

WORLD'S LARGEST COMPUTER MAGAZINE

Computers & ELECTRONICS

AUGUST 1984

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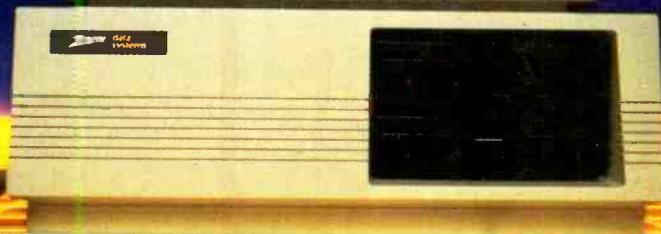
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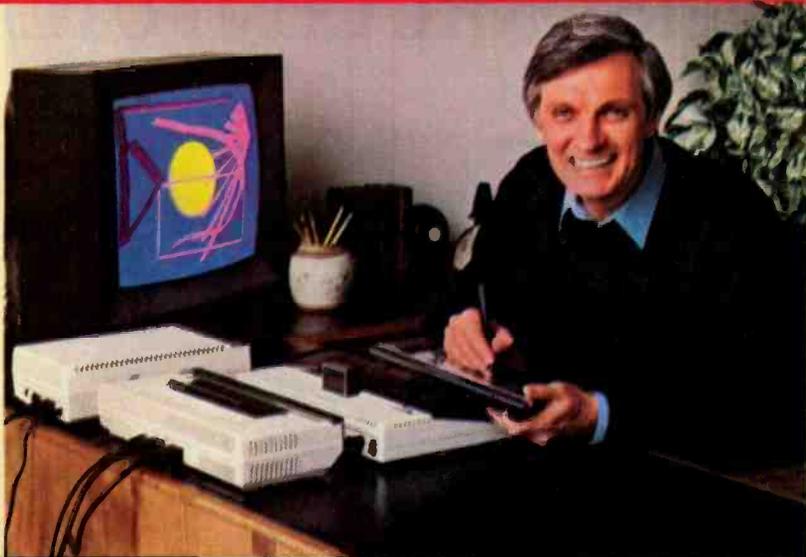


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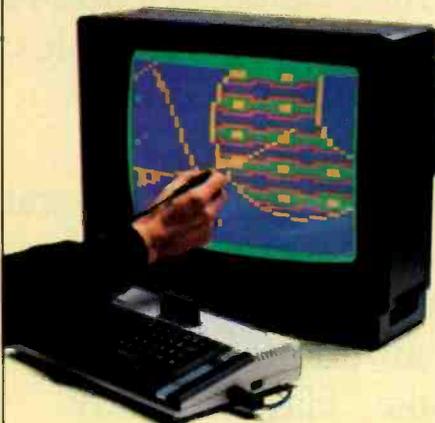
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Computers & ELECTRONICS

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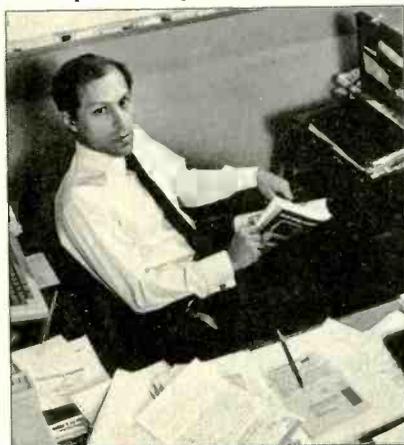
Personal Computer Software

SETH R. ALPERT EDITORIAL

SOFTWARE'S NEW WAVE

Are you ready for a significant change in the personal productivity software market? You better be, because several new products that have begun shipping ought to stand the market on its ear, with the end user being the ultimate beneficiary.

These new products represent a major advance because they integrate more functions, each done better, than the last generation of productivity tools. Three that I have seen demonstrated are Framework from Ashton-Tate (which we review in this issue), Symphony from Lotus Development Corporation, and Decision



Manager from Peachtree Software. Each incorporates its own window environment and word processing, spreadsheet, graphics, and data management capabilities. Other frills provided in different combinations include terminal emulation, micro-mainframe links, hooks into the operating system (MS-DOS in each case), and an underlying programming language.

All three products look very good indeed. Not just taken as a whole—the individual capabilities stand up very well on their own. While they are not up to the level of top-notch stand-alone systems, they seem to have the right mixture of ease of use and features for the typical business user.

Pricing is very aggressive—\$695 each for Symphony and Framework, and \$625 for Decision Manager. In fact, owners of 1-2-3 will be able to upgrade to

Symphony for only \$200! At prices like these, think of the pressure that will fall on those who market single capability products. Who is going to spend \$300 on a dedicated word processor? Only those who need very specialized, perhaps even esoteric, features. Makers of stand-alone products had better add very powerful capabilities or lower their prices or both. Either way, the consumer wins.

I think these new products are becoming available just when the buying public is most ready for them. Spreadsheets, for example, are pretty commonplace in business. They have made their mark and, in my view, a more sophisticated market is coming to recognize their limitations and will soon expect much more from software. By integrating spreadsheets with data management and word processing as well as graphics, vendors are providing far more complete and convenient packages for the end user.

Another effect of the new software is that its makers have dramatically raised the stakes for new entrants to the productivity software field. It is not just that they are willing and able to spend a fortune on advertising and promotion. On top of that, there is the enormous investment in man years by top software talent. Anything less than first rate development talent and marketing savvy won't cut it anymore.

Indeed, the windowing products that were so widely heralded last year could be among the casualties of the new generation of products. Such software provides an environment for integration rather than an integrated environment. For vendors of such products the economics have changed. They will have to convince you to buy a windowing environment for \$100 and a spreadsheet, data manager, graphics package, and word processor for \$300 to \$500 each, while the competition offers its new integrated package for \$700. The single packages will almost inevitably offer better integration and command consistency.

I can't wait to use these new packages. They look very capable and yet straightforward. And they will change the world we compute in. ◇

PHOTO BY STEVE BORNS

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Editorial and Executive Offices
One Park Avenue, New York, N.Y. 10016.
212-503-3500

Advertising Sales Offices

New York

Ken Lipka 212-503-5029

Midwestern

Robert Vanek, Suite 1400, 180 N. Michigan Ave., Chicago, IL 60601. 312-346-2600

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Janet Bish, 11 Davis Dr., Belmont, CA 94002. 415-594-2290

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LETTERS

The Digital Revolution in Recording

Thanks for the article "Microcomputers in the Recording Studio," by Martin Porter, in your March issue. I'd like to see Porter, who seems to have done a marvelous job of researching the article, do a companion piece solely on the production-end benefits of computer-aided recording. The March article touched on several examples of technology applied to production (under the subhead "A Musical Standard") but mostly covered how computers are aiding engineers to achieve analog results more easily.

The "digital revolution" in recording that Porter spoke of unfortunately does not exist on a production level. The consumer/listener cannot hear those admittedly fantastic benefits of computers aiding engineers. What we need to hear is computers helping producers (those not stuck in the analog world) to whip up aural delights that cannot even be simulated with analog methods. The use of microcomputers to help make music, not just record it, is far more important than using them "behind the boards."

—ALFRED ANESPY
Houston, TX

Plus for Sanyo

I haven't written a letter to a magazine editor in some time, but I do want to thank you for the Sanyo review in your May issue. In early February, after months of study, I decided Sanyo was the machine for me. It appeared to offer almost everything (actually more, in some areas) than "Big Blue" did—at an enormous price advantage. Since then, I have seen very, very little about the machine in the computer magazines. I was starting to believe I had really purchased a "pig in a poke." You changed all that.

Actually, I have been delighted with it. It has performed flawlessly. I run WordStar and CalcStar mostly in my business. Almost all BASIC programs either run directly or with minor (and in most cases, simple) modification. I have done some really nice 3D graphics, though these programs require rather lengthy execution times. I agree wholeheartedly with your conclusions concerning the poor Operations/Sanyo Graphics BASIC Manual. I discovered several nice little commands the machine is capable of performing, which are not even mentioned other than being listed in the reserved words list, in the manual. Why Sanyo would do this is in-

comprehensible. Also, you did not mention that the GET and PUT commands are not usable until one has expanded the memory to the 256K level.

My only real complaint at this point—which, as far as I know, has no solution—is that I would very much like to have a top-quality set of detailed schematics for the machine.

Thank you again for an objective and well-done review.

—ERNEST BRADFORD
Lake Charles, LA

Mystery at the Keys

I am writing in response to Les Solomon's column "On Computer Hardware" in the June issue. He presented us with a "mystery" of typing speed: that no one knows why anyone can type faster than 48 words/minute. Solomon's evidence for this mystery is that the delay time between stimulus and response is approximately 250 milliseconds. Surely, if you built an electronic delay line of 250 ms, you would not be limited to only sending signals less than 4 Hz through it. You would be limited by the delay line only if you waited for the output before entering the next signal (text, musical note, etc.). Touch typists (as well as musicians) compensate for this delay time by "reading ahead": Their eyes are reading 250 ms or more ahead of their fingers.

I hope that Solomon was being facetious in presenting this as a mystery; if he wasn't, then I wonder how he decided that no one knows the solution. Has he also considered the mystery of how a pianist can have the pages of his music turned without causing a gap in his performance? I suspect, though, that Solomon does realize all this and was just trying to provoke hotheads like me into writing letters.

—STEVEN MARSHALL
Westboro, MA

Just Ask Your Chameleon Dealer

Your Chameleon Plus review in the June issue suffered from two significant flaws which should be pointed out.

First, the lack of documentation which was mentioned repeatedly has long since been corrected.

Second, and more significant, the Chameleon and Chameleon Plus are *not* sold by mail order. Thus, before a sale is made, all of the questions Rubenstein (the author) had about Programmable Logic Array configuration, etc., would

be answered by the dealer or the sale would be lost. (And please note that his "problem" with SuperCalc3 was pure "pilot error.")

Yes, I am a Chameleon dealer, and many customers have given me permission to refer others to them as delighted Chameleon owners.

—RICHARD K. THOMPSON
Burbank, CA

A Star of Word Processing

It's funny how people become loyal to software. While my rational side realizes that software is constantly evolving and improving, I feel the need to come to the defense of Wordstar when someone claims to have found a better program. With that in mind, here are some corrections to Michael McCarthy's review of NewWord in your June issue.

He states that, after doing a save-and-resume on WordStar, users have to search back through the text to pick up where they left off. Not true! CONTROL-QP takes them back to where they were.

McCarthy also said WordStar's find-and-replace is slow. Try striking CONTROL-S after the process had begun. WordStar will replace all occurrences of the word almost instantaneously.

Something to consider when choosing a word processing program is the availability of support programs. I use five programs (spelling checker, footnotes, index, grammar and math) designed to work with WordStar. A buyer of a lesser-known program may be frustrated in attempts to locate these types of support software.

—AARON P. MORRIS
Tucson, AZ

Who Wrote NewWord?

Thank you for your recent review of NewWord (June 1984), our WordStar work-alike. The high marks your reviewer gave NewWord are the result of the hard work and dedication of Newstar's Peter Mierau and John Morris for the past several months. Their work speaks for itself.

We were surprised, however, that our company was not mentioned in the review. Newstar Software is the developer and publisher of NewWord; Rocky Mountain is a distributor of ours.

—RICHARD E. POST, Vice President
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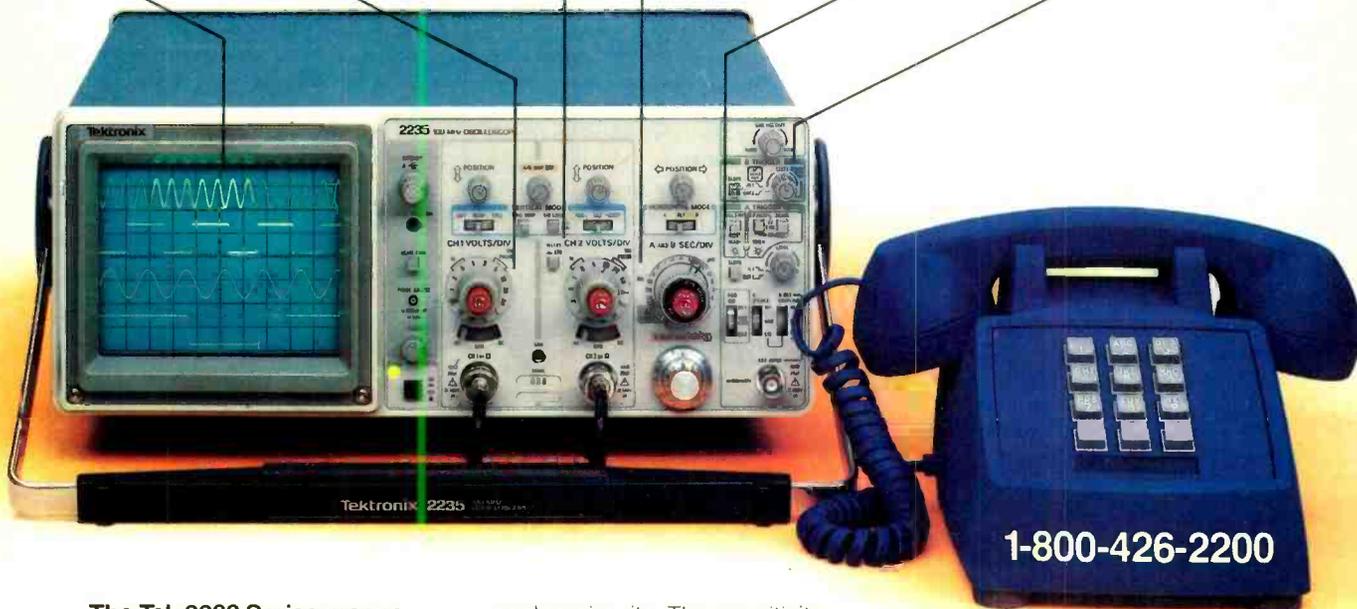
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BLESS THIS ABCDEFGH.DOC WORLD

ALTHOUGH I am reasonably happy with the various pieces of software that run on my elderly home-made, CP/M driven, S-100 system, I do have one gripe which I am sure is shared by lots of computer users.

Like so many other people, I have boxes of diskettes whose contents I have forgotten. My complaint starts when I run a DIR(ectory) on one of these diskettes to see what I stored there.

As you CP/M (and most other operating systems) fans know, most DOS's allow only 8 letters for a file name. This isn't too bad since some systems, the late lamented SOL for example, allow only 5 letters, while some early Radio Shack systems allowed a grand total of 6 letters.

I look at the names in the directory and wonder what the heck I was doing all this time. There is nothing in the directory that I can read. It all looks like some form of secret code. It is enough to make an ulcer growl.

There are file names there that defy translation. I am certain that I never named a file INTAXDED. Don't look at me, I don't know what it means until I dump it.

It never fails, I have to dump what seems to be hundreds of strangely named files to see what I was doing. In this case, INTAXDED turned out to be a list of income tax deductions I was itemizing. Sure you say, INTAXDED looks simple enough to be understandable (once it has been explained). Yes, but I started that file six months ago and haven't touched it since. I forgot what the name stood for.

Now I have to figure out what that ubiquitous WHATSUP.DOC, or HOLYMOLY.DOC (among other strangely named files) on the diskette means.

Every time I stick another diskette in the drive and DIR it, I have to go through the same time-wasting procedure. I have no more room on the diskette label to itemize the program list, and it I stick one more label on the diskette, it will not fit through the drive door. Then while still in CP/M, I have to use the

TYPE command. Talk about saving time and energy with a computer!

Although I have been going through this DIR "schtick" for years, it never really bothered me until I saw what Epson did in their QX-10 with Valdocs.

You want to know what aggravation is? Valdocs allows you to describe a file using 16 genuine whole words in English, or any other human language—on each of two lines if you need more space.

Imagine that, sixteen words—that's enough to fully describe almost anything I care to write about.

Valdocs users do not need a decoding book or a special file explaining what is going on to find out what they stored on

a couple of weeks (or months) later?

Who is going to be that wonderful person who adds at least 5 years of life to so many DOS users and reduces their dependency on coffee and aspirin? When you do it, you can count on me to contribute a few bucks towards a statue. If it will speed things up a little, why not try a DOS (CP/M) version of the specialized "hello" program as used with some Apples. When this software is run, a disk catalog appears on screen, with each program identified by a real, genuine, multi-word name and with each having a unique identifying letter.

The user simply types in the identifying letter of the program they want to



the diskette last month. With 16 real, genuine, English words per line, they can read it and understand it six months or even a year later!

Of course, the 16-word title is not the way that the computer seeks the file on the diskette, but that is the machine's problem not the user's.

My request is simple. I would like the people who develop operating systems, and modifications to operating systems, to emulate Valdocs a little and try to give us plain old DOS users more room to name a file. Maybe not 16 words, but something better than 8 letters.

Wouldn't it be wonderful to be able to use file names that we could understand

run, and the system then retrieves that program using a machine-understandable version of that name.

It appears to me that the real, genuine name could be several words long, thus making its identification perfectly clear even years later.

Direct Memory Access

There are several areas of microcomputers that seem to border on magic for many new users. So, every now and then, I will open the door to one of these dark areas and try to let a little light in. These small items will not be complete tutorials on the subject, but hopefully they will provide enough information so that the

ART BY YVONNE BUCHANAN

reader will learn a little more about his computer.

This first such small discussion will be a quick pass at DMA (direct memory access)—in which an external device is allowed to dash nimbly around the system memory without using the CPU. It is this latter fact that seems to be the problem. The speed at which the DMA operates is determined by how fast the RAM chips themselves can be accessed.

There are two basic types of DMA. The first is called "visible" in which the system CPU operation is temporarily suspended while an external device performs a memory access.

The action starts when the external device sends a "halt" signal to the CPU. At the end of the next machine cycle, the CPU stops operation and issues a "halt acknowledge" (or similar) signal. When this happens, the external device takes temporary control of both the system data and address busses. During this interval, the CPU outputs are usually in the high-impedance, or open state, thus for all intents, the CPU is not in the system.

When the hold signal is removed, at the next clock pulse, the system reverts to normal operation.

The second approach to DMA is called "transparent" or "cycle stealing". In the transparent approach the external device is synchronized with the CPU's memory accesses, so that the external device never accesses the same memory block at the same time that the system CPU wants to. Thus DMA can take place without interfering with the normal operation of the system.

In cycle stealing, the external device is allowed to access the memory only when the CPU is not "looking" at the memory and is busy doing something elsewhere—instruction decoding, for example.

There is a third approach coming into wide use where the CPU accesses memory via one port, while the DMA device uses another port. As long as the external DMA device does not try to access the same block of memory as the CPU, all is fine. In this case, the DMA device has access to all the other memory. ♦

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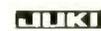
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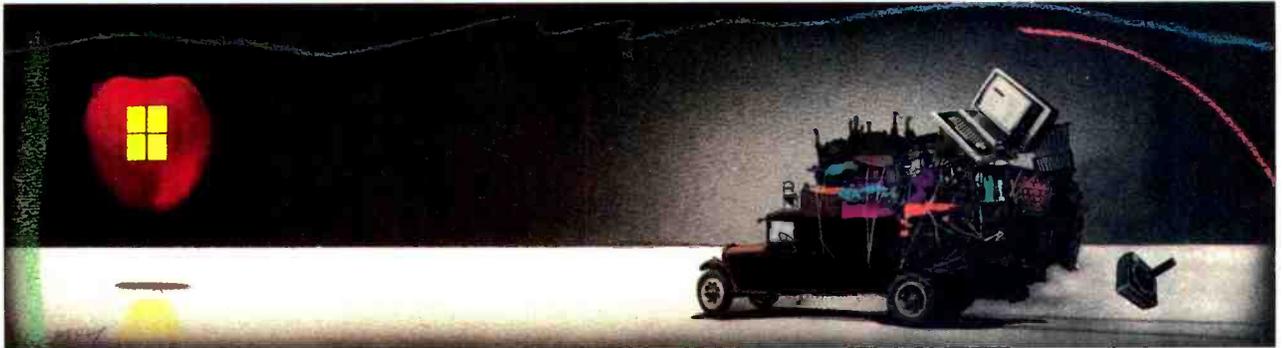
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Rumors & Gossip

► Commodore is expected to introduce its new IBM PC compatible this fall, in Europe first, with introduction in the U.S. not anticipated until next year. . . . AT&T will soon announce their IBM PC compatible desktop computer, an upgraded version of the Olivetti system using an 8-MHz 8086 and 512K RAM, serial and parallel ports, calendar/clock, disk controller, seven expansion slots and better graphics than the IBM machine. An XT version should contain a 10M-byte Winchester and dual slim-line drives. AT&T is expected to sell the machine via Bell System stores and at least one chain of computer stores. . . . Rumors continue that IBM will, this fall, announce a lap-portable battery-operated version of the PC that may contain a 24-line by 80-character display. . . . National Semiconductor is rumored readying an IBM PC compatible in both desktop and lap portable versions with super graphics.

U.S. Customs Releases 2,000 Apple Clones

► The U.S. customs service recently released 2,000 allegedly counterfeit foreign-made Apple computers that it had seized last year. The seized machines either did not contain their ROM software or contained dummy ROMs with "noncustoms service tested the machines they did not perform like Apple II computers. Thus the service felt that it did not have adequate legal basis for confiscating them. It is expected that importers will later install copies of the Apple II ROMs.

Apple had requested that the International Commission order Customs to seize Apple clones at U.S. entry ports whether or not they lacked ROMs or contained dummy ROMs. IBM has made a similar request of the Customs

service to stop IBM PC clones coming into this country.

IBM PC Shortage Over

► IBM dealers report that the shortages of IBM PCs and XTs that plagued dealers for the past year and a half are now over. They are no longer on allocation from IBM, and most dealers have machines in stock. The result is an upsurge in discounting of PCs and XTs and their compatibles. Even the IBM PC portable, which IBM began shipping in April, is already being discounted by some dealers. The PCjr has been heavily discounted by dealers since its first availability in February.

Another result is the dumping of systems by authorized IBM retailers, VARs and VADs to unauthorized dealers and discounters. These sellers invariably have to pay banks interest on systems in their stock for over 30 days and have to fulfill purchasing quotas with IBM. The result is that at the end of the month they will dump their inventories to unauthorized dealers at very substantial discounts. These dealers are invariably low budget retail or mail order operations and are therefore in a position to discount the systems. IBM, contrary to the policy followed by Apple Computer, has

chosen to ignore this "gray" market and thereby appears to be encouraging it.

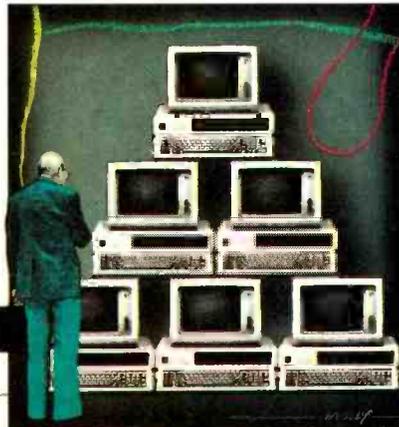
Josephson Technology Lives Again

► Last year IBM announced that it was dropping development of a new generation of computers based on ultra-high-speed Josephson junction devices. After spending several billion dollars and building several small prototype systems IBM claimed that the technology was too difficult and expensive to implement outside of the laboratory. Further, advances in conventional LSI solid-state devices made Josephson technology less advantageous than previously.

Now comes news that the Japanese Ministry of International Trade and Industry (MITI) and Hitachi Ltd (the largest computer company in Japan), have produced several prototype devices based on the Josephson technology. They have further announced that they plan to continue development with the objective of building a complete computer based on the technology. The computer is expected to operate several times faster than the fastest current systems and occupy about a quarter the space. However, it will be necessary to house the computer in a sealed, liquid helium container.

The Gigabit RAM

► S. Chou, Director of Intel's Portland Technology Development effort, predicts that, by the year 2000, IC makers should be producing integrated circuit dynamic RAMs containing 1 gigabit of memory. In the last 15 years RAM ICs have gone from 1K bits to 1M bits, a 1,000-times increase in bit density. He predicts further that the chips will be organized as 128M by 8-bit words and 64M by 16-bit words. The technology should be CMOS with power supply



voltages as low as 2 V. The problems now are what to do with that much memory and how long it will take to test the device.

Apple News

► Apple has disclosed that it has stopped development work to upgrade the Apple III, which probably means that Apple will phase out production by the end of the year. Apple had been working on memory expansion and boosting operating speed from 1.4 MHz to 6 MHz. The machine, which uses the 8-bit 6502 microprocessor was introduced in 1981, aimed at the business market. With an estimated 75,000 Apple IIIs sold. Apple has now shifted its business market emphasis to the Lisa and Macintosh systems.

Apple appears to be directing the IIe and its new IIc at the home and education markets. Over 50% of the IIe sales are reportedly being sold to the home market. The IIe has been Apple's bread and butter product and has sustained it through its less profitable Apple III and Lisa efforts. Apple has reduced the price of the IIe and improved it with a new operating system, expanded memory, half-height dual floppy disk unit and 5M-byte hard disk options. Thus, a complete dual drive 128K system now lists for about \$1,800 and the hard disk raises it to about \$3,000.

The IIc has been priced at \$1,295, the same list price as an IBM PCjr with one disk drive and 128K RAM. Thus Apple IIc appears to be competing directly with the PCjr. However, the PCjr has not met with the demand IBM had hoped for and dealers are widely discounting the system to under \$1,000. Thus, it is very likely that the IIc, in order to compete, may have to undergo similar discounting. The real test will come during the Christmas season.

Apple is expected, this October, to introduce a 3-lb, 24-line LCD display screen (rumored to be made by Sharp) for the IIc.

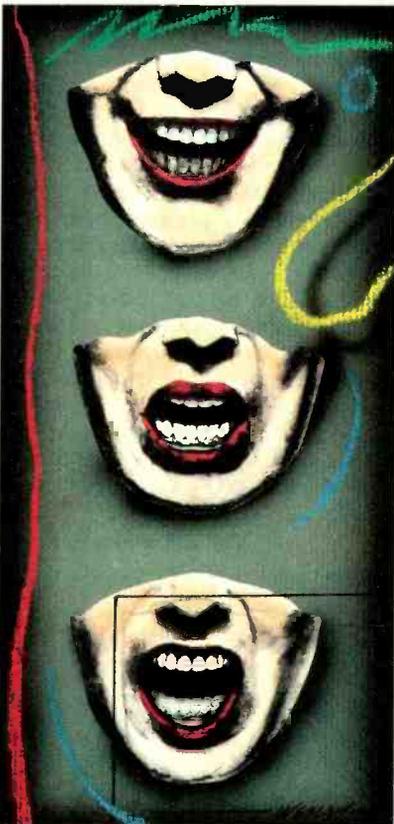
At the introduction show for the IIc held in San Francisco for 1,900 dealers, Apple sold each attendee a IIc for \$400 (the regular dealer price is \$845). Apple promised that by the end of May it would have shipped 50,000 units and that the simple design of the IIc will allow production of one unit every 7 seconds, once production is ramped up.

Apple also reported that in the first 100 days of sales, 70,000 Macintosh systems were shipped and installed and that the original goal had been only 50,000. Apple plans to spend about \$10 million to advertise the Mac, through the sum-

mer, to sustain the sales momentum, as they expect to be producing about 40,000 Macs a month. However, the question is more one of when will a sufficient amount of software become available for the Mac? Software is recognized as the prime mover of a computer system.

Smalltalk Goes OEM

► Smalltalk is the granddaddy of integrated-window-icon operating systems. Developed by Xerox in the early 1970s and used on their Star computer system, it became the model of the operating system used on the Apple Lisa, Macintosh and VisiCorp VisiOn systems. The Star system's popularity was limited by its



high price. However, companies such as Apple, IBM, Microsoft and Hewlett-Packard are known to have bought Star systems.

Xerox has now disclosed that it signed its first OEM (Original Equipment Manufacturer) agreement and plans to license Smalltalk to other system makers as well. The first OEM is Syte Information Technology, San Diego, CA, which will use Smalltalk on a 32-bit National Semiconductor 32032-based system for CAD/CAM applications.

New IBM Systems Rumored

► There are rumors that IBM will

shortly announce three new systems based on new microprocessors. The systems are expected to be sold through its VARs (Value Added Resellers) and use either Microsoft's multi-user/multiprocessing Xenix operating system or a new operating system written by IBM.

