know—that this path is not the shortest. More important, it means we can skip the permutation 1, 4, 2, 3, 6, 5, 1.

Now suppose we know that the shortest possible route involving *any three cities* then ending at city 1 covers 150 miles. We could then say that if the distance from 1 to 4 to 2 to 3 is greater than 250 miles, there is no point in calculating further. The distance from 3 thru two cities to 1, regardless of the choice of the intermediate cities, will add at least 150 miles to the 250 miles already calculated. The total trip must be at least 400 miles, so it cannot be shorter than a route we already know.

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In fact, if we knew that the shortest possible route involving any *five* cities, then ending at city 1, covers 300 miles, we would first ask if the distance from 1 to 4 is greater than 100 miles (400−300). If it is, we need not bother with the 24 permutations:

1,4,(2,3,5,6),1
1,4,(2,3,6,5),1
1,4,(2,5,3,6),1
.
.
.

Of course these shortest-possible-trip values (stored in an array called M in the program) are not obvious and must be calculated. Indeed, their calculation forms the solution to the problem. We first calculate M(2), which is the shortest possible trip touching any city other than city 1 and ending at city 1. Next we calculate M(3), the shortest route involving *two* cities then ending at city 1, using M(2) to reduce the number of permutations. Then M(2) and M(3) help in calculating M(4), and so on. Calculating each successive element, M(N), is approximately N times as complex as calculating the previous element. Because of powerful pruning, the time that is saved in calculating the higher-order elements of M more than makes up for the time spent in earlier M-element calculations.

In the 6-city problem, after calculating M(2) thru M(5), we slightly modify the routine to account for a fixed starting point. The resulting answer is the best route for the traveling salesman.

It is largely thru use of this technique that the 12-city problem requires less than one hour; it would normally require 40 days if all routes were fully evaluated. Put another way, of the 40 million possibilities, perhaps only several thousand need to be completely evaluated.

The execution time can be reduced further by converting specific numeric variables to intergers. The program is shown in listing 1 using standard floating-point variables (to allow it to be applicable to most

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readers' systems). Those with a version of BASIC supporting integer variables (eg: TRS-80 Level II and TSC Extended BASIC) may wish to alter the program to decrease the execution time by about 15%. All numeric variables may be changed to integers except the arrays R and A, and the scalar variables X1, Y1, X2, Y2, XT, YT, ZT, and TP. The percent sign (%) is the standard symbol used to indicate an integer variable in BASIC. Therefore, all references to elements of T may be changed to T%, and, in like manner, all references to elements of K may be changed to K%.

How to Use the Program

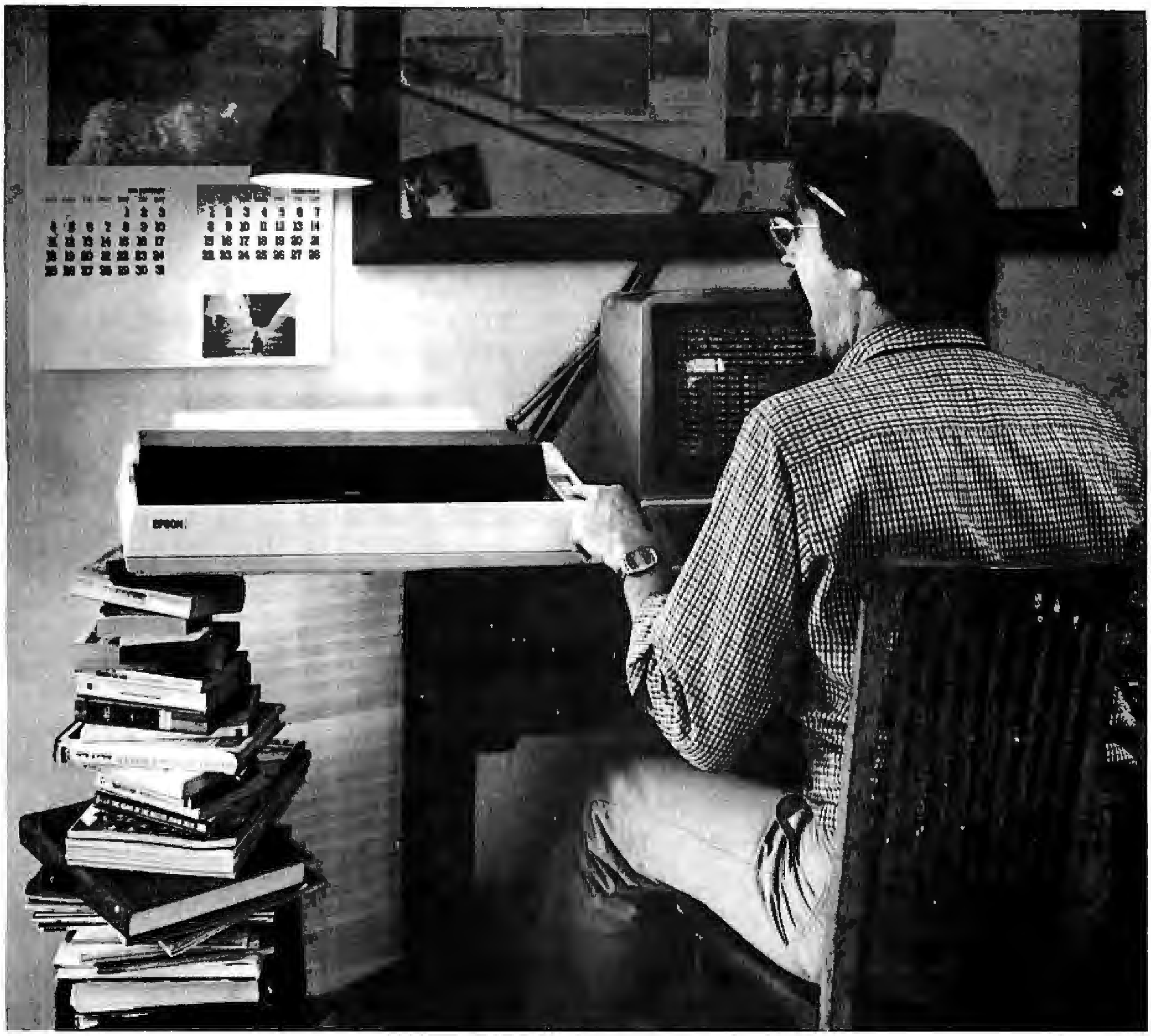
In this section we discuss two examples. Each illustrates certain features of the program and how they are used. In listing 2, we assume that a traveling salesman is responsible for visiting 12 cities in Illinois, in no particular order.

The program begins by prompting the user to supply the number of destinations to be visited, in this case 12. The program then gives the user three methods for entering the location of the cities. The first method allows the user to supply the location of the cities in rough polar coordinates, using a distance from a reference location and an angle in the form of a map heading (ie: N, S, NNW, etc).

The second method allows the user to supply the location of the cities' polar coordinates, using a distance from a reference location and an angle from a reference direction expressed in degrees.

Both of these methods force the user to supply the location data with respect to a reference. In listing 2, the reference is the city of Chicago. Any point may be a reference. In fact, the reference point need not be one of the cities in the problem. However, there must be only one reference point. With the data supplied exclusively thru these methods, the program constructs an "inter-destination" table, which gives the distance from every city to every other city. All computed

Text continued on page 284



Listing 1: *The source listing for the traveling-salesman program in TSC BASIC. All variables are shown as floating-point variables. However, changing specific variables to integer-type will decrease the execution time by about 15%. A copy of the program is available on a 5-inch floppy disk for those using a compatible computer system.*

```
 10 INPUT "HOW MANY DESTINATIONS "; N
 20 IF N<4 THEN PRINT "TOO FEW TOWNS, DO IT YOURSELF!" : GOTO 10
 30 DIM D(N,N), T(N+1 ), C(N+1), K(N+1 )
 40 DIM N$(N), R(N), A(N), A$(N), M(N)
 50 REM *******************************************
 60 REM * INSTRUCTIONS FOR SELECTING INPUT METHOD *
 70 REM *******************************************
 80 PRINT:PRINT
 90 PRINT "TYPE 1   IF YOU WANT TO INPUT THE ANGLE AS MAP DIRECTIONS"
100 PRINT TAB(9);"(E.G. SW, NNW, E, ENE ETC.)"
110 PRINT
120 PRINT "TYPE 2   IF YOU WISH TO INPUT THE ANGLE USING POLAR COORDINATES"
130 PRINT TAB(9);"(E.G. 0 DEGREES=EAST, 270 DEGREES=SOUTH ETC.)"
140 PRINT : PRINT "TYPE 3   IF YOU WISH TO INPUT ALL DATA VIA THE"
150 PRINT TAB(9);"INTER-DESTINATION TABLE."
160 PRINT : INPUT "METHOD 1, 2, OR 3 "; IM
170 IF IM<>1 AND IM<>2 AND IM<>3 THEN 160
180 IF IM=3 THEN 590
190 REM **** CONSTRUCT INPUT TABLE
200 FOR M=1 TO N
210 GOSUB 2490
220 NEXT M
230 REM **** DISPLAY INPUT DATA TABLE
240 PRINT : PRINT
250 PRINT TAB(15); "INPUT DATA TO BE USED"
260 PRINT TAB(8); "DESTINATION                  DISTANCE          BEARING"
270 FOR M=1 TO N
280 IF IM=1 THEN 300
290 PRINT M; ". "; N$(M); TAB(32); R(M); TAB(49); A(M) : GOTO 310
300 PRINT M; ". "; N$(M); TAB(32); R(M); TAB(49); A$(M)
310 NEXT M
320 REM ************************************
330 REM * EDIT MODE FOR EDITING INPUT DATA *
340 REM ************************************
350 INPUT "DO YOU WANT TO EDIT ANY (Y/N) "; Q$
360 IF LEFT$(Q$,1)="N" THEN 430
370 PRINT : PRINT "TYPE 0 TO END EDITING WHEN ASKED 'WHICH ONE'. " : PRINT
380 PRINT : INPUT "WHICH ONE "; M
390 IF M=0 THEN 230
400 IF M<1 OR M>N THEN 380 ELSE GOSUB 2490
410 GOTO 380
420 REM *************************************
430 REM * CONSTRUCT INTER-DESTINATION TABLE *
440 REM *************************************
450 FOR M=1 TO N-1
460 Y1=R(M) * SIN(A(M)*.01745329)
470 X1=R(M) * COS(A(M)*.01745329)
480 FOR L=M+1 TO N
490 Y2=R(L) * SIN(A(L)*.01745329)
500 X2=R(L) * COS(A(L)*.01745329)
510 IF X1>X2 THEN XT=X1-X2 ELSE XT=X2-X1
520 IF Y1>Y2 THEN YT=Y1-Y2 ELSE YT=Y2-Y1
530 ZT=SQR(XT*XT + YT*YT)
540 D(M,L)=ZT : D(L,M)=ZT
550 NEXT L
560 NEXT M
570 GOTO 680
580 REM ***********************************************************
```

Listing 1 continued on page 264

BASICØ9™
has a dual personality.

One craves meat-and-potatoes BASIC.

The other prefers Programme ala Pascal.

Some people say BASICØ9 is really a PASCAL in disguise, others say it's still BASIC. You'll understand this delightful dilemma when you look at both versions of the "bubble sort" program shown below: both can be run by BASICØ9. The program on top is unstructured and hard to understand, but it's traditional BASIC. The program on the bottom is well-structured and easy to follow, a virtue of PASCAL. With BASICØ9 you can program either way, or mix the best of both. It's like getting two languages for the price of one.

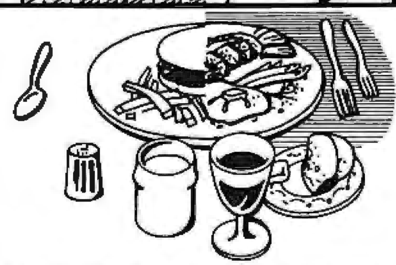
SORT AN ARRAY
IN ASCENDING SEQUENCE

```
90   DIM A(5)
100  I=5
110  IF I=1 THEN 200
120  FOR J=1 TO I-1
130  IF A(J)<=A(J+1) THEN 170
140  T=A(J+1)
150  A(J+1)=A(J)
160  A(J)=T
170  NEXT J
180  I=I-1
190  GOTO 110
200  RETURN
```

```
DIM array(5)
outer=5
WHILE outer> 1 DO
  outer=outer-1
  FOR inner=1 TO outer
    IF array(inner)>=array(inner+1) THEN
      temp=array(inner+1)
      array(inner+1)=array(inner)
      array(inner)=temp
    ENDIF
  NEXT inner
ENDWHILE
RETURN
```

Makes programs better

BASICØ9 has five kinds of loop structures: WHILE . . DO, REPEAT . . UNTIL,



LOOP . . ENDLOOP, FOR . . NEXT and IF . .THEN . . ELSE. If one of the five built-in data types (byte, integer, real, string, and boolean) doesn't suit the problem, you can make a new one of your liking with the TYPE statement. Need a tree, linked list, or symbol table? Complex non-rectangular data structures using any combination of data types are easy to define. Modular programming breaks down large programs to smaller, more manageable elements. BASICØ9 lets you create independent program modules called "procedures" with local variables for recursion plus parameter passing to any other BASICØ9 or machine language procedure. There is a complete set of statements for device-independent sequential or random I/O, plus a superlative PRINT USING system.

Makes programs faster

No full-feature BASIC for any 8-bit microprocessor is faster than BASICØ9, because it is an interactive compiler. As each program line is entered, it is instantly compiled to a smaller, faster form. Because BASICØ9 automatically converts programs back to original "source" form for listing, it is as friendly and easy-to-use as traditional interpreter BASICs. Each procedure can be independently compiled to position-independent, reentrant, ROMable format. Microware® developed a new ultra-fast 9-digit-accuracy floating point math system just for BASICØ9. And if that's still not fast enough, there's BYTE and INTEGER arithmetic.

Features that make programs easier to write

The compiler is integrated with a full-feature string AND line-number oriented text editor. If you make a mistake, BASICØ9 tells you instantly. String-oriented commands such as search, change, change all occurances, delete, and insert can be used on programs with or without line numbers. There's an automatic line renumbering function too.

Features that make programs easy to test

Debugging often takes longer than writing a program. That's why BASICØ9's integral high-level debugger sets it apart from all other compiled OR interpretive languages. The TRACE command shows you each statement executed in BASIC form, plus the result of any expression evaluation. STEP lets you run one or more statements at a time. LET and PRINT allow you to examine or change the values of variables, by name. STATE lists procedure calling order. And there are nine other debug commands. If you need to correct a program, you can edit, recompile, and rerun it in seconds.

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Listing 1 continued:

```
590 REM * INPUT VIA INTER-DESTINATION TABLE, GET DESTINATION NAMES *
600 REM ************************************************************
610 FOR M=1 TO N
620 PRINT M; ". NAME OF DESTINATION ";
630 INPUT N$
640 N$(M)=N$
650 NEXT M
660 PRINT : GOTO 730
670 REM **********************************
680 REM * DISPLAY INTER-DESTINATION TABLE *
690 REM **********************************
700 INPUT "DO YOU WANT TO EDIT OR EXAMINE THE INTER-DESTINATION TABLE "; Q$
710 IF LEFT$(Q$,1)="N" THEN 1080
720 PRINT : PRINT
730 PRINT TAB(15); "**** INTER-DESTINATION TABLE ****"
740 PRINT TAB(14); "(VALUES ROUNDED TO NEAREST INTEGER)"
750 FOR M=1 TO N
760 PRINT TAB(5*M-1); M;
770 NEXT M
780 FOR M=1 TO N
790 PRINT:PRINT M; "."; TAB(5);
800 FOR L=1 TO N
810 PRINT INT(D(M,L)+.5); TAB(5*L+4);
820 NEXT L
830 NEXT M
840 PRINT
850 REM ************************************************
860 REM * EDIT MODE FOR EDITING INTER-DESTINATION TABLE *
870 REM ************************************************
880 INPUT "DO YOU WISH TO EDIT ANY VALUES (Y/N) "; Q$
890 IF LEFT$(Q$,1)="N" THEN 1080
900 PRINT:PRINT
910 PRINT "TO ALTER, USE FORMAT : FROM,TO,NEW DISTANCE."
920 PRINT "FOR EXAMPLE,  2,4,512 ALTERS THE DISTANCE FROM DESTINATION 1"
930 PRINT "TO DESTINATION 2 TO 512.  DISTANCE FROM DESTINATION 2 TO"
940 PRINT "DESTINATION 1 IS ALSO CHANGED."
950 PRINT "INPUT 0,0,0 TO LEAVE EDIT MODE."
960 PRINT:PRINT
970 I=1
980 PRINT I; ". "; "FROM,TO,DIS=";
990 INPUT M,L,DI
1000 IF M=0 THEN 680
1010 IF M=L THEN PRINT "ILLEGAL INPUT" : GOTO 980
1020 IF M<1 OR M>N OR L<1 OR L>N THEN PRINT "ILLEGAL INPUT" : GOTO 980
1030 D(M,L)=DI
1040 D(L,M)=DI
1050 I=I+1
1060 GOTO 980
1070 REM ***************************************
1080 REM * GET STARTING AND ENDING DESTINATIONS *
1090 REM ***************************************
1100 INPUT "WHAT IS YOUR BEGINNING LOCATION "; BL
1110 IF BL<1 OR BL>N THEN 1100
1120 INPUT "WHAT IS YOUR ENDING LOCATION "; EL
1130 IF EL<1 OR EL>N THEN 1120
1140 IF BL=EL THEN K=N ELSE K=N-1
1150 IF K<4 THEN PRINT "TOO FEW TOWNS, DO IT YOURSELF!" : GOTO 1080
1160 IF BL<>EL THEN T(1)=BL : C(1)=BL : T(K+1)=EL : C(K+1)=EL : GOTO 1290
1170 REM **** BEGINNING AND ENDING POINT IS SAME, FIND OPTIMUM POINT
1180 SV=0
1190 FOR M=1 TO N
```

Listing 1 continued on page 266

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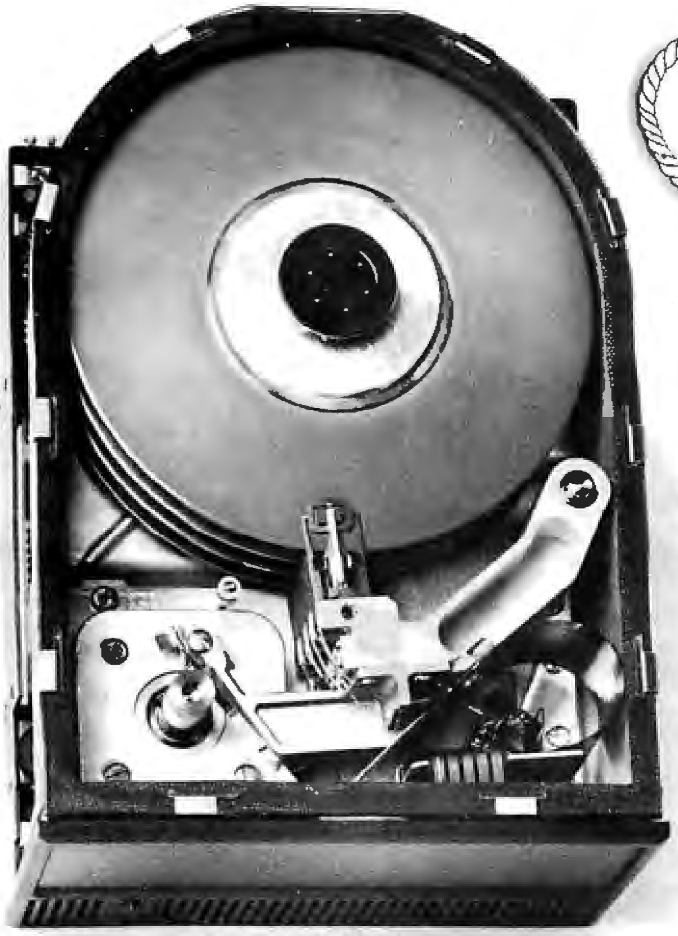
Listing 1 continued:

```
1200 SU=0
1210 FOR L=1 TO N
1220 SU=SU + D(L,M)
1230 NEXT L
1240 IF SU>SV THEN OL=M : SV=SU
1250 NEXT M
1260 IF K<4 THEN PRINT "TOO FEW TOWNS, DO IT YOURSELF!" : GOTO 1080
1270 T(1)=OL : C(1)=OL : T(K+1)=OL : C(K+1)=OL
1280 REM ****************************************
1290 REM * CALCULATE TOTAL POSSIBILITIES FOR TRIP *
1300 REM ****************************************
1310 TP=1
1320 FOR M=1 TO K-2
1330 TP=TP*(M+1)
1340 NEXT M
1350 PRINT "TOTAL POSSIBILITIES FOR TRIP "; TP
1360 REM ******************************************
1370 REM * CALCULATE POSSIBLE DESTINATIONS TO VISIT *
1380 REM ******************************************
1390 FOR PP=2 TO K
1400 FOR M=1 TO N
1410 FOR L=1 TO K+1
1420 IF M=T(L) THEN 1450
1430 NEXT L
1440 T(PP)=M
1450 NEXT M
1460 NEXT PP
1470 REM ****************************************************
1480 REM * PREPARATION COMPLETE, NOW CALCULATE SHORTEST TRIP.*
1490 REM * HOWEVER, BEFORE EXECUTING GENERAL TRIP ROUTINE    *
1500 REM * FIRST COMPUTE SPECIAL CASE OF P=2.                *
1510 REM ****************************************************
1520 M(2)=32000
1530 FOR L=2 TO K
1540 S=D(T(L),T(K+1))
1550 IF S<M(2) THEN M(2)=S : C(2)=T(L)
1560 NEXT L
1570 REM ************************
1580 REM * GENERAL CASE FOR P>2  *
1590 REM ************************
1600 LL=2 : LU=4
1610 SW=32000 : F=0
1620 FOR PP=3 TO K+1
1630 IF PP<>K+1 THEN P=PP ELSE P=K : LL=1 : LU=3
1640 FOR L=1 TO K
1650 K(L)=L
1660 NEXT L
1670 H=LL+1
1680 IF H<>P THEN 1920
1690 REM **** CALCULATE TOTAL DISTANCE FROM TOWN 2 THROUGH P + P TO K+1
1700 S=0
1710 IF H<4 THEN 1750
1720 FOR M=LL TO H-2
1730 S=S + D(T(M),T(M+1))
1740 NEXT M
1750 SD=S + D(T(H-1),T(H)) + D(T(H),T(K+1))
1760 REM **** SAVE DISTANCE AND TOWNS OF TRIP IF IT IS A BETTER ROUTE
1770 IF SD>SW THEN 1820
1780 SA=SD : SW=SD
1790 FOR L=2 TO K
1800 C(L)=T(L)
1810 NEXT L
```

Listing 1 continued on page 270



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Circle 430 on inquiry card.

Key Variable Definitions

Variable	Description
A()	*This array is used to store the polar coordinate angle of the destination. If map headings (N,SW,...) are used as input data, they are converted to an angle before they are stored in this array.*
A$()	*This array is used to store map headings for the destinations if the user enters the data using this method.*
BL	*User-specified beginning location of the trip.*
C()	*This array contains the route of the shortest trip found thus far. Each time the shortest-trip-search routine finds a path shorter than that previously encountered, the cities that make up this newly found shortest route must be saved to expedite the searching of subsequent routes. When the program ends, the C array contains the answer to the problem.*
D()	*This two-dimensional array contains the inter-destination table.*
EL	*User-specified ending location of the trip.*
F	*This flag variable is used in evaluating trip distances. When the last city in a sequence is changed, the new distance is calculated by merely correcting the previous distance for the change in the last city. However, some changes require a change in the next-to-last city as well. The flag alerts the distance-calculation routine that such a change has been made. This forces the routine to calculate the entire distance of the sequence from the beginning.*
H, K(H)	*The combinatorial algorithm used requires that destinations be changed and evaluated for a possible shortest route. Given a sequence of cities (stored in array T), these two variables tell the program to exchange the Hth city in that sequence with the city whose position in the sequence is K(H).*
IM	*Three input methods are available to input the location data to the program. This variable is equal to 1, 2, or 3, depending on the input method the user chooses.*
L	*A variable used to control a FOR...NEXT loop.*
LL,LU	*After all of the elements of M are calculated, limits LL and LU are changed from 2 to 1 and from 4 to 2 respectively: then the last M-element calculation is repeated. Changing these limits brings the fixed starting city into the calculation, and the resulting minimum path is the solution to the traveling-salesman problem.*
OL	*Optimum location to start and end the trip. If the user requests that the starting and ending point be the same, the program calculates the optimum location to begin and end, for greatest efficiency in calculating the routes. When the shortest trip has been found by the program, the point used in the calculation is rotated back to the point requested by the user if the optimum location differs from that specified by the user. This step substantially reduces the total execution time by making optimum use of decision-tree pruning.*
M	*A variable used to control a FOR...NEXT loop.*
M()	*The shortest-trip-search routine begins by searching for the minimum distance from a single city to the ending location specified by the user. The program then searches for the minimum distance from any two cities ending the route in the location specified by the user. This process continues until the shortest route is found. This array is used to store the minimum distance found for a particular number of cities. It is used extensively to reduce the search time by preventing obviously poor routes from being evaluated.*
N, K	*The variable N represents the number of destinations specified by the user at the beginning of the program. The variable K may or may not be equal to N. If the user wishes to start and end in the same location, K=N. However, if the starting and ending point differ, K=N−1.*
N$()	*This character-string array is used to store the names of the destinations specified by the user (ie: New York, Chicago, etc).*
P	*This variable indexes the M-element calculations. As P sequences from 2 thru K, each of the elements of M is calculated in turn.*
PP	*A variable to control a FOR...NEXT loop.*
R()	*This array is used to store the distances from the reference location to all destination points. The value is supplied by the user for each of the destinations.*
S,SA, SD,ST, SW	*These variables are all used in the shortest-trip-search routine. They represent the results of various partial or complete distance calculations.*
SU,SV	*These variables are used to calculate the optimum location to begin and end a trip. The optimum location may or may not coincide with the location specified by the user. See the definition of variable OL.*
TP	*This variable equals the total number of possible combinations for a trip. It is not used by the program; it is calculated to give the user an appreciation of the number of possible routes.*
T	*Each of the destinations supplied by the user is represented by a number stored in this array. This array is permuted many times before the final result is found and stored in the array C.*
X1,X2, XT,Y1, Y2,YT, ZT	*All of these variables are used to calculate the distance between cities. They serve as the basis for the construction of the inter-destination table. The variable pair X1, Y1 and the pair X2, Y2 represent the x and y components of two cities with respect to the reference location. The variable pair XT and YT are the x and y components of the absolute distance between the two cities, irrespective of the reference. These two* **variables** *are used to compute the line-of-sight distance ZT between the two cities.*

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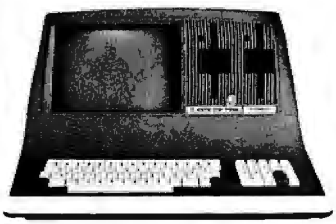

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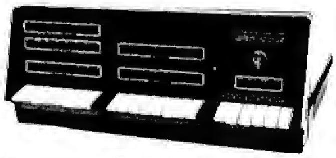

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Circle 22 on inquiry card.

Listing 1 continued:

```
1820 IF K(H)=K THEN 1850
1830 K(H)=K(H)+1
1840 EX=T(H) : T(H)=T(K(H)) : T(K(H))=EX : GOTO 1750
1850 IF H=K THEN 1900
1860 REM **** RETURN TOWNS BETWEEN H AND K TO ORIGINAL ORDER
1870 FOR L=H TO K-1
1880 EX=T(L) : T(L)=T(L+1) : T(L+1)=EX
1890 NEXT L
1900 K(H)=H : H=H-1 : F=1 : GOTO 2060
1910 REM **** GENERAL ALPHA-BETA CHECK
1920 IF H=LL THEN H=H+1 : GOTO 1680
1930 S=0
1940 IF H<LU THEN 1980
1950 FOR L=LL TO H-2
1960 S=S+D(T(L),T(L+1))
1970 NEXT L
1980 ST=S + D(T(H-1),T(H))
1990 IF ST + M(P-H+2) >SW THEN 2060
2000 REM **** CONTINUE ROUTE EVALUATION
2010 H=H+1
2020 IF H=P THEN 1700
2030 ST=ST + D(T(H-1),T(H))
2040 F=1 : GOTO 1990
2050 REM **** PATH ALREADY TOO LONG, TRY NEXT PERMUTATION
2060 IF K(H)=K THEN 2100
2070 K(H)=K(H)+1
2080 EX=T(H) : T(H)=T(K(H)) : T(K(H))=EX
2090 IF F=0 THEN 1980 ELSE F=0 : GOTO 1920
2100 FOR L=H TO K-1
2110 EX=T(L) : T(L)=T(L+1) : T(L+1)=EX
2120 NEXT L
2130 K(H)=H : H=H-1
2140 IF H<>1 THEN F=1 : GOTO 2060
2150 IF LL=1 THEN 2260
2160 M(P)=SA
2170 IF P=K THEN SW=D(T(1),C(2)) + M(P) : GOTO2240
2180 SW=32000
2190 FOR L=P+1 TO K
2200 S=D(C(2),C(L))
2210 IF S<SW THEN SW=S
2220 NEXT L
2230 SW=SW+M(P)+.01
2240 NEXT PP
2250 REM ****************************************************************
2260 REM * PERMUTATION COMPLETE, DISPLAY RESULTS.  HOWEVER, IF OPTIMUM *
2270 REM * BEGINNING AND ENDING POINT WAS USED INSTEAD OF POINT         *
2280 REM * REQUESTED BY USER, ROTATE BACK.                             *
2290 REM ****************************************************************
2300 IF BL<>EL THEN 2380
2310 IF C(1)=BL AND C(K+1)=EL THEN 2380
2320 C(K+1)=EL
2330 REM **** ROTATE ONE CITY
2340 FOR L=1 TO K-1
2350 EX=C(L) : C(L)=C(L+1) : C(L+1)=EX
2360 NEXT L
2370 GOTO 2310
2380 PRINT : PRINT : M=1
2390 IF M=K+1 THEN D=0 ELSE D=(INT((D(C(M),C(M+1))+.05)*10))/10
2400 PRINT M; "."; TAB(6); N$(C(M)); TAB(24); D;
2410 M=M+1 : IF M>K+1 THEN 2450
```

Listing 1 continued on page 272

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Circle 270 on inquiry card.

Listing 1 continued:

```
2420 IF M=K+1 THEN D=0 ELSE D=(INT((D(C(M),C(M+1))+.05)*10))/10
2430 PRINT TAB(32); M; "."; TAB(36); N$(C(M)); TAB(55); D
2440 M=M+1 : IF M<=K+1 THEN 2390
2450 PRINT
2460 PRINT "THE SHORTEST TRIP IS ";(INT((SA+.05)*10))/10
2470 END
2480 REM ******************************************************************
2490 REM * SUBROUTINE FOR INPUTTING DESTINATION NAME, DISTANCE, AND ANGLE *
2500 REM ******************************************************************
2510 PRINT : PRINT M; ".";
2520 PRINT TAB(5); "NAME OF DESTINATION ";
2530 INPUT N$(M)
2540 PRINT TAB(5); "DISTANCE FROM REFERENCE ";
2550 INPUT R(M)
2560 IF IM=1 THEN 2600
2570 PRINT TAB(5); "ANGLE (0 DEGREES=EAST) ";
2580 INPUT A(M)
2590 RETURN
2600 PRINT TAB(5); "MAP HEADING ";
2610 INPUT A$(M)
2620 IF A$(M)="E" THEN A(M)=0 : RETURN
2630 IF A$(M)="ENE" THEN A(M)=22.5 : RETURN
2640 IF A$(M)="NE" THEN A(M)=45   : RETURN
2650 IF A$(M)="NNE" THEN A(M)=67.5 : RETURN
2660 IF A$(M)="N" THEN A(M)=90 : RETURN
2670 IF A$(M)="NNW" THEN A(M)=112.5 : RETURN
2680 IF A$(M)="NW" THEN A(M)=135 : RETURN
2690 IF A$(M)="WNW" THEN A(M)=157.5 : RETURN
2700 IF A$(M)="W" THEN A(M)=180 : RETURN
2710 IF A$(M)="WSW" THEN A(M)=202.5 : RETURN
2720 IF A$(M)="SW" THEN A(M)=225 : RETURN
2730 IF A$(M)="SSW" THEN A(M)=247.5 : RETURN
2740 IF A$(M)="S" THEN A(M)=270 : RETURN
2750 IF A$(M)="SSE" THEN A(M)=292.5 : RETURN
2760 IF A$(M)="SE" THEN A(M)=315 : RETURN
2770 IF A$(M)<>"ESE" THEN 2600 ELSE A(M)=337.5 : RETURN
```

A machine-readable copy of the program is available from co-author Richard Parry for $9 on a 5-inch disk. The disk is formatted for TSC's FLEX Version 2.0 for 6800-based systems.

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Listing 2: *Sample run of the traveling-salesman program. The results of this run are shown in figure 1. The problem here is to find the shortest path that will allow a salesman to visit each city only once, beginning from and returning to Peoria. The execution time is 47 minutes on a SwTPC 6800 system.*

```
HOW MANY DESTINATIONS ? 12


TYPE 1    IF YOU WANT TO INPUT THE ANGLE AS MAP DIRECTIONS
          (E.G. SW, NNW, E, ENE ETC.)

TYPE 2    IF YOU WISH TO INPUT THE ANGLE USING POLAR COORDINATES
          (E.G. 0 DEGREES=EAST, 270 DEGREES=SOUTH ETC.)

TYPE 3    IF YOU WISH TO INPUT ALL DATA VIA THE
          INTER-DESTINATION TABLE.

METHOD 1, 2, OR 3 ? 2

 1 . NAME OF DESTINATION ? PEORIA
     DISTANCE FROM REFERENCE ? 128
     ANGLE (0 DEGREES=EAST) ? 223

 2 . NAME OF DESTINATION ? CHICAGO
     DISTANCE FROM REFERENCE ? 0
     ANGLE (0 DEGREES=EAST) ? 0

 3 . NAME OF DESTINATION ? BELLEVILLE
     DISTANCE FROM REFERENCE ? 261
     ANGLE (0 DEGREES=EAST) ? 244

 4 . NAME OF DESTINATION ? CARBONDALE
     DISTANCE FROM REFERENCE ? 297
     ANGLE (0 DEGREES=EAST) ? 255

 5 . NAME OF DESTINATION ? ROCKFORD
     DISTANCE FROM REFERENCE ? 70
     ANGLE (0 DEGREES=EAST) ? 163

 6 . NAME OF DESTINATION ? DECATUR
     DISTANCE FROM REFERENCE ? 158
     ANGLE (0 DEGREES=EAST) ? 247

 7 . NAME OF DESTINATION ? WAUKEGAN
     DISTANCE FROM REFERENCE ? 27
     ANGLE (0 DEGREES=EAST) ? 104

 8 . NAME OF DESTINATION ? CHAMPAIGN
     DISTANCE FROM REFERENCE ? 126
     ANGLE (0 DEGREES=EAST) ? 261

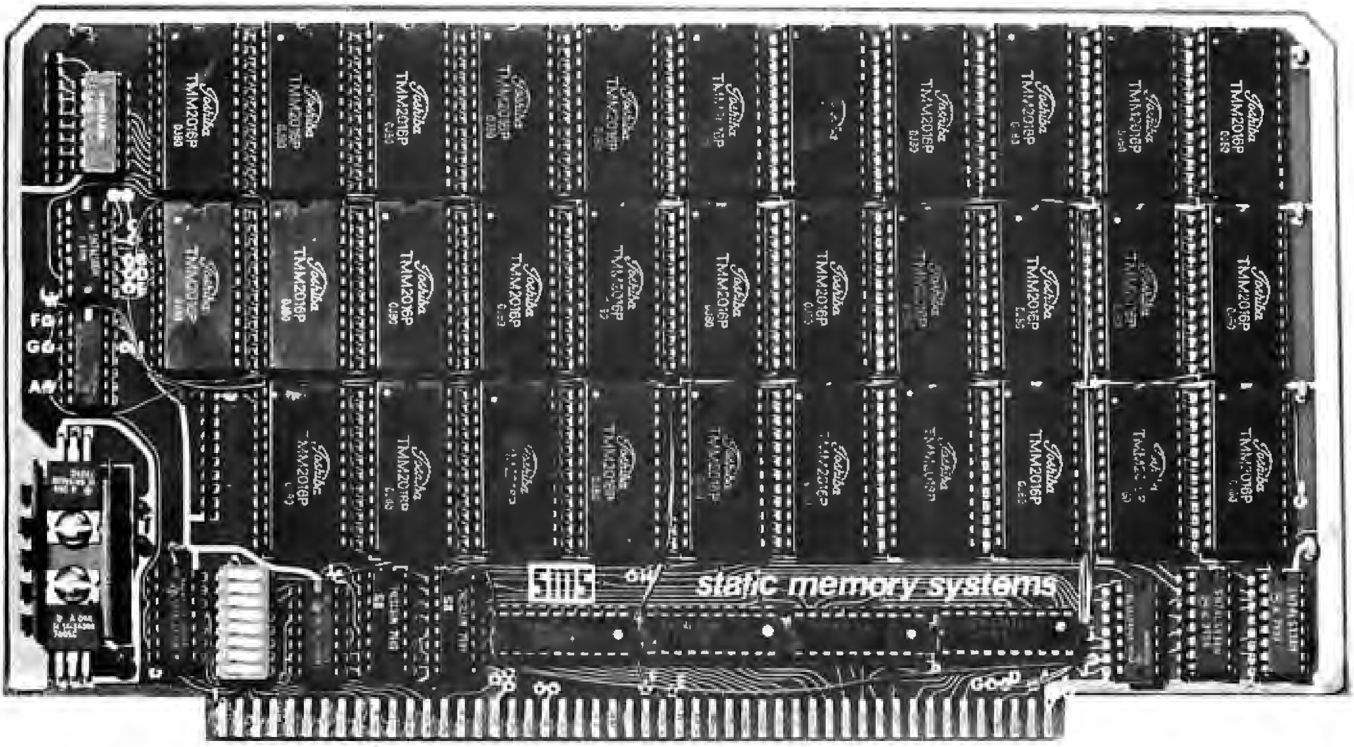
 9 . NAME OF DESTINATION ? DEKALB
     DISTANCE FROM REFERENCE ? 58
     ANGLE (0 DEGREES=EAST) ? 184

 10 .NAME OF DESTINATION ? SPRINGFIELD
     DISTANCE FROM REFERENCE ? 178
     ANGLE (0 DEGREES=EAST) ? 238

 11 .NAME OF DESTINATION ? KANKAKEE
     DISTANCE FROM REFERENCE ? 59
     ANGLE (0 DEGREES=EAST) ? 266
```

Listing 2 continued on page 276

THE LAST MEMORY



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At last a 64K *STATIC* memory board for S100 systems. But it's not just a 64K static RAM board, *EPROM's* can also be intermixed with RAM making it the only memory board needed for S100 systems. That's why we call it **THE LAST MEMORY.**

- *64K DENSITY*

THE LAST MEMORY uses the new 2016 byte-wide 16K static RAM to achieve a board density twice that possible with old 2114 static memories.

- *2716 EPROM COMPATIBLE*

A separate board is no longer required for EPROM's containing monitors, bootstrap loaders, etc.
2716 EPROM's can be inserted into the board without modification.

- *SIMPLE ADDRESS DECODING*

Where memory is required, just plug a RAM or EPROM in the corresponding socket. Empty memory sockets occupy no memory space, providing compatibility with memory mapped I/O devices.

- *EXTENDED ADDRESSING*

THE LAST MEMORY includes the IEEE S100 extended addresses. These are fully decoded allowing expansion to a full 16 megabyte system memory.

- *FAST*

The standard board allows 4 MHz operation.

- *LOW POWER*

Only one memory IC is ever active in byte-wide memory systems. The result is far less power consumption than older 16K static memory boards.

- *LOW COST*

Its best feature is the price:

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RAM-less Board	99.99	139.99
16K RAM	249.99	289.99
32K RAM	389.99	429.99
48K RAM	519.99	559.99
64K RAM	639.99	679.99

static memory systems

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Listing 2 continued:

```
12 .NAME OF DESTINATION ? AURORA
    DISTANCE FROM REFERENCE ? 34
    ANGLE (0 DEGREES=EAST) ? 204


                  INPUT DATA TO BE USED
          DESTINATION                 DISTANCE          BEARING
 1 . PEORIA                            128               223
 2 . CHICAGO                           0                 0
 3 . BELLEVILLE                        261               244
 4 . CARBONDALE                        297               255
 5 . ROCKFORD                          70                163
 6 . DECATUR                           158               247
 7 . WAUKEGAN                          27                104
 8 . CHAMPAIGN                         126               261
 9 . DEKALB                            58                184
 10 . SPRINGFIELD                      178               238
 11 . KANKAKEE                         59                266
 12 . AURORA                           34                204
DO YOU WANT TO EDIT ANY (Y/N) ? N
DO YOU WANT TO EDIT OR EXAMINE THE INTER-DESTINATION TABLE ? N
WHAT IS YOUR BEGINNING LOCATION ? 1
WHAT IS YOUR ENDING LOCATION ? 1
TOTAL POSSIBILITIES FOR TRIP  3.99168E+07


 1 .   PEORIA             90.6    2 .DEKALB              26.1
 3 .   ROCKFORD           60.7    4 .WAUKEGAN            27
 5 .   CHICAGO            34      6 .AURORA              52.5
 7 .   KANKAKEE           67.4    8 .CHAMPAIGN           47
 9 .   DECATUR            142.2   10 .CARBONDALE         64.4
 11 .  BELLEVILLE         86      12 .SPRINGFIELD        63.7
 13 .  PEORIA             0
THE SHORTEST TRIP IS  761.6


READY
```

Listing 3: *An everyday application of the traveling- salesman program. This particular program will chart the best route for someone who must do eight errands at eight different locations and then pick up the baby-sitter. Execution time is 17 minutes on a SwTPC 6800 system.*

```
HOW MANY DESTINATIONS ? 10


TYPE 1    IF YOU WANT TO INPUT THE ANGLE AS MAP DIRECTIONS
          (E.G. SW, NNW, E, ENE ETC.)

TYPE 2    IF YOU WISH TO INPUT THE ANGLE USING POLAR COORDINATES
          (E.G. 0 DEGREES=EAST, 270 DEGREES=SOUTH ETC.)

TYPE 3    IF YOU WISH TO INPUT ALL DATA VIA THE
          INTER-DESTINATION TABLE.

METHOD 1, 2, OR 3 ? 1

 1 . NAME OF DESTINATION ? HOME
     DISTANCE FROM REFERENCE ? 0
     MAP HEADING ? E
```

Listing 3 continued on page 278

★ ★

4MHZ, DOUBLE DENSITY,COLOR&B/W GRAPHICS . .THE LNW80 COMPUTER

COMPARE THE FEATURES AND PERFORMANCE

FEATURES	LNW80	PMC-80**	TRS-80* MODEL III
PROCESSOR	4.0 MHZ	1.8 MHZ	2.0 MHZ
LEVEL II BASIC INTERP.	YES	YES	LEVEL III BASIC
TRS80 MODEL 1 LEVEL II COMPATIBLE	YES	YES	NO
48K BYTES RAM	YES	YES	YES
CASSETTE BAUD RATE	500/1000	500	500/1500
FLOPPY DISK CONTROLLER	SINGLE/ DOUBLE	SINGLE	SINGLE/ DOUBLE
SERIAL RS232 PORT	YES	YES	YES
PRINTER PORT	YES	YES	YES
REAL TIME CLOCK	YES	YES	YES
24 X 80 CHARACTERS	YES	NO	NO
VIDEO MONITOR	YES	YES	YES
UPPER AND LOWER CASE	YES	OPTIONAL	YES
REVERSE VIDEO	YES	NO	NO
KEYBOARD	63 KEY	53 KEY	53 KEY
NUMERIC KEY PAD	YES	NO	YES
B/W GRAPHICS, 128 X 48	YES	YES	YES
HI-RESOLUTION B/W GRAPHICS, 480 X 192	YES	NO	NO
HI-RESOLUTION COLOR GRAPHICS (NTSC), 128 X 192 IN 8 COLORS	YES	NO	NO
HI-RESOLUTION COLOR GRAPHICS (RGB), 384 X 192 IN 8 COLORS	OPTIONAL	NO	NO
WARRANTY	6 MONTHS	90 DAYS	90 DAYS
TOTAL SYSTEM PRICE	$1,915.00	$1,840.00	$2,187.00
LESS MONITOR AND DISK DRIVE	$1,450.00	$1,375.00	---

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* TRS80 Product of Tandy Corporation.
** PMC Product of Personal Microcomputer, Inc.

LNW80

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  - NTSC Video or RF MOD - 128 x 192 in 8 Colors
  - Black and White - 480 x 192
- 4 MHz CPU
- 500/1000 Baud Cassette
- Upper and Lower Case
- 16K Bytes RAM, 12K Bytes ROM
- Solder Masked and Silkscreened

LNW SYSTEM EXPANSION

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The System Expansion will allow you to expand your LNW80, TRS-80*, or PMC-80** to a complete computer system that is still totally software compatible with the TRS-80* Model 1 Level II.

FEATURES:
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- Precision write precompensation circuit
- Software switch between single and double density
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Listing 3 continued:

```
2 . NAME OF DESTINATION ? QUILT SHOP
    DISTANCE FROM REFERENCE ? 3
    MAP HEADING ? NE

3 . NAME OF DESTINATION ? HARDWARE STORE
    DISTANCE FROM REFERENCE ? 4
    MAP HEADING ? N

4 . NAME OF DESTINATION ? SCHOOL
    DISTANCE FROM REFERENCE ? 10
    MAP HEADING ? NW

5 . NAME OF DESTINATION ? AUTO SHOP
    DISTANCE FROM REFERENCE ? 4
    MAP HEADING ? NW

6 . NAME OF DESTINATION ? GROCERY STORE
    DISTANCE FROM REFERENCE ? 5
    MAP HEADING ? W

7 . NAME OF DESTINATION ? BIKE SHOP
    DISTANCE FROM REFERENCE ? 6
    MAP HEADING ? SSW

8 . NAME OF DESTINATION ? BAKERY
    DISTANCE FROM REFERENCE ? 3
    MAP HEADING ? S

9 . NAME OF DESTINATION ? SHOE STORE
    DISTANCE FROM REFERENCE ? 5
    MAP HEADING ? S

10 .NAME OF DESTINATION ? BABYSITTER
    DISTANCE FROM REFERENCE ? 4
    MAP HEADING ? SE


              INPUT DATA TO BE USED
       DESTINATION              DISTANCE        BEARING


 1 . HOME                        0                E
 2 . QUILT SHOP                  3                NE
 3 . HARDWARE STORE              4                N
 4 . SCHOOL                      10               NW
 5 . AUTO SHOP                   4                NW
 6 . GROCERY STORE               5                W
 7 . BIKE SHOP                   6                SSW
 8 . BAKERY                      3                S
 9 . SHOE STORE                  5                S
 10 . BABYSITTER                 4                SE
DO YOU WANT TO EDIT ANY (Y/N) ? Y

TYPE 0 TO END EDITING WHEN ASKED 'WHICH ONE'.


WHICH ONE ? 4

 4 . NAME OF DESTINATION ? SCHOOL
     DISTANCE FROM REFERENCE ? 1
     MAP HEADING ? NW
```

Listing 3 continued on page 281

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Circle 65 on inquiry card.

Listing 3 continued:

```
WHICH ONE ? 7

 7 . NAME OF DESTINATION ? BIKE SHOP
     DISTANCE FROM REFERENCE ? 6
     MAP HEADING ? SW

WHICH ONE ? 0


                 INPUT DATA TO BE USED
         DESTINATION               DISTANCE          BEARING
 1 . HOME                          0                 E
 2 . QUILT SHOP                    3                 NE
 3 . HARDWARE STORE                4                 N
 4 . SCHOOL                        1                 NW
 5 . AUTO SHOP                       4                 NW
 6 . GROCERY STORE                 5                 W
 7 . BIKE SHOP                     6                 SW
 8 . BAKERY                          3                 S
 9 . SHOE STORE                    5                 S
 10 . BABYSITTER                   4                 SE
DO YOU WANT TO EDIT ANY (Y/N) ? N
DO YOU WANT TO EDIT OR EXAMINE THE INTER-DESTINATION TABLE ? Y


                ****  INTER-DESTINATION TABLE ****
               (VALUES ROUNDED TO NEAREST INTEGER)
       1    2    3    4    5    6    7    8    9    10
 1 .  0    3    4    1    4    5    6    3    5    4
 2 .  3    0    3    3    5    7    9    6    7    5
 3 .  4    3    0    3    3    6    9    7    9    7
 4 .  1    3    3    0    3    4    6    4    6    5
 5 .  4    5    3    3    0    4    7    6    8    8
 6 .  5    7    6    4    4    0    4    6    7    8
 7 .  6    9    9    6    7    4    0    4    4    7
 8 .  3    6    7    4    6    6    4    0    2    3
 9 .  5    7    9    6    8    7    4    2    0    4
 10 . 4    5    7    5    8    8    7    3    4    0
 DO YOU WISH TO EDIT ANY VALUES (Y/N) ? Y


 TO ALTER, USE FORMAT : FROM,TO,NEW DISTANCE.
 FOR EXAMPLE,  2,4,512 ALTERS THE DISTANCE FROM DESTINATION 1
 TO DESTINATION 2 TO 512.  DISTANCE FROM DESTINATION 2 TO
 DESTINATION 1 IS ALSO CHANGED.
 INPUT 0,0,0 TO LEAVE EDIT MODE.


  1 . FROM,TO,DIS=? 1,4,4.2
  2 . FROM,TO,DIS=? 2,3,5.4
  3 . FROM,TO,DIS=? 4,5,5.1
  4 . FROM,TO,DIS=? 5,6,6.1
  5 . FROM,TO,DIS=? 8,9,5.1
  6 . FROM,TO,DIS=? 8,10,4.5
  7 . FROM,TO,DIS=? 9,10,5.4
  8 . FROM,TO,DIS=? 3,5,5.5
  9 . FROM,TO,DIS=? 6,7,7.1
  10 . FROM,TO,DIS=? 5,6,6.6
  11 . FROM,TO,DIS=? 0,0,0
 DO YOU WANT TO EDIT OR EXAMINE THE INTER-DESTINATION TABLE ? Y
```

Listing 3 continued on page 282

Listing 3 continued:

```
                 **** INTER-DESTINATION TABLE ****
                (VALUES ROUNDED TO NEAREST INTEGER)
        1    2    3    4    5    6    7    8    9    10
 1 .  0    3    4    4    4    5    6    3    5    4
 2 .  3    0    5    3    5    7    9    6    7    5
 3 .  4    5    0    3    6    6    9    7    9    7
 4 .  4    3    3    0    5    4    6    4    6    5
 5 .  4    5    6    5    0    7    7    6    8    8
 6 .  5    7    6    4    7    0    7    6    7    8
 7 .  6    9    9    6    7    7    0    4    4    7
 8 .  3    6    7    4    6    6    4    0    5    5
 9 .  5    7    9    6    8    7    4    5    0    5
 10 . 4    5    7    5    8    8    7    5    5    0
DO YOU WISH TO EDIT ANY VALUES (Y/N) ? N
WHAT IS YOUR BEGINNING LOCATION ? 1
WHAT IS YOUR ENDING LOCATION ? 10
TOTAL POSSIBILITIES FOR TRIP  40320


 1 .  HOME          3       2 .QUILT SHOP          5
 3 .  AUTO SHOP     5.5     4 .HARDWARE STORE      3.4
 5 .  SCHOOL        4.4     6 .GROCERY STORE       5.8
 7 .  BAKERY        4.4     8 .BIKE SHOP           4.3
 9 .  SHOE STORE    5.4     10 .BABYSITTER         0

THE SHORTEST TRIP IS  41.2


READY
```


Circle 220 on inquiry card.

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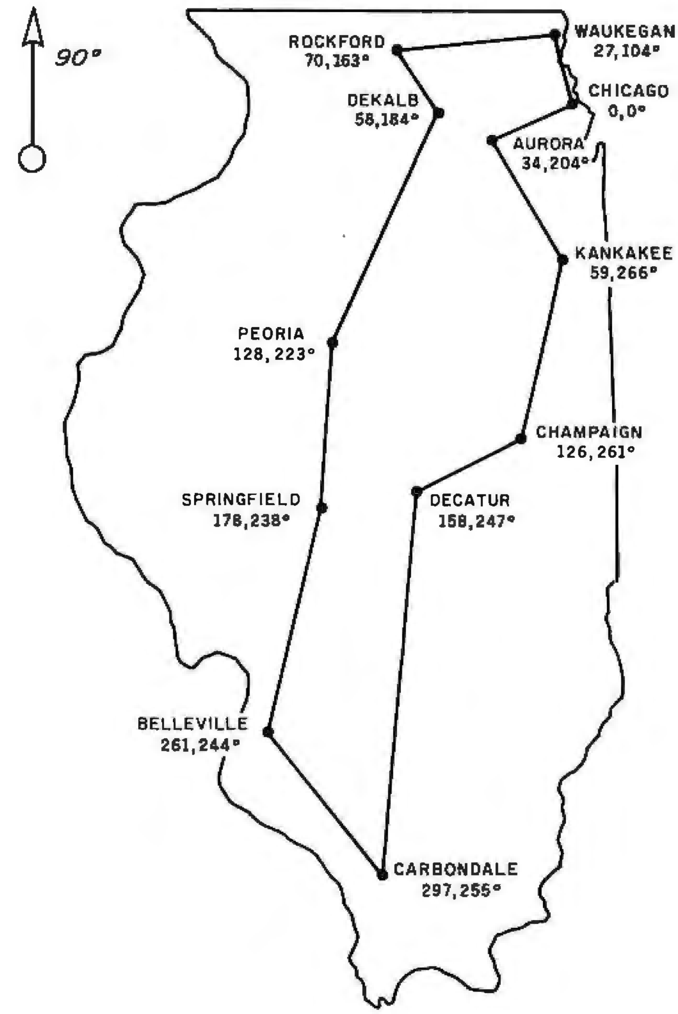

Figure 1: *The shortest route for visiting all 12 cities. The sample run from which this data was calculated is shown in listing 2. The total distance for the trip is 761.1 miles. While the results may seem simple, the total number of possible paths thru these 12 cities is 40 million. The program must evaluate each path to determine the shortest route.*

Text continued from page 260:

distances are line-of-sight distances. For the present example, these distances are fairly accurate because major highways run between most of the Illinois cities mentioned. In other examples, such as those involving travel thru a city, the line-of-sight distances may be grossly inaccurate because of one-way streets which dictate roundabout routes.

The third method for entering data allows the user to insert all distances directly in the inter-destination table. For this method to be used, the user must know the distance between every possible pair of points. In practice, a traveler will not have this information. But, over a period of time it is possible to get it. This input method is the most accurate, since true distances are used instead of line-of-sight distances.

In most situations, the user will start with one of the first two methods and then *edit* the inter-destination table by inserting known distances. Listing 3 shows how the inter-destination table can be edited.

In listing 2 polar coordinates are used to input the data. The program prompts the user to supply the name, distance, and angle of each of the 12 cities. When this step is completed, the program displays the input data in neat tabular form—this lets the user easily check the accuracy of the information. If an error is discovered, the user may edit the data before it is used.

The program then constructs the inter-destination table and gives the user the option to have it displayed. The user must now supply the starting and ending locations for the trip. In this example, Peoria (city 1) is the point from which the salesman starts and to which he returns. The program then executes the search algorithm and finds the shortest route. The time required for this calculation is 47 minutes.

All 12-city problems do not require this amount of time. The input data plays a major role in determining the execution time. In fact, our studies have shown that a 10-city problem can require more time to solve than an 11-city problem because of the tendency of the decision-tree-pruning method to use certain data more efficiently.

The program ends by displaying the shortest route as well as the distance between the cities and the total distance for the trip. For the sample run, the total distance is 761.6 miles. The results are shown in figure 1. In this particular example, we referred to an Illinois road map and changed 45 of the 132 line-of-sight distances to true traveling distances. With this more accurate data, the path was identical. Only the total distance changed.

Figure 2 illustrates an everyday application of the traveling-salesman problem. It will pick the most efficient route for someone who must, for example, do eight errands at eight different locations and then pick up the baby-sitter. The sample run in listing 3 shows how the data is supplied to the program using map headings. Note that two errors were made while supplying the data. The example shows how the edit mode is called to correct the errors. Both the school's distance and the bike shop's map heading are altered.

When all the location data has been supplied, the program constructs the inter-destination table. We now want to edit the table, because we know that several of the line-of-sight distances are inaccurate. Of the 90 distances in the table, 10 distances are

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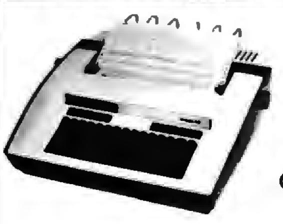

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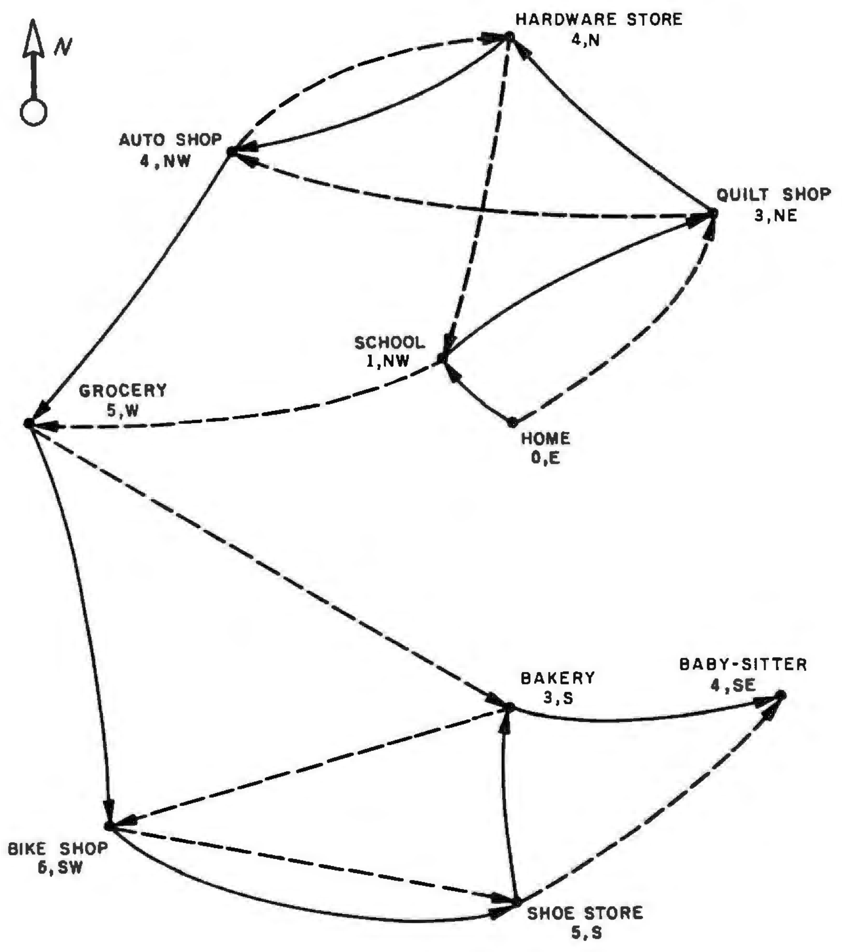

Figure 2: *The results of the sample run shown in listing 3. The black line indicates the best route to take if line-of-sight distances (distances as they appear on the map) are assumed. The dotted line is the true best route because it is developed from the input data as altered to reflect actual traveling distances between specific points. (A person would be hard-pressed to solve this type of problem visually.)*

altered. When editing is complete, the table is displayed again to show that it has been modified correctly.

The user must supply the starting and ending points, in this case his home. With this input, however, it is possible that the shortest route computed would require that the baby-sitter be picked up first, which means that the baby-sitter would be forced to tag along on all the errands. To eliminate that problem, the baby-sitter's house is supplied to the program as the end point. In this way the user can place some constraints on the route.

Before the program searches for the shortest route, the total number of possibilities for the trip is calculated and displayed. In this case, there are 40,320 possible paths.

When the search is completed, the best route is displayed as well as the distance between each point and the next point in the path. The total distance of 41.2 miles is also displayed. Figure 2 shows this path as a dotted line. The solid line is the route that would have been calculated if only the line-of-sight distances had been used. The figure vividly shows the need to supply the program with accurate distances.

In preparing this article, I gave maps to friends to see just how well they could do compared to the computer. In general, my friends did well. In fact, in some cases a person calculated the correct solution or near-correct solution more quickly than the computer. However, this apparent case of a person outperforming a computer quickly decays when the line-of-sight distances are quite different from the true distances.

An examination of figure 2 shows the drastic path change that occurs when true distances are used instead of line-of-sight distances. This stems from the fact that it is difficult or perhaps impossible for a person to visualize many points in which the true traveling distances have no relationship to the proximity of the points on a map.

Conclusion

Getting from one place to another efficiently is becoming increasingly important as the price of energy keeps climbing. This is true for anyone who travels, but it is particularly true for those who travel a great deal, such as salesmen. The need to plan trips in advance is obvious. However, planning a trip even when the number of destinations is relatively small is a hard task for a human as well as for a computer. By using a decision-tree-pruning method, the program execution time can be drastically reduced.

The BASIC program described here has its limits, but it should be of help in solving many practical problems. Until a major breakthrough is made, solving this NP-complete problem will remain difficult and time-consuming. ■

References

1. Berresford, G C, A M Rocket, and J C Stevenson. "Khachiyan's Algorithm, Part 1: A New Solution to Linear Programming Problems," BYTE, August 1980, page 198, and "Khachiyan's Algorithm, Part 2: Problems with the Algorithm," BYTE, September 1980, page 242.
2. Frey, Peter W and Larry R Atkin. "Creating a Chess Player," BYTE, October 1978, page 182.
3. Kolata, Gina Bari. "Trial-and-Error Game that Puzzles Fast Computers," *Smithsonian*, Volume 10, Number 7, October 1979, page 90.
4. Lewis, T G. "What Computers Cannot Do," BYTE, January 1980, page 100.
5. Maurer, W D. "Alpha-Beta Pruning," BYTE, November 1979, page 84.
6. Steen, Lynn Arthur. "Linear Programming: Solid New Algorithm," *Science News*, Volume 116, October 6, 1979, page 234.
7. Whaland, Norman D. "A Computer Chess Player Tutorial," BYTE, October 1978, page 168.

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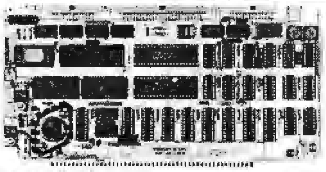

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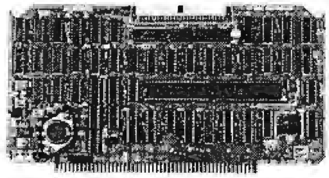

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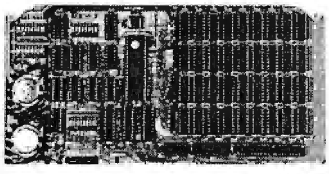

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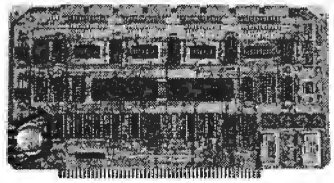

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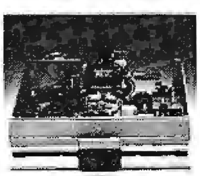

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Programming Quickies

Energy Measurement with the Apple II

William H Murray, Engineering Science Department
Boome Community College, Binghamton NY 13902

Anyone who has tried to make medium- to long-term electrical-energy measurements on a wind-driven generator or a bank of solar cells has found it difficult, *if* not impossible, to obtain the proper monitoring equipment. There are two good reasons for this: there is no real commercial demand for a direct-current kWh (kilowatt-hour) meter, and it is difficult to build a meter that will work on a system where both voltage and current can vary widely during the course of the monitoring period.

California Computer Systems came to my rescue when I tried to tackle this problem. It makes a 3¾-digit A/D (analog-to-digital) converter and a clock/calendar

Text continued on page 299

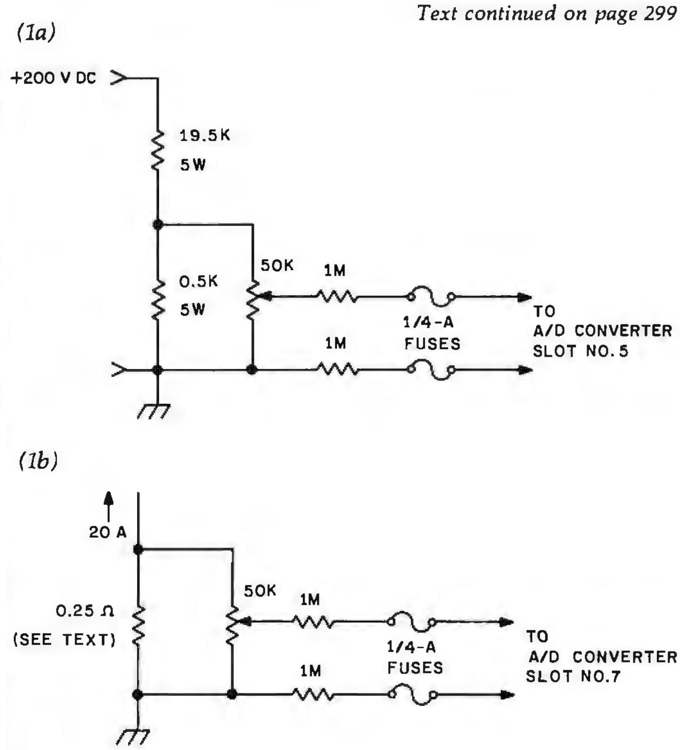

Figure 1: *Resistor networks used to ensure that input signals are within the proper range for use with A/D converter boards. The component values specified in figure 1a will divide the input voltage by a factor of 50. The circuit shown in figure 1b provides current division by a factor of 5. Both factors are taken into account by the Applesoft BASIC program in listing 1.*

Listing 1: *This Apple BASIC program performs data-logging functions. The A/D converters and the clock/calendar are initialized with the routines in listings 1b thru 1d.*

(1a)

```
]LIST

10  REM : LOAD MACHINE LANGUAGE
      CONTROL PROGRAMS
20  D$ =  CHR$ (4)
30  PRINT D$;"BLOAD ENERGY A/D5.O
      BJO"
40  PRINT D$;"BLOAD ENERGY A/D7.O
      BJO"
50  PRINT D$;"BLOAD ENERGY.OBJO"
60  REM : RUN MACHINE LANGUAGE
      PROGRAMS
70  CALL 50374
80  REM : CLEAR SPLIT SCREEN
90  CALL  - 936
100  REM : SET CONSTANTS FOR LEFT
      PORTION OF SCREEN
110 F1 = 0:TP = 0:BOTTM = 24
120 LEFTEDGE = 0:WIDTH = 25
130  POKE 32,LEFTEDGE: POKE 33,WI
      DTH
140  POKE 34,TP: POKE 35,BOTTM
150  VTAB 2: PRINT "           ENERGY
      DATA FOR"
160  VTAB 5: PRINT "    THE PRESEN
      T TIME IS"
170  VTAB 6: PRINT "THE PRESENT V
      OLTAGE IS"
180  VTAB 7: PRINT "THE PRESENT C
      URRENT IS"
190  VTAB 8: PRINT "THE PRESENT W
      ATTAGE IS"
200  VTAB 10: PRINT "THE AVERAGE
      WATTAGE IS"
210  VTAB 13: PRINT "    THE PEAK
      WATTAGE IS"
220  VTAB 15: PRINT "    THE TIME
      OF MAXIMUM"
230  VTAB 17: PRINT " NUMBER OF K
      W-HOURS IS"
240  VTAB 18: PRINT "  NUMBER OF
      SAMPLES IS"
260  REM : CHECK FOR COMPLETED
      CONVERSION
270 MM =  PEEK (774):MN =  PEEK (
      779)
280  IF MN > 0 THEN  GOTO 270
290  REM : STORAGE LOCATIONS: 757
      ($2F5) TO 778($30A)
300 Z = 768
310  REM : VOLTAGE
320 VA = ( PEEK (Z + 2))
330 VB = ( PEEK (Z + 3)) / 10
340 VC = ( PEEK (Z + 4)) / 100
350 VD = ( PEEK (Z + 5)) / 1000
360  REM : CURRENT
370 CA = ( PEEK (Z + 7))
380 CB = ( PEEK (Z + 8)) / 10
390 CC = ( PEEK (Z + 9)) / 100
400 CD = ( PEEK (Z + 10)) / 1000
410  REM : TIME AND DATE
420 TA =  PEEK (Z)
430 TB =  PEEK (Z - 1)
440 TC =  PEEK (Z - 2)
450 TD =  PEEK (Z - 3)
460 TE =  PEEK (Z - 4)
470 TF =  PEEK (Z - 5)
480 TG =  PEEK (Z - 6)
490 TH =  PEEK (Z - 7)
500 TI =  PEEK (Z - 8)
510 TJ =  PEEK (Z - 9)
520 TK =  PEEK (Z - 10)
530 TL =  PEEK (Z - 11)
540  REM : GET VOLTAGE DATA
550 VT = VA + VB + VC + VD
560 V = VT * 50
570  REM : GET CURRENT DATA
580 CT = CA + CB + CC + CD
590 C = CT * 5
600  IF V > 300 THEN  GOTO 270
610  REM : SET RIGHT PORTION OF
      SCREEN FOR TIME UPDATE
620 LEFTEDGE = 28:WIDTH = 10
630  POKE 32,LEFTEDGE: POKE 33,WI
      DTH
640  POKE 34,TP: POKE 35,BOTTM
650  REM : UPDATE TIME ONCE PER
      SECOND
660  VTAB 5: PRINT TF;TE;":";TD;T
      C;":";TB;TA
670  REM : AFTER ONE MINUTE,
      SAMPLE A/D'S FOR NEW DATA
680 X = (TB * 10) + TA
690  IF X = 0 THEN  GOSUB 750
700  POKE 7,4: POKE 7,4: POKE 7,4

710  GOTO 270
720  END
730  REM : SUBROUTINE FOR DATA UP
      DATE
740  REM : N=NUMBER OF SAMPLES
750 N = N + 1
760  REM : PC=PRESENT POWER
      READING
770 PC = C * V
780  REM : ACCUMULATED NUMBER OF
      K.W.H.
790 KWH = KWH + (PC / 60000)
800 TT = TT + PC
810  REM : PA=AVERAGE POWER
820 PA = TT / N
830  REM : SUBROUTINE TO GET PEAK
      POWER
840  IF RR < PC THEN  GOSUB 1080
850 V =  INT (V * 10 + .5) / 10
860 C =  INT (C * 10 + .5) / 10
870 PC =  INT (PC * 10 + .5) / 10

880 PA =  INT (PA * 10 + .5) / 10

890 RR =  INT (RR * 10 + .5) / 10

900 KWH =  INT (KWH * 1000 + .5) /
      1000
910  REM : CLEAR RIGHT PORTION OF
      SCREEN
920  VTAB 1: CALL  - 958
930  VTAB 2: PRINT TJ;TI;"/";TH;T
      G;"/";TL;TK
940  VTAB 5: PRINT TF;TE;":";TD;T
      C;":";TB;TA
950  VTAB 6: PRINT V;""
960  VTAB 7: PRINT C;""
970  VTAB 8: PRINT PC;""
980  VTAB 10: PRINT PA;""
990  VTAB 13: PRINT RR;""
1000  VTAB 15: PRINT T6;T5;":";T4
      ;T3;":";T2;T1
1010  VTAB 17: PRINT KWH;""
1020  VTAB 18: PRINT N;""
1030 X = 0
1040  REM : CHECK SEC. COUNT, GO
      TO MAIN STREAM AFTER A 1 SEC
      . DELAY
1050 TA =  PEEK (768)
1060  IF TA = 0 THEN  GOTO 1050
1070  RETURN
1080 RR = PC
1090 T1 = TA:T2 = TB:T3 = TC
1100 T4 = TD:T5 = TE:T6 = TF
1110  RETURN
```

(1b)

```
!                         CTRL-

SOURCE FILE: ENERGY A/D5
----- NEXT OBJECT FILE NAME IS ENERGY A/D5.OBJO
C500:              ORG   $C500      ;SLOT FOR CURRENT A/D
C500:A9 80         LDA   #$80       ;STOP CONV. TO SAMPLE
C502:A9 80         LDA   #$80
C504:8D D0 C0      STA   $C0D0
C507:8D D0 C0      STA   $C0D0
C50A:AD D3 C0      LDA   $C0D3      ;BIT 1
C50D:AD D3 C0      LDA   $C0D3
C510:29 0F         AND   #$0F       ;USE LOWER BITS
C512:8D 02 03      STA   $302       ;STORE BIT 1
C515:AD D2 C0      LDA   $C0D2      ;BIT 2
C518:AD D2 C0      LDA   $C0D2
C51B:29 0F         AND   #$0F
```

Listing 1 continued on page 296

Listing 1 continued:

```
C51D:8D 03 03     STA  $303      ;STORE BIT 2
C520:AD D1 C0     LDA  $C0D1     ;BIT 3
C523:AD D1 C0     LDA  $C0D1
C526:29 0F        AND  #$0F
C528:8D 04 03     STA  $304      ;STORE BIT 3
C52B:AD D0 C0     LDA  $C0D0     ;BIT 4
C52E:AD D0 C0     LDA  $C0D0
C531:29 0F        AND  #$0F
C533:8D 05 03     STA  $305      ;STORE BIT 4
C536:A9 00        LDA  #$00      ;LOAD A WITH 00
C538:A9 00        LDA  #$00
C53A:8D D0 C0     STA  $C0D0     ;START CONVERSIONS
C53D:8D D0 C0     STA  $C0D0
C540:8D 06 03     STA  $306      ;SIGNAL SAMPLE DONE
C543:8D 06 03     STA  $306
C546:60           RTS
```

(1c)

```
                    CTRL-

SOURCE FILE: ENERGY A/D7
----- NEXT OBJECT FILE NAME IS ENERGY A/D7.OBJ0
C700:             ORG  $C700     ;SLOT FOR VOLTAGE A/D
C700:A9 80        LDA  #$80      ;STOP CONV. TO SAMPLE

C702:A9 80        LDA  #$80
C704:8D F0 C0     STA  $C0F0
C707:8D F0 C0     STA  $C0F0
C70A:AD F3 C0     LDA  $C0F3     ;BIT 1
C70D:AD F3 C0     LDA  $C0F3
C710:29 0F        AND  #$0F      ;USE LOWER BITS
C712:8D 07 03     STA  $307      ;STORE BIT 1
C715:AD F2 C0     LDA  $C0F2     ;BIT 2
C718:AD F2 C0     LDA  $C0F2
C71B:29 0F        AND  #$0F
C71D:8D 08 03     STA  $308      ;STORE BIT 2
C720:AD F1 C0     LDA  $C0F1     ;BIT 3
C723:AD F1 C0     LDA  $C0F1
C726:29 0F        AND  #$0F
C728:8D 09 03     STA  $309      ;STORE BIT 3
C72B:AD F0 C0     LDA  $C0F0     ;BIT 4
C72E:AD F0 C0     LDA  $C0F0
C731:29 0F        AND  #$0F
C733:8D 0A 03     STA  $30A      ;STORE BIT 4
C736:A9 00        LDA  #$00      ;LOAD A WITH 00
C738:A9 00        LDA  #$00
C73A:8D F0 C0     STA  $C0F0     ;START CONVERSION
C73D:8D F0 C0     STA  $C0F0
C740:8D 0B 03     STA  $30B      ;SIGNAL SAMPLE DONE
C743:8D 0B 03     STA  $30B
C746:60           RTS
```

(1d)

```
                    CTRL-

SOURCE FILE: ENERGY1
----- NEXT OBJECT FILE NAME IS ENERGY1.OBJ0
C400:             ORG  $C400      LOAD AT SLOT 4
C400:A5 45        LDA  $45
C402:20 4A FF     JSR  $FF4A      SAVE REGISTERS
C405:BA           TSX
C406:BD 00 01     LDA  $0100,X
C409:0A           ASL  A          MULT BY 2
C40A:0A           ASL  A          MULT BY 2
C40B:0A           ASL  A          MULT BY 2
C40C:0A           ASL  A          MULT BY 2
C40D:A8           TAY              PUT IN Y
C40E:A2 40        LDX  #$40       PUT 40 IN X
C410:A9 20        LDA  #$20
C412:99 81 C0     STA  $C081,Y    GET SEC
C415:B9 80 C0     LDA  $C080,Y
C418:29 0F        AND  #$0F
C41A:9D C0 02     STA  $02C0,X
C41D:CA           DEX
C41E:A9 21        LDA  #$21
C420:99 81 C0     STA  $C081,Y    GET SEC
C423:B9 80 C0     LDA  $C080,Y
C426:29 0F        AND  #$0F
C428:9D C0 02     STA  $02C0,X
C42B:CA           DEX
C42C:A9 22        LDA  #$22
C42E:99 81 C0     STA  $C081,Y    GET MIN
C431:B9 80 C0     LDA  $C080,Y
C434:29 0F        AND  #$0F
C436:9D C0 02     STA  $02C0,X
C439:CA           DEX
C43A:A9 23        LDA  #$23
C43C:99 81 C0     STA  $C081,Y    GET MIN
C43F:B9 80 C0     LDA  $C080,Y
C442:29 0F        AND  #$0F
C444:9D C0 02     STA  $02C0,X
C447:CA           DEX
C448:A9 24        LDA  #$24
C44A:99 81 C0     STA  $C081,Y    GET HOUR
C44D:B9 80 C0     LDA  $C080,Y
C450:29 0F        AND  #$0F
C452:9D C0 02     STA  $02C0,X
C455:CA           DEX
C456:A9 25        LDA  #$25
C458:99 81 C0     STA  $C081,Y    GET HOUR
```

Listing 1 continued:

```
C45B:B9 80 C0     LDA  $C080,Y
C45E:29 03        AND  #$03
C460:9D C0 02     STA  $02C0,X
C463:CA           DEX
C464:A9 27        LDA  #$27
C466:99 81 C0     STA  $C081,Y    GET DAY
C469:B9 80 C0     LDA  $C080,Y
C46C:29 0F        AND  #$0F
C46E:9D C0 02     STA  $02C0,X
C471:CA           DEX
C472:A9 28        LDA  #$28
C474:99 81 C0     STA  $C081,Y    GET DAY
C477:B9 80 C0     LDA  $C080,Y
C47A:29 0F        AND  #$0F
C47C:9D C0 02     STA  $02C0,X
C47F:CA           DEX
C480:A9 29        LDA  #$29
C482:99 81 C0     STA  $C081,Y    GET MONTH
C485:B9 80 C0     LDA  $C080,Y
C488:29 0F        AND  #$0F
C48A:9D C0 02     STA  $02C0,X
C48D:CA           DEX
C48E:A9 2A        LDA  #$2A
C490:99 81 C0     STA  $C081,Y    GET MONTH
C493:B9 80 C0     LDA  $C080,Y
C496:29 0F        AND  #$0F
C498:9D C0 02     STA  $02C0,X
C49B:CA           DEX
C49C:A9 2B        LDA  #$2B
C49E:99 81 C0     STA  $C081,Y    GET YEAR
C4A1:B9 80 C0     LDA  $C080,Y
C4A4:29 0F        AND  #$0F
C4A6:9D C0 02     STA  $02C0,X
C4A9:CA           DEX
C4AA:A9 2C        LDA  #$2C
C4AC:99 81 C0     STA  $C081,Y    GET YEAR
C4AF:B9 80 C0     LDA  $C080,Y
C4B2:29 0F        AND  #$0F
C4B4:9D C0 02     STA  $02C0,X
C4B7:20 00 C5     JSR  $C500      SLOT 5 A/D
C4BA:20 00 C7     JSR  $C700      SLOT 7 A/D
C4BD:A9 6F        LDA  #$6F
C4BF:99 81 C0     STA  $C081,Y
C4C2:20 3F FF     JSR  $FF3F
C4C5:40           RTI
C4C6:08           PHP              ;CALL THIS LOC.
C4C7:48           PHA              ;TO START PROG.
C4C8:8A           TXA
C4C9:48           PHA
C4CA:20 CB FF     JSR  $FFCB
C4CD:BA           TSX
C4CE:BD 00 01     LDA  $0100,X    ;INTER. ADDRES
C4D1:8D FF 03     STA  $03FF      ;HI-INTER VEC.
C4D4:0A           ASL  A          MULT BY 2
C4D5:0A           ASL  A          MULT BY 2
C4D6:0A           ASL  A          MULT BY 2
C4D7:0A           ASL  A          MULT BY 2
C4D8:AA           TAX
C4D9:A9 00        LDA  #$00
C4DB:8D FE 03     STA  $03FE      ;LO-INTER VEC.
C4DE:A9 6F        LDA  #$6F
C4E0:9D 81 C0     STA  $C081,X
C4E3:68           PLA
C4E4:AA           TAX
C4E5:68           PLA
C4E6:28           PLP
C4E7:58           CLI
C4E8:60           RTS
C4E9:78           SEI
C4EA:60           RTS
```

Text continued from page 294:

module that can be directly interfaced with the Apple II computer to give accurate energy measurements.

The module's principle of operation is fairly simple. The clock calls for an interrupt once each second. Data is sampled and placed in a memory location where an Applesoft BASIC program assembles it into voltage, current, power, and energy readings. The clock/calendar card and the A/D cards must be fitted with 2112-type programmable memories to hold the machine-language programs shown in listing 1 (two devices per card). The machine-language programs were written to be "slot dependent," and unless they are modified, the clock/calendar must reside in slot 4, the voltage A/D card in slot 5, and the current A/D card in slot 7.

The Applesoft program in listing 1 uses a split screen to display the data. Because a clock/calendar module is used, you have the ability to record the date when the samples are taken, along with the time of *maximum* readings (often extremely important to solar- and wind-generator experimenters). The program displays the present voltage, current, and power being produced by the source, along with average and peak power, number of kilowatt-hours, number of samples, and time of maximum readings. The date and time are updated once per second, with the remainder of the data being updated once each minute.

If the power is being fed into a constant load, only one A/D converter will be necessary because you'll be able to calculate power from the equation:

$$P = \frac{E^2}{R}$$

where P is power in watts, E is voltage, and R is the load resistance in ohms. If this is the case, delete lines 40, 360, 370, 380, 390, 400, 570, and 580 from listing 1. Modify line 770 to read PC = (V↑2)/R and line 590 to read C = V/R, where R is the resistance of your load.

The A/D converter has a full-scale reading of 3.999 V, but the range can be extended with the use of a voltage divider. For example, the wind-driven generator I work with produces a maximum of +200 V DC. Figure 1a shows the voltage-divider network used in that application. The voltage-divider network reduces 200 V to 4 V, which is a 50-to-1 reduction. (Note that 50 is the multiplier constant in line 560 of the program.) The 50 k-megohm potentiometer permits calibration, while the two 1-megohm resistors and the fuses protect the Apple and the converter boards from trouble.

Current can be measured indirectly by sampling the voltage drop across a series resistance. (See figure 1b.) In my work application, currents of up to 20 A can be expected, so a shunt resistance of 0.25 ohms was made from a piece of 30 gauge wire, 2$\frac{9}{10}$ inches long. Again, the 50 k-ohm potentiometer permits calibration and the two 1-megohm resistors and the fuses provide protection. This current divider produces a 5-to-1 division (note the multiplier in line 590 of listing 1). ■

Further product information can be obtained from California Computer Systems, Santa Clara CA 95050. I will try to answer correspondence concerning the software if a self-addressed, stamped envelope is enclosed. Address correspondence to Dr William H Murray, Engineering Science Department, Broome Community College, Binghamton NY 13902.

Programming Quickies

Computing Inflation With the Consumer Price Index

Joe Haldeman
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The BASIC program INFLATION (see listing 1) reads in the United States' CPI (Consumer Price Index) from 1945 to the present as a one-dimensional array. It computes how much a certain amount in the past would buy today, or how much a current sum would be worth in yesterday's dollars. Within limits, it extrapolates inflationary trends into the future. (The limit being the assumption that inflation will continue at a steady, predictable rate. If you believe that, boy, do I have a bridge for you!)

The program helps when you are making a decision to buy something—check the item against an old catalog and see how much of a price increase is justified by inflation. You can also find out how much of a pay raise you actually got last time, or how to set the price of a piece of real estate. My own use for it has been in the preparation of a book on the space program, trying to get a realistic perspective on how much a few billion dollars is *really* worth, from Eisenhower to Reagan. (Answer: $10 billion 1952 = $36 billion 1981.)

One technical point is that there are now two Consumer Price Indices, our government having discovered that a dollar is worth more to a poor person than to a rich one. The CPI-W index is based on the purchasing patterns of urban wage-earners and clerical workers; the CPI-U index is weighted toward the needs of the retired and unemployed. I've used the former index, figuring that rather few people buy their computers with food stamps. ■

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Listing 1: *This Applesoft BASIC program, using Consumer Price Indices for past years, can calculate the current value of $50 from the year 1956, or help determine the increase in value of a piece of property due to inflation. Lines 190 and 210 must be updated every year.*

```
10  REM   ***************
20  REM   ** INFLATION **
30  REM   ***************
40  REM
50  REM    **. A PROGRAM GIVING
60  REM   DOLLAR EQUIVALENTS FOR
70  REM   ANY TWO YEARS BETWEEN
80  REM  1945 AND THE NEAR FUTURE

90  REM
100  REM   (NOTE THAT STATEMENTS
110  REM   190 AND 210 MUST BE
120  REM   ANNUALLY UPDATED.)
130  REM
140  DIM X(2000)
150  REM
160  REM      ** READ IN CONSUMER
170  REM      PRICE INDEX
180  REM
190  FOR I = 1945 TO 1981
200  READ X(I)
210  DATA  1.855,1.709,1.495,1.38
     7,1.401,1.387,1.285,1.258,1.
     248,1.242,1.247,1.229,1.186,
     1.155,1.145,1.127,1.116,1.10
     4,1.091,1.076,1.058,1.029,1,
     .96,.911,.86,.824,.799,.752,
     .678,.621,.587,.551,.493,.46
     1,.404,.35
220  NEXT
230 YEAR = I - 1
240  REM
250  REM   ** (FIGURE FOR 1981
260  REM   IS A CONSERVATIVE
270  REM   EXTRAPOLATION ... )
280  REM
290  PRINT : PRINT : PRINT "WHAT
     IS THE AMOUNT?"
300  INPUT P1
310  PRINT : PRINT : PRINT "IN WH
     AT YEAR?"
320  INPUT Y1
330  PRINT : PRINT : PRINT "FOR W
     HAT YEAR WOULD"
340  PRINT "YOU LIKE THE EQUI-"
350  PRINT "VALENT PRICE?"
360  INPUT Y2
370  IF Y2 > YEAR GOTO 510
380 P2 = P1 * X(Y1) / X(Y2)
390  REM
400  REM     ** PUT ANSWER INTO
410  REM        "DOLLAR" FORMAT
420  REM
430  IF P2 =  INT (P2) THEN P$ =
     "$" +  STR$ (P2): GOTO 450
440 P$ = "$" +  STR$ ( INT (P2)) +
      LEFT$ ( STR$ (P2 -  INT (P2
     )),3)
450  PRINT : PRINT : PRINT "IF IT
      COST $";P1;" IN ";Y1
460  PRINT "THEN IT WOULD COST ";
     P$;" IN ";Y2;"."
470  PRINT : PRINT : PRINT "ANOTH
     ER COMPUTATION? (Y OR N)": PRINT

480  INPUT Q$
490  IF Q$ = "Y" GOTO 290
500  END
510  PRINT : PRINT : PRINT "WHAT
     RATE OF INFLATION"
520  PRINT "DO YOU PREDICT?"
530  PRINT "(EXPRESS AS DECIMAL)"

540  INPUT R
550 P2 = P1 * X(Y1) / X(YEAR)
560 P2 = P2 * (1 + R) ^ (Y2 - YEA
     R)
570  GOTO 440
```

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BYTELINES

News and Speculation About Personal Computing

Conducted by Sol Libes

CSNET Approved: The National Science Foundation has approved the establishment of CSNET (computer science network), a cooperative effort of computer scientists to establish a computer-based communications network that will interconnect research groups in universities, industry, and government. Based on recent advances in computer-networking technology, including international protocol standards and the availability of commercial packet networks, CSNET will provide a means for collaborative work at the forefront of computer-science research. CSNET will initially link host computers on a number of other communications networks, including ARPANET, Telenet, and Tymnet. Later, it may be expanded to include other networks.

Computer Sales Up: The Department of Commerce (DOC) estimates that this year US computer makers will ship $32.8 billion worth of computers, up from $26 billion last year. This is an increase of 15% after inflation. 1980 saw a 24% increase over 1979. DOC estimates that personal-computer sales in 1980 exceeded $1 billion, a 100% increase over 1979. US computer exports are four times that of the Japanese, five times that of the French, seven times that of the West Germans, and almost ten times that of the British. DOC notes, however, that the Japanese are moving aggressively into the US and are expected to capture 30% to 40% of the personal-computer market.

Videodisk Players And Microcomputers Combined: The newest rage in DBS (data-base systems) and CAI (computer-aided instruction) is the combination of a videodisk player and microcomputer system. This allows large, highly intelligent, and low-cost CAI or DBS programs to be created. The videodisk player (VDP) is usually hooked up to the computer system via an RS-232C serial interface or IEEE-488 bus channel.

A user can interrogate and directly access any part of the information on the VDP in a fully interactive manner, with a typical response time of 1 second. For example, the DiscoVision VDP can store up to 100,000 megabytes on either side of a VDP disk. That's roughly the contents of 180 volumes of 300 pages each or about fifteen years' worth of BYTEs. With this approach, an immense library of information is instantly accessible to the user. Doctors, lawyers, engineers, and any other professionals constantly accessing reference material can have a complete library at their fingertips.

In CAI, the VDP/microcomputer combination makes high-fidelity mono- or multiple-channel audio, color video, and data available. If voice-input equipment matures, it's conceivable that the microcomputer keyboard may not even be needed.

SSM Microcomputer Products demonstrated a VDP/microcomputer system this past April at the San Francisco Computer Faire. The system used a DiscoVision Associates VDP (which is a joint venture of IBM and MCA) and an Apple II.

Peddle and Paivenen Back In Business: In 1975, a small outfit by the name of MOS Technology introduced a microprocessor called the 6502. Nobody paid much attention to it with heavyweights like Intel's 8080 and Motorola's 6800 around. Yet, the 6502 presented some unique features, and a few smart designers latched on to it (eg: Apple Computer Inc). Then in 1976, MOS Technology introduced a single-board computer called the KIM. Before the KIM, few had ever conceived of a whole computer on a single printed-circuit board; and, in 1977, MOS Technology shook everybody with the first "totally integrated personal computer"—the PET.

The 6502 went on to surpass the 8080 and 6800 in sales. The KIM and PET were copied by many companies and spearheaded the rocket-like growth of the personal-computer market.

The two fellows who started and led MOS Technology through its pioneering projects were John O Paivenen (founder) and Chuck Peddle (the technical guru). In late 1976, the company was bought by Commodore International, and John and Chuck lingered there for awhile, then left. They have now started a new venture called Sirius Systems Technology, Scotts Valley, California. Their first product will be a computer system to compete in the small-business-computer field. Strangely enough, it will use an Intel 8085 microprocessor.

Amateur Data Net Urged: A data-communications network for amateurs is being developed by AMRAD (Amateur Radio Research and Development Corporation). A formal proposal for funding of the AMNET (amateur network) project has been submitted to ARRL (American Radio Relay League). In it, AMRAD calls for a North American computer-communications network composed of seven HF (high-frequency) nodes (packet radio stations) tied into local VHF (very high frequency) message systems. (See the July 1981 "BYTELINES," page 214.) A portable node may be added later.

If approved, ARRL will serve as the network manager, AMRAD as the developer, and the VADCG (Vancouver Amateur Digital Communications Group) as the system designer. AMRAD hopes to have its link in operation soon. Different message formats are being developed for electronic mail, information conversations, and file transfer.

Two data-communications networks are already on air, one in Vancouver, British Columbia, and the other in San Francisco. Both systems use the VADCG packet-node-controller boards.

In other data-communications news, Kelly Smith, one

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of the leading developers of CP/M remote-network systems, is now publishing the *CP/M-Net News*. The newsletter has up-to-the-minute reports for CP/M developers and users. It costs $18. For details, write to *CP/M-Net News*, 3055 Waco St, Simi Valley CA 93063.

On another front, Novation Inc, the maker of low-cost modems, has set up a free computer-accessible information number. The system is available 24 hours a day. The data rate is 300 bps (bits per second). To gain access, dial (213) 881-6880 and type CAT followed by Return. You'll be given an eighteen-item menu of the information files (eg: there are modem and printer tests). The files are updated monthly.

Another UNIX Users Group Formed: Uni-ops is a new organization for UNIX fans. It intends to publish a monthly journal and a members' directory. Uni-ops will hold a convention the third week of October in San Francisco. Membership is $24. For details, write to Uni-ops, POB 5182, Walnut Creek CA 94596, or call (415) 933-8564.

Rockwell Casts Off Bubble Memories: Rockwell International, one of the earliest entrants in the bubble-memory market, is abandoning the race. Company sources concede that the bubble-memory market refused to develop as expected. The company will continue making the 256 K-bit bubble-memory devices for military applications. Rockwell had been working on a 1-megabit bubble device. Intel, Texas Instruments, and National Semiconductor are still making bubble-memory devices, and Motorola is expected to enter the market.

Maximum IC Density Predicted: Stanford University's James D Meindl has predicted that the maximum number of transistors fabricated on a single integrated-circuit chip will be 1 billion and that this density will be reached by the turn of the century. That's a big leap from current 8-bit microprocessors, which have about 30,000 transistors, or Intel's new iAPX432 32-bit microprocessor, which has approximately 150,000 transistors on each of the integrated circuits in its three-chip set.

OSI and Montgomery Ward To Open Computer Stores: For more than a year, Ohio Scientific and Montgomery Ward (MW) have been experimentally marketing personal computers in selected MW stores. Now the two companies have reached an agreement whereby OSI will site computer stores within MW outlets. Six such stores will be opened soon. The computer stores will be owned and operated by OSI dealers with a percentage of the income going to the Montgomery Ward store.

Memory Fixes Itself On-the-Fly: National Semiconductor has made public details of its new ECC (error-correcting code) memory. The ECC has sixteen spare programmable-memory integrated circuits per megabyte and substitutes a good memory for a faulty one on-the-fly. The error-checking and replacement are transparent to the main computer. While the technique is not new, applying it on the integrated-circuit level is.

Here's how it works: all data written is automatically read back and verified to determine if there is a memory error. If there is, a new integrated circuit is switched with the defective chip by "blowing" off fusible links. The system keeps track of the number of replacement circuits and gives a warning when the number of spares gets low.

Intel also has a self-correcting memory system. It switches memory banks into and out of a system.

Random News Bits: Atari will "private-label" microcomputer systems for Sears Roebuck. . . . Tandy will go into the OEM (original equipment manufacturing) computer business. Incidentally, Tandy reported net sales for January 1981 of $141.3 million, up from $112.3 million last year, a 26% gain. . . . Venture Development Corporation, Wellesley, Massachusetts, is predicting that shipments of personal computers will increase from fewer than 400,000 units in 1980 to almost two million in 1985. That's an effective growth rate of 37% per year. . . . RCA has been selected to design and install the Postal Service's first electronic mail system. It's projected to be operating by 1982. . . . Intel Corporation has reduced the price of the plastic-package version of the 8088 microprocessor to $14.10, in quantities over 100. The 8088 is instruction-set-compatible with the 16-bit 8086 microprocessor, but uses an 8-bit data bus. . . .

Random Rumors: It's rumored that Fujitsu is working on a large-capacity Winchester-technology disk drive for the micro/minicomputer market. The "Eagle" will supposedly have a capacity of 464 megabytes, using a 12-inch platter. It is expected to sell for $8000-$8500, in original equipment manufacturers quantities. . . . Apple Computer Inc may soon offer a modem card that operates at up to 1200 bps. It may be made by Novation. . . . Expect Hewlett-Packard (HP) to unveil a new color-video terminal at a substantially reduced price. It could be out by late summer. HP's current color terminal costs $40,000. . . . It's rumored that the Japanese Ministry of International Trade and Industry may fund the development of a "fifth generation" computer with a new architecture far beyond semiconductors. The funding could be as much as $2.1 billion. The undertaking could involve five large Japanese component manufacturers over a seven-year period. . . .

Quote Of The Month: "More than a million computers are churning out 220 billion pages of information every working day" . . . Robert M Price, President, Control Data Corporation.

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When I added Apple Pascal to my Apple II Plus system, I discovered that a few of my peripheral-device cards not made by Apple Computer Inc didn't work under the system. One was the Hayes Microcomputer Products Micromodem II direct-connect modem. Although the Pascal BIOS (basic input/output system) recognizes the Micromodem as a communication card, the BIOS does not contain the software necessary to control the modem's operations.

In BASIC, I could easily call and communicate with other modem-equipped systems, or have them call me. In Pascal, my system can't answer the phone even though the REMIN: and REMOUT: device names are associated with the Micromodem I/O card. This happens because BIOS doesn't use the Hayes modem's on-card firmware as Apple's DOS (disk operating system) and monitor ROM (read-only memory) do.

Various solutions were possible. In the February 1981 issue of BYTE, Thomas H Woteki described an Apple Pascal support procedure for the Hayes modem. (See "A Pascal Library Unit for the Micromodem II," page 106.) His method included modifying the BIOS routines in the SYSTEM.APPLE disk file and using a fair amount of machine-language routines. I decided against modification of the BIOS to maintain program compatibility with other Apple Pascal users. By using a programming trick that permits direct examination and modification of memory locations from Pascal, I knew I could reduce the amount of machine-language code needed. The final solution was to write a set of Pascal routines to supply some of the original Hayes modem firmware's services and use them in programs as needed.

I have several programs that would use these routines, so I wanted to have them compiled separately from the calling programs. Apple Pascal offers separately compiled routines through the "unit" option. A program gains access to the contents of the unit during compilation through inclusion of a "uses" statement. The object-code file from the compilation is linked with the unit's object-code file to make an executable program. Basically, a unit consists of three parts:

Accessing memory locations directly from Pascal reduces the amount of machine-language code required.

- the unit header, which specifies the name of the unit just as the program header does for normal programs. The name chosen is included in the USES statement of calling programs
- the "interface" portion, which specifies usable items to the calling program. These items could be procedures or functions, and include global data declarations
- the "implementation" portion, which specifies actual routines and functions that implement this unit and its interfaces

The code included in the interface portion of the Micromodem unit was determined by functions I needed. The BIOS didn't support dialing other systems, answering incoming calls, or hanging up the phone. Additionally, I thought that a function to determine if new data is available (similar to the APPLESTUFF "keypress" routine) would be useful because Apple Pascal is not interrupt-driven. Thus the Pascal routines to be coded were:

```
function MM_DIALER
   (NUMBER: string):
   boolean;
function MM_ANSWER
   (TIMING_ENABLED:
   boolean): boolean;
function MM_KEYPRESS:
   boolean;
procedure MM_HANGUP;
```

Before programming the implementation portion, I had to solve the fundamental problem of accessing the Control and Status registers on the Micromodem card. Actually, I needed to fool Pascal into allowing access to the contents of actual memory locations. This was accomplished through the infamous Pascal TRIX record, shown in listing 1, which sets up a relation between the variables ADDRESS and MEMORY like that produced by the EQUIVALENCE statement in FORTRAN.

To use the TRIX record, an assignment to the variable ADDRESS (the address field) is done followed by a read or write using the MEMORY

Circle 298 on Inquiry card.

Listing 1: *The TRIX record structure in Apple Pascal produces a relation between the variables ADDRESS and MEMORY like that produced by the EQUIVALENCE statement in FORTRAN.*

```
type TRIX =
  record
   case boolean of
    false:(ADDRESS:integer);
    true:(MEMORY:^char);
   end;
```

Listing 2: *The BTRIX record structure is a modification of TRIX for operation on individual bits. Due to the 16-bit operation of the packed-array type, some care must be taken during its use.*

```
type
  BBITS = packed array[0..7] of boolean ;
  BTRIX =
   record
    case boolean of
     false:(ADDRESS:integer);
     true:(BITS:^BBITS);
    end;
```

Listing 3: *This short Pascal program demonstrates the use of the TRIX record.*

```
type TRIX =
  record
   case boolean of
    false:(ADDRESS:integer);
    true:(MEMORY:^char);
   end;
procedure MM_SET_MODEM (CBYTE:char);
var MMII:TRIX;
begin
   MMII.ADDRESS := -16251+32;
   MMII.MEMORY^ := CBYTE;
end;

begin
 (*   Just Hangup the Modem   *)
   MM_SET_MODEM(chr(0));
end.
```

field. The "record" structure makes the integer field into a character pointer.

The TRIX record is adequate except for operations on individual bits in a character. It is common to test bits in I/O interfaces to determine the current status and service required (such as reading a character). For the Micromodem, bit testing is used to determine whether the phone is ringing or if a carrier tone has been detected on the phone line. The bit-operation TRIX record is shown in listing 2. Using the BTRIX record does have its side effects, however. A packed-array type causes the ADDRESS field to point at a word (16 bits or 2 bytes) not just a character (8 bits or 1 byte). When a reference to the MEMORY field is done, 2 bytes are read or written. This is normally not a problem because Pascal allocates data structures of that type in a word.

Reading 2 bytes can be a problem for the Micromodem because the Status and Data registers are adjacent bytes in the address space. A test of the Data Ready status bit will cause the character to be read and thrown away. (The MM_KEYPRESS function in the unit MICROMODEM was written in assembly language to circumvent the double-byte reference.) The example program in listing 3 demonstrates the use of the TRIX-type records.

Text continued on page 324

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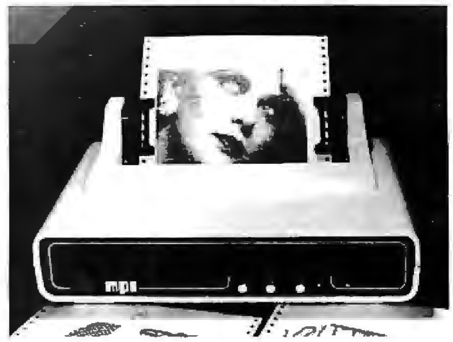

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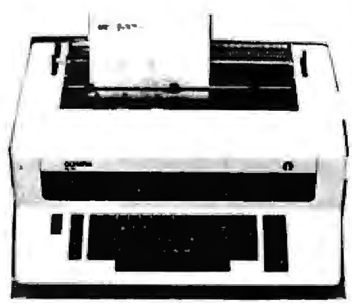

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Circle 302 on inquiry card.

Listing 4: *Apple Pascal support "unit" for the Hayes Microcomputer Products Micromodem II. Since the Pascal language system does not use the on-board firmware included with this peripheral card, functions to support dialing, answering calls, and automatic hang-up are provided in this procedure. Note that the "_" (underline, ASCII decimal 95) character is used to make the listing more readable, and that the "{ }" braces often replace the "(* *)" comment delimiters.*

```
MICROMODEM.TEXT          (c) 1980 Scott G. Robinson     Sept. 14, 1980     Page 1
{D.C. Hayes Micromodem II Support Unit}
--------------------------------------------------------------------------------

(*$S+*)
unit MICROMODEM;
{-------------------------------------------}
{ M I C R O M O D E M   II   S U P P O R T  }
{                                           }
{ Author: Scott G. Robinson                 }
{         120 Upland Rd.                    }
{         Marlboro, Ma.                     }
{                                           }
{ Version: 1.0                              }
{ Creation Date: August 27, 1980            }
{                                           }
{ (c) 1980 by Scott G. Robinson             }
{ All Commercial Rights Reserved            }
{-------------------------------------------}

interface
   function MM_KEYPRESS : boolean;
   function MM_DIALER(NUMBER:string) : boolean;
   function MM_ANSWER(TIMING_ENABLED: boolean) : boolean;
   procedure MM_HANGUP;

implementation
   const
{     These ensure Phone Co. standards         }
      DIAL_PULSE = 120;
      DIAL_PAUSE = 60;
      DIGIT_DELAY = 1200;
      A_2_SEC_DELAY = 3400;

{     These describe the Micromodem Registers }
      SLOT_X_16 = 32;
      MODEM = -16251;
         M_OFFHOOK = 128;
         M_INIT    = 8;
         M_ORIG    = 4;
         M_XMTE    = 2;
         M_300BAUD = 1;
      STATUS = -16250;
         S_PE      = 64;
         S_OVRN    = 32;
         S_FE      = 16;
         S_RESET   = 8;
         S_CD      = 4;
         S_XRDY    = 2;
         S_RRDY    = 1;
      CONTROL = -16250;
         C_INIT    = 3;
         C_8BITS   = 21;
      DATA  = -16249;

   type
      TRIX = record
              case boolean of
               false:(ADDRESS:integer);
               true:(MEMORY:^char);
              end;
      BBITS = packed array[0..7] of boolean;

      BTRIX = record
```

Listing 4 continued on page 314

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Circle 325 on inquiry card.

Listing 4 continued:

```
              case boolean of
               false:(ADDRESS:integer);
               true:(BITS:^BBITS);
              end;

   var
     DIGIT : integer;     { Holds digit while dialing }
     I,J : integer;       { Misc loop control vars    }
     CD,RI : boolean;     { Indicates carrier or ring }

procedure WAIT(HOWLONG:integer);
{
{ Delay for specified amount }
{                            }
var DELAY : integer;
begin
   for DELAY := 1 to HOWLONG do ;
end {WAIT};

function MM_GET_STATUS(BIT_NUMBER:integer): boolean;
{                                                 }
{ Test STATUS BIT_NUMBER and return true if set   }
{                                                 }
{ WARNING! An assembly language routine should    }
{          be used in data transfer usage         }
{          because PASCAL may read the DATA reg   }
{          along with the STATUS reg thus         }
{          causing lost characters or worse.      }
{                                                 }
var MMII: BTRIX;
begin
   MMII.ADDRESS := STATUS+SLOT_X_16;
   MM_GET_STATUS:=MMII.BITS^[BIT_NUMBER];
end {MM_GET_STATUS};

function MM_GET_MODEM(BIT_NUMBER:integer): boolean;
{                                                }
{ Test MODEM BIT_NUMBER and return true if set   }
{                                                }
var MMII: BTRIX;
begin
   MMII.ADDRESS := MODEM+SLOT_X_16;
   MM_GET_MODEM:=MMII.BITS^[BIT_NUMBER];
end {MM_GET_MODEM};

function MM_GET_DATA: char;
{                                       }
{ Return copy of DATA reg as char       }
{                                       }
{ NOTE: PASCAL's unitread should normally }
{       be used for this function.        }
{                                       }
var MMII: TRIX;
begin
   MMII.ADDRESS := DATA+SLOT_X_16;
   MM_GET_DATA:=MMII.MEMORY^;
end {MM_GET_DATA};

procedure MM_SET_CONTROL(CBYTE:char);
{                               }
{ Set CONTROL reg with CBYTE    }
{                               }
var MMII: TRIX;
begin
   MMII.ADDRESS := CONTROL+SLOT_X_16;
   MMII.MEMORY^ := CBYTE;
end {MM_SET_CONTROL};
```

Listing 4 continued on page 316

Listing 4 continued:

```
procedure MM_SET_MODEM(CBYTE:char);
{
  Set MODEM reg with CBYTE
}
var MMII: TRIX;
begin
   MMII.ADDRESS := MODEM+SLOT_X_16;
   MMII.MEMORY^ := CBYTE;
end {MM_SET_MODEM};

procedure MM_SETUP;
{
  Initialize ACIA chip to 8-bits/char
}
begin
   MM_SET_CONTROL(chr(C_INIT));
   MM_SET_CONTROL(chr(C_8BITS));
end {MM_SETUP};

(*$P*)

function MM_KEYPRESS;
{
  MM_KEYPRESS returns true if a character is
  ready for input from the micromodem
}
external;

function MM_DIALER;
{
  MM_DIALER attempts to establish communication
  with a modem after dialing NUMBER. If successful
  the function is 'true' otherwise 'false'.
}
   begin
{ Start by taking the phone line 'off-hook' }
   MM_SET_MODEM(chr(M_OFFHOOK));
   WAIT(A_2_SEC_DELAY);
{ Then dial NUMBER requested. }
   for I := 1 to length(NUMBER) do
      case NUMBER[I] of
         '0','1','2','3','4','5','6','7','8','9':
               begin
               DIGIT := ord(NUMBER[I])-ord('0');
               if DIGIT = 0 then DIGIT := 10;
               repeat
                  WAIT(DIAL_PAUSE);
                  MM_SET_MODEM(chr(0));
                  WAIT(DIAL_PULSE);

                  MM_SET_MODEM(chr(M_OFFHOOK));
                  DIGIT := DIGIT - 1;
               until DIGIT = 0;
               WAIT(DIGIT_DELAY);
               end;
         '*': WAIT(A_2_SEC_DELAY);
      end {case};
{ Set Originate Mode and wait for the carrier }
   MM_SET_MODEM(chr(M_OFFHOOK + M_ORIG));
   I := ord(MM_GET_DATA); {Ensure Valid CD bit}
   CD := false;
   J := 8;
   repeat
     WAIT(A_2_SEC_DELAY);
     CD := not(MM_GET_STATUS(2));
     J := J-1;
   until (J=0) or CD;
{ Finish up by either hanging up or enabling transmitter }
```

Listing 4 continued on page 318

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Listing 4 continued:

```
   if not(CD) then MM_SET_MODEM(chr(0))
   else MM_SET_MODEM(chr(M_OFFHOOK + M_ORIG + M_INIT
                         + M_XMTE + M_300BAUD));
   MM_DIALER := CD;
   MM_SETUP;
   end {MM_DIALER};

function MM_ANSWER;
{                                                      }
{ MM_ANSWER answers the telephone if ringing occurs   }
{ during the wait interval and returns "true" if      }
{ a carrier is detected otherwise "false"             }
{                                                      }
   begin
{ Wait for Ring indication and then carrier }
   J := 20;
   CD := false;
   RI := false;
   repeat
      I := 0;
      repeat
        if not(MM_GET_MODEM(7)) then RI := true;
        I := I+1;
      until (I=500) or RI;
      if TIMING_ENABLED then J := J-1;
   until (J=0) or RI;
   if RI then
      begin
{ Answer the phone and wait for carrier }
      MM_SET_MODEM(chr(M_OFFHOOK + M_XMTE + M_300BAUD + M_INIT));
      I := ord(MM_GET_DATA); {Ensure valid CD bit}
      J := 15;
      repeat
```

Listing 4 continued on page 320

Circle 74 on inquiry card.

Listing 4 continued:

```
         WAIT(A_2_SEC_DELAY);
         CD := not(MM_GET_STATUS(2));
         if TIMING_ENABLED then J := J-1;
      until (J=0) or CD;
      end;
{ If carrier wasn't found then hangup the phone }
   if not(CD) then MM_SET_MODEM(chr(0));
   MM_ANSWER := CD;


   MM_SETUP;
   end {MM_ANSWER};

procedure MM_HANGUP;
{                                                 }
{ HANGUP hangs up the telephone and returns to    }
{ the caller.                                     }
{                                                 }
   begin
   MM_SET_MODEM(chr(0));
   end {HANGUP};

begin {Main Program just Initializes }
  MM_SETUP;
end {unit MICROMODEM}.
```

Listing 5: *Assembly-language routine for the 6502 microprocessor that determines if the next character to be received is waiting in the Micromodem, eliminating problems caused by attempts to retrieve a character before it is ready. The name MM_KEYPRESS is derived from its similarity to the APPLESTUFF "keypress" routine, which performs the same function for the Apple keyboard.*

```
ASMBLR:MMKEY.TEXT     (c) 1980 Scott G. Robinson     Sept. 14, 1980     Page 1
;MM_KEYPRESS support for MICROMODEM
-------------------------------------------------------------------------------

        .TITLE  "MM_KEYPRESS support for MICROMODEM"
;-----------------------------------------------
; MM_KEYPRESS returns a boolean value indicating
; whether a character is waiting in the micromodem
; and can be read with UNITREAD in PASCAL
;
; Author: Scott G. Robinson
;         120 Upland Rd.
;         Marlboro, MA 01752
;
; (c) 1980 by Scott G. Robinson
; All Commercial Rights Reserved
;-----------------------------------------------

RETURN  .EQU    0               ;Return Address
SLTX16  .EQU    020
MMSTAT  .EQU    0C0A6           ;Status Register

        .FUNC   MMKEYPRE
;
; function MM_KEYPRESS : boolean;
;
        PLA                     ;Store Return Address
        STA     RETURN
        PLA
        STA     RETURN+1
        PLA                     ;Discard Stack Bias
        PLA
        PLA
        PLA
```

Listing 5 continued on page 322

Listing 5 continued:

```
        LDA     MMSTAT          ;See if character available
        AND     #01             ;Bit 0 is Character Ready
        TAX                     ;Store temp
        LDA     #00
        PHA                     ;Put MSB of return
        TXA
        PHA                     ;Put LSB of return value
        LDA     RETURN+1        ;Put Return Address back on Stack
        PHA
        LDA     RETURN
        PHA
        RTS                     ;Exit Routine
;
        .END
```

Listing 6: *Sample utility program that gives the user menu-driven access to the Micromodem support procedure, MICROMODEM.*

```
MMUTIL1.TEXT        (c) 1980 Scott G. Robinson     Sept. 14, 1980
{Micromodem Utility Routine}
------------------------------------------------------------------

program MMUTIL;
uses APPLESTUFF,
(*$UMICROMODEM.CODE*)
     MICROMODEM;
{------------------------------------------------}
{ Micromodem Utility Routine                     }
{                                                }
{ Demonstrates the usage of the micromodem       }
{  support unit.                                 }
{                                                }
{ Author: Scott G. Robinson                      }
{         120 Upland Rd.                         }
{         Marlboro, MA 01752                     }
{------------------------------------------------}

const
    KEYINP=2;
    MMINPUT=7;
    MMOUTPUT=8;

var
   ANYCHAR : char;
   DONE : boolean;
   NUMBER : string[32];
   RESULT : boolean;
   PCHAR : packed array[0..0] of char;

procedure PRINT_MENU;
begin
   page(output);
   writeln(´D.C. Hayes Micromodem II Utility´);
   writeln(´´);
   writeln(´´);
   writeln(´Pick an option from the following list:´);
   writeln(´´);
   writeln(´      # --> Number to Dial = ´,NUMBER);
   writeln(´´);
   writeln(´      D --> Dial the number´);
   writeln(´      A --> Answer the phone´);
   writeln(´      H --> Hangup the phone´);
   writeln(´      T --> Go into Terminal mode´);
   writeln(´´);
   writeln(´Type <esc> to leave program´);
end {PRINT_MENU};

begin
```

Listing 6 continued on page 324

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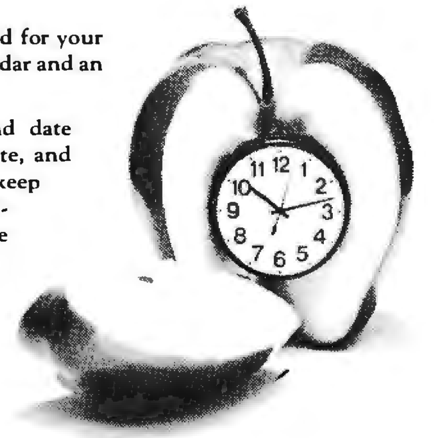

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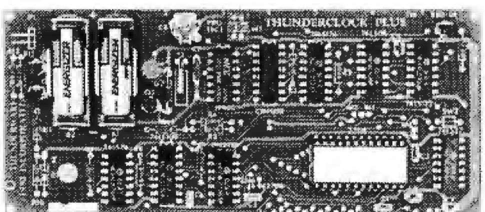

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Listing 6 continued:

```
DONE := false;
NUMBER := '999-9999';
repeat
   RESULT := true;
   PRINT_MENU;
   read(keyboard,ANYCHAR);
   if ANYCHAR <> chr(27) then
      case ANYCHAR of
         '#','3':
              begin
                 page(output);
                 writeln('Enter Telephone Number to dial:');

                    readln(NUMBER);
                 end;
            'A','a':
                 begin
                 page(output);
                 writeln('Waiting for call...');
                 RESULT := MM_ANSWER(true);
                 end;
            'D','d':
                 begin
                 page(output);
                 writeln('Dialing ',NUMBER);
                 RESULT := MM_DIALER(NUMBER);
                 end;
            'H','h': MM_HANGUP;
            'T','t':
                 begin
                 page(output);
                 writeln('Terminal Mode - type ^P to exit');
                 RESULT := false;
                 repeat
                    if keypress then
                       begin
                       unitread(KEYINP,PCHAR[0],1,,1);
                       if PCHAR[0] = chr(16) then RESULT := true
                       else unitwrite(MMOUTPUT,PCHAR[0],1,,1);
                       end;
                    if MM_KEYPRESS then
                       begin
                       unitread(MMINPUT,PCHAR[0],1,,1);
                       write(PCHAR[0]);
                       end;
                 until RESULT;
                 end;
         end {case}
      else
         DONE := TRUE;
      if not(RESULT) then
         begin
         page(output);
         writeln('Operation Failed, type <space> to continue');
         repeat read(keyboard,ANYCHAR); until (ANYCHAR = ' ');
         end;
   until DONE;
end.
```

Text continued from page 310:

The remaining program listings contain comments that detail the full implementation of the unit. These listings contain characters that you are probably not used to seeing in Apple Pascal unless you have an external terminal. The "_" (underline) character breaks names to make them more readable. You can leave out the "_" everywhere it appears and the program will still work. The brace characters "{ }" replace the comment delimiters "(* *)", in most cases. Listing 4 is the completed Micromodem support unit. Listing 5 is the 6502 assembly-language MM_KEYPRESS routine used as part of the unit. Listing 6 is a sample utility program that uses the unit.■

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Life After Death

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"All this and heaven too!"
—Mathew Henry's *Life of Philip Henry*

"And shall I couple Hell?"
—Shakespeare's *Hamlet*

In the conventional game of Life, death is final, and birth is the beginning. Cells simply vanish when they die, and they appear magically out of nowhere when births occur. The void on both ends saddened me. I could not accept Life without hope or a spiritual dimension. The result is Life After Death. After all, we create the microcosms known as cellular automata and make the rules known as state transitions. We can just as easily change the rules. If we want a cell to have an existence in the hereafter, then so be it.

In Life After Death, cells that die pass on to another state of existence; they enter a netherworld. Likewise, when a birth occurs, a cell from the other world descends to become the newly born cell, a gift from cell heaven or a reincarnation, if you will. More on this later.

The idea behind Life After Death is to explore Life systems with a view to generating interesting moving video displays or attractive printed patterns. This kind of study, however, poses several problems. One is the time and effort required to modify algorithms for new Life systems. A second problem is the slow execution of high-level interpretive languages. (Few of us have the time or inclination to tackle such studies in machine language or assembly language.) A third problem is the difficulty involved in analyzing results and manipulating output. This article illustrates one approach to simplifying these problems. It also suggests the many structures and rules that can be readily implemented.

A good starting point is offered by Jonathan Millen in "One-dimensional Life" (BYTE, December 1978, page 68). One-dimensional Life is easy to program in high-level languages. It also runs fast enough for study purposes.

A program to run this one-dimensional form of Life is shown in listing 1. It is written in extended BASIC for the Radio Shack TRS-80 Model I microcomputer. This version uses a wrap-around procedure so that the first cell, UN(1), is treated as being adjacent to the last cell UN(E), where E represents the number of elements in the cellular universe, or Life-line. The ASCII (American Standard Code for Information Interchange) codes 32 and 191 represent a blank and a fully white video character block on the TRS-80. To facilitate study, the program displays each line as it's generated. But, the entire screen can be changed by storing the lines and then displaying them after a time delay between displays.

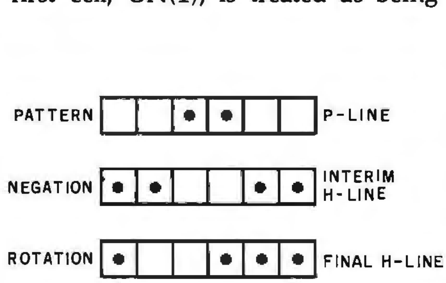

Figure 1: *A parallel pattern in the hereafter, H-line, is formed by negating the current Life pattern, P-line, and then rotating it by a circular shift to the left.*

Adding a Hereafter

One way to add a hereafter is to specify a parallel one-dimensional universe of cells, or H-line (hereafter line). Once a pattern is formed in the real world, or P-line (present line), two events immediately take place. First, an H-line is formed as a negation of the P-line of zeros and ones, ie: each zero or off-cell in P is paralleled by an on-cell or a one in H, and vice versa. Second, the H-line drifts relative to the P-line by rotating one cell to the left. (These events are shown in figure 1.) The rules for Millen's one-dimensional Life are now applied to the P-line, but with a significant exception. An otherwise possible birth will not occur unless a parallel cell in the spirit world is on. Likewise, a moribund cell will not die unless the adjacent cell in the hereafter is vacant. Its time has not come. (This is illustrated in figure 2.)

Listing 1: *Radio Shack Level II BASIC program for one-dimensional Life using Millen's rules. The Life-line wraps around to form a logical circle composed of E elements. Lines are displayed successively as generated until the screen is full. The display then returns to the top of the screen and continues.*

```
100 '---1-D LIFE, MILLEN'S RULES +WRAPAROUND +11-LINE DISPLAY
110 CLEAR 128:DIM UN(64):G=0:C=0
115 INPUT "DISPLAY WIDTH (MAX 60)",E '---SHOULD BE>PATTERN SIZE
120 PRINT"ENTER PATTERN OF 1'S & 0'S --MAX ", :PRINTE.INPUT P$
125 IF E<LEN(P$) THEN E=LEN(P$)    '---CENTERING ROUTINE 125-150
130 K=INT((E-LEN(P$))/2)
140 FOR J=1 TO LEN(P$)
150 UN(K+J)=VAL(MID$(P$,J,1)):NEXT
152 CLS:PRINT@K+4,P$; :GOTO 310
155 U1=UN(1):U2=UN(2):T2=UN(E-1):T1=UN(E) '---ALGORITHM 155-260
170 I=1:G=G+1:C=C+1
180 L1=UN(I+1):L2=UN(I+2)
190 T0=UN(I):N=T2+T1+L1+L2
200 IF T0=0 THEN GOTO 220
210 IF NOT(N=2 OR N=4) THEN  UN(I)=0.GOTO 230: ELSE 230
220 IF N=2 OR N=3 THEN  UN(I)=1
230 T2=T1:T1=T0:I=I+1
240 IF I<E-1 GOTO 180
250 IF I=E-1 L1=UN(E):L2=U1:GOTO 190
260 IF I=E THEN L1=U1:L2=U2:GOTO 190   '~~~~"THEN" IS A MUST!
310 L=15427+C*64:PRINT@0,G;    '---DISPLAY ROUTINE 310 TO 340
320 FOR J=1 TO E
330 IF UN(J)=1 POKE L+J,191.ELSE POKE L+J,32
340 NEXT:IF C>13 THEN C=-1:GOTO 155: ELSE 155 '---MAX C=13!!!
```

The rules for Life After Death can now be stated:

- Every cell in the hereafter is set opposite in state to its corresponding cell in the parallel current pattern immediately after it is established.
- The cells in the hereafter then drift (rotate) one position to the left. The cause of this drift is not known. Perhaps the drift is more apparent than real. While the world rushes on with its daily concerns of growth and survival, the occupants of the tenuous spirit world simply fade into memory.
- The cells of the pattern are scanned. A birth occurs if a cell is off and has 2 or 3 neighbors and the adjacent spirit cell is on. A neighborhood consists of 2 cells to the left and 2 cells to the right of the cell being scanned. The changes are deferred until the next step is complete.
- A death occurs if a cell in the pattern is on and has 0, 1, or 3 neighbors and the adjacent spirit world cell is off. Changes reflecting births and deaths are now made in the pattern-line. A new cycle of rules can now be applied.

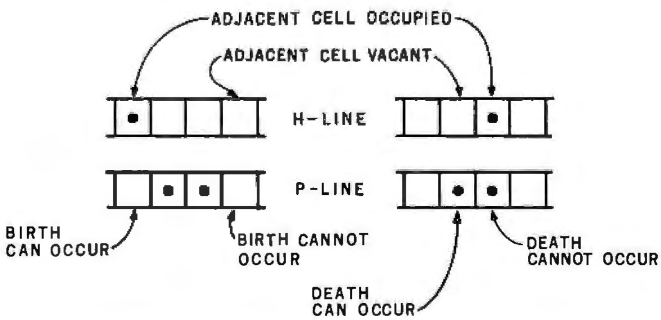

Figure 2: *Without a spirit in the adjacent otherworld cell, an otherwise possible birth cannot occur. If the adjacent space in the hereafter is occupied, an otherwise moribund cell cannot die.*

To achieve the objective of easy exploration, Millen's one-dimensional Life (MIL) was implemented in APL, as shown in listing 2. This gives results identical to the results of the BASIC version in listing 1 except that the APL program is set up for printing. This particular version was run on an APL microcomputer, the MCM-70, of Micro Computer Systems. Readers who studied the article by Mark Niemiec "Life Algorithms" (BYTE, January 1979, page 90) will see that this is the same type of APL algorithm used for John Conway's two-dimensional Life, but much simpler in the one-dimensional system. [**Editor's note:** *John Conway is the English mathematician who invented the game of Life.*] The heart of the algorithm is in line 6 of listing 2. The extended pattern (universe) is rotated 2 and 1 positions to the left and 2 and 1 positions to the right. The 4 shifted patterns are then summed.

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7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model
	NAME	**DESCRIPTION**
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
97	RENTPRCH	Purchase price for rental property
98	SALELEAS	Sale-leaseback analysis
99	RRCONVBD	Investor's rate of return on convertable bond
100	PORTVAL9	Stock market portfolio storage-valuation program

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The next 3 lines apply the transition rules as a series of logical operations. I refer to this as the "shake and bake" algorithm.

The advantage of using APL becomes evident when we modify the program to achieve Life After Death, (LD1), as shown in listing 2. All we have to do is replace line 3, which is a do-nothing line in MIL, with a new line. This defines the hereafter, H, as the negation of the pattern, P, rotated 1 cell to the left. This is done with the built-in editor, which is a standard feature of APL. The new variable joins the logical operations in line 9. OLD represents survivors; NEW and H represent births; P and H represent those whose time has not yet come. Note how closely the coding follows the concept (negate, rotate). It's easy and fast. Another advantage is the ease of display manipulation.

Preliminary experiments with these two programs, MIL and LD1, reveal a weakness in Life After Death. While one-dimensional patterns usually settle down to oscillating forms, the LD1 forms become stationary objects with a tendency to drift to the right of the screen (see figure 3). Failure to generate interesting patterns by a simple extension of one-dimensional Life is another example of a long known fact—it is difficult to improve existing Life systems. This applies to Millen's simplified system as well as to Conway's two-dimensional Life. The remainder of this article explores ways out of this difficulty. Some of the suggestions may well apply to the standard game of Life.

Before we discuss the addition of a netherworld, it is worth noting that we are dealing with a generalization of the game of Life. We are adding parallel structures with their own transition rules and with rules for interaction between the structures. In the present case, we have two or three parallel, interacting, one-dimensional spaces. Theorists may be quick to point out that Life After Death is equivalent to a simple one-dimensional Life with more than two states for cells and with more complex transition rules. Thus, the states "on" and "off" are augmented by the states "off but candidate for on" and "on but candidate for off." There are practical advantages with the present approach—ease of handling and pattern-generation spinoffs. We can, for example, print only the hereafter or netherworld Life-lines (by replacing P in line 4 of LD1 [listing 2] with H, for example), or we can combine the different Life-lines in various ways for display effects. Note the simplicity of specifying a display. An array of characters is indexed by an array of integers with the result taking the shape of the indexing array.

The introduction of a netherworld, N, brings complications. To speed things along, we will use a cellular theology of heaven and hell. As creators of such a system, we now face difficult choices. Shall hell be the negation of heaven or the reversal? Shall it drift or rotate in the opposite direction and how far? There are more problems. Shall dead cells go to one place or the other or both if vacancies exist? Shall the spirits of the newborn come only from heaven, or shall the innocence of the newborn be corrupted from below? After some experimentation, LD3 and LD6 emerged as interesting for pattern-generation potential. They are shown in listing 2 and are compared with MIL and LD1 in the last two columns of figure 3.

LD3 leans toward a variety of oscillators and stationary forms, while LD6 leans more toward stationary forms with some tendency for wider growth. Both of these triple-line forms of Life allow birth if an adjacent cell is occupied in either heaven or hell. Both of them also require an opening in at least one of the parallel lines for an otherwise allowable death to occur. They differ in that hell for LD3 is a combined negation, reversal, and rotation of one cell to the right. LD6, on the other hand, sees the netherworld as a simple contrary rotation of the heavenly pattern 2 cells to the right. These modifications are shown in line 3 of LD3 and LD6 in listing 2. The birth and death consequences show up in line 9. To assist in the inter-

Text continued on page 332

Listing 2: *These APL programs for four different Life systems differ in lines 3 and 9 only. Program MIL gives the same results as the BASIC program in listing 1. LD1 adds a hereafter, H. LD3 adds a netherworld, N. LD6 does the same, but defines N differently (see text). The influence of the parallel N- and H-lines is determined in line 9 of each program.*

```
   DISPLAY 'MIL'
 0∇R←S MIL P
 1 →0×ι2≠ρ,S←(1ρS),(1↓S)⌈ρP←,P
 2 R←0ρP←(1↓S)ρ((⌈0.5×(1↓S)-ρP)ρG←0),P='1'
 3START:X←''
 4 ⎕←' ⎕'[P+1],'    ',⍕G
 5 →0×ι(G←G+1)>¯1+1ρS
 6 SUM←+/[1]2 1 ¯1 ¯2 ⌽(4,ρP)ρP
 7 OLD←(2=SUM×P)∨4=SUM×P
 8 NEW←(2=SUM×~P)∨3=SUM×~P
 9 P←OLD∨NEW
10 →START
  ∇
   DISPLAY 'LD1'
 0∇R←S LD1 P
 1 →0×ι2≠ρ,S←(1ρS),(1↓S)⌈ρ,P
 2 R←0ρP←(1↓S)ρ((⌈0.5×(1↓S)-ρP)ρG←0),P='1'
 3START:H←1⌽~P
 4 ⎕←' ⎕'[P+1],'    ',⍕G
 5 →0×ι(G←G+1)>¯1+1ρS
 6 SUM←+/[1]2 1 ¯1 ¯2 ⌽(4,ρP)ρP
 7 OLD←(2=SUM×P)∨4=SUM×P
 8 NEW←(2=SUM×~P)∨3=SUM×~P
 9 P←(P∧H)∨(NEW∧H)∨OLD
10 →START
  ∇
   DISPLAY 'LD3'
 0∇R←S LD3 P
 1 →0×ι2≠ρ,S←(1ρS),(1↓S)⌈ρP←,P
 2 R←0ρP←(1↓S)ρ((⌈0.5×(1↓S)-ρP)ρG←0),P='1'
 3START:N←¯1⌽⌽~H←1⌽~P
 4 ⎕←' ⎕'[P+1],'    ',⍕G
 5 →0×ι(G←G+1)>¯1+1ρS
 6 SUM←+/[1]2 1 ¯1 ¯2 ⌽(4,ρP)ρP
 7 OLD←(2=SUM×P)∨4=SUM×P
 8 NEW←(2=SUM×~P)∨3=SUM×~P
 9 P←(P∧H∧N)∨(NEW∧H∨N)∨OLD
10 →START
  ∇
   DISPLAY 'LD6'
 0∇R←S LD6 P
 1 →0×ι2≠ρ,S←(1ρS),(1↓S)⌈ρP←,P
 2 R←0ρP←(1↓S)ρ((⌈0.5×(1↓S)-ρP)ρG←0),P='1'
 3START:N←¯2⌽H←1⌽~P
 4 ⎕←' ⎕'[P+1],'    ',⍕G
 5 →0×ι(G←G+1)>¯1+1ρS
 6 SUM←+/[1]2 1 ¯1 ¯2 ⌽(4,ρP)ρP
 7 OLD←(2=SUM×P)∨4=SUM×P
 8 NEW←(2=SUM×~P)∨3=SUM×~P
 9 P←(P∧H∧N)∨(NEW∧H∨N)∨OLD
10 →START
  ∇
```

Text continued from page 330:

pretation, the three phrases in line 9 of LD3, for example, can be read as:

- Cells whose time has not yet come (P, H, and N)
- Cells that are newborn (NEW, H, or N)
- Cells that survive (OLD)

The use of the reversal operation (backward order) in LD3 leads to an interesting property. The uniqueness of a pattern is determined not only by the sequence of on and off cells, but by its position with respect to the wrap-around point or "ends" of the Life-line. This is shown in figure 4 where the patterns 1011100, 0101110, and 0010111 are compared using LD3. Another point to note with circular or wrap-around Life is that the number of elements and their parity (odd or even) will modify the results when interacting patterns crowd the available space and approach the wrap-around point. Things get more interesting and complicated with larger patterns and Life-lines than are shown here. Many continue to evolve after a few dozen generations. These are left for the interested reader to explore. For those lacking access to APL, it will be necessary to modify the BASIC program accordingly. While not terribly difficult, it will take much more time and effort. Although APL has its problems, when it comes to speed of creating an application and maintaining (modifying) it, it has no peer among languages.

Now what about pattern generation? Many possibilities are open to us using what we have developed here. One scheme would be to fill the screen, then select a different pattern by program every time the scan starts at the top of the screen. Alternatively, a new pattern could be created by some random change in the pattern of the first video line. Likewise, the graphic characters can be changed on each new full screen cycle. Another variation would be to switch algorithms. Strong symmetries can be produced by running the reversed order line display on each half, quarter, and so on, of the screen. If

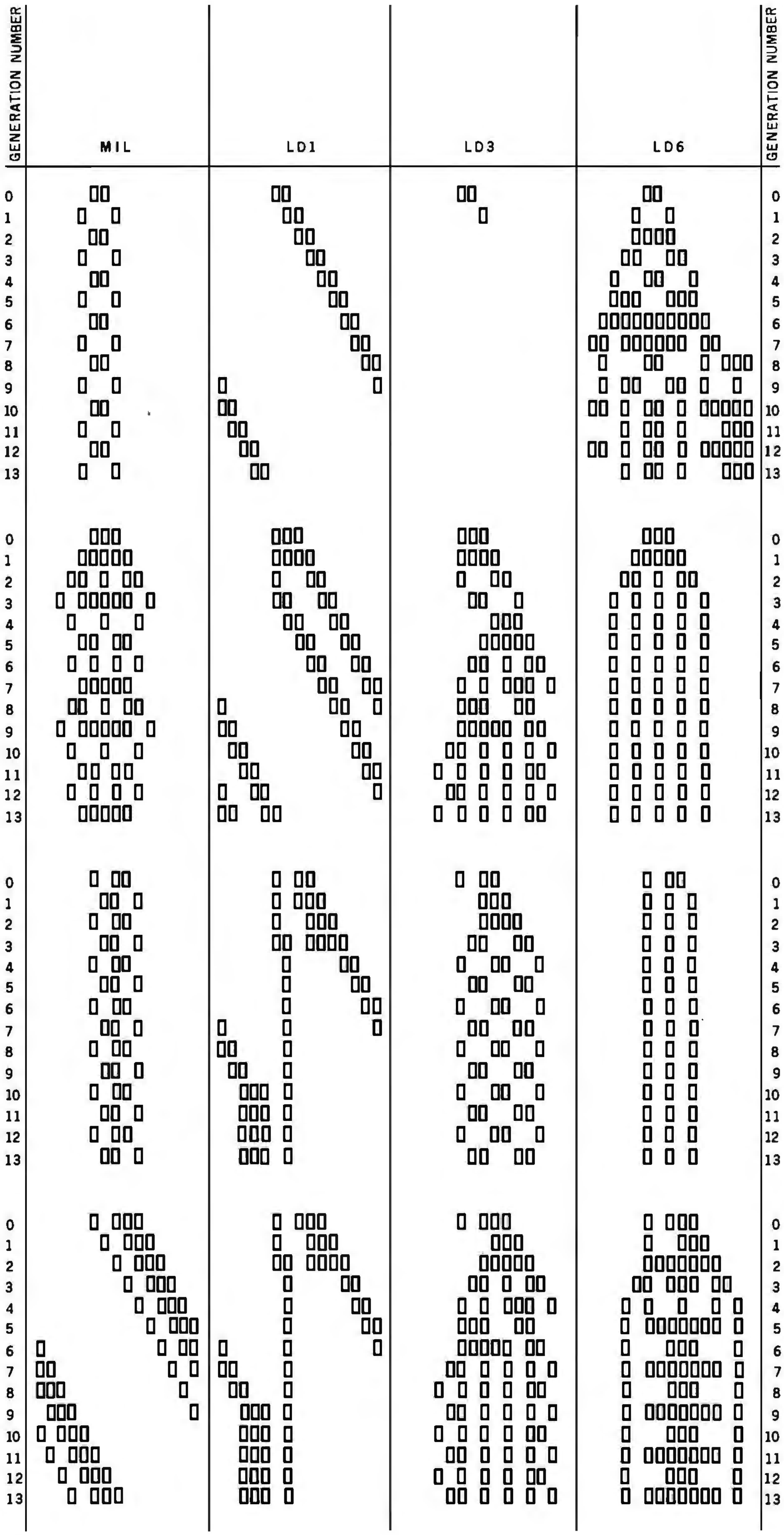

Figure 3: *Comparison of the four APL Life systems using four simple starting patterns. The Life-lines are 15 cells wide and were run for 14 generations.*

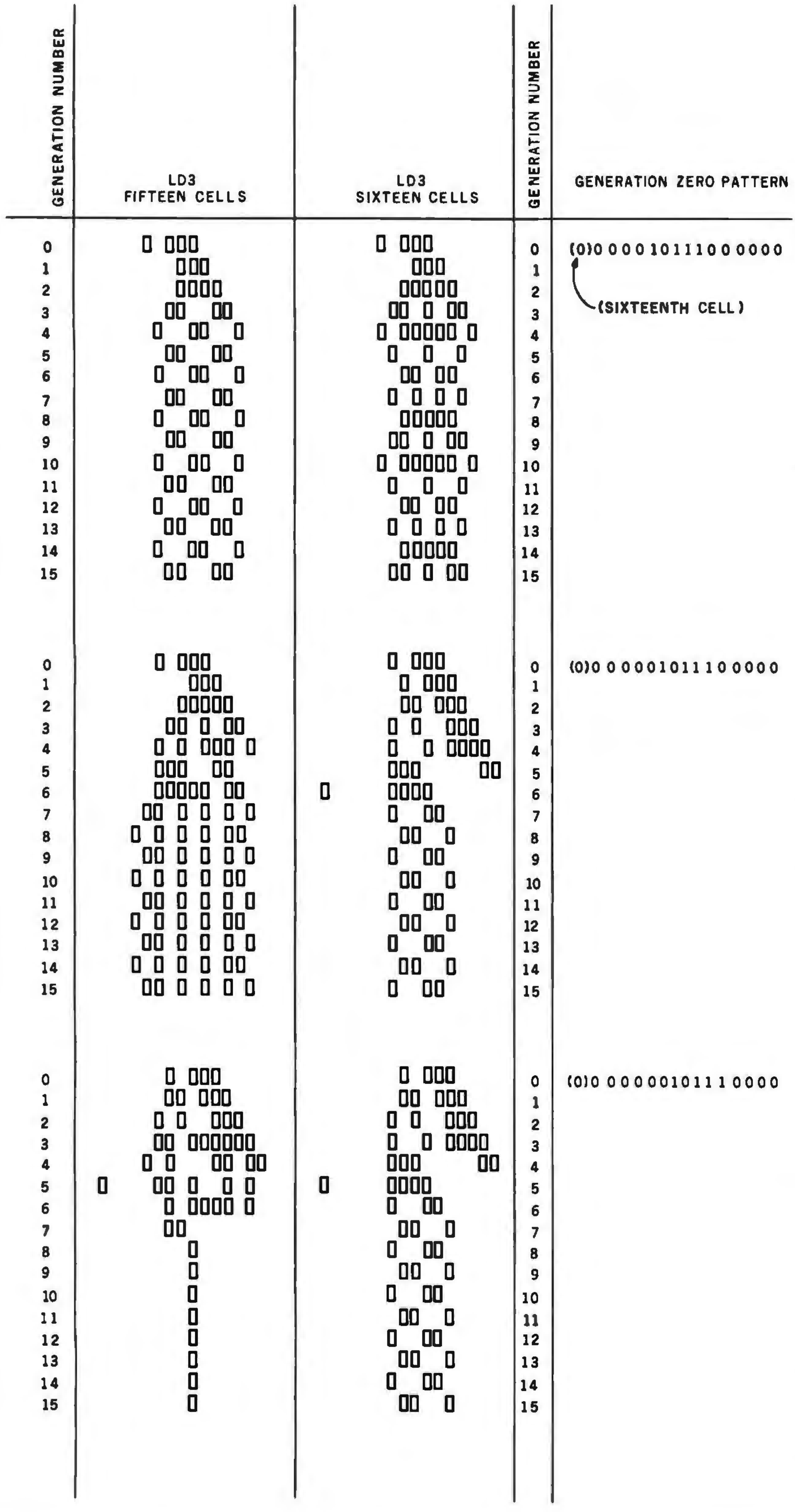

Figure 4: *The results for Life system LD3 are sensitive to the relative position of the starting pattern, in this case 10111, and the parity (odd or even) of the number of cells in the Life-line. This is a consequence of the reversal operation used in forming the H-line (see text); it's another simple way to generate display patterns.*

the routines are implemented in machine language, they will change much faster. Generally, this makes patterns more interesting. It would also allow lines to be traversed up and down at good speeds so that changing borders or rectangles might be designed. The key to pattern generation thru Life forms is that patterns are evolved not by programming their development but by changing the input data. This is easier than programming specific displays, and it may at times produce some spectacular surprises. The monotony or limited variation that is characteristic of programmed displays is easily avoided with the Life approach.

Many people say that the game of Life is addictive. One purpose of this article is to show how you can study Life without spending entire days in front of your computer. For example, I conducted trials of various triple-line Life systems while I went about other business by writing short supervisory programs (3 short APL lines) that could grind out sequences of pattern variations. I occasionally find it relaxing to experiment with Conway's Life. But I try to avoid the tube-trance syndrome by keeping a notebook on starting patterns and then placing a cardboard screen in front of the tube. On suitable occasions, I let myself peek. If a bare piece of cardboard is too stark for you, label it something like "Conway Cage" or "Anti-Medusa screen."

One final observation on the game of Life. We all have had the experience of demonstrating our home computer to non-computer-type guests who just stand by and yawn. I have found one sure-fire way to hold their interest: say nothing about Life, simply draw their initials or even their names on the screen. Then hit the start key. The reaction is always the same, a cry or a gasp as they see the familiar lines suddenly disintegrate or explode into strange patterns. Now as you explain what your computer does, they won't be bored. You'll have their attention —they've just seen your machine do something magical. ■

DOSPlus: Double-Density Operating System for the TRS-80

Yvon Kolya
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Peterborough NH 03458

Percom's Doubler, an add-on circuit board that allows your TRS-80 to store and retrieve data from the Radio Shack disk drives in double-density mode, has been on the market for almost a year now (see the review "Percom's Doubler" on page 344 in this issue of BYTE). The board comes with Percom's Double-DOS (disk operating system), an adaption of Radio Shack's TRS-DOS that lets you use the doubler board without buying a DOS from another source.

At a Glance

Name
DOSPlus Double Density

Type of package
Disk operating system

Publisher
Micro Systems Software, Inc
5846 Funston St
Hollywood FL 33023
(305) 983-3390

Price
$99.95

Medium
5-inch disk, TRS-DOS compatible

Documentation
45 pages, 8½ by 11 inches

Computer
TRS-80 Model I Level II with Expansion Interface, 5-inch disk drives, and Percom Double Density Board

Required Hardware
Percom Double Density Board (not supplied)

Audience
Programmers and owners of TRS-80 Model I Disk Systems with Percom's Double Density Board

Double-DOS is simply Radio Shack's TRS-DOS with the BACKUP, FORMAT, and COPY commands altered to operate in double-density mode. The COPY command has been changed to let you use special syntax to specify when you are going to transfer files to and from single-density DOS disks. Thus, as soon as you have installed the board and turned on the system, you can immediately enter double-density mode.