The systems appear to be designed to compete with the new AT&T 3B series of microcomputers. The first system is expected to use the 80186 microprocessor, have 256K of memory, a 10M-byte hard disk drive, support high-resolution graphics and run a new version of PC-DOS. The second system, is expected to use the 80286 8-MHz microprocessor, have a cache memory system, virtually unlimited hard disk capacity and 512K of memory. It will probably handle up to 16 users. The operating system is expected to be an upgraded version of Xenix, with windowing and a PC-DOS emulator to allow the execution of most PC software. The machine is also expected to find application as a file server in a local area network for PCs using Microsoft's MS-Net version of MS/PC-DOS.

The third system is expected to use a proprietary 32-bit microprocessor developed by IBM in Austin-TX and will support mainframe software environments such as VM (virtual memory). This system may act as a cluster controller for SNA devices.

The IBM scientific instruments division reportedly will unveil a new version of the Microsoft Xenix operating system for its CS9000, 68000-based office system. This new OS will provide enhanced graphics with icons and windows.

Random News

► Jack Tramiel, former president of Commodore International (and still a director), reported to the Securities and Exchange Commission that he has acquired over 5% of the stock of Adac Laboratories, Sunnyvale, CA, and that he plans to take an active interest in running the company. . . . IBM researchers reported, at the recent IEEE-Intermag conference, a new type of experimental magnetic recording head that will increase magnetic disk storage density up to six times. The head integrates thin film coils to write data on the disk and high-sensitivity solid-state sensors to read the data. . . . IBM researchers at its Essex Junction, VT, facility announced development of a dynamic RAM chip with a capacity of 1 megabit that operates from 5 volts. . . . Zenith has announced that they will cease marketing all 8-bit computer systems. This will include Z-89 and Z-90 systems. ◇

FORREST M. MIMS III THE COMPUTER SCIENTIST

COMPUTER CONTROLLED LIGHT METER

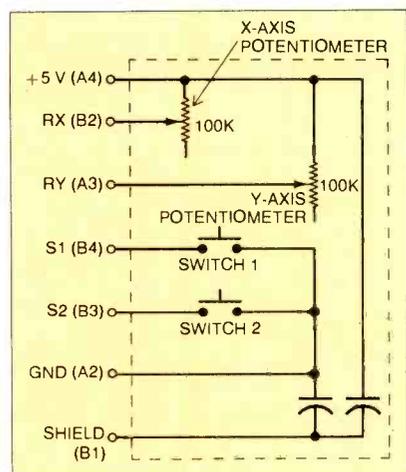


Fig. 1. PCjr joystick circuit.

PERSONAL computers equipped with analog joystick ports provide the potential for a host of applications never imagined by their designers. That's because the analog-to-digital conversion hardware and software required to support a pair of joysticks can be easily interfaced with a great many external sensing devices.

A good example is IBM's PCjr. This machine includes a pair of analog joystick ports ideal for use with sensors whose resistance varies with an applied stimulus such as temperature, light, heat or pressure. Up to four such sensors can be connected *directly* to the PCjr's joystick ports with no buffering or interfacing hardware.

In this column we'll take a close look at PCjr's joystick ports and use one of them to convert the Junior into both a simple light meter and a sophisticated, light-sensing storage oscilloscope. Even if you don't have access to a PCjr, read on. Some of the methods to be described apply equally well to the Apple IIe, Radio Shack's TRS-80 Color Computer and other machines with analog joystick ports.

Junior's Joysticks

Junior's *Attachable Joystick* (as IBM calls it) is a Made-in-Japan \$40 special with both spring-return-to-center and free-floating modes. Two small plastic

levers on the bottom of the joystick housing allow the spring-return feature to be selected independently for each axis. Thumbwheels on the top of the Joystick allow each axis to be mechanically centered when the spring-return feature is selected.

Lacking technical documentation, the quickest way to decipher a computer's joystick interface is simply to disassemble one of its joysticks. Junior's joysticks can be easily opened by removing a pair of self-tapping screws from the bottom side of the plastic enclosure.

Figure 1 shows the circuitry inside one of Junior's joysticks. The two potentiometers, one for the x-axis and the other for the y-axis, both have a linear taper resistance of 100,000 ohms. Two normally open, single-pole pushbutton "fire" switches are included.

Incidentally, be sure to note the *shield* connection (B1) in Fig. 1. The joystick cable is shielded to protect Junior's analog-to-digital (A/D) hardware from external noise. While experimenting with

the joystick port, I soon learned the significance of the shield provision.

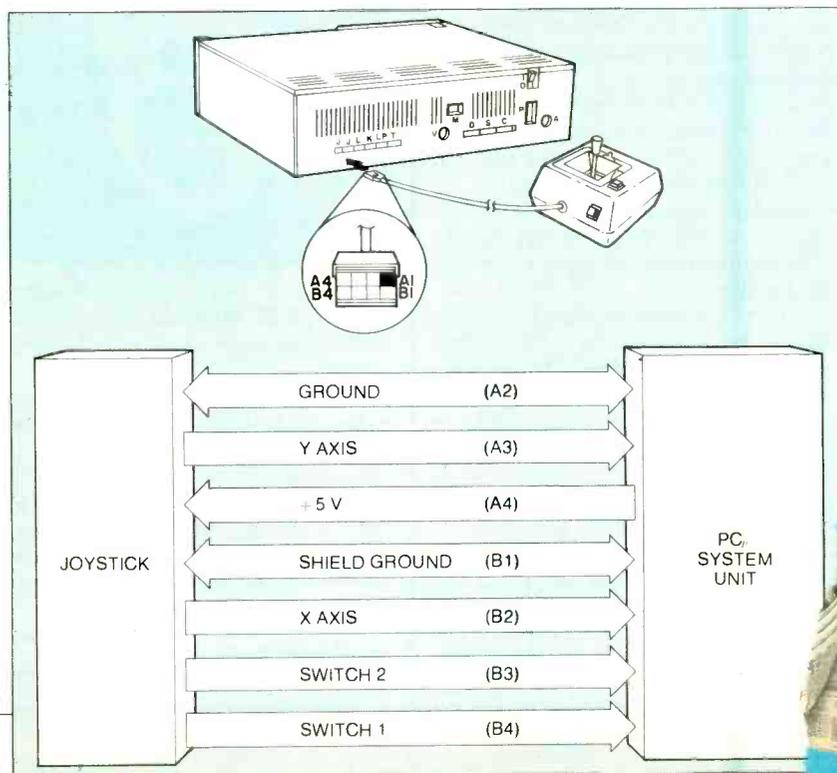
Figure 2 details the cable connections between a single joystick and one of Junior's system board joystick sockets. The most notable features are the unusual Berg-type connectors and, because of its shielding and its six wires, the rather thick (1/4-inch) and inflexible cable.

The Hardware-Software Connection

As I've noted before, Junior's version of BASIC is an expanded version of the BASIC supplied with Radio Shack's CoCo. Though both machines have analog joystick ports, however, their operation is quite different.

CoCo's 100K joystick potentiometers are connected across +5 volts and ground. Therefore, each potentiometer functions as a voltage divider that delivers to the joystick port a voltage ranging from about 0.25 to 4.75 V. This voltage is applied to a simple 6-bit firmware-driven A/D converter designed around

Fig. 2. Connections between the joystick and PCjr.



an analog comparator and a resistor network. For more details, see "Analog Sensors for Personal Computers" (COMPUTERS & ELECTRONICS, February 1984).

Though Junior's joysticks use the same 100K potentiometers as CoCo, their operating principle is entirely different. As you can see by referring back to Fig. 1, both potentiometers function merely as variable resistors and *not* as voltage dividers. In other words, while CoCo's joystick signal is a variable *voltage*, Junior's is a variable *resistance*.

Figure 3 shows the key ingredient of Junior's joystick hardware, a 558 quad timer IC. This chip includes four timer circuits, each of which is connected to a fixed capacitor (C1-C4) and a variable resistor (joystick potentiometers R1-R4). When triggered, each timer delivers an output pulse whose duration is approximately $1.1 \times RC$.

Junior's on-board ROM firmware includes a routine that measures the dura-



Adding a phone jack to joystick permits using a CdS sensor.

tion of each timer's output pulse.

Raw joystick values are returned by the STICK(*n*) function. Normally the retrieved values are assigned to a variable as in $A = STICK(n)$. Here are the potentiometer assignments for each allowed value of *n*:

STICK(0) returns x coordinate for Joystick A.

remaining joystick values. STICK(1), STICK(2) and STICK(3) simply get the values retrieved by STICK(0). They do *not* sample the joysticks.

CoCo's joysticks always return a value of 0 to 63. Though Junior's joysticks provide better resolution, their numeric range isn't given by IBM. Instead, as Junior's BASIC reference manual observes, "The range of values for x and y depends on your particular joysticks."

As I mentioned above, Junior can return a *potential* maximum joystick range of from about 3 to 255. Maximum excursions of the IBM joystick I purchased output values of from 3 to 124. You can enter and run this routine to find the values for *your* joystick(s):

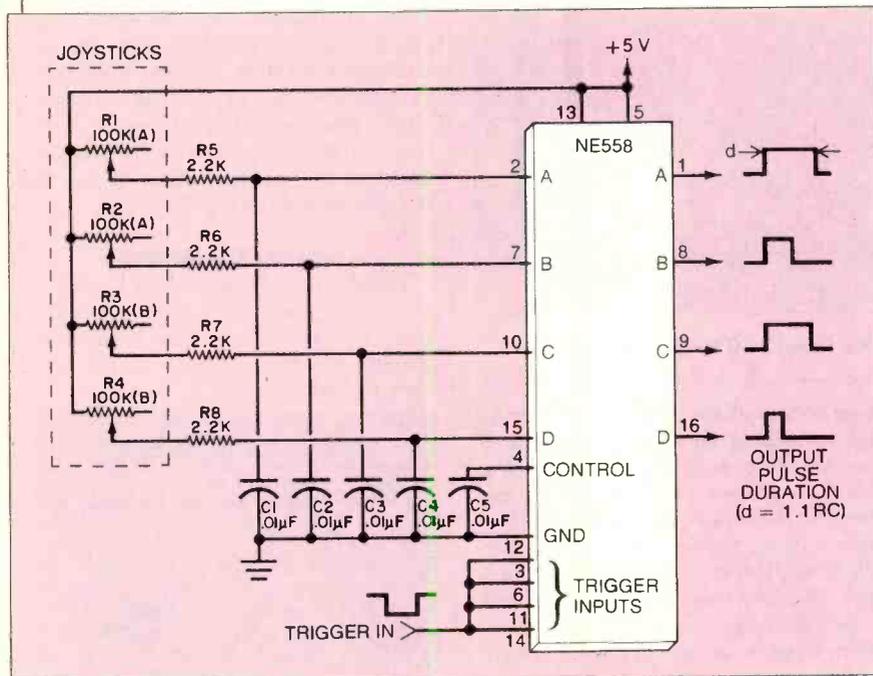
```
10 'STICKOUT
20 CLS
30 X=STICK(0)
40 Y=STICK(1)
50 LOCATE 15,15
60 PRINT "X="X;"Y="Y
70 GOTO 30
```

It's possible to take full advantage of Junior's entire range of joystick values when you replace the potentiometers with external sensors. This routine converts the 3-255 range of STICK(0) to a more convenient 0-100 range and prints the result:

```
10 'MAX STICK (0-100)
20 CLS
30 X=STICK(0)
40 X=(X/255)*100
50 LOCATE 15,15
60 PRINT "STICK(0) : "
  INT(X)
70 GOTO30
```

Line 40 converts the retrieved value of STICK(0) (0-255) into a range of 0-100. However, the resistance of many sensors suitable for use with the PCjr *decreases* as the stimulus level *increases*. This line will reverse or give the complement of the previous result: $45 X = 100 - X$.

Fig. 3. Simplified input circuit for the PCjr.



tion of each timer's output pulse. The resulting time is outputted as a number from about 3 to 255 when BASIC requests a joystick reading.

The lower joystick value would not necessarily extend to 0 if series resistors R5-R8 were bypassed. These resistors are necessary to ensure reliable operation of the timers. Without the series resistors, at maximum handle excursions the resistance of the joystick potentiometers might be too low to allow the timers

STICK(1) returns y coordinate for Joystick A.

STICK(2) returns x coordinate for Joystick B.

STICK(3) returns y coordinate for Joystick B.

It's important to understand that STICK(0) retrieves the values for *all* four joysticks. Therefore, it's necessary to include in a program a STICK(0) function before attempting to read any of the

Computer Scientist

Figure 4 is a calibration graph I made to gauge the accuracy of Junior's joystick output. The graph was made by replacing the potentiometer for STICK(0) with a precision (1%) decade resistance box. I then recorded the STICK(0) output, which was corrected for a scale of 0 to 100 and then complemented, at increments of 10 kilohms. As you can readily see, Junior's joystick hardware and software produces a very linear output.

A PCjr Light Meter

Among the simplest sensors that can be connected directly to PCjr's joystick

plug a sensor into the jack.

Unless you use a shielded cable (connect the shield to the joystick cable's shield), it's important to keep the leads between the sensor and the joystick as short as possible. Otherwise, as I quickly learned, external noise picked up by the connections will cause incorrect joystick readings and other strange behavior.

Warning: You may void all or part of your computer's warranty if internal damage results from your modifications. Use care.

As for the photoresistor, it's a good idea to wrap a cylinder of black electrical

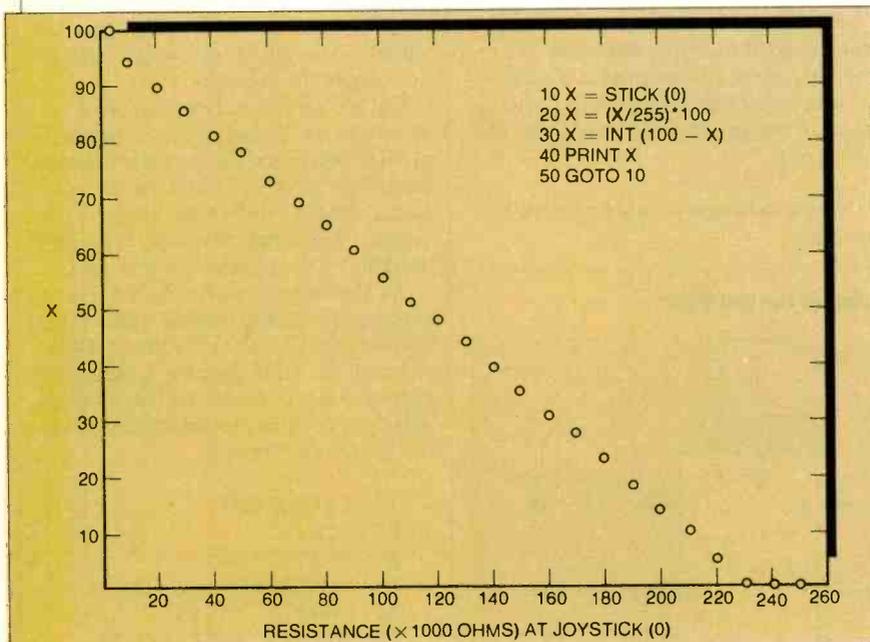


Fig. 4. Corrected joystick output for input of 0 to 250 kilohms.

ports is the cadmium sulfide (CdS) photoresistor. One I've used with excellent results is Radio Shack's catalog number 276-116 CdS Photocell. The resistance of this cell is about 100 ohms in bright light and several million ohms in total darkness.

The simplest way to connect a CdS cell to Junior is to open a joystick housing and remove the wires connected to the x-axis potentiometer (the one opposite the cable entry point). Carefully remove half an inch of insulation from each lead and wrap one of the exposed wires around each of the photoresistor's leads.

If you intend to do lots of experimenting with your joystick ports, you'll be better off installing a miniature phone jack for each potentiometer. Use the kind with a built-in switch connection. There's plenty of room, and your joystick will function normally until you

tape around its window to better control light reaching its sensitive surface. If you've never worked with a photoresistor, you'll better understand the need for this step after you try the program that follows. Suffice it to say that CdS photoresistors are *extremely* light sensitive. I've used them in conjunction with a two-transistor circuit to detect light from a match more than 200 feet away!

The possible ways to transform Junior into a light meter are limited only by your imagination. For starters, try this:

```

10 'PCjr LIGHT METER
20 CLS
30 X=STICK(0)
40 X=(X/255)*100
50 X=INT(100-X)
60 LOCATE 2,2
70 PRINT "LIGHT
  LEVEL: ",X
80 GOTO 30
    
```



Fig. 5. Simulated light meter.

This routine simply provides on a scale of 0 to 100 the level of light striking the photoresistor. Of course you can add many frills to the program. For example, you can add a correction factor that compensates for the inherent nonlinearity of photoresistive devices. You can also add various beeps and tones that indicate (or warn) when the light level equals, exceeds or falls below one or more desired values. You can even provide graphics, perhaps a shape resembling a photographer's light meter. Listing 1, for instance, electronically "constructs" the light meter shown in the screen photo in Fig. 5.

A Storage Oscilloscope

The light meter defined by Listing 1 provides only a single reading at any instant. But what if you want to monitor sunlight at a solar collector or the passage of clouds?

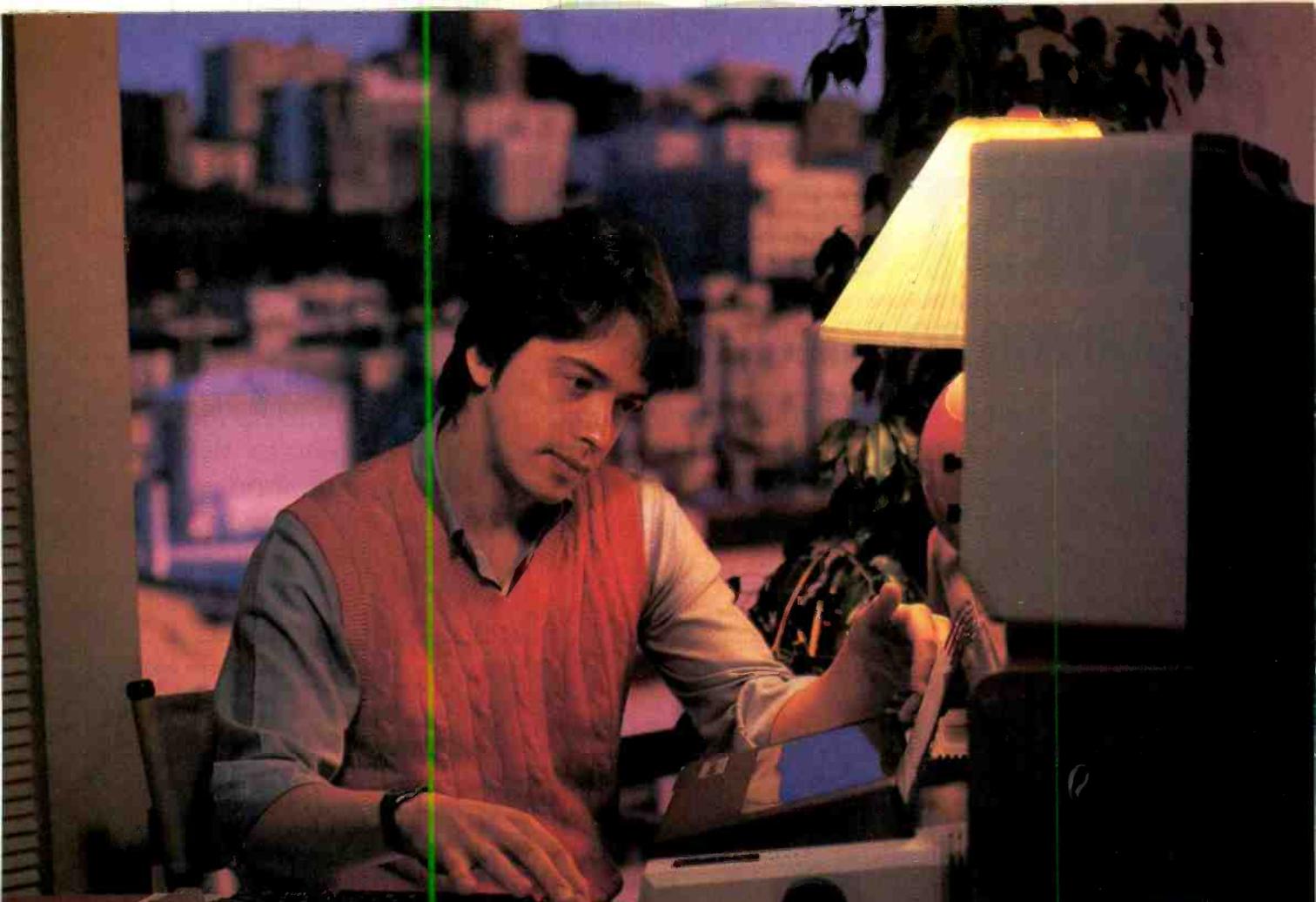
LISTING 1. PCjr LIGHT METER

```

10 'PCjr LIGHT METER
20 'COPYRIGHT 1984 BY FORREST M.
  MIMS III
30 KEY OFF:CLS
40 SCREEN 1,0:COLOR!
50 LINE (192,136)-(136,56),B
60 LINE -(144,48):LINE -(200,48
70 LINE -(200,128):LINE -(192,116)
80 LINE -(192,56)-(200,48)
90 LINE -(142,72)-(186,62),B
100 LOCATE 12,19:PRINT 'PCjr'
110 LOCATE 14,19:PRINT 'LIGHT'
120 LOCATE 16,19:PRINT 'METEF'
130 X=STICK(0)
140 X=(X/255)*100
150 X=INT(100-X)
160 LOCATE 9,19:PRINT X
170 GOTO 130
    
```

There are various ways to have Junior keep a record of readings for later retrieval and study. The simplest is to save on disk a list of readings under an appropriate name.

(Continued on page 76)



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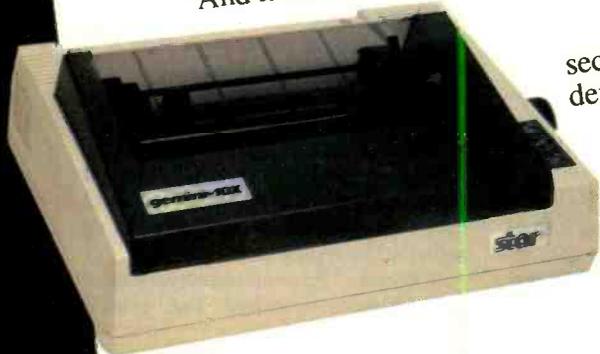
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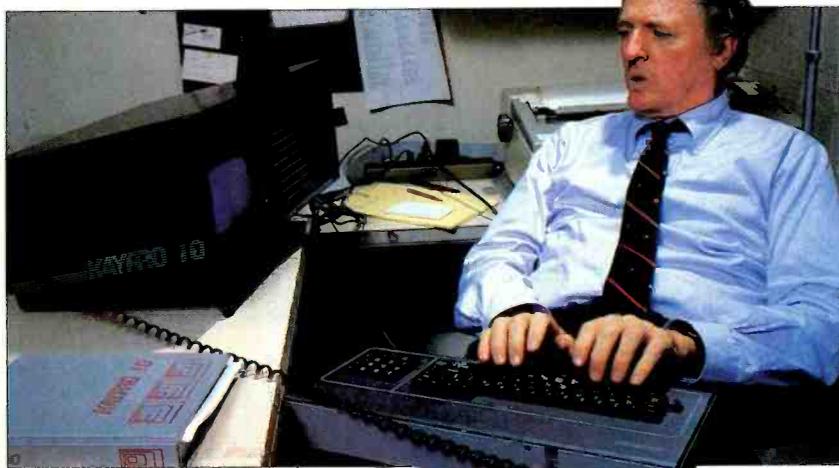
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GUEST COLUMN

LEARNING TO TOUCH TYPE

Because Computers & Electronics is dedicated to bringing its readers the latest in technology, we have commissioned author-television commentator William F. Buckley, Jr.—an inveterate Kaypro user—to reveal his unique method of teaching someone to touch type. In a companion article, two programs that teach touch typing are reviewed.

BY WILLIAM F. BUCKLEY, JR.



William F. Buckley, Jr., is editor of *National Review*.

WHEN I see an advertisement or read a notice on the subject (“We can teach you to type in 30 days!”) I am prompted to think back on three episodes, the first when I was 15, the second when my son was 12, and a final episode just last Christmas, while I was vacationing on a roomy sailboat with friends. I am 58, if anyone cares.

If there are scientists who have written on the general subject of congenital indecipherability, I don’t know who they are, but I am nevertheless persuaded that the phenomenon exists. I mean, there are people around us—very nice people, often, though not always—who simply do not write clearly. It isn’t that they desire to write unclearly, in order to suggest the profundity of their mind or their indifference to the workaday discipline of communication. Others suffer from the poor handwriting of an individual, but he suffers the most of all. True, he is likelier than others to be able to de-

cipher what he himself wrote, but it can be very difficult for him. I can give you a page of the handwriting of Henry Kissinger, of John Kenneth Galbraith (or, a page of my own), which the author will make out, but only with hesitation. Since we are all most dependent on our own handwriting, and suffer the most from its opacity, I deny that bad handwriting is a form of affectation: it is an affliction.

Well anyway, having been unsuccessfully taught, bribed, and threatened, the moment came when, at age 15, I was away at school, and a package arrived from my father. It was a Royal portable typewriter, and a message came with it. “Dear Billy: Henceforward when you write to me, use this machine.” (“Machine” was the closest my father ever came to a technical vocabulary.)

Now, I was then at a boarding school where a course in “Typing” was offered. Two hours every afternoon two days per week for one semester. That meant on

the order of eighty classroom hours. It was commonly thought then, and still is today, that anything that requires eighty hours to learn is pretty complicated—this side of shorthand, to be sure, but maybe like beginning Italian, or Home Carpentry.

Inside my father’s package came a note from his secretary, a kindly lady who knew something of my impatient habits. It was just a few sentences long, but it was the most liberating I ever read relating to the mastery of a skill. It was as if, having been given the gift of a dictionary, someone sent me an accompanying letter revealing the alphabet.

What she said was this: “Lift the caps off the keys”—in those days, typewriters came with caps; now they are mostly plastic, with the letters etched onto them—“and cut out a sheet of black paper—you can find this sort of thing in the school darkroom—little circular pieces that correspond to the size of the keys. Then replace the caps over the blacked-out keys. Then type out the sequence of the typewriter keys from left to right, leaving three spaces between each key. Then draw a line that separates the first set of vertical keys from the second set, and do that until they have all been separated. Then write down the finger of your hand that is used to depress each set of keys. Take a thumb tack and pin that piece of paper level with your eyes, over your desk. You will struggle for a while, but I expect you will be writing your father a typewritten letter not very long from now.”

I did exactly as suggested, but also borrowed an exercise book from a student living across the hall who was enrolled in the typing class.

It wouldn’t have mattered very much if I hadn’t borrowed the exercise

PHOTOS BY STEVE BORNIS

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book—you can easily make up your own; but this saved me the trouble. Saved me the trouble of doing what?

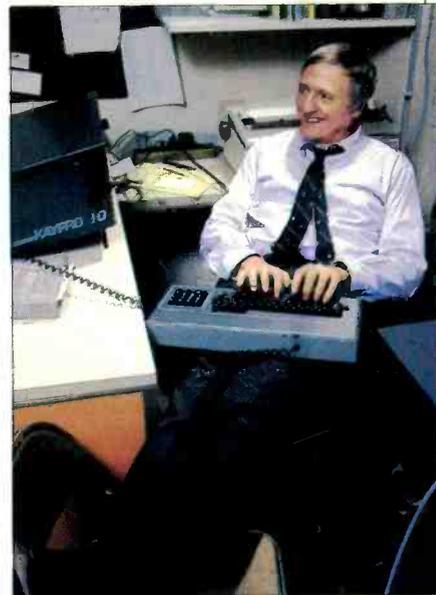
Well you see, the standard typewriter keyboard is laid out on what they call the "Qwerty" method. An odd word, but not at all odd if you are looking at the face of a typewriter, because the first letter on the left of the top letter-row (the numbers are the topmost row) is the Q. After that comes the W. Then the E, R, T, Y, etc.

Why is all that? Well, it doesn't require, in order for you to follow this narrative, that I tell you—but I will anyway. Speed on a typewriter is best achieved when successive letters are typed by alternating hands. This way while one finger is striking, the other, using wrist and finger, is coiling to strike. Take the sec-

ond finger of your second hand and try tapping it successively, as you would in typing the letter, R R R R R R R. That is slower than if you were alternating a left-hand letter with a right-hand letter. The letter Y is tapped with the second finger of the right hand, so that R Y R Y R Y R Y calls for alternating left hand-right hand strokes. You accomplish more strikes per second by alternating hands.

Well, that was easy enough to figure out, but when the technicians set out to keep the typist alternating from left hand to right hand as frequently as possible, they made the sorry discovery that they could very well end up with a typewriter configuration that would permit the typist to type faster than the machine's keys were (in those days) capable

(Continued on page 84)



TYPING TUTOR III AND MASTERTYPE BY LEE D. ZIMSKIND

Educational materials that use challenging game-playing techniques to add incentive to the learning process have demonstrably better results than traditional, dry tutorials. One area in which this technique is effective is in helping the student increase speed and accuracy at the typewriter keyboard. Two software offerings we have recently evaluated are Typing Tutor III developed by Kriya Systems, Inc., and published by Simon and Schuster, and MasterType from Scarborough Systems, Inc. Both programs are available for the IBM PC and PCjr, Apple II and IIe, Commodore 64, and most CP/M computers. MasterType also adds to this list the Atari computers. Typing Tutor III and MasterType each carry a suggested retail price tag of \$49.95.

Typing Tutor III

Typing Tutor III is more than just a game to teach users how to type. This program uses a Time Response Monitoring (TRM) process to create customized lessons tailored to the initial proficiency level of the user and adjusts itself to changing levels as the user proceeds through the lessons. It begins by creating exercises based on a few letters on the "home row" of keys on the typewriter keyboard. As the user masters these keys, the program adds new keys to the exercises, from other portions of the keyboard so that, by the end of the program, the user has complete proficiency in using every key.

As user proficiency increases, Typing Tutor III automatically increases the

difficulty of the exercises and tests. Progress reports are displayed after each lesson and performance results are shown at the end of each test.

In addition to teaching the standard keyboard, Typing Tutor III also teaches the numeric keypad. As a bonus, the program includes a full-keyboard test for evaluating deficiencies of more experienced typists and a Standard Speed

Challenging game-playing techniques, rather than dry tutorials, can be used to add incentive to the learning process

Test similar to many standard typing tests. (Users can create their own standard speed test; though, to do so, they must have some degree of familiarity with the basic text-editing capabilities of the computer.) In addition, there is a Letter Invaders game that is designed to provide practice on letters and combinations of letters.

This reasonably easy-to-use menu-driven program keeps an instruction line in reverse video on the bottom of the screen at all times. For the user who needs assistance, there is an on-demand help facility that allows the user to ob-

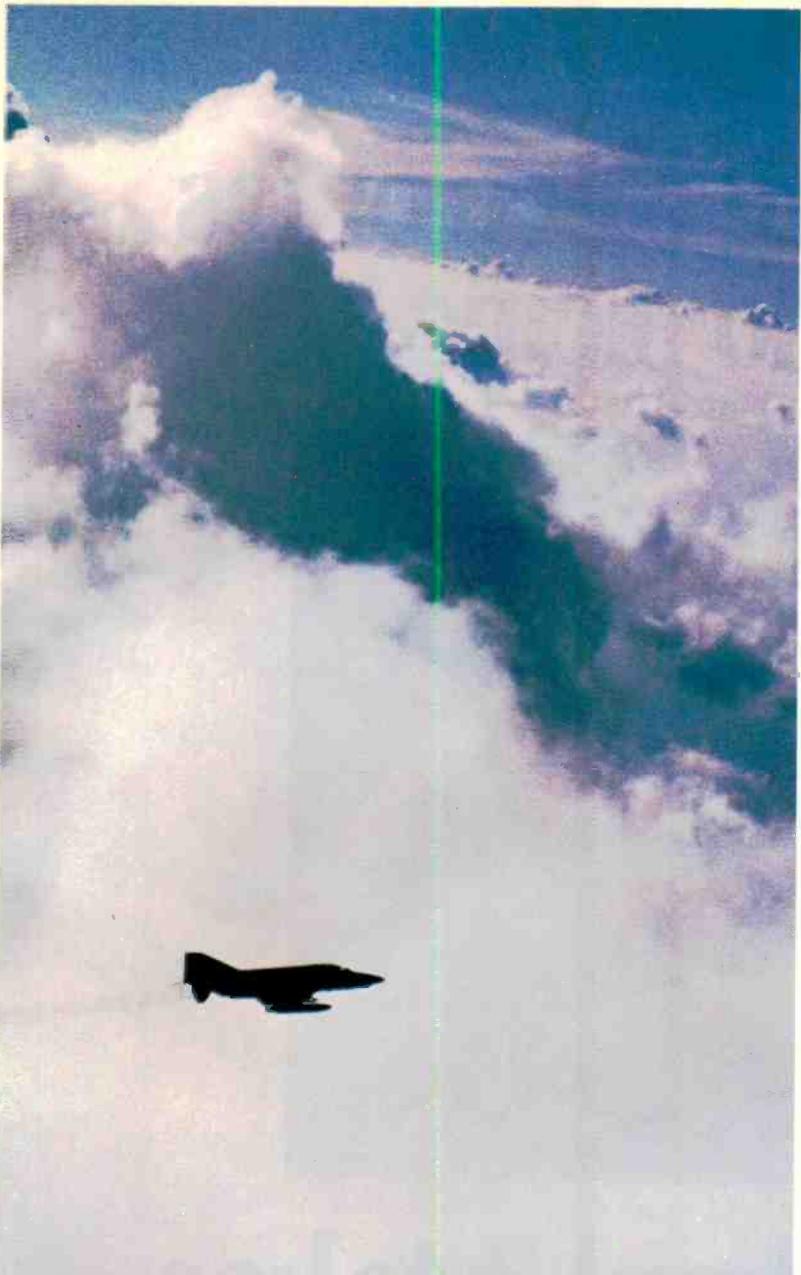
tain full explanations of available options at any time. More detailed help can be obtained from the manual that accompanies the program.

A unique feature of Typing Tutor III is its ability to keep track of different users and remember the results of the prior session. To keep track of progress and build upon previous sessions, the program requires each user to sign on with his own name or code. Should a user sign on with someone else's name, he will be presented with that other person's lessons. Graphic displays of the user's speed and accuracy progress on each key is available, shown automatically at the end of the session or upon request during a session.

MasterType

A somewhat different kind of typing instruction game, called MasterType, is available from Scarborough Systems, Inc. This program, though less sophisticated than Typing Tutor III, is much more fun to use and is certainly more appealing to children. The MasterType program works basically with letters (or words for more advanced players). Letters are displayed in the four corners of the screen and move toward the center. The player must type these letters before they reach the center of the screen and wipe him out.

MasterType is pretty good for teaching the basic keyboard and developing a certain level of speed proficiency. Its level of sophistication, lacking any facility for practice with regular text, would probably not allow the user to become a proficient touch typist. ♦



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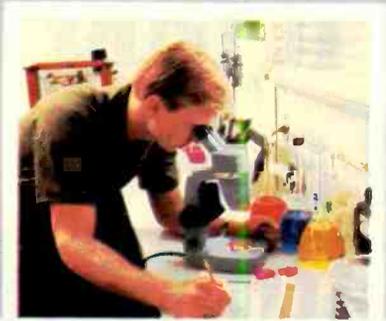
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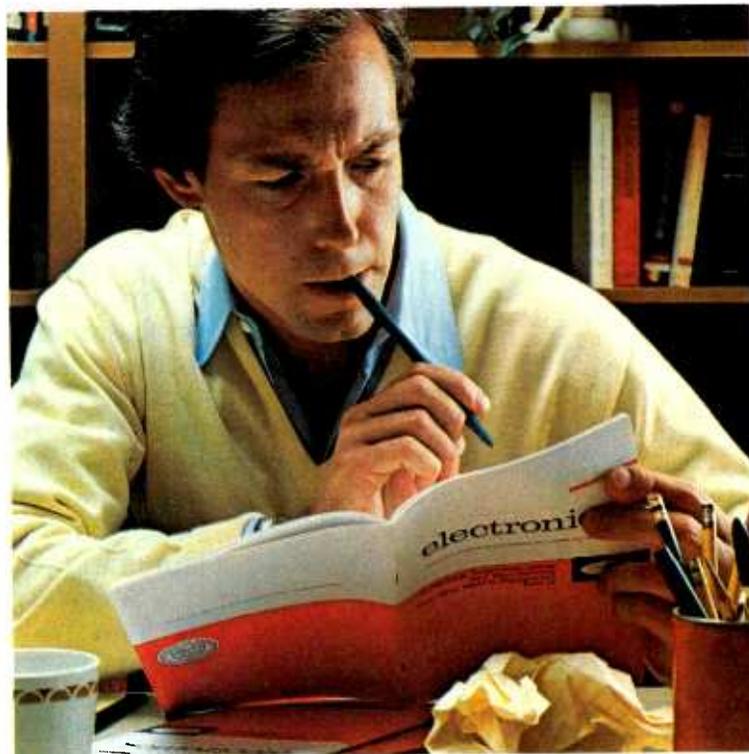
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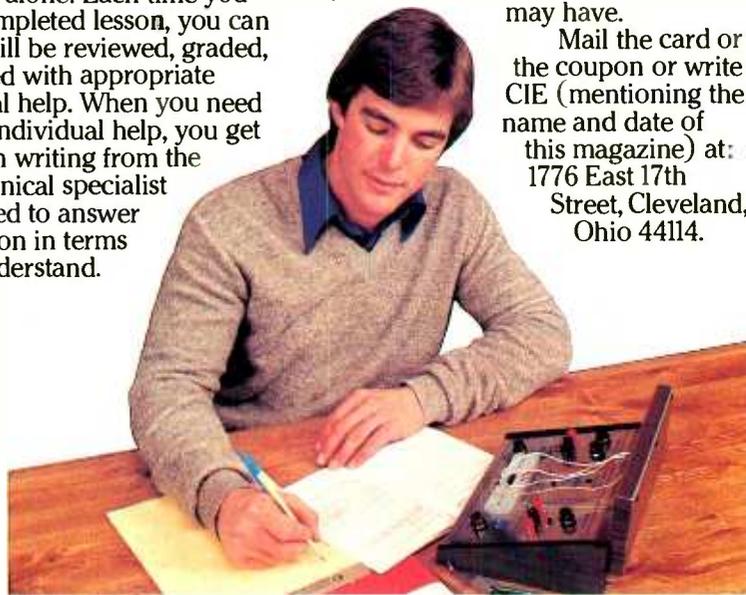
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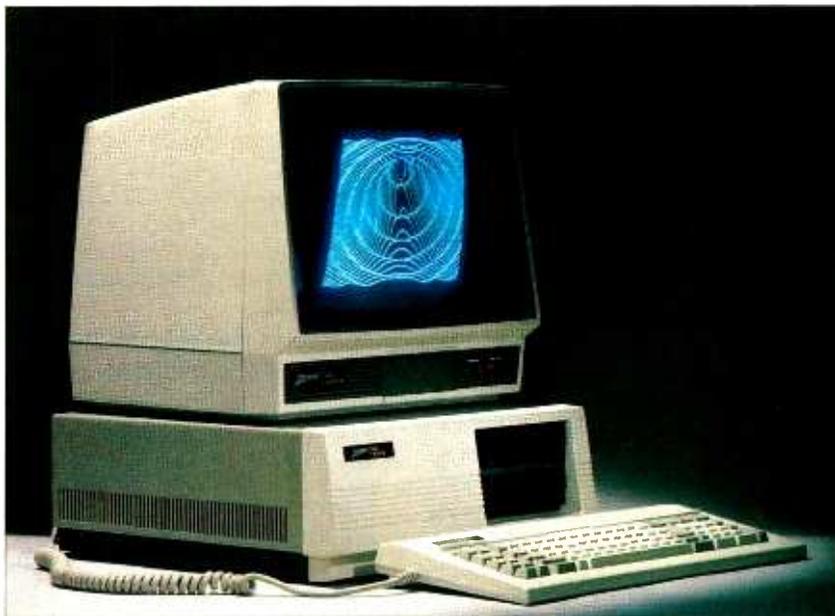
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HARDWARE REVIEWS



ZENITH Z151 COMPUTER

New micro from Zenith offers 99% software and hardware compatibility

BY MICHAEL GUTTMAN

IN 1982, Zenith Data Systems, the computer division of the electronics and TV giant, introduced its first 16-bit computers, the Z-100 Series. Although the Z-100s attracted a lot of industry attention for their excellent design and high performance, their growing popularity was soon eclipsed by the introduction of the now-dominant IBM Personal Computer, with which they are only partially compatible. Now Zenith is attempting to extend its share of the computer marketplace with a new line of computers that offer near-100% compatibility with the IBM PC. This new line includes the desktop Model Z-151 and the portable Model Z-161.

Compatibility and competition with the IBM PC is definitely the major goal in Zenith's latest efforts. Zenith is touting its line as being better built and better performing than the IBM PC—and significantly less expensive. In addition, Zenith plans to use the new line of PC-compatible computers as a springboard for a massive advertising campaign to convert

its public image from that of a purveyor of TV products to that of a major player in the burgeoning computer industry.

With so much riding on these new products from Zenith, we were very interested to find out just how good the new computers really are. We obtained both dual floppy disk and floppy disk/hard disk versions of the Z-151 for early evaluation. (The portable was not available at review time.)

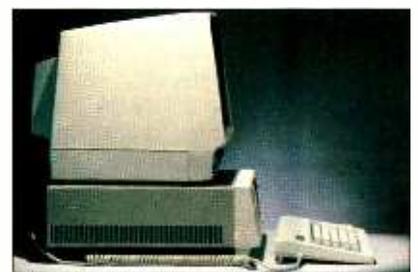
First Impressions

Our interest grew as soon as the computers arrived. The most striking feature is that these computers are much narrower in front than the IBM PC and most of its clones, creating a very sleek appearance. The two half-height 5¼-in. floppy drives are stacked on the right side of the front panel; the left side is blank, except for the Zenith logo and a small LED that comes on when the computer is powered up.

The computers required no special installation and connected easily to monitor and printer. Both units powered up quite rapidly, executing start-up diagnostics in just a few seconds. The disk drives and fan operated smoothly and quietly. And both MS-DOS and PC-DOS booted without a hitch and were off and running without requiring us to glance at the operator's manual.

Inside the Z-151

As soon as we opened the cover, the strategy behind the new design and styling immediately became apparent. The



drives occupy the front-right quarter of the cabinet's volume, while the rear-right quarter is occupied by the power supply and cooling fan. The computer's power switch is located on the rear panel.

The entire left side of the cabinet is devoted to an eight-slot IBM PC-compatible bus, except for a small space reserved for the loudspeaker located immediately behind the front panel.

The overall design creates a very neat, uncluttered workspace that we feel should make the hardware very accessible for upgrades and servicing. On the bus, the three slots to the far right (with the computer viewed from the front) accommodate the plug-in cards for the CPU, graphics, and communications, including the floppy disk controller.

The Z-151 comes standard with an 8088 processor, two serial ports, one parallel port, both monochrome and RGB color graphics capabilities, and one 5¼-in. floppy-disk drive. Each port terminates in a 25-pin DB-25 connector on the back panel. Color graphics output signals are available at a 9-pin RGB D-type connector, monochrome through a standard phono jack. Both video outputs are located on the back panel. A welcome feature is that all connectors are clearly labeled and easily accessible.

The five bus slots on the left are reserved for full-size IBM-compatible plug-in cards. In a standard system, one of these slots is occupied by the memory card. This board comes with 128K of RAM and can be populated with up to

PHOTOS BY BARRY BLACKMAN

HEATH MODEL HS-151 KIT REPORT BY ALEXANDER W. BURAWA

Zenith's new IBM PC/XT-compatible computers can save you a good deal of money; you can do even better with the kit versions of these computers from the Heath Company. All you need is some mechanical dexterity and the ability to follow instructions. The factory-assembled Zenith ZF-151-21 table-top single disk drive computer retails for \$2699; the identical Heath HS-151 sells for only \$1899, an \$800 savings. If you buy the two-drive HS-151-22 kit, you save an additional \$100 just by dropping in the second drive, which takes no more than 20 to 30 minutes.

Going the kit route yields a number of benefits. Most immediately, of course, you save roughly 29% of the cost of the assembled computer in the case of the HS-151-22 two-drive system. A further

benefit to the technically inclined is that kit assembly provides the builder with intimate knowledge of the product's innards. Should you decide to modify the computer or need to troubleshoot the system, you'll really appreciate this knowledge. A final benefit—one that ranks high with repeat Heath customers and hobbyists—is the satisfaction of knowing that *you* built it yourself.

Kit Details

You might be intimidated by the idea of a product as complex and sophisticated as a professional computer in build-it-yourself kit form. The Heath approach to kit packaging, component selection, and assembly directions, however, permits almost anyone, even someone who has never assembled an electronic kit be-

fore, to build a computer successfully.

One of the reasons Heath computer kits have such a good reputation is that much of the work of assembling them is already performed at the factory. Very complex assemblies that would be virtually impossible for the buyer to troubleshoot (to correct a wiring or other error made during assembly) are supplied assembled, tested, and burned in. With the HS-151, the central processing and video graphics boards and the power supply assembly come ready for you to drop them into the computer. What remains for you to wire are the backplane (bus) board, the memory card, and the floppy disk drive controller card. Let's you get the idea that wiring these three assemblies is a "piece of cake," however, con-

(Continued on page 92)

320K of RAM. Maximum system RAM expansion, using more than one card, is 640K. In the hard disk system, another slot would be occupied by the controller card.

With all the major functions accounted for, the Zenith computer still has four open slots for future expansion (three in the hard disk model). This compares very favorably with the IBM PC. A similarly configured PC could require as much as five additional cards for memory expansion and graphics and communications support, leaving no slots open on its five-slot bus.

List prices for the Z-151 are \$2699 for the single-floppy, \$3099 for the dual-floppy, and \$4799 for the single-floppy and 10M hard disk system versions. The Z-161 portable versions retail for \$2799

Specifications

Product: Z-151 Microcomputer

Mfr: Zenith Data Systems
1000 Milwaukee Ave.
Glenview
IL 60025

Dimensions: 16"W × 17"D × 6¼"H

Weight: 42 lb

Price: \$3099

Operating System: MS-DOS

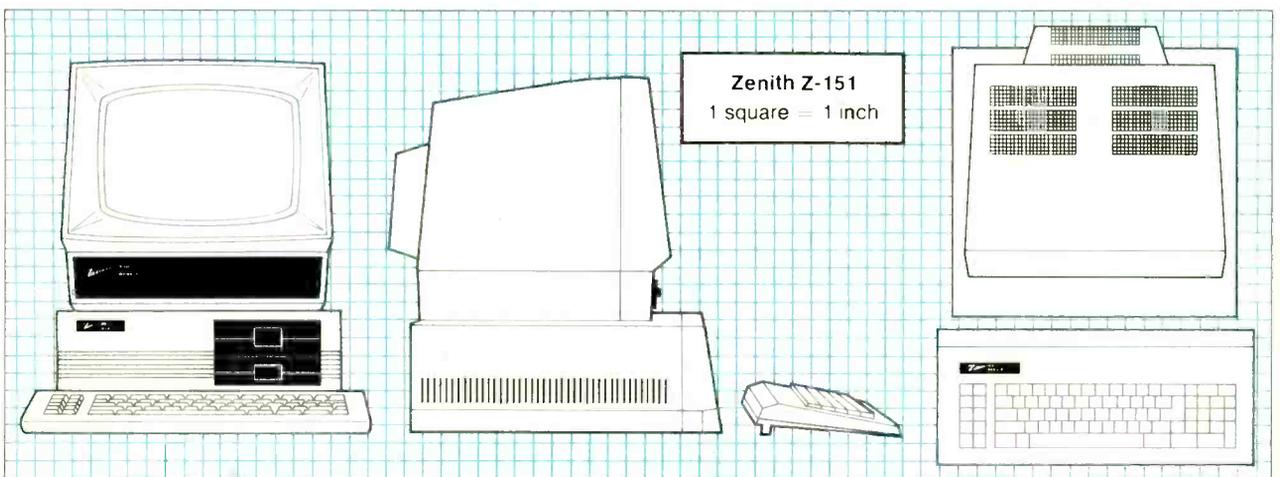
Features: 8088 microprocessor, dual 5¼" half-height floppy disk drives, RS-232, Centronics, 128K RAM, RGB color and monochrome outputs

for the single-floppy and \$3199 for the dual-floppy versions. Zenith's subsidiary, the Heath Company, has the same computers in kit form. They are the desktop Model HS-151, which retails for \$1899 with single drive and \$2199 with two drives, and the portable Model HS-161, which retails for \$1999 and \$2999 for the single- and dual-drive versions.

The Keyboard

One common complaint about the IBM PC is the awkward arrangement of its keyboard. Manufacturers of compatibles must choose between emulating the IBM keyboard exactly or introducing nonstandard keyboards that may not work with some PC software or conform to some PC-based documentation. Ze-

(Continued on page 91)



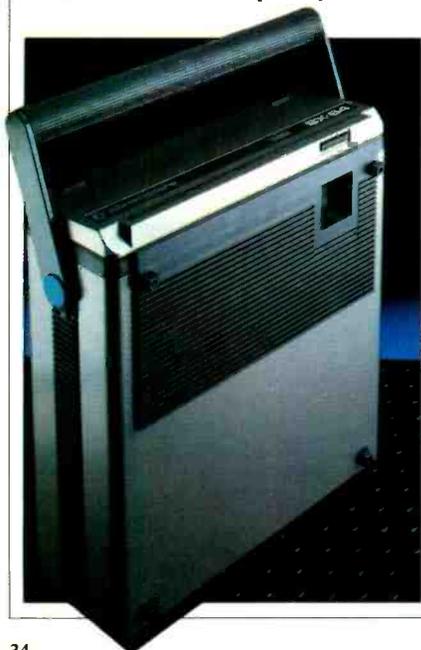
COMMODORE'S COMPLETE PORTABLE SYSTEM

The economical SX-64 has color, floppy disk storage and compatibility

BY TOM HAUGHNEY

Wasn't it Casey Stengel who said, "For a portable to be called a portable it should really be portable"? Those who have tried lugging Compaqs, IBM Portables and similar machines around know that 30 or more pounds is just too heavy to carry comfortably. Commodore's new micro-computer, the SX-64, though not as light as some lap-size computers, does offer true portability. It also is the only portable micro on the market with built-in (5¼") disk drive and (5") color monitor.

The SX-64 is the portable version of the Commodore-64, the largest-selling 64K microcomputer. (Editor's note: an in-depth review of the Commodore-64 appeared in the April 1983 issue of *COMPUTERS & ELECTRONICS*.) Accordingly, it offers the additional advantage of being almost 100% compatible with the Commodore-64. Unlike the C-64, however, the SX-64 is a complete system that



sells for about \$800 in most outlets. (Commodore does not provide suggested retail figures).

Outside the SX-64

The SX-64 is encased in a metal cabinet painted a metallic fleck medium



gray. The rest of the exterior is dark gray, with touches of white, silver, or blue trim.

Along the top of the SX-64 is a ROM cartridge port. Two hinged panel doors form a guideway that ensures such an easy cartridge fit that I couldn't find the wrong way to do it.

The back, a finned metal casting, serves as a heat sink—no fan is used. The sheet-metal body of the machine has plastic inserts on the top and bottom that have heat-venting grillwork molded in. The heat sink and venting system apparently work well. I often left the unit on for hours without noticing any balking or other problems due to excess heat.

The power cable fits into a receptacle in the back next to an on/off rocker power switch. Also on the back are two joystick ports, an audio/video DIN connector, a serial I/O DIN connector, and a user I/O port, which is a card edge connector. Regrettably, none of the ports are labeled.

Noticeably absent is the cassette tape port that is available on the C-64. Without it you cannot use tape programs for

the C-64 on the SX-64. The unit also lacks an r-f output. While you can connect the SX-64 to a video monitor if you want a larger screen display, you cannot connect directly to a television receiver.

The keyboard is connected to the main enclosure, at the bottom of the front, by means of a flexible 24" cable. The connectors are molded onto the cable and feature a pattern that won't allow the wire to break at the point of connector entry. As with the ROM cartridges and the power cable, the keyboard cable fits very well into its socket. Actually I marveled at how easy it was to fit the back end of the cable into the computer without looking.

Stash and Carry

The keyboard, detachable, fits right over the screen and disk drive for storage or transport. You can easily fit the long, narrow lip on the keyboard into a slot along the bottom front of the main unit. Once it is in place, you tilt the keyboard/cover up and secure it with two spring-loaded clasps. While the clasps usually catch on the first try, you might need to exercise some care and do some jiggling to make sure that both are secure.

The carrying handle on the SX-64 works quite well. It is a cylinder 1½" in diameter that extends the full width of the machine. A fluted plastic grip helps prevent accidental slipping. You can rotate the handle underneath the box and lock it into any one of 15 possible positions to use it as a stand. It can tilt the unit up about 12°.

Inside the SX-64

Like the Commodore-64, the SX-64 uses the 6510 microprocessor. The 6510

belongs to the 6500 family of processors, which also includes the popular 6502. One feature of the 6510 is an I/O port register that is used for memory management and allows it to control more than 64K of RAM and ROM memory. (The system contains 64K RAM and 20K ROM.)

The SX-64 uses the same sound and video chips as the C-64. The 6581 SID (sound interface device) is a real music synthesizer as well as a sound chip. It's capable of producing attack/decay sustain/release sounds in three voices. It also has filters and a white-noise genera-

Specifications

Product: SX-64 Portable Computer
Mfr: Commodore

Computer System Div.
1200 Wilson Dr.
West Chester, PA 19380

Dimensions: 14½" L × 14½" W × 5" D

Weight: 27.6 lb

Price: Not available (see text)

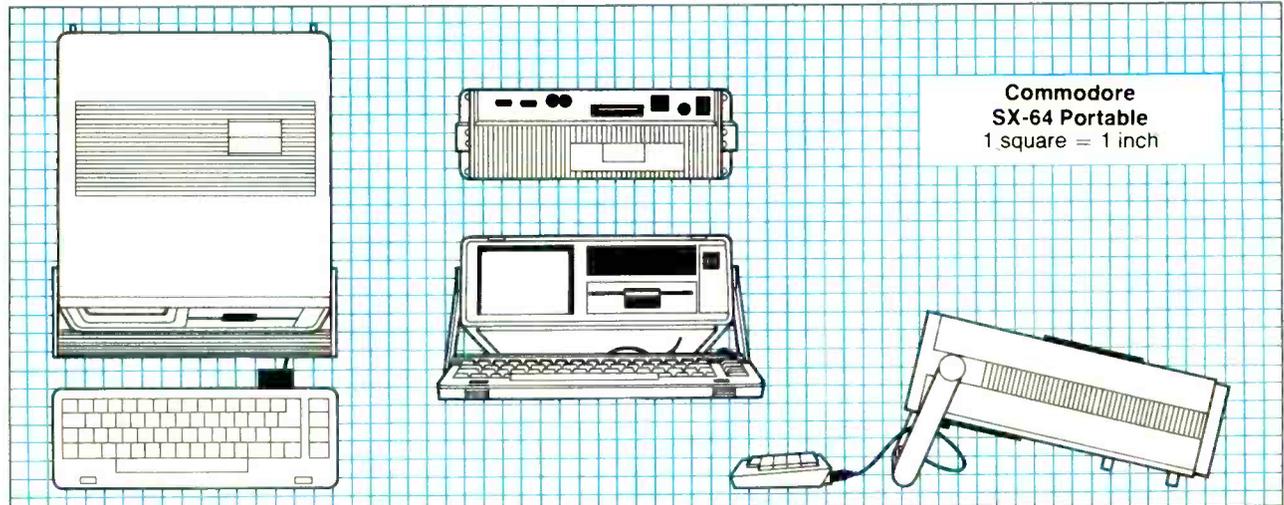
Operating System: Commodore dos

Features: Built-in 5" color-video monitor and 5¼" half-height floppy drive

prevent you from playing video games on the machine. Still, I would not want to troubleshoot a BASIC program listing while staring at this little window and trying to distinguish between, for example, "n" and "m." If you use the SX-64 at home, it may be best to plug it into a monitor with a screen of normal size. Unfortunately, lacking an r-f output, the unit cannot be connected to your TV at home or at a hotel. It is a sad omission.