The disadvantage of the DOS supplied by Percom is that you can only use double-density formatted disks; single-density disks cannot be mixed with double-density disks. You can transfer files to and from single-density disks, but you cannot read data files, read the directory, or use the disks in any other way while running Percom's double-density DOS.

There is, however, another double-density DOS on the market that can do this and more: DOSPlus is a complete rewrite of TRS-DOS. Available from Micro Systems Software of Hollywood, Florida, it is a double-density DOS that not only outperforms Percom's double-density DOS, but also outperforms most of the single-density DOSs. DOSPlus has all the features of TRS-DOS (and Percom's Double-DOS), so I won't detail the duplicate functions. Instead, I will focus on the additions to TRS-DOS by DOSPlus, beginning with the LIB (library) functions.

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DOSPlus Commands

The LIB command clearly shows the additions that have been made by DOSPlus (see table 1 for a comparison list of the library functions supplied by TRS-DOS and DOSPlus). There are also alterations in some of the commands that are common to both operating systems. I'll start with those and then deal with the new commands.

The first command usually given when a new disk is loaded is DIR (directory). With DOSPlus, instead of just getting the names of the entries in the disk's directory track, you get each file's protection attributes; logical record length, which is 256 for programs, 1 for ASCII (American Standard Code for Information Interchange) files, and anything in between for data files; the number of logical records used by the files; the number of sectors occupied by the files; the number of granules used by the files; the number of segments each file is broken into; and the position in the last sector of the end-of-file byte (see listing 1). At the bottom of the directory display is a final line that indicates the number of free (unoccupied) granules left on the disk, and what that equals in actual bytes.

Also, some changes have been made in the parameters allowed by DOSPlus. In TRS-DOS you can specify:

```
DIR :1 (S,I,A)
```

where S means display system files in addition to normal files, I means display invisible files in addition to normal files, and A means display the information on all the files.

In DOSPlus you can specify:

```
DIR :1 (S,I,D,P)
```

where S means display system files in addition to normal files; I means display invisible files in addition to normal files; D means display all those files in the directory that are currently considered *dead* files, in addition to the normal files (dead files are files that have been KILLed; they can be recovered if you haven't written a new file over the dead file); and P means send the directory display to the line printer. Typing in DIR alone under DOSPlus displays all visible files, statistics, and free disk space in granules and bytes.

The next major difference is in the FREE command. Rather than give the number of available free granules in the disk drives, DOSPlus gives an actual map of the disk drive specified, clearly labeling those granules used by the directory (a D is displayed), and by programs or data files (an X is displayed). Unused granules have only a period displayed (see listing 2).

Another improvement is in the COPY command. It is not necessary to repeat the name of a file to copy it. For example:

```
COPY MYFILE/CMD:0 :1
```

does the same thing as the TRS-DOS command:

```
COPY MYFILE/CMD:0 TO
MYFILE/CMD:1
```

TRS-DOS	DOSPlus
APPEND	APPEND
ATTRIB	ATTRIB
AUTO	AUTO
	BREAK
	BUILD
	CLEAR
CLOCK	CLOCK
	CONFIG
COPY	COPY
	CREATE
DATE	DATE
DEBUG	DEBUG
DEVICE	DEVICE
DIR	DIR
	DO
DUMP	DUMP
	FORCE
	FORMS
FREE	FREE
KILL	KILL
LIB	LIB
LIST	LIST
LOAD	LOAD
PRINT	(handled by LIST)
	PAUSE
PROT	PROT
RENAME	RENAME
	RS232
TIME	TIME
VERIFY	VERIFY

Table 1: *Comparison of functions provided by Radio Shack's TRS-DOS versus those provided by DOSPlus.*

Listing 1: *An example of the DOSPlus directory function.*

```
DIRECTORY DRIVE: 0      DOS 3.1S - 01/22/81 - 3.2
FILENAME        ATTRB   LRL   #LOG   #PHY   #GRN   #SEG   EOF
TBASIC   CMD    N*U6    256    16     16     4      1     120
DISKZAP  CMD    N*U6    256    11     11     3      1     166
COM64768 OBJ    N*XO    256     3      3     1      1       0
LISTER   CMD    N*XO    256    21     21     5      1       0
TRANSFER CMD    N*U6    256     4      4     1      1       4
CRUNCH   CMD    N*U6    256     3      3     1      1      65
CLRFILE  CMD    N*U6    256     2      2     1      1     153
DISKDUMP CMD    N*U6    256     4      4     1      1      84
SPOOL    CMD    N*U6    256     5      5     1      1      95
COPY1    CMD    N*U6    256     4      4     1      1     144
PURGE    CMD    N*U6    256     3      3     1      1      70
COMPARE         N*XO    256    12     12     3      2      36
RESTORE  CMD    N*U6    256     4      4     1      1      50
BASIC    CMD    N*XO    256    21     21     5      2      47
***      18 GRANS,      22 K ***
```

Listing 2: *An example of the DOSPlus FREE function.*

```
                  Free space map - Drive 0
00-06:   X X ! X X ! X . ! . . ! X X ! X X ! . .
07-13:   . . ! X X ! X X ! X X ! X . ! . . ! . .
14-20:   X X ! X X ! X X ! D D ! X X ! X X ! X X
21-27:   X X ! X X ! X X ! X X ! X X ! X X ! X X
28-34:   X X ! X X ! X X ! X X ! . . ! . . ! . .
```

There are other improvements but they are minor.

New Library Commands

BREAK lets you disable the break key to prevent people from using it to get into your programs.

BUILD lets you build a file of DOS commands that can be executed one right after the other. You can build a file that can go from a "boot-up" all the way to running a BASIC program (and setting the memory size to protect a machine-language program and any necessary disk buffers), without the operator having to do anything except press the Reset button.

CLEAR is a simple command that sets all memory locations above hexadecimal 7000 to 0.

CONFIG lets you tell DOSPlus of any special system or drive configurations. You can modify the number of tracks on a disk from 35 to 80, set the track-to-track stepping rate of the read/write head of the drive, use the high-speed or reverse-video modifications (if you have them), or specify if your drives are double sided. You can use this command, for example, to tell DOSPlus that you have an 80-track drive as drive 0, a 35-track drive as drive 1, and a double-sided 40-track drive as drives 2 and 3, as well as take advantage of the high-speed clock modification you've put into your computer. It will now "know" this each time you turn it on, giving you maximum effectiveness and efficiency.

CREATE lets you allocate space to a file before you actually put any information in it, thus eliminating the time required for updating the directory when you use the file. As well, this helps to prevent the file from being "chopped up" into many segments all over the disk. (Keeping the file together reduces drive-head seek time.)

DO tells DOSPlus to execute a file constructed by the BUILD command. It can be used in the AUTO command structure.

FORCE lets you route the I/O (input/output) between the different devices. You can force the computer to send all LPRINTs to the video instead of to the printer, for example. Or you can send the keyboard echo to the printer instead of to the video (handy when trying to do program documentation).

FORMS is, by far, one of the most

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6502 DISASSEMBLER (Stamm) Produce assembly language source files with labeled subroutines and references from programs already in memory. It is compatible with Hayden's ASSEMBLY LANGUAGE DEVELOPMENT SYSTEM. ***08609, APPLE II Disk, $39.95***

DISK CATALOGER (LeBar) Automatically maintains a cross-reference listing of all your programs, their location by disk number, their function and use. Catalogs, lists and sorts programs. ***05203, TRS-80 Level II tape, $16.95; 05208, TRS-80 Level II Disk, $21.95***

FINPLAN: A Financial Planning Program for Small Businesses (Montgomery) Allows you to enter data from a balance sheet into the program, to make assumptions about the future growth of business, and to have the computer project results for up to a five year period based on those assumptions. And if you change any data, the program revises all resulting data automatically. The disk version can be used only with TRSDOS version 2.3. ***05103, TRS-80 Level II tape, $69.95; 05108, TRS-80 Level II Disk Version, $74.95***

MAILING LIST (Tru-Data Software) Lists addresses, prints labels, allows for alterations and deletions, and has the capacity to make duplicate data file disks. Can only be used with version 1.5. ***05713, Heath Disk $49.95***

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Super FORTH (Bugbee) This is a fast, high-level, expandable language that features integer and floating-point math, high-resolution graphics and string handling capability. ***05509, APPLE II Disk, $49.95***

NEW!

OP-AMP DESIGN (Gabrielson) Provides the necessary values for your design and will suggest appropriate op-amp types. Includes a choice of six op-amps, and the program will then determine if your selection of an op-amp will be acceptable within your chosen parameters. Can be updated to accommodate future op-amps. ***09704, Apple II tape, $16.95***

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requested features of a DOS. You can set the number of lines on each page (for printing on special forms such as invoices); the number of characters on each line (nice if you have a 132-column printer and only 80-column paper). You can direct all normal printer output to the RS232 serial port instead of to the printer port. (All the software that is needed to drive the serial I/O is built into DOSPlus.) DOSPlus even generates an automatic linefeed upon carriage return, for printers that don't have this feature.

PAUSE halts program execution (usually a file being executed by the DO command) so the user can perform a needed operation such as inserting a data disk. It can be executed from BASIC by using the CMD " " command.

RS232 automatically prints out the switch settings of the RS232 board.

DOSPlus Utilities

The BACKUP utility works essentially the same as the BACKUP supplied with TRS-DOS except it is possible to BACKUP a 35-track disk to a 40-, 77-, or 80-track (or any number in between) disk, without losing the additional tracks. This means that although you have purchased a 35-track DOS, you can convert it to a 40-track DOS simply by using FORMAT to make a 40-track disk, and then using BACKUP to move all of the system files, utility files, and any other files on your 35-track disk, to the 40-track disk. You can also reverse the procedure and BACKUP a 40-track disk to a 35-track disk. If you have used only 34 tracks of your 40-track disk, this will work without problems, but if you have used all 40 tracks of your 40-track disk, then you will lose those files on the last 5 tracks.

FORMAT is similar to the TRS-DOS; the difference is that DOSPlus asks you how many tracks you want to format onto the new disk. Any number from 35 to 80 is acceptable.

CLRFILE is an interesting utility that lets you set the contents of a disk file to all 0s, achieving the results of KILLing a file without altering the file's directory entry. The end result is as if you used the CREATE command to preallocate space to a file.

COPY1 allows single-drive owners to copy a file from one disk to another without keeping a system disk in drive 0.

CRUNCH is a compression utility that removes unnecessary blanks and REM statements from a BASIC program. CRUNCH will ignore lines containing DATA statements to preserve the integrity of any string DATA. Unlike all the other compression utilities, this one is executed from DOS and reads the BASIC program file and writes it back to the disk under a new name. Thus, you have two files on the disk instead of one—your source file and your new file.

DISKDUMP is a machine-language program for displaying and modifying files on the disk.

DISKZAP is a powerful disk editor. It is similar in many ways to Apparat's Superzap. It lets you put all 0s in disk sectors, copy sectors, print them, verify them, format a disk, and display and modify sectors.

PURGE takes the drudgery out of removing files from your disk. When you type and enter PURGE, DOSPlus will list each file in the directory, one at a time, followed by a question mark. If you type Y, then that file will be deleted from the directory. If you just press ENTER, then nothing is done to that file and the next one is listed.

RESTORE is an emergency use utility. It recovers files that you've accidentally KILLed. It cannot recover files that have been overwritten by SAVEs or DUMPs that you've done since you KILLed the target file.

SPOOL is good for handling large amounts of printer output when you don't want to tie up the computer. This program sets up a buffer in memory (you set the size when you call up this utility) in which output to the printer is stored as it is generated. This buffer is dumped to the printer as fast as the printer can accept it, but if the program is generating data faster than this, the buffer holds the data until it can be printed. This allows more efficient use of the computer's time, since it no longer has to stop and wait for the printer to catch up with it. In addition, if the buffer is likely to be overfilled itself, you can specify a disk file that will be used to store data.

TRANSFER moves all the user files on one drive to another in one command, instead of typing in COPY for each file.

DOSPlus BASIC

DOSPlus is sold with two different BASICs on the disk. Both are written in Z80 Assembly Language code, unlike Microsoft BASIC that is written in 8080 code. It has many advantages over the BASIC sold by Radio Shack (and Percom). You can:

- Load BASIC with no protected memory and no disk-file buffers: <BASIC>
- Go from BASIC to DOS, and then reenter BASIC without losing your program: <BASIC*>
- Load BASIC and automatically RUN a program: <BASIC filespec>
- Load BASIC and reserve disk-file buffers: <BASIC −F:2>
- Load BASIC and protect memory: <BASIC −M:64000>
- Do 3, 4, and 5 together: <BASIC filespec −F:3 −M:60000>

Any DOS command can be executed from BASIC by typing CMD"DOS command". (This works internally or externally to a program.) You can move a line from one place in a program to another without having to type it in again: DI xxxx,yyyy moves line xxxx to a new line numbered yyyy. You can duplicate a line: DU xxxx,yyyy puts a duplicate of line xxxx at a new line numbered yyyy. The RENUMBER command allows renumbering of all or part of any BASIC program.

You can add data directly to the end of a sequential file without having to read the entire file into memory first: OPEN"E",1,"filespec." Sector deblocking of file records is supported in random-access files: OPEN"R",1,"filespec",xx where xx is any number between 1 and 256. Therefore, you can deal with any logical record length desired, regardless of the length of a physical disk sector.

The TAB function has been fixed so that you can LPRINTTAB(101) and have the line printer correctly tab to the 101st column of your paper. TRACE has been modified to control execution of a program by pressing <ENTER> each time you want the next program line to be executed. A variable and line number cross-reference utility has been added to BASIC. And a new command, CMD"M", is now available. CMD"M" will automatically give you a list of all of your program's variables *and their current values*. CMD"M" is a valid program-line command. It is easily the most powerful debugging tool a programmer could have.

Three main differences exist between DOSPlus BASIC and memory-saving DOSPlus TBASIC (Tiny BASIC): BASIC gives you 35,978 available memory locations; TBASIC gives you 40,205. TBASIC does not have expanded error messages (TBASIC says SN ERROR instead of SYNTAX ERROR). And TBASIC does not allow DOS commands from BASIC.

Overall, DOSPlus is a well written and executed DOS. It includes many features not found on other DOSs. It certainly outperforms Percom's Double-DOS. And even though you have to buy it as a separate unit from the Doubler board, it is worth the money, considering its power.■

Update

Since this review was written, Micro Systems Software has released version 3.3 of DOSPlus which contains several new features as well as some changes to original functions. Version 3.3 is available in three formats: single-density Radio Shack TRS-80 Model I, double-density TRS-80 Model I with the Percom Doubler, and double-density TRS-80 Model III. Except for some minor aspects of the system conversion (ie: single-density to double-density conversion) utilities and storage capacity, these three versions of DOSPlus are identical from the user's point of view. In fact, DOSPlus-equipped Model IIIs and Model Is can read each other's double-density disks.

Several changes were made to the basic system configuration. The version 3.3 CONFIG utility no longer assigns a separate drive number to each side of a double-sided disk drive; it defines them as one drive with two sides, A and B. Thus, the user may have either four single-sided drives or three double-sided drives on a system (only three double-sided drives are supported because the select signal for the fourth drive is used as a side-select signal). Unlike version 3.1 DOSPlus, all disk drives on a given system are assigned the same number of tracks.

CONFIG also can access a mode where TRS-80 graphics characters may be directly transmitted to compatible printers such as the Epson MX-80 and the Okidata Microline-80.

Version 3.3 DOSPlus has an improved RS232 command that lets you alter as well as display the serial interface control parameters. You can specify the communications rate in bits per second, alter the format of a data word (number of stop bits, word length, and parity), and control the handshaking protocol for interfacing with virtually any RS232C-compatible device.

The CLEAR command has been modified so that it clears memory starting at location 5700 hexadecimal.

The MAP command shows the disk space allocated to each file on a disk, by track and sector.

In BASIC, a CMD"REF", <parameter> command will immediately print a cross-reference by line number of all variables, keywords, or targets of GOTOs and GOSUBs (with optional hard copy) of any BASIC program in memory. A "LOAD filename,V" or "RUN filename,V" command placed in a BASIC program will execute or load the next BASIC program specified without destroying the contents of the variables used by the previous program. You can now easily pass data and arrays from one BASIC program to the next without having to write to the disk. ...**KC**

Percom's Doubler

Mahlon G Kelly, 268 Turkey Ridge Rd
Charlottesville VA 22901

Did you ever wish that you had an 8-inch floppy-disk-drive system, 80-track drives, or even a hard disk for your (Radio Shack) TRS-80 Model I?

Granted, disks were a great improvement over cassette tape for storage of programs and data, but many of us quickly found that even disk storage was limiting. Consequently, we bought additional drives but *still* wanted more storage than was available on each drive. Few of us could afford to trade in our old drives on the new, larger units, and many experimenters read about double-density drives and sighed wishfully, "Why didn't Radio Shack make the Model I a double-density system?"

At a Glance

Name
Doubler

Function
Hardware add-on and associated software to implement double-density disk operation on a TRS-80 Model I

Manufacturer
Percom Data Co
211 North Kirby
Garland TX 75042
(214) 272-3421

Price
$219.95

Features
Allows operation with 35-, 40-, 77-, and 80-track 5¼-inch floppy-disk drives in single density (ten sectors per track) or double density (eighteen sectors per track), giving the user 180 K bytes of disk storage on a regular 40-track drive

Documentation
Detailed installation and software-patching instructions

Options
Patches for at least four different operating systems

Audience
TRS-80 owners seeking to increase the storage capacity of their regular 5¼-inch disks

A single-density drive expects that much of the data stored on the disk is in the form of null characters. With the older recording heads and disks this practice was necessary. Removal of the null characters can improve storage capacity by 80% (and effect an equivalent change in the data transfer rate). This is called double density, and, in theory, by changing the LSI (large-scale integration) disk-controller device and the DOS (disk operating system) software, it should work with the TRS-80.

More than two years ago, one of the main suppliers of floppy-disk drives, Vista, advertised (and even pictured) a unit that would allow double density with the TRS-80. I was among the first to place an order, and about six phone calls and a year later I learned that they had abandoned the project because of insurmountable software problems. They actually told me that it couldn't be done.

Ten months ago, Percom, another disk-drive supplier, advertised a similar system, called the Doubler. With a certain amount of skepticism I ordered one. After a month (with delivery promised in a week) and two lost purchase orders, the double-density system arrived. Is it reliable? Does it perform as promised? Is it compatible with other software? Is it easy to install? These and other questions occurred to me, and now that I've answered them, I'm convinced. Percom's conversion nearly doubles the capacity of most disk drives, and it's very easy to use.

Hardware and Operation

How does the Percom system work? The answer is simple: by putting 18, rather than 10 sectors on a disk track. With a 40-track drive and normal density, you have 400 sectors of storage. With Percom's Doubler system you have 40 times 18, or 720 sectors of data. During routine operation you only notice this change by the increased storage and speed. (The speed is greater by a factor of 1.8 because more data is read on each rotation of the disk.) If you have 35-, 40-, or 77-track drives, the track number

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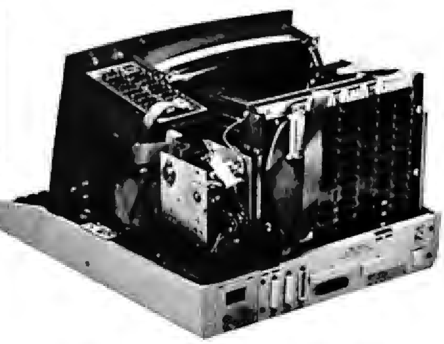

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doesn't change—there is simply more data stored on each track. The change is made by the simple installation of a small printed-circuit board in the Expansion Interface, and use of one of the double-density operating systems provided by Percom (it provides five different operating systems, the standard being DBLDOS). I will describe these systems later in the article. (See also "DOSPlus: A Double-Density Operating System" on page 334 of this issue.)

Percom supplies almost no information on the hardware modification, although it gives very detailed (almost intimidating) directions for the simple installation. Installation consists of removing the large, conspicuous disk-controller integrated circuit from the interface, plugging it into the little board, and then plugging the board into the original disk-controller socket. There's no trace cutting or soldering. Percom's printed-circuit board has ten small integrated circuits, a few capacitors and resistors, a second disk controller, and a socket for the controller from your interface. I was amused that Percom has removed all of the numbers from the devices, yet an advertisement in a major magazine shows a picture of the board on which all of the numbers can be read. The new controller circuit is used for double-density operation, while the old one allows normal operation. The double-density operating system actually boots in single density, then actuates a software switch that changes between the controllers (the first track on the double-density disks is really single density).

An important point of the modification is that if you used your old single-density operating system, you would never know that the hardware modification had been made, except that operation would be more reliable. (For some time, Percom has sold a nice modification called the Data Separator that corrects a reputed design fault in the TRS-80. This board, installed in the same way as the Doubler, prevents read/write and format errors on the highly packed center tracks. The Doubler does the same thing.)

Software

Percom provides five different operating systems: OS-80D, a modification of its own BASIC-oriented operating system OS-80; DBLDOS, the system provided with the Doubler (which is a modification of TRSDOS 2.1 but with errors and key bounce corrected); and NEWDOS/80 or VTOS 4.0, for which it sells patch programs (called DoubleZaps) that convert the systems for double density. It also sells a "super" version of the NEWDOS/80 patch (DoubleZap 2) that sets individual drives to either single or double density. Thus, just as NEWDOS/80 lets you set up a mixture of 35-, 40-, and 77-track drives, this lets you mix single- and double-density units.

I haven't used the OS-80 or OS-80D, and I've only briefly used VTOS without Percom's modification, so I'll say nothing about those systems. Percom tells me that the operating systems are continuously upgraded and that revisions will be sent to users who have returned their warranty card. I did not, however, find much need for revision.

The logical place to begin discussing the software is with DBLDOS. DBLDOS is so similar to TRSDOS that the TRSDOS manual is used for DBLDOS (and you'll need it if you're buying drives for the first time). Percom's documentation of the differences is very complete, with more examples than most of us want to read. There are changes in the BACKUP, FORMAT, and COPY functions, in the invocation of BASIC, and in different track numbers and track seek times. (The useless DEVICE function is also eliminated.) The function changes are needed for double density; the others are logical, simple enhancements of TRSDOS.

To back up (save a copy) or format (initialize) a disk, DOUBLE must be entered first. DOUBLE FORMAT :1 (enter) starts the double-density formatting procedure. You are then asked for the disk name, the date, and the number of tracks on the disk. Nonstandard track numbers are supported, and the default value on the number of tracks is 40.

The command DOUBLE BACKUP :0 TO :1 does what you would expect: it produces a double-density backup of the disk in drive 0 by copying to drive 1, and with the same number of tracks. DOUBLE BACKUP :0 TO :1 T77, however, would format the disk in drive 1 at 77 tracks, and then back up the information from 0, regardless of the number of tracks on that drive. Thus, the 35-track disk that DBLDOS is supplied on can be

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backed up with whatever track format is best for your system. Note that you can't back up a single-density disk to double density or vice versa: the drive that's incompatible with the operating system will simply spin until it realizes that something is wrong, then give you an error message. When making a backup from single to double density (or vice versa), files must be copied individually.

When converting from single to double density, the copy function is the most essential part of DBLDOS. It has been enhanced to operate on a single-drive system in a way that is similar to the old BACKUP function, and except for requiring a lot of disk "swapping" by hand, it works well. In the interest of simplicity, however, I'll describe the use of COPY with a multiple-drive system.

Entering a $ before the file name indicates that the file is on a single-density disk. Thus, COPY $GARBAGE:1 TO $GARBAGE:2 copies the file between two single-density disks. COPY $GARBAGE:1 TO GARBAGE:2 copies a file from the single-density disk on drive 1 to the double-density disk on drive 2; this is how you convert your old single-density files to double density. COPY GARBAGE:1 TO $GARBAGE:2 converts a double-density file in drive 1 to a single-density file in drive 2. Of course the disks must be formatted in single or double density, as appropriate.

If you're going to copy from double to single density on a virgin disk, you must format the disk using an old single-density operating system. If no $'s are specified, then the system assumes you're making a double to double copy. If you're operating completely in double-density mode, the COPY function is the same as for single density.

The BASIC-invocation procedure has been changed to conform with the NEWDOS format; no questions are asked after BASIC is loaded. You can specify the memory size and number of files when you call up BASIC. Thus, BASIC 64000 5 RUN"GARBAGE/BAS" will load BASIC, specify a memory size of 64000 bytes, ask for five files, and run a program named GARBAGE/BAS. The defaults are the same as before, and this usually saves hitting ENTER twice. More importantly, I suspect it saves memory so that the DBLDOS system will fit in the same space as TRSDOS. But whatever the reason, it is an improvement.

The final enhancement in DBLDOS is really only an implementation of modifications that have been available in the TRS-80 for some time. This feature allows you to speed up the disk drives. The system disk includes a program called PATCH/BAS that can be merged with the other programs provided, to give a variety of track-seek speeds. When the program is run, it modifies the operating system to perform at the faster speeds. If your drives allow a seek time of less than 40 ms (and most do) the patch is very worthwhile.

Are there any software incompatibilities with the DBLDOS operating system? The answer is, any machine-language program that does its own reads and writes from disk must be considered suspect. Z80ZAP/CMD,

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DIRCHECK/CMD, and the machine-language version of SuperZap will not work (although the BASIC version will), and RSM2D will not work with disk commands. Patches (using PATCH/BAS) for Electric Pencil, SUPERSCRIPT, the MISOSYS DISK*MOD EDTASM, and the Microsoft editor are provided. Microsoft compiled BASIC works, except for a minor and apparently unimportant change in the use of the Break key. Microsoft FORTRAN-80 is compatible. I'm sure that there are other programs that don't work, but they must be few in number since they would have to have their own disk I/O (input/output) routines, and not many do. All of my own utilities (and I have many) work well.

Problems

Are there any disadvantages to DBLDOS and the Doubler? Yes. The disadvantages become apparent if you have to convert many disks to double density, if you want to use double- and single-density disks on different drives at the same time, or if you want to use cheap disks and cheap drives. Every file must be individually copied from single to double density, and if you have several hundred files it is a very tedious task. Percom should have provided a single-to-double-density backup facility to remedy the problem.

Similarly annoying is the fact that neither the FREE nor DIR command will work on a single-density disk with DBLDOS installed. Thus, when you copy files from single to double you must have another list of file names that were produced using a single-density operating system. Suppose you have a three-drive system and a single-density disk installed in drive 2. If you type FREE, the system will "hang up" while drive 2 makes ten passes, then gives you a meaningless error message. Suppose that, while in DOS, you type GRIBBLE by mistake: the machine will search drives 0 and 1 and then hang up on drive 2 while it is trying to find this absurd, nonexistent file. The delays are irritating, and Percom's advertising doesn't alert you to the problem. Worse, the way I read the advertising suggested that single-density disks could be directly accessed from DBLDOS, and a conversation with a sales engineer left me with the same misconception. If you rely on DBLDOS you should have only double-density disks in the drives unless you are converting from one density to the other.

Percom's answer to this problem was that there is not enough memory to allow mixed-disk (double and single density) operation, although such a system could have been programmed. I can't believe that the system couldn't have been designed so that it would at least recognize a single-density disk and immediately respond with an error message. Also, DIR and FREE utilities (perhaps $DIR and $FREE) that work with single-density disks would have made things much easier. Both programs should have loaded into the same space.

Percom's documentation warns against using disks that are not rated for 40-track and double-density use. If you try to format a bad disk several errors will occur, and if more than five errors occur the system will refuse to format the disk. I use the cheapest disks available, and some are more than two years old. I found only two out of ten disks that could not take double density, and they only failed on the oldest and most battered of my three drives. I called Percom, and an engineer said they were having a problem discovering which disks worked best with which disk drives (including their own). When I told him I was using MPI (Micro-Peripherals Inc) drives, his response was, "Oh, that explains it—they've been checking their drives for double density for more than a year...."

Not all drives are created equal.

Many of the drives that are rated for double density perform well only with disks that are certified for double-density use. I was lucky. If you're not sure whether or not your drives will work with the commonly available disk media, be prepared to pay for double-density-rated disks, or to replace your drives. (Percom warns that early Shugart Associates drives, as sold by Radio Shack, may not work with double density, although several of my friends use them successfully.)

More on Software

Can these problems be overcome if you use other operating systems? NEWDOS/80 works the same in double density as in single, except that the enhancements for file copying are the same as those used in DBLDOS. And the problems are there as well. All of the utilities that come with NEWDOS/80 also work, except for SuperZap, which is a real loss. The DoubleZap 2 for NEWDOS/80 overcomes all of my previous complaints. If you have a multiple-drive system, any of the drives will automatically operate as single or double density as soon as the command ADR (automatic density recognition) is given after power-up. The status of the drives can be found and changed with the command DSET. Thus DSET may respond with: 0=A/D, 1=A/S, 2=S, indicating that drive 0 is in automatic mode with double density assumed for the first try, 1 is automatic but in single, and 2 is set in single. DSET 2=D would change drive 2 to fixed double, while DSET 2=A/D would make it automatic. The only time I use DSET is to format a disk in single density or to find the setting of the drives.

There are some other changes in DoubleZap 2, and most relate to the allocation of disk space. The operating system now works with "logical track numbers," each composed of ten physical sectors. Since there are eighteen sectors on a track, the physical track and logical track numbers are different. This has few repercussions except when you are copying. A disk copy is done by logical tracks, so you see 70 tracks copied on a 40-track drive. SuperZap (the machine-language version now works) also looks at logical tracks unless the DFS (display files sector) option is used. This use of logical tracks means that when a disk is copied it must already be formatted, and the copy must be done with the NFMT (no format) option. Otherwise, the copy would try to use the old format routine (which is still there and can still be used for single-density formatting).

Copying from single to double density must be done using the CBF (copy by file) specification, since the track numbers are different. Double-density formatting is done with the DBLFMT command, which works in the same way as the old FORMAT. A final difference is that when a system disk is copied, the single-density track 0 must be written by a separate routine loaded by the command FIXBOOT. A complete copy sequence for a system disk would look like the following:

```
DBLFMT :1 NAME 12/12/80
COPY :0 TO :1 12/12/80 NFMT
FIXBOOT 1
```

All of the other features of NEWDOS/80 seem to work well, and with double, single, and mixed density. This includes DIRCHECK, FREE, DIR, and every command I tried. In my estimation, the DoubleZap 2 modification of NEWDOS/80 is almost essential for serious use of the modified system.

Are there any remaining problems? Very few. I had some trouble installing DoubleZap, but that was my own fault. Installation is complex, but it is very well described. It does require that all zaps (software patches) through 31 be applied to the old system, and I made a mistake in zap 31 that took me some time to locate. (Presumably, the mistake would have found me sooner or later.) The double-density system is not compatible with some of the more recent NEWDOS/80 zaps, but Percom has provided modified zaps.

A real problem lies in the use of DBLFMT. I found that it would not work on virtually any of my disks; it told me there were verification errors on the upper tracks. Upon inquiry, Jim Stutsman of Software Etc, who wrote the system, sent me a zap that solved the problem. Apparently the verify uses a worst-case test, and a less stringent test (as used in DLBDOS) passes many more disks. He did warn me to use the modification at my own risk, since bad disks might be formatted.

What about service for any problems that might arise? Although I had problems when I bought the unit, I later found that a knowledgeable sales engineer was always available when I called. I have had no hardware problems, and the three sets of initials on the board that I received showed that it had been very well checked. Percom's literature describes one of the best service arrangements I have seen, and its reputation for service on disk drives is very good. All of my encounters with the manufacturer have been pleasant, and the response has always been helpful and refreshingly forthright.

Overall

Should you buy the Doubler system? If you want more disk space, and particularly more room on each disk, then this seems a practical choice. If you are satisfied with your present system, then it's a gimmick, and unless you like gimmicks you don't need it. If you have 77-track drives, the Doubler will give you more space than you would have with installation of 8-inch drives. If you have 40-track drives, for $200 you can have almost as much space as you would with a 77-track unit. If you have a single 35- or 40-track drive, it might be cheaper to sell your drive and buy a 77-track system.

The Doubler seems to be most useful to a multiple-drive user who must store large amounts of data or many programs; that is, the same person who might consider buying 8-inch drives. In this case, the "super" NEWDOS/80 operating system is almost essential. Most users who need additional drive space will have many files to copy, and the ability of DoubleZap 2 to allow copying of whole disks really improves speed. Of course, the ability to mix double- and single-density disks is also nice.

In summary, I like the Doubler; it's the greatest improvement to my system since I installed disks. It is well designed and reliable, the manufacturer is helpful, the software support is outstanding, and the flexibility of having five operating systems available is great. There's room for improvement in the procedure for converting from single to double density with the operating system provided, but I'm sure that will come. The TRS-80 has had a reputation for being a toy, but with the right enhancements it is a professional machine. The Doubler is one such enhancement. ■

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Videx Keyboard and Display Enhancer

Mark Pelczarski, 1206 Kings Cir, West Chicago IL 60185

If you plan to use your Apple II computer for word processing and are looking for a lowercase adapter, the Videx Keyboard and Display Enhancer may be your answer. Several adapters allowing an Apple to display lowercase letters on the screen are available. But a problem occurring with most Apple word-processing systems, or any software using uppercase and lowercase, is that the Apple keyboard does not recognize most shifted keys. It will, for instance, identify I and shift-I as the same character, even if you wanted one of them to be lowercase. The most popular adaptation has been to use the ESC (Escape) key as a pseudoshift. When ESC is pressed, a character is actually sent to the computer. Therefore, most text editors have required any character you want capitalized to be preceded by an Escape character. If you wanted the word HUMBUG in all capitals, you'd have to type ESC, H, ESC, U, ESC, M, ESC, B, ESC, U, ESC, G. This tedious process is necessary with most other lowercase adapters because they modify only the display, not the input from the keyboard.

The Videx Keyboard and Display Enhancer modifies both the display and the keyboard input. It uses a jumper to the keyboard ROM (read-only memory) to allow acceptance of standard shift-key operations, and it displays uppercase and lowercase letters on the screen. With this device, you can use an Apple as you would a typewriter. In addition, the Enhancer allows you to change RESET to work only when the CTRL (Control) key is pressed, a useful safety feature for people with early-production Apples. It also allows you to remap character sets by modifying the 2716 EPROM (erasable programmable ROM) included on the board.

At a Glance

Name
Videx Keyboard and Display Enhancer

Use
Provides the Apple II with a full ASCII keyboard and 96 ASCII display characters

Manufacturer
Videx Inc
897 NW Grant Ave
Corvallis OR 97330
(503) 758-0521

Price
$129

Dimensions
6¼- by 5½-inch card, fits on motherboard under the keyboard

Features
Uppercase/lowercase display, 96 ASCII display characters, all 128 ASCII codes available from keyboard, shift keys operate as a normal typewriter, Reset disable, user-definable character sets by changing EPROM

Hardware needed
Apple II or Apple II Plus, compatible with most other peripherals and word-processing software available

Manual
84 pages, 6 by 8½ inches

Software
Modifications to existing software, where necessary, are well documented in manual

Comments
Of interest to those seeking uppercase/lowercase display and standard keyboard operation, including shift key for uppercase; of particular use to anyone using an Apple for word processing

The Hardware

The Keyboard Enhancer comes on a 6¼- by 5½-inch card that fits onto the Apple motherboard beneath the keyboard. It replaces the character-generator chip, and two other chips are moved from the motherboard to the Enhancer board. Also, a jumper wire is attached to the keyboard circuit on the underside of the keyboard. Installation takes about an hour, since the Apple housing must be disassembled to reach the required circuits. The manual gives detailed and easy-to-follow instructions for installation, with many photographs. It can be accomplished easily by a novice.

The 2716 EPROM contains two character maps and a character set. The maps determine which character is displayed when a certain keystroke is received. The character set includes all 96 ASCII display characters. All 128 ASCII codes are accessible from the keyboard. Any character or mapping may be changed by reprogramming the EPROM.

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There are two versions of the Enhancer card: one for Revision 0 thru 6 Apples, and one for Revision 7 and later. The Revision 0 thru 6 card has a set of four DIP (dual-inline pin) switches. These switches control the mode of operation the Apple assumes when turned on. In the alpha-lock mode, the Apple operates as it would without the Keyboard Enhancer until you press SHIFT-RESET. This puts you in the alpha-unlock mode, giving you uppercase and lowercase. A Reset operation returns you to the default mode. The DIP switches may be set so the modes are reversed and alpha-unlock is the default. The switches may also be set so the RESET key itself does nothing; CTRL-RESET accomplishes the Reset operation. The fourth switch selects between the two alternate character maps.

The Revision 7 version contains an additional set of four switches. One setting of these switches selects whether a set of flashing characters will be numerals and special characters or lowercase letters. The other setting for these switches changes inverse characters to flashing characters, or vice versa.

Compatibility

The de facto standard for lowercase adapters has been the one produced by Dan Paymar. The Videx board works with any software compatible with the Paymar adapter. The manual also contains simple modifications allowing Apple Writer, a word-processing program from Apple Computer Inc, to work with the Enhancer. Also in the manual are patches allowing Pascal and either Applesoft floating-point BASIC or Integer BASIC to use the lowercase capabilities. The manual details modifications for any Apple configuration, describing each option available.

The Keyboard Enhancer works with any peripheral card compatible with the Paymar adapter, including the Videx Videoterm 80-column board, the Microsoft SoftCard (except that the SoftCard changes all display output to capitals, though some 80-column boards correct this), and the Hayes Microcomputer Products Micromodem II. A single-byte adjustment to the Micromodem software is also given in the manual.

Conclusions

When I opened the Enhancer package, I was quite skeptical. There were prominent disclaimers saying Videx would not be liable for damage done to any hardware as a direct or indirect result of installing its product. "The entire risk as to its quality and performance is with the buyer." That sounded ominous! After finally getting the nerve to risk the health and well-being of my Apple, I pulled it apart and installed the Enhancer. From step one of the installment, I was extremely impressed with the documentation. The simple instructions answered every question I had. Buyers are not left scrambling for back issues of magazines or newsletters to find fixes for software. The price is $129, twice that of other lowercase display adapters, but if you do much word processing, it's worthwhile. ■

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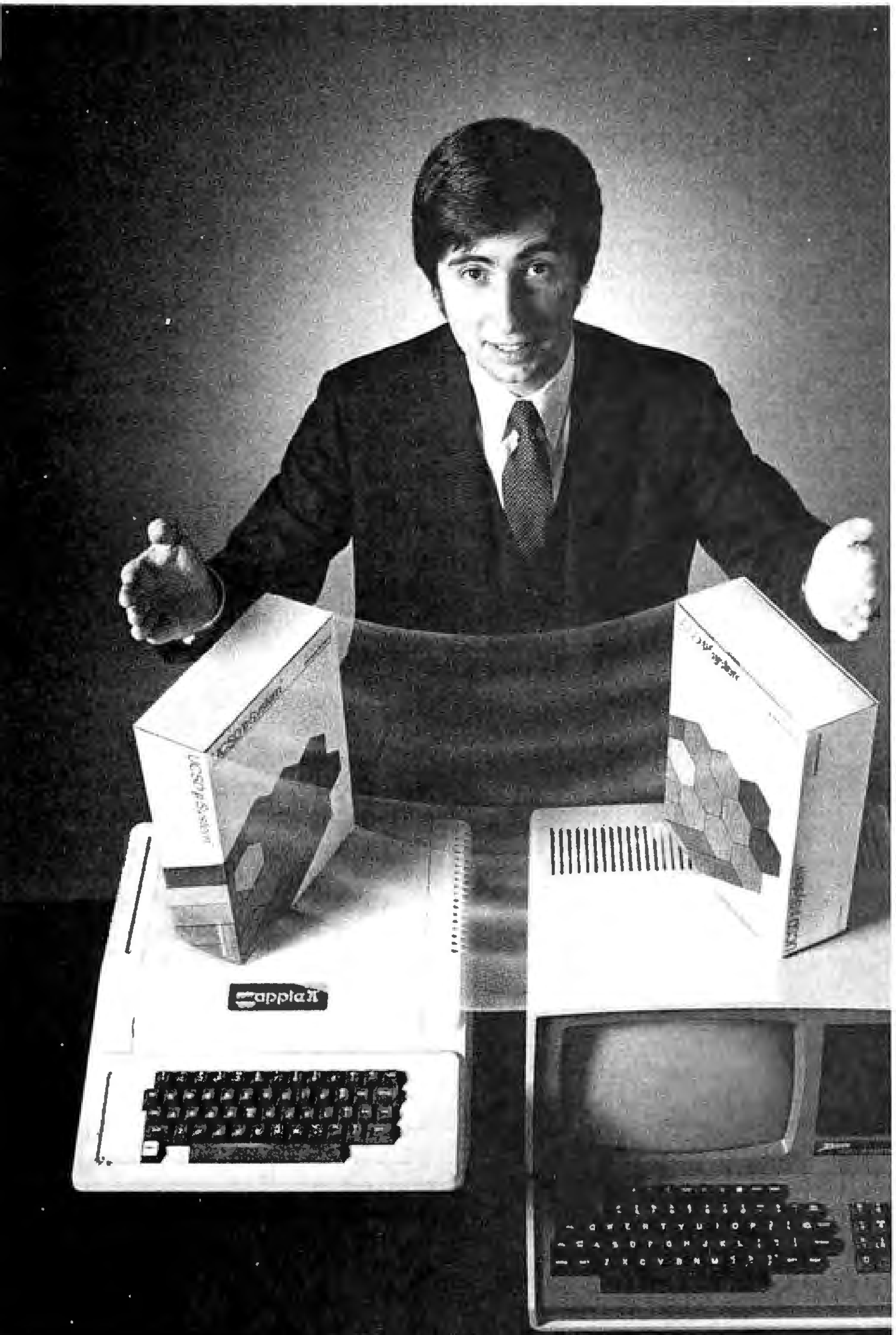

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Animation in Computer-Assisted Instruction

The Replication of DNA

Dr Richard R Eckert
Colegio de Ciencias
Universidad Catolica de Puerto Rico
Ponce PR 00731

CAI, or computer-assisted instruction, programs have achieved a high level of effectiveness as surrogate teachers. These programs present the student with written material on a video display and invite a response to written questions—a valuable approach, as the computer can be programmed to answer according to the individual response, and either reinforce correct answers or aid in the discovery of errors (see figure 1). Unfortunately, the effectiveness of this traditional use of CAI programs is limited by the student's interest in the material and his ability to read it. In many cases, a student does not learn effectively from the written word—whether it appears in a book or on a video screen.

An Example of a Lesson

This article will present a CAI lesson module that uses animated graphics and sound, in addition to the written word, to introduce material to a student. The module is not truly interactive, since my purpose is to demonstrate the use of animation and sound in computer-assisted instruction, but it would be a straightforward procedure to make it interactive. The program is written for the Radio Shack TRS-80 in Level II BASIC, but it can be adapted to other personal computers.

The subject of the module is the replication of a DNA (deoxyribonucleic acid) molecule, which, since it concerns the transmission of hereditary information, is one of the most important topics in any biology course.

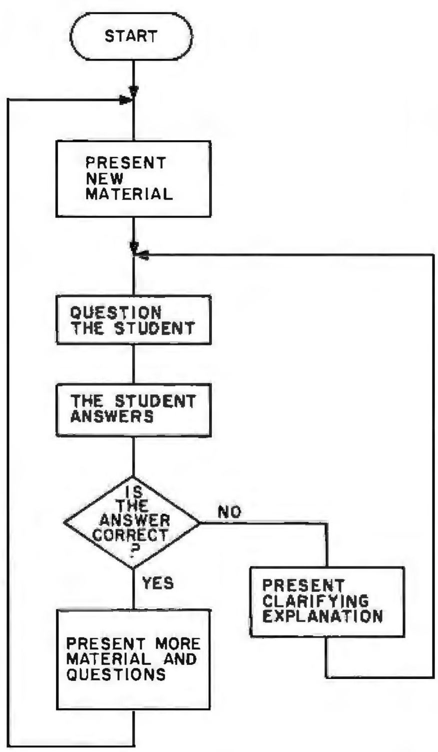

Figure 1: *The common CAI program follows this general flowchart. The instruction is repetitive, and since only simple text is displayed, no real advantage is gained through the use of a video display.*

The Audio Program

The program in listing 1 uses the BASIC instructions SET and RESET to control the TRS-80 video graphic display and present diagrams that represent the structure of the DNA molecule. (The POKE instruction can be used on other systems.) These diagrams move on the screen, in demonstration of how a DNA molecule replicates itself in the nucleus of a living cell, while an audio text, recorded on cassette tape and controlled by the program, explains the figures and the written information on the video screen. The key BASIC instruction is the Level II output instruction OUT *port, value*. On the TRS-80, output port 255 controls the cassette recorder: a value of 5 in the OUT instruction turns the recorder on, and a value of 16 turns it off.

The instructor prepares both the visual display and the accompanying audio material on a cassette tape. The most laborious aspect of the preparation concerns the coordination of the display with its accompanying sound. Once the instructor has recorded the audio information in proper sequence, he must determine its duration so that the program can delay the visual display and coordinate it with

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Education Forum

Listing 1: *This program, designed for use with the CAI lesson module and written in Level II BASIC for the Radio Shack TRS-80, presents an animated visual display of DNA replication.*

The subroutine beginning at line 890 fixes the location of a nucleotide on the screen, with its base facing downward. The subroutine beginning at line 760 places a nucleotide on the screen with its base facing upward, and moves it vertically. The values of Q and Z determine which nucleotide is to be displayed (for thymine, Q=1 and Z=1; for adenine, Q=2 and Z=1; for cytosine, Q=1 and Z=2; and for guanine, Q=2 and Z=2). The subroutines beginning at lines 580 and 670 present an entire segment of a DNA molecule, and call the subroutines at lines 890 and 760 as needed.

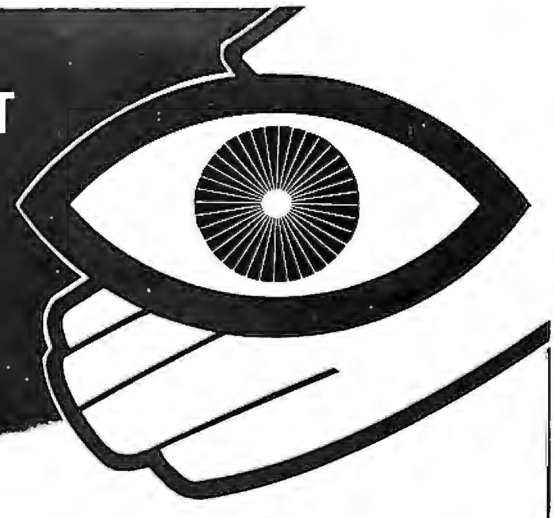
```
1 REM  "THE REPLICATION OF DNA--A TRS-80 COMPUTER ASSISTED INSTRUCTION MODULE"
2 REM  AUTHOR:  RICHARD R. ECKERT
3 REM  BOX 145, STATION 6, PONCE, PUERTO RICO.
4 REM  IN ORDER TO COORDINATE PROPERLY WITH THE AUDIO TEXT I HAVE ON TAPE,
5 REM  ALL <REM> STATEMENTS SHOULD BE REMOVED FROM THE PROGRAM.
9 REM  A, B, C, D, E DETERMINE THE POSITION ON THE SCREEN OF THE VARIOUS FIGURES
10 A=16:B=41:C=24:D=35:E=63
20 CLS
30 PRINT"THIS IS A COMPUTER ASSISTED INSTRUCTION MODULE."
40 PRINT"GET THE TAPE RECORDER READY."
50 INPUT"WHEN YOU'RE ALL SET HIT <ENTER>";XX
60 CLS
70 PRINT@394,"R E P L I C A T I O N   O F   D N A"
79 REM  SET DELAY TIME FOR UPCOMING AUDIO MATERIAL; SUBROUTINE CONTROLS RECORDER
.
80 TM=17.2:GOSUB950
90 CLS
100 Y=A
109 REM  DRAW UPPER HALF OF DNA MOLECULE
110 GOSUB580
120 Y1=C:S=C
129 REM  DRAW LOWER HALF OF DNA MOLECULE
130 GOSUB670
140 TM=7.4:GOSUB950
150 CLS
160 Y=A
170 GOSUB580
180 PRINT@277," T      C      A      G";
190 TM=23.5:GOSUB950
200 CLS
209 REM  PREPARE TO DRAW NUCLEOTIDE WITH THYMINE POINTING DOWNWARD
210 Q=1:Z=1:X=B:Y=A
219 REM  DRAW IT
220 GOSUB890
230 PRINT@396,"THYMINE";
240 TM=11.2:GOSUB950
248 REM  PREPARE TO DRAW NUCLEOTIDE WITH ADENINE POINTING UPWARD
249 REM  SINCE S=Y1, IT WILL NOT MOVE
250 Q=2:S=D:Y1=D
259 REM  DRAW IT
260 GOSUB760
270 PRINT@716,"ADENINE";
280 TM=18.0:GOSUB950
289 REM  PREPARE TO DRAW CITOSINE
290 Q=1:Z=2:Y=A:X=E
299 REM  DRAW IT
300 GOSUB890
310 PRINT@422,"CITOSINE";
320 TM=8.7:GOSUB950
329 REM  PREPARE TO DRAW GUANINE (STATIONARY)
330 Q=2:Y1=D:S=D
340 GOSUB760
349 REM  DRAW IT
350 PRINT@742,"GUANINE";
360 TM=10.0:GOSUB950
370 CLS
380 PRINT@466,"G E N E T I C   C O D E";
390 TM=24.5:GOSUB950
400 CLS
410 Y=A
419 REM  LINES 420-460 DRAW DNA MOLECULE COMPLETELY LABELED
420 GOSUB580
430 Y1=C:S=C
440 GOSUB670
450 PRINT@277," T      C      A      G";
460 PRINT@597," A      G      T      C";
470 TM=17.0:GOSUB950
479 REM  LINES 480-490 ELIMINATE ONE-HALF OF THE MOLECULE
480 FORX=41TO63:RESET(X,20):NEXT
490 FORY=21TO29:FORX=41TO84:RESET(X,Y):NEXT:NEXT
500 TM=16.0:GOSUB950
510 PRINT@790,"A      G      T      C";
519 REM  PREPARE FOR REPLICATION;  SINCE S<Y1, NUCLEOTIDES WILL MOVE
520 Y1=D:S=C
529 REM  PLACE MOVING NUCLEOTIDES ON SCREEN TO DEMONSTRATE REPLICATION
530 GOSUB670
540 PRINT@597," A      G      T      C";
550 PRINT@790,"REPLICATION COMPLETE";
560 TM=24.8:GOSUB950
570 END
579 REM  SUBROUTINE 580-660 DRAWS THE UPPER HALF OF THE DNA MOLECULE
580 FORN=1TO2
```

Listing 1 continued on page 362

NEW! ANOTHER APPLE* GIFT FROM PROMETHEUS

The IPP Guardian

Always awake. . .even when your Apple sleeps. . .



NOW. . .there is an Intelligent Peripheral Processor with "always on" background scheduling and BSR control . . .even when your Apple is turned off!

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The heart of the IPP-Guardian Board is an independent CMOS intelligent processor with up to 2K of user programmable RAM and a real-time clock/calendar with 1-millisecond resolution. They operate in background without any Apple overhead. Long-life battery back-up provides independence from AC power. 20 general purpose I/O lines are available for external interface.

Operational expansion can provide additional capability for expanded parallel I/O, serial I/O, and future expansion. Software options include general purpose or BSR scheduling, multitasking, and monitor routines.

There's a great deal more to the IPP-Guardian. Call **Prometheus** or see your local dealer for additional information about the IPP-1 and a demonstration.

MEMORY EXPANSION MODULE-1. The preferred 16K RAM Expansion Module for Apple II. *Compare these features:* • RAM data out is buffered into bus. • User selectable reset function. • Terminated data and control inputs. • Low noise array layout. • Extra decoupling capacitors for higher noise immunity. • 24-hour dynamic burn-in (minimum) • Total compatibility with all Apple and Microsoft Softcard software. • 1-year parts and labor warranty.

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PASCAL MT+ MEM-1. A modular native Z-80 code Pascal compiler and a MEM-1 (detailed above).

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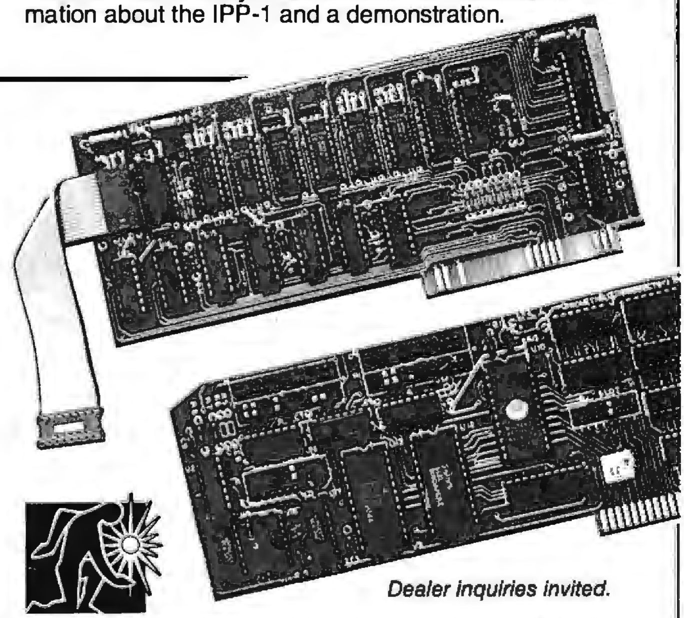

MONEY BACK GUARANTEE: All Prometheus boards are completely tested and burned-in prior to shipment. One-year warranty covers parts and labor. Order now without risk. Boards may be returned, in good condition (after up to 10 days of trial), for a full and prompt cash refund. California: add 6% tax; BART Counties, 6½%. *Quantity discounts available.*

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Listing 1 continued:

```
590 X=30+N*11:Q=1:Z=N
600 GOSUB890
610 NEXT
620 FORN=1TO2
630 X=52+N*11:Q=2:Z=N
640 GOSUB890
650 NEXT
660 RETURN
669 REM  SUBROUTINE 670-750 DRAWS THE LOWER HALF OF THE DNA MOLECULE
670 FORN=1TO2
680 X=30+N*11:Q=2:Z=N
690 GOSUB760
700 NEXT
710 FORN=1TO2
720 X=52+N*11:Q=1:Z=N
730 GOSUB760
740 NEXT
750 RETURN
756 REM  SUBROUTINE 760-880 DRAWS ONE NUCLEOTIDE FACING UPWARD.
757 REM  THE NUCLEOTIDE DRAWN DEPENDS ON THE VALUES OF Q & Z.
758 REM  IF S=Y1, THE NUCLEOTIDE REMAINS STATIONARY; IF NOT IT MOVES
759 AND EVENTUALLY MATES WITH ITS PARTNER ON THE UPPER HALF OF THE CHAIN.
760 FORY=Y1TOSSTEP-1
770 FORI=XTOX+10:SET(I,Y):NEXT
780 FORJ=1TOQ:SET(X+5,Y-J):NEXT
790 FORI=X+3TOX+7:SET(I,Y-Q-1):NEXT
800 IFZ=1THENFORI=X+4TOX+6STEP2:SET(I,Y-Q-2):NEXT
810 IFZ=2THENFORI=X+3TOX+7STEP2:SET(I,Y-Q-2):NEXT
820 FORK=1TO10:NEXT
830 IFY=STHENRETURN
840 IFQ=1ANDY=S+1THEN860
850 FORI=X+3TOX+7:RESET(I,Y-5):NEXT
860 FORI=X+3TOX+7:FORJ=Y-1TOY-4STEP-1:RESET(I,J):NEXT:NEXT
870 FORI=XTOX+10:RESET(I,Y):NEXT
880 NEXT
888 REM  SUBROUTINE 890-940 DRAWS ONE NUCLEOTIDE FACING DOWNWARD.
889 REM  THE NUCLEOTIDE DRAWN DEPENDS ON THE VALUES OF Q & Z.
890 FORI=XTOX+10:SET(I,Y):NEXT
900 FORJ=1TOQ:SET(X+5,Y+J):NEXT
910 FORI=X+3TOX+7:SET(I,Y+Q+1):NEXT
920 IFZ=1THENFORI=Y+4TOX+6STEP2:SET(I,Y+Q+2):NEXT
930 IFZ=2THENFORI=X+3TOX+7STEP2:SET(I,Y+Q+2):NEXT
940 RETURN
948 REM  SUBROUTINE 950-1000 TURNS ON THE CASSETTE RECORDER, DELAYS
949 REM  ACCORDING TO THE VALUE OF TM, AND THEN TURNS OFF THE RECORDER.
950 OUT255,5
960 TM=TM*485
970 FORIM=0TOTM:NEXT
980 TM=0
990 OUT255,16
1000 RETURN
```

the audio material. In the program of listing 1, the subroutine beginning at line 950 turns on the recorder, line 960 converts the duration of the audio material (expressed in seconds and stored in the variable TM) to the appropriate terminal value of a FOR-NEXT delay loop (lines 960 and 970), and line 990 turns the recorder off.

Video Animation

The program listing contains many comments, but an explanation of some of the graphics may also be helpful. The subroutines beginning at lines 890 and 760 do most of the work. The former fixes the location of a nucleotide (one of the basic structural units of DNA) on the screen, with its base facing downward. The latter subroutine places a nucleotide with its base facing upward, and moves it vertically, as needed. In each case the values of two variables, Q and Z, determine which nucleotide will be displayed.

At those moments when the entire DNA molecular segment is to be presented, the subroutines at lines 580 and 670 come into play. These subroutines call one nucleotide-locating subroutine for each nucleotide on the molecule. (This makes it easy to expand the program to show DNA segments that are longer than the four-unit chain presented here.)

A Sample Lesson

Before a lesson begins, the material is recorded on tape, and the cassette is placed in the recorder. (The connecting cable from the computer must be removed from the earphone jack on the recorder for the speaker to be activated.) The recorder must be set in the play mode before the program is started.

When the program begins to execute, the first in a series of graphic displays appears on the video screen, and the cassette recorder matches its information to the appearance of the images. Some of the more interesting graphic displays are shown in the ac-

Circle 379 on inquiry card.

companying photos, but many of the displays are animated so it is impossible to convey the true image.

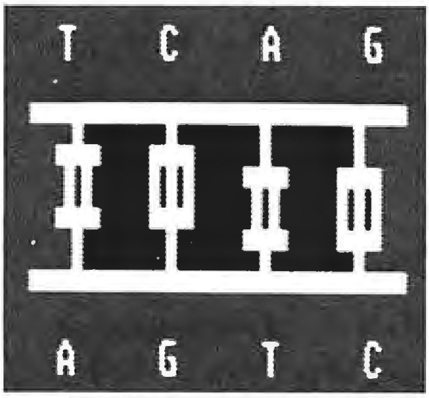
Audio Transcript

DNA is a molecule found in the nuclei of all living cells. In this lesson we'll examine the role it plays in the process of cell division. The DNA molecule is a double chain of nucleotides; let's look at a section of this molecule. (Display in photo 1a appears.)

Here we see part of the double chain. Now let's split it down the middle to examine its structure. (Photo 1b.)

We see the chain split down the middle. Each section of the chain consists of a nucleotide, and each nucleo-

(1a)



(1b)

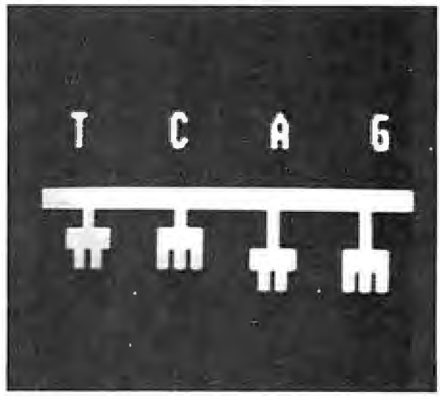
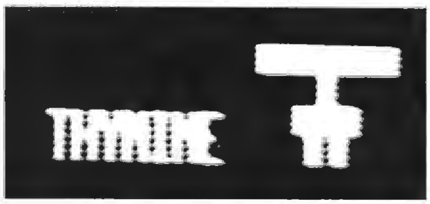
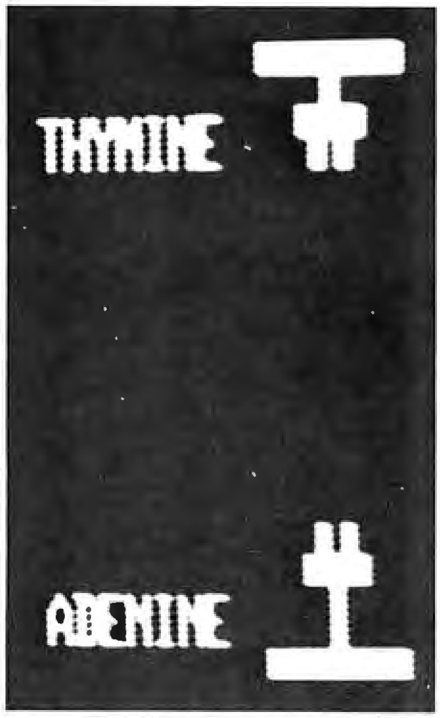


Photo 1a and 1b: *The initial displays help to orient the introductory information that is played on the computer-controlled cassette recorder.*

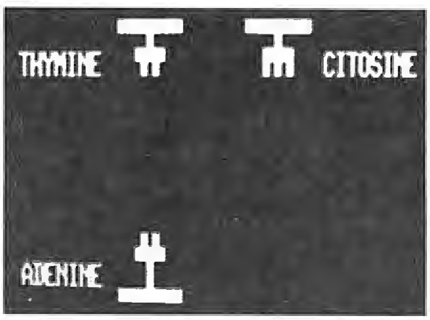
(2a)



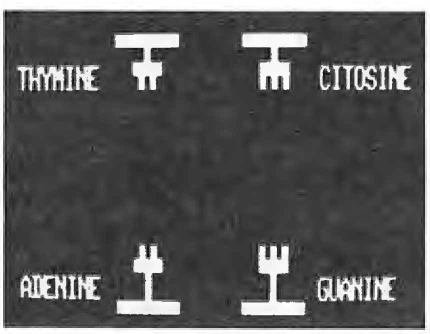
(2b)



(2c)



(2d)



Photos 2a thru 2d: *Series of displays that shows the possible variations in any nucleotide. Each nucleotide section may have a base with a unique combination of two or three bonding sites, and several possible lengths.*

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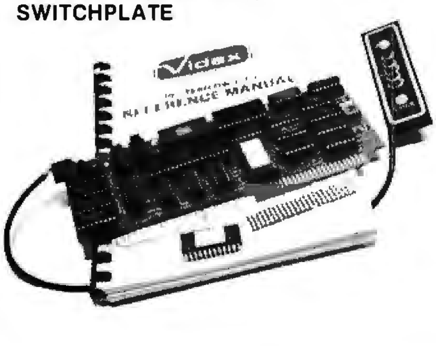
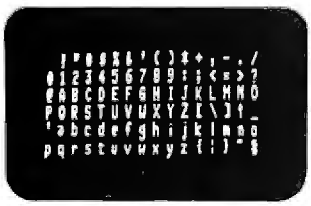


7X12 MATRIX
18X80 OPTIONAL



7X9 MATRIX
24X80 STANDARD

VIDEOTERM

BASICs VIDEOTERM lists BASIC programs, both Integer and Applesoft, using the entire 80 columns. Without splitting keywords. Full editing capabilities are offered using the ESCape key sequences for cursor movement. With provision for stop/start text scrolling utilizing the standard Control-S entry. And simultaneous on-screen display of text being printed.

Pascal Installation of VIDEOTERM in slot 3 provides Pascal immediate control of the display since Pascal recognizes the board as a standard video display terminal and treats it as such. No changes are needed to Pascal's MISC.INFO or GOTOXY files, although customization directions are provided. All cursor control characters are identical to standard Pascal defaults.

Other Boards The new Microsoft Softcard* is supported. So is the popular D. C. Hayes Micromodem II*, utilizing customized PROM firmware available from VIDEX. The powerful EasyWriter* Professional Word Processing System and other word processors are now compatible with VIDEOTERM. Or use the Mountain Hardware ROMWriter* (or other PROM programmer) to generate your own custom character sets. Naturally, VIDEOTERM conforms to all Apple OEM guidelines, assurance that you will have no conflicts with current or future Apple II* expansion boards.

Advanced Hardware Design VIDEOTERM's on-board asynchronous crystal clock ensures flicker-free character display. Only the size of the Pascal Language card, VIDEOTERM utilizes CMOS and low power consumption ICs, ensuring cool, reliable operation. All ICs are fully socketed for easy maintenance. Add to that 2K of on-board RAM, 50 or 60 Hz operation, and provision of power and input connectors for a light pen. Problems are designed out, not in.

Available Options The entire display may be altered to inverse video, displaying black characters on a white field. PROMs containing alternate character sets and graphic symbols are available from Videx. A switchplate option allows you to use the same video monitor for either the VIDEOTERM or the standard Apple II* display, instantly changing displays by flipping a single toggle switch. The switchplate assembly inserts into one of the rear cut-outs in the Apple II* case so that the toggle switch is readily accessible. And the Videx KEYBOARD ENHANCER can be installed, allowing upper and lower case character entry directly from your Apple II* keyboard.

Firmware 1K of on-board ROM firmware controls all operation of the VIDEOTERM. No machine language patches are needed for normal VIDEOTERM use.

Firmware Version 2.0

Characters	7 x 9 matrix	Display	24 x 80 (full descenders)
Options	7 x 12 matrix option; Alternate user definable character set option; Inverse video option.		18 x 80 (7 x 12 matrix with full descenders)

Want to know more? Contact your local Apple dealer today for a demonstration. VIDEOTERM is available through your local dealer or direct from Videx in Corvallis, Oregon. Or send for the VIDEOTERM Owners Reference Manual and deduct the amount if you decide to purchase. Upgrade your Apple II* to full terminal capabilities for half the cost of a terminal. VIDEOTERM. At last.

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ROMWriter* is a trademark of Mountain Hardware Inc.
Micromodem II* is a trademark of D. C. Hayes Associates Inc
Softcard* is a trademark of Microsoft
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PRICE:
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- MANUAL refund with purchase ..... $ 19
- 7 x 12 CHARACTER SET ..... $ 39
- MICROMODEM FIRMWARE ..... $ 25

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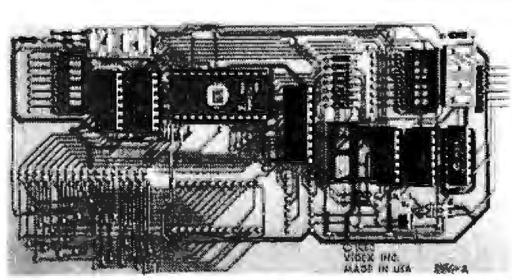
If you want to program in BASIC, just put it back into the alpha lock mode; and you have the original keyboard back with a few improvements. Now you can enter those elusive 9 characters directly from the keyboard, or require the Control key to be pressed with the RESET to prevent accidental resets.

KEYBOARD AND DISPLAY ENHANCER is recommended for use with all revisions of the APPLE II. It includes 6 ICs, and EPROM and dip-switches mounted on a PC board, and a jumper cable. Easy installation, meaning no soldering or cutting traces. Alternate default modes are dip-switch selectable. You can even remap the keyboard, selecting an alternate character set, for custom applications.



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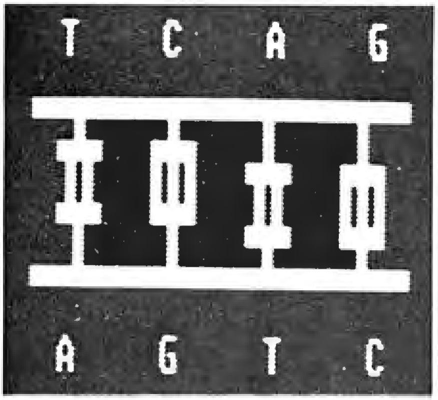
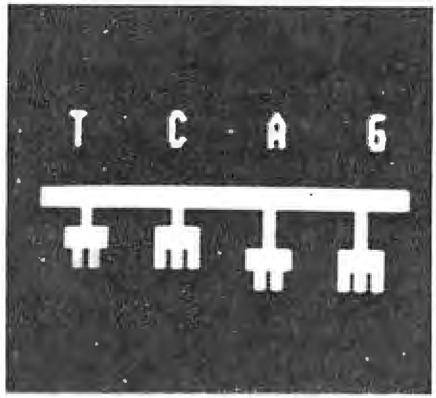
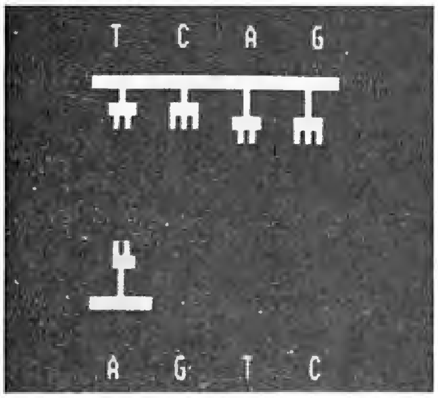
(3a)



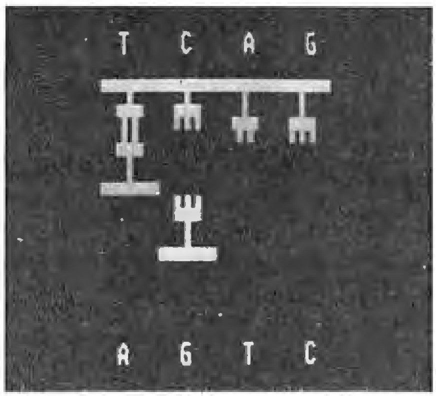
(3b)



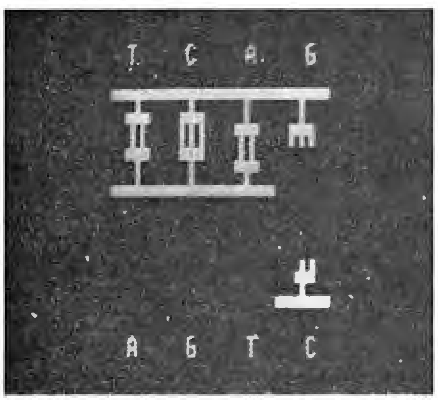
(3c)



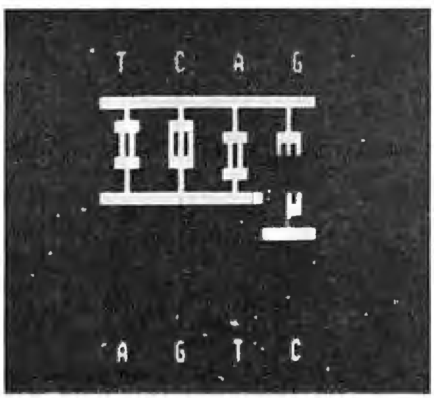
(3d)



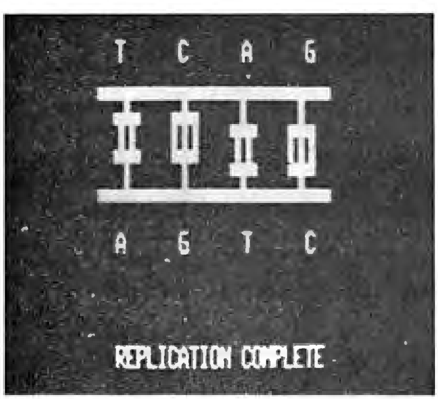
(3e)



(3f)



(3g)



Photos 3a thru 3g: *Animated sequence that demonstrates the passing of genetic information from parent cell to offspring cells. The DNA chain splits, the missing portion of each half is replaced when free nucleotides bond in place, and the new DNA chains take their positions as the cell splits.*

tide has a different base. Let's take a look at each one.

Now we see a nucleotide with the base thymine hanging downward. (Photo 2a.) Observe that there are two places where bonding can occur. Let's look at another nucleotide.

In this example, the base is adenine, and it is facing upward. (Photo 2b.) Notice that the base is larger than thymine and that it also has two places for bonding. Therefore, if nucleotides with thymine and adenine should meet, they can form a chemical bond and unite.

Another nucleotide uses the base citosine. (Photo 2c.) As we see, it is small and has three bonding sites.

The fourth nucleotide has the base guanine. (Photo 2d.) Its large size and the presence of three bonding sites allow it to unite with citosine.