Disk Drive

The SX-64 has a built-in 5¼" half-height single-sided floppy disk drive.



tor. The video is generated with a 6567 video interface chip called the VIC-II. This chip can produce a text display 25 lines by 40 characters or a bit-mapped color display, 320 by 200 pixels, that includes 16 colors and sprite graphics.

The Keyboard

The SX-64 keyboard is very similar to that of the C-64. The keys have been squared off, however, and the layout, overall, seems to have been reduced about ⅜" on each side. This narrowing does not seem to have affected the sizes of any of the keys.

The keyboard has the layout of the C-64, with several improvements. First, an LED graces the shift lock key. Second, the primary alpha or numeric designators occur on the upper left corners of the keys. This placement is ideal for those who have never broken the habit of staring at the keyboard while composing text. This little change won't make a bit of difference to typing pros, but it will be appreciated by those who struggle along at a blistering, error-pocked 20 words per minute. No more constantly pulling your hands back to make certain that they are lodged correctly on the keys.

Lateral key wobble is only a bit worse

than on my \$3700 IBM PC clone, but the SX-64, like the C-64, has less tendency for adjacent key triggering than the IBM. While no microcomputer keyboard that I have tried has a "feel" that compares to that of the IBM Selectric, I did like the touch of the SX-64.

The keyboard is light, as befits a portable, and has the tendency to wander over the surface it rests on. To restrict this movement, Commodore has inserted a narrow rubber strip into the keyboard. On slick surfaces, however, this tiny strip has to be supplemented. I placed some thin rubber sheets under the keyboard, which kept it in place.

The Video Display

The built-in color monitor, on the left front of the unit, has a nearly rectangular screen that measures only 5" across the diagonal. Although the monitor uses a composite video signal, the display is crisp. Video controls as well as the audio volume control are located neatly behind a small plastic door on the far right. They are convenient to use and work effectively.

The color on the screen is great, and text on the screen is readable despite the small size of the screen. The size does not

Though there is space for a second drive, Commodore does not yet offer that option. Instead, there is an empty compartment available for disk storage. The absence of a second drive is relieved somewhat by the availability of the cartridge port. For word processing, for example, you could pop a cartridge like "Write Now" (Cardco, Inc.) into the slot and use the drive for a data disk.

If you have ever loaded programs with the C-64's 1541 disk drive, you know the procedure is slow, due to the drive's serial interface. The SX-64 drive, which also communicates serially, is also slow. The drive uses single-sided single-density diskettes with a formatted capacity of about 174K bytes. The disk drive is an "intelligent" one that uses a 6502 microprocessor and includes 16K of ROM, 2K of RAM, disk controller circuitry, and a disk operating system.

Software

The SX-64 includes as standard features BASIC language and the Commodore disk operating system. BASIC is in system ROM, while DOS is contained in a ROM on the disk drive's circuit board. The SX-64 is completely compatible

(Continued on page 83)

HP110 COMPUTER AND THINKJET PRINTER

Desktop performance in a kneetop package

BY FORREST M. MIMS, III

The air of secrecy surrounding the development of a new computer is reminiscent of the security in a military research laboratory. One of the bonuses of writing for a major computer magazine is having the opportunity to inspect and even try out some of these new machines before they are officially announced.

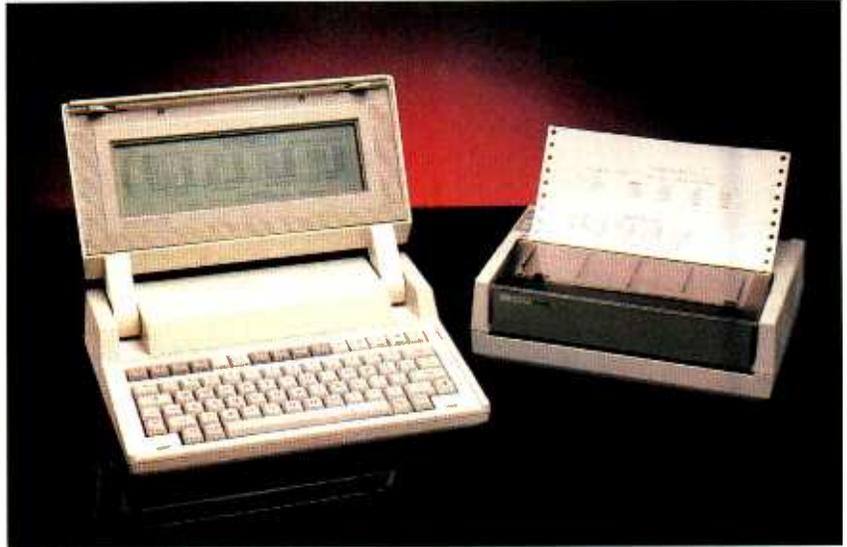
It's particularly fascinating to compare the actual computer with its rumored, leaked and speculated counterpart reported upon in the trade press. Those not in on the secret can be reasonably certain an unannounced computer actually exists when its manufacturer invokes a "No comment" policy or, especially, when a high company official vigorously denies the existence of the rumored machine.

Recently, for example, Hewlett-Packard's chairman, John Young, was reported by *Electronic Engineering Times* to have denied the existence of a rumored new portable known to insiders as *Nomad*. Normally, I read every word of confirmation signals like Mr. Young's, carefully looking for clues about the real machine, but this time it wasn't necessary. I had just concluded a busy session of poking away at the quiet keyboard of a very real HP 110 while a sheet of paper with neat rows of print emerged magically from Hewlett-Packard's whisper-quiet ThinkJet printer (see sidebar).

Being a dedicated portable computer fanatic (I bought a Model 100 within minutes after that machine was first placed on sale), you can imagine my excitement at having the opportunity to use the portable HP 110, the most powerful kneetop portable yet to appear.

My hands-on experience with the HP 110 was significantly enhanced by the knowledge that this remarkable new portable and its battery-powered ink jet printer are products of Hewlett-Packard. Just as the IBM logo symbolizes *service*, the initials HP denote *quality*.

Indeed, in the best tradition of HP's



line of scientific calculators (one of which survived burial in an avalanche; others, falls from great heights; and still others, the tires of ton-and-a-half automobiles) Hewlett-Packard claims the HP 110 can withstand a shock of 100 g in any direction! Though not verified with the prototype I evaluated, this means the HP 110 should easily survive a fall from a desk to the floor!

Getting to Know the HP 110

The HP 110 includes a high-resolution liquid crystal display, 280K bytes of RAM and a variety of powerful applications programs within its 392K bytes of ROM. All this fits nicely in a sturdy yet attractive package weighing 8½ lb and measuring 13" W × 10" D × 2⅞" H. When the two sliding latches on the front edge of the machine are moved toward one another, the top half of the computer unfolds to reveal a full-size 61-key typewriter keyboard, a row of 15 function and cursor control keys and a state-of-the-art 16-line by 80-character (128 × 480 pixel) liquid crystal display.

The appearance of the display is certainly the most striking feature of this new machine. The entire screen can be tilted back and forth to minimize glare. Contrast can be altered in discrete steps by pressing a special contrast key. Finally, text displayed on the screen is easy to

read since the character fonts resemble conventional type rather than the stick-figure format of most other dot-matrix displays.

Under the keyboard and behind the display window are a total of four circuit boards containing some 100 micropower CMOS chips. The microprocessor that drives and controls the machine is a CMOS version of the 8086. Unlike the 8088 used in IBM's PC, the 8086 is a bonafide 16-bit processor and provides about twice the processing speed.

The HP 110 can be switched off by pressing one of the function keys. Or, when the machine is operating from its internal battery pack, it can be set to switch itself off automatically after a period of inactivity ranging from 30 seconds to 30 minutes.

When the HP 110 is first switched on, its screen briefly displays copyright information about its bundled software and its serial number. The computer then enters its Personal Applications Manager (PAM) mode and the screen displays the number of available bytes in RAM, the time and date, and various menu options. It even displays, on a scale of 0 to 100, the percentage of charge remaining in the self-contained lead-acid battery pack.

Three of the menu options are the major applications programs permanently

PHOTOS BY MICHAEL BRESKIN

HP INTERFACE LOOP (HP-IL)

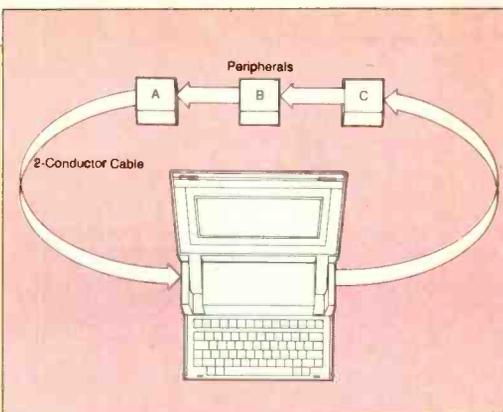
THE HP 110 is equipped with both a traditional RS-232C serial interface and Hewlett-Packard's Interface Loop (HP-IL). Though most computer users are familiar with the former, comparatively few ever heard of HP-IL.

Hewlett-Packard designed the HP-IL system to provide a low-cost bit-serial interface for battery-powered test instruments, programmable calculators (like the HP-41 series), computers and a wide range of printers, plotters and other peripherals. Each HP-IL device has output and input two-conductor sockets.

An HP-IL system is formed by connecting a two-conductor cable from the output of a computer or other controller

device to the input of a second HP-IL device. A second cable is then connected between the input of the computer and the output of the second HP-IL device. The result is a *closed interface loop*. It can include up to *thirty* devices. Each device is assigned an appropriate numerical address so it can be accessed by the loop's programmable calculator or computer.

Most HP-IL devices electronically identify their device classification. For instance, an HP-IL printer like Thinkjet responds with the HP-IL electronic ID number for printers when the computer issues a PRINT command. The information to be printed is then sent to the printer without the user having to specify a device address.



HP-IL allows devices to be separated by up to 100 meters using shielded twisted pair and 10 meters when the cable is unshielded.

In short, HP-IL provides a simple but powerful interface link for battery-powered computers like the HP 110 and their peripherals. ◇

HP'S WHISPER-QUIET THINKJET PRINTER

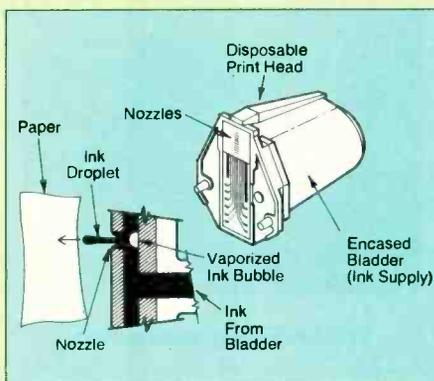
THE high noise level of nearly all impact-type dot-matrix printers is a major irritant to their users and anyone else within earshot. Consequently computer and printer companies have spent millions of dollars in efforts to develop quiet, nonimpact printers having acceptable print quality.

Until recently thermal printheads pressed against heat-sensitive paper provided the major non-impact printing technology. Though very quiet and moderately fast, thermal printers require special paper and produce relatively low-contrast characters.

Now, thanks to the arrival of the moderately priced (\$495) Hewlett-Packard 2225 Ink Jet Printer, the *ThinkJet*, the days of ear-numbing impact printers are numbered. The ThinkJet is just as quiet and, at 150 characters per second, much faster than a thermal printer. And since its characters are formed by spraying microscopic droplets of ink, it produces crisp, high-contrast characters. Though the ThinkJet isn't a letter-quality printer, its print matrix of 11 × 12 dots forms well-defined, highly legible characters.

Three versions of the ThinkJet are available. The HP 2225A is line-powered and fully compatible with Hewlett-Packard's Model 150 touch-screen computer. The HP 2225C, also line-powered, includes an industry standard Centronics-type parallel bus.

The HP 2225B is battery powered and includes a built-in HP-IL interface (see accompanying sidebar). Therefore, it forms an ideal companion for Hewlett-Packard's new HP 110 portable computer. It can print some 200 pages of text on a single battery charge.



Though ink jet printers have been around for some time, their tiny ink lines, pumps and reservoirs have been subject to clogging problems. The ThinkJet eliminates these problems entirely by employing a novel method of generating droplets of ink. The technique was conceived first by Ichiro Endo of Japan's Canon, Inc., where it is known as *Bubblejet*, and then independently by John Vaught at Hewlett-Packard.

The key to the ThinkJet is a disposable print head cartridge containing a bladder filled with enough ink to print 500 pages of text and a tiny print head equipped with a linear array of microscopic apertures. Each tiny aperture is backed by a miniature heating element. When a brief pulse of current is passed through the element, a vaporized bubble of ink is generated. The bubble then bursts, propelling a droplet of ink through the aperture and toward the paper where it forms a black dot 0.015" in diameter.

The entire printing process is imple-

mented by the disposable print head cartridge. Unlike conventional ink jet printers, there is *no* ink-collecting gutter and no tubes, pumps or reservoirs to clog.

As the ink supply runs out, the bladder, which can be viewed through the cartridge's clear walls, collapses. Its appearance provides a visual clue to the amount of ink remaining.

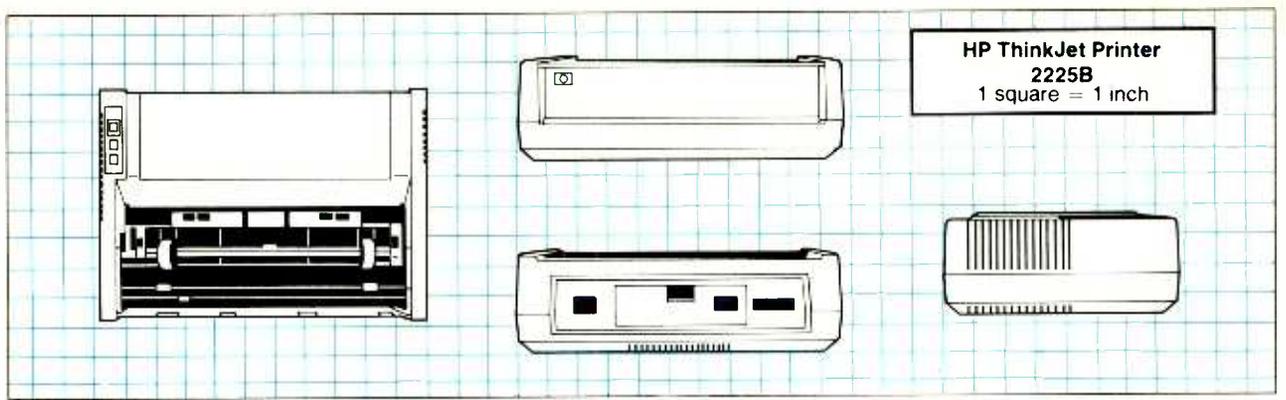
Using the ThinkJet

Either single sheets or sprocketed fan-fold paper can be used with the ThinkJet (the machine has both friction and tractor drive). After a sheet of paper is loaded and the machine is turned on, the print head clears its apertures by spraying a few drops of ink on a replaceable absorber pad.

Proper operation of the printer can be verified by depressing the machine's line feed button while turning the power on. Releasing the line feed button then causes the printer to spray on the paper a preprogrammed sequence of test characters. Switching the machine off ends the test session.

The ThinkJet can print 256 different characters in several different pitches. It can also print single-pass boldface and underlined characters and words. These and many other special printing and formatting features are available by means of special control code sequences which must be entered into a companion computer (but which are themselves not printed).

As for graphics, the ThinkJet can print anything displayed on the screen of an HP 110 or other compatible computer. Its resolution is 96 × 96 or 96 × 192 dots per inch. ◇



**HP ThinkJet Printer
2225B**
1 square = 1 inch

stored within the system's 384K bytes of CMOS ROM. They include a simple word processor package called *MemoMaker*, a terminal emulator and, believe it or not, all the graphics and information management features of Lotus 1-2-3, the best-selling spreadsheet package.

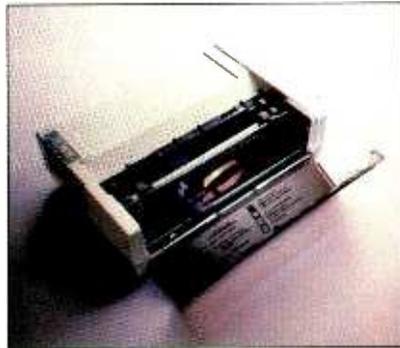
The fourth option is the MS-DOS operating system. Any of these packages can be selected by moving a small pointer with the cursor-control keys and pressing RETURN.

Below the titles of the bundled application programs appears a row of menu options corresponding to the eight function keys. These keys allow you to begin operating a selected applications program, set the computer's clock, establish the data communication configuration, reconfigure many of the machine's operating modes and switch the machine off.

Of particular importance is the HELP key. Summaries of the critical portions of the HP 110's various operating man-

uals are stored in ROM, and they can be instantly recalled simply by pressing the HELP key which is provided in virtually every operating mode. Pressing HELP fills the screen with a detailed explanation of how to proceed.

For example, when the machine wakes up in the PAM mode, pressing HELP provides "Running Applications" to "Turning Off the HP 110." After a topic is selected (using the cursor-control keys to



ThinkJet spray mechanism

highlight the desired topic), the screen provides a concise explanation.

Apparently assuming most potential users will use the HP 110's bundled application programs and commercial software, Hewlett-Packard chose not to include BASIC in the machine's ROM. However, Microsoft BASIC, FORTRAN, COBOL and Pascal are or soon will be available on disk, as will be many other popular software packages. They include Microsoft Word, Wordstar, Spellstar, Multiplan, Compiled

Specifications

Product: ThinkJet Printer (2225B)
Mfr: Hewlett-Packard
 Personal Computer Group
 1000 N.E. Circle Blvd.
 Corvallis, OR 97330
Dimensions: 11"W x 7½"D x 3¼"H
Weight: 5 lb
Price: \$495
Features: Ink jet printer, 150 cps, battery power, HP-IL interface, disposable print head cartridge, 11 x 12 print matrix, 96 x 96 or 96 x 192 per inch

BASIC, dBase II, DataLink and many others.

Configuring the System

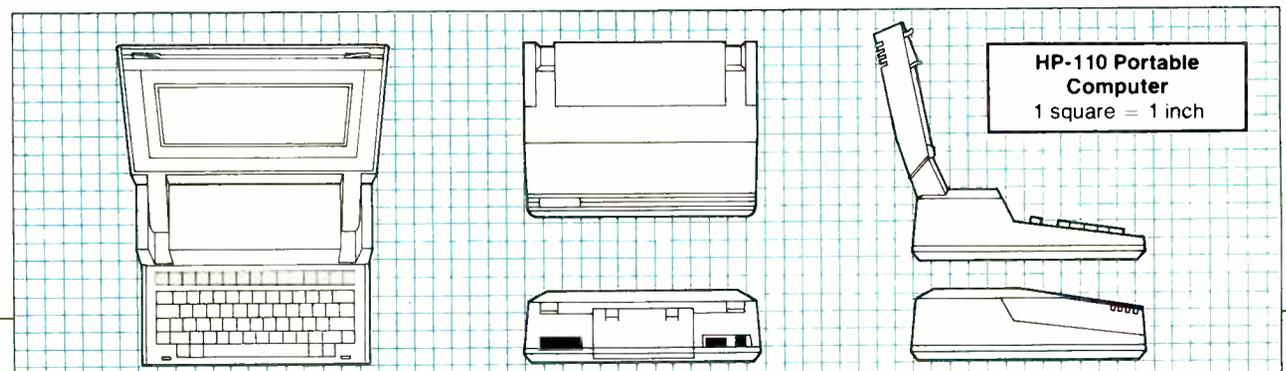
Pressing the *System Configuration* menu key allows many of the HP 110's standard (default) parameters to be altered. For example, the user can select a new time delay for the automatic timeout feature, change the way characters are displayed on the screen, and change the cursor from a nearly invisible underscore to a clearly visible box. It's also possible to establish various communication parameters for printers and plotters.

The most powerful feature of the System Configuration menu option is the ability to specify how the HP 110's memory is organized. Briefly, a portion of RAM can be assigned as system memory while the remainder electronically emulates a super-fast solid-state "disk drive." Let's look at this powerful capability in more detail.

(Continued on page 90)

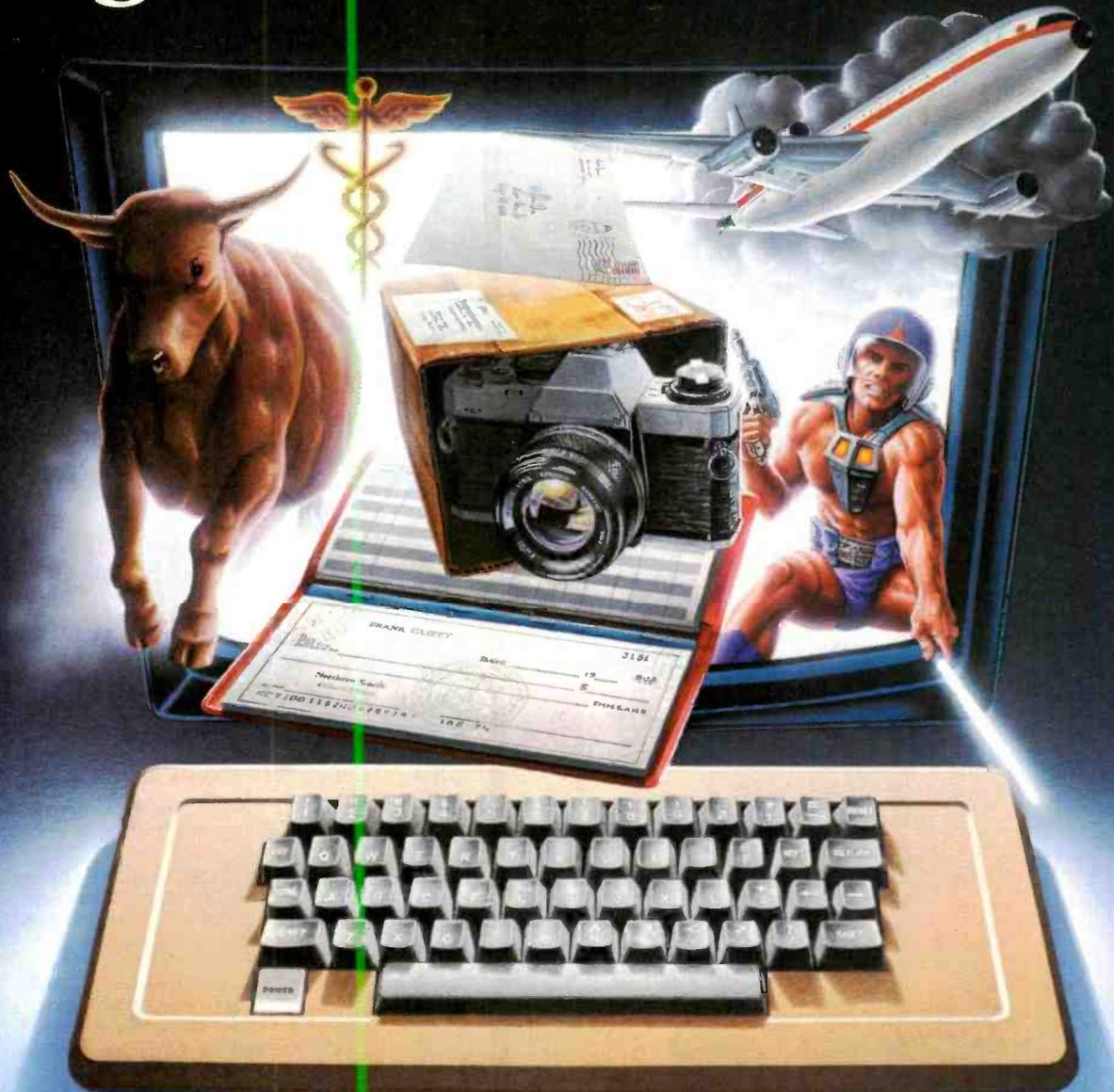
Specifications

Product: HP-110 Portable Computer
Mfr: Hewlett-Packard
 Personal Computer Group
 1000 N.E. Circle Blvd.
 Corvallis, OR 97330
Dimensions: 13"W x 10"D x 3"H
Weight: 9 lb
Price: \$2995
Operating System: MS-DOS
Features: 80C86 microprocessor, 384K CMOS ROM, 272K CMOS RAM, 16 x 80 LCD, modem, battery power, RS-232, HP-IL, Lotus 1-2-3, MemoMaker, Terminal Emulation



**HP-110 Portable
Computer**
1 square = 1 inch

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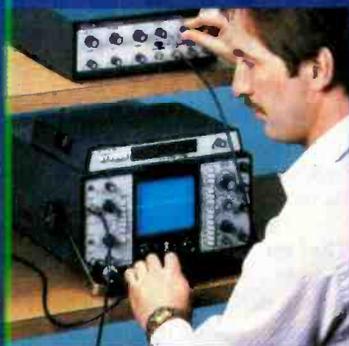
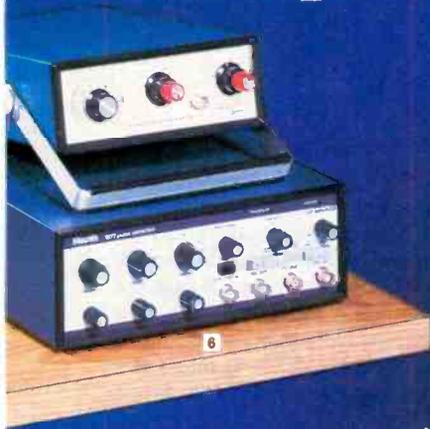
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- 1 IG-4244 Scope Calibrator. <math>< 1</math> ns rise time. 0.015% tolerance.
- 2 IO-4205 Dual-Trace 5 MHz Scope. Low cost, 10mV/cm sensitivity.
- 3 IT-2232 Component Tracer. Checks parts and circuits without energizing them.
- 4 IP-2718 Power Supply. One fixed 5 VDC and two adjustable 20 VDC supplies.
- 5 IG-1271 Function Generator. Sine, square, triangle waveforms. 0.1 Hz to 1 MHz.
- 6 IG-1277 Pulse Generator. Pulses from 100 ns to 1 sec width.
- 7 IT-5230 CRT Tester. Tests, cleans, restores CRT's.
- 8 IM-2264 DMM. True RMS readings of AC voltages. Analog metering, too.
- 9 IM-2420 Frequency Counter. 5 Hz to 512 MHz. 25 mV RMS guaranteed, 4 to 15 mV typical. Ovenized oscillator. Has period and frequency modes, too.
- 10 IM-2215 Hand-held DMM. Five DC V ranges. Accuracy: $\pm 0.25\%$ of reading + 1 count.
- 11 IT-2250 Capacitance Meter. 199.9 pF to 199.9 mF. 0.2% basic accuracy. Auto ranging.
- 12 IO-4360 Scope and IOA-4200 Time/Voltage Module. Our finest. Triple trace, 60 MHz, <math>< 7</math> ns rise time. Revolutionary IOA-4200 controls CRT cursor and multi-function display.

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SOFTWARE REVIEWS

FRAMEWORK

Ashton-Tate puts it all together with an integrated package

BY LEE D. ZIMSKIND

IN 1981 Ashton-Tate introduced dBASE II, a best-selling database management system for microcomputers. During the last three years they have continued to develop new products for database and file management, including the recently announced dBASE III. Framework is Ashton-Tate's newest entry into the rapidly expanding integrated software market. Ashton-Tate was scheduled at the time of this writing to begin shipping it on July 2.

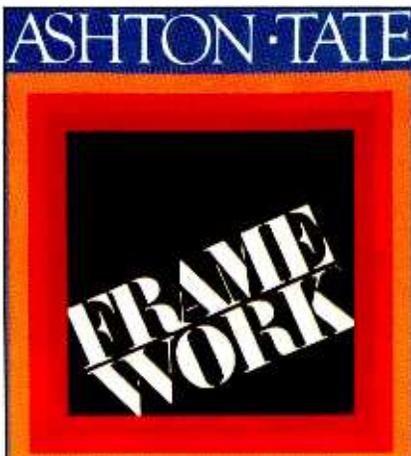
The theory behind integrated software is that productivity and utility are increased when several applications are combined under one interface. Most integrated packages include at least word processing, spreadsheet, and business graphics. Some add communications and/or other facilities. Framework is a very well-equipped package. It includes word processing, spreadsheet, graphics and communications, plus data management, forms processing, and two features which, according to Ashton-Tate, differentiate their product from others—an outline generator and a very powerful high-level programming language called FRED that makes Framework ideal for developing vertical applications and integrating other programs into the Framework environment. Indeed, Ashton-Tate has chosen to implement the communications features of Framework by using FRED to incorporate Mycroft Labs' popular terminal emulation package, MITE. Its cost is included in Framework's \$695 price.