Hereditary information is determined by the order of the nucleotides along the DNA molecule. This is known as the genetic code. (Photo 3a.) One DNA molecule may have more than 1000 nucleotides along the chain, so the number of possible combinations is enormous. This is the property that allows such variety among life forms.

We will now explore the question of how genetic information is passed from mother to daughter cells. The first action in the replication process is the splitting of the DNA molecule. Here we see part of a DNA molecule. (Photo 3b.)

Here we see one-half of the split molecule. Free nucleotides begin to bond to each half of the molecule. Observe that the bonding occurs only when adenine pairs with thymine, or when citosine pairs with guanine. (Photos 3c, 3d, 3e, and 3f.)

The replication has finished, and a new DNA molecule, identical to the original, has been formed from each half of the double chain. (Photo 3g.) We have seen how the molecule DNA, found in all living cells, replicates itself and passes the genetic information to new cells. ■

Acknowledgments

I wish to thank Ramon Rivera for his technical suggestions regarding this project.

Catch Bytes with a Comparator

Doug MacDonald, Suite 2, 533 Harbinger St
Victoria BC, V8V 4H9, Canada

Anyone who has tried to track down glitches and bugs on a data bus has probably looked with envy at advertisements for those multi-thousand-dollar logic analyzers. If those Cadillac devices are out of your price range, you might like to try the Byte Catcher. This device has quickly become an invaluable addition to my test bench.

Very often your goal is to catch a malfunctioning microprocessor at a particular portion of a program: the occurrence of one instruction, or a port output. Often you simply want to know if a program reached a certain stage. Unfortunately, the days of the front panel with that row of blinking address lights and a single-step switch are gone. Did a certain memory select signal come up when it was supposed to? Is that PROM (programmable read-only memory) putting out correct data?

The Byte Catcher can answer most of these questions. It is based on Advanced Micro Devices' 25LS2521, an 8-bit Equal-to Comparator. This 20-pin TTL (transistor-transistor logic) integrated circuit puts out a logic-low signal whenever the eight *A* inputs are equal to the eight *B* inputs. By switch selecting the *A* inputs you can catch that elusive byte on the fly whenever it occurs. The match can be as short as about 10 ns, which is fast enough for most microcomputer circuits.

A separate enabling line on the chip allows you a ninth input, which is usually used as a data strobe. You can use any number of the eight inputs. I often set the Byte Catcher to watch a single line. On the other hand, ganging two of these devices together allows you to monitor all sixteen address lines.

With the addition of a few gates for polarity selection, a DIP (dual-inline package) switch, a 555 timer, and two LEDs (light-emitting diodes), you end up with a fairly powerful multibit logic probe.

The components fit nicely on a breadboard strip, or you can mount the circuit in a box. Since the entire circuit pulls a maximum of only 65 milliamps (with both LEDs on), you can usually take your power off the circuit under test.

Figure 1 shows the Byte Catcher's design. The 8-bit "word" for comparison is preset on the switch SW1. I used an 8-line mini-DIP type, but there are various other types — a thumbwheel hexadecimal switch might be nice for a box-mounted version. The set data is negative logic (that is, a closed switch for a logic zero) because TTL is

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easier to pull low than high. The 4.7 K pull-up resistors (R5 to R12) are not really necessary, but are good insurance against noise.

The *B* inputs come from the device under test. You can fit them onto the board any way you choose, but my experience is that care here saves a lot of cursing later. I bought some Tektronix test clips which attach onto an integrated circuit pin and stay there, as well as some flexible test leads from AP Products (who also make breadboard strips). I brought all inputs to a 16-pin DIP header which plugs into the breadboard.

The optional input trigger (pin 1 of IC2) is handy for creating a "window"; the device will only signal a match when the input trigger is active. For example, you might want to search the data bus for a particular byte, but only when some specific device-select signal is active. SW2 allows either an active high or active low trigger. With the exclusive OR gate (IC2), the rule is to set the switch for the same polarity as your desired trigger: to ground for active low, to VCC for active high. If the trigger is not used, leave the switch on VCC, since an open TTL input pulls itself high; or better, tie the trigger high.

The remainder of the circuit gives you a visible clue of what is going on in the test. More often than not, I take the comparator's output (pin 19 of IC1) and use it as a scope trigger or send it back into the test circuit to generate an interrupt or some other function.

For poking around in a circuit, however, it is handy to use LEDs. The RC (resistor-capacitor) network (R1 and C1) provides a fast trigger pulse for the 555; if the data matches and stays matched for longer than the timer's duty cycle, it stays latched on and you don't know what's happening. R2 and C2 provide the 555 (rigged as a monostable multivibrator) with an on-time of about a half second; you can change this value to suit your taste. Or, you can substitute a beeper for the LED.

The LED (D1) will light for any data match down to about 10 ns. I use the cross-coupled NAND gate set-reset latch to "remember" a data match, in case I have my head buried in a circuit when it occurs. D2 will light and stay lit when a match occurs. SW3 resets the latch and turns the LED off again. This feature can be eliminated if desired.

You can add any bells and whistles which occur to you. For example, to gang two of the comparators together, you would tie the enable out (pin 19) of the first to the trigger input (pin 1) of the second and use the second enable out as your signal. Tying these two directly to the address bus gives you a switch-selectable, memory-mapped device-select strobe.

Another possibility is to use a pre-settable binary or decade counter (such as a 74LS161) to keep track of how many "hits" occur, or as a trigger input divider (flag a data match on the third...or fifth...or tenth..occurrence of a certain signal). Further gating of the inputs from the device under test could be added for various boolean functions. Or the output (pin 19 of IC1) could be tied back into the polarity selector on the exclusive-OR gate for further decoding. The possibilities are almost endless; I have found I can usually rig up whatever logic I need quickly, with the Byte Catcher as my basic test instrument. ■

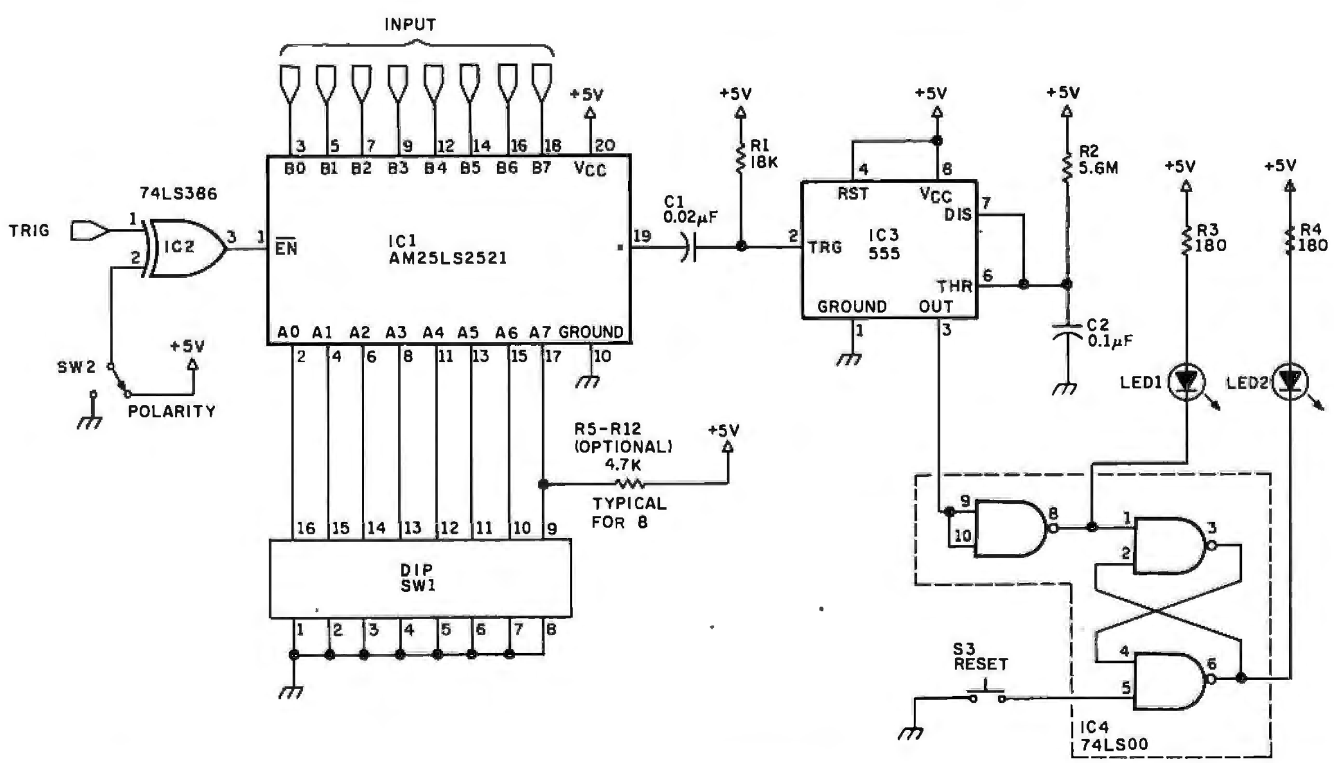


Figure 1: *Schematic diagram of the Byte Catcher Logic Analyzer. The 25LS2521 integrated circuit is an 8-bit Equal-to Comparator made by Advanced Micro Devices which outputs logic low whenever the eight* A *inputs are equal to the eight* B *inputs. Parts placement is not critical. See the text for a number of possible variations and modifications to this circuit.*

Event Queue

July 1981

July-September
Short Courses from the Continuing Education Institute (CEI), various sites throughout the US. Three- and four-day courses on data-base systems, applied microprocessor systems, microprocessor interfacing, digital filtering, and applied time-series analysis, are being offered by CEI. Fees range from $595 to $795. Contact the Continuing Education Institute, 10889 Wilshire Blvd, Suite 1030, Los Angeles CA 90024, (213) 824-9545.

July 9-10
Software Engineering, Denver CO. Tailored for systems analysts, designers, programmers, and managers, this seminar examines the latest developments in software engineering. For more information, contact Battelle, Seminar and Studies Program, 4000 NE 41st St, POB C-5395, Seattle WA 98105, (206) 525-3130.

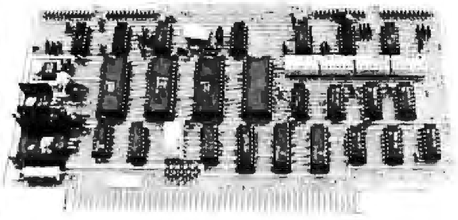
July 13-15
The Automated Office, Chicago IL. Sessions will describe an automated office and how it functions. Word and data processing, electronic-communication, and computerized records-management approaches to implementing office automation will be covered. This conference is designed for executives and professionals. Contact Department K-Automated Off, NIMR Seminars, POB 3727, Santa Monica CA 90403, (213) 450-0500.

July 13-17
The Eighth International Colloquium on Automata, Languages, and Processing (ICALP 81), Palm Beach Hotel, Acre (Akko), Israel. Among the seminar topics to be covered at this conference are factoring algorithms, data-flow analysis, linear-decision trees, and countable nondeterminism. For more information, contact Dr Oded Kariv, ICALP 81, Computer Science Department, The Technion, Haifa, Israel.

July 13-24
Computer Camp East, various sites throughout New England. The camp is open to children aged 10 to 17. Contact Professor Howard A Peelle, Instructional Applications of Computers, School of Education, University of Massachusetts, Amherst MA 01002, (413) 545-0496.

July 15-17
Summer Computer Simulation Conference, Washington DC. This conference will present over forty sessions on topics of computer-simulation technology and applications. Contact William E Buchanan, Applied Physics Laboratory, Johns Hopkins Rd, Laurel MD 20810, (301) 953-7100.

S-100 SERIAL PORT CARD



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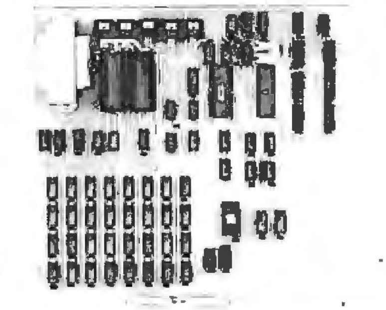

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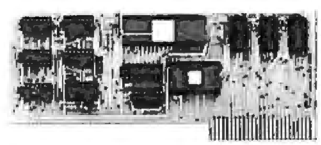

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2422A	Floppy Controller	320.00
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7712A	Serial Synch Bd.	152.00
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7720B	Centronic Parallel Interface	99.00
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1N5245B	.20
1N5248B	.20
1N5250B	.20
1N5252B	.20
1N5255B	.20

1 WT

Part#	Price
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1N4746A	.30
1N4747A	.30
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Part#	Price
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SY1.8432	5.75
SY2	5.75
SY2.4576	5.75
SY3.579	5.75
SY4	4.50
SY5.068	4.50
SY6	4.50
SY6.144	4.50
SY8	4.50
SY10	4.50
SY12	4.50
SY14.31818	4.50
SY15	4.50
SY18	4.50
SY18.432	4.50

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.47mf	35v	.35	.30	.26
.68mf	35v	.35	.30	.26
1mf	35v	.35	.30	.26
1.5mf	35v	.45	.39	.33
2.2mf	35v	.45	.39	33
3.3mf	35v	.50	.42	.36
4.7mf	25v	.50	.42	.36
4.7mf	35v	.65	.56	.44
6.8mf	35v	65	.56	.44
10mf	25v	.85	.72	.61
10mf	35v	1.19	1.00	.84
15mf	25v	1.30	1.09	.92
22mf	25v	1.30	1.09	.92
33mf	25v	1.35	1.12	.95
47mf	25v	1.55	1.29	1.05
100mf	6v	2.95	2.48	2.08

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LOW-PROFILE SOLDER TIN

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S8LT	.15	.11	.08
S14LT	.18	.16	.14
S16LT	21	.18	16
S18LT	.26	22	18
S20LT	.31	.26	.20
S22LT	.33	.28	.22
S24LT	35	.29	.24
S28LT	41	.34	28
S40LT	.53	.47	.40

WIRE-WRAP SOLDER TIN

Part#	1+	25+	100+
S8WT	.37	.33	.30
S14WT	.48	43	.39
S16WT	.53	48	.43
S18WT	.61	.55	50
S20WT	85	.77	69
S22WT	.89	.80	.72
S24WT	.96	.86	.77
S28WT	1.22	1.11	.99
S40WT	1.75	1.57	1.40

WIRE-WRAP GOLD

Part#	1+	25+	100+
S8WG	54	.49	.44
S14WG	77	.69	.62
S16WG	.83	.75	.68
S18WG	1.00	90	.81
S20WG	1.24	1.11	.99
S22WG	1.35	1.22	1.10
S24WG	1.40	1.26	1.13
S28WG	1.78	1.60	1.44
S40WG	2.25	2.03	1.83

VOLTAGE REGULATORS

Part#	Case	Price
78L05	TO92	45
78L12	TO92	.45
78L15	TO92	.45
79L05	TO92	.65
79L12	TO92	.65
79L15	TO92	.65
7805P	TO220	1.20
7812P	TO220	1.20
7815P	TO220	1.20
7905P	TO220	1.25
7912P	TO220	1.25
7915P	TO220	1.25
7605K	TO3	1.50
7812K	TO3	1.50
7815K	TO3	1.50
7905K	TO3	1.60
7912K	TO3	1.60
7915K	TO3	1.60
309H	TO39	95
309K	TO3	1.25
317P	TO220	1.95
317K	TO3	2.95
323K	TO3	5.50
337P	TO220	2.40
337K	TO3	3.80
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10pf	.07	.06	.04
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33pf	.07	.08	.04
39pf	.07	.06	.04
47pf	.07	.06	.04
68pf	.07	.06	.04
100pf	.07	.06	.04
150pf	.07	.06	.04
220pf	.07	.06	.04
270pf	07	.06	.04
330pf	.07	.06	.04
470pf	.07	.06	.04
.001mf	.07	.06	.04
.0022mf	.07	.08	.04
.0033mf	07	.06	.04
.0047mf	.07	.06	.04
.01mf	.07	.06	.04
.022mf	.10	.08	.06
.033mf	.10	.08	.06
.047mf	.11	.09	.07
.1mf	.14	.12	.10

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2N3904	.20
2N3908	.20
PN2222A	.19
PN2907A	.19

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20	200	2K	20K	200K	2M
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24	240	2.4K	24K	240K	2.4M
27	270	2.7K	27K	270K	2.7M
30	300	3K	30K	300K	3M
33	330	3.3K	33K	330K	3.3M
36	360	3.6K	36K	360K	3.6M
39	390	3.9K	39K	390K	3.9M
43	430	4.3K	43K	430K	4.3M
47	470	4.7K	47K	470K	4.7M
51	510	5.1K	51K	510K	5.1M
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62	620	6.2K	62K	620K	
68	680	6.8K	68K	680K	
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74LS02	.32
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74LS05	.32
74LS08	.32
74LS09	.35
74LS10	.38
74LS11	.38
74LS12	.39
74LS13	.32
74LS14	.65
74LS15	.35
74LS20	.32
74LS21	.36
74LS22	.36
74LS26	.35
74LS27	.39
74LS28	.37
74LS30	.36
74LS32	.40
74LS37	.38
74LS38	.39
74LS40	.36
74LS42	.95
74LS47	1.15
74LS48	1.15
74LS51	.32
74LS54	.38
74LS55	.34
74LS73	.49
74LS74	.49
74LS75	.63
74LS76	.55
74LS83	.95
74LS85	1.25
74LS86	.55
74LS90	.79
74LS92	.75
74LS93	.75
74LS95	.99
74LS107	.50
74LS109	.50
74LS112	.52
74LS113	.52
74LS114	.52
74LS123	1.05
74LS125	.70
74LS126	.70
74LS132	.95
74LS136	.53
74LS138	.85
74LS139	.85
74LS148	1.75
74LS151	.79

74LS152	.79
74LS153	.79
74LS154	2.05
74LS157	1.15
74LS158	1.15
74LS160	.85
74LS161	85
74LS162	85
74LS163	.95
74LS164	1.10
74LS165	1.10
74LS166	2.55
74LS170	1.90
74LS173	1.35
74LS174	1.25
74LS175	95
74LS181	2.35
74LS190	1.15
74LS191	1.15
74LS192	1.15
74LS193	1.15
74LS194	1.15
74LS195	1.15
74LS196	.99
74LS197	.99
74LS221	.95
74LS240	1.05
74LS241	1.05
74LS242	1.45
74LS243	1.45
74LS244	1.05
74LS245	2.15
74LS251	1.29
74LS253	.99
74LS255	.99
74LS257	1.15
74LS258	1.15
74LS260	.95
74LS261	2.49
74LS268	.65
74LS273	1.65
74LS283	1.05
74LS365	.85
74LS366	.85
74LS367	.85
74LS368	.85
74LS373	1.65
74LS374	1.45
74LS375	.99
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74LS390	1.75
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July 20

Passive-Solar Architecture and Computers, Berkeley CA. CALPAS3 is a computer program to model the thermal performance of residential buildings. It is explained in this class for architects, engineers, and energy consultants. Contact Sara Bennett, Berkeley Solar Group, 3140 Grove St, Berkeley CA 94703, (415) 843-7600.

July 20-21

Software Engineering, Seattle WA. For details, see July 9-10.

July 22-24

Diagnostic Software: Planning and Design, the Registry Hotel, Bloomington MN. This is a seminar for design, test, and diagnostic engineers and managers. Design examples, lectures, informal sessions, and individual and group diagnostic-programming sessions are part of the course. Tuition is $495. Contact Professor Donald D French, Institute for Advanced Professional Studies, One Gateway Center, Newton MA 02158, (617) 964-1412.

July 27-August 10

Computer Camp East, various sites throughout New England. For details, see July 13-24.

July 29-31

The 1981 Microcomputer Show, Wembley Conference Centre, London, England. Seminars on microcomputer applications in business, production, and education will be presented. Topics for conference sessions include hardware availability, software packages and development, automatic test equipment, robotics and process control. Exhibits from major European and American manufacturers will also be featured. Contact TMAC, 680 Beach

St, Suite 428, San Francisco CA 94109, (800) 227-3477; in California (415) 474-3000.

August 1981

August 3-7
Workshops in Digital Sound Synthesis and Processing, Digital Music Systems Inc, Boston MA. These workshops will provide a hands-on introduction for electronic-music composers and performers, recording engineers, psychoacoustic researchers, and others who work in the digital-audio field. The topics to be covered are fundamentals of digital audio, unit generators, automated synthesis and processing, nonlinear techniques, digital delay, filtering and reverberation, digital-audio hardware, and future trends. The fee is $300. Contact Digital Music Systems Inc, POB 1632, Boston MA 02110, (617) 542-3042.

August 10-14
Reliability and Life Testing, University of California, Los Angeles, Los Angeles CA. Engineers and scientists involved with the reliability, design, product assurance, quality, and safety aspects of components, equipment, and systems are invited to attend this course. The fee is $775. Contact the Short Course Program Office, 6266 Boelter Hall, UCLA Extension, Los Angeles CA 90024, (213) 825-1047.

August 10-21
Computer Camp East, various sites throughout New England. For details, see July 13-24.

August 10-14
Workshops in Digital Sound Synthesis and Processing, Digital Music Systems Inc, Boston MA. For details, see August 3-7.

August 17-21
Workshops in Digital Sound Synthesis and Processing, Digital Music Systems Inc, Boston MA. For details, see August 3-7.

August 24-27
Software Design, Reliability, and Testing, Sheraton Motor Inn, Lexington MA. This four-day seminar for engineers, programmers, and technical managers examines concepts and techniques for developing and testing reliable, cost-effective software. The conference also addresses management concerns and recommended policies. Tuition is $600, which includes course notes, luncheon, refreshments, and an evening reception. Contact Professor Donald D French, Institute for Advanced Professional Studies, One Gateway Center, Newton MA 02158, (617) 964-1412.

August 24-28
The Seventh International Joint Conference on Artificial Intelligence, University of British Columbia, Vancouver British Columbia, Canada. This conference examines computer applications of medical diagnosis, computer-aided design, robotics, programmable automation, speech understanding, vision, and other artificial-intelligence-related topics. A tutorial program and artificial-intelligence exhibits are to be presented. For more information, contact Louis G Robinson, American Association for Artificial Intelligence, Stanford University, POB 3036, Stanford CA 94305, (415) 495-8825.

August 25-28
Vector and Parallel Processors in Computational Science, Chester, England. The conference will concentrate on hardware, software, algorithms, applications, and case studies concerning vec-

tor and parallel processors. For information, contact Mrs S A Lowndes, Science Research Council, Daresbury Laboratory, Daresbury, Warrington, WA4 4AD, England.

August 26-29
The Fifth Annual National Small Computer Show, New York Coliseum, New York NY. Daily lectures and a five-hour executives-only seminar will be featured. The executive seminar is designed for upper-level managers who need an introduction to the understanding, acquisition, and use of computers in business. The registration fee for the show is $10 per day. The seminar for executives is $200, which includes all materials and show registration. For information, contact the National Small Computer Show, 110 Charlotte Pl, Englewood Cliffs NJ 07632, (201) 569-8542.

August 28-30
Personal-Computer Arts Festival '81 (PCAF '81), Philadelphia Civic Center, Philadelphia PA. PCAF '81 will include technical sessions, demonstrations, and exhibits. Also featured is the annual computer-music concert and computer-graphics film and video show. PCAF '81 is being held in conjunction with the Personal Computing Show '81. For complete details, contact PCAF '81, POB 1954, Philadelphia PA 19105.

September 1981

September-December
Four Seminars from Management Information Corporation (MIC), various sites throughout the US. These seminars are designed for businesspeople who need an introduction to system selection and use. For a complete

schedule of seminars, fees, and locations, contact Carrol Bell, c/o MIC, 140 Barclay Ctr, Cherry Hill NJ 08034, (609) 428-1020.

September 1-3

Computerized Office Equipment Expo (COEE), Civic Center, Atlanta GA. COEE provides a forum where the owners and executives of small and large businesses can learn about office automation. Office equipment for word processing, record storage and retrieval, and micrographics will be exhibited. Contact Cahners Exposition Group, 222 W Adams St, Chicago IL 60606, (312) 263-4866.

September 9-11

Eurographics '81, Technical University, Darmstadt, West Germany. Almost seventy exhibitors are expected to attend this computer graphics show. Detailed information can be obtained from Diebold Deutschland GmbH, Attn: Dr H J Grobe, Feuerbachstrasse 8, D-6000 Frankfurt/Main, West Germany.

September 10-13

Mid-West Computer Show, McCormick Place, Chicago IL. This show features office systems, data- and word-processing equipment, telecommunications equipment, microcomputers, computer graphics, peripherals, and other related supplies. For information, contact the National Computer Shows, 824 Boylston St, Chestnut Hill MA 02167, (617) 739-2000.

September 14-17

Productivity—An Urgent Priority, Capital Hilton Hotel, Washington DC. This conference is intended to provide a focus on productivity throughout the computer industry. General inquiries for program information should be addressed to Compcon

Fall '81, POB 639, Silver Spring MD 20901, (301) 589-3386.

September 15-17
WESCON/81, Brooks Hall, Municipal Auditorium, and Hilton Hotel, San Francisco CA. Sessions on communications, components and devices, computer and microprocessor hardware and software, office automation, and memory systems will be presented. Computer equipment and related products exhibits will be featured. Contact Electronic Conventions Inc, Suite 410, 999 N Sepulveda Blvd, El Segundo CA 90245, (213) 772-2965.

September 16-18
Diagnostic Software: Planning and Design, Boston MA. For details, see July 22-24.

September 16-18
The Engineer as a Communicator, Crystal City Marriott, Arlington VA. This conference will feature discussions on communications technology, information gathering, storage, and retrieval, using computers in technical communications, and other related topics. Contact Dr Daniel Rosich, School of Business Administration, University of Connecticut, Stamford CT 06903, (203) 322-1673.

September 24-25
Microprocessors: Hardware, Software, and Applications, Worcester Polytechnic Institute, Worcester MA. Among the courses to be offered are hardware and software basics, selection and evaluation of microprocessors, memory and input/output systems, multiprocessor systems, real-time system design, and circuit testing and debugging. For more information, contact Ginny Bazarian, c/o Office of Continuing Education, Worcester

Polytechnic Institute, Worcester MA 01609, (617) 753-1411, ext 517.

September 24-27
Mid-Atlantic Computer Show, Washington Armory, Washington DC. For details, see September 10-13.

September 30-October 2
Data and Telecommunications Expo '81, Rhein-Main-Halle, Wiesbaden, West Germany. This exhibition and conference will cover all areas of technology in data handling and distribution and telecommunications. Power supplies, processors, software, terminals, cables, test equipment, and modems are some of the items that will be exhibited. Contact Kiver Communications S A, UK Branch Office, Millbank House, 171/185 Ewell Rd, Surbiton, Surrey, KT6 6AX, England. ■

BYTE's Bits

Engineering Design Data on Tap

How do scientists, engineers, and technicians resolve conflicts in research materials? Many find help at Purdue University's Center for Information and Numerical Data Analysis and Synthesis (CINDAS). CINDAS evaluates and resolves conflicts in published information and concludes what should be transmitted as valid. The service cuts through the inconsistencies found in research materials, especially in heat, electrical, electronic, magnetic, and optical studies.

When a conflict is deemed resolved, the information is entered into the CINDAS data banks, which now have more than 180,000 indexed and coded entries. Each year

CINDAS adds more than 10,000 new citations from well over 8500 unclassified sources.

The service also has property-measurement laboratories offering analytical services and technical assistance. In addition, retrospective searches, document reproduction service, and data publications can be obtained.

For inquiry services, contact CINDAS, Purdue University, 2595 Yeager Rd, West Lafayette IN 47906, (800) 428-7675; in Indiana (317) 463-1581.

Call for Papers

"Reliability in Electrical and Electronic Components and Systems" is the theme for the Fifth European Conference on Electrotechnics. The conference will be held at the Technical University of Denmark June 14 through the 18, 1982.

The program committee is soliciting papers on reliability theory, management and economic issues, human and legal aspects, energy processing, and communication data and signal processing. Three copies of a one- or two-page summary in English (the conference language) should be submitted by September 1, 1981. The papers will be accepted on the basis of the summaries. Authors transfer their copyright to the conference after submission of the article.

The conference program will be designed for electrical and electronic engineers, marketing experts, and those concerned with research and development, manufacturing, and applications of electrical and electronic systems. Contact DIEU, Danish Engineers' Post Graduate Institute, The Technical University of Denmark, Bldg 208, DK-2800 Lyngby, Denmark.■

Clubs and Newsletters

Software Maintenance Techniques

The first issue of *Software Maintenance Techniques*, a new quarterly newsletter devoted to maintaining programs and systems, is available free upon request. The publication acts as a focal point for the collection and distribution of knowledge about maintenance.

Each issue presents topics applicable to all levels of data processing and to all data-processing systems. *Software Maintenance Techniques* has articles on the latest modification tools and approaches.

Reader contributions are invited. Subscriptions are $20 per year. Contact EduCo Corporation, 6777 Wadsworth, Suite 102, Arvada CO 80003, (303) 424-4425.

Club Apple de Quebec

Club Apple de Québec meets every Monday at 7 PM. The club's principal interest is languages, but it will review everything from hardware to games. Fees are $5 per month (Canadian funds).

For complete details, contact Octavio Prieto-Cox, Club Apple de Québec, 1575 De Niverville, #4, P Q, G1J 4Z7, Canada, (418) 663-3241; or Societé d'Informatique Amateur du Québec, c/o Club Apple de Québec, POB 9242, Ste-Foy, P Q, G1V 4B1, Canada.

Flint 6500 Users Group

The Flint 6500 Users Group can be contacted at POB 4310, Flint MI 48504; or by calling R Riley (313) 695-1117, weekdays from 7 to 8 PM.

Computer Club in Delaware

DUMPS (Delaware Users of Micro-Processor Systems) is a group of enthusiasts in northern Delaware. DUMPS has a program exchange and supports different microcomputers. Contact John T Lund, 901 Centre Rd, Westover Hills, Wilmington DE 19807, (302) 655-1854.

Apple Group for Teachers

The Apple for the Teacher group promotes the educational uses of Apple computers. Its primary interests are in computer-aided instruction, special education, and funding sources for educational uses of the Apple. A journal, *Apple Educators Newsletter*, is published.

For additional information, contact Ted Perry, 5848 Riddio St, Citrus Heights CA 95610, (916) 961-7776.

Educational Electronics

Educational Electronics is a new monthly newsletter with information on advances in technology for educational purposes. It focuses on the development of computer hardware and software for instructional and administrative purposes. Also included is material on information-retrieval systems, voice synthesis, speech control, audio-visual equipment, and materials for training the handicapped.

Educational Electronics keeps track of research and development programs within the manufacturing community. Information about grants, legislation, and government trends affecting educational technology and reviews of new products are featured. Subscriptions are $60 per year.

Circle 69 on inquiry card.

For more information, contact Educational Electronics Inc, 1 Lincoln Plz, New York NY 10023, (212) 877-8539.

Earn Money with Your Hobby

The *Micro Moonlighter* newsletter is a publication for those wishing to use their microcomputer for part- or full-time business ventures. Marketing methods, advertising hints, contracts, and industry trends are covered regularly. The newsletter is aimed at advanced computer users.

Charter subscriptions are $25 per year in the US, $29 in Canada, and $35 elsewhere. Contact J Norman Goode, 2115 Bernard Ave, Nashville TN 37212.

TRS-80 Group In West LA

The TRS-80 Users Group of West Los Angeles, California, has been organized. An exchange of public-domain software and discussions of hardware and software topics are planned. Contact the group at POB 85, Culver City CA 90230, (213) 836-4103.

Attention ZX80 and MicroAce Fans

The ZX80 and the MicroAce computers deserve a user group. If you're interested in exchanging or publishing newsletters about these computers and if you would like to help form a users group for that purpose, contact Conan La Motte, 712 Pidgeon St, San Diego CA 92114.

Wanted: SD Systems Z80 Starter Kit Users

The SD Systems Z80 Starter Kit is a single-board computer that longs for a central information clear-

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inghouse. If you'd like to exchange information, write an article, or devise tutorials, contact Cary N Davids, 6000 Puffer Rd, Downers Grove IL 60516.

TUG Calls

The Technico Users Group (TUG) is interested in hearing from anyone who has a Technico computer or any computer based on the Texas Instruments 990 or TMS 9900's architecture. TUG publishes a newsletter and is looking for articles on software, hardware, novel applications, other items of interest, and ads for software and hardware. Currently, there are no dues.

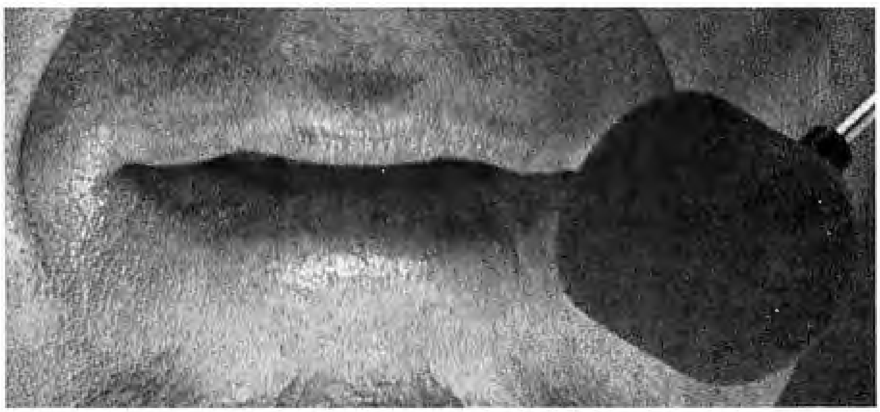
Contact Penn S Avera, Quantum Data Systems Inc, 259 S Farragut Ter, Philadelphia PA 19139, (215) 747-8341.■

BYTE's Bits

Microcomputers in Public Service

Suncoast Micro-Systems (SMS) is developing and placing microcomputers within community-based, public service and charitable organizations. SMS, a nonprofit corporation, seeks contact and collaboration with other groups involved in similar activities in communities around the country. Information on software and hardware materials available or being developed is sought.

Contact SMS at 1870 Sailfish Rd, St Petersburg FL 33707, (813) 347-6733.■



Software Received

Apple

App-L-ISP, a version of the LISP programming language for the Apple II. Floppy disk, $124.95. DataSoft Inc, 19519 Business Center Dr, Northridge CA 91324.

The Asteriod Field, graphics arcade game for the Apple II. Floppy disk, $24.95. Cavalier Computer, POB 2032, Del Mar CA 92014.

Baker's Trilogy, three arcade-type games for the Apple II. Floppy disk, $29.95. Softape, 10432 Burbank Blvd, North Hollywood CA 91601.

Graphtrix, a text and high-resolution graphics-printing program for the Apple II. Floppy disk, $55. Data Transforms Inc, 906 E Fifth Ave, Denver CO 80218.

Job Costing II, a project-management program for the Apple II. Floppy disk, $160. Garbo, 1205 W Riverside Dr, Carlsbad NM 88220.

Personal Check Manager, a checkbook utility program for the Apple II. Floppy disk, $30. D R Poling, 6929 La Cienega Blvd, Los Angeles CA 90045.

Star Warrior, a graphics action game for the Apple II. Floppy disk, $29.95. Automated Simulations Inc, POB 4247, Mountain View CA 94040.

Super FORTH, a version of the FORTH programming language for the Apple II. Floppy disk, $49.95. Hayden Book Company Inc, 50 Essex St, Rochelle Park NJ 07662.

CP/M

Eliza, the original Rogerian therapist simulation program for CP/M computers. Floppy disk, $24.95. The Artificial Intelligence Research Group, 921 N La Jolla Ave, Los Angeles CA 90046.

RAID, an assembly-language debugging utility for CP/M computers. Floppy disk, $250. Southern Computer Systems, POB 3373A, Birmingham AL 35255.

Radio Shack

BasicPro, BASIC programming utility for the TRS-80 Model I. Cassette, $24.95. Softworx, Inc, POB 9080, Seattle WA 98109.

CIE Head Azimuth Alignment Tape, a program-recorder head-alignment utility for the TRS-80 Model I. Cassette, $3.95. Computer Information Exchange, POB 159, San Luis Rey CA 92068.

Devil's Island, an adventure program for the TRS-80 Model I. Cassette, $14.95. Computhings, 708 Broadway, Chelsea MA 02150.

GAPP, a cassette-based file-card program for the TRS-80 Model I or III. Cassette, $9.50. Robert G Gallie, 4726 W 13th St, Cicero IL 60650.

Menu Master, a formatted video input and output utility for the TRS-80 Model I or III. Floppy disk, $24.95. AHEA, 545 Macenta Ln, Diamond Bar CA 91765.

Star Warrior, a graphics-action game for the TRS-80. Cassette, $29.95. Automated Simulation (see above).

Texas Instruments

The Cube, Rubik's Cube simulation program for the TI 99/4. Cassette, $14.95. Linear Aesthetic Systems, POB 23, West Cornwall CT 06796.

The Shrink, an artificial-intelligence simulation program for the TI 99/4. Cassette, $15. Tinnware, 30 S First Ave, Suite 171, Arcadia CA 91006.■

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

BYTE's Bits

Calling All TRS-80 Model II Users

A group of enthusiasts invites all TRS-80 Model II users to participate in a project to document user-developed SVCs (supervisor calls) for TRSDOS 2.0 and to establish a BASIC memory map for those users that want to use the PEEK and POKE modifications available from several sources. The project seeks to act as a clearinghouse for all TRSDOS 2.0 SVCs and BASIC memory-map information. The accumulated data will be published and distributed to all participants.

Here are the guidelines:

All submissions must include name, address, and telephone number. Submitted material must not be restricted from being published. When submitting information, send a listing in 80-column format, with as many remarks as possible. The purpose of the SVC must be explained. If the purpose of the SVC is not apparent, a listing using the SVC should be given. Any variables passed must be identified, and their handling into and out of the SVC must be explained. Indicate if the SVC is not original and give the source if possible. Any memory-map information submitted with doubts about its location must be indicated. If the location must work with others, document the use.

The group would appreciate the SVCs being sent on floppy disk, which will be returned after transfer. The group reserves the right to select or reject any submissions and to merge or condense the submission with another. Those submissions printed will be credited to the persons or companies that submitted them.

The group is also interested in any Model II "tricks" or subtle programming ideas. Send submissions to Pete Charlton, 491 Elbow Ct, Weatherford TX 76086.

Camp Instructors Needed

Computer Camp East is looking for instructors for its July 27 to August 7 and August 10 to August 21 sessions. The sessions are held in different parts of New England. The camp directors are looking for individuals to teach 10- to 17-year-olds APL, BASIC, Pascal, and Logo, and to supervise the use of Apple II, PET, Atari 800, and TI 99/4 microcomputers.

Contact Professor Howard A Peelle, Instructional Applications of Computers, School of Education, University of Massachusetts, Amherst MA 01002, (413) 545-0496.■

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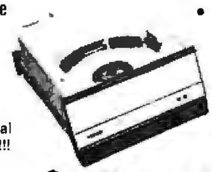

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Computer-Aided Drafting with Apple Pascal

Dan Sokol
285 Pacific Ave
Brookdale CA 95007

Electronic hardware design, like any creative endeavor, has its high points and its low points. A personal low point has always been the time it takes to draw usable schematics. The problem is compounded when you consider that after the schematic is drawn and the hardware prototyped, the schematic must be modified (in any number of colors) as the circuit is debugged. Then, of course, the circuit has to be redrawn. And usually by me.

At a trade show a few years ago, I saw a high-quality graphics terminal that was used with a light pen to draw schematic diagrams. A menu of devices was available from the keyboard, and the light pen was used to place the selected device on the screen. Fantastic! . . . and only $150,000.

Technology marches on. Some time ago, Apple Computer announced a new product—a Graphics Tablet. My Apple already had Pascal and an M & R Enterprises Sup'r'terminal board, so I only needed the Graphics Tablet (and some software) to build a computer-aided drafting system (see photo 1).

I began the project with a great deal of enthusiasm. Being fairly proficient with Pascal, I did not anticipate any major problems. It was only after I read the fourth page of the Graphics Tablet operation manual that I began to realize I might have bitten off more than I could compile. It read, ". . . the Graphics Tablet software will not operate . . . in an Apple Pascal environment." I immediately called the Apple Software Hotline (408-996-9868).

Fortunately, the people at Apple were very helpful. They explained that the reason the tablet would not interface to Pascal was that the Pascal BIOS (basic input/output subsystem) did not recognize its existence. They sent me a copy of the BIOS initialization routines, from which I was able to write an assembly-language linkage routine to read data from the pad and transfer it back to Pascal. (Not one to dwell on failures, suffice it to say that it took me three weeks of experimentation to reach that point.)

The program that accomplished this feat was called PAD.ASSY.TEXT (see listing 1). It contained two procedures, one for setting the default parameters, and the other for reading the pad, flashing the cursor, and scaling the results. Both procedures worked in essentially the same manner. First, I accessed hexadecimal location CFFF to disable any active read-only memories in the C800 thru CFFF range (one is found on the Sup'r'terminal board). Then the slot number that contained the Graphics Tablet interface card was stored at hexadecimal location 7F8 and in the 6502 microprocessor's X-register (a small piece of information missing from the Graphics Tablet manual).

The first address of the slot where the interface card was located was accessed (with a load or store instruction) to enable the read-only memory. (In my case, this was slot number five.) Now the subroutines in the read-only memory were available to the processor. After I called the routines that I needed, I turned off the read-only memories at hexadecimal C800 and executed a return. Pascal's BIOS took care of turning the Sup'r'terminal read-only memory back on.

After reading the tablet and flashing the cursor, the x and y coordinates were stored at decimal locations 645 thru 648. Pascal recovered this data using the PEEK intrinsic that I added to my library (see "Notes on Absolute Location Interfaces to Apple Pascal," September 1980 BYTE, page 324). After compiling the main program the Pascal linker linked the program to PAD.ASSY.CODE.

As soon as I could read data from the tablet, I began to work on the program, which I had named LOGIC-

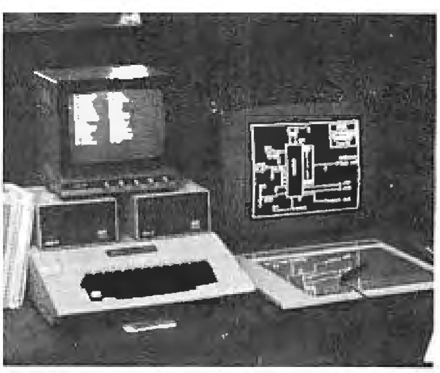


Photo 1: *The author's computer-aided drafting system for the Apple II computer. Addition of a Graphics Tablet, a Sup'r'terminal 80-column display board, and some software can take the drudgery out of designing electronic circuits.*

Listing 1: *Assembly-language routine that reads data from the Graphics Tablet for use in Pascal.*

```
0000|                   ; assembly language linkage
0000|                   ; to APPLE GRAPHICS TABLET
0000|                   ;
0000|                   ; 28 Mar 80 - Dan Sokol
0000|                   ;
0000|                   ; procedure SETUPAD; external;
0000|                   ; procedure READPAD; external;
0000|
0000| CFFF              CFFF    .EQU    0CFFF       ; TURN OFF ALL ROMS
0000| 07F8              MSLOT   .EQU    7F8         ; ACTIVE SLOT = Cn
0000| C500              PADAT   .EQU    0C500       ; SLOT ADDR FOR PAD
0000| CEF9              MREAD   .EQU    0CEF9       ; READ THE PAD
0000| C8F0              CURSOUT .EQU    0C8F0       ; XOR CURSOR AND SCALE PAD OUTPUTS
0000| CCA1              QWAIT   .EQU    0CCA1       ; MIDEAST COUNTRY WITH MUCH OIL
0000| CE90              DEFAULT .EQU    0CE90       ; SETUP PAD
0000| CEEA              DEF4    .EQU    0CEEA       ; SETUP PAGE AND MPAGE FOR SCREEN 1
0000| 0080              DELAY   .EQU    80          ; DELAY FOR QWAIT (CURSOR ON)
0000|
0000|                           .PROC SETUPAD,0;
0000|
0000| AD FFCF           DFLT    LDA     CFFF        ; ALL ROMS OFF
0003| A9 C5                     LDA     #0C5
0005| AA                        TAX
0006| 8D F807                   STA     MSLOT
0009| AD 00C5                   LDA     PADAT
000C| AD 00C5                   LDA     PADAT       ; TURN PAD ON
000F| 20 90CE                   JSR     DEFAULT
0012| A9 20                     LDA     #20
0014| A8                        TAY
0015| 20 EACE                   JSR     DEF4        ; SET SCREEN 1 & STREAM ON
0018| AD FFCF                   LDA     CFFF
001B| A9 C3                     LDA     #0C3
001D| 8D F807                   STA     MSLOT
0020| AA                        TAX                 ; RESET SUP'RTERM
0021| 60                        RTS
0022|
0000|                           .PROC READPAD,0;
0000|
0000| AD FFCF           READIT  LDA     CFFF        ; ALL ROMS OFF
0003| A9 C5                     LDA     #0C5
0005| AA                        TAX
0006| 8D F807                   STA     MSLOT
0009| AD 00C5                   LDA     PADAT
000C| AD 00C5                   LDA     PADAT       ; PAD ON
000F| 20 F9CE                   JSR     MREAD       ; READ PAD
0012| 20 F0C8                   JSR     CURSOUT     ; FLASH CURSOR & SCALE X & Y
0015| A9 80                     LDA     #DELAY
0017| 20 A1CC                   JSR     QWAIT
001A| 20 F0C8                   JSR     CURSOUT
001D| AD FFCF                   LDA     CFFF
0020| A9 C3                     LDA     #0C3
0022| 8D F807                   STA     MSLOT       ; RESET SUP'RTERM
0025| AA                        TAX
0026| 60                        RTS
0027|                   ;
0027|                   ; ON EXIT >>> PEN UP/DOWN        -      640 (decimal)
0027|                   ;             SCALED X (HIGH BYTE)  - 646
0027|                   ;             SCALED X (LOW BYTE )  - 645
0027|                   ;             SCALED Y (HIGH BYTE)  - 648
0027|                   ;             SCALED Y (LOW BYTE )  - 647

Assembly complete:        62 lines
     0   Errors flagged on this Assembly
```

DESIGN. At first, I had intended to include the initialization of the logic symbols in the program, but the program got very large, very fast. I then decided to create a file with the logic symbols in it (I needed the practice). I used the example on one of the disks supplied with the Apple's language card (APPLE3, the butterflies program) as a basis for converting groups of strings into boolean arrays. The program LOGIC.SYMB.TEXT (see listing 2) was the result.

As you can see from the listing, each named shape is a square array of pixels (picture elements), 16 elements on a side. Some of the larger devices (eg: JK flip-flop, MSI) are made up of two shapes, end to end. There are ten initialization procedures (INIT1 thru INIT10): Pascal, it seems, has a limit to the number of (code) words in a procedure. When executed, the program creates two files called LOGIC.CHARSET and USER.CHARSET. The files must exist on the prefix disk prior to running LOGICDESIGN. The source file (LOGIC.SYMB.TEXT) and the code file (LOGIC.SYM.CODE) used to create the character-set files

should be saved elsewhere, as they occupy too much room on the disk and are not needed once the character sets have been created.

The program LOGICDESIGN (see listing 3, on page 415) performs an initialization of the tablet and then, waiting for input from the tablet, loops in the procedure MYPLOT. The bottom three rows of the tablet are used as a menu (see figure 1) for selecting the device to be plotted or the function to be executed.

The command menu, from the lower leftmost corner of the tablet to the lower right-hand corner (ie: the bottom row), is decoded as follows:

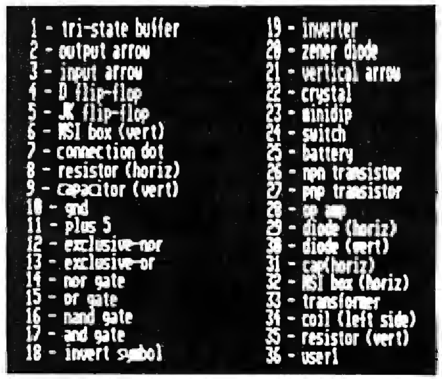
CLEAR SCREEN: clears the graphics screen
CLEAR BLOCK: clears a section of the screen
CLEAR LOCK: clears the horizontal and vertical locks
HORIZ LOCK: sets the horizontal lock
VERT LOCK: sets the vertical lock
LIST ITEMS: lists the device names on the text screen
LOAD: loads an image file to the HIRES screen
SAVE: saves the HIRES screen to an image file
EXIT: leaves the program (does a SAVE first)
PRINT SCREEN: transfers the HIRES screen to the printer
ERASE BORDER: removes the border from the HIRES screen
DRAW BORDER: draws a border around the HIRES screen
LABEL: writes characters on the HIRES screen
DRAW LINES: draws horizontal or vertical lines only
EAT RIGHT: deletes lines going to the right
EAT LEFT: deletes lines going to the left
EAT UP: deletes lines going upwards
EAT DOWN: deletes lines going downward
SET USER: allows the user to create a new device
TOGGLE DEBUG FLAG: sets/clears debug flag

The next two rows up from the bottom of the tablet are used to select devices for plotting (see figure 1). Representations of the devices that can be plotted are shown in the boxes in these two rows. When the program is running, the user simply selects the device he wants to plot or the command he wants to perform from the tablet's menu. The Sup'r'terminal screen displays the active mode and other useful information (see photos 2a and 2b).

I wrote the program LOGICDESIGN a little at a time and added new functions as I debugged the old ones. Such is the beauty of Pascal. Two procedures do most of the work: the first, MYPLOT, is inside a never-ending loop in the main program (the variable HELLFREEZESOVER does not ever become true). MYPLOT calls MENU if the pen is pushed down outside of the tablet area that is mapped on the Apple's HIRES (high-resolution) screen (ie: if VALIDXY is false). If the pen is pushed down within the screen area, the active device is plotted (if you're in the plotting mode).

When you enter MYPLOT, it checks to see if the pen is down over the CLEAR pad in the upper left-hand corner of the tablet: this executes a special function. It exclusive-OR's the last device plotted, thus making it disappear from the screen. The variable D is used to determine which device to plot. If D is 0, then nothing is plotted. The procedure MENU selects the device that will be plotted or calls a sequence of procedures to effect a specific function. MENU begins by setting D to 0. It then divides X and Y by a value that neatly generates integers concurrent with the boundaries of the boxes on the tablet. (The actual value of the divisor may be different on another tablet.) A set of nested

(2a)



(2b)

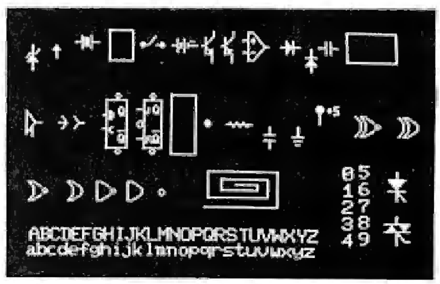


Photo 2: *Component types available for drafting. All figures shown are created by the program in listing 2.*

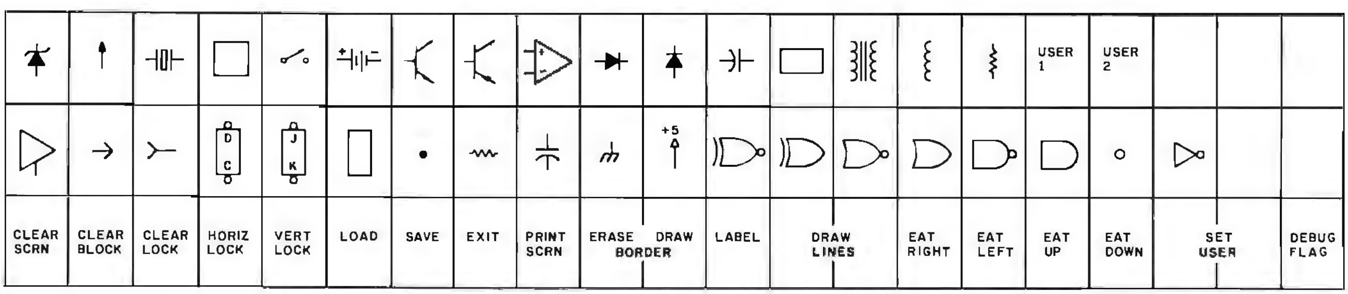


Figure 1: *Graphics Tablet menu. The bottom row is dedicated to plotting functions, while the second and third rows from the bottom contain component types to be plotted.*

CASE statements determines the function that is to be performed.

The procedures SAVESCREEN and LOADSCREEN can (with one or two minor alterations) be found in the Pascal Reference Manual in section 2.2.6.2 (untyped files). These procedures are used to save (or load) the Apple's HIRES display to (or from) a disk file. The disk files are sixteen blocks long (8 K bytes). HIRES image files are appended with .SCRN for the purpose of directory identification. I have considered compressing the data in order to save disk space, but unfortunately I haven't found a method that guarantees this result. I have tried various approaches, including counting the number of similar dots in succession. This works, but if there are more than 4 K changes (on-to-off, off-to-on) then the disk file exceeds sixteen blocks. (I'd be glad to hear any innovative ideas in this area.)

The procedures CONVERTFROM and CONVERTO are used to convert small integer values (between 0 and 16) to and from the boolean array USER3. The values that are stored are the plot offsets used by the "drawblock" statement in MYPLOT. The offset aligns the cursor with a specific point in the plot array. CONVERTO is called by SETUSR. SETUSR allows you to define two devices that are then saved on disk in the file USER.CHARSET, along with the offset information.

GETXY reads the tablet. When this routine is called, it loops around the external procedure READPAD *until* the pen is pushed down. It then sets the condition of VALIDXY and fixes the Y value. (The tablet's 0,0 is at the top left, Pascal's is the bottom left.)

The final routine that I will mention is PRINTOUT. PRINTOUT is decidedly implementation-dependent. My printer is a HyType I (old, slow, and occasionally reliable) with a serial interface, and it has a limited graphics capability. This limitation is primarily one of time: at 300 bps (bits per second) it takes about 1½ hours to print the screen; to generate a dot, I print "dot-space-space", and "space-space" for no dot. (See figure 2.) In order to increase the speed of this process, I look ahead at the beginning of each line, and stop after the last dot in the line. (I also try to avoid printing pictures with borders.)

The sequence of screens in photo 3 labeled "CMOS frequency doubler" gives you some idea of the ease of designing with this system. It took about 1½ minutes to reach the stage shown in photo 3. I then changed the

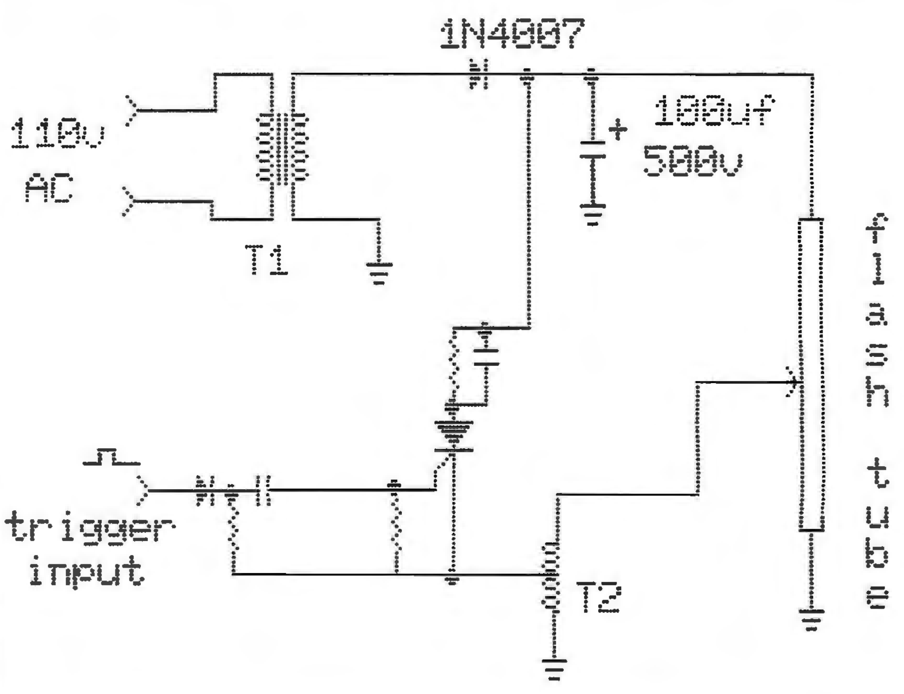
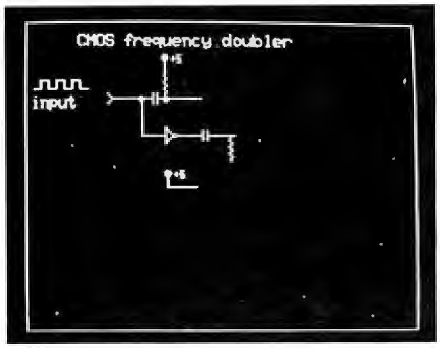
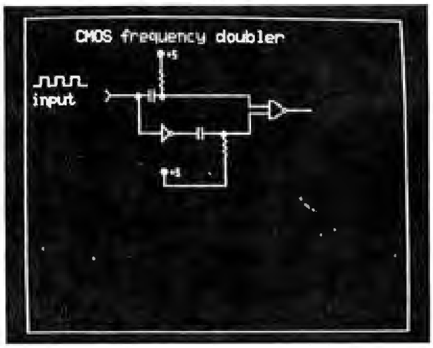


Figure 2: *Sample hard copy produced by HyType I with serial interface.*

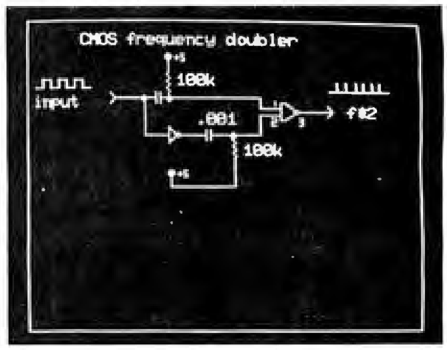
(3a)



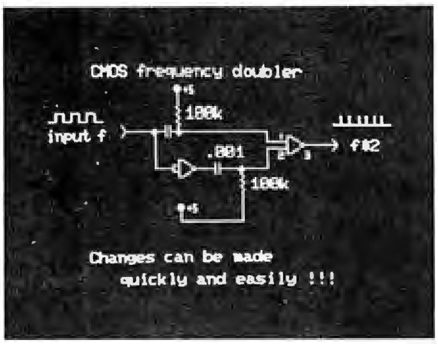
(3b)



(3c)



(3d)



(3e)

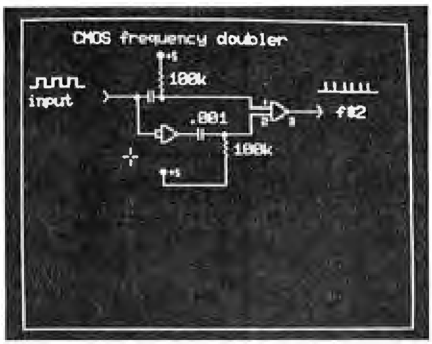
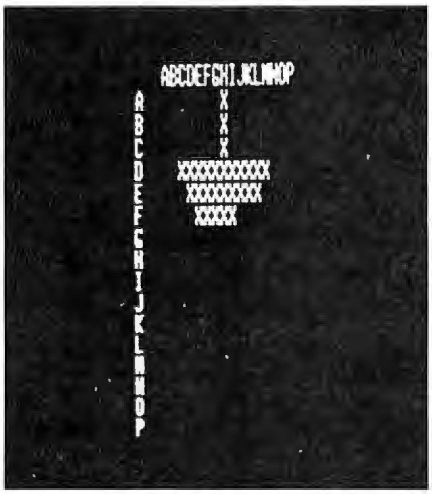


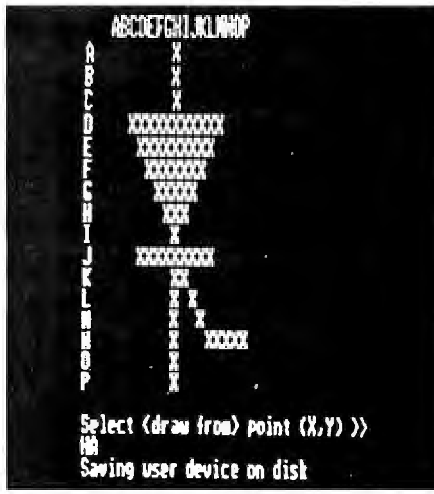
Photo 3: *Sequence of displays in an actual design project. Diagrams 3a thru 3c were created in less than two minutes, and the circuit was slightly changed in photo 3d. The finished product is shown in photo 3e.*

Photo 4: *Definition of nonstandard devices. Each component is composed of a 16 by 16 pixel array; two menu items allow users to draw their own components on the video screen.*

(4a)



(4b)



inverter to a NAND gate (used as an inverter) to minimize package count.

The tablet's command *set user* allows you to define two devices of your own choosing. These are plotted as USER1 and USER2. When the command is called, the text screen displays a blank 16 by 16 array (see photo 4). The array is filled by typing a space for a space and any alphanumeric character for a dot. The backspace key moves the cursor back, and the escape key aborts the command. After the last position in the array has been filled, the system asks for the coordinates of the cursor. This is the position that the cursor will be in when the array is plotted.

This program has all of the appearances of one that will grow forever. I already have several ideas for additions, and have had abundant input from friends. And although I have managed to resist the urge to modify long enough to write this article, now that it's done....Did I hear someone say, "Boolean equations as input, schematics as output"?■

Listing 2: *Apple Pascal program INITLOGIC for creating the components displayed on the video monitor.*

```
 1     1:D     1 (*$L PRINTER:*)
 1     1:D     1 (*$I PART1.SYMB.TEXT*)
 1     1:D     1 (****************************************************************
 1     1:D     1 *                                                               *
 1     1:D     1 *        This program creates the file 'LOGIC.CHARSET'          *
 1     1:D     1 *        which is used by LOGICDESIGN. Each character           *
 1     1:D     1 *        is a 16 by 16 array (of boolean .. i.e. true           *
 1     1:D     1 *        or false .. 1 or 0).                                   *
 1     1:D     1 *                                                               *
 1     1:D     1 *        Dan Sokol - 2 Apr 80                                   *
 1     1:D     1 *                                                               *
 1     1:D     1 ****************************************************************)
 1     1:D     1 Program INITLOGIC;
```

Listing 2 continued on page 398

Listing 2 continued:

```
 1      1:D       3
 1      1:D       3  type SHAPE = packed array [0..15,0..15] of boolean;
 1      1:D       3
 1      1:D       3  var INVERTER,NAND,NOR,ORGATE,ANDGATE,DTOP,DBOT,JKTOP,JKBOT,BUFFER,GND,PLUS5,
 1      1:D       3      MSITOP,MSIBOT,INV,INTHING,OUT,DOT,CAP,RESISTOR,XOR,XNOR,HCAP,DIODE,SW,BAT,
 1      1:D       3      MINIDIP,HDIODE,OPAMP,NPN,PNP,MINIDIP,HMSIL,HMSIR,XTAL,WIPER,ZENER,
 1      1:D       3      LCOIL,RCOIL,VRESIST,USER1,USER2,USER3 : SHAPE;
 1      1:D     691
 1      1:D     691      USERFILE,SHAPEFILE : file of SHAPE;
 1      1:D    1323
 1      1:D    1323      I,J,ROW : integer;
 1      1:D    1326
 1      1:D    1326      BIT : boolean;
 1      1:D    1327
 1      1:D    1327
 1      1:D    1327
 1      1:D    1327  (**************  MAKESHAPES  ***********************************
 1      1:D    1327  *                                                              *
 1      1:D    1327  *       Converts strings to boolean arrays.                    *
 1      1:D    1327  *       This procedure is borrowed from GRAFDEMO.TEXT          *
 1      1:D    1327  *       on APPLE3:                                             *
 1      1:D    1327  *                                                              *
 1      1:D    1327  *       Called from : INIT1 thru INIT10.                       *
 1      1:D    1327  *                                                              *
 1      1:D    1327  ***************************************************************)
 1      2:D       1  procedure MAKESHAPES(var BITMAP:shape;ST:string);
 1      2:0       0          begin
 1      2:1       0           for J:=1 to length(ST) do
 1      2:2      23            begin
 1      2:3      23              BIT:=(ST[J]<>' ');
 1      2:3      35              BITMAP[ROW,J-1]:=BIT;
 1      2:2      59            end;
 1      2:1      69           ROW:=ROW-1;
 1      2:0      77         end;
 1      2:0      92
 1      2:0      92  (*$P*)
 1      2:0      92  (**************  SAVESHAPES  ***********************************
 1      2:0      92  *                                                              *
 1      2:0      92  *       Saves the ARRAYS in a disk file.                       *
 1      2:0      92  *                                                              *
 1      2:0      92  *       Called from : Main program loop.                       *
 1      2:0      92  *                                                              *
 1      2:0      92  ***************************************************************)
 1      3:D       1  procedure SAVESHAPES;
 1      3:0       0          begin
 1      3:1       0            rewrite(SHAPEFILE,'LOGIC.CHARSET');
 1      3:1      26            SHAPEFILE^:=INVERTER; put(SHAPEFILE);
 1      3:1      42            SHAPEFILE^:=NAND; put(SHAPEFILE);
 1      3:1      58            SHAPEFILE^:=NOR; put(SHAPEFILE);
 1      3:1      74            SHAPEFILE^:=ORGATE; put(SHAPEFILE);
 1      3:1      90            SHAPEFILE^:=ANDGATE; put(SHAPEFILE);
 1      3:1     106            SHAPEFILE^:=DTOP; put(SHAPEFILE);
 1      3:1     122            SHAPEFILE^:=DBOT; put(SHAPEFILE);
 1      3:1     138            SHAPEFILE^:=JKTOP; put(SHAPEFILE);
 1      3:1     154            SHAPEFILE^:=JKBOT; put(SHAPEFILE);
 1      3:1     170            SHAPEFILE^:=BUFFER; put(SHAPEFILE);
 1      3:1     186            SHAPEFILE^:=GND; put(SHAPEFILE);
 1      3:1     202            SHAPEFILE^:=PLUS5; put(SHAPEFILE);
 1      3:1     218            SHAPEFILE^:=MSITOP; put(SHAPEFILE);
 1      3:1     234            SHAPEFILE^:=MSIBOT; put(SHAPEFILE);
 1      3:1     250            SHAPEFILE^:=INV; put(SHAPEFILE);
 1      3:1     266            SHAPEFILE^:=INTHING; put(SHAPEFILE);
 1      3:1     282            SHAPEFILE^:=OUT; put(SHAPEFILE);
 1      3:1     298            SHAPEFILE^:=DOT; put(SHAPEFILE);
 1      3:1     314            SHAPEFILE^:=CAP; put(SHAPEFILE);
 1      3:1     330            SHAPEFILE^:=RESISTOR; put(SHAPEFILE);
 1      3:1     346            SHAPEFILE^:=XOR; put(SHAPEFILE);
 1      3:1     362            SHAPEFILE^:=XNOR; put(SHAPEFILE);
 1      3:1     378            SHAPEFILE^:=HCAP; put(SHAPEFILE);
 1      3:1     394            SHAPEFILE^:=DIODE; put(SHAPEFILE);
 1      3:1     410            SHAPEFILE^:=HDIODE; put(SHAPEFILE);
 1      3:1     426            SHAPEFILE^:=OPAMP; put(SHAPEFILE);
 1      3:1     442            SHAPEFILE^:=NPN; put(SHAPEFILE);
 1      3:1     458            SHAPEFILE^:=PNP; put(SHAPEFILE);
 1      3:1     474            SHAPEFILE^:=BAT; put(SHAPEFILE);
 1      3:1     490            SHAPEFILE^:=SW; put(SHAPEFILE);
 1      3:1     506            SHAPEFILE^:=MINIDIP; put(SHAPEFILE);
 1      3:1     522            SHAPEFILE^:=HMSIL; put(SHAPEFILE);
 1      3:1     538            SHAPEFILE^:=HMSIR; put(SHAPEFILE);
 1      3:1     554            SHAPEFILE^:=XTAL; put(SHAPEFILE);
```

Listing 2 continued on page 400

Listing 2 continued:

```
1    3:1    570            SHAPEFILE^:=WIPER; put(SHAPEFILE);
1    3:1    585            SHAPEFILE^:=ZENER; put(SHAPEFILE);
1    3:1    600            SHAPEFILE^:=LCOIL; put(SHAPEFILE);
1    3:1    615            SHAPEFILE^:=RCOIL; put(SHAPEFILE);
1    3:1    630            SHAPEFILE^:=VRESIST; put(SHAPEFILE);
1    3:1    645            close(SHAPEFILE,lock);            (* create dummy userfile *)
1    3:1    654            rewrite(USERFILE,'USER.CHARSET');
1    3:1    679            USERFILE^:=USER1; put(USERFILE);
1    3:1    694            USERFILE^:=USER2; put(USERFILE);
1    3:1    709            USERFILE^:=USER3; put(USERFILE);
1    3:1    724            close(USERFILE,lock);
1    3:1    733          end;
1    3:0    746  (*$P*)
1    3:0    746  (****************  INIT1  ******************************************
1    3:0    746  *                                                                  *
1    3:0    746  *        Creates arrays from strings.                              *
1    3:0    746  *                                                                  *
1    3:0    746  *        Called from : Main program loop.                          *
1    3:0    746  *                                                                  *
1    3:0    746  *******************************************************************)
1    4:D      1  procedure INIT1;
1    4:0      0          begin
1    4:1      0            write('.');
1    4:1     10            ROW:=15;
1    4:1     14            MAKESHAPES(INV,' XX             ');
1    4:1     38            MAKESHAPES(INV,'X  X            ');
1    4:1     62            MAKESHAPES(INV,'X  X            ');
1    4:1     86            MAKESHAPES(INV,' XX             ');
1    4:1    110            for I:=1 to 12 do
1    4:2    124            MAKESHAPES(INV,'                ');
1    4:1    158            ROW:=15;
1    4:1    162            MAKESHAPES(INVERTER,'X               ');
1    4:1    186            MAKESHAPES(INVERTER,'XX              ');
1    4:1    210            MAKESHAPES(INVERTER,'X X             ');
1    4:1    234            MAKESHAPES(INVERTER,'X  X            ');
1    4:1    258            MAKESHAPES(INVERTER,'X   X XX        ');
1    4:1    282            MAKESHAPES(INVERTER,'X    X  X       ');
1    4:1    306            MAKESHAPES(INVERTER,'X   X XX        ');
```

Listing 2 continued on page 402

Listing 2 continued:

```
1   4:1   330       MAKESHAPES(INVERTER,'X  X            ');
1   4:1   354       MAKESHAPES(INVERTER,'X X             ');
1   4:1   378       MAKESHAPES(INVERTER,'XX              ');
1   4:1   402       MAKESHAPES(INVERTER,'X               ');
1   4:1   426       for I:=1 to 5 do
1   4:2   440       MAKESHAPES(INVERTER,'                ');
1   4:1   474       ROW:=15;
1   4:1   478       MAKESHAPES(ORGATE,'XXXX            ');
1   4:1   502       MAKESHAPES(ORGATE,' X  XX          ');
1   4:1   526       MAKESHAPES(ORGATE,'  X   XX        ');
1   4:1   550       MAKESHAPES(ORGATE,'   X    X       ');
1   4:1   574       MAKESHAPES(ORGATE,'   X     X      ');
1   4:1   598       MAKESHAPES(ORGATE,'   X     X      ');
1   4:1   622       MAKESHAPES(ORGATE,'   X     X      ');
1   4:1   646       MAKESHAPES(ORGATE,'   X    X       ');
1   4:1   670       MAKESHAPES(ORGATE,'  X   XX        ');
1   4:1   694       MAKESHAPES(ORGATE,' X  XX          ');
1   4:1   718       MAKESHAPES(ORGATE,'XXXX            ');
1   4:1   742       for I:=1 to 5 do
1   4:2   756       MAKESHAPES(ORGATE,'                ');
1   4:1   790       ROW:=15;
1   4:1   794       MAKESHAPES(NOR,'XXXX            ');
1   4:1   818       MAKESHAPES(NOR,' X  XX          ');
1   4:1   842       MAKESHAPES(NOR,'  X   XX        ');
1   4:1   866       MAKESHAPES(NOR,'   X    X       ');
1   4:1   890       MAKESHAPES(NOR,'   X      XX    ');
1   4:1   914       MAKESHAPES(NOR,'   X     X  X   ');
1   4:1   938       MAKESHAPES(NOR,'   X      XX    ');
1   4:1   962       MAKESHAPES(NOR,'   X    X       ');
1   4:1   986       MAKESHAPES(NOR,'  X   XX        ');
1   4:1  1010       MAKESHAPES(NOR,' X  XX          ');
1   4:1  1034       MAKESHAPES(NOR,'XXXX            ');
1   4:1  1058       for I:=1 to 5 do
1   4:2  1072       MAKESHAPES(NOR,'                ');
1   4:0  1106     end;
1   4:0  1126 (*$P*)
1   4:0  1126 (***************  INIT2  ****************************************
1   4:0  1126 *                                                                *
1   4:0  1126 *       Creates arrays from strings.                             *
1   4:0  1126 *                                                                *
1   4:0  1126 *       Called from : Main program loop.                         *
1   4:0  1126 *                                                                *
1   4:0  1126 *****************************************************************)
1   5:D     1 procedure INIT2;
1   5:0     0     begin
1   5:1     0       write('.');
1   5:1    10       ROW:=15;
1   5:1    14       MAKESHAPES(XOR,'X  XXXX         ');
1   5:1    38       MAKESHAPES(XOR,' X  X  XX       ');
1   5:1    62       MAKESHAPES(XOR,'  X  X   XX     ');
1   5:1    86       MAKESHAPES(XOR,'   X  X    X    ');
1   5:1   110       MAKESHAPES(XOR,'   X  X     X   ');
1   5:1   134       MAKESHAPES(XOR,'   X  X     X   ');
1   5:1   158       MAKESHAPES(XOR,'   X  X     X   ');
1   5:1   182       MAKESHAPES(XOR,'   X  X    X    ');
1   5:1   206       MAKESHAPES(XOR,'  X  X   XX     ');
1   5:1   230       MAKESHAPES(XOR,' X  X  XX       ');
1   5:1   254       MAKESHAPES(XOR,'X  XXXX         ');
1   5:1   278       for I:=1 to 5 do
1   5:2   292       MAKESHAPES(XOR,'                ');
1   5:1   326       ROW:=15;
1   5:1   330       MAKESHAPES(XNOR,'X  XXXX         ');
1   5:1   354       MAKESHAPES(XNOR,' X  X  XX       ');
1   5:1   378       MAKESHAPES(XNOR,'  X  X   XX     ');
1   5:1   402       MAKESHAPES(XNOR,'   X  X    X    ');
1   5:1   426       MAKESHAPES(XNOR,'   X  X      XX ');
1   5:1   450       MAKESHAPES(XNOR,'   X  X     X  X');
1   5:1   474       MAKESHAPES(XNOR,'   X  X      XX ');
1   5:1   498       MAKESHAPES(XNOR,'   X  X    X    ');
1   5:1   522       MAKESHAPES(XNOR,'  X  X   XX     ');
1   5:1   546       MAKESHAPES(XNOR,' X  X  XX       ');
1   5:1   570       MAKESHAPES(XNOR,'X  XXXX         ');
1   5:1   594       for I:=1 to 5 do
1   5:2   608       MAKESHAPES(XNOR,'                ');
1   5:1   642       ROW:=15;
1   5:1   646       MAKESHAPES(NAND,'XXXX            ');
1   5:1   670       MAKESHAPES(NAND,'X   XX          ');
1   5:1   694       MAKESHAPES(NAND,'X     XX        ');
1   5:1   718       MAKESHAPES(NAND,'X       X       ');
1   5:1   742       MAKESHAPES(NAND,'X         XX    ');
1   5:1   766       MAKESHAPES(NAND,'X        X  X   ');
1   5:1   790       MAKESHAPES(NAND,'X         XX    ');
1   5:1   814       MAKESHAPES(NAND,'X       X       ');
1   5:1   838       MAKESHAPES(NAND,'X     XX        ');
1   5:1   862       MAKESHAPES(NAND,'X   XX          ');
```

Listing 2 continued on page 404

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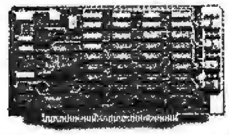

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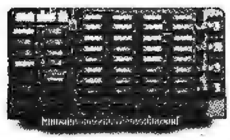

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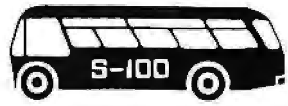

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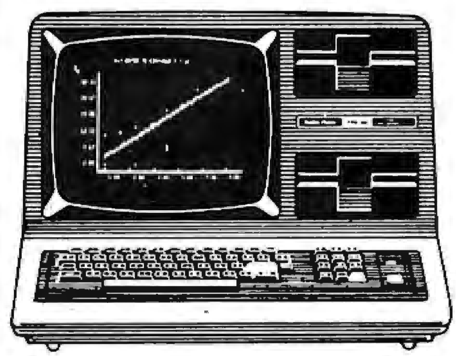

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Listing 2 continued:

```
1    5:1    886            MAKESHAPES(NAND,'XXXX            ');
1    5:1    910            for I:=1 to 5 do
1    5:2    924            MAKESHAPES(NAND,'                ');
1    5:0    958          end;
1    5:0    976
1    5:0    976 (*$P*)
1    5:0    976 (***************  INIT3  *****************************************
1    5:0    976 *                                                                 *
1    5:0    976 *       Creates arrays from strings.                              *
1    5:0    976 *                                                                 *
1    5:0    976 *       Called from : Main program loop.                          *
1    5:0    976 *                                                                 *
1    5:0    976 ******************************************************************)
1    6:D      1 procedure INIT3;
1    6:0      0          begin
1    6:1      0            write('.');
1    6:1     10            ROW:=15;
1    6:1     14            MAKESHAPES(ANDGATE,'XXXX             ');
1    6:1     38            MAKESHAPES(ANDGATE,'X   XX           ');
1    6:1     62            MAKESHAPES(ANDGATE,'X     XX         ');
1    6:1     86            MAKESHAPES(ANDGATE,'X       X        ');
1    6:1    110            MAKESHAPES(ANDGATE,'X        X       ');
1    6:1    134            MAKESHAPES(ANDGATE,'X        X       ');
1    6:1    158            MAKESHAPES(ANDGATE,'X        X       ');
1    6:1    182            MAKESHAPES(ANDGATE,'X       X        ');
1    6:1    206            MAKESHAPES(ANDGATE,'X     XX         ');
1    6:1    230            MAKESHAPES(ANDGATE,'X   XX           ');
1    6:1    254            MAKESHAPES(ANDGATE,'XXXX             ');
1    6:1    278            for I:=1 to 5 do
1    6:2    292            MAKESHAPES(ANDGATE,'                 ');
1    6:1    326            ROW:=15;
1    6:1    330            MAKESHAPES(BUFFER,'X                ');
1    6:1    354            MAKESHAPES(BUFFER,'XX               ');
1    6:1    378            MAKESHAPES(BUFFER,'X X              ');
1    6:1    402            MAKESHAPES(BUFFER,'X  X             ');
1    6:1    426            MAKESHAPES(BUFFER,'X   X            ');
1    6:1    450            MAKESHAPES(BUFFER,'X    X           ');
1    6:1    474            MAKESHAPES(BUFFER,'X     XXXXX      ');
1    6:1    498            MAKESHAPES(BUFFER,'X    X           ');
1    6:1    522            MAKESHAPES(BUFFER,'X   X            ');
1    6:1    546            MAKESHAPES(BUFFER,'X  XX            ');
1    6:1    570            MAKESHAPES(BUFFER,'X X X            ');
1    6:1    594            MAKESHAPES(BUFFER,'XX  X            ');
1    6:1    618            MAKESHAPES(BUFFER,'X   X            ');
1    6:1    642            MAKESHAPES(BUFFER,'    X            ');
1    6:1    666            MAKESHAPES(BUFFER,'                 ');
1    6:1    690            MAKESHAPES(BUFFER,'                 ');
1    6:1    714            ROW:=15;
1    6:1    718            MAKESHAPES(RESISTOR,' X   X   X     ');
1    6:1    742            MAKESHAPES(RESISTOR,'XX X X X X X XXX');
1    6:1    766            MAKESHAPES(RESISTOR,'    X   X   X   ');
1    6:1    790            for I:=1 to 13 do
1    6:2    804            MAKESHAPES(RESISTOR,'                ');
1    6:1    838            ROW:=15;
1    6:1    842            for I:=1 to 5 do
1    6:2    856            MAKESHAPES(GND,'   X           ');
1    6:1    890            MAKESHAPES(GND,'XXXXXXX         ');
1    6:1    914            MAKESHAPES(GND,'                ');
1    6:1    938            MAKESHAPES(GND,' XXXXX          ');
1    6:1    962            MAKESHAPES(GND,'                ');
1    6:1    986            MAKESHAPES(GND,'  XXX           ');
1    6:1   1010            for I:=1 to 6 do
1    6:2   1024            MAKESHAPES(GND,'                ');
1    6:0   1058          end;
1    6:0   1078 (*$P*)
1    6:0   1078 (***************  INIT4  *****************************************
1    6:0   1078 *                                                                 *
1    6:0   1078 *       Creates arrays from strings.                              *
1    6:0   1078 *                                                                 *
1    6:0   1078 *       Called from : Main program loop.                          *
1    6:0   1078 *                                                                 *
1    6:0   1078 ******************************************************************)
1    7:D      1 procedure INIT4;
1    7:0      0          begin
1    7:1      0            write('.');
1    7:1     10            ROW:=15;
1    7:1     14            MAKESHAPES(PLUS5,' XXX        XXX  ');
1    7:1     38            MAKESHAPES(PLUS5,'XXXXX    X  X    ');
1    7:1     62            MAKESHAPES(PLUS5,'XXXXX   XXX XXX  ');
1    7:1     86            MAKESHAPES(PLUS5,' XXX     X    X  ');
1    7:1    110            MAKESHAPES(PLUS5,'  X         XXX  ');
1    7:1    134            for I:=1 to 5 do
1    7:2    148            MAKESHAPES(PLUS5,'  X              ');
1    7:1    182            for I:=1 to 6 do
1    7:2    196            MAKESHAPES(PLUS5,'                 ');
```

Listing 2 continued on page 406

Listing 2 continued:

```
 1    7:1   230                ROW:=15;
 1    7:1   234                for I:=1 to 4 do
 1    7:2   248                MAKESHAPES(CAP,'   X            ');
 1    7:1   282                MAKESHAPES(CAP,'XXXXXXX         ');
 1    7:1   306                MAKESHAPES(CAP,'                ');
 1    7:1   330                MAKESHAPES(CAP,'                ');
 1    7:1   354                MAKESHAPES(CAP,'XXXXXXX         ');
 1    7:1   378                for I:=1 to 4 do
 1    7:2   392                MAKESHAPES(CAP,'   X            ');
 1    7:1   426                for I:=1 to 4 do
 1    7:2   440                MAKESHAPES(CAP,'                ');
 1    7:1   474                ROW:=15;
 1    7:1   478                MAKESHAPES(DOT,' XX             ');
 1    7:1   502                MAKESHAPES(DOT,'XXXX            ');
 1    7:1   526                MAKESHAPES(DOT,'XXXX            ');
 1    7:1   550                MAKESHAPES(DOT,' XX             ');
 1    7:1   574                for I:=1 to 12 do
 1    7:2   588                MAKESHAPES(DOT,'                ');
 1    7:1   622                ROW:=15;
 1    7:1   626                MAKESHAPES(INTHING,'X               ');
 1    7:1   650                MAKESHAPES(INTHING,' X              ');
 1    7:1   674                MAKESHAPES(INTHING,'  X             ');
 1    7:1   698                MAKESHAPES(INTHING,'   XXXX         ');
 1    7:1   722                MAKESHAPES(INTHING,'  X             ');
 1    7:1   746                MAKESHAPES(INTHING,' X              ');
 1    7:1   770                MAKESHAPES(INTHING,'X               ');
 1    7:1   794                for I:=1 to 9 do
 1    7:2   808                MAKESHAPES(INTHING,'                ');
 1    7:0   842              end;
 1    7:0   868 (*SP*)
 1    7:0   868 (***************  INIT5  ****************************************
 1    7:0   868 *                                                               *
 1    7:0   868 *       Creates arrays from strings.                            *
 1    7:0   868 *                                                               *
 1    7:0   868 *       Called from : Main program loop.                        *
 1    7:0   868 *                                                               *
 1    7:0   868 ****************************************************************)
 1    8:D     1 procedure INIT5;
 1    8:0     0              begin
 1    8:1     0                write('.');
 1    8:1    10                ROW:=15;
 1    8:1    14                MAKESHAPES(OUT,'  X             ');
 1    8:1    38                MAKESHAPES(OUT,'   X            ');
 1    8:1    62                MAKESHAPES(OUT,'    X           ');
 1    8:1    86                MAKESHAPES(OUT,'XXXXXX          ');
 1    8:1   110                MAKESHAPES(OUT,'    X           ');
 1    8:1   134                MAKESHAPES(OUT,'   X            ');
 1    8:1   158                MAKESHAPES(OUT,'  X             ');
 1    8:1   182                for I:=1 to 9 do
 1    8:2   196                MAKESHAPES(OUT,'                ');
 1    8:1   230                ROW:=15;
 1    8:1   234                MAKESHAPES(MSITOP,'XXXXXXXXXXXXXXXX');
 1    8:1   258                for I:=1 to 15 do
 1    8:2   272                MAKESHAPES(MSITOP,'X              X');
 1    8:1   306                ROW:=15;
 1    8:1   310                for I:=1 to 15 do
 1    8:2   324                MAKESHAPES(MSIBOT,'X              X');
 1    8:1   358                MAKESHAPES(MSIBOT,'XXXXXXXXXXXXXXXX');
 1    8:1   382                ROW:=15;
 1    8:1   386                MAKESHAPES(JKTOP,'       XX      ');
 1    8:1   410                MAKESHAPES(JKTOP,'      X  X     ');
 1    8:1   434                MAKESHAPES(JKTOP,'       XX      ');
 1    8:1   458                MAKESHAPES(JKTOP,'    XXXXXXXXXXX');
 1    8:1   482                MAKESHAPES(JKTOP,'    X         X');
 1    8:1   506                MAKESHAPES(JKTOP,'    X         X');
 1    8:1   530                MAKESHAPES(JKTOP,'    X      XX X');
 1    8:1   554                MAKESHAPES(JKTOP,'    X  X  X  X X');
 1    8:1   578                MAKESHAPES(JKTOP,'XXXXX  X  X  X X');
 1    8:1   602                MAKESHAPES(JKTOP,'    XX X  X XX X');
 1    8:1   626                MAKESHAPES(JKTOP,'    X X    XXX X');
 1    8:1   650                for I:=1 to 3 do
 1    8:2   664                MAKESHAPES(JKTOP,'    X          X');
 1    8:1   698                MAKESHAPES(JKTOP,' XX X          X');
 1    8:1   722                MAKESHAPES(JKTOP,'X  XX          X');
 1    8:1   746                ROW:=15;
 1    8:1   750                MAKESHAPES(JKBOT,'X  XX          X');
 1    8:1   774                MAKESHAPES(JKBOT,' XX X          X');
 1    8:1   798                MAKESHAPES(JKBOT,'    X          X');
 1    8:1   822                MAKESHAPES(JKBOT,'    X     XXXX X');
 1    8:1   846                MAKESHAPES(JKBOT,'    X          X');
 1    8:1   870                MAKESHAPES(JKBOT,'    X       XX X');
 1    8:1   894                MAKESHAPES(JKBOT,'    X X X X  X X');
 1    8:1   918                MAKESHAPES(JKBOT,'XXXXX XX  X  X X');
 1    8:1   942                MAKESHAPES(JKBOT,'    X X X X XX X');
```

Listing 2 continued on page 408

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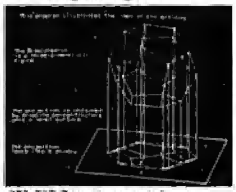
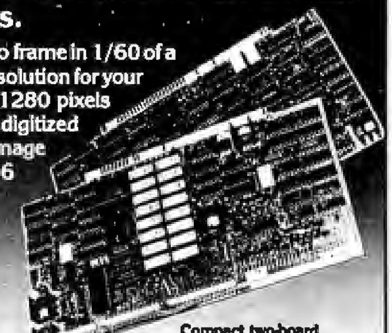


480x512 Computer generated



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Listing 2 continued:

```
1    8:1   966              MAKESHAPES(JKBOT,'    X X  X XXX X');
1    8:1   990              MAKESHAPES(JKBOT,'    X          X');
1    8:1  1014              MAKESHAPES(JKBOT,'    X          X');
1    8:1  1038              MAKESHAPES(JKBOT,'    XXXXXXXXXXXX');
1    8:1  1062              MAKESHAPES(JKBOT,'         XX     ');
1    8:1  1086              MAKESHAPES(JKBOT,'        X  X    ');
1    8:1  1110              MAKESHAPES(JKBOT,'         XX     ');
1    8:0  1134            end;
1    8:0  1154 (*$I PART1.SYMB.TEXT*)
1    8:0  1154 (*$I PART2.SYMB.TEXT*)
1    8:0  1154 (*$P*)
1    8:0  1154 (***************  INIT6  *********************************
1    8:0  1154 *                                                         *
1    8:0  1154 *       Creates arrays from strings.                      *
1    8:0  1154 *                                                         *
1    8:0  1154 *       Called from : Main program.                       *
1    8:0  1154 *                                                         *
1    8:0  1154 **********************************************************)
1    9:D     1 procedure INIT6;
1    9:0     0            begin
1    9:1     0              write('.');
1    9:1    10              ROW:=15;
1    9:1    14              MAKESHAPES(DTOP,'         XX     ');
1    9:1    38              MAKESHAPES(DTOP,'        X  X    ');
1    9:1    62              MAKESHAPES(DTOP,'         XX     ');
1    9:1    86              MAKESHAPES(DTOP,'  XXXXXXXXXXXXXX');
1    9:1   110              for I:=1 to 3 do
1    9:2   124              MAKESHAPES(DTOP,'  X            X');
1    9:1   158              MAKESHAPES(DTOP,'  X        XX  X');
1    9:1   182              MAKESHAPES(DTOP,'  X       X  X X');
1    9:1   206              MAKESHAPES(DTOP,'  X XX    X  X X');
1    9:1   230              MAKESHAPES(DTOP,'  X X X   X XX X');
1    9:1   254              MAKESHAPES(DTOP,'XXX X X    XXX X');
1    9:1   278              MAKESHAPES(DTOP,'  X X X        X');
1    9:1   302              MAKESHAPES(DTOP,'  X XX         X');
1    9:1   326              for I:=1 to 2 do
1    9:2   340              MAKESHAPES(DTOP,'  X            X');
1    9:1   374              ROW:=15;
1    9:1   378              MAKESHAPES(DBOT,'  X            X');
1    9:1   402              MAKESHAPES(DBOT,'  X  XX        X');
1    9:1   426              MAKESHAPES(DBOT,'XXX X          X');
```

Listing 2 continued on page 410

Circle 44 on inquiry card.

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Circle 381 on inquiry card.

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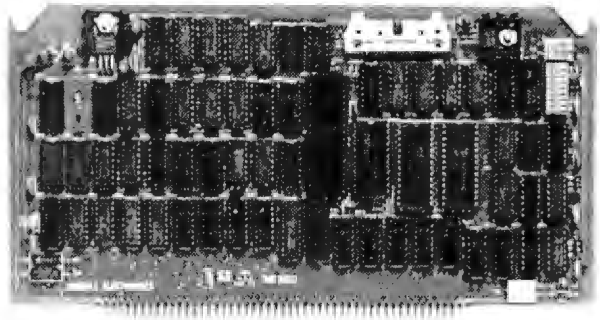

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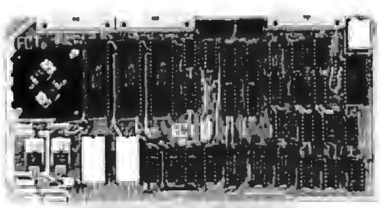

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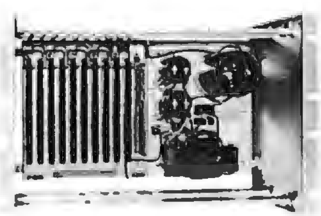

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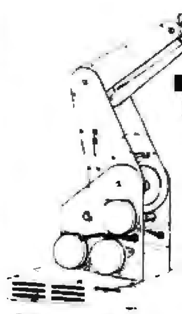
Circle 138 on inquiry card.

Listing 2 continued:

```
1    9:1   450               MAKESHAPES(DBOT,'X X    XXXX X');
1    9:1   474               MAKESHAPES(DBOT,'X XX        X');
1    9:1   498               MAKESHAPES(DBOT,'X       XX  X');
1    9:1   522               MAKESHAPES(DBOT,'X      X  X X');
1    9:1   546               MAKESHAPES(DBOT,'X      X  X X');
1    9:1   570               MAKESHAPES(DBOT,'X      X XX X');
1    9:1   594               MAKESHAPES(DBOT,'X       XXX X');
1    9:1   618               for I:=1 to 2 do
1    9:2   632               MAKESHAPES(DBOT,'X           X');
1    9:1   666               MAKESHAPES(DBOT,'XXXXXXXXXXXXX');
1    9:1   690               MAKESHAPES(DBOT,'      XX     ');
1    9:1   714               MAKESHAPES(DBOT,'     X  X    ');
1    9:1   738               MAKESHAPES(DBOT,'      XX     ');
1    9:0   762             end;
1    9:0   780
1    9:0   780 (*$P*)
1    9:0   780 (***************  INIT7  *********************************
1    9:0   780 *                                                         *
1    9:0   780 *       Creates arrays from strings.                      *
1    9:0   780 *                                                         *
1    9:0   780 *       Called from : Main program.                       *
1    9:0   780 *                                                         *
1    9:0   780 ***********************************************************)
1   10:D     1 procedure INIT7;
1   10:0     0         begin
1   10:1     0         write('.');
1   10:1    10         ROW:=15;
1   10:1    14         for I:=1 to 3 do
1   10:2    28         MAKESHAPES(HCAP,'   X  X         ');
1   10:1    62         MAKESHAPES(HCAP,'XXXXX   XXXXX   ');
1   10:1    86         for I:=1 to 3 do
1   10:2   100         MAKESHAPES(HCAP,'   X  X         ');
1   10:1   134         for I:=1 to 9 do
1   10:2   148         MAKESHAPES(HCAP,'                ');
1   10:1   182         ROW:=15;
1   10:1   186         for I:=1 to 4 do
1   10:2   200         MAKESHAPES(DIODE,'   X            ');
1   10:1   234         MAKESHAPES(DIODE,'XXXXXXX         ');
1   10:1   258         MAKESHAPES(DIODE,'   X            ');
1   10:1   282         MAKESHAPES(DIODE,'  XXX           ');
1   10:1   306         MAKESHAPES(DIODE,' XXXXX          ');
1   10:1   330         MAKESHAPES(DIODE,'XXXXXXX         ');
1   10:1   354         for I:=1 to 3 do
1   10:2   368         MAKESHAPES(DIODE,'   X            ');
1   10:1   402         for I:=1 to 4 do
1   10:2   416         MAKESHAPES(DIODE,'                ');
1   10:1   450         ROW:=15;
1   10:1   454         MAKESHAPES(HDIODE,'   X   X        ');
1   10:1   478         MAKESHAPES(HDIODE,'   XX  X        ');
1   10:1   502         MAKESHAPES(HDIODE,'   XXX X        ');
1   10:1   526         MAKESHAPES(HDIODE,'XXXXXXXXXXXX    ');
1   10:1   550         MAKESHAPES(HDIODE,'   XXX X        ');
1   10:1   574         MAKESHAPES(HDIODE,'   XX  X        ');
1   10:1   598         MAKESHAPES(HDIODE,'   X   X        ');
1   10:1   622         for I:=1 to 9 do
1   10:2   636         MAKESHAPES(HDIODE,'                ');
1   10:1   670         ROW:=15;
1   10:1   674         MAKESHAPES(OPAMP,'   XXXX         ');
1   10:1   698         MAKESHAPES(OPAMP,'   X   X        ');
1   10:1   722         MAKESHAPES(OPAMP,'   X    X       ');
1   10:1   746         MAKESHAPES(OPAMP,'   X  X  X      ');
1   10:1   770         MAKESHAPES(OPAMP,'XXXX XXX  X     ');
1   10:1   794         MAKESHAPES(OPAMP,'   X  X    X    ');
1   10:1   818         MAKESHAPES(OPAMP,'   X        X   ');
1   10:1   842         MAKESHAPES(OPAMP,'   X         XXX');
1   10:1   866         MAKESHAPES(OPAMP,'   X        X   ');
1   10:1   890         MAKESHAPES(OPAMP,'   X       X    ');
1   10:1   914         MAKESHAPES(OPAMP,'XXXX XXX  X     ');
1   10:1   938         MAKESHAPES(OPAMP,'   X     X      ');
1   10:1   962         MAKESHAPES(OPAMP,'   X    X       ');
1   10:1   986         MAKESHAPES(OPAMP,'   X   X        ');
1   10:1  1010         MAKESHAPES(OPAMP,'   XXXX         ');
1   10:1  1034         MAKESHAPES(OPAMP,'                ');
1   10:0  1058       end;
1   10:0  1084
1   10:0  1084 (*$P*)
1   10:0  1084 (***************  INIT8  *********************************
1   10:0  1084 *                                                         *
1   10:0  1084 *       Creates arrays from strings.                      *
1   10:0  1084 *                                                         *
1   10:0  1084 *       Called from : Main program.                       *
1   10:0  1084 *                                                         *
1   10:0  1084 ***********************************************************)
1   11:D     1 procedure INIT8;
1   11:0     0       begin
```

Listing 2 continued on page 412



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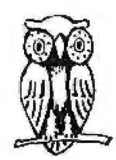

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Listing 2 continued:

```
1   11:1     0         write('.');
1   11:1    10         ROW:=15;
1   11:1    14         for I:=1 to 3 do
1   11:2    28         MAKESHAPES(NPN,'       X        ');
1   11:1    62         MAKESHAPES(NPN,'  X   X         ');
1   11:1    86         MAKESHAPES(NPN,'  X  X          ');
1   11:1   110         MAKESHAPES(NPN,'  X X           ');
1   11:1   134         MAKESHAPES(NPN,'  XX            ');
1   11:1   158         MAKESHAPES(NPN,'XXX             ');
1   11:1   182         MAKESHAPES(NPN,'  XX            ');
1   11:1   206         MAKESHAPES(NPN,'  X XXX         ');
1   11:1   230         MAKESHAPES(NPN,'  X XX          ');
1   11:1   254         MAKESHAPES(NPN,'  X X X         ');
1   11:1   278         for I:=1 to 4 do
1   11:2   292         MAKESHAPES(NPN,'      X         ');
1   11:1   326         ROW:=15;
1   11:1   330         for I:=1 to 3 do
1   11:2   344         MAKESHAPES(PNP,'       X        ');
1   11:1   378         MAKESHAPES(PNP,'  X   X         ');
1   11:1   402         MAKESHAPES(PNP,'  X  X          ');
1   11:1   426         MAKESHAPES(PNP,'  X X           ');
1   11:1   450         MAKESHAPES(PNP,'  XX            ');
1   11:1   474         MAKESHAPES(PNP,'XXX             ');
1   11:1   498         MAKESHAPES(PNP,'  XX            ');
1   11:1   522         MAKESHAPES(PNP,'  X X X         ');
1   11:1   546         MAKESHAPES(PNP,'  X  XX         ');
1   11:1   570         MAKESHAPES(PNP,'  X XXX         ');
1   11:1   594         for I:=1 to 4 do
1   11:2   608         MAKESHAPES(PNP,'      X         ');
1   11:1   642         ROW:=15;
1   11:1   646         MAKESHAPES(BAT,'   X   X        ');
1   11:1   670         MAKESHAPES(BAT,'   X   X   XXX  ');
1   11:1   694         MAKESHAPES(BAT,'   X X X X      ');
1   11:1   718         MAKESHAPES(BAT,'XXXX X X XXXXXXX');
1   11:1   742         MAKESHAPES(BAT,'   X X X X      ');
1   11:1   766         MAKESHAPES(BAT,'   X   X        ');
1   11:1   790         MAKESHAPES(BAT,'   X   X        ');
1   11:1   814         for I:= 1 to 9 do
1   11:2   828         MAKESHAPES(BAT,'                ');
1   11:1   862         ROW:=15;
1   11:1   866         MAKESHAPES(SW,'         X      ');
1   11:1   890         MAKESHAPES(SW,'        X       ');
1   11:1   914         MAKESHAPES(SW,'       X        ');
1   11:1   938         MAKESHAPES(SW,' XX   X      XX ');
1   11:1   962         MAKESHAPES(SW,'XXXXXX    XXXXXX');
1   11:1   986         MAKESHAPES(SW,' XX          XX ');
1   11:1  1010         for I:=1 to 10 do
1   11:2  1024         MAKESHAPES(SW,'                ');
1   11:0  1058       end;
1   11:0  1082
1   11:0  1082 (*$P*)
1   11:0  1082 (***************  INIT9  ********************************
1   11:0  1082 *                                                       *
1   11:0  1082 *       Creates arrays from strinas.                    *
1   11:0  1082 *                                                       *
1   11:0  1082 *       Called from : Main proaram.                     *
1   11:0  1082 *                                                       *
1   11:0  1082 ********************************************************)
1   12:D     1 procedure INIT9;
1   12:0     0       begin
1   12:1     0         write('.');
1   12:1    10         ROW:=15;
1   12:1    14         MAKESHAPES(MINIDIP,'XXXXXXXXXXXXXXXX');
1   12:1    38         for I:=1 to 14 do
1   12:2    52         MAKESHAPES(MINIDIP,'X              X');
1   12:1    86         MAKESHAPES(MINIDIP,'XXXXXXXXXXXXXXXX');
1   12:1   110         ROW:=15;
1   12:1   114         MAKESHAPES(HMSIL,'XXXXXXXXXXXXXXXX');
1   12:1   138         for I:=1 to 14 do
1   12:2   152         MAKESHAPES(HMSIL,'X               ');
1   12:1   186         MAKESHAPES(HMSIL,'XXXXXXXXXXXXXXXX');
1   12:1   210         ROW:=15;
1   12:1   214         MAKESHAPES(HMSIR,'XXXXXXXXXXXXXXXX');
1   12:1   238         for I:=1 to 14 do
1   12:2   252         MAKESHAPES(HMSIR,'               X');
1   12:1   286         MAKESHAPES(HMSIR,'XXXXXXXXXXXXXXXX');
1   12:1   310         ROW:=15;
1   12:1   314         MAKESHAPES(XTAL,'    X     X     ');
1   12:1   338         MAKESHAPES(XTAL,'    X XXX X     ');
1   12:1   362         MAKESHAPES(XTAL,'    X XXX X     ');
1   12:1   386         MAKESHAPES(XTAL,'XXXXX XXX XXXXXX');
1   12:1   410         MAKESHAPES(XTAL,'    X XXX X     ');
1   12:1   434         MAKESHAPES(XTAL,'    X XXX X     ');
```

Listing 2 continued on page 414

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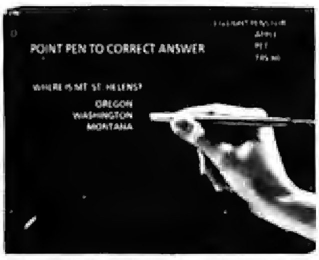

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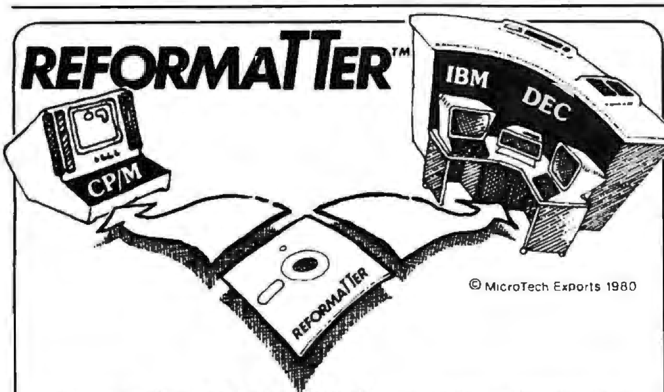

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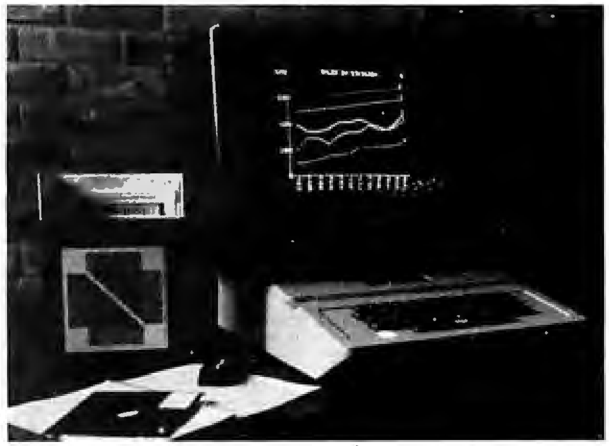

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Listing 2 continued:

```
  1   12:1    458          MAKESHAPES(XTAL,'   X     X      ');
  1   12:1    482          for I:=1 to 9 do
  1   12:2    496          MAKESHAPES(XTAL,'                ');
  1   12:1    530          ROW:=15;
  1   12:1    534          MAKESHAPES(WIPER,' X              ');
  1   12:1    557          MAKESHAPES(WIPER,' XXX            ');
  1   12:1    580          MAKESHAPES(WIPER,'XXXXX           ');
  1   12:1    603          for I:=1 to 4 do
  1   12:2    617          MAKESHAPES(WIPER,' X              ');
  1   12:1    650          for I:=1 to 9 do
  1   12:2    664          MAKESHAPES(WIPER,'                ');
  1   12:1    697          ROW:=15;
  1   12:1    701          MAKESHAPES(ZENER,'    X           ');
  1   12:1    724          MAKESHAPES(ZENER,'    X           ');
  1   12:1    747          MAKESHAPES(ZENER,'    X   X       ');
  1   12:1    770          MAKESHAPES(ZENER,'    X  X        ');
  1   12:1    793          MAKESHAPES(ZENER,'  XXXXX         ');
  1   12:1    816          MAKESHAPES(ZENER,' X    X         ');
  1   12:1    839          MAKESHAPES(ZENER,'X  XXX          ');
  1   12:1    862          MAKESHAPES(ZENER,'  XXXXX         ');
  1   12:1    885          MAKESHAPES(ZENER,' XXXXXXX        ');
  1   12:1    908          for I:=1 to 4 do
  1   12:2    922          MAKESHAPES(ZENER,'    X           ');
  1   12:1    955          for I:=1 to 3 do
  1   12:2    969          MAKESHAPES(ZENER,'                ');
  1   12:0   1002        end;
  1   12:0   1030  (*$P*)
  1   12:0   1030  (****************  INIT10  ********************************
  1   12:0   1030  *                                                         *
  1   12:0   1030  *       Creates arrays from strings.                      *
  1   12:0   1030  *                                                         *
  1   12:0   1030  *       Called from : Main program.                       *
  1   12:0   1030  *                                                         *
  1   12:0   1030  **********************************************************)
  1   13:D      1  procedure INIT10;
  1   13:0      0        begin
  1   13:1      0          for I:=1 to 4 do begin
  1   13:3     14            ROW:=16-(4*I);
  1   13:3     24            MAKESHAPES(LCOIL,'X X X           '); end;
  1   13:1     57          for I:=1 to 8 do begin
  1   13:3     71            ROW:=16-(2*I)+1;
  1   13:3     83            MAKESHAPES(LCOIL,'X X  XXX        '); end;
  1   13:1    116          for I:=1 to 4 do begin
  1   13:3    130            ROW:=16-(4*I)+2;
  1   13:3    142            MAKESHAPES(LCOIL,'X X X   X       '); end;
  1   13:1    175          for I:=1 to 4 do begin
  1   13:3    189            ROW:=16-(4*I);
  1   13:3    199            MAKESHAPES(RCOIL,'    X           '); end;
  1   13:1    232          for I:=1 to 8 do begin
  1   13:3    246            ROW:=16-(2*I)+1;
  1   13:3    258            MAKESHAPES(RCOIL,' XXX            '); end;
  1   13:1    291          for I:=1 to 4 do begin
  1   13:3    305            ROW:=16-(4*I)+2;
  1   13:3    317            MAKESHAPES(RCOIL,'X   X           '); end;
  1   13:1    350          ROW:=15;
  1   13:1    354          for I:=1 to 16 do
  1   13:2    368            MAKESHAPES(USER1,'                ');
  1   13:1    401          ROW:=15;
  1   13:1    405          for I:=1 to 16 do
  1   13:2    419            MAKESHAPES(USER2,'                ');
  1   13:1    452          ROW:=15;
  1   13:1    456          for I:=1 to 16 do
  1   13:2    470            MAKESHAPES(USER3,'                ');
  1   13:1    503          ROW:=15;
  1   13:1    507          MAKESHAPES(VRESIST,' X              ');
  1   13:1    530          MAKESHAPES(VRESIST,' X              ');
  1   13:1    553          MAKESHAPES(VRESIST,'X               ');
  1   13:1    576          MAKESHAPES(VRESIST,' X              ');
  1   13:1    599          MAKESHAPES(VRESIST,'  X             ');
  1   13:1    622          MAKESHAPES(VRESIST,' X              ');
  1   13:1    645          MAKESHAPES(VRESIST,'X               ');
  1   13:1    668          MAKESHAPES(VRESIST,' X              ');
  1   13:1    691          MAKESHAPES(VRESIST,'  X             ');
  1   13:1    714          MAKESHAPES(VRESIST,' X              ');
  1   13:1    737          MAKESHAPES(VRESIST,'X               ');
  1   13:1    760          MAKESHAPES(VRESIST,' X              ');
  1   13:1    783          MAKESHAPES(VRESIST,'  X             ');
  1   13:1    806          MAKESHAPES(VRESIST,' X              ');
  1   13:1    829          MAKESHAPES(VRESIST,' X              ');
  1   13:1    852          MAKESHAPES(VRESIST,' X              ');
  1   13:0    875        end;
  1   13:0    906
  1   13:0    906  (*$P*)
```

```
   1   13:0   906 (*******************************************************
   1   13:0   906 *                                                     *
   1   13:0   906 *        MAIN PROGRAM STARTS HERE ....                *
   1   13:0   906 *                                                     *
   1   13:0   906 *******************************************************)
   1    1:0     0 begin
   1    1:1     0      write('initializing array');
   1    1:1    52      INIT1;
   1    1:1    54      INIT2;
   1    1:1    56      INIT3;
   1    1:1    58      INIT4;
   1    1:1    60      INIT5;
   1    1:1    62      INIT6;
   1    1:1    64      INIT7;
   1    1:1    66      INIT8;
   1    1:1    68      INIT9;
   1    1:1    70      INIT10;
   1    1:1    72      writeln; writeln('Writing "LOGIC.CHARSET" to disc');
   1    1:1   131      SAVESHAPES;
   1    1:0   133 end.
```

Listing 3: *Apple Pascal program LOGICDESIGN accepts plotting inputs from the Graphics Tablet.*

```
  1     1:D     1 (*$L PRINTER:*) (* last update - 25 Apr 80 *)
  1     1:D     1 (*$I PART1.TEXT*)
  1     1:D     1 (* PART1 OF LOGICDESIGN *)
  1     1:D     1 program LOGICDESIGN;
  1     1:D     3 (************************************************
  1     1:D     3 *                                              *
  1     1:D     3 * This program draws logic diagrams on the hires *
  1     1:D     3 * screen. It uses the Graphics Tablet for most  *
  1     1:D     3 * input.                                        *
  1     1:D     3 *                                              *
  1     1:D     3 * It expects (and requires) the Graphics Tablet  *
  1     1:D     3 * card to be in slot #5, and a Sup'r'terminal   *
  1     1:D     3 * board in slot #3.                             *
  1     1:D     3 *                                              *
  1     1:D     3 *           Dan Sokol - 28 Mar 80              *
  1     1:D     3 *               rev B   12 Apr 80              *
  1     1:D     3 *                                              *
  1     1:D     3 ************************************************)
 26     1:D     3
 26     1:D     3
 26     2:D     1 PROCEDURE POKE(VAR ADDR,DATA:INTEGER);
 26     3:D     3 FUNCTION PEEK(VAR ADDR:INTEGER):INTEGER;
 26     3:D     4
 22     1:D     4 {$  }
 22     1:D     3
 22     1:D     3
 22     2:D     3      FUNCTION PADDLE(SELECT: INTEGER): INTEGER;
 22     3:D     3      FUNCTION BUTTON(SELECT: INTEGER): BOOLEAN;
 22     4:D     1      PROCEDURE TTLOUT(SELECT: INTEGER; DATA: BOOLEAN);
 22     5:D     3      FUNCTION KEYPRESS: BOOLEAN;
 22     6:D     3      FUNCTION RANDOM: INTEGER;
 22     7:D     1      PROCEDURE RANDOMIZE;
 22     8:D     1      PROCEDURE NOTE(PITCH,DURATION: INTEGER);
 22     8:D     3
 22     1:D     3    IMPLEMENTATION
 22     1:D     1
 20     1:D     1
 20     1:D     3      TYPE
 20     1:D     1        SCREENCOLOR=(none,white,black,reverse,radar,
 20     1:D     1                     black1,green,violet,white1,black2,orange,blue,white2);
 20     1:D     1
 20     2:D     1      PROCEDURE INITTURTLE;
 20     3:D     1      PROCEDURE TURN(ANGLE: INTEGER);
 20     4:D     1      PROCEDURE TURNTO(ANGLE: INTEGER);
 20     5:D     1      PROCEDURE MOVE(DIST: INTEGER);
 20     6:D     1      PROCEDURE MOVETO(X,Y: INTEGER);
 20     7:D     1      PROCEDURE PENCOLOR(PENMODE: SCREENCOLOR);
 20     8:D     1      PROCEDURE TEXTMODE;
 20     9:D     1      PROCEDURE GRAFMODE;
 20    10:D     1      PROCEDURE FILLSCREEN(FILLCOLOR: SCREENCOLOR);
 20    11:D     1      PROCEDURE VIEWPORT(LEFT,RIGHT,BOTTOM,TOP: INTEGER);
 20    12:D     3      FUNCTION  TURTLEX: INTEGER;
 20    13:D     3      FUNCTION  TURTLEY: INTEGER;
 20    14:D     3      FUNCTION  TURTLEANG: INTEGER;
 20    15:D     3      FUNCTION  SCREENBIT(X,Y: INTEGER): BOOLEAN;
 20    16:D     1      PROCEDURE DRAWBLOCK(VAR SOURCE; ROWSIZE,XSKIP,YSKIP,WIDTH,HEIGHT,
 20    16:D     2                          XSCREEN,YSCREEN,MODE: INTEGER);
 20    17:D     1      PROCEDURE WCHAR(CH: CHAR);
 20    18:D     1      PROCEDURE WSTRING(S: STRING);
 20    19:D     1      PROCEDURE CHARTYPE(MODE: INTEGER);
```

Listing 3 continued on page 416

Listing 3 continued:

```
20    19:D    2
 1     1:D    2 uses peekpoke,applestu,turtlegr;
 1     1:D    3 (*$P*)
 1     1:D    3 (*********************************************************
 1     1:D    3 *                                                       *
 1     1:D    3 *         GLOBAL VARIABLE DECLARATIONS                   *
 1     1:D    3 *                                                       *
 1     1:D    3 *********************************************************)
 1     1:D    3
 1     1:D    3 type SHAPE = packed array [0..15,0..15] of boolean;
 1     1:D    3
 1     1:D    3 (*********************************************************
 1     1:D    3 *                                                       *
 1     1:D    3 *         INTEGER VARIABLES                              *
 1     1:D    3 *                                                       *
 1     1:D    3 *********************************************************)
 1     1:D    3 var
 1     1:D    3
 1     1:D    3     PITCH,                       (* frequency for audio feedback *)
 1     1:D    3     DURATION,                    (* length of audio feedback     *)
 1     1:D    3     PEN,                         (* pen switch (up or down)      *)
 1     1:D    3     X,Y,                         (* pen position on pad          *)
 1     1:D    3     D,                           (* Device being plotted         *)
 1     1:D    3     I,J,K,                       (* various loop counters        *)
 1     1:D    3     USR1X,USR1Y,USR2X,USR2Y,     (* position pointer for user1&2 *)
 1     1:D    3     LASTD,LASTX,LASTY,           (* last D,X, & Y for deleting   *)
 1     1:D    3     DMODE                        (* mode used for plotting       *)
 1     1:D    3                                  : integer;
 1     1:D   20
 1     1:D   20
 1     1:D   20 (*********************************************************
 1     1:D   20 *                                                       *
 1     1:D   20 *         PLOTTED SHAPE NAMES                            *
 1     1:D   20 *                                                       *
 1     1:D   20 *********************************************************)
 1     1:D   20
 1     1:D   20     INVERTER,NAND,NOR,ORGATE,ANDGATE,DTOP,DBOT,JKTOP,JKBOT,BUFFER,GND,PLUS5,
 1     1:D   20     MSITOP,MSIBOT,INV,INTHING,OUT,DOT,CAP,RESISTOR,XOR,XNOR,HCAP,DIODE,SW,BAT,
 1     1:D   20     MINIDIP,HDIODE,OPAMP,NPN,PNP,MINDIP,HMSIL,HMSIR,XTAL,WIPER,ZENER,
 1     1:D   20     LCOIL,RCOIL,VRESIST,USER1,USER2,USER3 : SHAPE;
```

```
1  1:D   708
1  1:D   708
1  1:D   708 (*********************************************************
1  1:D   708 *                                                       *
1  1:D   708 *          DISK FILES                                   *
1  1:D   708 *                                                       *
1  1:D   708 *********************************************************)
1  1:D   708
1  1:D   708     SHAPEFILE,                    (* plotted devices are here *)
1  1:D   708     USERFILE                      (* The screen image file *)
1  1:D   768                                   : file of SHAPE;
1  1:D  1340 (*$P*)
1  1:D  1340 (*********************************************************
1  1:D  1340 *                                                       *
1  1:D  1340 *          BOOLEANS                                     *
1  1:D  1340 *                                                       *
1  1:D  1340 *********************************************************)
1  1:D  1340
1  1:D  1340     BIT,                          (* flags 'delete lastx' mode *)
1  1:D  1340     USR,                          (* Used in SETUSR could be local *)
1  1:D  1340     SAFETY,                       (* checks for SAVE on exit *)
1  1:D  1340     FLAG,                         (* debug - display X&Y on screen *)
1  1:D  1340     VALIDXY,                      (* true if X&Y are on screen *)
1  1:D  1340     HELLFREEZESOVER,              (* never true - for infinite repeats *)
1  1:D  1340     LOCKX,LOCKY                   (* locks X&Y axis *)
1  1:D  1340                                   : boolean;
1  1:D  1348
1  1:D  1348
1  1:D  1348 (*********************************************************
1  1:D  1348 *                                                       *
1  1:D  1348 *          STRINGS and THINGS                           *
1  1:D  1348 *                                                       *
1  1:D  1348 *********************************************************)
1  1:D  1348
1  1:D  1348     FILENAME,                     (* for LOAD and SAVE names *)
1  1:D  1348     IDENT                         (* for names of plotted devices *)
1  1:D  1348                                   : string;
1  1:D  1430     CH                            (* for inputs and control *)
```

Listing 3 continued on page 418

Listing 3 continued:

```
  1     1:D  1430                                          : char;
  1     1:D  1431
  1     1:D  1431 (*$P*)
  1     1:D  1431 (***************  SAVESCREEN  ***************************
  1     1:D  1431 *                                                        *
  1     1:D  1431 *    Copies HIRES screen 1 into a file named by the      *
  1     1:D  1431 *    user (FILENAME).                                    *
  1     1:D  1431 *                                                        *
  1     1:D  1431 *    Called by : MENU,EXIT                               *
  1     1:D  1431 *                                                        *
  1     1:D  1431 *********************************************************)
  1     1:D  1431 (*$I-*)
  1     2:D     1 procedure SAVESCREEN;
  1     2:D     1         var BLOCKNUMBER,SCREEN : integer;
  1     2:D     3             IMAGE : file;
  1     2:D    43             BUFFER : packed array[0..511] of char;
  1     2:D   299             BADIO : boolean;
  1     2:0     0         begin
  1     2:1     0           write(chr(12)); write('Save with what name ?'); readln(FILENAME);
  1     2:1    67           if length(FILENAME) = 0 then exit(SAVESCREEN);
  1     2:1    80           SCREEN:=8192; BLOCKNUMBER:=0; BADIO:=false;
  1     2:1    92           if length(FILENAME) > 10 then
  1     2:2   101             begin writeln; writeln('File name is too long !!!',chr(7));
  1     2:3   156               SAFETY:=false; exit(SAVESCREEN);
  1     2:2   164             end else FILENAME:=concat(FILENAME,'.SCRN');
  1     2:1   203           rewrite(IMAGE,FILENAME);
  1     2:1   213           while ((IORESULT=0) and (NOT BADIO) and (BLOCKNUMBER<>16)) do
  1     2:2   228             begin
  1     2:3   228              for I:=0 to 511 do
  1     2:4   244               begin J:=peek(SCREEN); BUFFER[I]:=chr(J); SCREEN:=SCREEN+1; end;
  1     2:3   275              K:=blockwrite(IMAGE,BUFFER,1,BLOCKNUMBER);
  1     2:3   290              BLOCKNUMBER:=BLOCKNUMBER+1;
  1     2:2   295             end;
  1     2:1   297            close(IMAGE , lock);
  1     2:1   303            SAFETY:=true;
  1     2:0   307          end;
  1     2:0   330 (*$P*)
  1     2:0   330 (***************  LOADSCREEN  ***************************
  1     2:0   330 *                                                        *
  1     2:0   330 *    Copies file named by the user into HIRES screen 1.  *
  1     2:0   330 *                                                        *
  1     2:0   330 *    Called by : MENU                                    *
  1     2:0   330 *                                                        *
  1     2:0   330 *********************************************************)
  1     3:D     1 procedure LOADSCREEN;
  1     3:D     1         var BLOCKNUMBER,SCREEN : integer;
  1     3:D     3             IMAGE : file;
  1     3:D    43             BUFFER : packed array[0..511] of char;
  1     3:D   299             BADIO : boolean;
  1     3:0     0         begin
  1     3:1     0           write(chr(12)); write('Load what file name ?'); readln(FILENAME);
  1     3:1    67           if length(FILENAME) = 0 then exit(LOADSCREEN);
  1     3:1    80           SCREEN:=8192; BLOCKNUMBER:=0; BADIO:=false;
  1     3:1    92           if length(FILENAME) > 10 then
  1     3:2   101             begin writeln; writeln('File name is too long !!!',chr(7));
  1     3:3   156                 exit(LOADSCREEN);
  1     3:2   160             end else FILENAME:=concat(FILENAME,'.SCRN');
  1     3:1   199           reset(IMAGE,FILENAME);
  1     3:1   209           while ((IORESULT=0) and (NOT eof(IMAGE)) and (BLOCKNUMBER<>16)) do
  1     3:2   228             begin
  1     3:3   228              K:=blockread(IMAGE,BUFFER,1,BLOCKNUMBER);
  1     3:3   243              for I:=0 to 511 do
  1     3:4   259                begin J:=ord(BUFFER[I]); poke(SCREEN,J); SCREEN:=SCREEN+1; end;
  1     3:3   289              BLOCKNUMBER:=BLOCKNUMBER+1;
  1     3:2   294             end;
  1     3:1   296            close(IMAGE);
  1     3:0   302          end;
  1     3:0   324 (*$I+*)
  1     3:0   324
  1     3:0   324 (*$I PART1.TEXT*)
  1     3:0   324 (*$I PART2.TEXT*)
  1     3:0   324 (*$P*)    (* Part2 of LOGICDESIGN *)
  1     3:0   324 (***************  CLEARTTY  *****************************
  1     3:0   324 *                                                        *
  1     3:0   324 *     Clears Text screen & homes cursor.                 *
  1     3:0   324 *                                                        *
  1     3:0   324 *     Called from : Just about everywhere....            *
  1     3:0   324 *                                                        *
  1     3:0   324 *********************************************************)
  1     4:D     1 procedure CLEARTTY;
  1     4:0     0         begin
```

```
1     4:1     0            write(chr(12));
1     4:0    10          end;
1     4:0    22
1     4:0    22 (***************  BEEP  *********************************
1     4:0    22 *                                                       *
1     4:0    22 *    Audio feedback                                     *
1     4:0    22 *                                                       *
1     4:0    22 *    Called from : Just about everywhere....            *
1     4:0    22 *                                                       *
1     4:0    22 *********************************************************)
1     5:D     1 procedure BEEP;
1     5:0     0         begin note(PITCH,DURATION); end;
1     5:0    20
1     5:0    20 (***************  KEY  **********************************
1     5:0    20 *                                                       *
1     5:0    20 *    Replaces applestuff KEYPRESS function which        *
1     5:0    20 *    doesn't work if there is a card in slot #3.        *
1     5:0    20 *                                                       *
1     5:0    20 *    Called from : GETXY                                *
1     5:0    20 *                                                       *
1     5:0    20 *********************************************************)
1     6:D     3 function KEY : boolean;
1     6:D     3         var CLEAR,KEYBOARD,TEMP : integer;
1     6:0     0         begin
1     6:1     0           CLEAR:=-16368; KEYBOARD:=-16384; TEMP:=peek(KEYBOARD);
1     6:1    21           if TEMP > 128 then
1     6:2    28           begin KEY:=true; poke(CLEAR,TEMP); end
1     6:1    38           else KEY:=false;
1     6:0    43         end;
1     6:0    56
1     6:0    56 (***************  CONVERTFROM  **************************
1     6:0    56 *                                                       *
1     6:0    56 *    Converts the boolean information in the shape      *
1     6:0    56 *    USER3 to the integer values used by MYPLOT as      *
1     6:0    56 *    the X & Y offset information.                      *
1     6:0    56 *                                                       *
1     6:0    56 *    Called from : GETSHAPES                            *
1     6:0    56 *                                                       *
1     6:0    56 *********************************************************)
1     6:0    56 (*$R-*)
1     7:D     1 procedure CONVERTFROM;
1     7:0     0         begin
1     7:1     0           K:=0; I:=0; USR1X:=0;
1     7:1     9           while USER3[I,K] and (K<15) do begin K:=K+1; USR1X:=USR1X+1; end;
1     7:1    37           I:=1; K:=0; USR1Y:=0;
1     7:1    46           while USER3[I,K] and (K<15) do begin K:=K+1; USR1Y:=USR1Y+1; end;
1     7:1    74           I:=2; K:=0; USR2X:=0;
1     7:1    83           while USER3[I,K] and (K<15) do begin K:=K+1; USR2X:=USR2X+1; end;
1     7:1   111           I:=3; K:=0; USR2Y:=0;
1     7:1   120           while USER3[I,K] and (K<15) do begin K:=K+1; USR2Y:=USR2Y+1; end;
1     7:0   148         end;
1     7:0   168 (*$R+*)
1     7:0   168 (*$P*)
1     7:0   168 (***************  GETSHAPES  ****************************
1     7:0   168 *                                                       *
1     7:0   168 *       Loads the shapes from the file 'LOGIC.CHARSET'  *
1     7:0   168 *                                                       *
1     7:0   168 *       Called from : Main program loop.                *
1     7:0   168 *                                                       *
1     7:0   168 *********************************************************)
1     8:D     1 procedure GETSHAPES;
1     8:0     0         begin
1     8:1     0           reset(SHAPEFILE,'LOGIC.CHARSET');
1     8:1    26           INVERTER:=SHAPEFILE^; get(SHAPEFILE);
1     8:1    42           NAND:=SHAPEFILE^; get(SHAPEFILE);
1     8:1    58           NOR:=SHAPEFILE^; get(SHAPEFILE);
1     8:1    74           ORGATE:=SHAPEFILE^; get(SHAPEFILE);
1     8:1    90           ANDGATE:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   106           DTOP:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   122           DBOT:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   138           JKTOP:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   154           JKBOT:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   170           BUFFER:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   186           GND:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   202           PLUS5:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   218           MSITOP:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   234           MSIBOT:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   250           INV:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   266           INTHING:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   282           OUT:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   298           DOT:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   314           CAP:=SHAPEFILE^; get(SHAPEFILE);
```

Listing 3 continued on page 420

Listing 3 continued:

```
1     8:1   330       RESISTOR:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   346       XOR:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   362       XNOR:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   378       HCAP:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   394       DIODE:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   410       HDIODE:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   426       OPAMP:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   442       NPN:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   458       PNP:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   474       BAT:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   490       SW:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   506       MINIDIP:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   522       HMSIL:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   538       HMSIR:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   554       XTAL:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   570       WIPER:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   586       ZENER:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   601       LCOIL:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   616       RCOIL:=SHAPEFILE^; get(SHAPEFILE);
1     8:1   631       VRESIST:=SHAPEFILE^;
1     8:1   638       close(SHAPEFILE);
1     8:1   647       reset(USERFILE,'USER.CHARSET');
1     8:1   672       USER1:=USERFILE^; get(USERFILE);
1     8:1   687       USER2:=USERFILE^; get(USERFILE);
1     8:1   702       USER3:=USERFILE^; get(USERFILE);
1     8:1   717       close(USERFILE);
1     8:1   726       CONVERTFROM;
1     8:0   728      end;
1     8:0   740
1     8:0   740
1     8:0   740 (*$I PART2.TEXT*)
1     8:0   740 (*$I PART3.TEXT*)
1     8:0   740 (*$P*)  (* Part3 of LOGICDESIGN *)
1     8:0   740
1     8:0   740 (***************  SETUPAD & READPAD  ********************
1     8:0   740 *                                                      *
1     8:0   740 *       Assembly language procedures to setup and      *
1     8:0   740 *       read the graphics tablet.                      *
1     8:0   740 *                                                      *
1     8:0   740 *       Called by : GETXY and Main program             *
1     8:0   740 *                                                      *
1     8:0   740 *******************************************************)
1     9:D     1 procedure SETUPAD; external;
1     9:D     1
1    10:D     1 procedure READPAD; external;
1    10:D     1
1    10:D     1 (***************  CONVERTO  *****************************
1    10:D     1 *                                                      *
1    10:D     1 *       Converts the integer values set by the user    *
1    10:D     1 *       as the X & Y offsets for USER1 & 2 to boolean  *
1    10:D     1 *       values and saves them in USER3.                *
1    10:D     1 *                                                      *
1    10:D     1 *       Called by : SETUSR                             *
1    10:D     1 *                                                      *
1    10:D     1 *******************************************************)
1    11:D     1 procedure CONVERTO;
1    11:D     1      var X1,X2,Y1,Y2 : integer;
1    11:0     0      begin
1    11:1     0       for I:=0 to 15 do for K:=0 to 15 do USER3[I,K]:=false;
1    11:1    53       I:=0; X1:=USR1X;
1    11:1    59       while X1 >=0 do begin
1    11:3    64         USER3[I,X1]:=true; X1:=X1-1; end;
1    11:1    88       I:=1; Y1:=USR1Y;
1    11:1    94       while Y1 >=0 do begin
1    11:3    99         USER3[I,Y1]:=true; Y1:=Y1-1; end;
1    11:1   123       I:=2; X2:=USR2X;
1    11:1   129       while X2 >=0 do begin
1    11:3   134         USER3[I,X2]:=true; X2:=X2-1; end;
1    11:1   158       I:=3; Y2:=USR2Y;
1    11:1   164       while Y2 >=0 do begin
1    11:3   169         USER3[I,Y2]:=true; Y2:=Y2-1; end;
1    11:0   193      end;
1    11:0   218
1    11:0   218 (*$P*)
1    11:0   218 (***************  SETUSR  *******************************
1    11:0   218 *                                                      *
1    11:0   218 *       Builds the shapes USER1 and USER2 and saves    *
1    11:0   218 *       them in the file 'USER.CHARSET'.               *
1    11:0   218 *                                                      *
1    11:0   218 *       Called by : MENU                               *
1    11:0   218 *                                                      *
```

```
 1   11:0   218 *********************************************************)
 1   12:D     1 procedure SETUSR;
 1   12:0     0    begin
 1   12:1     0      CLEARTTY; writeln('Build your own device....');
 1   12:1    47      write('Which one (1 or 2)'); read(CH);
 1   12:1    88      if (CH='1') or (CH='2') then begin
 1   12:3   101        CLEARTTY; for I:=0 to 15 do begin
 1   12:5   114                  gotoxy((I+3),0); write(chr(I+65)); end;
 1   12:3   140         for I:=1 to 16 do begin gotoxy(0,I); write(chr(I+64)); end;
 1   12:3   175         if (CH='1') then USR:=true else USR:=false;
 1   12:3   192         for I:=0 to 15 do
 1   12:4   203          for K:=15 downto 0 do
 1   12:5   214            begin gotoxy((15-K+3),(I+1)); read(CH);
 1   12:6   236               BIT:=true;
 1   12:6   240                case ord(CH) of
 1   12:6   245                27: exit(SETUSR); (* ESC *)
 1   12:6   251                32: BIT:=false;    (* SPACE *)
 1   12:6   257                 8: begin if K<13 then K:=K+2 else
 1   12:9   269                    begin K:=1; if I<>0 then I:=I-1; end;
 1   12:8   282                    BIT:=false; end; (* BACK-SPACE *)
 1   12:6   288                end; (* end of case *)
 1   12:6   346               if USR then USER1[15-I,15-K]:=BIT else USER2[15-I,15-K]:=BIT;
 1   12:5   399             end;
 1   12:3   413      writeln; writeln; writeln('Select <draw from> point (X,Y) >> ');
 1   12:3   483      read(CH); I:=(ord(CH)-65); read(CH); J:=(ord(CH)-65);
 1   12:3   519                  if J>15 then J:=15; if I>15 then I:=15;
 1   12:3   535                  if J<0 then J:=0; if I<0 then I:=0;
 1   12:3   551                  if USR then begin USR1X:=I; USR1Y:=15-J; end
 1   12:3   564                         else begin USR2X:=I; USR2Y:=15-J; end;
 1   12:3   574      writeln; write('Saving user device on disk');
 1   12:3   620      rewrite(USERFILE,'USER.CHARSET');
 1   12:3   645      USERFILE^:=USER1; put(USERFILE);
 1   12:3   660      USERFILE^:=USER2; put(USERFILE);
 1   12:3   675      CONVERTO;
 1   12:3   677      USERFILE^:=USER3; put(USERFILE);
 1   12:3   692      close(USERFILE , lock);
 1   12:2   701      end;
 1   12:0   701    end;
 1   12:0   728 (*$P*)
 1   12:0   728 (***************  EXT  **********************************
 1   12:0   728 *                                                       *
 1   12:0   728 *       The only legitimate exit from LOGICDESIGN       *
 1   12:0   728 *                                                       *
 1   12:0   728 *       Called by : MENU                                *
 1   12:0   728 *                                                       *
 1   12:0   728 *********************************************************)
 1   13:D     1 procedure EXT;
 1   13:0     0         begin
 1   13:1     0           SAFETY:=true;
 1   13:1     4           CLEARTTY;
 1   13:1     6           write('Do you want to save the screen ?'); read(CH); writeln;
 1   13:1    69           if (CH='y') or (CH='Y') then SAVESCREEN;
 1   13:1    84           if SAFETY then exit(program);
 1   13:1    93           if not SAFETY then begin writeln; writeln;
 1   13:3   115             write('The screen was NOT saved. Do you want to exit anyway ?');
 1   13:3   181             read(CH); if (CH='Y') or (CH='y') then exit(program); end;
 1   13:0   209         end;
 1   13:0   222
 1   13:0   222 (********************************************************
 1   13:0   222 *                                                       *
 1   13:0   222 *       Sound-off when ready to go...                   *
 1   13:0   222 *                                                       *
 1   13:0   222 *       Called by : BORDER,Main.                        *
 1   13:0   222 *                                                       *
 1   13:0   222 *********************************************************)
 1   14:D     1 procedure BEEPREADY;
 1   14:0     0         begin
 1   14:1     0           PITCH:=24; DURATION:=15; BEEP;
 1   14:0     8         end;
 1   14:0    20
 1   14:0    20 (*$I PART3.TEXT*)
 1   14:0    20 (*$I PART4.TEXT*)
 1   14:0    20 (*$P*)  (* Part4 of LOGICDESIGN *)
 1   14:0    20
 1   14:0    20 (***************  GETXY  ********************************
 1   14:0    20 *                                                       *
 1   14:0    20 *       Read tablet and get the X & Y coordinates.      *
 1   14:0    20 *       Determine if X & Y are on screen (VALIDXY).     *
 1   14:0    20 *                                                       *
 1   14:0    20 *       Called by : MENU,DRAWLINE,EATLINE,SETLOCK,      *
 1   14:0    20 *                   WRITEONSCREEN,CLEARBLOCK,Main       *
 1   14:0    20 *
```

Listing 3 continued on page 422

Listing 3 continued:

```
1   14:0    20 ***********************************************************)
1   15:D     1 procedure GETXY;
1   15:D     1         var B1,B6,B7,B8,
1   15:D     1             B9 : integer;
1   15:0     0         begin
1   15:1     0           B1:=640; B9:=648;
1   15:1    10           B6:=645; B7:=646; B8:=647;
1   15:1    25           repeat READPAD;
1   15:2    27             PEN:=peek(B1);
1   15:2    36             X:=256*(peek(B7))+peek(B6);
1   15:2    57             Y:=256*(peek(B9))+peek(B8);
1   15:2    78             if FLAG then begin                 (* for debugging - displays *)
1   15:4    83               gotoxy(0,23);                    (* X & Y on screen          *)
1   15:4    88               write('X = ',X,'  Y = ',Y,'      ');
1   15:3   159             end;
1   15:2   159             if KEY then                        (* exit on keypress *)
1   15:3   165              begin
1   15:4   165                VALIDXY:=false;
1   15:4   169                X:=-100; Y:=-100;
1   15:4   177                exit(GETXY);
1   15:3   181              end;
1   15:1   181           until PEN=2;                         (* pen just went down *)
1   15:1   187           if (X>=0)
1   15:1   190              and (X<280)
1   15:1   195              and (Y>=0)
1   15:1   199              and (Y<192)
1   15:1   205              then VALIDXY:=true
1   15:1   208              else VALIDXY:=false;
1   15:1   218           if VALIDXY then Y:=191-Y;            (* Y axis inverted in Pascal *)
1   15:0   230         end;
1   15:0   244
1   15:0   244 (*$P*)
1   15:0   244 (***************  PRINTYPE  ****************************
1   15:0   244 *                                                         *
1   15:0   244 *       Prints out the name of the device that will       *
1   15:0   244 *       be plotted. Determined by the value of D.         *
1   15:0   244 *                                                         *
1   15:0   244 *       Called by : LISTALL,GETYPE                        *
1   15:0   244 *                                                         *
1   15:0   244 ***********************************************************)
1   16:D     1 procedure PRINTYPE;
1   16:0     0         begin
1   16:1     0            case D of
1   16:1     3            0:IDENT:='** INVALID **   ';
1   16:1    29            1:IDENT:='tri-state buffer';
1   16:1    55            2:IDENT:='output arrow    ';
1   16:1    81            3:IDENT:='input arrow     ';
1   16:1   107            4:IDENT:='D flip-flop     ';
1   16:1   133            5:IDENT:='JK flip-flop    ';
1   16:1   159            6:IDENT:='MSI box (vert)  ';
1   16:1   185            7:IDENT:='connection dot  ';
1   16:1   211            8:IDENT:='resistor (horiz)';
1   16:1   237            9:IDENT:='capacitor (vert)';
1   16:1   263            10:IDENT:='gnd             ';
1   16:1   289            11:IDENT:='plus 5          ';
1   16:1   315            12:IDENT:='exclusive-nor   ';
1   16:1   341            13:IDENT:='exclusive-or    ';
1   16:1   367            14:IDENT:='nor gate        ';
1   16:1   393            15:IDENT:='or gate         ';
1   16:1   419            16:IDENT:='nand gate       ';
1   16:1   445            17:IDENT:='and gate        ';
1   16:1   471            18:IDENT:='invert symbol   ';
1   16:1   497            19:IDENT:='inverter        ';
1   16:1   523            20:IDENT:='zener diode     ';
1   16:1   549            21:IDENT:='vertical arrow  ';
1   16:1   575            22:IDENT:='crystal         ';
1   16:1   601            23:IDENT:='minidip         ';
1   16:1   627            24:IDENT:='switch          ';
1   16:1   653            25:IDENT:='battery         ';
1   16:1   679            27:IDENT:='pnp transistor  ';
1   16:1   705            26:IDENT:='npn transistor  ';
1   16:1   731            28:IDENT:='op amp          ';
1   16:1   757            29:IDENT:='diode (horiz)   ';
1   16:1   783            30:IDENT:='diode (vert)    ';
1   16:1   809            31:IDENT:='cap(horiz)      ';
1   16:1   835            32:IDENT:='MSI box (horiz) ';
1   16:1   861            34:IDENT:='coil (left side)';
1   16:1   887            33:IDENT:='transformer     ';
1   16:1   913            35:IDENT:='resistor (vert) ';
1   16:1   939            36:IDENT:='user1           ';
1   16:1   965            37:IDENT:='user2           ';
```

```
1   16:1   991             end;
1   16:1  1074             write(IDENT);
1   16:0  1086           end;
1   16:0  1102
1   16:0  1102 (*$I PART4.TEXT*)
1   16:0  1102 (*$I PART5.TEXT*)
1   16:0  1102 (*$P*)  (* Part5 of LOGICDESIGN *)
1   16:0  1102
1   16:0  1102 (***************  LISTALL  ******************************
1   16:0  1102 *                                                      *
1   16:0  1102 *         List all the names of all the devices that   *
1   16:0  1102 *         can be plotted on the text screen.           *
1   16:0  1102 *                                                      *
1   16:0  1102 *         Called by : MENU                             *
1   16:0  1102 *                                                      *
1   16:0  1102 ********************************************************)
1   17:D     1 procedure LISTALL;
1   17:0     0         begin
1   17:1     0           CLEARTTY;
1   17:1     2           for I:=1 to 18 do begin
1   17:3    13           write(I,' - '); D:=I; PRINTYPE;
1   17:3    43           write(chr(9),' ',chr(9),I+18,' - ');
1   17:3   100           D:=I+18; PRINTYPE;
1   17:3   107           writeln;
1   17:2   115           end;
1   17:0   122         end;
1   17:0   136
1   17:0   136 (***************  BORDER  *******************************
1   17:0   136 *                                                      *
1   17:0   136 *         Draws or Erases the border around the HIRES  *
1   17:0   136 *         screen.                                      *
1   17:0   136 *                                                      *
1   17:0   136 *         Called by : MENU                             *
1   17:0   136 *                                                      *
1   17:0   136 ********************************************************)
1   18:D     1 procedure BORDER;
1   18:0     0         begin
1   18:1     0           CLEARTTY;  X:=0; Y:=0; pencolor(none); moveto(X,Y);
1   18:1    17           if CH='F' then pencolor(black) else pencolor(white);
1   18:1    34           X:=279; moveto(X,Y); Y:=191; moveto(X,Y);
1   18:1    54           X:=0; moveto(X,Y); Y:=0; moveto(X,Y);
1   18:1    70           BEEPREADY;
1   18:0    72         end;
1   18:0    84
1   18:0    84 (***** FORWARD REFRENCES *****)
1   18:0    84
1   19:D     1 procedure LISTMODE; forward;
1   19:D     1
1   20:D     1 procedure MENU; forward;
1   20:D     1
1   21:D     1 procedure CANCEL; forward;
1   21:D     1
1   21:D     1 (*$P*)
1   21:D     1 (***************  GETYPE  *******************************
1   21:D     1 *                                                      *
1   21:D     1 *         Sets up text display to show what is being   *
1   21:D     1 *         plotted and the status of the X & Y locks.   *
1   21:D     1 *                                                      *
1   21:D     1 *         Called by : MENU                             *
1   21:D     1 *                                                      *
1   21:D     1 ********************************************************)
1   22:D     1 procedure GETYPE;
1   22:0     0         begin
1   22:1     0           CLEARTTY; gotoxy(0,19);
1   22:1     7           write('Device type >> '); PRINTYPE; CH:='P'; LISTMODE;
1   22:0    42         end;
1   22:0    54
1   22:0    54 (***************  TESTLAST  *****************************
1   22:0    54 *                                                      *
1   22:0    54 *         Sets up conditions for deleting the last     *
1   22:0    54 *         device plotted. (Activated by the CLEAR      *
1   22:0    54 *         pad in the upper left corner of the tablet). *
1   22:0    54 *                                                      *
1   22:0    54 *         Called by : MYPLOT                           *
1   22:0    54 *                                                      *
1   22:0    54 ********************************************************)
1   23:D     1 procedure TESTLAST;
1   23:0     0         begin
1   23:1     0           if (X>-45) and (X<-30) and (Y>-65) and (Y<-50) then begin
1   23:3    21             BIT:=false; X:=LASTX; Y:=LASTY; DMODE:=6; D:=LASTD; VALIDXY:=true;
1   23:2    41           end;
1   23:0    41         end;
```