Ashton-Tate provided a pre-release version of their product for review. Since documentation was incomplete, I will not comment on it, except to say that it appears to be extensive, providing templates, reference cards and tutorials. Documentation for the programming language is not included in the standard package, but is available separately.

What Framework does is simulate a desktop using the computer's display. It can place various kinds of documents or frames—word processing, spreadsheet, graphs, databases—on the desktop, singly or in combination. Each frame is

identified by a user-assigned name of up to 255 characters (whose usefulness is increased if the first eight characters are unique). The list of frames on the desktop is kept in a "tray" on the right-hand part of the desktop (screen). The user, always knowing what is there, can easily retrieve or move among the frames. Since there is no limit to the number of frames on the desktop, the screen sometimes resembles a messy desk. To clear it, a single command can move the contents of the desktop to the tray. The process is quite orderly—and quite different from the usual clearing of ordinary desktops.

Frames can be nested within other frames (called "containing frames") without any limit. Different types of frames can be combined, so one document may contain text, spreadsheets and graphs. One of the strengths of Frame-



work is its capacity to organize frames within the containing frame as a tree structure or outline. For example, in order to write this article I created an outline within a containing frame called "framework article." All of the standard data-management functions exist at the frame level—create, add, delete, insert, move—which makes it very easy to organize ideas into coherent presentations.

You can move frames around on the desktop or change them in shape or size, or with a "zoom" feature, enlarge a frame to take up the whole screen. Frame management and function are similar to "windows" in other products. Ashton-Tate attributes the superiority of the frame concept to two capacities: using it, you can assign a name to a frame and store information (e.g., print options or, indeed, an entire program) with a frame. In the above example I was

able to supply the margin and paragraph indentation parameters for this entire article by defining them for "framework article." It is also possible to change the parameters when necessary. This is a very simple example of a very powerful capability: You can define as much as a 32,000-line program behind a frame border.

Implementation

The minimum system requirements of Framework are 256K of RAM and two 360K disk drives. We used the configuration for most of our testing and found that the software performed with quick speed and good response. In our pre-release version the files, especially spreadsheets, seemed to take up a huge amount of space both in memory and on the disk, but we assume this problem will be corrected.

You can use Framework with either a monochrome display or a color graphics adapter and color monitor. Ashton-Tate has used color not for the screens, but for display of graphs. The graphics features also work on IBM monochrome boards with standard monochrome adapters.

Framework makes extensive use of a help library. Whenever you press the F1 key, a help screen is displayed with information about current function options. The screens we saw were well-written and helpful.

When you first invoke Framework, an empty desktop is displayed on the screen. Across the top is a list of menus—Disk, Create, Edit, Locate, Frames, Words, Numbers, Graphs, Print—which you can access by hitting the INS key and moving the cursor onto the desired function or by holding the CTRL key down while typing the first letter of the desired function. One of the things I had trouble getting accustomed to was the use of the INS key as an "instruction" key rather than an "insert" key. When you select any of the functions, a menu appears listing the various options. You make a selection by moving the cursor onto it and pressing RETURN or by typing the first letter of the function.

The other item on the desktop at startup is a list of available storage devices. By selecting the appropriate device, again by highlighting it with the cursor, you can load a frame from a disk.

A highlighted line called the status panel near the bottom of the screen shows the name of the frame and the

column/row location of the cursor. For spreadsheets and databases, formulas behind the current cell are also shown. The bottom line on the screen is used to give more information. For example, during editing of a spreadsheet cell, that line displays the values or formulas; when a menu is in use, it shows a sentence describing the result of selecting the option.

At any point you can save the entire state of the system on disk. This feature makes it possible to leave Framework (perhaps to go home) and start it later exactly where you had left off.

One of Framework's strengths is its consistency across all applications. You use the same series of key strokes to move data whether in word processing, spreadsheet, database or outline mode. The same can be said for copying, search and replace, sorting, or any other function. Once you learn basic functions for any one application, you can apply them logically to the others.

Framework enables you to define up to 46 macros. In addition, more than 14 built-in functions are available for various applications: finances, statistics, control, logic, to name a few. If you find you need functions not provided by Framework, you can define others and store them in a library that will be invoked automatically.

There are four main types of frames: word processing, spreadsheet, graphics and database.

Word Processing

Framework incorporates most common word processing functions. When you create a word processing or "empty word" frame, it resembles a blank sheet of paper. You can begin typing immediately and format the page later. Alternatively, you can begin by using the Words menu for setting the left and right margins (maximum of 255 characters), paragraph indentation (including negative for hanging indents) and justification. You also use this menu to change the tab size—tabs are set at equal intervals across the page. There is no decimal tab. (Ashton-Tate suggests using a spreadsheet for columns of numbers and incorporating it in the document, but, as I will explain, there are drawbacks to this method.) Word processing defaults include "word wrap" and "insert" modes.

The approach Framework employs is "what you see is what you get." If you select full justification, the document ap-



Framework's outline feature helps organize ideas.

pears with it. The justified margins are maintained dynamically as text is added or deleted. In fact, all spacing is maintained dynamically; there is no reformatting function. This approach is maintained with the horizontal and vertical scrolling through the document and the display of underlined, boldfaced and italic characters.

While some of the fancier options, such as superscripting and subscripting, have not been included, all the basics—global search and replace, locate, move and copy—are implemented.

The word processor is not meant to be used for creating large documents, such as books. Although it is easy to get around a document if it is broken into manageable pieces in multiple frames, no partitioning (page breaks) within a frame is possible. In fact, it is impossible to reference a section of a document by page number: The frame must be paged through a screen at a time. To users of highly sophisticated word processing equipment this may prove an annoyance.

Spreadsheets

The spreadsheet implementation contains all the usual functions of spreadsheet programs. The number of rows and columns is limited only by machine memory (maximum array size is 32,000 rows by 32,000 columns). You address cells using letters to represent columns and numbers to refer to rows: Thus C5 refers to the fifth row of the third column. You may also reference or display a cell using a "meaningful" name, which is the concatenation of the column label and the row label, separated by a period.

Like other spreadsheet programs, Framework enables you to define formulas behind a cell or group of cells. In fact, a cell may contain a full 32,000-line program. Formulas or programs may reference other cells in the same spreadsheet or in another one. Generally the cell references in formulas are relative; that is, a formula that you move or copy is adjusted for the new position of the cell.

Framework also has the capability of specifying absolute cells, which do not change when the formula is moved. But, again, the real difference in Framework is the powerful command language that you can use in the definition of any cell.

Framework supplies most of the usual cursor functions, but not the capacity to "jump" directly to a specific cell. Entering data in other than row order requires two keystrokes between each entry instead of one. Adding and deleting rows and columns is somewhat more clumsy than in some competitors' products because you must set the cursor properly: Sometimes it is difficult to remember whether the new row or column will go before or after the cursor position (it's after). It is also possible to move or copy from another spreadsheet or database and to consolidate spreadsheets.

Choices for formatting are more than adequate. Text can be aligned left, right or centered and appear underlined, boldfaced or italic. Numbers can be displayed as integers, fixed decimals, in business format or in scientific notation with percent or dollar signs. A "nationalize" function allows currency conversion. It is easy to widen columns.

You can protect cells against change or editing, and easily create templates, by protecting the cells that don't change and using the "Blank All" command to erase the rest.

Graphics

Creating graphs from a spreadsheet or database is very easy in Framework. You select the data and invoke the "draw new graph" option of the graphics menu. The variables are automatically selected from the headers of the row or column being graphed. You can set various options, such as manual scaling and headings. You are also able to link the graph to the spreadsheet or database containing the data elements so that the graph is updated automatically. Since you can conveniently show both the data and the graph, you can immediately see the effect of changes in the data. The program defaults to a bar graph format, but stacked-bar, line, scatter, x-y, pie and exploded pie are available.

The technology employed for the graphics permits graphs to be run even on an IBM monochrome screen without a graphics adapter. Color, however, is supported for graphs on color monitors.

Although they were not ready at the
(Continued on page 73)

COMPAQ'S NEWEST COMPATIBLE

The company that made the first transportable IBM clone introduces a line of powerful new desktop computers

BY B&J MCMULLEN



Further, all models utilize the maximum 200-watt power supply for Model 4. These design choices give purchasers the ability to expand any model to the maximum without having to send the unit back to the shop.

Compaq is also distributing the new line, whose suggested retail prices (without a \$255 monitor) run from about \$2240 for the Model 1 to approximately \$6940 for the Model 4.

Backup

The internal hard disk backup is a 10.35 M-byte tape cartridge housed directly under a floppy disk drive (the flop-



COMPAQ Computer Corporation of Houston recently announced a new line of desktop computers called DESKPRO. The new series includes four models, all based on the Intel 8086 chip. The use of the 8086, which has an internal speed twice that of the Intel 8088, gives the new line a significant increase in throughput over the IBM PC and PC-XT as well as over other 8088-based PC-compatibles (including Compaq's own Portable and Plus models). Despite the use of a different processor, Compaq is equipping DESKPRO with the same level of compatibility with the IBM/MS-DOS standard that other Compaq models have.

The DESKPRO series is a complete line of four different units, ranging from Model 1, a 128K single floppy disk system, to Model 4, a 640K system containing a single floppy drive (expandable to dual floppy), a 10 M-byte fixed disk drive, an internal 10 M-byte fixed disk

backup and an asynchronous communications/clock board. In between, Model 2 is a 256K dual floppy system while Model 3 is equivalent to the IBM PC-XT (256K RAM, single floppy and 10 M-byte fixed disk drive) with an additional asynchronous communications/clock board.

All models have the same housing (14.74" wide by 13.75" deep by 10.75" high) which contains internal space and sockets for the maximum configuration.

py drives are half-height). This device also has the capacity to back up data from any logical DOS drive and permits users to archive files from floppies or from external network systems, such as Corvus Omninet. Gary Stimac, director of engineering for the Compaq Office Computer Division, which is responsible for the DESKPRO, estimated time needed for backup. He figures that to back up 10M bytes takes approximately 18 minutes (assuming that the target

Barbara and John McMullen are contributing editors to C&E.

cartridge has already been formatted for use, which takes approximately 40 minutes). Software supplied with DESKPRO units permits users also to take "directories" of the archival tape cartridges.

Compatibility

In pursuit of true PC compatibility for the DESKPRO, Compaq was able to tap its experience in reaching the same compatibility for its Portable units. Steve Flannigan, vice president, system engineering, who has the responsibility for ensuring software compatibility, points out that Compaq had developed internal programs to test software compatibility for the Portable and Plus models. These were already available when needed for DESKPRO development. Moreover, Compaq, in developing its earlier products, had learned—better than anyone else, including IBM (witness the non-compatibility of the PCjr)—the importance of compatibility and was able to implement it.

In order to provide full compatibility with the IBM PC, Compaq is equipping units with two different clock speeds:

a) 7.14 MHz—the internal speed of the 8086, which allows a DESKPRO unit to run at its maximum throughput rate. This setting is to be used for most normal business applications.

b) 4.77 MHz—a speed comparable to the 8088 processing utilized in the IBM PC and PC-XT. In this mode, which Compaq calls "common," is run any software that is dependent on internal clock rate (for example, communication programs that utilize programmed "time-out" loops or time-based dialing or handshaking protocols). Common mode is also used when speed is detrimental to the application. (In hobby or entertainment programs, like PacMan, double speed would be inappropriate.)

Switching between the two clock modes may be accomplished under soft-

ware control or by manual keyboard intervention (at any time). The current status of the setting is indicated by a light on the front left surface of the system: green for the native 8086 mode; red for the common mode.

Also in the interest of compatibility, the system contains eight IBM PC-XT-compatible expansion slots (one short and seven long). Of these slots, the floppy disk printer controller board and the video monitor board take a long slot each in all models. The fixed disk controller takes a long slot in Models 3 and 4, while the asynchronous communications/clock board uses the short slot in Models 3 and 4. This utilization leaves five long and one short slot available for additional peripherals in Models 1 and 2 and four long slots available in Models 3 and 4.

Throughput

While speed may not be a foremost concern of PC users today, Stimac believes that software is just beginning to push the limits of the 8088-based systems and that speed will soon become of utmost importance. Stimac makes the



point that DESKPRO permits technical expansion. Larger fixed disks, local area networks, etc., can utilize the same basic configuration as time goes on. (Early product testing, Stimac points out, showed that popular LAN's that were severely degraded by multi-computer access in an 8088 environment suffered no degradation in the DESKPRO 8086 environment.)

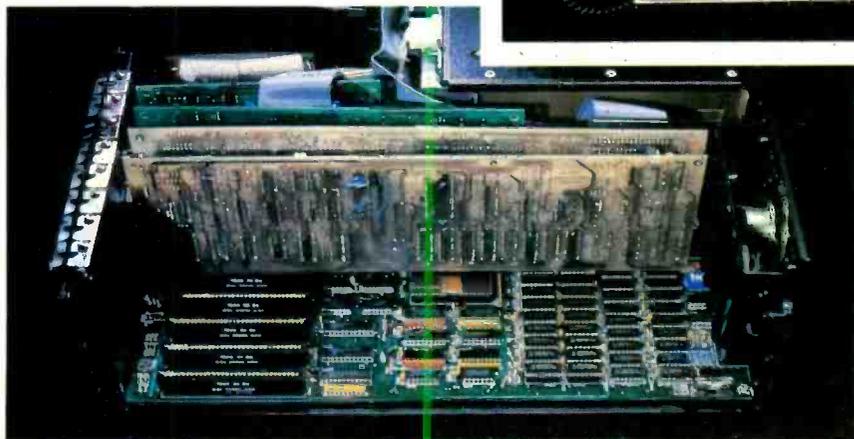
A further throughput enhancement is a motherboard that can contain up to 640K bytes "on-board." Its design allows users to access all RAM in the full 8086 16-bit format rather than through the 8-bit I/O bus that is utilized when



All models contain internal space and sockets for maximum configuration as shown at left.

accessing memory above 256K bytes on the IBM PC and PC-XT and PC-compatibles. In this way DESKPRO eliminates the degradation that occurs in these other systems.

The DESKPRO keyboard has the same layout as the Portable family (and thus the IBM line). The feel of the keys
(Continued on page 80)



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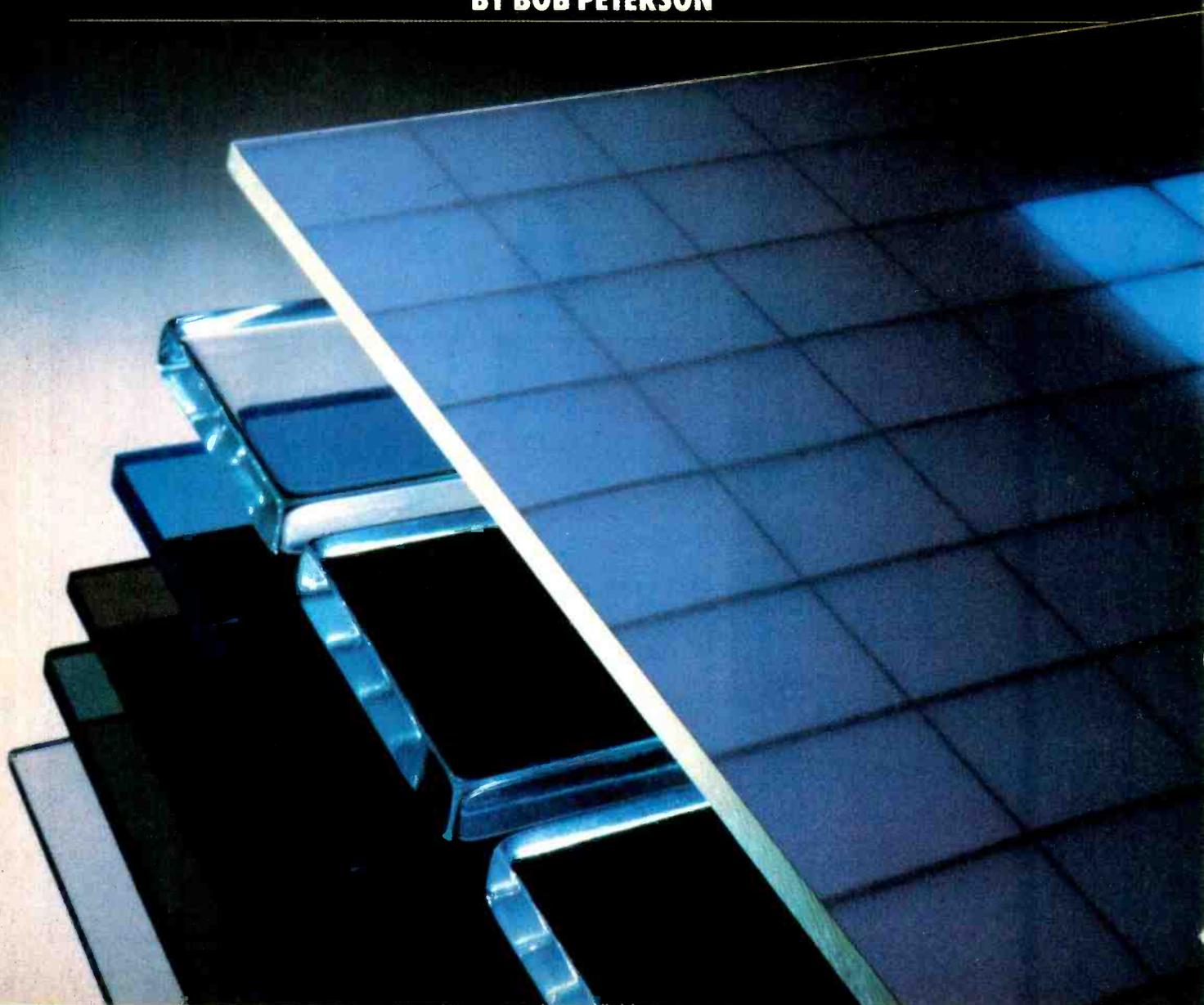
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BIG PICTURE LCD'S

New liquid crystal displays offer increasing competition for CRTs

BY BOB PETERSON



LIKE the protagonist in a Shakespearean play, the liquid-crystal display (LCD) has been hampered by a tragic flaw—its small size. However, that flaw is likely to disappear very soon.

In fact, several manufacturers are now making LCDs that display 24 or 25 lines of 80 characters—the same capacity as a standard CRT.

LCD panels are flat and require very little power, which makes them potentially the best display medium for lap-sized portable computers. But most of the big LCDs still suffer from the minor problems associated with smaller panels concerning viewing angle, speed of response, temperature range, and brightness. Fortunately, the benefits of the big

LCDs far outweigh the drawbacks.

Only one question must be answered before big LCDs are wedded to portable computers: Will users pay the price? Big LCDs aren't cheap. They cost much less than other flat panel alternatives, but that's not the only consideration involved. Are people willing to pay \$500 more for a computer such as the Radio Shack Model 100 (which has an 8-line display and costs under \$1000), just for

the convenience of a 24-line panel? The latter isn't available yet, but it won't be long before it (or something similar to it) will be.

All of the high-capacity LCDs, except one, are coming from Japan. Companies that have announced 24 × 80-character panels include Seiko Instruments, Sanyo, Sharp, and CrystalVision. The

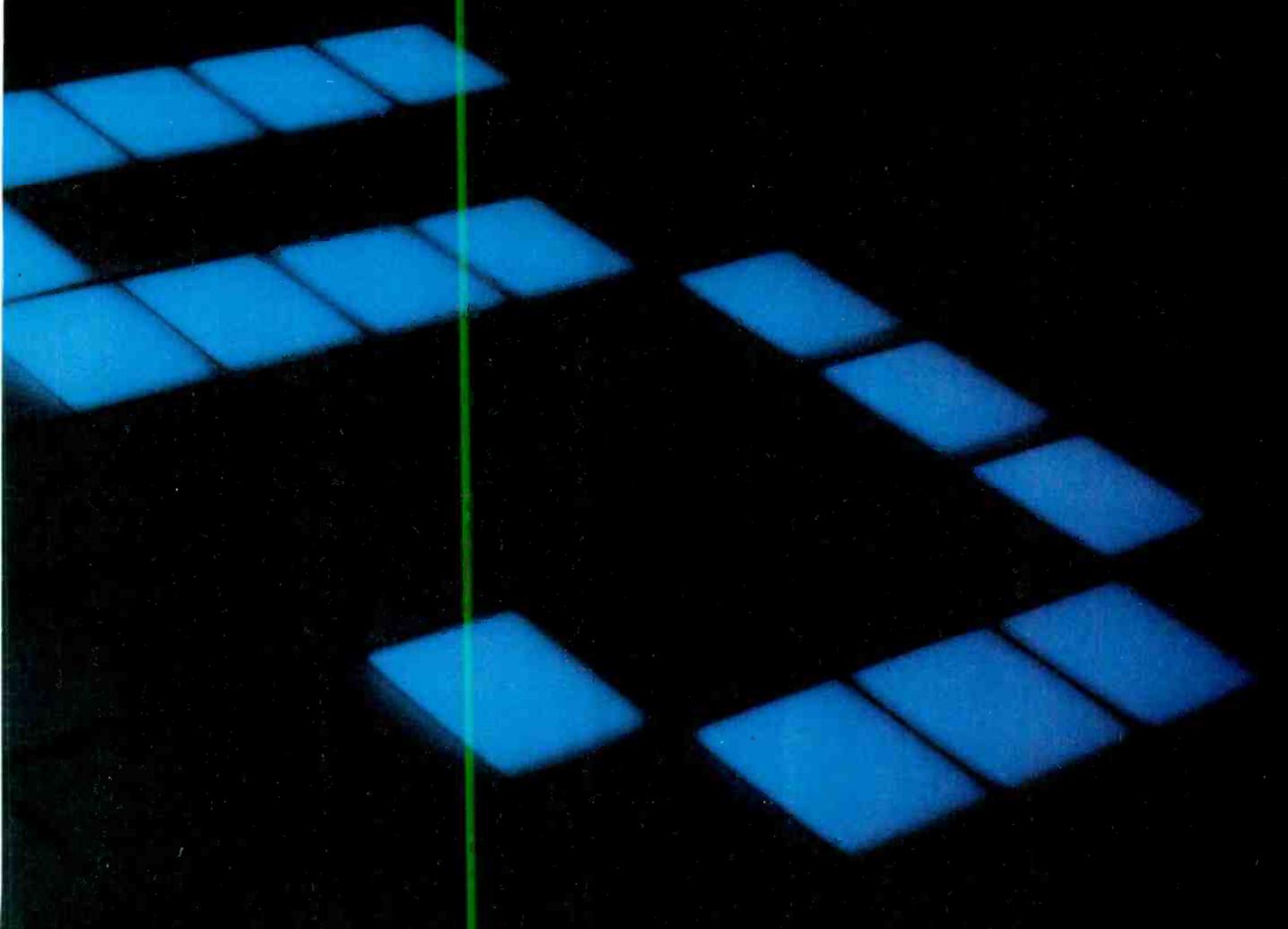


PHOTO BY BARRY BLACKMAN



Seiko's 24-line LCD.

Japanese are considered so far ahead in the LCD race, it's surprising to see a U.S. firm on this list, but CrystalVision claims to have a significant contribution to make.

Seiko is now marketing a 24×80 -character LCD that sells to manufacturers for about \$400 in small quantities. Although Seiko has been selling panels with on-board LCD controllers, the 24-line product won't include this circuitry because computer makers would rather handle control functions externally. By using a CRT controller instead of a dedicated LCD controller, the entire system can work much faster.

Also coming from Seiko, though, are three LCD graphic panels, one of which has 128×480 dots—or 16 rows of 80 characters if you count it that way. Unlike most LCDs, which require more than one voltage, the graphic displays require only one 5-V supply. They also contain a compensation circuit that keeps the voltage levels to the display at the best possible value for any given temperature.

Sanyo promises an LCD that displays a few more characters than a standard CRT. This panel provides 200×640 dots—25 rows of over 100 characters each. The product comes with CMOS drivers on a pc board for \$273 in large quantities. It's interesting to note that

the multiplexing rate of this panel is more than three times as great as some of the LCDs currently on the market. Sanyo is obviously pushing standard LCD technology further than other manufacturers.

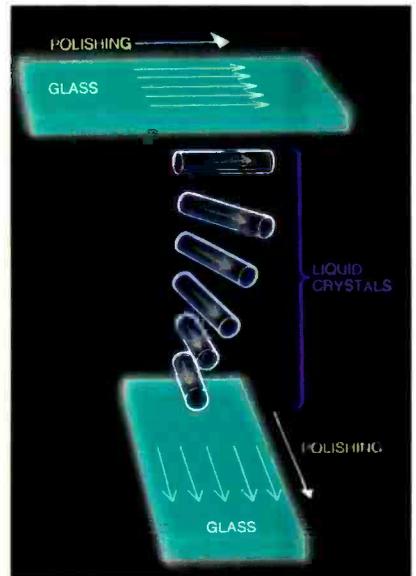
The third Japanese large-LCD entry—and the winner so far in the race to lower prices—is Sharp. The company plans to sell its 25×80 -character panel for less than \$200 in large quantities. It's difficult to tell how the panel cost will translate into a final computer product price, but you'll probably find out before long. Sharp is shipping prototypes at the time of this writing and expects to sell production quantities by June.

A U.S. firm that recently began working on LCD technology, CrystalVision, plans to compete in the large-panel race in a big way. The company has developed a 25×80 -character display that differs markedly from standard LCDs. Though the cost is about twice as much as a comparably sized CRT, this panel's display quality may enable it to compete favorably with conventional CRTs.

LCDs Aren't Created Equal

The differences between the LCD from CrystalVision and those from the Japanese companies stem from the type of LCD technology used. A complete understanding of these technologies requires a crash course in the chemistry

Fig. 1. Twisted nematic molecules.



behind LCDs, but the basic principles are fairly simple.

Two types of liquid crystals exist. One type, lyotropic crystals, are very common in living things; every living cell contains this kind of crystal. You can see the optical properties of lyotropic crystals in dishwashing liquid if you let some run down the sides of a clear glass. The thread-like refractions you see are long

Layers of twisted nematic LCD.

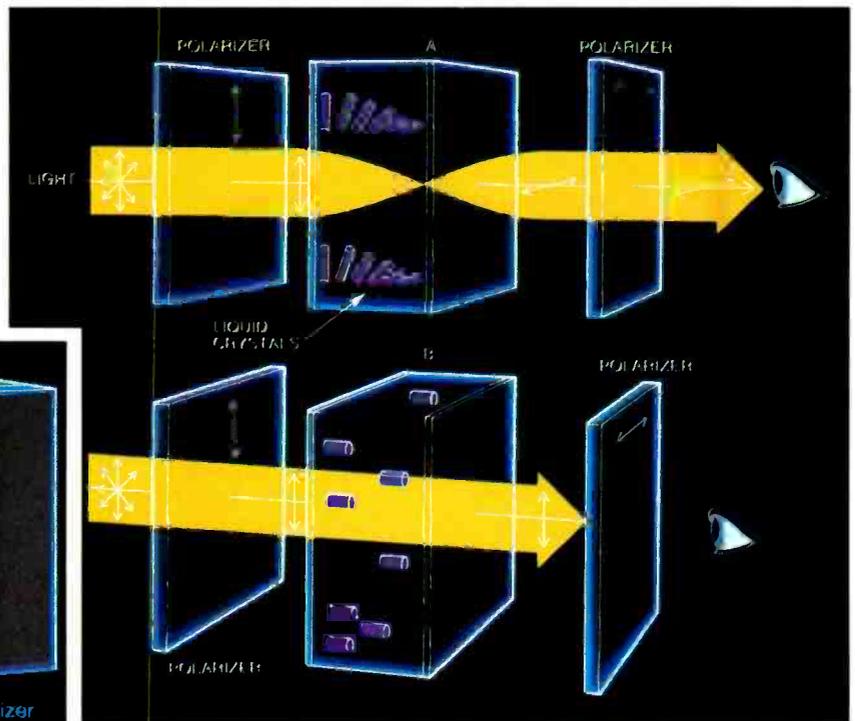
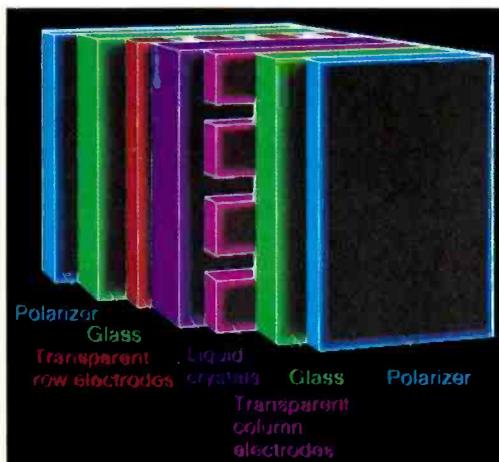
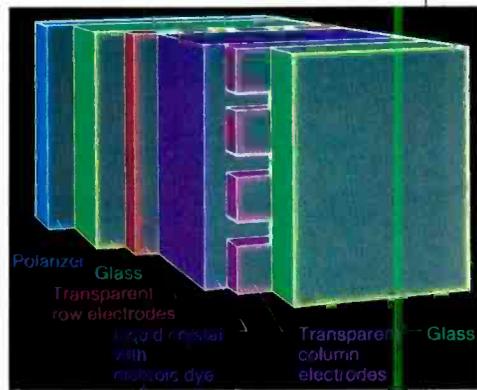


Fig. 2. Twisted nematic LCD is off at (A); on at (B).

liquid crystal molecules that scatter light, thus making themselves apparent when you look through them. Because these crystals consist of two phases (more on that in a moment), they aren't used in LCD displays.