Listing 3 continued on page 424

Listing 3 continued:

```
1   23:0    54
1   23:0    54
1   23:0    54 (*$P*)
1   23:0    54 (***************  MYPLOT  ******************************
1   23:0    54 *                                                      *
1   23:0    54 *        Plots a device if X & Y are valid,            *
1   23:0    54 *        calls MENU if not.                            *
1   23:0    54 *                                                      *
1   23:0    54 *        Called by : Main program loop.                *
1   23:0    54 *                                                      *
1   23:0    54 *******************************************************)
1   24:D     1 procedure MYPLOT;
1   24:0     0       begin
1   24:1     0         pencolor(white); TESTLAST;
1   24:1     6         if not VALIDXY then MENU;
1   24:1    14         if D=0 then exit(MYPLOT);
1   24:1    23         if BIT then begin if LOCKY then X:=LASTX; if LOCKX then Y:=LASTY; end;
1   24:1    44         if VALIDXY then case D of
1   24:2    52           1:drawblock(BUFFER,2,0,0,16,16,X,Y-9,DMODE);
1   24:2    70           2:drawblock(OUT,2,0,0,16,16,X,Y-12,DMODE);
1   24:2    88           3:drawblock(INTHING,2,0,0,16,16,X,Y-12,DMODE);
1   24:2   106           4:begin drawblock(DTOP,2,0,0,16,16,X,Y,DMODE);
1   24:4   120                   drawblock(DBOT,2,0,0,16,16,X,Y-16,DMODE); end;
1   24:2   138           5:begin drawblock(JKTOP,2,0,0,16,16,X,Y,DMODE);
1   24:4   152                   drawblock(JKBOT,2,0,0,16,16,X,Y-16,DMODE); end;
1   24:2   170           6:begin drawblock(MSITOP,2,0,0,16,16,X,Y,DMODE);
1   24:4   184                   drawblock(MSIBOT,2,0,0,16,16,X,Y-16,DMODE); end;
1   24:2   202           7:drawblock(DOT,2,0,0,16,16,X-2,Y-13,DMODE);
1   24:2   222           8:drawblock(RESISTOR,2,0,0,16,16,X,Y-14,DMODE);
1   24:2   240           9:drawblock(CAP,2,0,0,16,16,X-3,Y-16,DMODE);
1   24:2   260           10:drawblock(GND,2,0,0,16,16,X-3,Y-16,DMODE);
1   24:2   280           11:drawblock(PLUS5,2,0,0,16,16,X-2,Y-5,DMODE);
1   24:2   300           12:drawblock(XNOR,2,0,0,16,16,X,Y-10,DMODE);
1   24:2   318           13:drawblock(XOR,2,0,0,16,16,X,Y-10,DMODE);
1   24:2   336           14:drawblock(NOR,2,0,0,16,16,X,Y-10,DMODE);
1   24:2   354           15:drawblock(ORGATE,2,0,0,16,16,X,Y-10,DMODE);
1   24:2   372           16:drawblock(NAND,2,0,0,16,16,X,Y-10,DMODE);
1   24:2   390           17:drawblock(ANDGATE,2,0,0,16,16,X,Y-10,DMODE);
1   24:2   408           18:drawblock(INV,2,0,0,16,16,X,Y-14,DMODE);
1   24:2   426           19:drawblock(INVERTER,2,0,0,16,16,X,Y-10,DMODE);
1   24:2   444           20:drawblock(ZENER,2,0,0,16,16,X-4,Y-16,DMODE);
1   24:2   463           21:drawblock(WIPER,2,0,0,16,16,X-1,Y-16,DMODE);
1   24:2   483           22:drawblock(XTAL,2,0,0,16,16,X,Y-11,DMODE);
1   24:2   501           23:drawblock(MINIDIP,2,0,0,16,16,X,Y-8,DMODE);
1   24:2   519           24:drawblock(SW,2,0,0,16,16,X,Y-11,DMODE);
1   24:2   537           25:drawblock(BAT,2,0,0,16,16,X,Y-12,DMODE);
1   24:2   555           26:drawblock(PNP,2,0,0,16,16,X,Y-8,DMODE);
1   24:2   573           27:drawblock(NPN,2,0,0,16,16,X,Y-8,DMODE);
1   24:2   591           28:drawblock(OPAMP,2,0,0,16,16,X-2,Y-8,DMODE);
1   24:2   611           29:drawblock(HDIODE,2,0,0,16,16,X,Y-12,DMODE);
1   24:2   629           30:drawblock(DIODE,2,0,0,16,16,X-3,Y-16,DMODE);
1   24:2   649           31:drawblock(HCAP,2,0,0,16,16,X,Y-12,DMODE);
1   24:2   667           32:begin drawblock(HMSIL,2,0,0,16,16,X-16,Y-7,DMODE);
1   24:4   685                   drawblock(HMSIR,2,0,0,16,16,X,Y-7,DMODE); end;
1   24:2   703           33:begin drawblock(RCOIL,2,0,0,16,16,X-3,Y-16,DMODE);
1   24:4   720                   drawblock(LCOIL,2,0,0,16,16,X+3,Y-16,DMODE); end;
1   24:2   739           34:drawblock(RCOIL,2,0,0,16,16,X-3,Y-16,DMODE);
1   24:2   758           35:drawblock(VRESIST,2,0,0,16,16,X-1,Y-16,DMODE);
1   24:2   777           36:drawblock(USER1,2,0,0,16,16,X-USR1X,Y-USR1Y,DMODE);
1   24:2   796           37:drawblock(USER2,2,0,0,16,16,X-USR2X,Y-USR2Y,DMODE);
1   24:2   815           end; (* OF CASE STMNT *)
1   24:1   896           PITCH:=D+5; DURATION:=5; BEEP; DMODE:=14;
1   24:1   909           if VALIDXY then begin LASTX:=X; LASTY:=Y; LASTD:=D; end;
1   24:1   923           if not BIT then begin BIT:=true; D:=0; CANCEL; end;
1   24:0   938       end;
1   24:0   956 (*$I PART5.TEXT*)
1   24:0   956 (*$I PART6.TEXT*)
1   24:0   956 (*$P*)  (* Part6 of LOGICDESIGN *)
1   24:0   956
1   24:0   956 (***************  DRAWLINE  ****************************
1   24:0   956 *                                                      *
1   24:0   956 *       Draws horizontal or vertical lines only.       *
1   24:0   956 *       Exits on not VALIDXY (or keypress).            *
1   24:0   956 *                                                      *
1   24:0   956 *       Called by : MENU                               *
1   24:0   956 *                                                      *
1   24:0   956 *******************************************************)
1   25:D     1 procedure DRAWLINE;
1   25:D     1         var OLDX,OLDY : integer;
1   25:0     0         begin
```

```
1   25:1    0               GETXY; BEEP; pencolor(none);
1   25:1    8               moveto(X,Y); pencolor(white);
1   25:1   17               while VALIDXY do begin
1   25:3   22                 OLDX:=X; OLDY:=Y; GETXY; BEEP;
1   25:3   32                 if abs(OLDX-X) > abs(OLDY-Y) then Y:=OLDY else X:=OLDX;
1   25:3   51                 if VALIDXY then moveto(X,Y);
1   25:2   61               end;
1   25:0   63             end;
1   25:0   78
1   25:0   78 (***************  EATLINE  ******************************
1   25:0   78 *                                                      *
1   25:0   78 *       Deletes lines in any one direction until       *
1   25:0   78 *       it runs out of line.                           *
1   25:0   78 *                                                      *
1   25:0   78 *       Called by : MENU                               *
1   25:0   78 *                                                      *
1   25:0   78 ********************************************************)
1   26:D    1 procedure EATLINE;
1   26:0    0         begin
1   26:1    0           repeat GETXY; until ((screenbit(x,y)) or (not VALIDXY));
1   26:1   16           if screenbit(X,Y) then
1   26:2   25            begin
1   26:3   25              PITCH:=5; DURATION:=12; BEEP;
1   26:3   33              pencolor(none); moveto(X,Y);
1   26:3   42              pencolor(black);
1   26:3   46              while screenbit(X,Y) do
1   26:4   55              begin
1   26:5   55                moveto(X,Y);
1   26:5   60                case CH of
1   26:5   65                'H': X:=X+1;            (* to the right *)
1   26:5   72                'I': X:=X-1;            (* to the left  *)
1   26:5   79                'J': Y:=Y+1;            (* going up     *)
1   26:5   86                'K': Y:=Y-1;            (* and down     *)
1   26:5   93                end;
1   26:4  108              end;
1   26:2  110            end;
1   26:0  110          end;
1   26:0  126
```

Listing 3 continued on page 426

Listing 3 continued:

```
1  26:0  126 (*$P*)
1  26:0  126 (****************  LISTMODE  ******************************
1  26:0  126 *                                                        *
1  26:0  126 *       More info for the text screen.                   *
1  26:0  126 *                                                        *
1  26:0  126 *       Called by : MENU,GETYPE,Main                     *
1  26:0  126 *                                                        *
1  26:0  126 **********************************************************)
1  19:D    1 procedure LISTMODE;
1  19:0    0      begin
1  19:1    0        gotoxy(0,15); write('Mode = ');
1  19:1   24        case CH of
1  19:1   29        'A': write('Clear an area on screen - contact any 2 diagonal corners');
1  19:1   99        'G': write('Draw lines');
1  19:1  123        'H': write('Delete lines - to the right');
1  19:1  164        'I': write('Delete lines - to the left');
1  19:1  204        'J': write('Delete lines - going up');
1  19:1  241        'K': write('Delete lines - going down');
1  19:1  280        'P': begin  write('Plot devices'); gotoxy(17,5);
1  19:3  309          if LOCKY then write('<<< HORIZONTAL AXIS IS LOCKED AT ',LASTY,' >>>');
1  19:3  385          if LOCKX then write('<<< VERTICAL AXIS IS LOCKED AT ',LASTX,' >>>');
1  19:3  459          if (not LOCKX) and (not LOCKY) then write
1  19:4  470          ('                                              '); end;
1  19:1  524        'B','C','D': write('Setup lock');
1  19:1  548        'E': write('Transfering screen to printer - cancel with any key');
1  19:1  613        'Z': write(' ?????????? ');
1  19:1  639        end;
1  19:1  698        gotoxy(17,5);
1  19:1  703          if (not LOCKX) and (not LOCKY) then write
1  19:2  714          ('                                   ');
1  19:0  758      end;
1  19:0  774
1  19:0  774 (***************  SETLOCK  *******************************
1  19:0  774 *                                                        *
1  19:0  774 *       Sets up (or clears) the horizontal and           *
1  19:0  774 *       vertical locks for neat plotting.                *
1  19:0  774 *                                                        *
1  19:0  774 *       Called by : MENU                                 *
1  19:0  774 *                                                        *
1  19:0  774 **********************************************************)
1  27:D    1 procedure SETLOCK;
1  27:0    0         begin
1  27:1    0           case CH of
1  27:1    5           'C': begin writeln; writeln; write('Use pen to select row.');
1  27:3   55                      repeat GETXY; until VALIDXY; LASTX:=X; LASTY:=Y;
1  27:3   68                      LOCKX:=true; LOCKY:=false; end;
1  27:1   78           'D': begin writeln; writeln; write('Use pen to select column.');
1  27:3  131                      repeat GETXY; until VALIDXY; LASTX:=X; LASTY:=Y;
1  27:3  144                      LOCKX:=false; LOCKY:=true; end;
1  27:1  154           'B': begin LOCKX:=false; LOCKY:=false; end;
1  27:1  164           end;
1  27:0  178         end;
1  27:0  196
1  27:0  196 (*$I PART6.TEXT*)
1  27:0  196 (*$I PART7.TEXT*)
1  27:0  196 (*$P*)  (* Part7 of LOGICDESIGN *)
1  27:0  196
1  27:0  196 (***************  WRITEONSCREEN  ***********************
1  27:0  196 *                                                        *
1  27:0  196 *       Overlays strings on HIRES screen 1.              *
1  27:0  196 *       Labels can be horiz or vertical.                 *
1  27:0  196 *                                                        *
1  27:0  196 *       Called by : MENU                                 *
1  27:0  196 *                                                        *
1  27:0  196 **********************************************************)
1  28:D    1 procedure WRITEONSCREEN;
1  28:D    1         var ST : string;
1  28:D   42             C1 : char;
1  28:0    0         begin
1  28:1    0           CLEARTTY; write('H(orizontal or V(ertical labels?'); read(CH);
1  28:1   57           writeln; writeln; write('Enter label -> ');
1  28:1  100           readln(ST); GETXY;
1  28:1  121           chartype(6);
1  28:1  125           pencolor(none);
1  28:1  129           while VALIDXY do begin
1  28:3  134             case CH of
1  28:3  139             'h','H': begin moveto(X,Y); wstring(ST);  end;
1  28:3  151             'v','V': begin for I:=1 to length(st) do
1  28:6  166                      begin moveto(X,Y); C1:=ST[I]; wchar(C1); Y:=Y-9;  end;
1  28:4  195                      end;
1  28:3  197             end;
```

```
1  28:3   298          GETXY;
1  28:2   300          end; (* of while loop *)
1  28:0   302        end;
1  28:0   322
1  28:0   322 (***************  CLEARBLOCK  ***************************
1  28:0   322 *                                                        *
1  28:0   322 *       Deletes a portion of the screen delimited        *
1  28:0   322 *       by any two diagonal corners.                     *
1  28:0   322 *                                                        *
1  28:0   322 *       Called by : MENU                                 *
1  28:0   322 *                                                        *
1  28:0   322 **********************************************************)
1  29:D     1 procedure CLEARBLOCK;
1  29:D     1         var X1,Y1,X2,Y2 : integer;
1  29:0     0         begin
1  29:1     0            GETXY; BEEP; X1:=X; Y1:=Y; if not VALIDXY then exit(CLEARBLOCK);
1  29:1    20            GETXY; BEEP; X2:=X; Y2:=Y; if not VALIDXY then exit(CLEARBLOCK);
1  29:1    40            pencolor(none);
1  29:1    44            if X < X1 then begin X2:=X1; X1:=X; end;
1  29:1    55            if Y < Y1 then begin Y2:=Y1; Y1:=Y; end;
1  29:1    66            for I:=X1 to X2 do begin
1  29:3    77              moveto(I,Y1); pencolor(black);
1  29:3    86              moveto(I,Y2); end;
1  29:0    98          end;
1  29:0   112
1  29:0   112 (*$P*)
1  29:0   112 (***************  PRINTOUT  *****************************
1  29:0   112 *                                                        *
1  29:0   112 *       Transfers HIRES screen 1 to the printer.         *
1  29:0   112 *       (In this case a Hytype I with limited            *
1  29:0   112 *       graphics capability.) There are a number of      *
1  29:0   112 *       local procedures which can be changed as         *
1  29:0   112 *       required for other printers.                     *
1  29:0   112 *                                                        *
1  29:0   112 *       Called by : MENU                                 *
1  29:0   112 *                                                        *
1  29:0   112 **********************************************************)
1  30:D     1 procedure PRINTOUT;
1  30:D     1         const  XMAX=279; YMAX=191;
1  30:D     1                CR=13; LF=10; ACK=6; BELL=7;
1  30:D     1
1  30:D     1         (***** LOCAL PROCEDURES *****)
1  30:D     1
1  31:D     1         procedure PRINT(X:char);         (* sends 1 character to printer *)
1  31:0     0           begin
1  31:1     0             unitwrite(6,X,1,,1);
1  31:0     9           end;
1  31:0    22
1  32:D     1         procedure CRLF;                  (* in graphics mode does a CR and *)
1  32:0     0           begin                          (* small LF .. 1/48th inch ..     *)
1  32:1     0             PRINT(chr(CR)); PRINT(chr(LF));
1  32:0     6           end;
1  32:0    18
1  33:D     1         procedure SETPRINTER;            (* BELL sets Text mode, ACK sets *)
1  33:0     0           begin                          (* Graphics mode on printer.     *)
1  33:1     0             PRINT(chr(BELL)); PRINT(chr(ACK));
1  33:0     6           end;
1  33:0    18
1  34:D     1          procedure CLEARPRINTER;
1  34:0     0            begin
1  34:1     0            PRINT(chr(BELL)); CRLF;
1  34:0     5            end;
1  34:0    18
1  35:D     3          function LASTTRUE(J:integer) : integer;       (* Finds the location *)
1  35:0     0            begin                                       (* of the last dot in *)
1  35:1     0             K:=XMAX;                                   (* in the line. Saves *)
1  35:1     5              repeat K:=K-1                             (* time at 300 baud   *)
1  35:1     6              until ((screenbit(K,YMAX-J)) or (K=0));
1  35:1    27             LASTTRUE:=K;
1  35:0    30            end;
1  35:0    44
1  35:0    44 (*$P*)
1  36:D     1          procedure PRINTIT;              (* does the real work *)
1  36:0     0            begin
1  36:1     0              if KEY then I:=0; (* clears keyboard strobe *)
1  36:1     9              pencolor(none);
1  36:1    13               for J:=0 to YMAX do
1  36:2    26                 begin
1  36:3    26                   for I:=0 to LASTTRUE(J) do
1  36:4    41                    begin
1  36:5    41                       pencolor(none); moveto(I-1,YMAX-J);
```

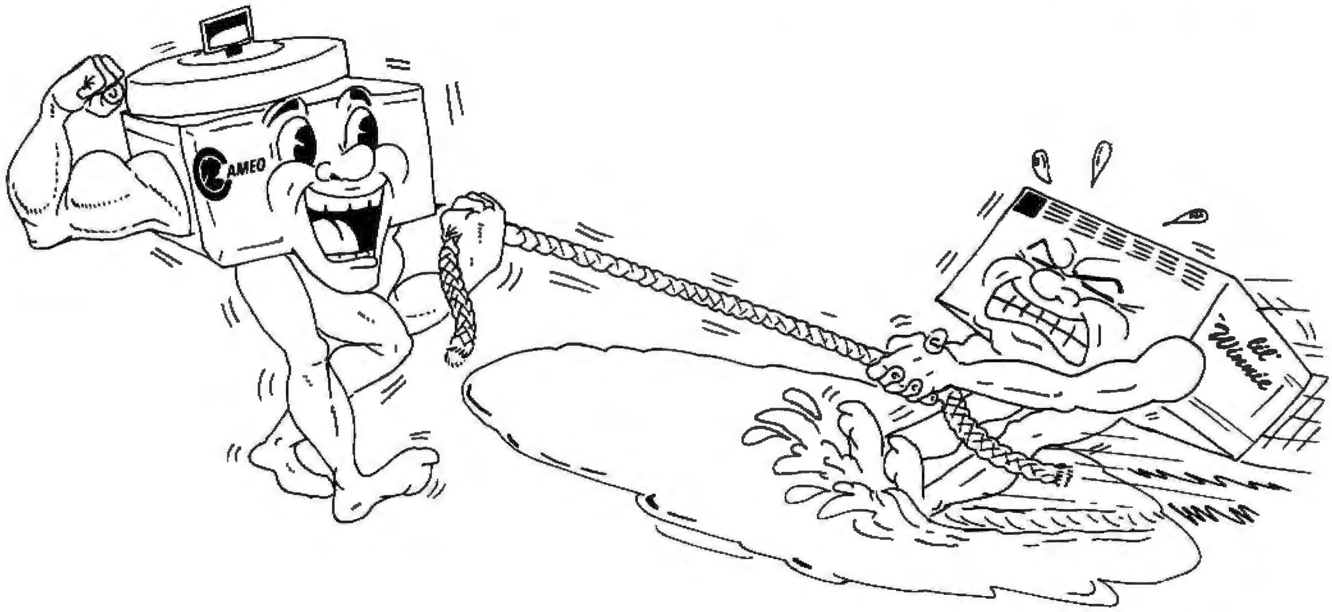
Listing 3 continued on page 428

```
  1    36:5     56                       if screenbit(I,YMAX-J) then PRINT('.');
  1    36:5     72                       PRINT(' '); PRINT(' ');
  1    36:5     78                       pencolor(reverse); moveto(I,YMAX-J);
  1    36:4     91                      end;
  1    36:3     98                    CRLF; moveto(I-1,YMAX-J); pencolor(none);
  1    36:3    115                    if KEY then exit(PRINTIT);
  1    36:2    125                  end;
  1    36:0    132              end;
  1    36:0    148
  1    30:0      0    begin                      (* procedure PRINTOUT *)
  1    30:1      0      write(chr(25));
  1    30:1     10      write('Print the screen (takes a while) - Type "Y" to start.');
  1    30:1     75      read(CH); writeln; if (CH='Y') or (CH='y') then
  1    30:2    107             begin
  1    30:3    107               SETPRINTER;
  1    30:3    109               PRINTIT;
  1    30:3    111               CLEARPRINTER;
  1    30:3    113               CRLF;
  1    30:2    115             end;
  1    30:0    115    end;
  1    30:0    128
  1    30:0    128  (*$P*)
  1    30:0    128  (***************  CLEARSCREEN  *************************
  1    30:0    128  *                                                     *
  1    30:0    128  *       Clears Hires screen 1.                        *
  1    30:0    128  *                                                     *
  1    30:0    128  *       Called by : MENU                              *
  1    30:0    128  *                                                     *
  1    30:0    128  *****************************************************)
  1    37:D      1  procedure CLEARSCREEN;
  1    37:0      0          begin
  1    37:1      0            CLEARTTY; write('CLEAR THE SCREEN - Are you sure? (Y/N)');
  1    37:1     52            read(CH); if (CH='Y') or (CH='y') then initturtle;
  1    37:0     79          end;
  1    37:0     92
  1    37:0     92  (***************  CANCEL  *******************************
  1    37:0     92  *                                                     *
  1    37:0     92  *       Fixes Text screen on leaving any command.     *
  1    37:0     92  *                                                     *
  1    37:0     92  *       Called by : MENU,MYPLOT,Main                  *
  1    37:0     92  *                                                     *
  1    37:0     92  *****************************************************)
  1    21:D      1  procedure CANCEL;
  1    21:0      0          begin
  1    21:1      0             CLEARTTY; gotoxy(27,12); write('*** NO MODE ACTIVE ***');
  1    21:1     41             PITCH:=6; DURATION:=3; BEEP; PITCH:=4; DURATION:=6; BEEP;
  1    21:1     57             D:=0; CH:='Z';
  1    21:0     64          end;
  1    21:0     76
  1    21:0     76  (***************  ACCEPT  *******************************
  1    21:0     76  *                                                     *
  1    21:0     76  *       Beeps when a MENU command is acceptable.      *
  1    21:0     76  *                                                     *
  1    21:0     76  *       Called by : MENU                              *
  1    21:0     76  *                                                     *
  1    21:0     76  *****************************************************)
  1    38:D      1  procedure ACCEPT;
  1    38:0      0          begin
  1    38:1      0            PITCH:=(X div 16) + 5; DURATION:=7; BEEP;
  1    38:0     12          end;
  1    38:0     24
  1    38:0     24
  1    38:0     24  (*$I PART7.TEXT*)
  1    38:0     24  (*$I PART8.TEXT*)
  1    38:0     24  (*$P*)  (* Part8 of LOGICDESIGN *)
  1    38:0     24
  1    38:0     24  (***************  MENU  *********************************
  1    38:0     24  *                                                     *
  1    38:0     24  *       Main mode selection happens here.             *
  1    38:0     24  *                                                     *
  1    38:0     24  *       Called by : MYPLOT                            *
  1    38:0     24  *                                                     *
  1    38:0     24  *****************************************************)
  1    20:D      1  procedure MENU;
  1    20:D      1          var XPOS, YPOS : integer;
  1    20:0      0          begin
  1    20:1      0           D:=0;
  1    20:1      3           XPOS:=trunc((X+65) / 16.0);     (* actual value of the divisor *)
  1    20:1     18           YPOS:=trunc((Y-224) / 16.0);    (* may vary from Tablet to Tablet *)
```

```
1   20:1    36            case YPOS of
1   20:1    39            3: case XPOS of              (* Bottom row, left to right *)
1   20:2    42                 0: begin CLEARSCREEN; CANCEL; end;
1   20:2    48                 1: begin CH:='A'; CLEARTTY; LISTMODE;
1   20:4    56                          ACCEPT; CLEARBLOCK; CANCEL; end;
1   20:2    64                 2: begin CH:='B'; CLEARTTY; LISTMODE;
1   20:4    72                          ACCEPT; SETLOCK; CANCEL; end;
1   20:2    80                 3: begin CH:='D'; CLEARTTY; LISTMODE;
1   20:4    88                          ACCEPT; SETLOCK; CANCEL; end;
1   20:2    96                 4: begin CH:='C'; CLEARTTY; LISTMODE;
1   20:4   104                          ACCEPT; SETLOCK; CANCEL; end;
1   20:2   112                 5: begin LISTALL; end;
1   20:2   116                 6: begin ACCEPT; LOADSCREEN; CANCEL; end;
1   20:2   124                 7: begin ACCEPT; SAVESCREEN; CANCEL; end;
1   20:2   132                 8: EXT;
1   20:2   136                 9: begin CH:='E'; CLEARTTY; LISTMODE;
1   20:4   144                          ACCEPT; PRINTOUT; CANCEL; end;
1   20:2   152                 10: begin CH:='F'; BORDER; CANCEL; end;
1   20:2   162                 11: begin CH:='L'; BORDER; CANCEL; end;
1   20:2   172                 12: begin ACCEPT; WRITEONSCREEN; CANCEL; exit(MYPLOT); end;
1   20:2   184                 13,14: begin CH:='G'; CLEARTTY; LISTMODE;
1   20:4   192                        ACCEPT; DRAWLINE; CANCEL; end;
1   20:2   200                 15: begin CH:='H'; CLEARTTY; LISTMODE;
1   20:4   208                           ACCEPT; EATLINE; CANCEL; end;
1   20:2   216                 16: begin CH:='I'; CLEARTTY; LISTMODE;
1   20:4   224                           ACCEPT; EATLINE; CANCEL; end;
1   20:2   232                 17: begin CH:='J'; CLEARTTY; LISTMODE;
1   20:4   240                           ACCEPT; EATLINE; CANCEL; end;
1   20:2   248                 18: begin CH:='K'; CLEARTTY; LISTMODE;
1   20:4   256                           ACCEPT; EATLINE; CANCEL; end;
1   20:2   264                 19,20 : begin ACCEPT; SETUSR; CANCEL; exit(MYPLOT); end;
1   20:2   276                 21: FLAG:=not FLAG;
1   20:2   285               end; (* of YPOS=3 *)
1   20:1   338            2: begin D:=XPOS+1; if D>19 then D:=0; GETYPE; end;
1   20:1   355            1: begin D:=XPOS+20; if D>37 then D:=0; GETYPE; end;
1   20:1   372          end; (* of YPOS case stmt *)
1   20:0   386        end;
1   20:0   404
1   20:0   404 (*$P*)
1   20:0   404 (****************  MAIN PROGRAM LOOP  ********************
1   20:0   404 *                                                        *
1   20:0   404 *       Calls the initialization routines, loads         *
1   20:0   404 *       shapes, loops in MYPLOT till the EXIT            *
1   20:0   404 *       routine is called.                               *
1   20:0   404 *                                                        *
1   20:0   404 **********************************************************)
1    1:0     0 begin
1    1:0     0  (* initialize booleans *)
1    1:1     0  SAFETY:=true;
1    1:1    26  HELLFREEZESOVER:=false;
1    1:1    30  FLAG:=false;
1    1:1    34  LOCKX:=false;
1    1:1    38  LOCKY:=false;
1    1:1    42
1    1:1    42  (* initialize ploting mode *)
1    1:1    42  LASTD:=100; DMODE:=14;
1    1:1    48  write('loading "LOGIC.CHARSET"'); GETSHAPES; writeln; BEEPREADY;
1    1:1    95
1    1:1    95  (* setup pad and screen *)
1    1:1    95  SETUPAD;
1    1:1    97  INITTURTLE;
1    1:1   100
1    1:1   100  (* setup text screen *)
1    1:1   100  CANCEL; LISTMODE;
1    1:1   104
1    1:1   104  (* lets doit *)
1    1:1   104  repeat
1    1:2   104    GETXY; MYPLOT;
1    1:1   108  until HELLFREEZESOVER;
1    1:0   113 end.
```


ADVENTURE GAME
BY TOM SLOAN
I CAN REALLY GET INTO THIS ADVENTURE GAME.
COMMAND RUN ADVENTURE GAME
LETS SEE NOW. I HAVE TO FIND THE BURIED TREASURE. I'M ON THE LEDGE OF THE 'TYPE MISMATCH MOUNTAIN'..
...THERE'S A TUNNEL NEARBY
I'LL GO IN.
INPUT
IT'S DARK IN HERE... I KNOW!, I'LL "LIGHT CANDLE"!
THERE...THATS BETTER
HELLO
AHH!
OH MAN! WHAT DO I DO NOW
LONGJOHN OVERFLOW APPEARS AND BLOCKS YOUR EXIT.
PIECES OF EIGHT BITS
OH LOOK!
SWISH
POLYMORPHIC WANNA CRACKER
HERE YOU GO.
YO HO HO
RUM
THAT GIVES HIM A HOBBY.
GEE. HERE'S THE RECTIFIER BRIDGE.
OH NO! A DIVIDE BY ZERO TROLL!
AHHHH
I MUST BE IN THE VALLEY OF THE DROPPED BITS.
CRASH
WHAT LUCK! I FOUND THE TREASURE
NOW I BETTER GET BACK BEFORE THESE SPECIAL CHARACTERS GET ME.
THERE ARE SOME OLD RUINS AHEAD
E PLURIBUS BAD PARAMETERS
OH-OH! THE SYNTAX MONSTER
AHH!
WOW! WHAT A WILD SITUATION TO BE IN.
SYNTAX MONSPER GRABS YOU
BUT THE ONLY TROUBLE IS THAT THE GAME IS NOT VERY REALISTIC.
TOM SLOAN

It's not hard . . .



to win with fast, reliable, mass storage

- The Cameo cartridge disk subsystem provides 40 to 100 times the storage capacity of floppy disks. Data transfer rates and reliability are correspondingly faster.
- Our cartridge feature lets you . . . COPY . . . BACK UP . . . EXTEND . . . or REMOVE your data base easily by just removing the disk pack as you now remove your floppy.
- The densely packed cartridges, although storing five million characters each, are byte-for-byte less expensive than floppy diskettes!
- Available on most 8-bit microprocessors (Apple, Heath, S-100, TRS-80 and others*) with most major operating systems (CPM, APPLE DOS, TRS DOS, OASIS, PASCAL, MPM, SCREEN EDIT and others*).

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Circle 54 on inquiry card.

What's New?

PERIPHERALS

Serial-Interface Board for Multibus

The Multibus Octal Serial Interface Board allows up to eight RS-232C interfaces to be hooked to any Multibus system. Each interface has a data-rate generator that enables users to set each USART (universal synchronous/asynchronous receiver/transmitter) at a different speed. The board allows 16-bit addressing and interrupt capabilities. Available data rates range from 50 to 19,200.

The Multibus Octal Serial Interface Board costs $435. For more information, contact Central Data Corporation, 713 Edgebrook Dr, Champaign IL 61820, (217) 359-8010.

Circle 500 on inquiry card.

Paper-Tape Reader for Hobbyists

The Model 605 paper-tape reader reads at 150 cps (characters per second), has a parallel TTL (transistor-transistor logic) output, and is bidirectional. It stops on character and has automatic taut-tape sensing. The reader has 5 V DC and 24 V DC output power available and an optional internal clock.

The 605 costs $495. It is available from Addmaster Corporation, 416 Junipero Serra Dr, San Gabriel CA 91776, (213) 285-1121.

Circle 501 on inquiry card.

Portable RS-232C Memory System

The MTL 900 is a portable cassette system for remote data gathering, memory downloading, and remote program updating. The unit uses a Braemar digital-cassette read/write unit with RS-232C interfacing. The necessary cable and connector assembly is included. Each miniature cassette holds up to 86 K bytes at 800 bits per inch. The MTL 900 has a data-transfer rate of 2400 bps (bits per second). Power is normally supplied from the host equipment, but internal AC or battery power supplies are available as options. The MTL 900 is priced at $425.

For additional information, contact Braemar Computer Devices Inc, 11950 12th Ave S, Burnsville MN 55337, (612) 890-5135.

Circle 502 on inquiry card.

Graphics Printer

The Model 84G graphics printer features a 7 by 7 or 14 by 7 dot matrix, six different character sizes, 100 cps (characters per second) bidirectional print speed, and selectable tractor or friction paper feed. It has variable line density and continuous form-length controls. Its high-resolution graphics capability can provide plotting, printing, videographics hard copy, and special-effect symbols. The printer has a 96-character ASCII set, upper- and lowercase printing, an 800-character buffer, a 100% duty cycle, and 40 to 132 characters per line. Operator controls include power, select/deselect, line-feed, top-of-form, self-test, and variable vertical-tab setting.

The 84G is $795. For more information, contact DIP Inc, 745 Atlantic Ave, Boston MA 02111, (617) 482-4214.

Circle 503 on inquiry card.

Thin, 58-Key Sealed Keyboard

The Model MK 058-001 keyboard meets the ergonometric (safety) standards now required by many European countries. The keyboard profile is approximately 0.4 inch. Key spacing, operating force, and row-offset of the MK 058-001 are that of a conventional typewriter. Normal specifications include 15 million mean characters between failure, 0.06-inch travel, 2.8-ounce force, 2 ms bounce, and 2-ohm contact resistance. The keys are sealed and provide tactile feel.

For information, contact Advanced Input Devices, POB 1818, Coeur d'Alene ID 83814, (208) 773-3586.

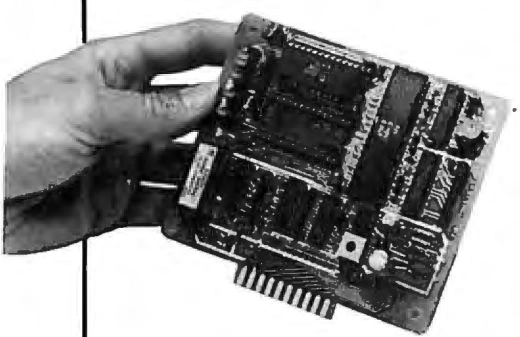
Circle 504 on inquiry card.

Where Do New Products Items Come From?

The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgment the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first-in first-out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.

What's New?

PERIPHERALS



Speech-Synthesizer Module

The Series III Speech Module can accommodate standard and custom vocabularies up to a total of 256 utterances. It consists of TSI's (Telesensory Systems Inc's) speech synthesizer, vocabulary memory, an on-board speech filter, and an audio amplifier. It is TTL- (transistor-transistor logic) compatible and uses a single + 5 V supply. The memory can be a combination of one or two 16, 32, or 64 K ROMs (read-only memories) or PROMs (programmable ROMs), providing up to 128 K bits. With the Series III, about 100 seconds of speech can be stored in ROM. For complete details, contact Telesensory Systems Inc, 3408 Hillview Ave, POB 10099, Palo Alto CA 94304, (415) 493-2626.

Circle 575 on inquiry card.

Lowercase Conversion Kit for TRS-80 and Centronics Printers

The Conversion Kit I for the TRS-80 and the Centronics 779 printer allows the option of lowercase. This is a full 96-character ASCII (American Standard Code for Information Interchange) uppercase and lowercase set with the option of changing slash zero to a standard zero. The kit does not require etch cuts or soldering. Installation can be done with a screwdriver. No program modification or additional interfacing is required. The kit can be removed in a matter of seconds should any warranty repairs on the printer be required. The price is $125. For details, contact Service Technologies, 32 Nightingale Rd, Nashua NH 03062, (603) 883-5369.

Circle 505 on inquiry card.

Boost TRS-80 5-Inch Floppy-Disk Storage to 354 K Bytes

Using the Doubler, TRS-80 Model I users can store up to 354 K bytes of data on a 5-inch disk. The Doubler adapter plugs into the controller device socket of the TRS-80 Expansion Interface. The device reads, writes, and formats either single- or double-density floppy disks. The price for the Doubler, DBLDOS operating system, and a utility for converting TRSDOS, Percom OS-80, and other single-density files and programs into double-density format is $219.95. For additional information, contact Percom Data Company, 211 N Kirby, Garland TX 75042, (800) 527-1592.

Circle 506 on inquiry card.

8-Inch Floppy Disks for North Star

John D Owens Associates Inc has an 8-inch floppy-disk subsystem for North Star microcomputer users. The 8-inch drives allow transfers to and from standard North Star 5-inch drives. This software/hardware package is designed to operate in single or double density on 8-inch floppy disks.

The subsystem's hardware includes a Tarbell double-density controller and dual Shugart 800R drives in a cabinet with power supply, fan, and all cables. The software interface, DMA-DOS, is a single-user CP/M-compatible 8080/Z80 disk operating system that maintains control of the microcomputer systems' resources. Features of DMA-DOS include user-protect passwords; file-write protection and invisibility to the directory; storage for up to six files for printing; batched console processing; user-oriented prompting and error messages; support for disk files of up to 4.2 megabytes; and 20 basic system commands. The subsystem is available from John D Owens Associates Inc, 12 Schubert St, Staten Island NY 10305, (212) 448-6283, for $1910. The software can be purchased separately without the Tarbell interface for $150, or with the interface for $200.

Circle 508 on inquiry card.

Hand-Held Terminal with an LCD

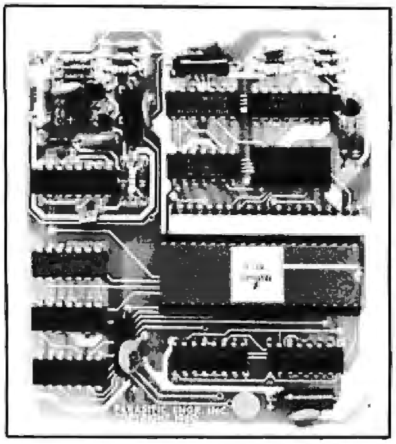
The TransTerm 1 uses a 64-character, 5 by 7 dot-matrix LCD (liquid-crystal display) organized in two 32-character lines with an underscore cursor. The character set is standard 96-character ASCII. The keyboard contains fifty-three membrane keys. The unit communicates in full-duplex RS-232C serial asynchronous ASCII, with 20 mA current loop or RS-422 available as options. Switch-selectable data rates of 300 to 9600 bps (bits per second) are included. A teletypewriter-compatible mode, block-send mode, or polled multidropping operation are included. The unit measures 29.7 by 17.5 by 4.4 cm ($11\frac{7}{10}$ by $6\frac{9}{10}$ by $1\frac{3}{4}$ inches). It consumes 10 W of power.

The TransTerm 1 is available for $449 from Computerwise Inc, 4006 E 137th Ter, Grandview MO 64030, (816) 765-3330.

Circle 507 on inquiry card.

What's New?

PERIPHERALS



TRS-80 Data Separator

Parasitic Engineering's 5-inch floppy-disk-drive data separator eliminates most disk errors, including CRC, track locked out, and disk I/O error. The separator uses a phase-locked-loop circuit for error tracking. It plugs inside the TRS-80 Model I Expansion Interface. The data separator is compatible with all TRS-80 software and includes the FD1771 disk controller. The 5-inch-drive unit is upward compatible with 8-inch drives.

The data separator costs $250. Contact Parasitic Engineering Inc, 1101 Ninth Ave, Oakland CA 94606, (415) 839-2636.

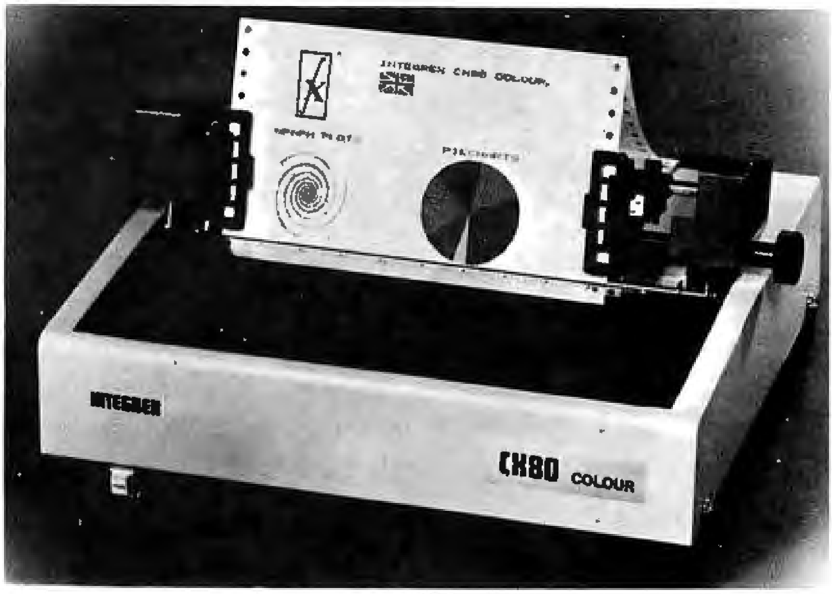
Circle 512 on inquiry card.

Interface for IBM Electronic Typewriters

The Mediamix ETI² connects IBM Model 50, 60, and 75 electronic typewriters to any computer with a Centronics-type parallel port. The device includes a Z80 microprocessor and 2 K bytes of programmable memory. It features user-definable codes and characters for any word-processing program and the ability to use all the functions of the IBM typewriters with most programs.

For more information, contact Mediamix, POB 67B57, Los Angeles CA 90067, (213) 475-9949.

Circle 513 on inquiry card.



Color-Matrix Printer from Britain

The Integrex CX80 is a new color-matrix printer that doesn't require special-absorbency paper. The machine can print text, graphs, histograms, and video-display images in seven colors without restrictions on mixing characters, dot-addressed areas, and color changes on the same line. Stripes from a three-color ribbon are selected to produce the required colors.

The unit is dot-addressable in all seven colors, and a character-set ROM (read-only memory) contains 96 ASCII (American Standard Code for Information Interchange) and 64 graphics characters. The seven-wire head produces 5 by 7 and 6 by 7 formats. The print width is 80 columns, resolution is 60 dots per inch, and print speed is 125 cps (characters per second) in a primary color. There are 15 user-programmable characters. All characters can be printed in double-length and reverse. Buffer length is two lines. Paper movement is programmable.

The printer comes with a Centronics-compatible interface; RS-232C and IEEE-488 interfaces are optional. The Integrex CX80 costs approximately $2000. For details, contact Integrex Ltd, Portwood Industrial Estate, Church Gresley, Burton-on-Trent, Staffs, DE11 9PT, England. In North America, contact Integrex Inc, 233 N Juniper St, Philadelphia PA 19107, (215) 627-0966.

Circle 514 on inquiry card.

Serial Interface for the Epson MX-80

The Epax is a buffered serial interface with selectable data rates for the Epson MX-80 printer. Epax is a single board that installs inside the printer and provides 1000 characters of buffer storage. Transmission restraints can operate in one of two ways: XON-XOFF signaling or Centronics-compatible handshaking. Buffer-control characters are user-selectable.

The Epax is $175 from Vardon & Associates Inc, 1401 Walnut Hill Ln, Irving TX 75062, (800) 527-7700; in Texas (214) 659-3800.

Circle 515 on inquiry card.

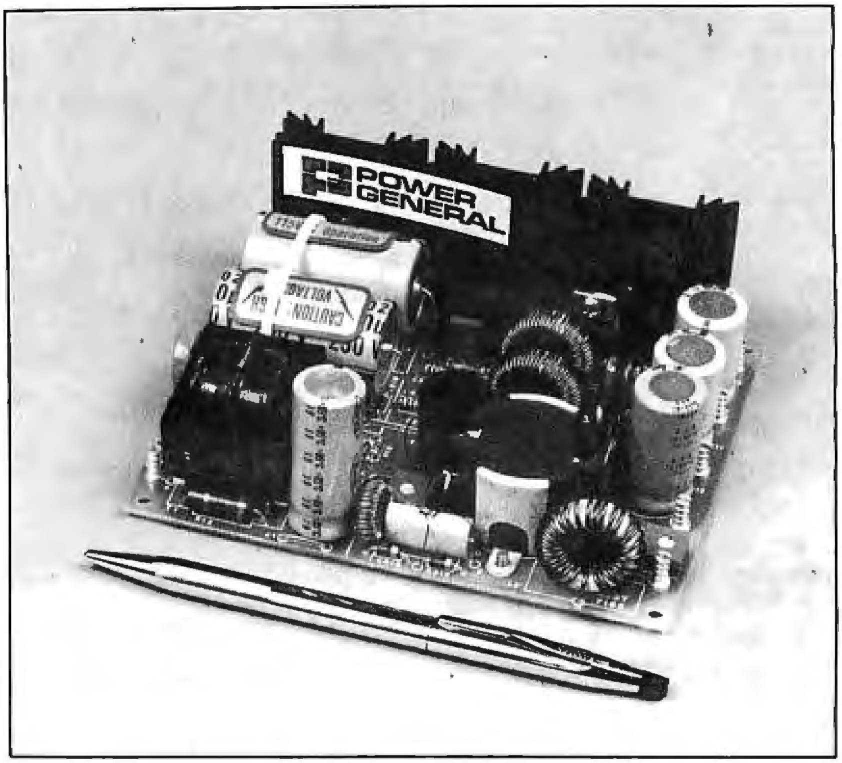
What's New?

MISCELLANEOUS

50 W, Triple-Output Power Supplies

The Series 3050 power supplies feature two models, the 3050-1A and the 3050-2A. The Model 3050-1A has +5 V DC at 6 A and ±12 V DC at 1 A, and the Model 3050-2A has +5 V DC at 6 A and ±15 V DC at 1 A. Basic specifications include 80% efficiency; 90 to 130 V AC input; 20 kHz clock oscillator; ±0.1% line regulation; ±0.1% load regulation; 50 mV peak-to-peak output noise; 300 μs response time; and 1500 V AC input/output isolation. The units weigh 18 ounces. Output current limit and soft start are standard on both models. No external heat sink is required.

The price for Models 3050-1A and 3050-2A is $95 each. Contact Power General, 152 Will Dr, Canton MA 02021, (617) 828-6216. Circle 509 on inquiry card.



TRS-80 Model I Development System

The Developmate 81 upgrades the TRS-80 Model I into a full development system. Priced at $329, the Developmate 81 adds Z80 in-circuit emulation and EPROM (erasable programmable read-only memory) and EEPROM (electrically erasable programmable read-only memory) capabilities. The device plugs into the expansion connector and includes the PROM programmer and the emulator. The unit can handle 2758, 2508, 2716, 2516, 2532, 2816, and 48016 devices. Software for programming and verification is included.

When the target-system hardware and software works under emulation, the program is copied into PROM by the built-in PROM programmer. During emulation development, DMA (direct memory access) is not supported, nor are the HALT, NMI, RFSH, and M_1 signals. Clock speed during emulation is 1.8 MHz. Address mapping is not provided in the emulator, so target-system address assignments must be made to avoid conflict with addresses used by the TRS-80. Any of the 251 unassigned I/O (input/output) ports can be used in the target system. A program can be tested at one address space and run at another without reassembly.

Developmate 81 comes with a power supply, emulation cable, TRS-80 cable, and a universal personality module. The TRS-80 Expansion Interface is not required. For more information, contact Orion Instruments, 172 Otis Ave, Woodside CA 94062, (415) 851-1172.

Circle 510 on inquiry card.

Programmable Character Generator

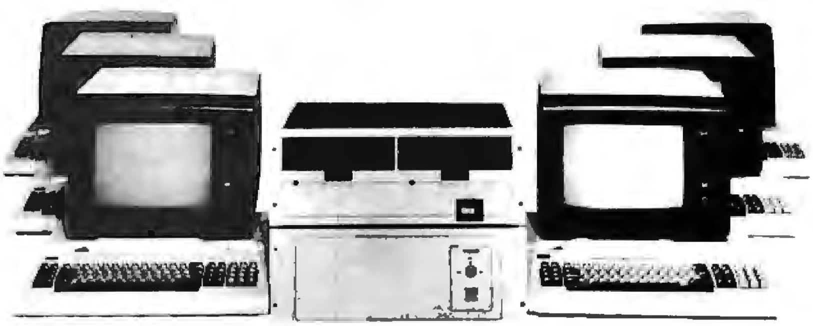
The Model 801 character generator is a test instrument that aids in the design and production of raster-scan video displays. The unit is microprocessor-controlled and has an internal frequency synthesizer that provides video dot rates up to 65 MHz. Video-sync timing is user-programmable. The unit has a complete set of 5 by 7 and 7 by 9 characters and can display up to 256 characters per row with 128 rows. A built-in battery-backup memory system allows storage of five complete display formats. The unit automatically calculates and displays the vertical, horizontal, and video rates as a result of entered display parameters. It costs $1995. Contact Quantum Data Inc, 455 E Kehoe Blvd, Carol Stream IL 60187, (312) 668-3301.

Circle 511 on inquiry card.

What's New?

SYSTEMS

Multiuser, Multiprocessor Microcomputer

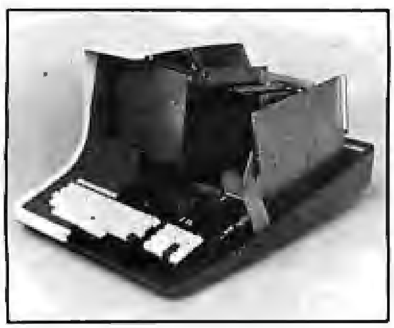


The Model 6500 is an S-100 bus, CP/M-compatible system expandable from one to sixty-four users. The motherboard can accommodate up to twelve users, and additional enclosures allowing up to eighteen users each can be added. Each unit contains two microprocessors, 64 K bytes of programmable memory, and serial and parallel I/O (input/output).

OSM's CP/M-compatible Multi-User System Executive operating system is written in Z80 code and features automatic print spooling, user selection of a local or a master system printer, file-sharing interlock, and a password/security system. Directories are provided for user- and common-file areas. Logon/off time is automatically stored.

Options include two 8-inch double-density double-sided floppy-disk drives and 29- to 96-megabyte hard-disk subsystems. System prices start at $5715. For more information, contact OSM Computer Corporation, 2364 Walsh Ave, Santa Clara CA 95051, (408) 496-6910.

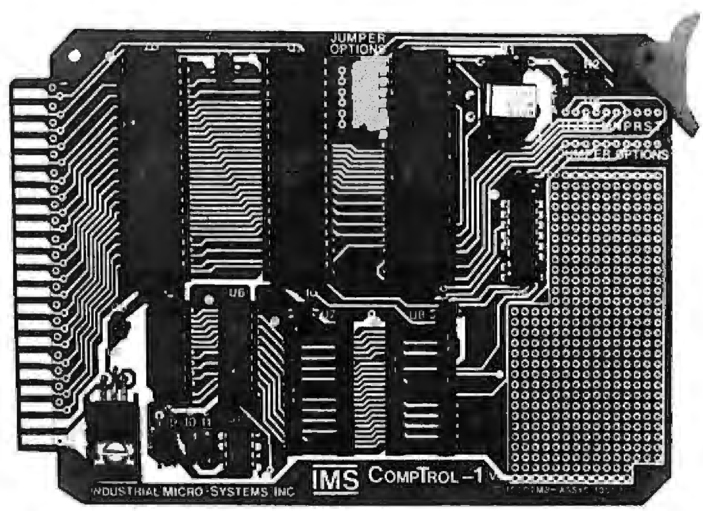
Circle 516 on inquiry card.



64 K Bytes Standard with SuperBrain

SuperBrain, an S-100 microcomputer, is now marketed with 64 K bytes of programmable memory instead of 32 K. The retail price of the unit is $3495. SuperBrain features dual 5-inch floppy-disk drives capable of storing 350 K bytes, Digital Research's CP/M operating system, a 12-inch video monitor, and two Z80A microprocessors. For more information, contact Intertec Data Systems, 2300 Broad River Rd, Columbia SC 29210, (803) 798-9100.

Circle 517 on inquiry card.



6802 Single-Board Microcomputer

The CompTrol-1 Model SBC681 features a 6802 microprocessor and up to 8 K bytes of ROM or EPROM (read-only memory or erasable programmable ROM). Programmable-memory expansion sockets are provided for a 1 K-byte expansion beyond the 128 bytes inside the 6802. The board is provided with a 6821 PIA (peripheral interface adapter) and/or a 6522 VIA (versatile interface adapter). The VIA contains an 8-bit shift register, two programmable 16-bit timers, and two parallel ports. Jumper options select processor-interrupt connections and ROM size.

The board operates at 1 MHz from a single 5 V supply, or with a power-supply option, from an unregulated 8 V supply. Mounting options are provided. For more information on this $139.42 microcomputer board, contact Industrial Micro-Systems Inc, POB 306, Plantsville CT 06479, (203) 628-4844. Circle 518 on inquiry card.

SOFTWARE

Mate Solves Chess Problems on the Apple

Mate is a chess-problem-solving program that quickly determines whether or not mating is possible within the remaining number of moves, and it can solve mate in n moves, helpmate in n moves, and self-mate in n moves. Mate supports all four promotions, en passant, and castling. Abbreviations for the pieces are in FIDE (World Chess Federation) standard and the board layout uses European notation, but users can define their own abbreviations. Mate consists of instructions to use the program, examples of use, assembly-language code, chess-specific information tables, and a 6 K-byte data area.

Mate requires an Apple II or Apple II Plus with 48 K bytes of programmable memory and one floppy-disk drive. It is available for $60 from Mika Korhonen, Neitsytpolku 6 A 8, SF-00140 Helsinki 14, Finland. Circle 519 on inquiry card.

Lucidata Pascal for Heath Systems

Version 2.8 of Lucidata Pascal, for Heath systems operating under HDOS, is compatible with all HDOS files and devices. Pascal source programs compile into p-code for execution. Features include random and sequential disk-file access, integer and nine-digit floating-point arithmetic, virtual memory operation, and an assembly-language interface. Supplied on a 5-inch floppy disk, the system includes fourteen demonstration programs and a manual. The compiler can run in a 24 K-byte HDOS system, but 40 K bytes are recommended. It is available for $95 from Polybytes, 325 19th St SE, Cedar Rapids IA 52403.

Circle 520 on inquiry card.

Data-Base System for CP/M Systems

IDM-C1 is a data-base-management system that includes an initialization program, a data-base-manipulation program, and a report writer and generator. Features include up to forty fields, search commands, statistics, reuse of deleted records for key access, error trapping, and more. It requires a dual-disk system with 60 K bytes of programmable memory and CP/M. IDM-C1 costs $159 from Micro Architect Inc, 96 Dothan St, Arlington MA 02174, (617) 643-4713.

Circle 521 on inquiry card.

Data-Base System for Commodore Computers

Jinsam 8.0 for the Commodore 8000 series and Jinsam 4.0 for the Commodore 4000 series computers are data-base-management systems that use relative files, hold approximately 1900 records per data base, allow different data bases on each data disk, and impose no limit on record lengths or number of fields. The programs include the data-base core, label and report writers that allow sorting of three fields at one time, Wordpro interface for form-letter generation, mathematical and statistical interfaces, four-level password system, auto-time-out feature, auto-dating of all printouts, two recovery systems, and a rotating backup system. Utilities that upgrade data files to new Jinsam systems, change the current data-base form, and generate new data bases from an existing system are included. Jinsam 8.0 controls screen format and displays the maximum defined field lengths. For more information, contact Jini Micro-Systems Inc, POB 274, Riverdale NY 10463.

Circle 522 on inquiry card.

6809 Cross Assembler

XASM6809 is a 6809 cross assembler written in FORTRAN IV and designed for industrial and scientific applications. The assembler includes free-format input, statement labels up to eight characters long, and compatibility with all the instructions and addressing modes of the target microprocessor. Assembler directives are mostly identical to those found in the original manufacturer's assembler products. Output of complete assembly listings, including object code, source lines, addresses, and the number of machine cycles required for each instruction, is provided. Error messages are inserted into the assembled listings. The assembler comes in a punched-card-deck package for $75 and on magnetic tape for $100. Contact Intelligent Devices of Minnesota, POB 14538, Minneapolis MN 55414, (612) 427-0787.

Circle 523 on inquiry card.

Form-Letter Module from Muse

The Form-Letter Module features automatic repetitive printing of letters from mailing-list records using the Muse Address Book software, individual printing of letters without permanent mailing-list storage, insertion of mailing-list information anywhere in a letter, on-screen prompts, and commands that allow changing the contents of individual letters dependent on the recipient.

The program runs on the Apple II or Apple II Plus with 48 K bytes of memory and a disk drive. It retails for $100. Contact Muse Software, 330 N Charles St, Baltimore MD 21201, (301) 659-7212.

Circle 524 on inquiry card.

What's New?

SOFTWARE

Financial Planning Software for CP/M Systems

FPL (Financial Planning Language) can perform profit and loss forecasts, commercial-loan evaluations, pro forma statements, product-line planning, budget planning and consolidation, product evaluation, cash-flow management, real-estate acquisition and development analysis, acquisition or merger analysis, and computations for marketing plans and performance, material and labor requirements, and capital-investment analysis. Users can customize worksheets with FPL. Special report functions allow combination, extraction, and comparison of separate sets of data.

FPL operates on any 8080- or Z80-based microcomputer with 60 K bytes of programmable memory, CP/M, and Microsoft BASIC, version 5.X. The program costs $695, and documentation alone is $30. Contact Lifeboat Associates, 1651 Third Ave, New York NY 10028, (212) 860-0300.

Circle 525 on inquiry card.

Smart Programs for the TRS-80 Model III

SmartIII is a smart-terminal program for the TRS-80 Model III. It permits transfer of BASIC programs and source-code files between a remote computer and the local cassette or disk-storage device. The FILE program permits generation and storage of text, then transmission by SmartIII, for those who do not have word processors. AUTOBUF opens and closes the data-storage buffer automatically when up- or downloading. SmartIII recognizes the automatic buffer-open and -close codes transmitted by another Smart-series (ie: Model I or II) program. With SmartIII, the video-display line length can be formatted. Half- or full-duplex operation is software-selectable. The program will automatically send messages to bulletin boards and can be used with any RS-232C-compatible modem.

SmartIII is priced at $99.50 from The MicroPeripheral Corporation, 2643 151st Pl NE, Redmond WA 98052, (206) 881-7544.

Circle 526 on inquiry card.

Graphic Writer Program

The Graphic Writer program allows Apple users to get hard copy of the Gothic, Blippo Black, Roman, Outline, and other character sets available in Apple's Applesoft Tool Kit. This software can be used in conjunction with the Applewriter word-processing program. Graphic Writer can also be used as a stand-alone product for use with PRINT statements within a user's program.

Graphic Writer is available for Silentype and Paper Tiger Model 440G, 445G, or 460G printers. It requires a 48 K-byte Apple II or Apple II Plus, DOS 3.3, the Applesoft Tool Kit, Apple parallel or Centronics interface card, and a printer. It is available from Computer Station Inc, 12 Crossroads Plz, Granite City IL 62040, (618) 452-1860. The suggested retail price is $34.95.

Circle 527 on inquiry card.

PET Programs for Young Students

Menu-driven addition and subtraction programs, suitable for grades 1 through 6, provide twenty-four levels of difficulty for addition and twelve levels of difficulty for subtraction. Immediate feedback is given, with graphics reinforcing correct responses. The letters and numbers program uses large characters created with PET graphics. Options include matching of one or more items, completing sequences, and filling in missing items.

The match-game program is useful for memory building and for putting lesson reviews into a game format. The game can be played with exact matches or paired matches (eg: synonyms or translations). Users can enter their own items or can choose from options including shape matching, math problems and answers, and synonyms. One to four players can participate, and single players can play against the computer. These programs are available for $20 on cassette. They will run on any PET with at least 8 K bytes of memory and versions 1.0, 2.0, or 4.0 of ROM (read-only memory). For information, contact Teaching Tools, POB 12679, Research Triangle Park NC 27709, (919) 851-2374.

Circle 528 on inquiry card.

A Gem of a Program

Amethyst combines Mince, a full-screen editor; Scribble, a text formatter; the BDS C compiler; the Mince command-set source code; and a user-support program. Mince is written in C, so it is possible to personalize or extend the editor. Amethyst can be used as an editor/compiler combination for program development. A user's manual and a book describing theory of operation are included. The program requires a 48 K-byte CP/M system and a video terminal with cursor positioning. Amethyst is $350. Mince and Scribble are $125 each, or $175 for both. Contact Mark of the Unicorn, POB 423, Arlington MA 02174, (617) 489-1387.

Circle 529 on inquiry card.

What's New?

PUBLICATIONS

Personal Computer Letter

The Carl Helmers Personal Computer Letter is a monthly analysis of issues, trends, and current events that affect the small-computer industry. A major topic affecting the design, marketing, and support of small-computer hardware and software is discussed in each letter. Some of the forthcoming topics include studies on computer options for small colleges, mass-storage technology, configurable software, standards, color graphics, the importance of smooth power supplies, object-oriented languages, artificial intelligence, local communications networks, high-level languages, and interactive operating systems.

Another feature of the newsletter is a free personal-computer industry telephone conference call held once a month. With up to twenty people on a conference line, Mr Helmers moderates discussions and answers questions from subscribers about issues concerning popular microcomputers and the industry.

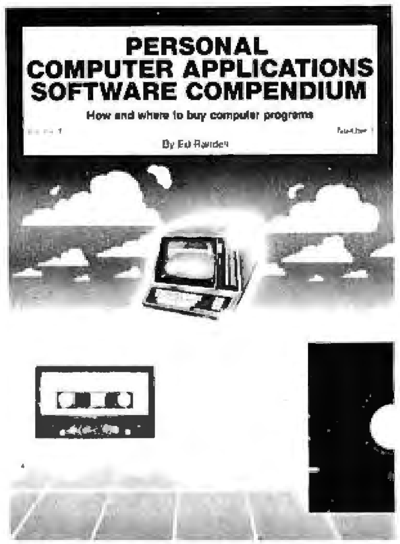
A charter subscription to the newsletter is $200. For more information, contact North American Technology Inc, Strand Bldg, Suite 23, 174 Concord St, Peterborough NH 03458, (603) 924-6048.

Circle 530 on inquiry card.

Books from Addison-Wesley

Books on languages, hardware fundamentals, programming, and computer science are featured in the "Books About Computers" catalog from Addison-Wesley Inc, Reading MA 01867, (617) 944-3700.

Circle 531 on inquiry card.



Program Listing Catalog

Personal Computer Applications Software Compendium will contain program descriptions and information on how and where to buy programs written for many different microcomputers. For additional information on how you can be a contributor and place a listing in this book, contact El Dorado Publishing Company, POB 446, Los Alamitos CA 90720.

Circle 532 on inquiry card.

CMOS Databook

CMOS/MOS Integrated Circuits is a 688-page book on CMOS (complementary metal-oxide semiconductor) and MOS devices. The book includes technical data, application notes, product-classification and function-selection charts, package information, functional diagrams, operating and handling considerations, and ratings and characteristics for all standard digital integrated circuits in RCA's CMOS CD4000 product line. The book costs $7. Request CMOS/MOS Integrated Circuits, volume number SSD-250B, from RCA Solid State Division, RT 202, POB 3200, Somerville NJ 08876.

Circle 533 on inquiry card.

Keyboard Catalog

A catalog of standard keyboards is available from George Risk Industries. Bulletin KB-20 includes data on the company's Model 753, 756, and 771 keyboards, plus models ranging from 10 to 98 keys. Featured are the Process Control Keyboard for industrial-control-system applications, user-programmable ASCII (American Standard Code for Information Interchange) keyboards, and keyboard enclosures and accessories. Off-the-shelf models include units for hobby and educational use and keyboards suitable for a variety of prototype, limited production, and specialized applications. Versions for heavy-duty industrial and military applications are also offered.

Your free copy can be obtained from George Risk Industries Inc, GRI Plz, Kimball NE 69145, (800) 445-5218; in Nebraska (308) 235-4645.

Circle 534 on inquiry card.

Guide to Optical Cable

In its Guide to Optical Cable, Probe Research describes and compares the optical-communications cable being sold in the data and telephone/CATV applications market. Tables compare operating and mechanical specifications of the cables, including type of fiber used, cabling loss, application, cable construction, tensile strength, bandwidth, and more. The report also describes this rapidly changing market, including regulatory implications and the type of purchasing being done. The Probe Guide to Optical Cable is available for $50 from Probe Research Inc, POB 251, Millburn NJ 07041, (212) 732-5415.

Circle 535 on inquiry card.

What's New?

PUBLICATIONS

Shirt-Pocket Guide to the 6502

The 6502 Instruction Handbook is a handy shirt-pocket-sized guide to the 6502 microprocessor. It contains a synopsis of each instruction available for the 6502, with mnemonic and machine codes in hexadecimal format provided for each addressing mode. Appendices list the instruction set alphabetically by assembler mnemonics and numerically by machine code. A hexadecimal-to-decimal conversion chart is provided. A circuit pinout diagram, basic timing information, and diagrams of the architecture are also included.

The 6502 Instruction Handbook is available for $4.95 plus $0.50 postage from Scelbi Publications, 20 Hurlbut St, Elmwood CT 06110. Circle 536 on inquiry card.

Computer Equipment on CIA's List

CIA is a publication for advertising new and used computers, software, and related products. Display ad rates range from $35 to $175. The subscriber rate for classified ads is $0.10 per word, and the nonsubscriber rate is $0.30 per word.

For more information on deadlines and subscription prices, contact Computer Instant Ads Association, 277 E 6100 South, Salt Lake City UT 84107, (800) 453-6464; in Utah (801) 268-3000. Circle 537 on inquiry card.

Power Supply Catalog

Power General, makers of power supplies, has published a catalog describing its products. For a copy, contact Power General, 152 Will Dr, Canton MA 02021, (617) 828-6216.

Circle 538 on inquiry card.

Challenge Computer Supplies Catalog

Challenge Computer Supplies has published its Spring/Summer 1981 Catalog. The company sells computer furniture, magnetic media, computer-paper forms, and related items. For a copy, contact Challenge Computer Supplies Inc, POB 3269, 727 Middlefield Rd, Redwood City CA 94064, (415) 365-8105.

Circle 539 on inquiry card.

Ampex Offers a Magazine

Databits is a quarterly magazine designed to keep Ampex customers informed of developments in the Ampex Memory Products Division. The magazine reviews new Ampex computer-product developments, discusses applications of existing products, lists trade shows, and provides technical discussions of various aspects of computer technology. Interested readers can obtain a free copy of Databits by writing Ampex Corporation, Memory Products Division, Attn: Marketing Communications M-15, 200 N Nash St, El Segundo CA 90245.

Circle 540 on inquiry card.

Furniture Catalog

A color catalog from Structural Concepts Corporation describes furniture for office and personal computers. Both stock and custom units are available. Pre-wired and dedicated electrical circuits are available in some of the furniture. A variety of options and accessories, including pass-throughs and shared terminal turntables, are featured. Contact Structural Concepts Corporation, 17237 Van Wagoner Rd, Spring Lake MI 49456, (800) 253-5102; in Michigan (616) 846-3300.

Circle 541 on inquiry card.

Catalog Lists TI 99/4 Hardware and Software

TI Source is a catalog and newsletter for TI 99/4 users. Included in the catalog are software programs for education and science, business and professional applications, games, music, utilities, and languages. Many accessories are listed. The newsletter contains news and reviews of software packages. The free catalog and newsletter is available from Microcomputers Corporation, POB 191, Rye NY 10580, (914) 967-8370.

Circle 542 on inquiry card.

Free Courseware Catalog

The MicroMedia catalog contains over 400 kindergarten through grade 12 instructional programs, games, packages, and books for use with Apple, Atari, PET, and TRS-80 microcomputers. Organized by subject and grade level, each entry includes program name, type, functional description, and memory requirements. Contact MicroMedia, 686 Sierra Vista Ln, Valley Cottage NY 10989, (914) 358-2582.

Circle 543 on inquiry card.

Adventure Games Brochure

If you are looking for something to do on sleepless nights, try an adventure game from Adventure International. Its catalog describes dozens of fantasy and role-playing games available for TRS-80, Apple, PET, Atari, and Sorcerer microcomputers. For a copy, contact Adventure International, POB 729, Casselberry FL 32707, (800) 327-7172; in Florida (305) 862-6917.

Circle 544 on inquiry card.

What's New?

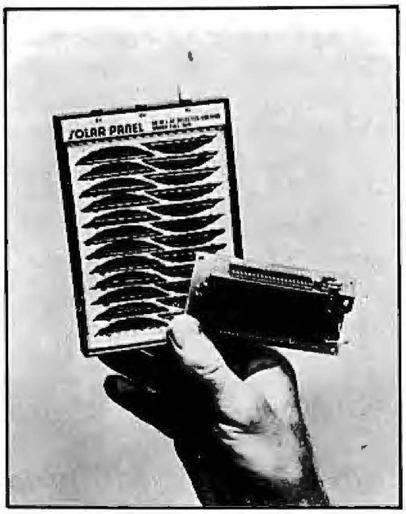
MISCELLANEOUS

Programmable Memory Has 8 K

The 8112 static programmable memory is pin-for-pin compatible with the 2716 EPROM (erasable programmable read-only memory). Built into the design of the 8112 is a delatched write function that allows incoming data to be controlled by the write-enable function. This arrangement provides for a delayed write. Power-consumption requirements are lower with the 8112 because the device operates in an enabled and disabled mode. It requires a single +5 V supply. Organized as 1024 words by 8 bits, the 8112 is available in access times of 200, 300, and 400 ns. In lots of 100, prices for the 8112 range from $10.70 to $14.70. Contact GTE Microcircuits, 2000 W 14th St, Tempe AZ 85281, (602) 968-4431.

Circle 545 on inquiry card.

Low-Power LCD



A 3½-digit LCD (liquid-crystal display) panel meter has been introduced by Datel-Intersil. The DM-LX3 has a ¾-inch-high display. Using CMOS (complementary metal-oxide semiconductor) circuitry, the meter uses 17.5 mW (+5 V at 3.5 mA). The device can operate continuously for several months on a battery of four AA alkaline cells. The meter displays digits with an accuracy of ±0.1%. The board measures 10.5 by 5 by 1 cm (4 by 2 by ⅜ inches).

The DM-LX3 features balanced differential inputs, high-impedance inputs with low-bias currents, autozeroing, selectable display and hold, and blank circuit pads for attenuation or shunt resistors. The DM-LX3 sells for $57.50. Contact Datel-Intersil Inc, 11 Cabot Blvd, Mansfield MA 02048, (617) 339-9341.

Circle 547 on inquiry card.

Computer Stands

Comstand computer stands hold microcomputers and small-business systems. They have a table height of 66.5 cm (26½ inches), the same as a typewriter stand. A storage shelf is mounted below the table. There are additional shelves above the table for monitors, disk drives, or other items. The Model 2036, priced at $150, is 90.5 by 137 cm (36 by 54 inches) and the Model 2048, priced at $165, is 123 by 120 cm (48 by 47 inches). Both styles have 50-centimeter- (20-inch) wide tables. An optional printer stand with two shelves and a middle slot for paper feed is priced at $140. Contact Ever Roll, 3988 Troy Rd, Springfield OH 45504, (513) 964-1322.

Circle 546 on inquiry card.

EAROM from General Instrument

The ER4201 EAROM (electrically alterable read-only memory) is an N-channel device for applications that require a small memory and where ease of use and speed are important. The 128- by 8-bit ER4201 features +5 V operation in read mode, 350 ns maximum access time, in-circuit electrical word alterability, and on-board address, mode, and data latching. A program command will place the device in the busy mode and initiate an erase followed by a write. This allows the processor and system bus to be freed during the EAROM's 10 μs reprogramming operation.

In quantities of 250, the EAROM price is approximately $11.50 each. For more information, contact General Instrument Corporation, Microelectronics Division, 600 W John St, Hicksville NY 11802, (516) 733-3120.

Circle 549 on inquiry card.

Keep It Quiet

Vitech Inc has a sound enclosure that blocks noise pollution from printers, word processors, and Telex machines. The interior and exterior panels are covered with plastic laminate, and the acrylic tops are transparent. Custom covers can be made for any printer. Models start at $275.