The second type of crystal, the thermotropic, is the kind used in all LCD displays. Thermotropic crystals are useful because they exist in only one phase at a time. The phase of a liquid crystal depends on its temperature, just as the phase of H₂O does. When H₂O is very



Layers of guest host LCD.

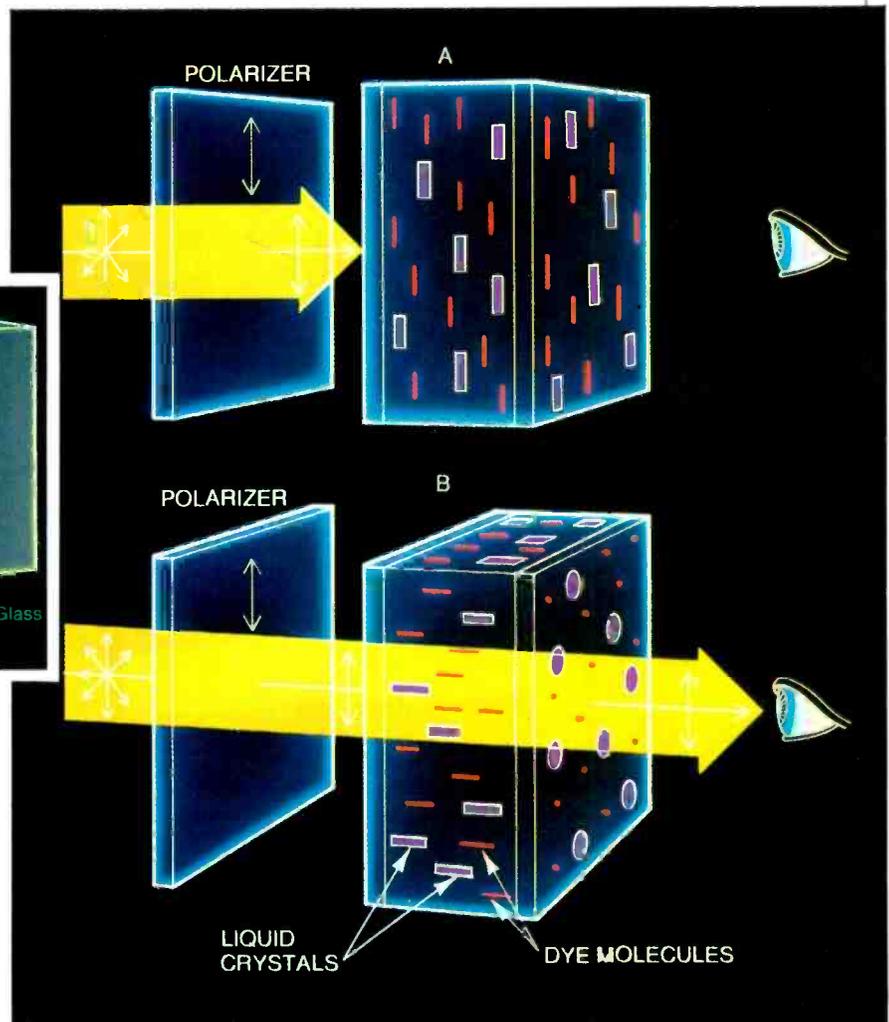
cold, for example, it exists in the solid phase—ice. Heating it changes its phase to liquid—water. And heating it further produces the gas phase—steam.

Liquid crystals go through similar changes, but they go through many more phases than H₂O does. These phases can be described in terms of the way the material's molecules are organized. At very low temperatures, a liquid crystal is a solid and is organized in three dimensions; that is, the molecules aren't free to move in any direction. Heating the material a certain amount changes the crystals to what is called the smectic phase, where they are in a semi-solid form that's organized in two dimensions. This smectic phase still doesn't allow the crystal molecules to move freely. Further heating changes the material from the smectic phase to the nematic phase, in which one-dimensional organization lets the molecules move freely in all directions except one.

The nematic phase exists in the thread-like scattering caused by dish-washing liquid; the long liquid crystals organize in this way when the temperature allows them to exist in long molecules. As Kevin Hathaway, a flat-panel display consultant from Mesophase, Inc. (Cupertino, CA), explains, it's like throwing pencils into a box and shaking the box: The pencils tend to line up.

Heating the liquid crystal further causes the material to lose all forms of

Fig. 3. Guest-host LCD is off at (A); on at (B).



ordering and enter the isotropic liquid phase. The material is now a "normal" liquid. A certain amount of additional heat boils the material into a gas.

Whipping Crystals Into Line

Three of the phases just described—the smectic, nematic and isotropic—are important to understanding liquid-crystal displays. Almost all LCDs now available use the nematic phase, where the molecules line up in one dimension. But even though these LCDs use the same phase, there are still different types of devices that work in different ways. The CrystalVision panel, however, uses a completely different approach from the rest.

The two main types of standard LCDs are twisted nematic and guest-host. The large LCDs coming from the Japanese, as well as almost all other commercially available LCDs, are twisted nematic panels. These devices depend on the use

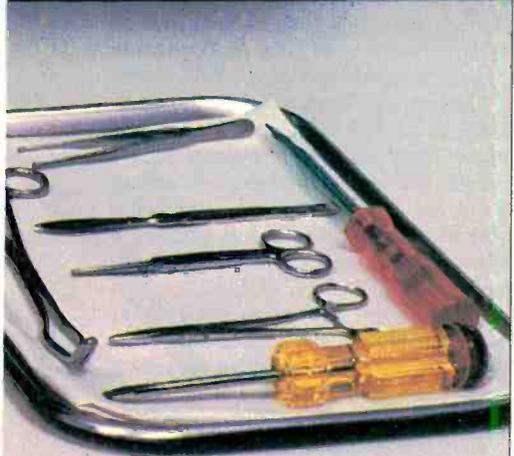
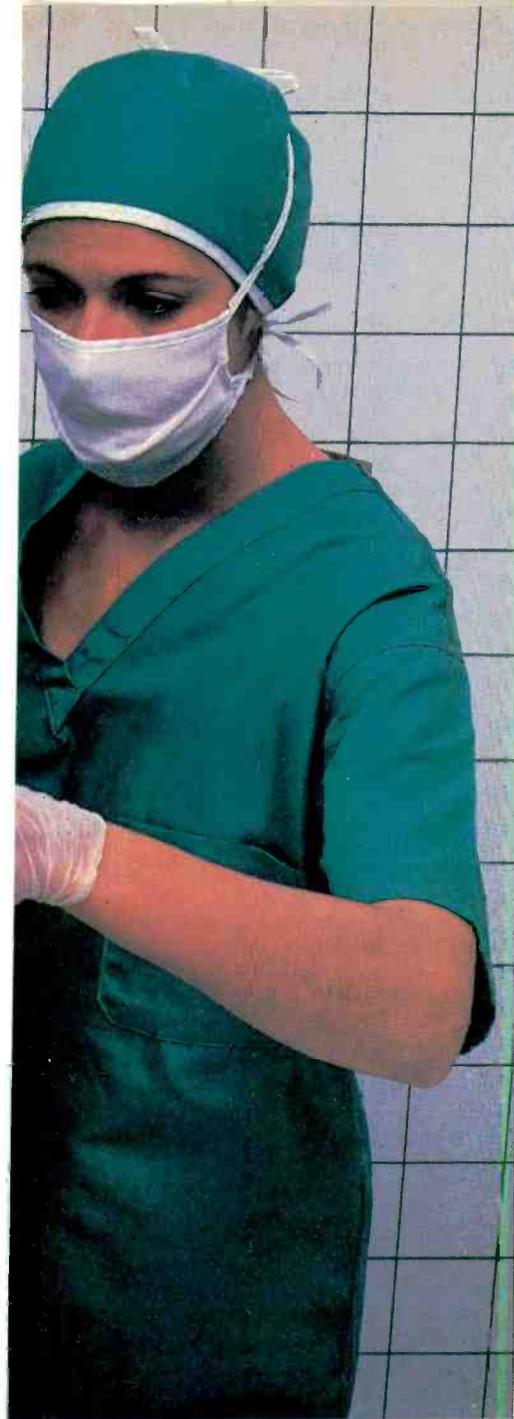
of two polarizers, and so have some performance drawbacks such as a narrow viewing angle and contrast limitations due to loss of light in the polarizers. The other conventional LCD type, guest-host, shows promise of providing better performance for many uses, but still needs some work before becoming widely useful.

The liquid crystal part of a twisted nematic LCD is sandwiched between sheets of glass (Fig. 1). When the display is off, its design causes the crystal molecules near one sheet of glass to line up horizontally, while the crystals near the other sheet line up vertically. Because the molecules try to line up like the pencils in a box but are held in different directions at either glass sheet, they end up

Bob Peterson is an engineer and freelance author in the fields of computers and electronics.

(Continued on page 85)





MICRO SERVICE ORGANIZATIONS

Outfits you can turn to when—or before—your hardware fails

BY ELIZABETH BIBB

Most computer owners don't worry about service until their machines break down. That's usually long after the original purchase and *after* the warranty has expired, when the owner is in no position to bargain. His main concern is getting the computer back up and running again. Choices are few in these emergency situations so most users turn to their manufacturer for service. Service is, in fact, why many chose their machine in the first place, but relying on the original manufacturer may not always be the best or most economical choice.

To maintain their options in the event of machine failure, more micro owners are signing service contracts that offer a guaranteed fixed annual rate for all repairs and parts required.

Most computers come with 90-day warranties that include parts and labor. Extended warranties are usually available for an additional year for a flat rate. Service contracts offer protection after the warranty and extension expire.

Service contracts, or maintenance agreements, as they are often called, are offered by numerous sources, including the manufacturers, dealers and third-party maintenance organizations (TPMs). In the beginning, when the personal computer was just a vision, most computer users leased their mainframe equipment from IBM. Then, after the Consent Decree of 1956 was issued, IBM was legally required to sell, as well as lease, equipment. That meant that for the first time, service manuals and documentation had to be provided to the public. With that decree, a new industry was born—third-party computer servicing and maintenance.

Even now that the microprocessor has expanded the computer universe exponentially, most users opt to stay with the

original manufacturers of their equipment when problems arise. Many are not even aware of the alternatives or have been cautioned by their manufacturer that third party maintenance is inferior.

In the 1970s, however, as multiple configurations of systems appeared, owners with, for example, an IBM PC, an Okidata printer and a Hayes Smartmodem, found IBM's service limited to only the PC.

IBM and most of the other familiar names in microcomputers, including Apple and Radio Shack, continue to service only their own equipment, but at least one, Xerox, has extended its service division to include other manufacturers.

At least 12 national firms offer multi-vendor service at hundreds of field locations. Added to their numbers are many local service groups and dealers who service the equipment they sell.

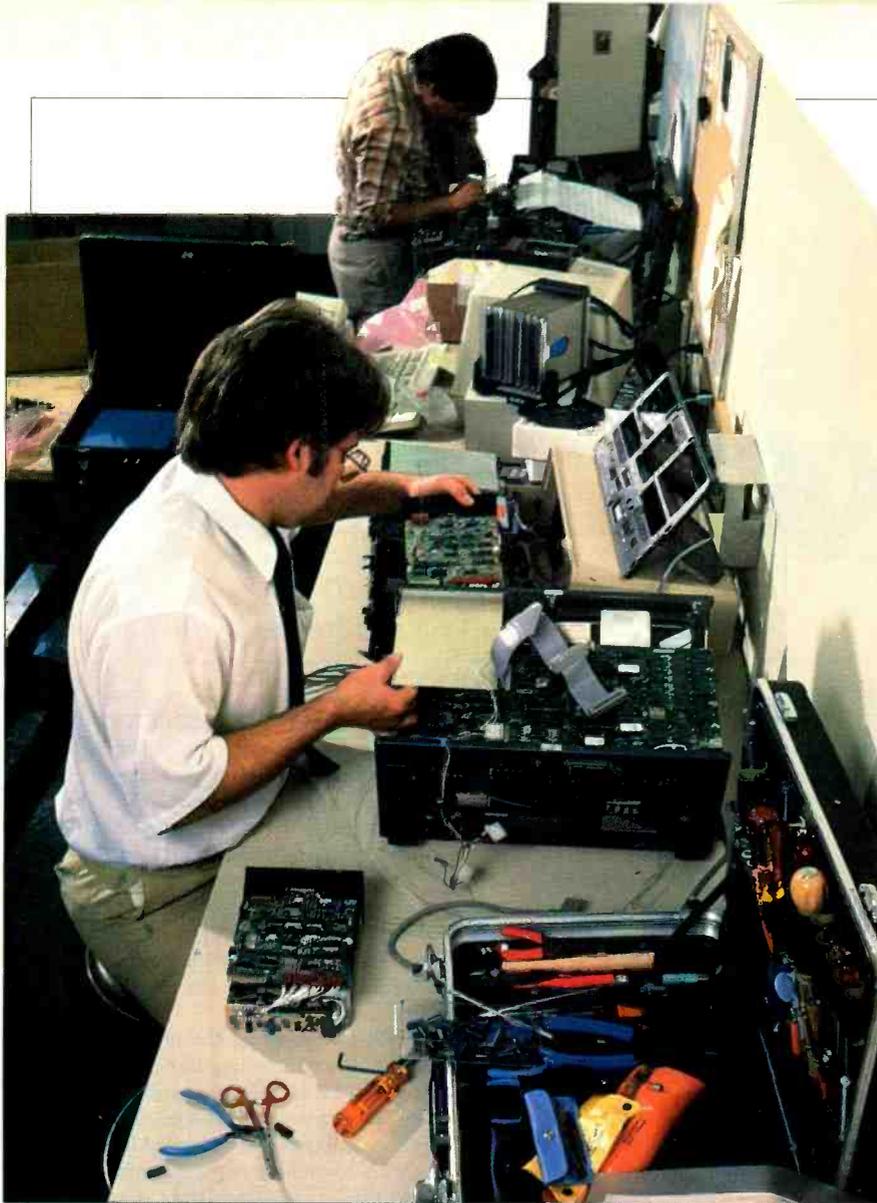
Comma was the first TPM, founded in the late 1960s by two former IBM maintenance engineers who left to start their own venture. Because the fledgling micro industry had not yet burgeoned when Comma began, high start-up costs involved in servicing mainframes mixed with user hesitancy caused problems for this early TPM. It was bought in 1973 by Control Data, today one of the leaders in the field.

An \$850 Million Industry

In 1982 six firms were responsible for over half the \$850 million collected in the service field, according to a report by Decision Services Corporation. They include TRW Customer Service Division, MAI/Sorbus, Control Data Corporation Engineering Services, RCA Services, Western Union Field Services, and

Elizabeth Bibb is a former wire service reporter who writes often about microcomputers.

PHOTO BY ERIC BARRICK



Xerox service technicians in New York replace defective micro boards.

General Electric Equipment and Computer Services.

With so many companies competing to offer service, getting that service should be easy and inexpensive for the consumer. But it's not always as simple as it seems. The number of plans and options can be as boggling as trying to figure out why there are glitches on your screen.

Most service organizations offer maintenance agreements that become effective after the typical 90-day warranty period. Some dealers offer extended warranties as well, such as the \$99 extension offered by Computer Era for the Apple computer, which extends the life of a warranty for a year.

What all these agreements have in common is that they offer insurance against unforeseen and potentially costly repair problems. The average life of a microprocessor is five to seven years, according to George Harmon, president of Serviceland Corporation, a California-

based TPM. A service contract can extend the life of a computer at least two more years, according to Harmon. Given the national average for the cost of a service call, which is \$130, the contract, which averages between \$150 to \$350, might pay for itself within a year.

Prices of the agreements themselves vary according to the type of equipment covered. Different service options also mean different prices. These can include the use of a loaned machine during the repair period or even replacement equipment, an important feature if avoiding downtime is a priority.

Although each vendor offers different plans, most service organizations, be they dealer-based, manufacturer-based or independent, usually give users the option of on-site or carry-in service. On-site is generally the preferred plan, but it is also the most expensive, since it requires a personal call by a service technician.

Carry-in service is cheaper, but it can

SERVICE COMPANIES FOR MICROS

TRW Customer Service
15 Law Dr.
Fairfield, NJ 07006
201-575-7110

MAI-Sorbus
50 E. Swedesford Rd.
Frazer, PA 19355
215-296-6000

Control Data Corp.
8100 34th Ave. South
Minneapolis, MN 55440
612-853-8100

Xerox Customer Service
(Americare Program)
Xerox Square
Rochester, NY 14644
716-423-4205

Western Union
Field Service
1 Lake St.
at Arrow Rd. Annex
Upper Saddle River, NJ 07458
201-934-0200

RCA Service Co.
Bldg. 204-2
Route 38
Cherry Hill, NJ 08538
201-338-4400

General Electric
Equipment and Services
21 Madison Rd.
Fairfield, NJ 07006
201-227-7900 or
212-349-2687

be inconvenient. Some companies offer carry-in service with the option of a courier to pick up the equipment.

Contracts may be purchased through a service vendor directly or through dealers. Although some dealers such as Wolff Computer in New York provide their own service and agreements, smaller dealers who cannot afford the overhead of service departments, are the most likely to sell third-party agreements. Service is an important selling point for small computers, and being able to offer it—even if it is through a third party at another location—is advantageous to dealers.

TPMs offer incentive programs, which enable a dealer to earn a percentage of repair costs each time he sells a service contract. To further attract dealers, Xerox, through the company's Americare program, allows dealers to sell service contracts without ever mentioning the Xerox name, according to Donald Flynn, manager of Xerox mar-

keting communications. Other incentives, such as travel and gift bonuses, in addition to discounts on service, add further encouragement to dealers.

An individual can also choose to deal directly with a TPM. Xerox offers direct service in addition to dealer service. They have over 80 walk-in sites across the country. Individual end-users are encouraged to bring in their equipment, although Xerox "is sensitive to the potential conflict of channels in the dealer relationship," according to Flynn. He adds that dealers are also encouraged to work with a variety of service plans, using the Americare program as a back-up.

Finding TPMs is becoming easier now that service organizations are an industry unto themselves. They have begun to advertise to end users, rather than rely on manufacturers and dealers to spread the word about them. As they overcome user resistance to break away from traditional manufacturer-based servicing, TPMs are further challenged to offer competitive maintenance.

Turnaround Times

Initially, price was a primary concern of customers, but now quality of service and turnaround time rank with saving money in the list of user considerations. Personal computer users are the least satisfied with after-sales support of all office-product users, according to a survey conducted by Input, a computer market research firm based in Mountain View, CA. A study conducted by Frost and Sullivan, Inc. (a consulting firm), found TPM service on a par or above manufacturers' service.

But price is still a factor, and most ser-

vice organizations' fees are 15 to 20 percent lower than manufacturers' service. For the end-user who is price-conscious but still prefers to stick with the manufacturer for service, there is a compromise solution. A hybrid form of service organization, the service broker, provides a link between manufacturer and third-party maintenance.

Dataserv, of Hopkins, Minnesota, is one of the largest service brokers in the United States. The company sells both

**Quality of service
and turnaround
time rank with
price nowadays
in the list
of user expectations**

new and used IBM equipment, but its main function is as a maintenance go-between.

Service brokers sell maintenance agreements, usually for about 15 percent less than a standard manufacturer's agreement, to end-users. The companies then send the machines needing repair to authorized factory service outlets, paying the full hourly rate for the work. The brokers gamble that the revenues from service contracts that they sell will exceed the cost of the actual repairs. They usually do. "Our payments are only about 60 to 65 percent of what a standard IBM contract costs," says

Mark Thompson, Dataserv's senior vice-president.

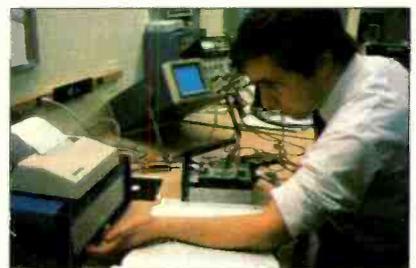
That is the main reason the service industry is booming. Manufacturers are getting in on the act, too. Xerox currently will perform warranty and non-warranty work on equipment manufactured by 18 firms, covering 55 to 60 different product lines.

Kaypro is the latest to sign a service authorization agreement with Xerox. Others include IBM, Osborne, Corona, STM/Pied Piper, Okidata, Epson, and Diablo (a subsidiary of Xerox) printers; and the Morrow Microdecision. Flynn, of Xerox, says that servicing IBM equipment is a move towards the recognition of IBM as the closest thing to an industry standard.

Control Data Corporation of Minneapolis, one of the oldest service firms, introduced a new maintenance agreement for volume users of the IBM PC and XT with a flexible fee plan. (Control Data was the first national maintenance organization to service IBM computers, outside of IBM, over 14 years ago.) For about \$200 per year, users enrolled in Control Data's Back-Up program are assured four-hour exchange of their IBM PC or XT. If replacement is necessary, flexible fee customers pay an additional fee based on the type of equipment replaced. But there is a ceiling on the total amount any customer will pay during the course of a year.

Finding one source to service all the equipment in a computer system, including peripherals, can save a lot of headaches. So can developing a good dealer relationship to ensure personal treat-

(Continued on page 80)



Teaming up at the Xerox service center to solve a difficult intermittent problem.

GUIDE TO COMMUNICATIONS SOFTWARE

Features you should look for in terminal emulation packages

BY JOHN HELLIWELL

IT isn't just hardware, it's also software that counts in microcomputer communications.

To communicate with other computers over a telephone network, your micro needs two things: a modem (the hardware that translates computer signals into information the phone network can handle), and controlling software. Although the modem may be more expensive (the software, in fact, may be available free), the software will have much more impact on what you can do and the ease with which you can do it.

For two computers to communicate, they must agree on a number of variables. Because you can't always control the settings on the other computer, your software must enable you to control them at your end.

The principal variables are baud rate, parity, the number of data bits transmitted, and the number of start and stop bits used.

Baud rate is the rate of data transmission in bits per second. The two speeds most commonly used are 300 baud and 1200 baud. Software therefore must allow for at least these two speeds (be aware, too, that many systems also require the baud rate to be set in hardware). If you're exchanging information with another computer that can be directly connected to yours (without modems and phone lines), then much higher speeds may be practical. Over voice-grade telephone lines, though, speeds for reliable communication are limited to 1200 baud.

Parity checking is a scheme that helps ensure that the data received is the same

as the data sent. Parity checking is accomplished by tacking an extra bit (a "parity bit") onto the seven-bit ASCII code, making a total of eight data bits transmitted.

There are two types of parity checking, even and odd. If even parity is in effect, the parity bit is assigned by the sending computer so that the total number of logic-1 bits in the eight-bit cluster is even. At the receiving end, the number of 1s is recomputed. If nothing got lost in the transmission, that number should still be even. If it isn't, something was incorrectly transmitted and the character is discarded. Odd parity works exactly the same way, except the total number of logic-1 bits must be odd.

Because some systems use even parity checking, others odd, and others no parity checking at all, these three modes must be allowed by your software.

Your system and the one you're communicating with must also agree on the number of bits that constitute a character. The modems used on micros communicate serially—that is, the bits that make up the character are transmitted one after the other.

In order that the other computer can tell where one character ends and the next begins, a short gap is left between characters. Each character begins with a *start bit* before the actual data bits and is followed by one or two *stop bits*. While the start bit is taken for granted, both systems must agree on the number of data bits and the number of stop bits; otherwise, the receiving system could confuse the final data bit with a stop bit.

Finally, there is the parameter that is often called *duplex*, but is more properly called *echo*. As a verification that the correct characters have been transmit-

ted, many host computers echo, or retransmit, each character they receive back to you, through the modem-phone connection. If such a remote echo is in effect, when you type a character on your keyboard, it is not routed to your screen; what appears on your screen are the characters that have made the round trip from your keyboard to the distant computer, and back.

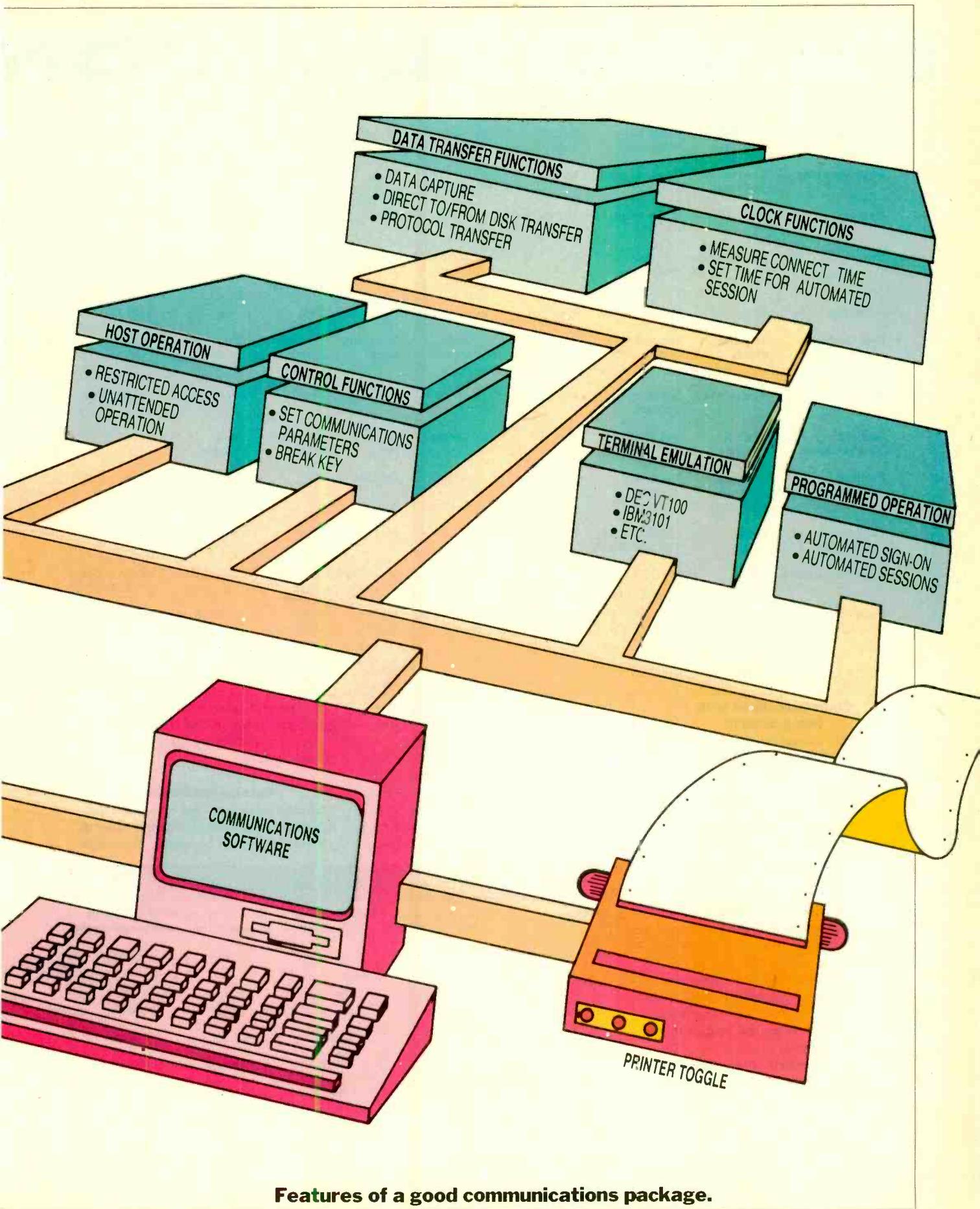


TELEPHONE FUNCTIONS

- DIALING DIRECTORY
- AUTO ANSWER
- AUTO DIAL

They should, of course, be the same; if they're not, there's a problem. The alternative is for the remote computer just to accept the characters without echoing them. In that case, for you to see what you've transmitted, your software will have to provide a *local echo*. This feature, properly referred to as "local echo on" or "off," is often called *full duplex* (when local echo is off and the distant computer is echoing) and *half duplex* (when local echo is on). "Duplex" actually refers to the physical ability to transmit data in both directions simultaneously, an ability that all common microcomputer modems have.

John Helliwell is a Toronto-based computer consultant and writer.



Features of a good communications package.

ART BY JOANN AGRESS

PROGRAM FEATURES

| FEATURES | ASCOM | CROSTALK XVI | MICROLINK II | MITE | MODEM7 | PFS:ACCESS | RELAY | SMARTCOM I, SMARTCOM II |
|--------------------------------------|--------------------------------|--------------------------------|------------------------------|---|---------------------|--------------------------------|-------------------------|---|
| Automated dialing | Unlimited—script files | Unlimited—script files | By using some macros | Unlimited—script files | 26 numbers | Script files for 8 svces. | Unlimited | Script files for 25 svces. |
| Host operation | Can host, no protection | Can host, good protection | No | Can host, no protection | No | No | Yes, protected | Yes, password protected |
| Macros | No | 40 per script file | 20 total | 10 per script file | No | No | No | 20 per script file |
| Scripts | Yes, complete | Yes, time, string | No | Yes, composed of macros—time, character | No | Yes, memorizes actual sequence | Yes, complete | Yes, composed of macros—time, character |
| Break key | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Data Capture | To memory or disk | To memory or disk | To memory, can write to disk | To memory, can write to disk | To memory or disk | To memory or disk | To memory or disk | To disk |
| Printing | Yes, buffered | Yes, not buffered | Yes | Yes, not buffered | Yes | Yes | Yes, buffered | Yes, buffered |
| Text file transmission | Yes, no throttle | Yes, throttle | Yes | Yes, throttle | Yes, throttle | Yes, can encrypt | Yes, throttle | Yes |
| Protocol file transfer | Xmodem, Crosstalk, proprietary | Proprietary + Xmodem | Xmodem | Proprietary, Xmodem, CLINK, Hayes | Xmodem | No | Xmodem plus proprietary | Hayes verification protocol |
| Terminal emulation | None | VT100, IBM3101 TV910&920, ADDS | No | No | No | No | VT100, VT52 | No |
| Available versions | CP/M, MS-DOS | MS-DOS | CP/M 80/86 MS-DOS | CP/M 80/86 | CP/M, Apple, MS-DOS | MS-DOS Apple | MS-DOS | DOS 3.3, Pascal, CP/M, MS-DOS |
| Restricted to certain modems? | Any modem | Any modem | Any modem | Any modem | Any modem | Direct support for 12 makes | Tailored for Hayes | Hayes |
| Price | \$195 | \$195 | \$99 | \$150 | Usually free | \$70 Apple \$95 IBM | \$149 | Comes with Hayes modems |

Communications with Some Smarts

If your communications software does no more than allow you to set these variables, it is just a "dumb terminal" program. But your computer is far more than a dumb terminal. It has memory; it has a powerful microprocessor; it has disk drives; it has a printer; and more. Dumb terminal software doesn't use these facilities; smart users use smart software that does.

The challenge is to choose a communications program that does a good job of implementing the "smart" features that matter to you; which features those are depends on what sort of communications application you have in mind. The universe of microcomputer communications applications can be broken down into four categories:

- micro-to-micro communications, including transfer of documents, data, and programs
- electronic mail and messaging, by connecting to a central computer utility to deposit and retrieve text and messages
- data retrieval from on-line databases, including text and numeric information

• transaction handling or programming on corporate mainframes or minis (or other special-purpose systems)

Which features of a communications program are important depends on the application(s) you have in mind. The table below ranks features as "essential," "useful," or "depends," with respect to each of these four applications category.

The table above describes ten programs according to how they implement the feature. Following is an explanation of each feature.

Automated Dialing

If your modem is capable of auto dialing, then an automated dialing feature in your software can be useful, no matter

APPLICATIONS FOR VARIOUS FEATURES

| Features | Micro-to-micro communications | Electronic mail and messaging | Data retrieval and databases | Transactions and programming |
|-------------------------------|-------------------------------|-------------------------------|------------------------------|------------------------------|
| Automatic dialing | | Useful | Useful | Useful |
| Host operation | Useful | | | |
| Macros | Useful | Useful | Useful | Useful |
| Scripts | Useful | Useful | Useful | Useful |
| Break key | | Useful | Essential | Essential |
| Data capture | | Essential | Essential | |
| Printing | | Useful | Useful | Useful |
| Text file transmission | Useful | Essential | | Depends |
| Protocol file transfer | Essential | | | |
| Terminal emulation | | | Depends | Depends |

| TELIOS | VIDTEX |
|------------------------------|------------------------------|
| Unlimited, script files | Unlimited, script files |
| No | No |
| 10 per script file | No |
| Yes, time | Yes, time, character |
| Yes | |
| To memory, can write to disk | To memory, can write to disk |
| Yes | Yes |
| Yes, throttle | Yes, throttle |
| No | CompuServe protocol |
| | No |
| MS-DOS | Commodore 64 |
| Any, tailored for Hayes | Comm. 1600 or 1650 modem |
| \$119.95 | \$39.95 |



gram claims to support auto dialing or a dialing directory, ask what modems it is compatible with. Be sure yours is on the list before you accept the program.

Auto-dialing directories are very convenient if there are several different remote computers with which you have dealings. When auto dialing is implemented through script files or macros (see below), then it usually will allow you to store the parameters (parity, number of stop bits, and so on) of each remote along with its phone number, so the parameters can be set automatically when the call is placed.

Auto dialing is only really useful in micro-to-micro communications if you can be sure the micro on the other end is waiting to answer your call (see "Host Operation," below); otherwise, you'll often find it easier to start out your communication as a regular voice call, and then turn con-

trol over to your computers.

Host Operation

If your modem can auto-answer when the phone rings, then you are equipped to set up your computer as a host—a computer that other computers can dial in to. If you want to do this, be sure your software has "hosting" or "answer mode" or "unattended operation" features. Such features should give you some control over who can dial in (using passwords, for instance), and over what they can do once they have dialed in.

For example, can the caller send your computer a file? Request one from your disks? Erase files from your disks? (Software that allows really sophisticated host operation is often called "bulletin board service" or BBS software.) Determine how much control you want to allow before settling on a communications program.

Automated Signons and Sessions: Macros and Scripts

If your software can manage auto dialing, the next level of sophistication is automating the procedure of signing on to remote systems. This includes things like sending remote service network numbers, account numbers, and passwords in response to the service's prompts, and goes beyond that to automation of complete on-line sessions, including hanging up when the session has been completed.

Two different approaches to this automation are common: macros and scripts. Some programs use both.

Macros are strings of characters that can be transmitted by pressing just one

(Continued on page 86)

what your application.

The software should allow you to store a set of telephone numbers, allow you to tell it to dial The Source or your friend Pat, and automatically transmit the correct instruction code and telephone number to the modem. To do this, the software has to know how to tell your modem to dial a number. If a pro-

COMMUNICATIONS SOFTWARE SUPPLIERS

Ascom
Westico, Inc.
25 Van Zant St.
Norwalk, CT 06855

Crosstalk XVI
Microstuf, Inc.
1845 The Exchange
Suite 205
Atlanta, GA 30339

Micro Link II
Digital Marketing Corp.
2363 Boulevard Circle
Walnut Creek, CA 94595

Mite
Mycroft Labs., Inc.
PO Box 6045
Tallahassee, FL 32314

MODEM7
Available free from most microcomputer user groups and RBBSs.

PFS:Access
Software Publishing Corp.
1901 Landings Dr.
Mountain View, CA 94043

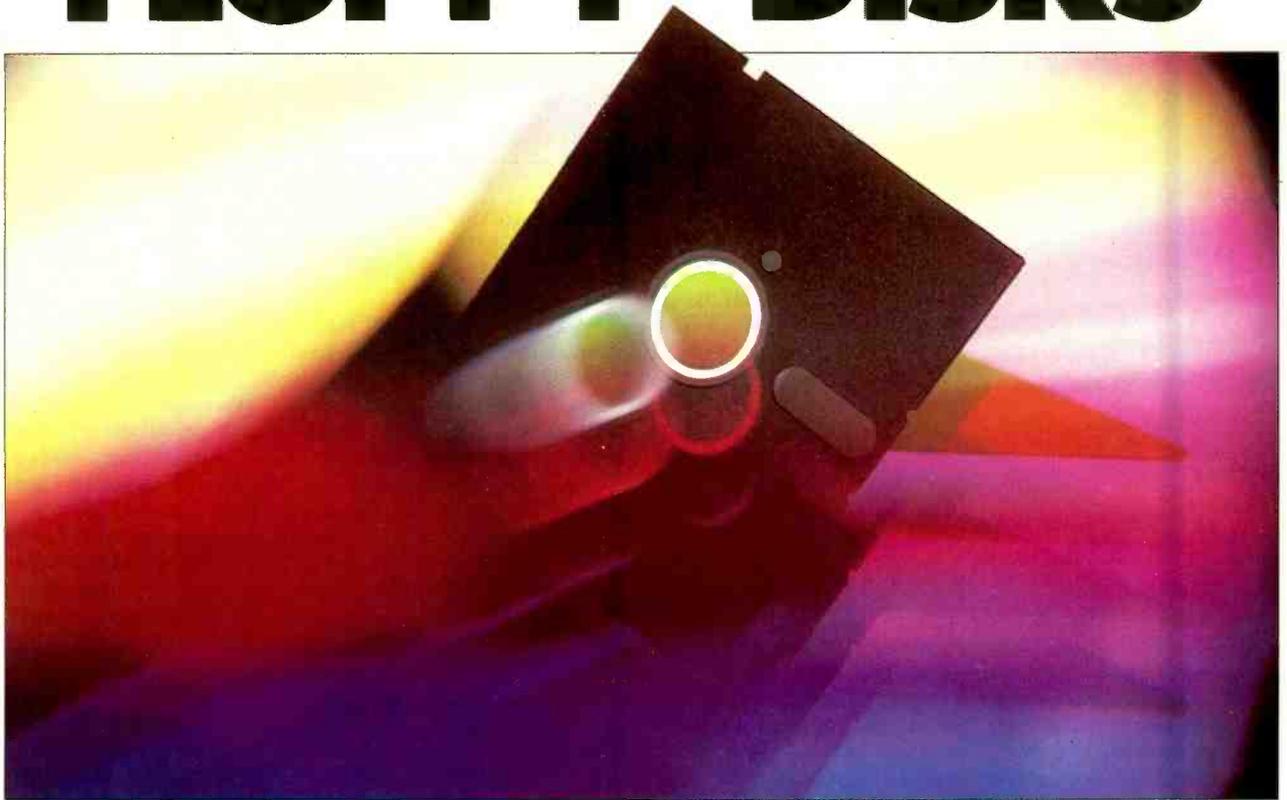
Relay
Westico, Inc.
25 Van Zant St.
Norwalk, CT 06855

Smartcom
Hayes Microcomputer Products
5923 Peachtree Industrial Blvd.
Norcross, GA 30092

Telios
Genasys Corp.
11820 Parklawn Dr.
Rockville, MD 20852

Vidtex
CompuServe
5000 Arlington Centre Blvd.
Columbus, OH 43220

3M STRETCHES THE CAPACITY OF FLOPPY DISKS



Hard disk performance is attained by building a floppy with a flexible surface

BY J. SMITH-RICHARDSON

DATA storage and rapid access to that data have always been prime functions of the personal computer. Although we talk of *Star Wars* gadgetry that can store the entire knowledge of the universe in someone's pocket, the reality is that disk storage is more affordable.

A recent and exciting development in high-density disk technology affecting personal computers is 3M's Stretched Surface Recording, a "compliant" disk system that—using present technology—combines the storage capabilities of the Winchester hard disk with the environmental tolerances of the floppy disk.

How It Began

With almost the same fervor that medieval knights used in searching for the Holy Grail, certain modern heroes—engineers—have searched for new ways to pack ever greater amounts of data into ever smaller amounts of space. The modern era of mass disk storage started with the hard disk: Not the itty-bitty 5¼" hard disk we shoehorn into a portable computer but a platter up to 14" in diameter that was intended for use with

J. Smith-Richardson is a free-lance author who writes frequently on computer-related subjects.

mainframes and minicomputers.

The early modern hard disks were precision-milled metal platters coated with a magnetic oxide medium. With a diameter of 14 inches and spinning at 3600 rpm, the hard disk could store enormous amounts of data: better than 12 megabytes per side, 25 megabytes per disk (two sides). Often, two or more disks were combined in a sealed "disk pack" to increase storage capacity into the multi-megabyte range: a pack consisting of 12 hard disks could store 300 megabytes. And all this was before we really learned to pack data on a disk.

Obviously, a disk spinning at the

PHOTO BY PETER ANGELO SIMON

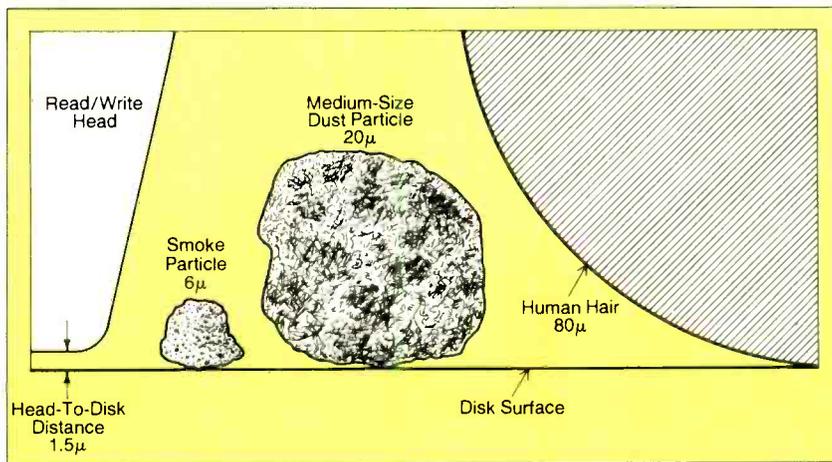


Fig. 1. Relative sizes of particles that can cause head crashes.

speed of 3600 rpm was sure to: (a) rapidly wear down anything in contact with the disk, such as a read/write head; (b) produce extreme friction-developed heat in anything touching the disk (the read/write head again); (c) have anything that touched the disk slice off the magnetic coating at the contact point, along with all the data stored in that coating.

The original hard disk drives eventually evolved into the "flying head" drive we use today, which we call a "Winchester" because that was IBM's code name for the device when it was under development. In Winchester-type hard disk drives the read/write heads fly above the surface of the disk and do not wear or damage the magnetic medium. Fortunately for the data processing industry, the technology that made the flying head possible was already in existence, having been originally developed way back in the late 1940s for professional tape recorders.

The Air Cushion

One description of early 1/4" audio tape was "sandpaper on an acetate base." At the then common professional slow speed

of 15 ips (inches per second) the relatively coarse oxide coating could wear out a recording, playback, or erase head in just a few months. If the tape could do that at 15 ips, imagine the wear when the tape was run at high-speed rewind or wind! To eliminate the high-speed wear, most tape

But tape lifters were not the order of the day for Ampex, already the leading producer of professional tape recorders. Ampex engineers determined that when the tape ran at high speed it sucked molecules of air along with the tape. As the molecules were compressed and forced between the tape and the head, they formed a cushion of air that lifted the tape off the head. There was not enough lift to actually be seen because the "gap" between the tape and head was but the thickness of a few molecules of air, but there was enough so the tape did not contact the head.

Using that lift produced by an air cushion developed by the speed of the recording medium, it was possible to fly the head of a disk mechanism over the medium and still detect magnetic impulses from the media, much as the audio engineers could hear the rewind playback even though the air cushion had lifted the tape off the reproduce

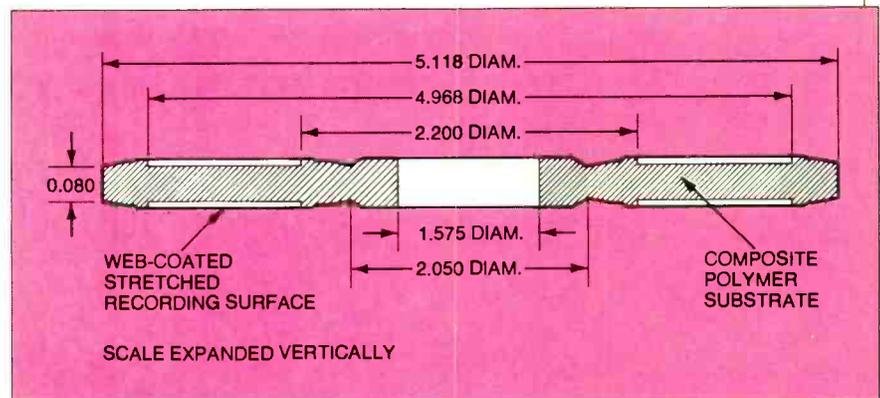
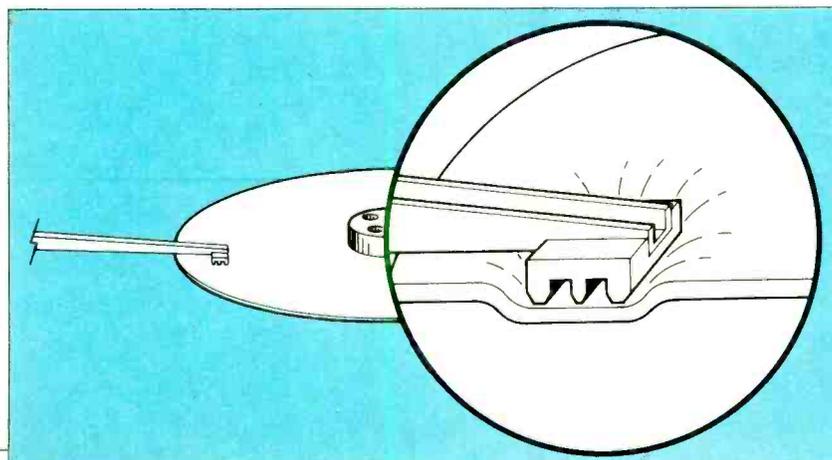


Fig. 2. Cross section of 3M's new SSR technology disk.

recorder manufacturers employed some form of "tape lifter" mechanism that lifted the tape away from the erase, record and reproduce heads during high-speed winding.

head. It was the Ampex "air cushion" that made the modern hard disk possible, even if the persons who designed the flying head didn't know they were inspired by the Ampex audio recorders.

Fig. 3. Air pressure causes disk medium to "dimple" beneath head.



The read/write head of a hard disk system is mounted on the end of what is essentially a driven arm with free vertical motion. The signal head, the part that responds to magnetic and electrical impulses, is a very tiny strip of metal that looks like nothing more than a pencil scratch. It is normally mounted either in a relatively large block of plastic which serves to trap the air cushion or in a smaller plastic block with longitudinal grooves that help direct the air stream under the head. Either way, the head itself amounts to little more than a dot of metal in a plastic shell about the size of a dime.

The head normally comes to rest or is "parked" on a safe area of the disk called

(Continued on page 78)

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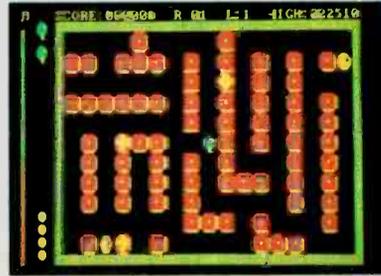
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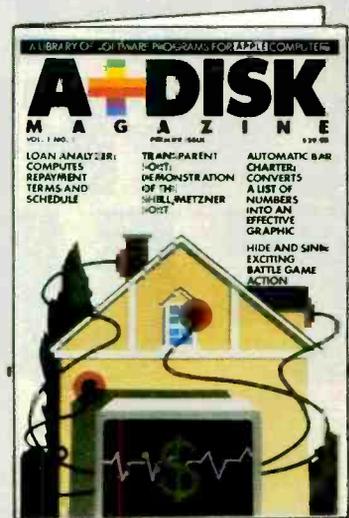
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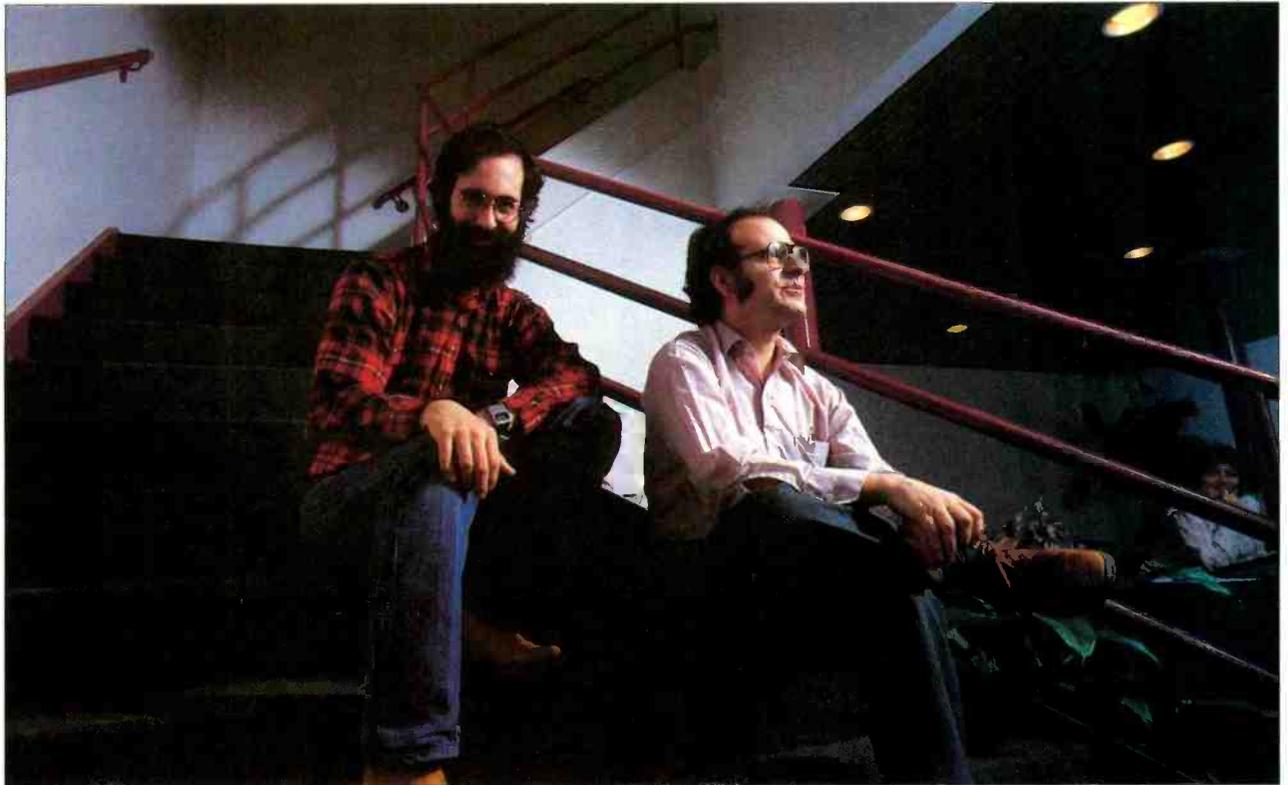
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SOFTWARE ARTS' OFFICE OF THE FUTURE

*The company that gave the world VisiCalc
is a heavy user of advanced technology*

SOFTWARE Arts is widely acknowledged as the software firm most responsible for success of the microcomputer. Its program VisiCalc gets credit for the original proliferation of microcomputers throughout the professional and business marketplace. Even so, the firm has, until recently, had little exposure to the general public. It became more visible in May 1982, when it announced TK!Solver, the first product it both produced and marketed. This year, however, on went the klieg lights. Software Arts became embroiled in multi-

BY B&J McMULLEN



Dan Bricklin (left) and Bob Frankston, founders of Software Arts.

million dollar litigation with VisiCorp, a company Software Arts contracted to market VisiCalc.

Most of the publicity has dealt with legal and marketing ramifications; some has concerned the merits of the TK!Solver program. Little attention has been paid to the rapid expansion of the firm (from two founders in January 1979 to over 150 staff members in the spring of 1984).

The most interesting aspect of Software Arts has been ignored. Even though it is at the forefront of office

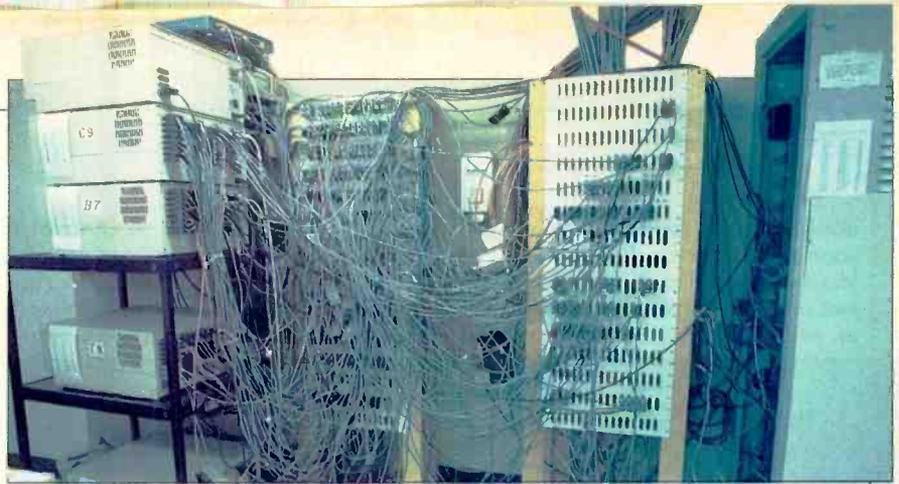
PHOTOS BY KIMBERLY BUTLER

automation, its up-to-the-minute efficiency occurs in a work environment that is relaxed, even serene. Software Arts may be today's version of the office of the future.

The company occupies a venerable stone building on the bank of the Charles River in Wellesley, Massachusetts. Within its three solid stories are more than one mile of telephone cable and more than three miles of computer cable. This network connects a main computer complex, all employees within the building, those in a nearby annex, and certain people at more distant locations (for example, a public relations representative in New York City and employees temporarily working at home).

Each office within the building and annex contains at least four outlets for any computer with an RS-232C interface. The office may be the workspace of a programmer, a documentation specialist, the chairman, or any other employee: All offices are equipped with the same computer access. The particular computers installed vary from office to office, depending on the project the employee is working on, the computer preference of the employee, and the current inventory within the firm. (Although every popular computer configuration appears in some office, most frequent—in offices accessible to the public—are IBM PCs.)