For more details, contact Vitech Inc, 4555 W 77th St, Minneapolis MN 55435, (612) 831-8757. Circle 548 on inquiry card.

Multistrike Ribbon Cartridge

Aspen Ribbons Inc has a version of the multistrike ribbon cartridge required by NEC (Nippon Electric Company) printers. The used ribbons can be returned to the company for replacement. Each ribbon costs $5. For additional details, contact Aspen Ribbons Inc, 1700 N 55th St, Boulder CO 80301, (800) 525-0646; in Colorado, (303) 444-4054.

Circle 550 on inquiry card.

What's New?

MISCELLANEOUS

Cross Reformatter for CP/M and DEC Files

MicroTech Exports' Reformatter conversion software allows CP/M users to exchange data files with DEC (Digital Equipment Corporation) computers using a floppy disk as the transfer medium. Reformatter runs under CP/M and reads and writes in the DEC RT-11 format. Data files can be transferred bidirectionally, and any fields in the directory can be altered. Reformatter lists the DEC directory and displays the unused areas of the disk. The price of the program is $195 from MicroTech Exports, 467 Hamilton Ave, Palo Alto CA 94301, (415) 324-9114.

Circle 551 on inquiry card.

Datapro Offers a Catalog of Reports

Information processing professionals can look to the 1981 Datapro Report catalog for information comparing electronic data processing, word processing, office, and data communications products. Datapro's free catalog describes studies on fifty-two categories of popular equipment and management methods. The reports contain narratives, comparison charts, prices, specifications, and characteristics on products and services. User ratings are included in many reports, which are priced at $15 each. The catalog is available from Datapro Research Corporation, 1805 Underwood Blvd, Delran NJ 08075, (609) 764-0100.

Circle 553 on inquiry card.

All-CMOS Microcomputer

The Model PPS-12 is an all-CMOS (complementary metal-oxide semiconductor) microcomputer system. The system employs an IM6100 CMOS microprocessor, and has been designed for applications where only battery or solar power is available. Operation requires only a 5 V power supply at less than 0.5 mW. The board includes three parallel I/O (input/output) ports, one RS-232C serial port, a programmable real-time clock, 4 K 12-bit words of CMOS EPROM (erasable programmable read-only memory) and read/write memory, a memory-expansion controller, and an on-board monitor and debugger. The board is also supported by parallel and serial I/O modules, memory-expansion modules, an all-CMOS A/D (analog-to-digital) converter, and bubble memory. The modules can be plugged into any Multibus card cage.

The 12-bit IM6100 microprocessor uses a binary instruction set identical to Digital Equipment Corporation's PDP-8 and VT-78 DECstation minicomputers. The single-quantity price for the PPS-1201 is $999. For more information, contact Pacific Cyber/Metrix Inc, 6800 Sierra Ct, Dublin CA 94566, (415) 829-8700.

Circle 554 on inquiry card.

Computer Cable and Interface Catalog

A computer cable and interface catalog is available from CCP Computer Cable Products Division, 147 Gazza Blvd, Farmingdale NY 11735, (800) 645-9434; in New York (516) 293-1610. Described are specifications for RS-232C, EIA 449 assemblies, and bulk cable. Accessories described in the catalog include ribbon, coaxial kits, switching boxes, plenum and molded assemblies, adapters, and isolated power supplies. Request catalog H10.

Circle 552 on inquiry card.

High-Speed Memory

The CI-6800-2 dynamic memory board is designed for Motorola's EXORcisor I and II and Rockwell's System 65. The memory is available in 16 K-, 32 K-, 48 K-, or 64 K-byte configurations. The board features hidden-refresh control logic. The access time is 225 ns and cycle time is 400 ns, which allows the unit to operate as a static programmable-memory device at clock rates in excess of 1.5 MHz. For 2 MHz operation, the memory board can be configured to utilize a cycle-stealing refresh operation.

Memory selection is available in 4 K-byte increments up to 64 K bytes. The memory has on-board even parity, with output jumper-selectable to the system bus as a parity error or nonmaskable interrupt. Power consumption is under 7 W.

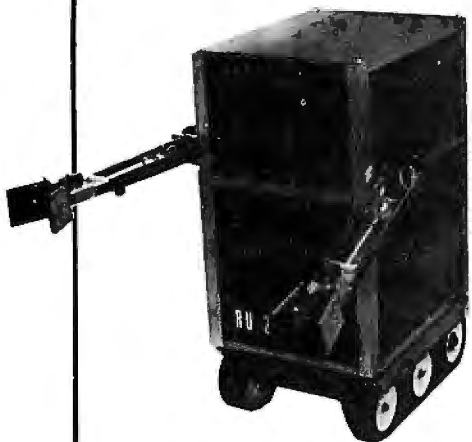
The prices are $565 for the 16 K-byte board and $750 for the 64 K-byte board. Contact Chrislin Industries Inc, 31352 Via Colinas #102, Westlake Village CA 91361, (213) 991-2254.

Circle 555 on inquiry card.

Anti-Static Mats

Anti-static floor and table mats can protect terminals, computers, and disk drives from electrostatic discharge. Pervel Industries' mats can be placed on tables and floors and connected to ground.

For more information, contact Pervel Industries Inc, POB 61, Plainfield CT 06374, (203) 564-2741. **Circle 556 on inquiry card.**



Robot for Hobbyists

The Robot Unit RU-II is a package of mechanical modules that includes the base transport (legs), structural unit (body), and manipulator units (shoulders, arms, and hands). Also included are the relay controls required to drive the motors and a manual pushbutton control box to drive the relays. RU-II comes in kit form, including all parts, except a 12 V battery. There is room inside the body unit for more mechanical and electrical accessories. All the components can be used separately for experiments. The robot can be controlled by remote-control transmitter/receiver systems or by interfacing a computer into the relay control units.

RU-II weighs less than 100 pounds and can carry more than 50 pounds of batteries, computers, and other external loads. Speed of the unit is approximately two feet per second, fully loaded. Each arm can grasp, lift, and move more than 15 pounds.

RU-II comes with a one-year update, manual, and a free subscription to the **Amateur Robotics Designer Newsletter**. The price of the RU-II is $1495, plus 5% shipping and handling. Contact Hobby Robotics Company, 4055 Lawrenceville Hwy, Suite 410, POB 997, Lilburn GA 30247, (404) 923-5650.

Circle **557** on inquiry card.

Digital Multimeter Uses LCD Display

A hand-held 3½-digit LCD

(liquid-crystal display) digital multimeter has been introduced by Eico Electronic Instrument Company. Priced at $89.95, the Eico 274 measures AC and DC voltages, DC current, and resistance in twenty-one ranges. It features single-circuit LSI (large-scale integration) logic, automatic decimal point, and overload protection. Up to 200 hours of operation time are possible from a 9 V transistor power cell. An automatic low-power indicator is provided. Accuracy is better than 0.8%. Input impedance is 10 megohms. The Eico 274 comes with a 9 V power cell, test probes, carrying case, and a spare fuse. Contact Eico Electronic Instrument Company Inc, 108 New South Rd, Hicksville NY 11801, (516) 681-9300.

Circle **558** on inquiry card.

Portable Design Kit

The LD-1 Pencil Box Logic Designer is a portable logic-design and breadboarding device. Among its features are a variable clock, two pulsers, eight LED (light-emitting diode) displays, eight logic-level switches, and E & L Instruments' SK-10 breadboarding socket. Power is supplied through batteries or an optional AC supply. All of this is contained within a portable molded-plastic case with a hinged cover.

The LD-1 kit is $75 and the assembled unit is $99.50. For more information, contact E & L Instruments Inc, 61 First St, Derby CT 06418, (203) 735-8774.

Circle **559** on inquiry card.

Headcleaning FlexyDisks from BASF

BASF Headcleaning FlexyDisks clean read/write heads on floppy-disk drives in one minute. The disks, available in 5- and 8-inch sizes, are for single-sided floppy-disk drives only. Each FlexyDisk can be used up to thirty times. A package of three retails for $45 from BASF Systems Corporation, Crosby Dr, Bedford MA 01730, (617) 271-4000.

Circle **560** on inquiry card.

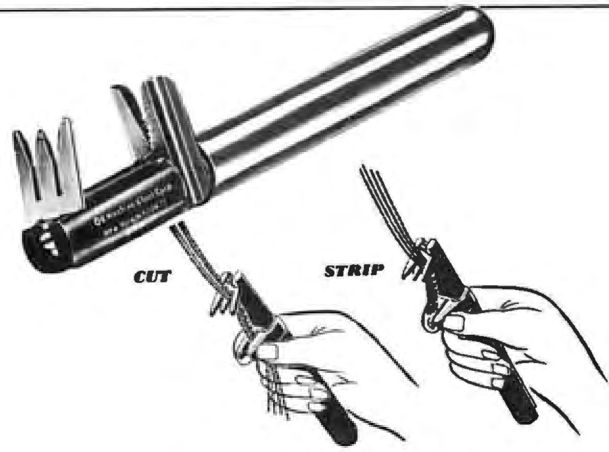
What's New?

MISCELLANEOUS

Wire-Wrapping Tool

The ST-100 cuts and strips wire and automatically generates the proper strip length for wire wrapping. The stripping blade is replaceable. The ST-100 is available for wire sizes from 20 to 30 AWG from OK Machine and Tool Corporation, 3455 Conner St, Bronx NY 10475, (212) 994-6600 for $9.84.

Circle 561 on inquiry card.



V300 Daisy-Wheel Printers

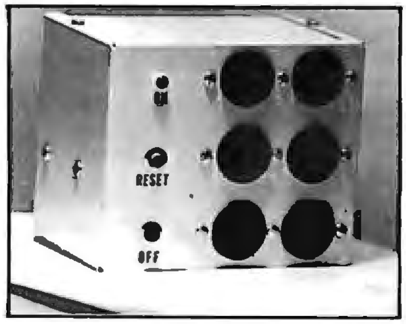
The V300 series of daisy-wheel printers is available in 25 and 40 cps (characters per second) models. Both models are impact printers that produce letter-quality printing using standard Diablo- or Qume-type 96-character print wheels. The printers can accommodate paper widths of up to 15 inches and can print up to 136 columns. Character spacing is 1/120 inch minimum, and line spacing is 1/48 inch minimum.

The V300 series are available with Centronics parallel or RS-232C interfaces. Seven- or eight-bit character lengths, single or double stop bits, odd or even parity, and 300, 600, 1200, or 2400 bps (bits per second) data rates are all switch-selectable. Form lengths of up to 66 lines with top-of-form and vertical-tab justification are programmable. Indicators are provided for power on, on-line status, and for paper and ribbon out. Multistrike fabric or carbon-film Diablo-type cartridge ribbons can be used. The V300-25 is priced at $1895, and the V300-45 is $2195. For complete details, contact Vista Computer Company, 1317 E Edinger Ave, Santa Ana CA 92705, (714) 953-0523.

Circle 562 on inquiry card.

Programmable Memory and Disk Protector

When the AC power is interrupted for more than a few milliseconds, most microcomputers using the CP/M operating system attempt to bootstrap CP/M from the disk. Sometimes the disk controller destroys the operating system's tracks rather than reading them. To prevent this disaster, the AMC Protector allows the computer to be initialized in the proper sequence by powering up the computer, then calling up the operating system from disk. The programmable memory and other circuitry is protected by a capacitive reactive RFI (radio-frequency interference) filter. This provides protection from lower-voltage RFI that



causes semiconductor circuits to change state. The standard AMC Protector has a 20 A, 115 V capacity, reset and off-momentary switches, a power-on light, and is housed in a steel box with six grounded AC outlets. Prices start at $110. Contact American Microcomputer Company, 465 Jillana Ave, Livermore CA 94550, (415) 449-0323.

Circle 564 on inquiry card.

64 K-Bit Memory Circuit

The MSM3764 is a 64 K-bit programmable-memory integrated circuit. It is offered in three operating speeds: 200, 150, and 120 ns. The MSM3764 is a fully decoded dynamic circuit organized as 65,536 one-bit words. Soft-error protection is featured.

The MSM3764 has noncritical clock-timing requirements. It needs a single +5 V supply with ±10% tolerance. All inputs and outputs are TTL- (transistor-transistor logic) compatible. Each 200 ns device (ie: MSM3764-20) is priced at $50.70. The 150 ns unit (ie: MSM3764-15) is $62.40 for one, and the 120 ns memory (ie: MSM3764-12) is $107.25 for one unit. OKI will be introducing a 256 K-bit programmable memory device that will be pin-compatible with these 64 K-bit memories. Contact OKI Semiconductor Inc, 1333 Lawrence Expy, Santa Clara CA 95051, (408) 984-4842.

Circle 563 on inquiry card.

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DISK DRIVES

FOR TRS-80* Model I

CCI-100	5¼", 40 Track (102K)	$314
CCI-280	5¼", 80 Track (204K)	$429

ADD-ON DRIVES FOR ZENITH Z-89

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External card edge and power supply included. 90 day warranty/one year on power supply.

RAW DRIVES	8" SHUGART 801R		$395
5¼" TEAC or TANDON	$ CALL	POWER SUPPLIES	$ CALL

DISKETTES — Box of 10

5¼"	Scotch	$30	Maxell	$40	BASF/Verbatim		$26.95
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PLASTIC FILE BOX-Holds 50 5¼" diskettes			$19.00
PLASTIC LIBRARY CASE	5¼" $3.00	3"	$ 4.00
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FLOPPY SAVER	$11.95	RINGS	$ 6.95

16K RAM KITS — 2 for $37 — $19

200 ns for TRS-80,* Apple II, (specify): Jumpers $2.50

SYSTEM SPECIAL

Apple II Plus 48K w/drive and controller. Epson MX-80 printer and interface. SUP-R Mod RF Modulator: List $2965 You Pay $2299

COMPUTERS/TERMINALS

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ZENITH	Z-19			$ 735
TELEVIDEO	920C	$ 748	950	$1049
IBM	3101 Display Terminal			$1189
ATARI	400	$ 479	800	$ 795
APPLE PERIPHERALS				$ CALL

MONITORS

APF	9" B & W TVM-10			$115
BELL & HOWELL	9" B & W BHD911			$195
LEEDEX	12" B & W	$ 129	13" Color	$329
SANYO	9" B & W VM4509			$155
SANYO	12" B & W DM5012			$226
SANYO	12" Green Screen DM5112			$238
SANYO	13" Color DMC6013			$406
ZENITH	13" Color			$349

TELECOMMUNICATIONS

LIVERMORE STAR MODEM 2-year guarantee	$125
UNIVERSAL DATA SYSTEMS UDS-103	$179
D-CAT HARD WIRED DIRECT MODEM	$189
AUTO-CAT Auto Answer, Direct Connect Modem	$249
D.C. HAYES MICRO-MODEM	$295
CCI Telnet Communications Package	$135

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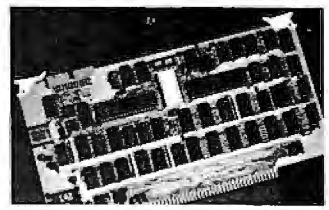
PAPER TIGER				
IDS 445	Graphics & 2K buffer			$ 699
IDS 460	Graphics & 2k buffer			$1050
IDS 560	Graphics			$1450
ANADEX	DP-8000	$ 849	DP-9500/01	$1295
OKIDATA				
Microline 80	Friction & pin feed			$ 415
Microline 80	Friction, and pin & tractor feed			$ 500
Microline 82	Friction & pin feed feed			$ 615
Microline 83	120 cps, uses up to 15" paper			$ 849
CENTRONICS	730 $ 595	799 $ 969	737	$ 749
TI-810				
TRS-80* software, compressed print & vert. form control				$1865

PRINTER SPECIAL

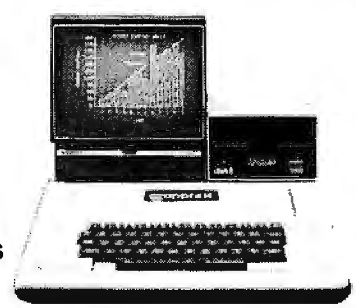
SEIKOSHA GP-80M List $399 You Pay $319

S-100 CALIFORNIA COMPUTER SYSTEMS



MAINFRAME	Model 2200A	$349
Z80 CPU	Model 2810	$259
MOTHER BOARD	Model 2501	$106
16K STATIC RAM, 200ns	Model 2116C	$309
32K STATIC RAM, 200ns	Model 2032C	$619
64K DYNAMIC RAM	Model 2065C	$580
FLOPPY DISC CONTROLLER	Model 2422A	$345
EXTENDER BOARD	Model 2520K	$ 52
2P + 2S I/O	Model 2718A	$309

APPLE ACCESSORIES AND SOFTWARE



VISICALC	$119.00
DB MASTER	$159.00
Z-80 SOFTCARD	$269.00
VIDEX BOARD	$259.00
16K CARD	$169.00
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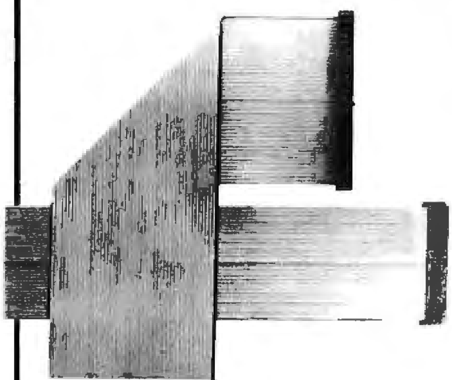
Circle 103 on Inquiry card.

What's New?

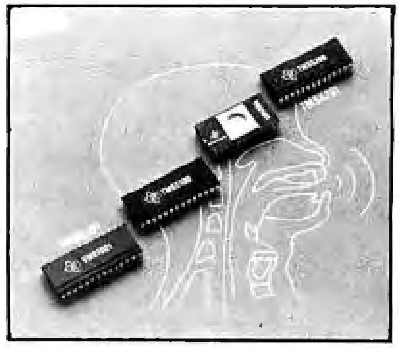
MISCELLANEOUS

Universal Socket Jumpers

A P Great Jumper Company's keyed socket jumpers are interchangeable replacements for all industry-standard IDC socket-cable assemblies. The socket jumpers mate with dual-row male headers, dual-row plugs with 0.635 mm square or round posts on 2.54 mm spacing. Slotted ends are also built in. Sizes offered include 10, 14, 16, 20, 26, 34, 40, 50, and 60 contacts. They supply slot-keyway, tab-key, and insertable-key sockets. The socket jumpers are designed for jumpering within a board; interconnecting between boards, backplanes, and motherboards; interfacing I/O (input/output) signals to the system; and for testing and checking equipment. For more information, contact The A P Great Jumper Company, POB 938, 72 Corwin Dr, Painesville OH 44077, (216) 354-0925.



Circle 565 on inquiry card.



Speech Evaluation Kits

The first two of a series of speech-synthesis evaluation kits have been announced by Texas Instruments Inc. The TMSK101 and TMSK201 provide a means of evaluating the TMS5100 and TMS5200 speech-synthesis integrated circuits for speech applications. Both kits use TI's linear predictive coding (LPC) technique.

The TMSK101 kit provides evaluation capability for 4-bit microprocessors. It includes a TMS5100 device and a TMS6100 ROM (read-only memory) with 204 LPC analysis-synthesis words.

The TMSK201 kit is designed for 8- or 16-bit microprocessors. It includes a TMS5200 voice-synthesis processor and a TMS2532 EPROM (erasable programmable ROM). The EPROM is programmed with a set of thirty-five items (thirty-two words, two phrases, and one tone).

Both kits are available for $140 each. Contact Texas Instruments Inc, Inquiry Answering Service, (Attn: TMSK101/201), POB 225012, M/S 308, Dallas TX 75265.

Circle 567 on inquiry card.

Disk-Copying Service

ALF Products is offering a disk-copying service for Apple-compatible floppy disks. Prices range from $2.60 each for a minimum of 50 copies to $2.10 each for 5000 copies. Memorex disks are used, but other brands can be specified. Copying can be done on customer-supplied disks for $0.60 to $0.20 each. The one-time setup charge for standard 13- or 16-sector disks is $10; special formats have a higher setup charge. A service for making standard DOS 3.2 or 3.3 disks copy-resistant is available for $25 and up. Copying of different disks can be combined to take advantage of the quantity discounts. Masters are kept on file for reorder.

For more information, contact ALF Products Inc, 1448 Estes, Denver CO 80215, (303) 234-0871.

Circle 566 on inquiry card.

12-Bit A/D Converter

The MN5245 is a 12-bit A/D (analog-to-digital) converter that offers a conversion time of less than 1 μs. Linearity is ± 0.5 LSB (least significant bit), and no missing of codes is guaranteed over the full operating-temperature range. Absolute accuracy error is 0.3% of full-scale maximum over the working temperature range. The converter can be used in spectrum analyzers, transient analysis, radar, video digitizing, and data-acquisition systems. Sample quantities are priced at $339 from Micro Networks, 324 Clark St, Worcester MA 01606, (617) 852-5400.

Circle 568 on inquiry card.

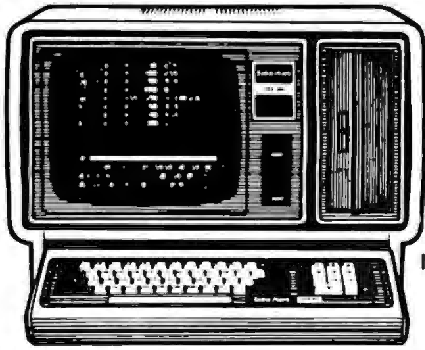
Products from Gimix

Gimix Inc, makers of memories, microprocessors, interfaces, and graphics boards for the SS-50 bus system, has published a brochure of its products. Descriptions and prices of all its items, including complete motherboard enclosures for SS-50 systems, are included. For your copy, contact Gimix Inc, 1337 W 37th Pl, Chicago IL 60609, (312) 927-5510.

Circle 569 on inquiry card.

TRS-80™ Quality Lasts . . .
OUR SALE DOESN'T!

SALE ENDS JULY 31ST, 6:00 P.M. CENTRAL TIME



Model II

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Radio Shack® TRS-80 Model II					
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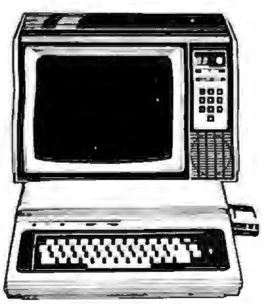
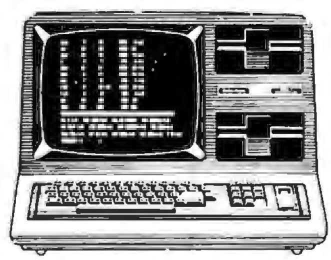
26-4002	64K 1-Disk Model II	3,899.00	3,579.30	3,440.00	459.00
Radio Shack® TRS-80 Model III					
26-1061	Model III 4K Level-I	699.00	629.10	629.10	69.90
26-1062	Model III 16K	999.00	888.00	888.00	111.00
26-1063	Model III 32K	2,495.00	2,269.50	2,225.00	270.00
Radio Shack® TRS-80 Color Computer					
26-3001	4K Color Computer	399.00	359.10	359.10	39.90
26-3002	16K Color Computer	599.00	539.10	539.10	59.00
Radio Shack® TRS-80 Printers					
26-1158	Daisy Wheel II	1,960.00	1,789.00	1,789.00	171.00
26-1165	Line Printer V	1,860.00	1,674.00	1,674.00	186.00
26-1166	Line Printer VI	1,160.00	1,044.00	1,044.00	116.00
26-1167	Line Printer VII	399.00	359.10	359.10	39.90



Color Computer

CALL TOLL FREE 1-800 531-7466 TO ORDER



Model III

To Order Call Toll Free 800-531-7466, Ask for Operator 17
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Circle 303 on inquiry card.

What's New?

MISCELLANEOUS

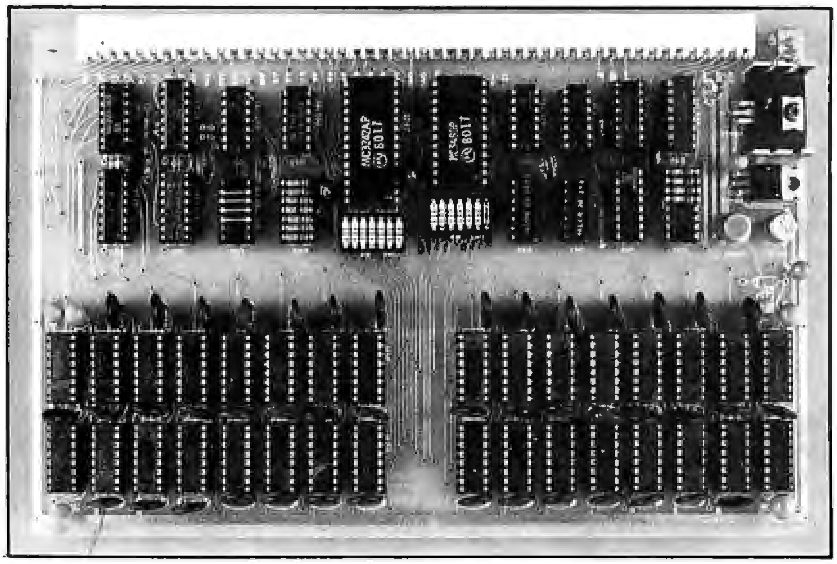
Carrying Cases

The Computer Case Company has developed five new computer-carrying cases. The cases feature padded handles, brass hardware, and key locks. The tops are removable, so the equipment can be operated in the case. Provisions are made for cords to exit the case even when the top is on and locked. Storage space is provided for manuals, cords, working papers, and supplies.

The AP104 carrying case is for the Apple III. The AP104 holds the computer, two disk drives, and a Silentype printer. It costs $139. For a video monitor, there is the AP105, which retails for $99. For the TRS-80 Model III, there's the RS204. It sells for $129. The RS205 is a $99 carrying case for the TRS-80 Color Computer. The P403 is designed for the Epson MX-80 and MX-70 printers. It costs $99.

For further details, contact Computer Case Company, 5650 Indian Mound Ct, Columbus OH 43213, (614) 868-9464.

Circle 570 on inquiry card.

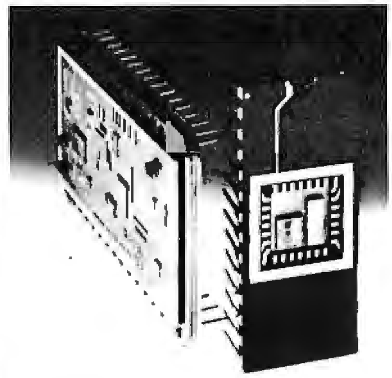


SS-50 Memory Board

Boaz Company has introduced a 64 K-byte programmable memory board for the SS-50 bus. The board features transparent refresh at 1 MHz, operation with 6800 and 6809 systems, compatibility with the 20-bit extended addressing mode, memory selection and relocation for testing, and a 200 ns access time. Power-supply requirements are +12 V at 150 mA, +5 V at 500 mA, and −5 V at 7 mA.

For complete details, contact Boaz Company, POB 18081, San Jose CA 95158.

Circle 571 on inquiry card.



16-Channel, 12-Bit Data-Acquisition Circuit

The AD364 is a 16-channel, 12-bit integrated-circuit data-acquisition system that allows users to mix single-ended and differential signals and to select either without hard-wiring. It is packaged in two hermetic DIPs (dual-inline packages), guarantees no missing codes over the working temperature range, and offers 20 kHz throughput rate.

The packages include two 8-channel multiplexers, a differential amplifier, a sample-and-hold circuit, a latched channel-address register, an input mode control, control logic, and a 12-bit A/D (analog-to-digital) converter. Inputs can be sixteen single-ended, eight differential, or a combination. Switching between single-ended and differential-signal sources or two single-ended inputs is accomplished by the use of the input mode control.

Other features include a 50 μs maximum total acquisition and conversion time per channel and input voltage ranges of ± 2.5, ± 5.0 and ± 10 V; 0 to +5 V, and 0 to ± 10 V. Output can be in either 8-bit bytes or 12-bit words. The price is $198 for single units. Contact Analog Devices, Rt 1, Industrial Park, POB 280, Norwood MA 02062, (617) 935-5565.

Circle 572 on inquiry card.

16K Memory 8/$19.95

4116 200ns

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74LS00	.32	74LS155	1.19
74LS01	.28	74LS156	.95
74LS02	.38	74LS157	.79
74LS03	.32	74LS158	.82
74LS04	.35	74LS160	.94
74LS05	.28	74LS161	.99
74LS08	.38	74LS162	.99
74LS09	.38	74LS163	.99
74LS10	.32	74LS164	.99
74LS11	.29	74LS165	.99
74LS12	.29	74LS166	2.40
74LS13	.38	74LS168	1.79
74LS14	.99	74LS169	1.79
74LS15	.35	74LS170	1.89
74LS20	.26	74LS173	.82
74LS21	.30	74LS174	1.19
74LS22	.34	74LS175	1.09
74LS26	.40	74LS181	2.19
74LS27	.35	74LS190	1.15
74LS28	.39	74LS191	1.31
74LS30	.35	74LS192	.88
74LS32	.39	74LS193	.98
74LS33	.54	74LS194	1.80
74LS37	.78	74LS195	1.39
74LS38	.39	74LS196	.82
74LS40	.25	74LS197	.82
74LS42	.79	74LS221	1.28
74LS47	.78	74LS240	1.89
74LS48	.78	74LS241	1.89
74LS51	.35	74LS242	1.89
74LS54	.35	74LS243	1.89
74LS55	.32	74LS244	1.79
74LS73	.44	74LS245	2.89
74LS74	.48	74LS251	1.32
74LS75	.58	74LS253	.89
74LS76	.50	74LS257	.89
74LS78	.59	74LS258	.89
74LS83	.90	74LS259	2.89
74LS85	1.23	74LS260	.68
74LS86	.45	74LS266	.68
74LS90	.70	74LS273	1.69
74LS92	.82	74LS275	3.39
74LS93	.71	74LS279	.59
74LS95	1.11	74LS283	1.03
74LS96	.86	74LS290	1.25
74LS107	.43	74LS293	1.89
74LS109	.49	74LS295	1.09
74LS112	.48	74LS298	1.24
74LS113	.48	74LS352	1.59
74LS114	.55	74LS353	1.59
74LS122	.55	74LS363	1.39
74LS123	.99	74LS365	.99
74LS124	2.99	74LS366	.99
74LS125	.99	74LS367	.99
74LS126	.88	74LS368	.99
74LS132	.69	74LS373	1.85
74LS136	.58	74LS374	1.81
74LS138	.79	74LS377	1.48
74LS139	.79	74LS385	1.90
74LS145	1.19	74LS386	.65
74LS148	1.39	74LS390	1.90
74LS151	.79	74LS393	1.90
74LS153	.79	74LS395	1.69
74LS154	2.39	74LS670	2.20

16K STATIC

TMM 2016 200ns 19.95ea

64K DYNAMIC

8164 200ns SINGLE SUPPLY 29.95ea

RAMS

			100pcs
2101	(450ns)	2.49	2.29
2102-1	(450ns)	.99	.95
21L02-1	(450ns)	1.29	1.15
2111	(450ns)	2.99	2.49
2112	(450ns)	2.99	2.79
2114	(450ns)	2.95	2.85
2114L-2	(200ns)	8/29.95	3.10
2114L-3	(300ns)	8/24.95	2.95
4027	(250ns)	4.95	3.95
4116-15	(150ns)	8/21.95	2.65
4116-20	(200ns)	8/19.95	2.35
4116-30	(300ns)	8/18.99	2.00

EPROMS

			8pcs
1702	(1us)	4.95	4.75
2708	(450ns)	4.95	4.75
2758	(5v) (450ns)	9.95	Call
2716	(5v) (450ns)	7.95	6.95
2716-1	(5v) (350ns)	12.95	10.95
TMS2716	(450ns)	9.95	8.95
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2532	(5v) (450ns)	21.95	Call

6502

6502	10.95
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T = TO-220 K = TO-3 L = TO-92

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T = TO-220 V = 8 PIN K = TO-3

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Circle 196 on inquiry card.

What's New?

MISCELLANEOUS

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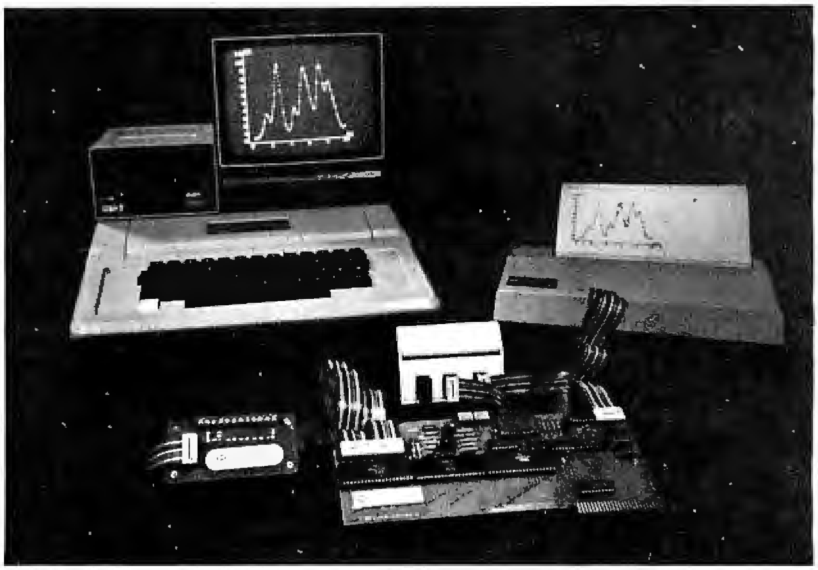


Applab is a microcomputer system designed for laboratory applications. When used with an Apple II Plus, Applab can control or collect data from spectrophotometers, chromatography systems, pH meters, strip-chart recorders, and temperature controllers.

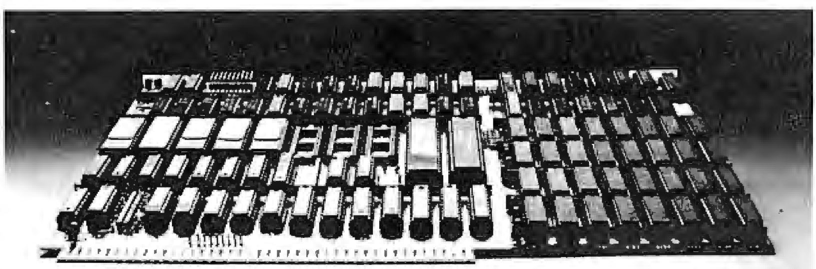
Applab's hardware interface features 12-bit D/A (digital-to-analog) and A/D (analog-to-digital) converters with ranges of ±0.5 to ±4.0 V, differential input, and automatic zeroing.

The I/O (input/output) subsystem features 8 bits each of input and output, handshaking signals, interrupt circuitry, and TTL- (transistor-transistor logic) compatible signal levels. A real-time clock permits timing of events to an accuracy of 0.1 second. Two 16-bit timers can be configured as an interval timer, pulse counter, pulse generator, square-wave frequency generator, or shift register.

Included is the QuickI/O program, which makes it easy to write BASIC programs to control scientific instruments. The Applab interface card, QuickI/O software on floppy disk, three cables, a self-test adapter board, diagnostic software, and two manuals are available for $495. For further information, contact Interactive Microware Inc, POB 771, State College PA 16801, (814) 238-8294.

Circle 573 on inquiry card.

Multichannel Video Controller



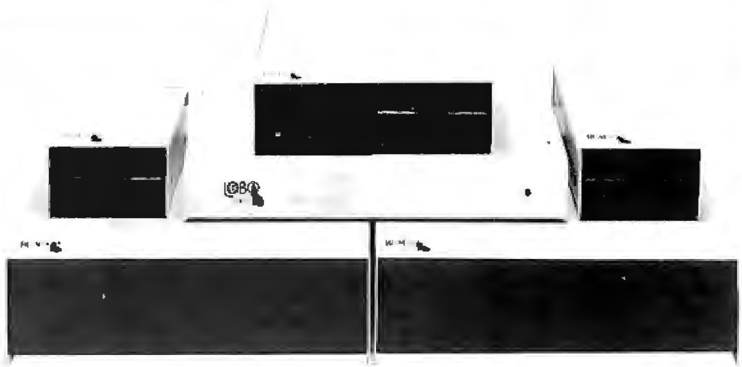
The MCV-1023 multichannel video controller is Multibus-compatible. It is designed for on-line information, graphics, and data-processing applications. An on-board microprocessor performs control and logic functions, providing intermixable text and graphics display. Three software-selectable character fonts, user-defined custom characters, an addressable cursor, an independently addressed status line, and an on-board date and time clock are also included. Characters of differing sizes can be intermixed on the screen. Underlining, strike through, blinking, boxing, reverse, and dual-intensity video fields are included. A paging feature switches the video on a single display between two sources, allowing screen updating.

Typical graphics operations, such as animation, facsimile presentation, vector lines, point plots, and box or block generation, can be performed with minimal software overhead. In graphics operations, the display is treated as 512 horizontal dots by 256 vertical lines. Communication between the MCV-1023 and the host system is done through programmed input/output and a shared 2 K-byte block of programmable memory. The MCV-1023 evaluation board is $695. It is available from Metacomp Inc, 7290 Engineer Rd, Suite F, San Diego CA 92111, (714) 278-0635.

Circle 574 on inquiry card.

Circle 197 on inquiry card.

LOBO Add-On Disk Drive Subsystems For Apple, TRS-80, S-100 Based Computers



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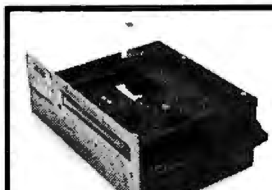

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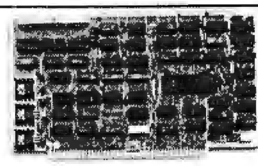

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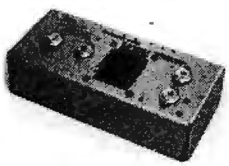

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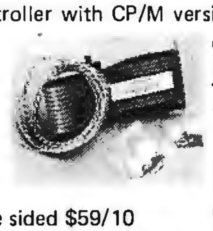

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7475N	.49
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7493N	.43
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74190N	1.15
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74365N	.75
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74LS05N	25
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74LS14N	1.00
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74LS22N	35
74LS28N	35
74LS30N	.35
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74LS38N	50
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CDP1802D	35.00
CDP1816P	7 95
UART/FIFO	
AY5-1013	5.50
AY5-1014	7.50
3341	6.95
PROM	
1702A	5 85
2708	6 10
2716T1	12 00
2716 5 Volt	10 50
8/2716 5 Volt	64 00
2732	19 95
2758	14.00
8741A	55 00
8746	55 00
8748-8	55 00
8755A	55.00
N82S23	2.95
N82S123	4.95
N82S126	4 75
N82S129	4 95
N82S131	4 95
N82S136	8 75
N82S137	8 75
DM8577	2 90
8223	3 50

CONNECTORS

30 pin edge	2.50
44 pin edge	2 75
86 pin edge	4 00
100 pin edge	4.50
100 pin edge WW	5.25

IC SOCKETS

Solder Tin Low Profile

PIN	1 UP	PIN	1UP
8	.15	22	.30
14	.14	24	35
16	.16	28	42
18	.27	36	58
20	29	40	57

2 level 14 pin ww 20

WIRE WRAP LEVEL 3

PIN		PIN	
14	55	24	93
16	57	28	1 00
18	.67	40	1.59

CRYSTALS

1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4 25
10 MHz	4 25
18 MHz	3 90
20 MHz	3 90
32 MHz	3 90
32768 Hz	4 00
1.8432 MHz	4 50
3.5795 MHz	1.20
2.0100 MHz	1 95
2.097152 MHz	4 50
2.4576 MHz	4 50
3 2768 MHz	4 50
5.0688 MHz	4 50
5.185 MHz	4.50
5.7143 MHz	4.50
6.5536 MHz	4.50
14 31818 MHz	4.25
18 432 MHz	4.50
22 1164 MHz	4 50

KEYBOARD ENCODERS

AY5-2376	$12.50
AY5-3600	17.95
AY5-9100	10.50
AY5-9200	16.50
74C922	5 50
74C923	5 50
HD0165-5	6.95
AY5-9400	10.50

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DB25P	3 62
DB25S	5.20
Cover	1.67
DE9S	1.95
DA15P	2 10
DA15S	3.10
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Hickok 3½ Digit LED multimeter	**89.95**
Stopwatch Kit	**26.95**
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8K/16K Eprom Kit (less PROMS)	$89.00
Motherboard	$39 00
Extender Board	$15 00

RESISTORS ¼ watt 5%

10 per type	03
25 per type	025
100 per type	015
1000 per type	.012
350 piece pack 5 per type	6 75

½ watt 5% per type 05

Televideo Terminal

Model 912	$785 00
Model 920	$885.00

KEYBOARDS

56 keyASCII keyboard kit	$67.50
Fully assembled	77 50
53 key ASCII keyboard kit	60 00
Fully assembled	70.00
Enclosure Plastic	14 95
Metal Enclosure	29.95

LEDS

Red T018	15
Green, Yellow T018	20
Jumbo Red	20
Green, Orange, Yellow Jumbo	25
Cliplite LED Mounting Clips	8/$1.25

(specify red, amber, green, yellow, clear)

CONTINENTAL SPECIALTIES in stock
Complete line of breadboard testequip
MAX-100 8 digit Freq. Ctr. $149.95

OK WIRE WRAP TOOLS in stock
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Complete line of AP Products in stock.

SPECIAL PRODUCTS

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3 pos. slide	25
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2.5 MHz Frequency Counter Kit	**$37.50**
30 MHz Frequency Counter Kit	**$47.75**

TRANSFORMERS

6V 300 ma	3 25
12 Volt 300 ma transformer	1 25
12 6V CT 600 ma	3.75
12V 250 ma wallplug	2.95
12V CT 250 ma wall plug	3 75
24V CT 100 ma	3 95
10V 1.2 amp wall plug	4.85
12V 6 amp	12 95
12V 500 ma wall plug	4 75
12V 1 amp wall plug	6 50
10 15 VAC & 15 VA wall plug	9 75

DISPLAY LEDS

MAN1	CA	270	2.90
MAN3	CC	125	39
MAN72/74	CA/CA	300	1 00
DL704	CC	300	1 25
DL707/DL707R	CA	300	1.00
DL727/728	CA/CC	500	1 90
DL747/750	CA/CC	600	1 95
FND359	CC	357	70
FND500/507	CC/CA	500	1.35
FND503/510	CC/CA	.500	90
FND800/807	CC/CA	800	2 20
3 digit Bubble			60
10 digit display			1 25
7520 Clairex photocells			39
TIL311 Hex			9 50
MAN3640	CC	30	1 10
MAN4610	CA	.40	1.20
MAN4640	CC	40	1.20
MAN4710	CA	40	95
MAN4740	CC	40	1.20
MAN6640	CC	56	2 95
MAN6710	CA	60	1 35
MAN6740	CC	60	1.35

MA1002A, C, E	**8.95**
MA1012A	**8.95**
102P3 Transformer	**2.25**
MA1012A Transformer	**2.25**

DIP Switches

4-position	$ 95	7-position	1.00
5-position	1.00	8-position	1.05
6-position	1.00		

4116 200ns Dynamic RAM 8/$18.40

RCA Cosmac 1802 Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a **small** single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded with additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during** and **after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step.** Large, on board displays provide output and optional **high and low address.** There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for **all** IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game. Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and R&D.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** All metal Expansion Cabinet, painted and silk screened, with room for 5 S-100 boards and power supply **$57.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a software publication for 1802 computer users is available by subscription for $12.00 per 12 issues. Single issues $1.50. Issues 1-12 bound $16.50.

Free 14 page brochure.

Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface.** Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf.** The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or **TI** 2716) and is **fully socketed.** EPROM can be used for the monitor and TinyBasic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports with full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $15.25 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply).

Quest Super Basic V5.0

A new enhanced version of **Super Basic** now available. Quest was the first company worldwide to ship a full size Basic for 1802 Systems. A complete function **Super Basic** by **Ron Cenker** including floating point capability with scientific notation (number range ±.17E88), 32 bit integer ±2 billion; multi dim arrays, string arrays; string manipulation; cassette I/O; save and load, basic, data and machine language programs; and over 75 statements, functions and operations.

New improved faster version including **re-number** and essentially **unlimited variables.**

Also, an exclusive user expandable command library.

Serial and Parallel I/O included.

Super Basic on Cassette $55.00.

PROM Eraser

assembled. 25 PROM capacity **$37.50** (with timer **$69.50**). 6 PROM capacity OSHA/UL version **$69.50** (with timer **$94.50**).

Z80 Microcomputer

16 bit I/O, 2 MHz clock, 2K RAM, ROM Breadboard space. Excellent for control. Bare Board **$28.50. Full Kit $99.00. Monitor $20.00.** Power Supply Kit **$35.00. Tiny Basic $30.00**

S-100 Computer Boards

8K Static Godbout Econo IIA Kit	149.00
16K Static Godbout Econo XIV Kit	269.00
24K Static Godbout Econo XX-24 Kit	414.00
32K Static Godbout Econo XX-32 Kit	537.00
16K Dynamic RAM Kit	289.00
32K Dynamic RAM Kit	328.00
64K Dynamic RAM Kit	399.00
Video Interface Kit	**$161.00**
Color Video Kit	129.95

81 IC Update Master Manual $79.95

Comp. IC data selector, 2 vol. master reference guide. Over 51,000 cross references. Free update service through 1981. Domestic postage $4.75.

Modem Kit $60.00

State of the art, orig., answer. No tuning necessary. 103 compatible 300 baud. Inexpensive acoustic coupler plans included. Bd. only $17.00. Article in May *Radio Electronics*.

LRC 7000+Printer $389.00

64/40/32/20 column dot matrix impact, std. paper. Interface all personal computers.

LRC 7000 printer interface cable for Super Elf with software $35.00

NiCad Battery Fixer/Charger Kit

Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$9.95**

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. **$405.00.** 4K version **$450.00.** 4K Assembler **$85.00,** 8K Basic Interpreter **$100.00.**

Special small power supply for AIM65 assem. in frame **$54.00.** Complete AIM65 in thin briefcase with power supply **$499.00.** Molded plastic enclosure to fit both AIM65 and power supply **$47.50.** Special Package Price: 4K AIM, 8K Basic, power supply, cabinet **$625.00.**

AIM65/KIM/VIM/Super Elf 44 pin expansion board; 3 female and 1 male bus. Board plus 3 connectors **$22.95.**

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy.

Video Modulator Kit $9.95

Convert TV set into a high quality monitor w/o affecting usage. Comp. kit w/full instruc.

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12v option. ±5v, ±12v are regulated. Basic Kit **$35.95.** Kit with chassis and all hardware **$51.95.** Add $5.00 shipping. Kit of hardware **$16.00.** Woodgrain case **$10.00.** $1.50 shipping.

Ohio Scientific Computers

CIP Series 2 **$447.00.** Like an Apple at less than half the price! CIPMF Series 2 **$1199.00.** Minifloppy version with additional RAM/ROM. Complete software and peripherals available. Send for free brochure.

Gremlin Color Video Kit $69.95

32 x 16 alpha/numerics and graphics; up to 8 colors with 6847 chip; 1K RAM at E000. Plugs into Super Elf 44 pin bus No high res. graphics. On board RF Modulator Kit **$4.95**

1802 16K Dynamic RAM Kit $149.00

Expandable to 32K. Hidden refresh w/clocks up to 4 MHz w/no wait states. Addl. 16K RAM **$25.00**

Tiny Basic Extended on Cassette $15.00
(added commands include Stringy, Array, Cassette I/O etc.) S-100 4-Slot Expansion $ 9.95
Super Monitor VI.I Source Listing $15.00

Elf II Adapter Kit $24.95

Plugs into Elf II providing Super Elf 44 and 50 pin plus S-100 bus expansion. (With Super Expansion). High and low address displays, state and mode LED's optional **$18.00.**

Super Color S-100 Video Kit $129.95

Expandable to 256 x 192 high resolution color graphics. 6847 with all display modes computer controlled. Memory mapped. 1K RAM expandable to 6K. S-100 bus 1802, 8080, 8085, Z80 etc.

Dealers: Send for excellent pricing/margin program.

Editor Assembler	**$25.00**
(Requires minimum of 4K for E/A plus user source)	
1802 Tiny Basic Source listing	**$19.00**
Super Monitor V2.0/2.1 Source Listing	**$20.00**

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax. $10.00 min. BankAmericard and Master Charge accepted. $1.00 insurance optional. Postage: Add 5%. C.O.D. $10.00 min. order.

FREE: Send for your copy of our NEW 1981 QUEST CATALOG. Include 48¢ stamp.

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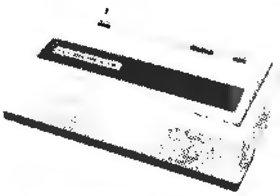

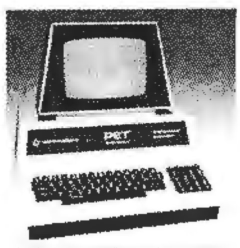

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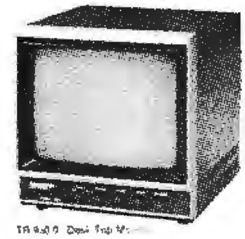

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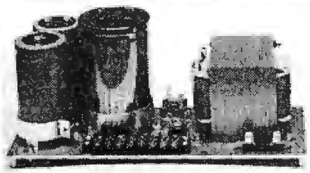
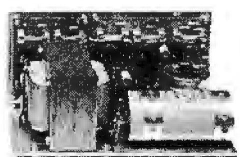
SUNNY LOW LOW COST POWER SUPPLIES

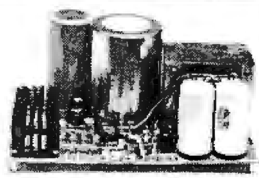
FOR S-100, FLOPPY DISKS.



KIT 1, 2 & 3 For S-100



R3 For Three 8" or 5¼" Disk Drives



S3 2 in 1 Unit for S-100 and two 8" or 5¼" Disk Drives. It fits most Disk System Mainframes.

S-100 POWER SUPPLY KITS (OPEN FRAME WITH BASE PLATE, 3 HRS. ASSY. TIME)

ITEM	USED FOR	@ + 8 Vdc	@ − 9 Vdc	@ + 16 Vdc	@ − 16 Vdc	@ + 28 Vdc	SIZE W × D × H	PRICE
KIT 1	15 CARDS SOURCE	15A		2.5A	2.5A		12" × 5" × 4⅞"	52.95
KIT 2	SYSTEM SOURCE	25A		3A	3A		12" × 5" × 4⅞"	59.95
KIT 3	DISK SYSTEM	15A	1A	2A	2A	4A	14" × 6" × 4⅞"	67.95

DISK DRIVE POWER SUPPLY "R3" REGULATED, OPEN FRAME, ASSY. & TESTED 67.95

SPECS: + 5V @ 5A OVP, −5V @ 1A + 24V@ 5A, SHORTS PROTECT. 2 SIZES AVAIL., 1.) 9" (W) × 6¼" (D) × 4⅜" (H), 2) 9" (W) × 5⅜" (D) × 5¼" (H)
OPTION: 1.) REPLACE + 24V BY + 12V, 2.) FOR SIZE 1 ONLY, ADD ± 12V @ 1A, AT AN ADDITIONAL $12.00.
IDEAL FOR THREE 8" or 5¼ FLOPPY DISK DRIVES, SUCH AS SHUGART 801/851, SIEMANS FDD 100-8/200-8 OR 100-5 ETC.

DISK SYSTEM PWR SUPPLY "S3" OPEN FRAME, ASSY. & TESTED. COMPACT SIZE: 10"(W) × 6" (D) × 5" (H) 92.95

REGULATED OUTPUTS FOR DISK DRIVES: +5V @ 4A, −5V @ 1A, +24V @ 4A (OR + 12V @ 4A). SHORTS PROTECT.
UNREGULATED OUTPUTS FOR S-100: +8V @ 14A, ± 16V @ 3A. (OPTION: ADD OVP FOR +5V, ADD $5.00)
A COMPLETE UNIT FOR DISK SYSTEM WITH THE MAINFRAME CONTAINING 12 SLOTS & TWO 8" or 5¼" DISK DRIVES.

POWER TRANSFORMERS (WITH MOUNTING BRACKETS)

ITEM	PRIMARY	SECONDARY #1	SECONDARY #2	SECONDARY #3	SIZE W × D × H	PRICE
T_1	110/120	2 × 8 Vac, 15A	28 Vac, CT, 2.5A		3¾" × 3⅝" × 3⅛"	21.95
T_2	110/120	2 × 8 Vac, 25A	28 Vac, CT, 3.5A		3¾" × 4⅜" × 3⅛"	27.95
T_3	110/120	2 × 8 Vac, 15A	28 Vac, CT, 2.5A	48 Vac, CT, 2A	3¾" × 4⅜" × 3⅛"	29.95
T_4	110/120	2 × 8 Vac, 6A	28 Vac, CT, 1.5A	48 Vac, CT, 3A	3¾" × 3⅝" × 3⅛"	22.95
T_5	110/120	2 × 8 Vac, 6A	28 Vac, CT, 2A		3" × 3" × 2½"	14.95

SHIPPING For each power supply $5.50 in Calif., $7.50 in other states, $14.00 in Canada. For each Transformer $5.00 in all States, $10.00 in Canada. Calif. Residents add 6% Sales Tax.

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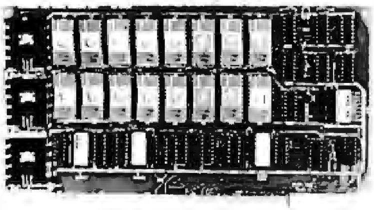
32K S-100 EPROM CARD

NEW!



$79.95
KIT

USES 2716's

Blank PC Board - $34

ASSEMBLED & TESTED ADD $30

SPECIAL: 2716 EPROM's (450 NS) Are $9.95 Ea. With Above Kit.

KIT FEATURES:
1. Uses +5V only 2716 (2Kx8) EPROM's.
2. Allows up to 32K of software on line!
3. IEEE S-100 Compatible.
4. Addressable as two independent 16K blocks.
5. Cromemco extended or Northstar bank select.
6. On board wait state circuitry if needed.
7. Any or all EPROM locations can be disabled.
8. Double sided PC board, solder-masked, silk-screened.
9. Gold plated contact fingers.
10. Unselected EPROM's automatically powered down for low power.
11. Fully buffered and bypassed.
12. Easy and quick to assemble.

32K SS-50 RAM

$329.00 KIT

For 2MHZ Add $10

Blank PC Board $50

For SWTPC 6800 - 6809 Buss

Support IC's and Caps $19.95

Complete Socket Set $21.00

Fully Assembled, Tested, Burned In Add $30

NEW!

At Last! An affordable 32K Static RAM with full 6809 Capability.

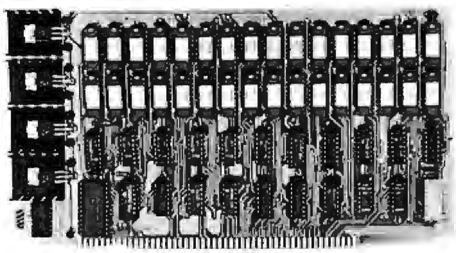
FEATURES:
1. Uses proven low power 2114 Static RAMS.
2. Supports SS50C - EXTENDED ADDRESSING.
3. All parts and sockets included.
4. Dip Switch address select as a 32K block.
5. Extended addressing can be disabled.
6. Works with all existing 6800 SS50 systems.
7. Fully bypassed. PC Board is double sided, plated thru, with silk screen.

16K STATIC RAM KIT-S 100 BUSS

PRICE CUT!

$169.95 KIT

FOR 4MHZ ADD $10



KIT FEATURES:
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!). Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 1.5 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

BLANK PC BOARD W/DATA-$33

LOW PROFILE SOCKET SET-$12

SUPPORT IC'S & CAPS-$19.95

ASSEMBLED & TESTED-ADD $35

OUR #1 SELLING RAM BOARD!

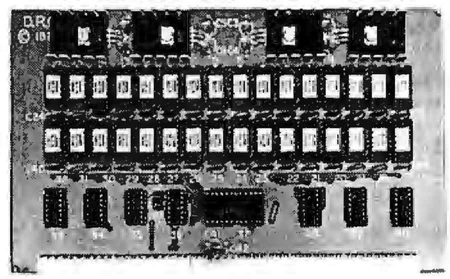
16K STATIC RAM SS-50 BUSS

PRICE CUT!

$159 KIT

FULLY STATIC!

FOR 2MHZ ADD $10



FOR SWTPC 6800 BUSS!

ASSEMBLED AND TESTED - $35

KIT FEATURES:
1. Addressable on 16K Boundaries
2. Uses 2114 Static Ram
3. Fully Bypassed
4. Double sided PC Board Solder mask and silk screened layout
5. All Parts and Sockets included
6. Low Power Under 1.5 Amps Typical

BLANK PC BOARD—$35 COMPLETE SOCKET SET—$12
SUPPORT IC'S AND CAPS—$19.95

STEREO! S-100 SOUND COMPUTER BOARD

NEW! NEW!

At last, an S-100 Board that unleashes the full power of two unbelievable General Instruments AY3-8910 NMOS computer sound IC's. Allows you under total computer control to generate an infinite number of special sound effects for games or any other program. Sounds can be called in BASIC, ASSEMBLY LANGUAGE, etc.

COMPLETE KIT! **$84.95** (WITH DATA MANUAL)

BLANK PC BOARD W/DATA $31

KIT FEATURES:
* TWO GI SOUND COMPUTER IC'S.
* FOUR PARALLEL I/O PORTS ON BOARD.
* USES ON BOARD AUDIO AMPS OR YOUR STEREO.
* ON BOARD PROTO TYPING AREA.
* ALL SOCKETS, PARTS AND HARDWARE ARE INCLUDED.
* PC BOARD IS SOLDERMASKED, SILK SCREENED, WITH GOLD CONTACTS.
* EASY, QUICK, AND FUN TO BUILD, WITH FULL INSTRUCTIONS.
* USES PROGRAMMED I/O FOR MAXIMUM SYSTEM FLEXIBILITY.

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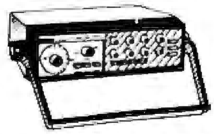

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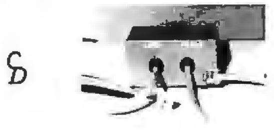

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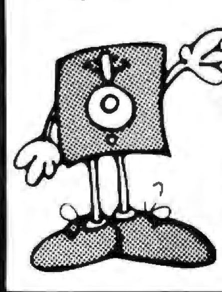

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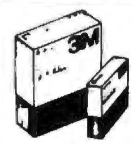

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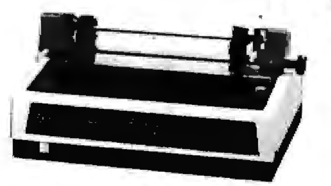

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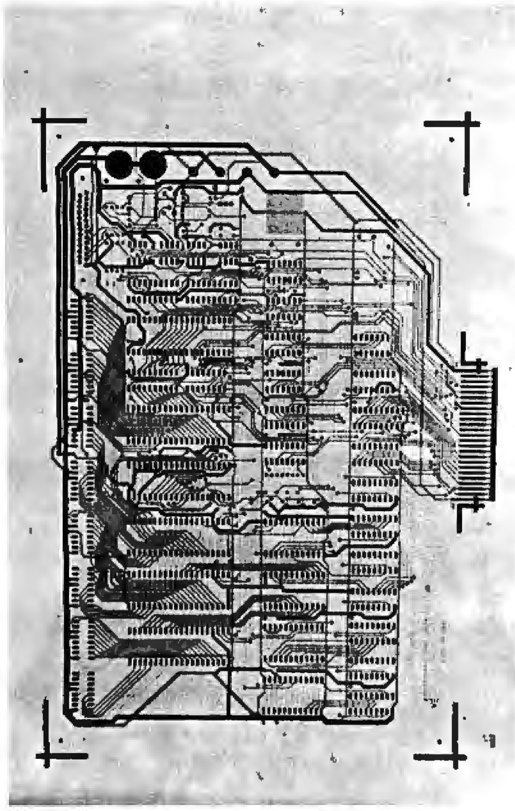

6502 JBE I Micro-Computer

John Bell Engineering is announcing their JBE I Micro-Computer. This computer is available partially or fully populated or as a bare board. The fully populated version includes:

1	6502 CPU	8	2114 RAMS (4K)
4	6522 VIA (8 Parallel Ports)	2	2716 EPROM (with monitor & tiny basic)
1	AY5-1013 (Serial I/O Port)		

The partially populated version includes:

1	6502 CPU	2	2114 RAMS (1K)
1	6522 VIA (2 parallel ports)	1	2716 EPROM (with monitor)
1	AY5-1013 (Serial I/O port)		

Both versions include sockets for 4 2716s or 2732s, 8 16 pin sockets for I/O interfacing and a DB25 connector for RS232.

All address and data lines, power supply, RDY, interrupts, DMA, phase 1 & phase 2 clocks, read/write, reset and NMI and IRQ are brought off the board to the 50 pin connector.

This board also features power on reset and cassette interface.

Documentation includes 6502 programming manual and complete documentation for the 6522 VIA. Also included is documentation for interfacing with JBE A-D and D-A converter, solid state switches and EPROM programmer.

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81-030C	Fully populated assembled & tested	**$349.95**
81-030M	Partially populated assembled & tested	**$249.95**
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EPROM Substitution Card

NEW

This board looks like RAM to the Apple® II and like an EPROM to the computer being programmed. It features 2K or 4K of RAM and emulates a 2716 or 2732. A 24 pin ribbon cable connects the computer being programmed to the EPROM sub. board. Documentation includes disk with basic & pascal utility routines including save, write, CMP, error checking. Complete Source Code User Manual also included. This board allows you to test programs without burning your EPROM. Three control lines from the board are used to control the computer being programmed (reset etc.).

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**Because of the high cost of the SC-01 at this time, it will be sold separately. This way as the price goes down we can pass the savings on directly to you.

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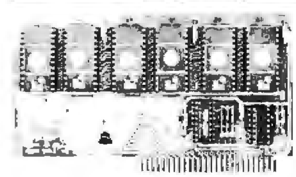

JBE EPROM Expander for the Apple II holds six 5 volt 2716s for a total of 12K bytes of ROM. This board takes the place of the on board ROM in the Apple. It is software switchable by the same technique used by the Apple® II firmware card. Solder jumpers are for reset to the Apple ROM or 2716s on the card. (EPROMs available separately). Use JBE EPROM programmer and parallel I/O cards to program your EPROMs.

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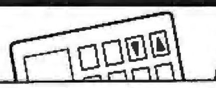

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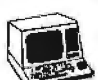

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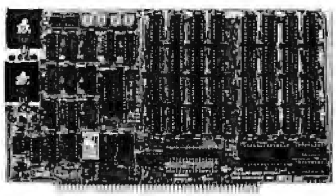

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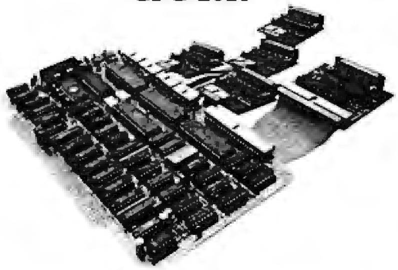

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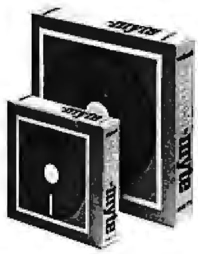

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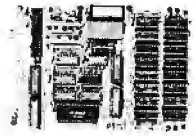

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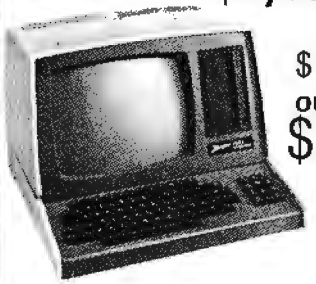

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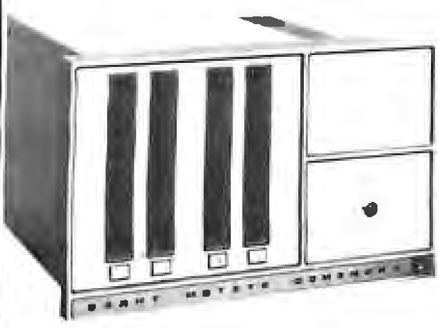

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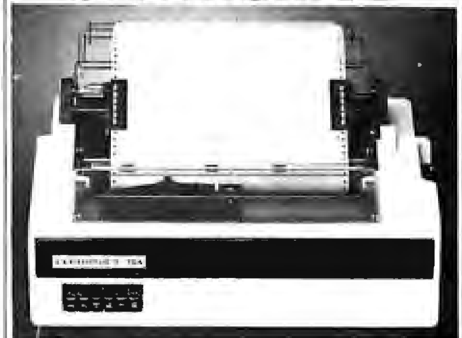

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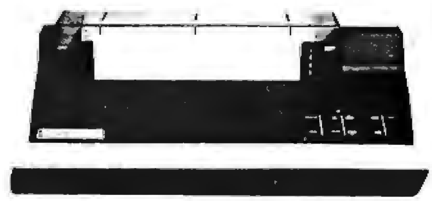

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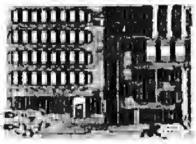

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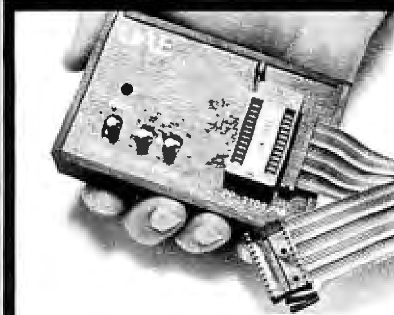

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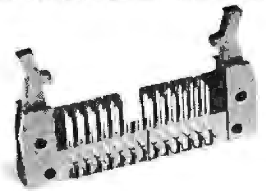
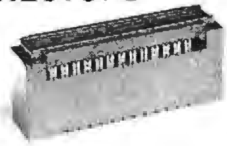


Pins	PC Mounting		WireWrap	
10	IDH10SR	.80	IDH10WR	1.75
20	IDH20SR	1.25	IDH20WR	2.75
26	IDH26SR	1.85	IDH26WR	3.60
34	IDS34SR	2.15	IDH34WR	4.15
40	IDH40SR	2.50	IDH40WR	4.90
50	IDH50SR	3.15	IDH50WR	6.15

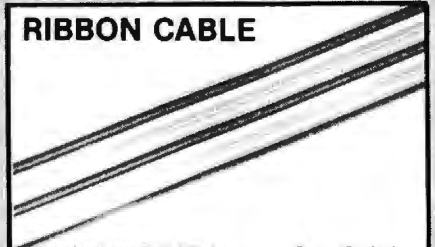
EJECTOR EARS .25 EACH

CARD EDGE CONNECTORS



Pins	Part No.	
10	IDE10	3.25
20	IDE20	3.50
26	IDE26	4.05
34	IDE34	4.85
40	IDE40	5.65
50	IDE50	5.90

RIBBON CABLE



Conductors:	Solid Color 10 ft.	Solid Color 100 ft.	Color Coded 10 ft.	Color Coded 100 ft.
10	2.90	17.00	4.00	30.00
14	3.40	23.80	5.00	42.00
16	3.70	27.20	5.60	48.00
20	4.40	34.00	7.00	60.00
24	5.00	40.80	8.00	72.00
26	5.40	44.20	8.60	78.00
34	6.80	57.80	11.00	102.00
40	7.80	68.00	13.00	120.00
50	9.50	85.00	16.00	150.00

25 PIN "D" CONNECTORS

Style	Part #	
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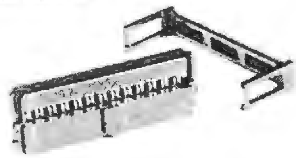
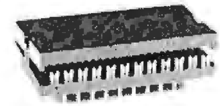
Female	DB255	3.00
Hood	DB25C	1.10
INSULATION DISPLACEMENT		
Male	IDC25P	4.95
Female	IDC255	5.25
Hood	IDC25C	1.35

SOCKETS



Pins	Part No.		Stain Relief
10	IDS10	1.25	.25
20	IDS20	2.02	.25
26	IDS26	2.65	.25
34	IDS34	3.50	.25
40	IDS40	4.05	.25
50	IDS50	5.06	.25

CABLE PLUGS



Pins	Part No.	
14	IDP14	1.25
16	IDP16	1.40
24	IDP24	2.25
40	IDP40	3.65

WIRE WRAP WIRE

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3.0"	1.30	3.86	6.78	7.0"	1.99	6.76	12.44
3.5"	1.37	4.15	7.37	7.5"	2.08	7.07	13.09
4.0"	1.42	4.44	7.94	8.0"	2.14	7.38	13.73
4.5"	1.48	4.74	8.54	8.5"	2.18	7.69	14.36
5.0"	1.54	5.04	9.13	9.0"	2.24	8.11	15.01
5.5"	1.58	5.38	9.72	9.5"	2.30	8.32	15.65
6.0"	1.65	5.66	10.31	10.0"	2.39	8.71	16.28

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WIRE KITS

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250	3½"	100	5"	500	3"	500	5"
100	4"	100	6"	500	3½"	500	5½"
				500	4"	500	6"
Kit No. 2		**$24.95**		**Kit No. 4**		**$59.95**	
250	2½"	250	5"	1000	2½"	1000	4½"
500	3"	100	5½"	1000	3"	1000	5"
500	3½"	250	6"	1000	3½"	1000	5"
500	4"	100	6½"	1000	4"	1000	6"
250	4½"	100	7"				

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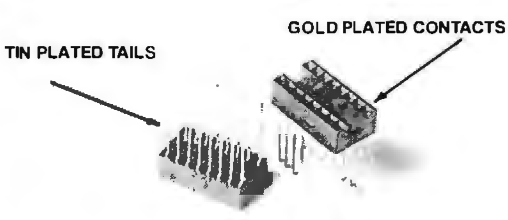

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18	23	.70	16.10
20	21	.87	18.27
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SN7428N	.49	SN74116N	1.95	SN74191N	1.25
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SN7437N	.25	SN74123N	.59	SN74194N	.89
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74LS48	1.15	74LS161	1.15	74LS353	1.29
74LS49	1.15	74LS162	1.15	74LS365	.75
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CD4034	3.49	CD4078	.55	MC14419	4.95
CD4035	.99	CD4081	.39	MC14433	13.95
CD4040	1.49	CD4082	.39	MC14538	2.49
		CD4093	.99	MC14541	1.95

A P PRODUCTS

DIP JUMPERS

- Matewith Standard IC Sockets
- Fully Assembled and Tested
- Integral Molded-On Strain Relief
- Line-By-LineProbeability

DipJumpersareused for jumpering within a PC Board; interconnectingbetweenPC Boards, backplanes andmother boards; and interfacing input/output signals.

Part Number	No. of contacts	Description	Wire Length	Price
924102 12	14	single end	12"	$1.61
924102 24	14	single end	24"	[illegible]
92410236	14	single end	36"	2.33
924106 12	14	double end	12"	2.61
924106 24	14	double end	24"	3.02
924106 36	14	double end	36"	3.43
92411212	16	single end	12"	1.67
92411224	16	single end	24"	2.13
92411236	16	single end	36"	2.59
924116 12	16	double end	12"	2.88
92411624	16	double end	24"	3.34
92411636	16	double end	36"	3.80
924122 12	24	single end	12"	[illegible]
92412224	24	single end	24"	3.30
92412236	24	single end	36"	4.00
924126 12	24	double end	12"	4.50
924126 24	24	double end	24"	5.20
924126-36	24	double end	36"	5.80
924132-12	40	single end	12"	4.35
924132-24	40	single end	24"	5.53
924132-36	40	single end	36"	[illegible]

DISCRETE LEDS

XC556R	.200"	red	5/$1	MV50	.085"	red	6/$1	XC111R	.190"	red	5/$1
XC556G	.200"	green	4/$1	XC209R	.125"	red	5/$1	XC111G	.190"	green	4/$1
XC556Y	.200"	yellow	4/$1	XC209G	.125"	green	4/$1	XC111Y	.190"	yellow	4/$1
XC556C	.200"	clear	4/$1	XC209Y	.125"	yellow	4/$1	XC111C	.190"	clear	4/$1
XC22R	.200"	red	5/$1	XC526R	.185"	red	5/$1				
XC22G	.200"	green	4/$1	XC526G	.185"	green	4/$1				
XC22Y	.200"	yellow	4/$1	XC526Y	.185"	yellow	4/$1				
MV10B	.170"	red	4/$1	XC526C	.185"	clear	4/$1				

XC556 RED LED, METAL MTG. HDW. 2-5" LEADS.
RL-2 . . $.39 ea.or 3/$1.00

DISPLAY LEDS

C.A. — Common Anode C.C. — Common Cathode

Type	Polarity	Ht	Price	Type	Polarity	Ht	Price
MAN 1	C.A.—red	.270	2.95	DLG507	C.A.—green	.500	1.25
MAN 2	5x7 D.M.—red	.300	4.95	DL704	C.C.—red	.300	1.25
MAN 3	C.C.—red	.125	.25	DL707	C.A.—red	.300	1.25
MAN 52	C.A.—green	.300	1.25	DL728	C.C.—red	.500	1.49
MAN 54	C.C.—green	.300	1.25	DL741	C.A.—red	.600	1.25
MAN 71	C.A.—red	.300	.75	DL746	C.A.—red ± 1	.630	1.49
MAN 72	C.A.—red	.300	.75	DL747	C.A.—red	.600	1.49
MAN 74	C.C.—red	.300	1.25	DL750	C.C.—red	.600	1.49
MAN 82	C.A.—yellow	.300	.49	DLO847	C.A.—orange	.800	1.49
MAN 84	C.C.—yellow	.300	.99	OLO850	C.C.—orange	.800	1.49
MAN 3620	C.A.—orange	.300	.49	DL33B	C.C.—red	.110	.35
MAN 3630	C.A.—orange ± 1	.300	.99	FND358	C.C. ± 1	.357	.99
MAN 3640	C.C.—orange	.300	.99	FND359	C.C.	.357	.75
MAN 4610	C.A.—orange	.400	.99	FND503	C.C. (FND500)	.500	.99
MAN 6610	C.A.—orange—DD	.560	.99	FND507	C.A. (FND510)	.500	.99
MAN 6630	C.A.—orange ± 1	.560	.99	HDSP-3401	C.A.—red	.800	1.50
MAN 6640	C.C.—orange—DD	.560	.99	HDSP-3403	C.C.—red	.800	1.50
MAN 6650	C.C.—orange ± 1	.560	.99	5082-7751	C.A.,R.H.D.—red	.430	1.25
MAN 6660	C.A.—orange	.560	.99	5082-7760	C.C.,R.H.D.—red	.430	1.75
MAN 6710	C.A.—red—DD	.560	.99	5082-7300	4x7sgl.dig. RHD	.600	22.00
MAN 6750	C.C.—red ± 1	.560	.99	5082-7302	4x7 sgl. dig. LHD	.600	22.00
MAN 6780	C.C.—red	.560	.99	5082-7304	Overnge. char. (± 1)	.600	19.95
DLO304	C.C.—orange	.300	1.25	4N28	Photo XsistorOpto-Isol.		.99
DLD307	C.A.—orange	.300	1.25	LIT-1	Photo Xsistor Opto-Isol.		.69
DLG500	C.C.—green	.500	1.25	MOC3010	Optically Isol.Triac Driver		1.25

SOCKETS RECEPTACLES

Test TEXTOOL Sockets

ZERO INSERTION FORCE

- Nickel Boron Plating
- G.F. PSF Plastic Body
- For testing IC's

- Nickel Boron Plating
- G.F. PSF Plastic Body
- Wire Wrap Contacts

Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price	Part No.	Pins	Price
214-3339	14 pin	5.95	222-3343	22 pin	9.95	214-3592	14 pin	9.75	222-3596	22 pin	12.95
216-3340	16 pin	6.49	224-3344	24 pin	9.75	216-3593	16 pin	9.95	224-3597	24 pin	12.75
218-3341	18 pin	7.95	228-3345	28 pin	11.95	218-3594	18 pin	10.95	228-3598	28 pin	13.95
220-3342	20 pin	8.95	240-3346	40 pin	12.95	220-3595	20 pin	11.95	240-3599	40 pin	15.95

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

		10 Ohm	12 Ohm	15 Ohm	18 Ohm	22 Ohm		
ASST. 1	5ea.	27 Ohm	33 Ohm	39 Ohm	47 Ohm	56 Ohm	50pcs.	$1.95
		68 Ohm	82 Ohm	100 Ohm	120 Ohm	150 Ohm		
ASST. 2	5ea.	180 Ohm	220 Ohm	270 Ohm	330 Ohm	390 Ohm	50pcs.	$1.95
		470 Ohm	560 Ohm	680 Ohm	820 Ohm	1K		
ASST. 3	5ea.	1.2K	1.5K	1.8K	2.2K	2.7K	50pcs.	$1.95
		3.3K	3.9K	4.7K	5.6K	6.8K		
ASST. 4	5ea.	8.2K	10K	12K	15K	18K	50pcs.	$1.95
		22K	27K	33K	39K	47K		
ASST. 5	5ea.	56K	68K	82K	100K	120K	50pcs.	$1.95
		150K	180K	220K	270K	330K		
ASST. 6	5ea.	390K	470K	560K	680K	820K	50pcs.	$1.95
		1M	1.2M	1.5M	1.8M	2.2M		
ASST. 7	5ea.	2.7M	3.3M	3.9M	4.7M	5.6M	50pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)						$10.95 ea.

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7/81

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	22.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	28.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IOR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LEO Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7206CEV/Kit*	Tone Generator Chip, XTL	9.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	11.10
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Oigit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Oigit LED Up/Down Counter	12.95
7218CIJI	8-Oigit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.36
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.50
8212CPA	Volt Ref/Indicator	2.50

74C

74C00	.39			74C195	1.59
74C02	.39			74C221	1.95
74C04	.39			74C240	2.25
74C08	.39	74C106	.75	74C244	2.25
74C10	.39	74C107	1.89	74C373	2.49
74C14	.75	74C151	2.95	74C374	2.59
74C20	.39	74C154	3.95	74C901	.89
74C30	.39	74C157	2.25	74C903	1.15
74C42	1.39	74C160	1.69	74C911	10.95
74C48	1.95	74C161	1.60	74C912	10.95
74C73	.79	74C162	1.49	74C915	1.69
74C74	.79	74C163	1.69	74C917	10.95
74C85	1.95	74C164	1.59	74C922	5.49
74C86	.99	74C173	1.39	74C923	5.75
74C89	6.95	74C174	1.39	74C925	7.50
74C90	1.29	74C175	1.39	74C926	7.50
74C93	1.29	74C192	1.69	80C95	.79
74C95	1.59	74C193	1.69	80C97	.79

LINEAR

LH0002CN	6.85			LM702H	.79
LM10CLH	4.50			LM703CN	.89
LM11CLH	4.75	LM340T-5	1.25	LM709N	.49
LH0070-OH	6.05	LM340T-12	1.25	LM710N	.79
TL071CP	.79	LM340T-15	1.25	LM711N	.79
TL072CP	1.39	LM341P-5	.75	LM723N	.69
TL074CN	2.49	LM341P-12	.75	LM733N/H	1.00
LH0082CD	35.80	LM341P-15	.75	LM739N	1.19
TL082CP	1.19	LM342P-5	.69	LM741CN	.35
TL084CN	2.19	LM342P-12	.69	MC1741SCG	3.00
LH0094CD	36.80	LM342P-15	.69	LM747N/H	.79
LM300H	.99	LM348N	1.25	LM748N/H	.59
LM301CN/H	.35	LM350K	5.75	LM1014N	2.75
LM302H	1.95	LF351N	.60	LM1310N	1.95
LM304H	1.95	LF353N	1.00	LM1458CN	.59
LM305H	.99	LF355N	1.10	LM1488N	1.25
LM307CN/H	.45	LF356N	1.10	LM1489N	1.25
LM308CN/H	1.00	LM358N	1.00	LM1496N	1.95
LM309H	1.95	LM359N	1.79	LM1556V	1.75
LM309K	1.25	LM370N	4.49	LM1800N	2.95
LM310CN	1.75	LM373N	2.95	LM1877N-9	3.25
LM311H/CN	.90	LM377N	2.95	LM1889N	3.20
LM312H	2.49	LM380N	1.25	LM1896N	1.75
LM317MP	1.15	LM381N	1.95	LM2002T	1.49
LM317T	1.75	LM382N	1.79	LM2877P	2.05
LM317K	3.95	LM384N	1.95	LM2878P	2.25
LM318CN/H	1.95	LM386N-3	1.29	LM2896P-1	2.25
LM319N	1.95	LM387N	1.45	LM3189N	2.95
LM320K-5	1.35	LM389N	1.35	LM3900N	.69
LM320K-12	1.35	LM392N	.69	LM3905CN	1.25
LM320K-15	1.35	LF398N	4.00	LM3909N	1.15
LM320T-5	1.25	LM399H	5.00	LM3914N	3.95
LM320T-12	1.25	TL494CN	4.49	LM3915N	3.95
LM320T-15	1.25	TL496CP	1.75	LM3916N	3.95
LM323K-5	5.95	NE510A	6.00	RC4136N	1.25
LM324N	.99	NE529A	4.95	RC4151NB	3.95
LM329DZ	.65	NE531H	3.95	RC4194TK	5.95
LM331N	3.95	NE536H	6.00	RC4195TK	5.49
LM334Z	1.30	NE540H	6.00	KB4428	4.25
LM335Z	1.40	NE544N	4.95	KB4429	5.95
LM336Z	1.75	NE550A	1.30	LM4500A	3.25
LM337T	1.95	NE555V	.39	ICL8038B	4.95
LM337MP	1.15	LM556N	.99	LM13080N	1.29
LM338K	6.95	NE564N	3.95	LM13600N	1.49
LM339N	.99	LM565N	1.25	75138N	1.95
LM340K-5	1.35	LM566CN	1.95	75450N	.89
LM340K-12	1.35	LM567V	1.25	75451CN	.39
LM340K-15	1.35	NE570N	4.95	75492	.89

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

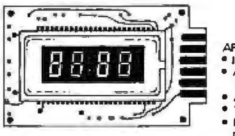
.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

Circle 195 on inquiry card.

National Semiconductor Clock Modules



12VDC AUTOMOTIVE/ INSTRUMENT CLOCK

APPLICATIONS:
- In-dash autoclocks
- After-market auto/ RV clocks
- Aircraft-marine clks.
- 12VDC oper. Instru.
- Portable/battery powered instrumnts.

Features: Bright 0.3" green display. Internal crystal time-base. ± 0.5 sec./day accur. Auto.display brightness control logic. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

MA1003 Module $16.95

CLOCK MODULES

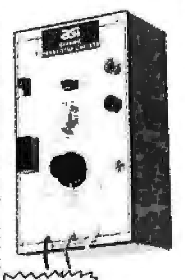
MA1023	.7" Low Cost Digital LED Clock Module	8.95
MA1026	.7" Dig. LED Alarm Clock/Thermometer	18.95
MA5036	.3" Low Cost Digital LED Clock/Timer	6.95
MA1002	.5" LED Display Dig. Clock & Xformer	9.95

TRANSFORMERS

102-P20	Xformer for MA1023 Clock Modules	3.49
102-P22	Xformer for MA1026 Clock Modules	3.49
102-P20	Xformer for MA5036 Clock Modules	3.49

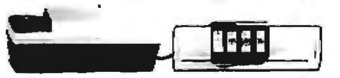
Transistor Checker

The *ASI Transistor Checker* is capable of checking a wide range of transistor types, either "in circuit" or out of circuit. It has been specially designed to take advantage of the newest concept of dynamic testing under current amplifier conditions. To operate, simply plug the transistor to be checked into the front panel socket, or connect it with the alligator clip test leads provided. No preliminary set-up is needed. The unit safely and automatically identifies low, medium and high-power PNP and NPN transistors. The ASI Transistor Checker also permits matching similar transistors in actual operating circuits, and provides a reliable GO/NO-GO test at practical collector currents (from 5mA on small signal types to 50mA and more on power types.) Match similar type transistors by observing and comparing dial readings; the higher the reading, the higher the gain. Completely assembled — battery operated. ("C" cell battery not included.)



Trans-Check .... CLOSE-OUT **$9.95**

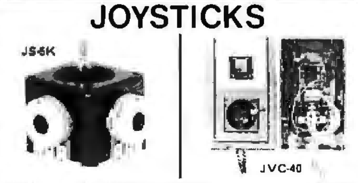
EPROM Erasing Lamp



- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact — only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips.

UVS-11E $79.95

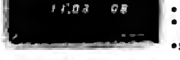
JOYSTICKS



JS-5K	5K Linear Taper Pots	$5.25
JS-100K	100K Linear Taper Pots	$4.95
JVC-40	40K (2) Video Controller in case	$5.95

6-Digit Clock Kit

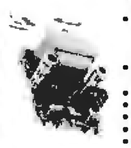
- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 V AC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"



JE701 .... $19.95

NEW! JE215 Adjustable Dual Power Supply

General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.



FEATURES:
- Adjustable regulated power supplies, pos. and neg. 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling
- LED "on" indicator
- Printed Board Construction
- 120VAC input
- Size: 3-1/2"w x 5-1/16"L x 2"H

JE215 Adj. Dual Power Supply Kit (as shown) . . $24.95

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp)	$14.95
JE205 Adapter Brd. (to JE200) ±5, ±9 & ±12V.	$12.95
JE210 Var. Pwr. Sply. Kit. 5-15VDC, to 1.5amp.	$19.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

INS8080A	CPU	6.50
DP8212	8-Bit Input/Output	3.25
DP8214	Priority Interrupt Control	5.95
DP8216	Bi-Directional Bus Driver	3.49
DP8224	Clock Generator/Driver	3.95
DP8226	Bus Driver	3.49
DP8228	System Controller/Bus Driver	4.95
DP8238	System Controller	5.95
INS8243	I/O Expander for 48 Series	9.95
INS8250	Asynchronous Comm. Element	16.95
DP8251	Prog. Comm. I/O (USART)	7.95
DP8253	Prog. Interval Timer	14.95
DP8255	Prog. Peripheral I/O (PPI)	9.95
DP8257	Prog. DMA Control	19.95
DP8259	Prog. Interrupt Control	14.95
DP8275	Prog. CRT Controller	49.95
DP8279	Prog. Keyboard/Display Interface	19.95
DP8300	Octal Bus Receiver	6.95
DP8303	System Timing Element	6.95
DP8304	8-Bit Bi-Directional Receiver	3.95
DP8307	8-Bit Bi-Directional Receiver	3.95
DP8308	8-Bit Bi-Directional Receiver	3.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	14.95
MC6802CP	MPU with Clock and RAM	19.95
MC6810API	128x8 Static RAM	[illegible]
MC6821	Peripheral Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	10.95
[illegible]	1024x8-Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	6.95
MC6852	Synchronous Serial Data Adapter	6.95
MC6860	0-600bps Digital MODEM	10.95
MC6862	2400bps Modulator	12.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS

Z80 (780C)	CPU (MK3880N) (2MHz)	[illegible]
Z80A (780-1)	CPU (MK3880N-4) (4MHz)	15.95
CDP1802	CPU	19.95
2650	MPU	16.95
IDM2901ADC	CPU—4-Bit Slice (Com. Temp. Grade)	19.95
MCS6502	MPU w/Clock (65K Bytes Memory)	11.95
INS8035N 6	MPU—8-Bit (6MHz)	16.95
INS8039N-6	CPU—Sgl. Chip 8-Bit (128 bytes RAM)	19.95
INS8040N-6	CPU (256 Bytes RAM)	24.95
INS8070N	CPU—64 Bytes RAM	24.95
INS8073N	CPU w/Basic Micro Interpreter	29.95
P8085	CPU	19.95
INS8900	CPU—16-Bit	29.95
TMS9900JL	MPU—16-Bit	49.95

SHIFT REGISTERS

MM500H	Dual 25-Bit Dynamic	.50
MM501H	Dual 50-Bit Dynamic	.50
MM506H	Dual 100-Bit Static	.50
MM510H	Dual 64-Bit Accumulator	.50
MM1402	256-Bit Dynamic	3.95
MM5013	1024-Bit Dynamic/Accumulator	1.95
MM5016H	500/512-Bit Dynamic	[illegible]
MM5034N	Octal 80-Bit	9.95
MM5035N	Octal 80-Bit	9.95
2504V (1404A)	1024-Bit Dynamic	3.95
2518N	Hex 32-Bit Static	4.95
2522V	Dual 132-Bit Static	2.95
2524V	512-Bit Dynamic	.99
2525V	1024-Bit Dynamic	2.95
2527V	Dual 256-Bit Static	2.95
2528V	Dual 250-Bit Static	4.00
2529V	Dual 240-Bit Static	4.00
2532N	Quad 80-Bit Static	2.95
3341PC	Fifo (Dual 80)	6.95

DATA ACQUISITION

AF100-1CN	Universal Active Filter 2.5%	[illegible]
AF121-1CJ	Touch Tone Low pass Filter	19.95
AF122-1CJ	Touch Tone Low pass Filter	19.95
LM308AH	Super Gain Op Amp	1.00
LM334Z	Constant Current Source	1.30
LM 335Z	Temperature Transducer	1.40
LF356N	JFET Input Op Amp	1.10
LF398N	Sample & Hold Amplifiers	3.95
LM399H	Temp.Comp. Prec. Ref. (.5pPm/C°)	4.95
ADC0804LCN	8-Bit A/D Converter (1 LSB)	4.95
DAC0806LCN	8-Bit D/A Converter (0.78% Lin.)	2.25

DATA ACQUISITION (CONTINUED)

ADC0809CCN	8-Bit A/D Converter (8-Ch. Multi.)	5.25
ADC0817CCN	8-Bit A/D Converter (16-Ch. Multi.)	10.95
DAC1000LCN	10-Bit D/A Conv. Micro.Comp. (0.05%)	13.95
DAC1008LCN	10-Bit D/A Conv. Micro.Comp. (0.20%)	8.95
DAC1020LCN	10-Bit D/A Converter (0.05% Lin.)	8.49
DAC1022LCN	10-Bit D/A Converter (0.20% Lin.)	5.95
DAC1222LCN	12-Bit D/A Converter (0.20 Lin.)	9.95
CD4051N	8-Channel Multiplexer	1.19
AY-5-1013	30K BAUD UART	5.95

RAM'S

1101	256x1 Static	1.49
1103	1024x1 Dynamic	.99
2101 (8101)	256x4 Static	3.95
2102	1024x1 Static	1.75
21L02	1024x1 Static	[illegible]
2111 (8111)	256x4 Static	[illegible]
2112	256x4 Static MOS	4.95
2114	1024x4 Static 450ns	5.95
2114L	1024x4 Static 450ns Low Power	6.95
2114-3	1024x4 Static 300ns	7.49
2114L-3	1024x4 Static 300ns Low Power	7.95
2117	16,384x1 Dynamic 350ns (housemarked)	4.95
4116N-4 (UPD416)	16K Dynamic 250ns (MM5290N-4)	[illegible]
4164	64K Dynamic 250ns	49.95
MM2147J	4096x1 Fast 70ns	19.95
5101	256x4 Static	7.95
MM5261	1024x1 Dynamic Fully Decoded	.99
MM5262	2Kx1 Dynamic	.25
MM5280/2107	4096x1 Dynamic	4.95
MM5290N-2 (4116)	16K Dynamic 150ns (UPD416C-3)	5.25
MM5298J-3A	8K Dyn. 200ns (lower ½ of MM5290J)	4.95
MM5799NAA/N	Controller Oriented Processor	9.95
UPD414/MK4027	4K Dynamic 16-Pin	4.95
TMS4044-45NL	4K Static	14.95
TMS4045	1024x4 Static	14.95

PROMS/EPROMS

1702A	2K UV Erasable PROM	5.95
2708	8K EPROM	5.95
TMS2716	16K EPROM (-5V, +5V, +12V)	19.95
2716 Intel (2516) TI	16K EPROM (Single +5V)	10.95
2732 Intel (2532) TI	32K EPROM	19.95
2758	8K EPROM (450ns) (Single +5V)	7.95
5203	2048 PROM	14.95
82523 (74S188)	32x8 PROM (Open Collector)	4.95
82S115	4096 Bipolar PROM	19.95
82S123 (74S288)	32x8 Tri-State Bipolar PROM	4.95
82S185	8K PROM	29.95

ROM'S

2513 (2140)	Character Generator (Upper Case)	9.95
2513 (3021)	Character Generator (Lower Case)	9.95
2516N	Character Generator	10.95
MM5230N	2048-Bit Read Only Memory	1.95

NMOS READ ONLY MEMORIES

MCM66710P	128x9x7 ASCII Shifted w/Greek	13.50
MCM66740P	128x9x7 Math Symbol & Pictures	13.50
MCM66750P	128x9x7 Alpha. Control Char. Gen.	13.50

MICROPROCESSOR MANUALS

M-Z80	User Manual	7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

SPECIAL FUNCTION

DS0025CN	Dual MOS Clock Driver (5MZ)	3.50
DS0026CN	Dual MOS Clock Driver (5MZ)	1.95
INS1771N-1	Floppy Disc Controller	24.95
INS2651N	Communication Chip	19.95
MM58167N	Microprocessor Real Time Clock	8.95
MM58174N	Microprocessor Compatible Clock	11.95
CDP402N	Microcontroller with 64-Digit RAM and Direct LED Drive	6.95
COP402MN	Microcontroller with 64-Digit RAM & Direct LED Drive w/N Buss Int.	[illegible]
COP470N	32-Seg. VAC Fluor. Driver (20-pin pkg.)	3.25

TELEPHONE/KEYBOARD CHIPS

AY-5-9100	Push Button Telephone Dialer	14.95
AY-5-9200	Repertory Dialer	14.95
AY-5-9500	CMOS Clock Generator	4.95
AY-5-2376	Keyboard Encoder (88 keys)	11.95
HD0165-5	Keyboard Encoder (16 keys)	7.95
74C922	Keyboard Encoder (16 keys)	5.49
74C923	Keyboard Encoder (20 keys)	5.75
MM53190N	Push Button Pulse Dialer	7.95
MM5740N	96/144-Key Serial Keyboard Encoder	8.95

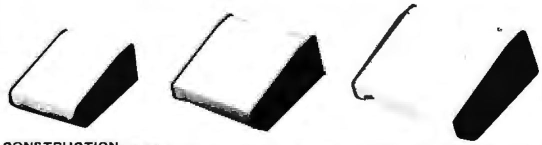
ELECTRONIC TOY MOTORS

.937 O.D. x 1.201 Length

Typical Power Source	Operating Voltage Range	Voltage	No Load Speed RPM	No Load Current AMP	At Maximum Efficiency Speed RPM	Current AMP	Torque OZ-IN	Output W	Eff. %	Stall Torque OZ-IN
DRY CELL	1.5 6.0	3.0	9,200	0.20	6,750	0.90	0.280	1.30	57.0	0.97

MABUCHI RE280 $.99 each . . . 10/$7.50 . . . 100/$50.00

DESIGNERS' SERIES
Blank Desk-Top Electronic Enclosures



CONSTRUCTION:
The "DTE" Blank Desk Top Electronic Enclosures are designed to blend and complement today's modern computer equipment and can be used in both industrial and home. The end pieces are precision molded with an internal slot (all around) to accept both top and bottom panels. The panels are then fastened to ¼" thick tabs inside the end pieces to provide maximum rigidity to the enclosure. For ease of equipment servicing, the rear/bottom panel slides back on slotted tracks while the rest of the enclosure remains intact. Different panel widths may be used while maintaining a common profile outline. The molded end pieces can also be painted to match any panel color scheme.

Enclosure Model No.	Panel Width	PRICE
DTE-8	8.00"	$29.95
DTE-11	10.65"	$32.95
DTE-14	14.00"	$34.95

$10.00 Min. Order — U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage—Add 5% plus $1 Insurance

Spec Sheets — 25¢
Send 52¢ Postage for your FREE 1981 JAMECO CATALOG

NEW 1981 CATALOG

Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1355 SHOREWAY ROAD, BELMONT, CA 94002
PRICES SUBJECT TO CHANGE

7/81

Bourns Potentiometer

3/4 Watt Single Turn (TOP ADJUSTMENT)

Values: 500Ω 1K 2.5K 5K 10K 25K 50K 100K 250K 500K 5Meg

INDIVIDUAL PRICING:

1-49	50-99	100-999	1K-up
.19	.17	.15	.12

GB174 ...... $1.95/lot (25 pieces all 11 asst. values)

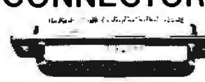
To order: Specify Bourns 3355 — (Value desired)

AC and DC Wall Transformers

Ideal for use with clocks, games, power supplies or any other type of AC or DC application.

Part No.	Input	Output	Price
AC 250	117V/60Hz	12 VAC 250mA	$3.95
AC 500	117V/60Hz	12 VAC 500mA	$4.95
AC1000	117V/60Hz	12 VAC 1 amp	$5.95
AC1700	117V/60Hz	9 VAC 1.7 amp	$6.95
DV 9200	117V/60Hz	9 VDC 200mA	$3.25
DC 900	120V/60Hz	9 VDC 500mA	$3.95

CONNECTORS



DB25P	D-Subminiature Plug	$2.95
DB25S	D-Subminiature Socket	$3.50
DB51226	Cover for DB25P/S	$1.75
22/44SE	P.C. Edge (22/44 Pin)	$2.95
UG88/U	BNC Plug	$1.79
UG89/U	BNC Jack	$3.79
UG175/U	UHF Adapter	$ .49
SO239	UHF Panel Recp.	$1.29
PL258	UHF Adapter	$1.60
PL259	UHF Plug	$1.60
UG260/U	BNC Plug	$1.79
UG1094/U	BNC Bulkhead Recp.	$1.29

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
★8 ea. MM5290 (UPD416/4116) 16K Dyn. Rams (*NS)
★ Documentation for Conversion

TRS-16K2 *150NS **$39.95**
TRS-16K4 *250NS **$29.95**

JE610 ASCII Encoded Keyboard Kit

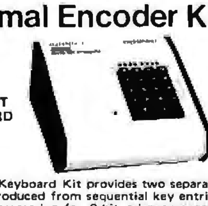
The JE610 ASCII Keyboard Kit can be interfaced into most any computer system. The kit comes complete with an industrial grade keyboard switch assembly (62-keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10 mA for operation. Features: 60 keys generate the 126 characters, upper and lower case ASCII set. Fully buffered. Two user-define keys provided for custom applications. Caps lock for upper-case-only alpha characters. Utilizes a 2376 (40-pin) encoder read-only memory chip. Outputs directly compatible with TTL/DTL or MOS logic arrays. Easy interfacing with a 16-pin dip or 18-pin edge connector. Size: 3½"H x 14½"W x 8¾"D

JE610/DTE-AK (After assembled as pictured above) ... **$124.95**
JE610 Kit 62-Key Keyboard, PC Board, & Components (no case) ..... **$ 79.95**
K62 62-Key Keyboard (Keyboard only) ... **$ 34.95**
DTE-AK (case only — 3¼"Hx11"Wx8¾"D) **$ 49.95**

NEW! JE212 — Negative 12VDC Adapter Board Kit for JE610 ASCII KEYBOARD KIT Provides −12VDC from incoming 5VDC . . $9.95

JE600 Hexadecimal Encoder Kit

FULL 8-BIT LATCHED OUTPUT 19-KEY KEYBOARD

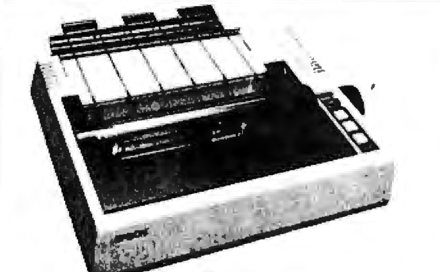


The JE600 Encoder Keyboard Kit provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8-bit microprocessor or 8-bit memory circuits. Three additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with 9 LED readouts. Also included is a key entry strobe. Features: Full 8-bit latched output for microprocessor use. Three user-define keys with one being bistable operation. Debounce circuit provided for all 19 keys. 9 LED readouts to verify entries. Easy interfacing with standard 16-pin IC connector. Only +5VDC required for operation. Size: 3½"H x 8¾"W x 8¾"D

JE600/DTE-HK (After assembled as pictured above) **$99.95**
JE600 Kit 19-Key Hexadec. Keyboard, PC Board & Cmpnts. (no case) .. **$59.95**
K19 19-Key Keyboard (Keyboard only) **$14.95**
DTE-HK (case only —3½"Hx8¾"Wx8¾"D) **$44.95**

Lower Prices,

Printers



MX-80 - Epson

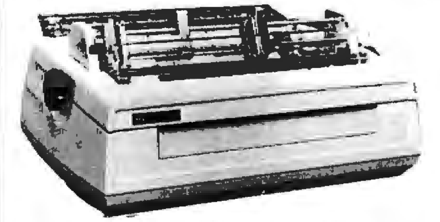
132 column, 9 x 9 dot matrix, multiple fonts

PRM-27080 *Save $100.00* .... Call

MX-70

PRM-27070 With Graftrax II .... Call

Interface & Cable for Apple $110.00



SPINWRITER - NEC

65 cps, bi-directional, letter quality printer with deluxe tractor mechanism, both parallel and serial interfaces on-board, 16K buffer, ribbon, print thimble, graphics, micro-space justification, data cable, and self test/diagnostic ROM.

PRD-55511 *without 16K buffer* ... $2795.00
PRD-55512 *with 16K buffer* $2895.00

Accessories for TRS-80

DISK DRIVES for TRS-80

23% more storage, 8 times faster, 40 track with free patch, 120 day warranty.

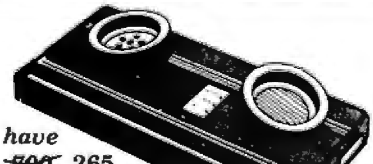
MSM-12410C *Save $125.00 !!!* $325.00

8" DISK DRIVES for MODEL II

2 double density drives with cabinet, power supply, & cables

END-000433 *Kit* $1050.00
END-000434 *Assembled* $1250.00
WCA-5036A *Cable (required)* $29.95

Special Purchase - Save $50.00
Novation Cat Modem
300 baud, answer and originate



(We have only ~~700~~ 265 availible at this special price)

IOM-5200A *List price $189.95* $139.95

D-CAT 300 baud, direct connect modem

IOM-5201A *Special sale price* $189.00

AUTO-CAT Auto answer/originate, direct connect

IOM-5230A *Special sale price* $239.95

Accessories for Apple

16K MEMORY UPGRADE

Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.

MEX-16100K *TRS-80 kit* $29.00
MEX-16101K *Apple kit* $29.00
MEX-16102K *Exidy kit* $29.00

16K RAM Card - Microsoft

(There is life after 48K)

MEX-16300A *A & T* $174.95

Z-80* CARD for APPLE

Two computers in one, Z-80 & 6502, more than doubles the power & potential of your Apple, includes Z-80 CPU card, CP/M 2.2, & BASIC-80*

CPX-30800A *A & T* $279.95

32K Atari 800 ....$799.95

APPLE CLOCK - Cal Comp Sys

Real time clock w/battery back-up

IOK-2030A *A & T* $109.95

APPLE STICK - Micromate

Joy stick with pots for Apple II

SYA-1510A *A & T* $49.95

VISICALC - Personal Sftwr

The ultimate program for your Apple II

SFA-24101005M *Complete package* $139.95

DOS 3.3 UPGRADE - Apple

Upgrade your old DOS to the improved 3.3

IOD-2233A *Complete kit* $64.95

DISK DRIVE for APPLE

5¼" disk drive with controller for your Apple

MSM-12310C *with controller* $475.00
MSM-123101 *w/out controller* $375.00

8" DRIVES for APPLE

Controller, DOS, two 8" double densisty drives, cabinet, power supply, & cables

Special Package Price *Kit* $1399.95

PRINTER INTERFACE - C.C.S.

Centronics type I/O card w/ firmware

IOI-2041A *A & T* $99.95

AIO, ASIO, APIO - S.S.M.

Parallel & serial interface for your Apple (see Byte pg 11)

IOI-2050K *Par & Ser kit* $139.95
IOI-2050A *Par & Ser A & T* $169.95
IOI-2052K *Serial kit* $89.95
IOI-2052A *Serial A & T* $99.95
IOI-2054K *Parallel kit* $69.95
IOI-2054A *Parallel A & T* $89.95

A488 - S.S.M.

IEEE 488 controller, uses simple basic commands, includes firmware and cable, 1 year guarantee. (see April Byte pg 11)

IOX-7488A *A & T* $399.95

Disk Drives

JADE's new dual disk sub-assemblies include: ***Handsome*** *metal cabinet with* ***proportionally balanced*** *air flow system,* ***assembled & tested*** *dual drive power supply,* ***quiet whisper type*** *cooling fan, power-cable kit, lighted power switch, approved fuse assembly, line cord,* ***Never-Mar*** *rubber feet, and all necessary hardware to mount 2-8" disk drives - it's* ***all American made, guaranteed for six months,*** *and it's in stock!*

Dual 8" Sub-Assembly Cabinet

END-000421 *Cabinet kit* $225.00
END-000420 *Bare cabinet* $59.95

Single sided, double density disk drive sub-system

END-000423 *Kit w/2 8" drives* $975.00
END-000424 *A & T w/2 8" drives* $1195.00

Double sided, double density disk drive sub-system

END-000426 *kit w/2 8" drives* $1495.00
END-000427 *A & T w/2 8" drives* $1695.00

8" DISK DRIVES

Highly reliable double density floppy disk drives

Shugart 801R single sided, double density

MSF-10801R *SA-801R* $425.00
Special Sale Price .... ***2 for $790.00***

Shugart 851R double sided, double density

MSF-10851R *SA-851R* $595.00
Special Sale Price .... ***2 for $1150.00***

Siemens FDD100-8D2 single sided, double density

MSF-201120 *6 mo warranty* $385.00
Special sale price .... ***2 for $750.00***

Qume Datatrak 8 double sided, double density

MSF-750080 *SA-851R compatible* .. $599.95
Special sale price .... ***2 for $1160.00***

JADE DISK PACKAGE

Double density controller, two 8" double density floppy disk drives, CP/M 2.2 (configured for controller), hardware and software manuals, boot PROM, cabinet, power supply, fan, & cables

Special Package Price *Kit* $1395.00

Diskettes

DISKETTES - Jade

Bargain prices on magnificent magnetic media

5¼" single sided, single density, box of 10

MMD-5110103 *Soft sector* $27.95
MMD-5111003 *10 sector* $27.95
MMD-5111603 *16 sector* $27.95

5¼" double sided, double density, box of 10

MMD-5220103 *Soft sector* $39.95

8" single sided, single density, box of 10

MMD-8110103 *Soft sector* $33.95

8" single sided, double density, box of 10

MMD-8120103 *Soft sector* $39.95

8" double sided, double density, box of 10

MMD-8220103 *Soft sector* $49.95

Video Monitors

13" COLOR MONITOR - Zenith

The hi res color you've been promising yourself

VDC-201301 .... $449.00

12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price

VDM-651200 *12" monitor* $259.95

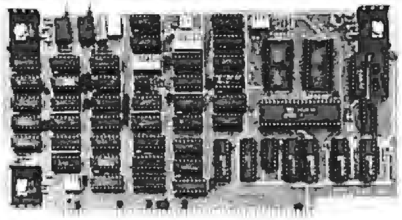
Leedex / Amdek

Reasonably priced video monitors

VDM-801210 *Video 100 12" B&W* .. $149.95
VDM-801230 *Video 100-80 12" B& W* $189.95
VDM-801250 *12" Green Phospor* $189.95
VDC-801310 *13" Color I* $399.95

Faster Service.

S-100 CPU



CB-2 Z-80 CPU - S.S.M.
2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K *Kit* $239.95
CPU-30300A *A & T* $299.95

THE BIG Z* - Jade
2 or 4 MHz switchable Z-80 CPU with serial I/O, accomodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600*

CPU-30201K *Kit* $145.00
CPU-30201A *A & T* $199.00
CPU-30200B *Bare board* $35.00

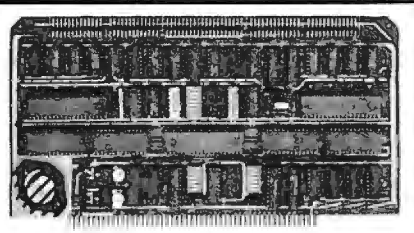
2810 Z-80* CPU - Cal Comp Sys
2/4 MHz Z-80A CPU with RS-232C serial I/O port and on-board MOSS 2.2 monitor PROM, front panel compatible.*

CPU-30400A *A & T* $269.95

SBC-200 - SD Systems
4 MHz Z-80 CPU with serial & parallel I/O ports, up to 8K of on-board PROM, software programmable baud rate generator, 1K of on-board RAM, Z-80 CTC.*

CPC-30200K *Kit* $339.95
CPC-30200A *Jade A & T* $399.95

S-100 I/O



S.P.I.C. - Jade
Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K *2 CTC's, 1 SIO, 1 PIO* .. $169.95
IOI-1045A *A & T* $244.95
IOI-1046K *4 CTC's, 2 SIO's, 1 PIO* $219.95
IOI-1046A *A & T* $319.95
IOI-1045B *Bare board w/ manual* .. $59.95
IOI-1045D *Manual only* $20.00

I/O-4 - S.S.M.
2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K *Kit* $179.95
IOI-1010A *A & T* $249.95
IOI-1010B *Bare board* $35.00

Motherboards

ISO-BUS - Jade
Silent, simple, and on sale - a better motherboard

6 Slot (5¼" x 8¾")

MBS-061B *Bare board* $19.95
MBS-061K *Kit* $39.95
MBS-061A *A & T* $49.95

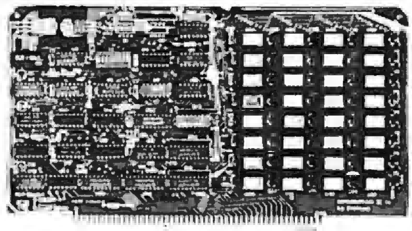
12 Slot (9¾" x 8¾")

MBS-121B *Bare board* $29.95
MBS-121K *Kit* $69.95
MBS-121A *A & T* $89.95

18 Slot (14½" x 8¾")

MBS-181B *Bare board* $49.95
MBS-181K *Kit* $99.95
MBS-181A *A & T* $139.95

S-100 Memory



EXPANDORAM II - S D Systems
4 MHz RAM board expandable from 16K to 64K

MEM-16630K *16K kit* $275.95
MEM-32631K *32K kit* $295.95
MEM-48632K *48K kit* $315.95
MEM-64633K *64K kit* $335.95
Assembled & tested .... add $50.00

64K RAM - Calif Computer Sys
4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A *A & T* $575.00

MEMORY BANK - Jade
4 MHz, IEEE S-100, bank selectable, 8 or 16 bit, expandable from 16K to 256K

MEM-99730B *Bare board* $55.00
MEM-99730K *Kit, no RAM* $219.95
MEM-16730K *16K kit* $249.95
MEM-32731K *32K kit* $289.95
MEM-48732K *48K kit* $324.95
MEM-64733K *64K kit* $359.95
Assembled & tested .... add $50.00

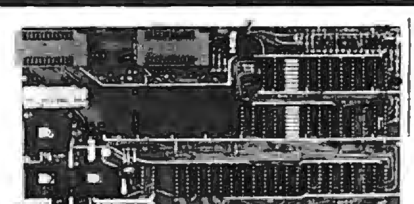
32K STATIC RAM - Jade
2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16151K *16K 4 MHz kit* $169.95
MEM-32151K *32K 4 MHz kit* $299.95
Assembled & tested .... add $50.00

16K STATIC RAM - Mem Merchant
4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

MEM-16171A *A & T* $174.95

S-100 PROM Boards



PB-1 - S.S.M.
2708, 2716 EPROM board with built-in programmer

MEM-99510K *Kit* $154.95
MEM-99510A *A & T* $219.95

PROM-100 - SD Systems
2708, 2716, 2732, 2758, & 2516 EPROM programmer

MEM-99520K *Kit* $219.95
MEM-99520A *Jade A & T* $269.95

EPROM BOARD - Jade
16K or 32K uses 2708's or 2716's, 1K boundary

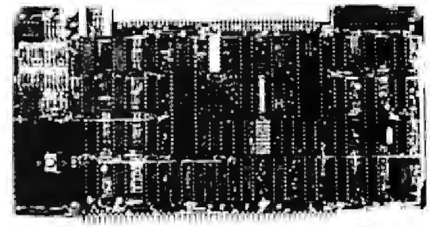
MEM-16230K *Kit* $79.95
MEM-16230A *A & T* $119.95

Mainframes

MAINFRAME - Cal Comp Sys
12 slot S-100 mainframe with 20 amp power supply

ENC-112105 *Kit* $379.95
ENC-112106 *A & T* $409.95

S-100 Disk Controller



DOUBLE-D - Jade
Double density controller with the inside track, on-board Z-80A, printer port, IEEE S-100, can function on an interrupt driven buss*

IOD-1200K *Kit* $299.95
IOD-1200A *8" A & T* $389.95
IOD-1205A *5¼" A & T* $389.95
IOD-1200B *Bare board* $65.00

DOUBLE DENSITY - Cal Comp Sys
5¼" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2 and manual set.*

IOD-1300A *A & T* $369.95

VERSAFLOPPY II - SD Systems
New double density controller for both 8" & 5¼"

IOD-1160K *Kit* $339.95
IOD-1160A *A & T* $379.95

S-100 Video

VB-3 - S.S.M.
80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K *4 MHz kit* $349.95
IOV-1095A *4 MHz A & T* $439.95
IOV-1096K *80 x 48 upgrade* $39.95

VDB-8024 - SD Systems
80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A.*

IOV-1020K *Kit* $399.95
IOV-1020A *Jade A & T* $459.95

VIDEO BOARD - Jade
64 characters x 16 lines, 7 x 9 dot matrix, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1050K *Kit* $99.95
IOV-1050A *A & T* $125.00
IOV-1050B *Bare board* $29.95

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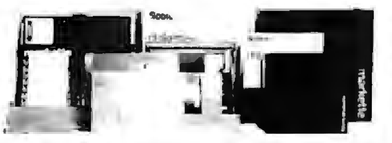

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FREE PLASTIC LIBRARY CASE INCLUDED WITH THE PURCHASE OF EVERY BOX OF DISKETTES

a plastic library case is included with every box of diskettes.
Please specify computer or required sectors.

$24.95 BOX

Ten boxes $22.75 One hundred boxes $21.50

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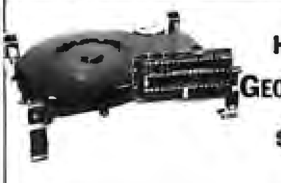
3401	$27.00	$25.00	Scotch 744(0)(10)(16)	$31.00	$29.00
	29.00	27.00	Dysan	45.00	43.00

	Scotch	box	10 bx.	Dysan	box	10 bx.	MRX	box	10 bx.
	740-0	$35.	$33.	3740/1	$49.	$47.	3060	$ 5.	$ 3.
	741-0	45.	43.	3740/1d	75.	73.	3090	37.	35.
	740-32	36.	33.	na.			na.		
	743-0	65.	53.	na.			3115	49.	

brand head cleaning kit. $24.95 MMA-CK(5)(8) please specify 5 1/4 8"
available on request for: tape, cartridges, diskpacks, volume diskettes.

26 Megabyte Hard Disk Drive



from GEORGE MORROW'S Thinker Toys

$3950

Other Morrow Products.			
Additional hard disk	$3650	Disc Jockey 2D controller	$341
Discus 2D 1 drive	950	Disk Jockey 1 Controller	193
Discus 2D 2 drives	1627	M26 hard disk Controller	625
Discus 2-2 1 drive	1250	Switchboard interface	219
Discus 2-2 2 drives	2237	New Multiboard	275
		M-10 Ten Megabyte hard	2150

SPECIAL $295

SHUGART SA800/1

Your Choice 115V. 60Hz or 230V. 50Hz.

These Shugart eight inch disk drives were originally purchased by major computer manufacturers. Upon failing incoming inspection the drives were sent back to Shugart for realigment.

California Digital has negotiated an extremely attractive agreement to purchase the entire inventory of the SA800's We are offering the drives on a first come basis at only $295. (Subject to remaining inventory on hand.) Installation manual $10 additional. Warranty 30 days from date of receipt. NOTE: The SA800/1 is standard mount and not the "R" suffix rack mount-unit.

SPC-800/115 or SPC-800/230 16 Lbs.

HEWLETT PACKARD

$2650

HP 85

The Hewlett Packard HP-85 is a complete, low cost portable computer system. This self contained package include CPU, keyboard, printer, CRT display and cassette tape drive. SYS-10085 30 lbs.

Shugart Associates

$395

801/ R Disk Drive 15 lbs.

Shugart 801/R with CP 206 power supply, muffin exhaust fan, complete in dual enclosure with all the necessary harnessing cables. Documentation included. 36 pounds. MSD-1801 **$795**

Same as above but with two Shugart 801R disk drives. 50 pounds. MSD-2001 **$1195**

Disk drive cable. 6 feet 50 conductor with edge card connector at both ends. WCA-6305 $25.00

Export Disk drives. 220V. 50MHz add $30.00 per disk drive.

MEMORY

TRS-80 APPLE II $25

16k memory (8) 4116's

Factory prime. Unconditionally guarenteed for one full year. Add $3.00 for TRS-80 jumpers and instructions.

BSR SYSTEM X-10

The new BSR timer runs your home just like clockwork. Turns on lamps and appliances while your away from home. Completely compatible with your existing System X-10 devices.

BSR Timer eight channel	$65.00	Appliance Module 500 W.	$13.95
Master control console	34.95	Lamp Module 300 Watts	13.95
Ultrasonic Controller	19.95	NEW full control wall switch	14.50

DYNAMIC

		ea.	32+	100+	1K+
4116-	200ns	3.25	3.00	2.75	2.50
4116	150ns	3.75	3.50	3.25	3.00
4164 64K		49.50	45.00		

STATIC

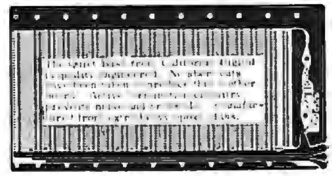
21L02	450ns.	1.19	1.05	.99	
21L02	250ns	1.49	1.45	1.39	
2114L4	450ns	3.95	2.95	2.75	2.50
2114L3	300ns	4.25	3.75	3.00	2.75
4044-4	450ns	4.95	4.50	4.25	4.00
4044-2	250ns	5.50	4.95	4.50	4.35
5257-3	300ns	4.47	4.25	4.05	3.75

EPROM

2708	450ns	4.95	4.50	3.75	3.25
2716 5V.		7.95	6.50	5.00	4.50
2716 tri-volt		9.95	9.00	8.25	7.50
2732 Intel		19.00	17.50	16.00	
2532 TI		21.50	19.00		
2764		*			

S-100 Mother Board $35

Quiet Buss



8803-18
18 slot
IMSAI

NEW from Shugart Technology

5 Megabyte Hard Disk Drive

Packaged in the same physical size as the industry standard 5 1/4" minifloppy disk drive. The micro-Winchester stores thirty times as much data (6.38 megabytes unformatted), accesses data twice as fast (170 milliseconds) and transfers data twenty times faster (5.0 megabits per second.)

The ST506 is factory sealed to protect the media from environmental contaminates. Requires only DC voltage.

Dual California Digital 5 1/4" enclosure. ST506 drive and power supply. **$1500**

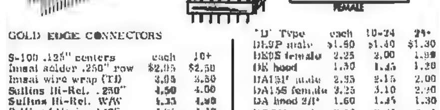
Shugart Associates SA400 removable media disk drive for above package. add: S-100 & Apple controller scheduled for spring release. **$300**

SWITCHES

DIP SWITCHES pos.	ea.	100+	1K+
4	.88	.79	.65
7	.99	.83	.79
8	1.05	.94	.87
12	1.19	.99	.93

TOGGLE		ea.	100+
7101	on/on	1.19	.98
7103	on/off/on	1.49	1.19
7107		1.49	1.19
7108		1.29	1.19
7205		1.85	1.6

CONNECTORS



GOLD EDGE CONNECTORS

S-100 .125" centers	each	10+
Imsai solder .250" row	$2.85	$2.50
Imsai wire wrap (TI)	3.85	3.50
Sullins Hi-Rel. .250"	4.50	4.00
Sullins Hi-Rel. W/W	4.35	4.00
Sullins / Altair .140"	1.95	1.30
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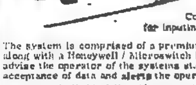
22/44 Kim Eyelet	2.50	2.15
36/72 Digital Group S/T	5.05	5.50
36/72 Digital Group W/W	6.60	6.15
43/86 Motorola 6800 S/T	6.60	6.15
43/86 Moto. 6800 W/W	7.00	6.65

INTEGRATED CIRCUIT SOCKETS

	Low Profile each	Low Profile 100+	Wire Wrap each	Wire Wrap 100+
8 pin	$.10	$.09	$.46	$.11
14 pin	.10	.09	.45	.41
16 pin	.12	.11	.50	.45
18 pin	.15	.13	.68	.61
24 pin	.24	.24	.94	.87
40 pin	.42	.40	1.50	1.47

"D" Type	each	10-24	25+
DE9P male	$1.50	$1.40	$1.30
DE9S female	2.25	2.00	1.89
DE hood	1.30	1.45	1.20
DA15P male	2.35	2.15	2.00
DA15S female	3.25	3.10	2.90
DA hood 2/P	1.60	1.45	1.30
DB25P male	2.50	2.35	2.25
DB25S female	3.35	3.15	3.05
DB hood 2/P	1.35	1.15	1.05
DC37P male	4.30	4.00	3.70
DC37S female	6.00	5.75	5.50
DC hood 2/P	2.25	2.00	1.75
DD50P male	5.50	5.10	4.75
DD50S female	9.50	8.50	8.00
DD50 hood 2/P	2.60	2.40	2.10
CENTRONICS			
57-30360	7.95	6.75	5.75
RIBBON CABLE CONNECTORS			
17/34 5" disk	4.85	4.15	3.95
20/40 TRS-80	5.65	5.03	4.70
25/50 8" disk	5.90	5.15	4.90



DATA INPUT TERMINAL

This Keystation terminal was recently acquired from the CMC division of the Pertec Corporation. The unit was originally designed for inputing data directly onto magnetic tape.

The system is comprised of a premium cast aluminum and fiberglass enclosure, along with a Honeywell / Microswitch hall effect keyboard. Thirty display lamps advise the operator of the systems status. Four inch loud speaker acknowledges acceptance of data and alerts the operator of pending problems.

But most of all this "USED" terminal, with a little imagination, can be engineered to make the perfect home for an S-100 computer and video display: or with slight modification will accept the Rockwell AIM-65 micro/computer.

Five volt regulated power supply is available for an additional $20. (see June Byte) All units are in excellent condition. Original acquisition over $700. 22 lbs.

direct connect MODEM

Your Choice $169

Direct connect modems eliminate lose of information due to the carbon compression associated with acoustic modems. Choose either of these two great units.

The Universal Data Systems 103LP is switch selectable between answer and originate modes. Fully Bell 103 compatable. Directly connects to the new modular telephone jack. 100% powered from the telephone line. No need to locate modem in proximity to A.C. power receptical. MOD-103LP 2 pounds.

"D" Cat connects to most of the new "Bell" modular handsets. Ideal line office telephones. Requires external A.C. power. MOD-DCAT

UDS 103J/LP AUTO ANSWER $219

Regulated Power Supply 5 VOLT 5 AMP

$11.95

This USED surplus power supply was removed from working equipment. Pass transistor regulation outputs five volts at a conservative five amps. Suitable for TTL linear applications. SPC-PS1 8 pounds.

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All merchandise sold by California Digital is premium grade.
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Circle 51 on inquiry card.

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MEMOREX 8"DISKETTES

$25 WITH FREE LIBRARY CASE

Recently the Memorex Corporation had a cancellation on a contract for a truck load of eight inch diskettes. California Digital was fortunate to be offered this load of prime magnetic media.

These diskettes are "UNBRANDED" but are guaranteed first quality Memorex Brand. (3060 single den.)

Like all diskettes sold by California Digital, a library case is supplied free with the purchase of every box.

This offer is subject to remaining inventory on hand.

SUPER BUY

World's Best Selling Printer

EPSON MX80

Immediate Delivery

Only $475

Correspondence quality printing.

A lot of printers costing a lot more can't touch the MX-80's performance. It gives you a choice of 40, 80, 66 or 132 columns of printing in as many as four distinct printing density modes, a total of twelve different combinations which can accommodate nearly any printing requirement.

Bidirectional printing. Logical seeking of shortest lines. 80 CPS. 64 graphics characters. Forms handling. The list of standard features goes on and on. The fact is that there are few printers that can compete with the MX-80 at ANY price. And none—ZERO—in its extraordinarily affordable price range.

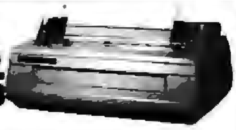
ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJ

NEW from INTEGRAL DATA 460 Paper Tiger with GRAPHICS $1150

The 460 Paper Tiger uses a dot matrix character formation technique in which dots are overlapped both horizontally and vertically to achieve a correspondence quality printing. The printer's nine-wire print head uses staggered needle rows to create the vertically overlapping dots. The head is driven bi-directionally under microprocessor control by a stepper motor driven mechanism. The 2K buffer allows the printer to accept the entire content of a 1,920 character CRT screen. With graphics suggested retail price $1,395 27 lbs. PRO-460G.

NEC Spinwriter 5510P/S $2795

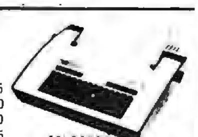
The word processing quality Spinwriter prints at speeds upto 55 characters per second. The Model 5510 P/S is supplied with both parallel and RS-232 serial interfacing. Also included is the tractor feed mechanism, along with print thimble and ribbon. PRN-5510PS 70 lbs. Keyboard (KSR) Model 5520 P/S available $2995. PRN-5520 PS 75 lbs.



TEC V-300 Word Processing Daisy Wheel Printer $1595

Finally a reasonably priced letter quality printer... Bi-directional printing at 25 characters per second. Full 136 print positions wide. Proportional spacing 1/120 horizontal, 1/48" vertical. Uses standard Diablo brand interchangable daisy print wheels. Intel 8085 CPU microprocessor controlled. Interfaces via Centronics parallel connector. Shipping 58 lbs. PRV-300.

TELETYPE MODEL 43



4320 KEYBOARD MODELS

TTL serial output	AAA	$ 995
RS232 serial	AAK	1050
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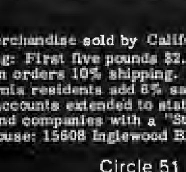
VIDEO MONITORS



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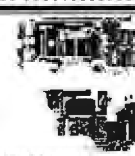

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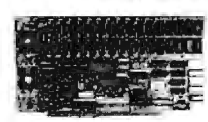

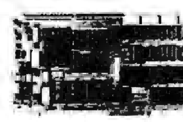

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The DIGITALKER is a speech synthesis system consisting of multiple N-channel MOS integrated circuits. It contains a speech processor chip (SPC) and speech ROM and when used with external filter, amplifier, and speaker, produces a system which generates high quality speech including the natural inflection and emphasis of the original speech. Male, female, and children's voices can be synthesized.

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- Designed to be easily interfaced to most popular microprocessors
- 256 possible addressable expressions
- Male, female, and children's voices
- Natural inflection and emphasis of original speech
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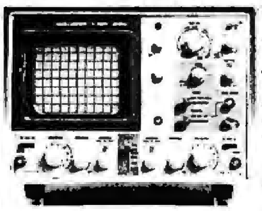

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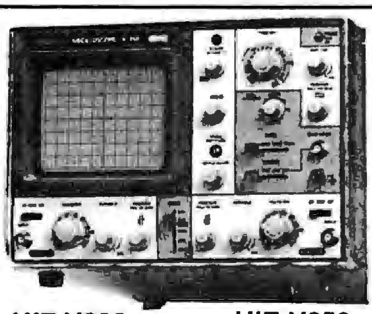

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Among its features, the MX-80 prints 96 ASCII, 64 graphics and 8 international character in tack-sharp 9x9 matrix. It prints bidirectionally at 80 CPS with a logical seeking function to maximize all of these capabilities. And it has the world's first disposable print head, with a life expectancy of over 50 million characters. When it wears out, just snap it out and throw it away! A newone costs less than $30., and you can install it yourself...with one hand.

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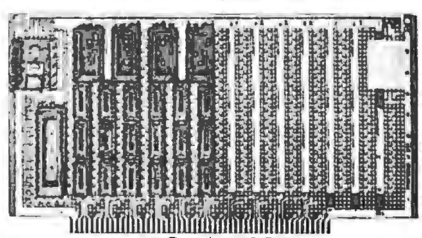

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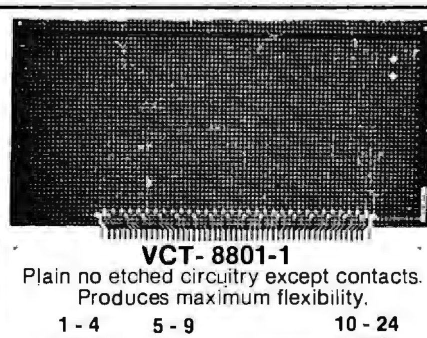

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From the power supply through the sturdy chassis, TEI constructs and assembles each mainframe with great care. Every TEI mainframe utilizes a constant voltage transformer (CVT) which delivers clean, regulated power at the proper level, reducing the heat in the computer cards. The output voltage on the transformer remains nearly even with the input voltage varying from approximately 85V to 140V. This means the mainframe will never notice voltage variations or even a brownout. It also provides 100 dB noise rejection to protect the computer from voltage spikes and line noise.

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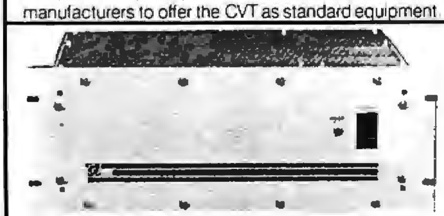

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Shipping Weight: On 12 Slot Mainframes 35 Lbs
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12 slot; +8V @ 17A, ±16V @ 2A; 35 lbs.
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RAM 17, 10 MHZ, 2 Watt, DMA Compatable

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I/O Mapped, controls 8" or 5¼", single or double density

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DISK JOCKEY 2D - MORROW
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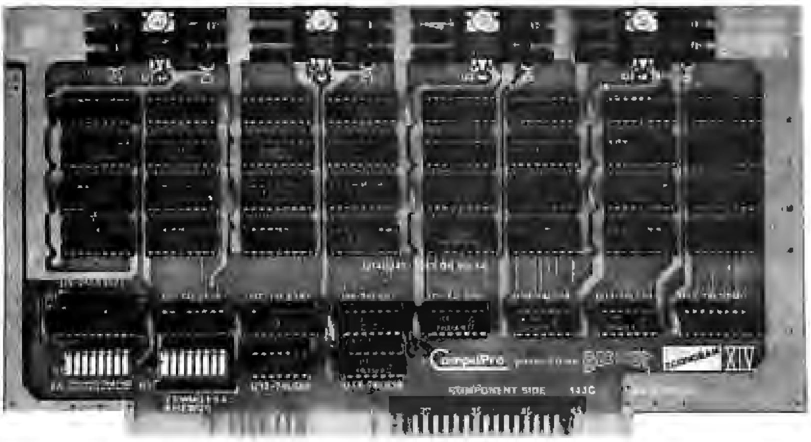

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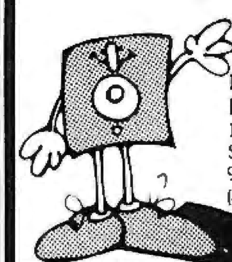

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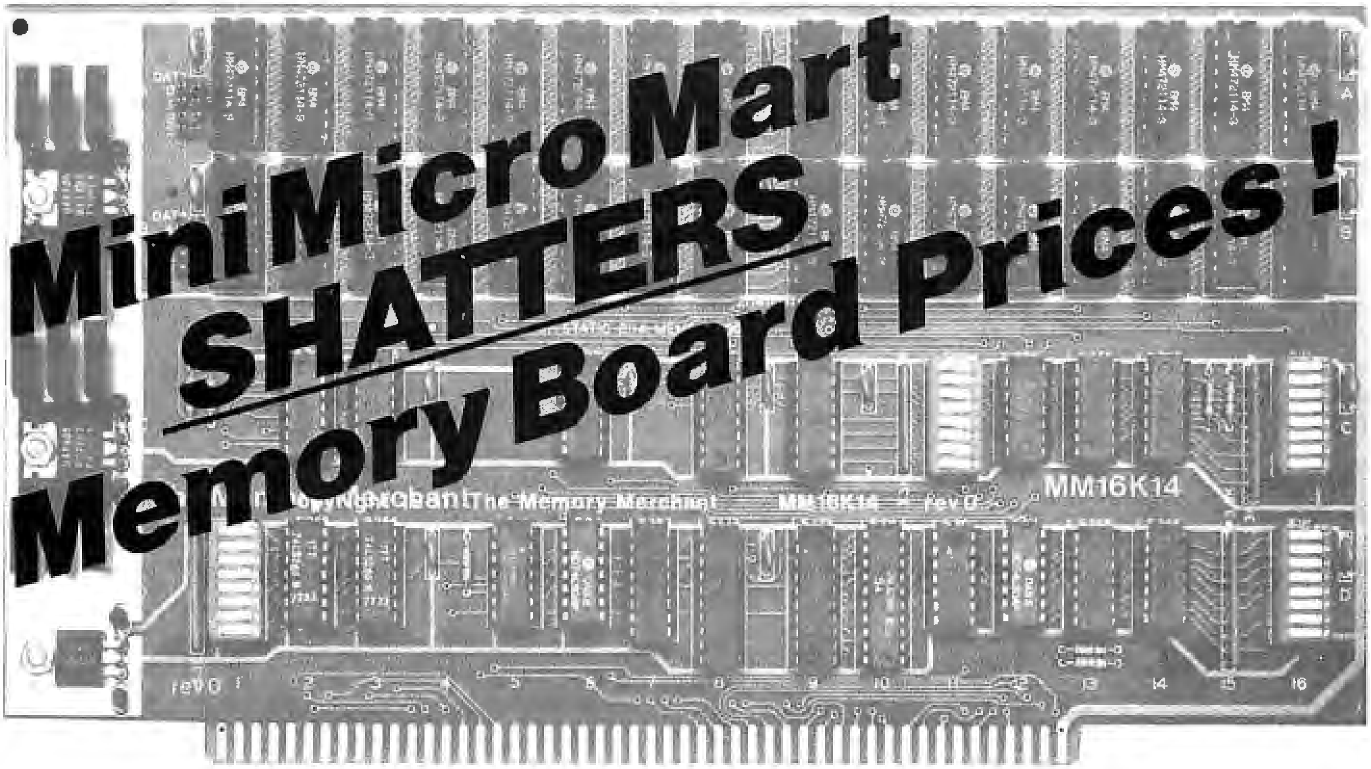

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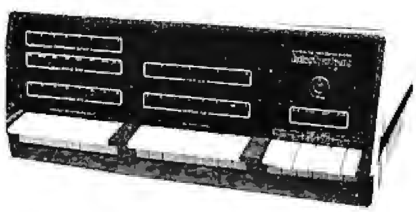

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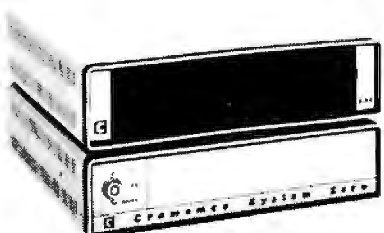

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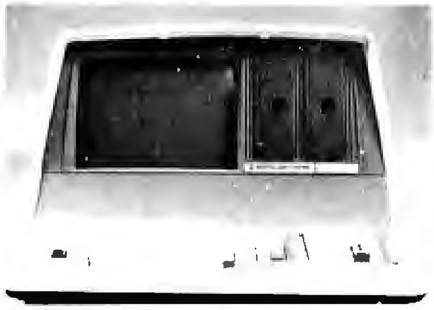

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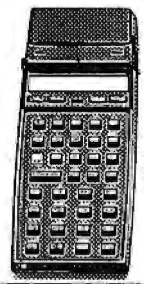

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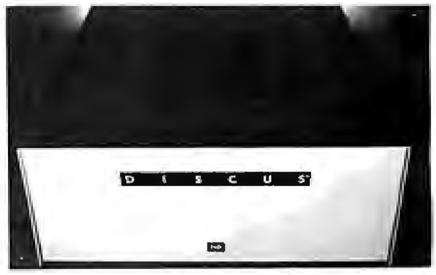

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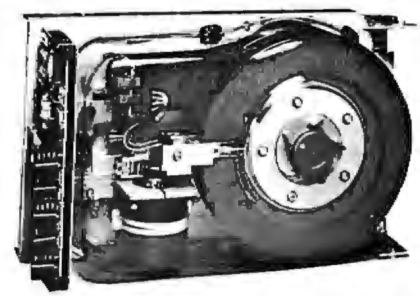

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FOR SALE: North Star 64Q computer. New in box, never used. Cost $4300, want $3500. Also, Anabex 9500. Cost $1600, want $1200. You pay shipping. Jeff Lee, Rte 1, Box 640, American Cyn Rd, Vallejo CA 94590, (707) 642-5310.

FOR SALE: Two Intel memory boards with a total of 64 K bytes of programmable memory. Containing 250 ns 2107Cs and some interface circuitry. Each board can be used as 9 bits by 32 K or 18 bits by 16 K. Excellent for making 8- or 16-bit memory. $250 gets both boards and their documentation. Willard Korfhage, POB 5408, Richardson TX 75080.

FOR SALE: BYTE, March 1977 to February 1980, Kilobaud Microcomputing, January 1978 to February 1981, and Interface Age, November 1977 to August 1980. Excellent condition. R Kolla, 4443 Fuller St, Santa Clara CA 95050, (408) 496-6798.

FOR SALE: Tektronix Model 611 storage-display system. Brand-new tube, system completely up to factory specifications. $1500. J McCord, 330 Vereda Leyenda, Goleta CA 93117, (805) 963-6589.

FOR SALE: Facit 4070 paper-tape punch: parallel TTL interface, 75 cps, roll, and manuals. In excellent shape; $325. Digitronix 2540EP 400 cps paper-tape reader: 19-inch rack and manuals. In good shape; $225. Remex 651 paper-tape reader: 19-inch rack; $200. S81 music board by SSM with manuals and CP/M format music floppy disk; $175. SwTPC CT1024 terminal, RS-232C, video output, 32 characters by 16 lines, with manuals; $100. Larry Snyder, S78 W17675 Canfield Dr, Muskego WI 53150, (414) 679-9706.

FOR SALE: The first year of BYTE in very good condition. Arthur Mechler, 2724 Wagner St, Cincinnati OH 45225.

WANTED: Schematics and any other technical information on a Raytheon video terminal, type DIDS-400, Model #401-2AM70. Will pay reasonable reproduction costs or will return originals after reproduction. Anthony Ploski, 40 Brookside Ter, Clark NJ 07066.

FOR SALE: Digital Group Bytemaster computer, video display, and keyboard. 64 K, 4-channel serial communications, and double-density disk controller card. Excellent condition, full documentation, in original shipping cartons. $1500 firm. Brian Goodheim, 100 S Spring St, Aspen CO 81611, (303) 925-1558.

FOR SALE: Radio-teletypewriter interface for TRS-80 Model I. Macrotronics M80 with M800 and FSD-1 demodulator for baudot and ASCII. All factory built, one chassis with power supply, tuning meter, and audio frequency-shift-keying generator. $250. Mel Olinsky, 35 Lance Dr, Somers CT 06071, (203) 763-0581.

FOR SALE: TRS-80 Model I, Level 2, 16 K. Realistic cassette recorder CTR-80. Expansion interface with RS-232C board. Novation CAT modem, documentation, programs, manuals, etc. Will sell for $1000 or best offer. Lee Costache, 25-98 36th St, Long Island City NY 11103, (212) 545-9088.

FOR SALE: OSI Challenger IIP system with 5-inch floppy-disk drive, OS-65D operating system, 32 K programmable memory, 32 by 64 video and graphics, joysticks, sound output, printer output, books, manuals, and software. $1275. Al Casper, 3632 CTH I, Saukville WI 53080, (414) 272-0920 days, 675-6946 evenings.

FOR SALE: DG systems, both 100% functional, in dress cabinets with documentation and software. Z80, 26 K static, single 8-inch floppy, full keyboard, and monitor; $1700. Z80, 64 K static, dual 8-inch floppies, printer B, full keyboard, and monitor; $2600. Dual 8-inch floppies in dress cabinet; $800. Willing to deal. Hary Johnson, 6915 Maple Fox Ln, Houston TX 77338.

FOR SALE: MicroChess 2.0. For old-ROM PETs, incompatible with my present system. Has eight levels of play, clock, and algebraic notation on squares for move entry. Fits in 8 K of memory. Write or phone me with your offer. David Magill, 2001 Carling Ave, Apt #1709, Ottawa Ontario, K2A 3W5 Canada, (613) 722-3566.

BOMB

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April BOMB Is Logical Choice

Once again, Steve Ciarcia won first place, this time for "Build a Low-Cost Logic Analyzer," (page 36). Steve will receive $100 for his article describing champagne troubleshooting for beer budgets. Harold Corbin took second place with his article, "An Introduction to Data Compression," (page 218) which described how to get more bang for the byte. Harold receives $50. "The MicroAce Computer," by Delmar Searls (page 46) came in third, and described the trials and tribulations of building and using this low-priced Z80-based computer kit.

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BYTE'S BOMB is your direct line to the editor's desk. Each month, the two top-rated authors receive bonuses based on your votes. To cast your vote, first look at the list of this month's articles and corresponding article numbers (located in the unclassified ads section on the page preceding the Reader Service list), then rate each article as **Excellent, Good, Fair,** or **Poor** by circling the appropriate number in each column below. Your feedback helps to produce the best possible magazine each month.

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2	22	42	62	82	102	122	142	162	182	202	222	242	262	282	302	322	342	362	382	402	422	442	462	482	502	522	542	562	582	602	622	642	662	682
3	23	43	63	83	103	123	143	163	183	203	223	243	263	283	303	323	343	363	383	403	423	443	463	483	503	523	543	563	583	603	623	643	663	683
4	24	44	64	84	104	124	144	164	184	204	224	244	264	284	304	324	344	364	384	404	424	444	464	484	504	524	544	564	584	604	624	644	664	684
5	25	45	65	85	105	125	145	165	185	205	225	245	265	285	305	325	345	365	385	405	425	445	465	485	505	525	545	565	585	605	625	645	665	685
6	26	46	66	86	106	126	146	166	186	206	226	246	266	286	306	326	346	366	386	406	426	446	466	486	506	526	546	566	586	606	626	646	666	686
7	27	47	67	87	107	127	147	167	187	207	227	247	267	287	307	327	347	367	387	407	427	447	467	487	507	527	547	567	587	607	627	647	667	687
8	28	48	68	88	108	128	148	168	188	208	228	248	268	288	308	328	348	368	388	408	428	448	468	488	508	528	548	568	588	608	628	648	668	688
9	29	49	69	89	109	129	149	169	189	209	229	249	269	289	309	329	349	369	389	409	429	449	469	489	509	529	549	569	589	609	629	649	669	689
10	30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330	350	370	390	410	430	450	470	490	510	530	550	570	590	610	630	650	670	690
11	31	51	71	91	111	131	151	171	191	211	231	251	271	291	311	331	351	371	391	411	431	451	471	491	511	531	551	571	591	611	631	651	671	691
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13	33	53	73	93	113	133	153	173	193	213	233	253	273	293	313	333	353	373	393	413	433	453	473	493	513	533	553	573	593	613	633	653	673	693
14	34	54	74	94	114	134	154	174	194	214	234	254	274	294	314	334	354	374	394	414	434	454	474	494	514	534	554	574	594	614	634	654	674	694
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16	36	56	76	96	116	136	156	176	196	216	236	256	276	296	316	336	356	376	396	416	436	456	476	496	516	536	556	576	596	616	636	656	676	696
17	37	57	77	97	117	137	157	177	197	217	237	257	277	297	317	337	357	377	397	417	437	457	477	497	517	537	557	577	597	617	637	657	677	697
18	38	58	78	98	118	138	158	178	198	218	238	258	278	298	318	338	358	378	398	418	438	458	478	498	518	538	558	578	598	618	638	658	678	698
19	39	59	79	99	119	139	159	179	199	219	239	259	279	299	319	339	359	379	399	419	439	459	479	499	519	539	559	579	599	619	639	659	679	699
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