Some of the RS-232C ports lead directly to the central computer; in most cases, however, they are connected to a local patch panel, which acts as a concentrator to an Ethernet network to the



The main panel in the computer room connects to Ethernet.

central complex. The Ethernet network and the direct-connect terminals enter a massive patch panel in the main computer room that connects everything to the central system, which consists of four Prime 9950s. These 9950s, operating at approximately one-half the power of The Source (which also uses Primes), are interconnected via Primenet, a telecom-



munications system manufactured by Prime. The system supports a Symbolics laser printer and a Diablo 630 on-line. Tape drives are attached to the system for backup; backup is the only function that requires operator intervention. The central computer complex also contains

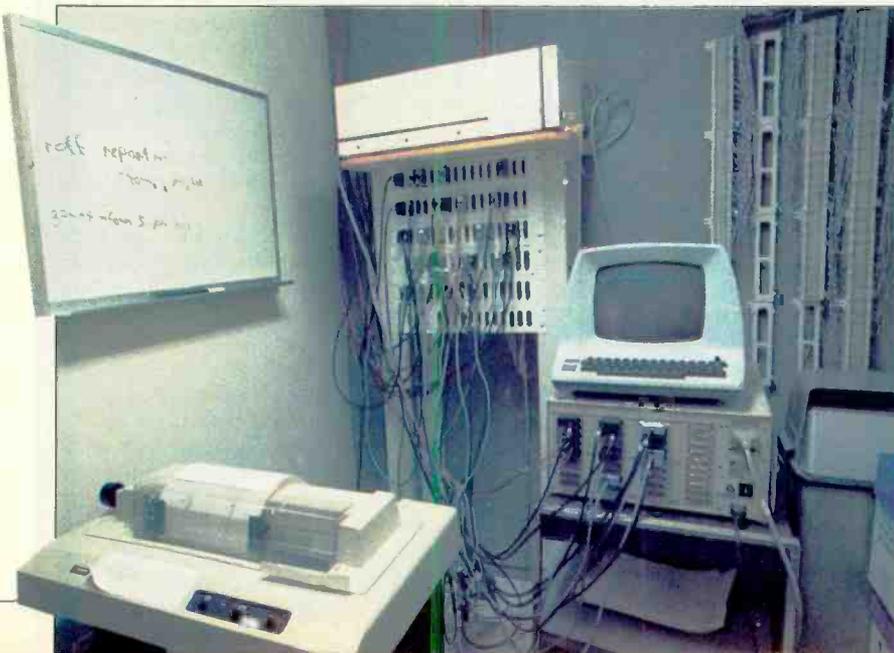
a DEC VAX, used solely in batch mode for accounting, outside the on-line network.

The microcomputers in the offices—the employees' individual working tools—link them to the office routine. All interoffice communication is performed via electronic mail. Recipients are notified by "bells" in their micros that messages have been entered into the system for them. (On the various micros, Software Arts uses its own terminal software, which provides VT-100 terminal emulation and a Prime electronic mail control program written by Software Arts Vice Chairman Bob Frankston.) Recipients read the messages whenever convenient and may print them either on printers attached to their micros or on higher-speed printers situated in the same rooms as the local patch panels (one on each floor). When they reply, recipients have the option of being informed automatically when addressees receive their replies.

All employee schedules are maintained in the computer network, so, for example, if Bruce Rampe (vice president of sales and marketing) wishes to schedule a meeting with Tracy Licklider (chief operating officer) and Dave Reed (vice president for research and exploratory development) to review plans for a new product campaign, he calls up their schedules on his micro, selects a date and time convenient to all, enters the meeting on their respective schedules, and sends electronic memos informing them of the meeting. If Reed has an appointment that was not listed on his schedule or cannot attend the meeting for some other reason, he responds via electronic mail and the meeting will be rescheduled.

Employees engaged in programming or documentation on their own micros may direct output to their own systems, to the printers at the local patch panel stations, or to the printers attached to the central computer. In every case they are assured of sufficient password security to safeguard their work. Strict security with an organization as harmonious as Software Arts may not seem to have

Most RS-232C ports are connected to a local patch panel.



much intrinsic importance. To other companies, however, the issue is critical. Hardware manufacturers, such as Apple and IBM, and software developers, such as Microsoft, provide Software Arts

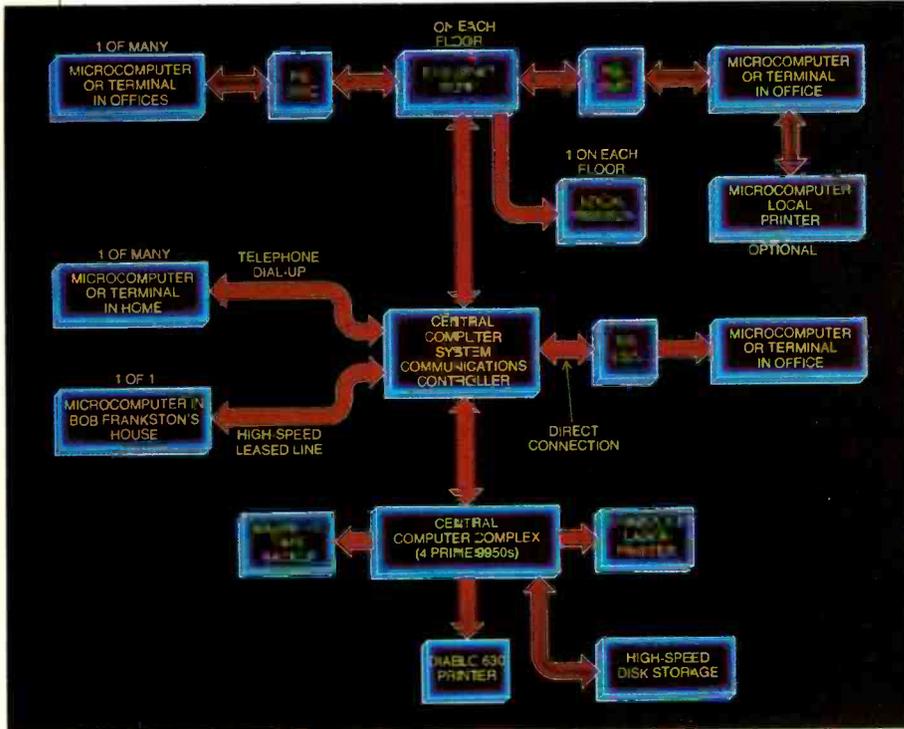
with their products prior to announcement so that Software Arts can develop compatible versions of VisiCalc Advanced Version or TK!Solver, which will be ready by announcement of the new

product of Apple, IBM or Microsoft.

Project research and general computer literature review are also conducted through the Software Arts internal computer network. The company employs two librarians who maintain an extensive computer periodical library. They review each periodical as it comes in and prepare a weekly report citing articles of particular interest. Their report is circulated by electronic mail throughout the company. In addition, an employee who needs specific information may request the librarians to gather data from one of the time-sharing services—Dialog, The Source, CompuServe, etc.—and to forward the data by electronic mail.

A startling feature of Software Arts is that there are scarcely any secretaries or clerks. With routine functions handled through the computer network, there is no need for a support staff. The professional staff and senior executives do their own word processing, maintain their own schedules, file their own documents (electronically), answer their own telephones, and get their own coffee. Clerical work has not been eliminated; instead it has been so streamlined that it is handled efficiently as incidental tasks of all employees.

At Software Arts there is almost no traffic: Halls and other public places are usually empty because employees are provided with almost any information



Block diagram of the company's complex computer system.

THE FOUNDERS

DAN Bricklin remembers waiting once a month at Seltzer's Candy Store, next to Ray's Barber-shop, in the Germantown section of Philadelphia for the arrival of his favorite magazine, *Popular Electronics* (the former name of *COMPUTERS & ELECTRONICS*). His interest in electronics and inventions stayed with Bricklin all through his years at Akiba Hebrew High School and his undergraduate days at MIT (BS in electrical engineering/computer science, 1973).

At MIT, Bricklin met Bob Frankston (BS in mathematics and electrical engineering/computer science, 1970; MS and engineer's degree in computer science, in 1974). Frankston had grown up in Brooklyn, New York, had attended Stuyvesant High School, and also had developed an interest in electronics and computers. The similarities between the two went further: The fathers of both were engineers—Frankston's a civil engineer; Bricklin's a mechanical engi-

neer—and entrepreneurs.

In the early days of their friendship, Bricklin and Frankston discussed the idea of going into business together at some time. In 1979 the possibility became a reality. Bricklin, then in the MBA program at Harvard, conceived of the "electronic spreadsheet" that created the opportunity for such a business venture. The concept, of course, became VisiCalc. Out of it was born Software Arts.

Bricklin and Frankston, as chairman and vice chairman, respectively, created the kind of work environment in which they themselves would want to work. In matters ranging from staff selection to employee "perks," they made decisions that resonate with their personalities. They hired people who appreciate the atmosphere and, in some cases, share backgrounds with them. Julian Lange, Software Arts' president, was educated at Harvard (MBA as well as AM and PhD); Dave Reed, vice president for re-

search and exploratory development, went to MIT (BS, SM, EE, and PhD).

Stocking refrigerators with free beverages dates back to Frankston's desire always to be within reach of a Pepsi-Cola. Bricklin being a lifetime member of the Boston Computer Society, all employees receive paid membership in BCS. Other employee benefits are consonant with Bricklin and Frankston's own informality and egalitarianism:

- Software Arts makes cash contributions toward employees' enrollment in any program for a physical activity (racketball, exercise club, etc.);
- Restrooms have showers;
- There are racks and storage spaces for bicycles;
- Children are welcome in the office.

While not all of these are unique to Software Arts, they help convey the personality of the company and its founders, individuals who deserve much of the credit for the development of the entire microcomputer industry. ◇

CHRONOLOGY OF SOFTWARE ARTS

SOFTWARE Arts has grown prodigiously in its five years. Here is a synopsis of the roots and rise of this prototype of successful software firms throughout the industry. (Microsoft, Lotus Development, and Software Publishing have had similar, meteoric successes.)

1970: MIT computer science students Dan Bricklin and Bob Frankston meet and become good friends. They remain friends while Frankston subsequently works as a computer consultant and Bricklin works for Digital Equipment and FasFax.

1978: Bricklin, now an MBA student at the Harvard Business School, designs a theoretical electronic spreadsheet to eliminate drudgery in business calculations. He takes a prototype of the design to Frankston, who agrees to help develop a workable version of the program. Bricklin and Frankston reach an agreement with Dan Fylstra, a Harvard MBA student, for Fylstra's young company, Personal Software, Inc. (to become VisiCorp, Inc., in February 1982), to market the new product (which will be named VisiCalc in spring 1979).

January 2, 1979: Bricklin and Frankston incorporate Software Arts.

Spring/summer 1979: Bricklin and Frankston show VisiCalc at the West

Coast Computer Faire and the National Computer Conference. The program receives its first critical acclaim: Ben Rosen, in the *Morgan Stanley Electronics Letter*, refers to it as the "software tail that might wag the personal computer dog." Bolstered by the reception, Bricklin and Frankston move Software Arts offices to 905 Main Street, Cambridge, MA, and hire three people.

October 1979: VisiCalc is shipped to the public. The initial version is for the Apple II. Subsequent versions are developed for Atari, Commodore, Hewlett-Packard, IBM and Radio Shack computers. (By May 1981, VisiCalc sales will exceed 100,000 units; by February 1983, 500,000.)

December 1979: Software Arts moves to larger quarters in a high-rise office building in Central Square, Cambridge.

Spring 1980: The company introduces DIF, a convention for transferring data between personal computer programs.

September 1981: Software Arts begins publication of SATN, a user-support journal for Software Arts' products.

May 17, 1982: Software Arts announces TK!Solver, an equation-solving program. Its introduction marks Software Arts' first venture into marketing and distribution.

August 1982: Software Arts moves

into its current headquarters at 27 Mica Lane, Wellesley, Massachusetts. Sixty-seven people are now employed.

September 1982: VisiCalc Advanced Version, written by Software Arts and marketed by VisiCorp, is introduced.

February 1983: TK!Solver is shipped to the public. The initial version is for the IBM PC; subsequent versions are announced for DEC, Wang, Apple IIe and generic MS-DOS. In addition, Software Arts announces TK!SolverPack, which provides predefined equations for specific vertical markets (for example, mechanical engineering, financial management).

June 1983: Software Arts signs an agreement with McGraw-Hill Book Company for the publication and distribution of a major series of TK!SolverPack applications packages. Subsequent agreements in January 1984 will provide for McGraw-Hill's sale and distribution of TK!Solver through more than 3,500 college and university bookstores and for the publication and distribution of TK!SolverPack applications based on their college texts.

Spring 1984: Software Arts, after withdrawing marketing rights to VisiCalc from VisiCorp, begins to market VisiCalc Advanced Version. Software Arts now employs over 150 people. ♦

they need through their computers. With the exception of visits to the refrigerator, water fountain or bathroom, employees never have to leave their offices.

Before you envision a "mental sweatshop" of the kind Craig Brod described in his fine book, *Techno Stress* (Addison-Wesley, 1984), understand that Software Arts encourages its employees to take breaks and mingle. The firm has a full kitchen, lunchroom and lounge (which contains Atari games for those who cannot get too far away from computers). On each floor is a smaller lounge with refrigerator and hot drink machine and sink. The refrigerators are stocked at firm expense with a wide variety of drinks (fruit juices, soft drinks, mineral water, and lemonade, depending on what employees request). Conviviality is also served with a sunny patio and picnic tables on the river bank.

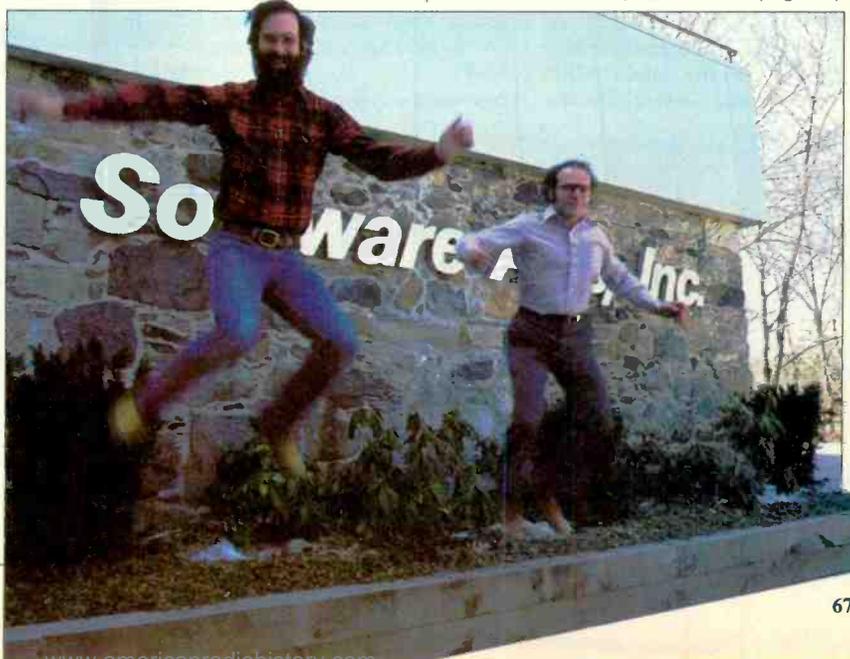
The policy of Software Arts is that employee interaction fosters creativity and boosts morale. While the firm provides computers to employees for working at home (these communicate with the office network via telephone lines), such systems are used to handle emer-

gencies and to supplement employees' in-office work rather than to substitute for it. Otherwise, "telecommuting," which one hears so much about, is shunned. When Jack McGrath, editor of SATN (the Software Arts end-user support journal) and the firm's chief documentation writer, was confined at home

while recovering from a collapsed lung, he was able to write the documentation for VisiCalc Advanced Version using telecommunications to the office network.

At the present state of the art, there isn't much room for improvement of

(Continued on page 83)



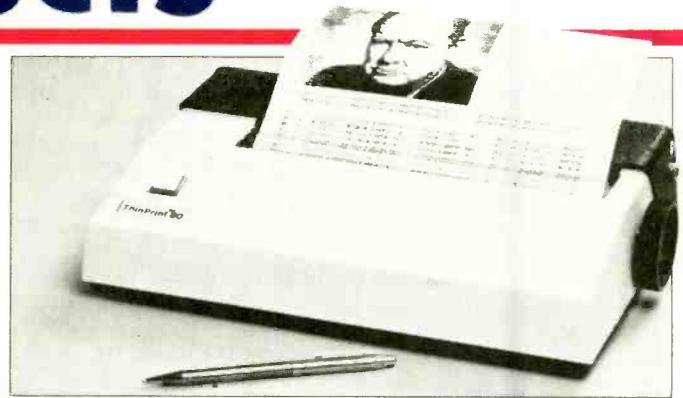
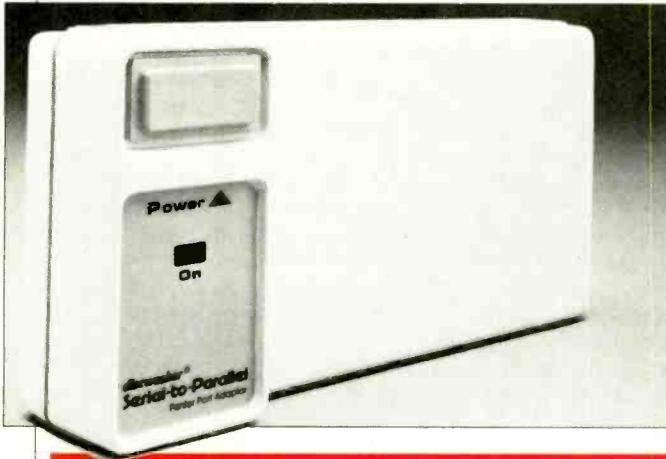
NEW PRODUCTS

SERIAL-TO-PARALLEL ADAPTER

A new accessory designed to permit owners of the new Apple IIc computer to convert the computer's serial printer port to the more common parallel configuration is available from Discwasher. The Serial-

to-Parallel Printer Port Adapter simply connects between the computer's serial I/O and the printer's input interface. No other hardware or software installation is required to immediately use the system. \$129.95.

Circle No. 83 on Free Information Card



PORTABLE THERMAL GRAPHICS PRINTER

Axonix's ThinPrint 80 is a battery-powered, full-page thermal graphics printer that weighs only 4 lb and fits in less than half the volume of a typical briefcase. The bidirectional 40-cps printer features a 2048-character buffer, 80 or 136 characters per line, serial or parallel interfaces, and single-sheet or

roll-paper feed, the latter from an internal paper compartment. A dot-addressable resolution of 960×7 dots per line creates facsimile-like images of graphs, charts, and digitized pictures. The printer comes with rechargeable battery, ac adapter, and 80-page roll of thermal paper. \$279. Address: Axonix Corp., 417 Wakara Way, Salt Lake City, UT 84108.

HIGH-PERFORMANCE DESKTOPPER

Eagle's new Turbo XL is a high-speed, 8086-processor-based IBM PC-compatible personal computer with built-in 10M hard disk and 360K double-sided, double-density $5\frac{1}{4}$ -in. floppy drive. The computer features a speed switch that allows the user to select either 8 MHz or 4.77 MHz operating speed. It comes with the latest versions of MS-DOS and BASIC; 256K of RAM (expandable to 512K on the main CPU board); and low-profile de-

tached keyboard with 10 function keys, numeric keypad, and status LEDs for all locking keys. The system is designed to utilize the benefits of Eagle's EagleNet I local area network option for linking computers and peripherals to use electronic mail capabilities and to share programs and information. An 80×25 -character high-resolution 12-in. non-glare monochrome video monitor and a 13-in. color monitor, are available as options. \$4995.

Circle No. 84 on Free Information Card



MULTIMODE MATRIX PRINTER

Datasouth's Model DS220 bidirectional logic-seeking dot-matrix printer offers correspondence-quality printing for word processing, draft-quality printing for high-speed data processing, and full dot-addressable graphics printing. In the correspondence mode, an 18×48 -dot matrix is used for near-letter-quality appearance at a throughput of 40 cps. Multiple type fonts can be selected from the control panel or through program codes. Standard features include: two

correspondence-quality fonts; two memo fonts; variable-pitch draft fonts; and a special micro-character set. Throughput in the draft mode is 220 cps, with characters formed in a 9×7 matrix. Pitch is selectable 10, 12, or 16 characters per inch in standard mode or 5, 6, or 8 characters per inch in expanded mode. Up to 217 columns can be printed for spreadsheeting. Other features include both serial and parallel interfaces and a 2K buffer. \$1995. Address: Datasouth Computer Corp., 4216 Stuart Andrew Blvd., Charlotte, NC 28210.

LETTER-QUALITY PRINTERS

Amdek has introduced a new 5000 Series of formed-character letter-quality printers for use in personal computer systems. The three models in the series include the transportable 25-cps Model 5025, the desktop 40-cps Model 5040, and the desktop 55-cps Model 5055. All three models feature built-in Centronics-compatible parallel and RS-232 serial interfaces and are able to print up to 132 columns per line. A new daisywheel print element gives the user access to up to 125 characters on a single wheel. Printwheels for the Models 5040 and 5055 are interchangeable. External soft-



ware controls allow the 5000 Series to print up to 309 Teletext characters. A cassette-type ribbon is included with each printer. \$799 for Model 5025; \$1675 for Model 5040; \$1990 for Model 5055. **Address:** Amdek Corp., Printer Products, 2201 Lively Blvd., Elk Grove Village, IL 60007.

COMPUTER PLOTTERS

Roland DG is currently offering single- and eight-pen x/y plotters that can be used with personal computers. Both include serial and parallel interfaces, 16 different print sizes, 11" x 17" flat bed, and 8K of on-board memory buffers. Available separately is a business graphics package, called Keychart, that can be used with the plotters to create full-color graphics with an IBM PC. \$750 for Model DXY-800 single-pen model; \$995 for Model DXY-101 8-pen model. **Address:** Roland DG, 7200 Dominion Cir., Los Angeles, CA 90040.



LOW-COST SMART MODEM

Anchor Automation has introduced the Signalman Mark X, a smart 300-baud auto-dial/auto-answer modem for use with virtually all personal computers. The modem operates with most popular software communications packages and can be operated

manually through a keyboard, without computer coding. Operation can also be automatic, to answer and originate calls under the Bell 103 standard. The Mark X detects dial-tone and busy signals and automatically displays dialing status on the computer's video display screen. An on-board CMOS microprocessor main-

tains a very low current drain. Interface to the computer is through a standard RS-232C serial interface, through a built-in cable. The modem comes with two telephone jacks and 12-volt power supply. \$169. **Address:** Anchor Automation, Inc., 6913 Valjean Ave., Van Nuys, CA 91406.



BUS CARD FOR COMMODORE

BusCard from Batteries Included is claimed to transform the Commodore C-64 into a full-fledged business computer. The compact hardware interface device permits any compatible disk drive, including a hard disk, and virtually any printer on the market to be added to the C-64 system. BusCard plugs directly into the C-64's cartridge slot and provides parallel printer and IEEE-488 outputs and restores the occupied cartridge slot. Device allocation switches are accessible through a slot in the device's housing and are in function mode at all times. Built in is a full machine-language monitor that includes assemble and disassemble commands. **Address:** Batteries Included, 186 Queen St. W., Toronto, Ontario, M5V 1Z1, Canada.

SOFTWARE SOURCES

Warehousing Software. Warehouse Master is a comprehensive warehouse management software package for microcomputers. The program provides the answers needed to fill orders quickly and accurately while cutting costs and improving productivity in a distribution warehouse. It enables the user to sequence picking documents, increase effective storage capacity, and track the activity of fast-moving items for optimum placement. **Address:** Penton Software, Inc., 420 Lexington Ave., Suite 2846, New York, NY 10017.

dBASE II Successor. Ashton-Tate has announced a new database management software program designed for 16-bit and larger computers. The program, dBASE III, is said to be the fastest and most powerful of its kind. It allows the user to enter, manipulate and retrieve large volumes of data, and to develop customized application programs that make use of the data through simple English-like commands.

Features of dBASE III include the ability to store up to two billion records per file (limited by the computer system used) with 128 fields per database. Up to ten database files can be in use simultaneously. The new system also provides "ultra fast" sort and indexing of stored data. Color displays are supported.

Ease of use is considerably greater than with dBASE II. While it is possible to program directly in the dBASE programming language, there are also such amenities as a command assistance mode, the dBASE Assistant, to guide the first-time user.

Initially available for the IBM PC and XT, and for PC-compatibles, the program requires a minimum of 256K of RAM and two 5¼" double-sided disk drives. \$695. **Address:** Ashton-Tate, 10150 West Jefferson Boulevard, Culver City, CA 90230.

creative computing

10TH

ANNIVERSARY

SPECIAL OFFER

1984 is a banner year for CREATIVE COMPUTING, it marks our first decade of bringing you the latest information regarding introductions and changes that have occurred in our fast-paced industry.

We were there as the respected publication in the beginning... when businesses were struggling under reams of paper... when video games meant a dot bouncing from one side of a TV screen to the other... when computer technology meant main frames and punch cards.

Before it happened we told you about the transition from tape to disks... telecommunications and networking simplifying business transactions... new programs eliminating hours of waste and unproductivity! We will be there for the next ten years because *we are not going to rest on our laurels!* 1984 is the beginning of a decade of fresh ideas, new innovations and reliable evaluations certain to keep you abreast of our quick-charged stimulating world!

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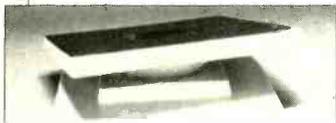
NEW PRODUCTS

RGB COLOR VIDEO MONITOR

Princeton Graphic Systems' new Model SR-12 is an RGB color video monitor that can display up to 16 colors simultaneously and offers both text and graphics display capabilities. The 12-in. diagonal screen can display up to 25 rows of 80 columns per row in the text mode and 690 by 480 pixels in the noninterlaced graphics mode. Video bandwidth is rated at 25 MHz, and misconvergence is listed at 0.5 mm maximum in the center of the screen, 1.0 mm maximum in the corners. Power consumption at 120 volts ac is 95 watts. The monitor is supplied with a standard DB-9 (nine-pin) cable. \$799. **Address:** Princeton Graphic Systems, 1101-1 State Rd., Princeton, NJ 08540.

MONITOR STAND

The Twist and Tilt video monitor stand from Inland is designed to hold the IBM PC monochrome or color monitor in a comfortable viewing position. It also has an adapter plate to accommodate oth-



er monitors. The stand is made of high-impact plastic and is colored and textured to match the IBM PC and present the appearance that the Twist and Tilt is an integral part of the computer. The stand measures 11" x 11" x 3". It can rotate in a complete 360° circle and tilt back and forth over a range of 25°. \$29.95. **Address:** Inland, 32052 Howard, Madison Heights, MI 48071.



COMPUTER PROTECTOR

The Wire Cube from Networkx is a single-outlet device for protecting personal computers from voltage spikes or surges from RFI (radio-frequency interference). The Wire Cube's protection stems in part from its silicon transient suppressor, which opens an internal fuse whenever a transient exceeds the circuit rating. Simultaneous with breaking the electrical con-

nection to the computer, the Wire Cube lights a LED to indicate that the protection circuit has been tripped. RFI is suppressed by a built-in filter, and a pi-type circuit with a common-mode choke provides additional noise attenuation in both common and transverse modes. Response to potentially damaging conditions is rated in nanoseconds. \$34.95. **Address:** Networkx, 203 Harrison Pl., Brooklyn, NY 11237.

UPGRADE SYSTEM FOR COMMODORE

Commodore C-64 users can now run true CP/M software with a new add-on system from Estes Electronics. The system comes with a Z80 microprocessor, DMA, parallel printer and serial communications ports, disk controller, and 64K of DRAM. It can

control both 8- and 5¼-in. single- and double-sided, double-density disks. The 5¼-in. system will run Kaypro, Radio Shack TRS-80, Xerox, Televideo, and many more formats. It comes complete with the CP/M 2.2 operating system. \$500. **Address:** Estes Electronics, Inc., Box 753, Salina, KS 67402.

212A-COMPATIBLE MODEM

The Companion is a Bell 212A-compatible modem from CTS Corp. The RS-232C modem comes with the



company's Mite communications software package and offers full-duplex asynchronous operation at 300 baud and synchronous operation at 1200 baud. The modem supports keyboard diagnostics, including local analog loopback, local digital loopback, and remote digital loopback test. Other features include adaptive dialing, tone or pulse operation, automatic answering and speed detection call progress monitoring, automatic storage and dialing of last dialed number, and two RJ11C jacks for both voice and data communication. **Address:** CTS Corp., 400 Reimann Ave., Sandwich, IL 60548.



DOT-MATRIX PRINTER

Apple is offering a wide-carriage model of its Imagewriter dot-matrix printer. The Wide Carriage Imagewriter can accommodate paper ranging from 3 in. to 15 in. wide, uses a 7 x 9 print matrix, and features a throughput of up to 120 cps. Eight character fonts are featured, and variable resolution, pitch, and line spacing are provided. Various fonts, underscoring, and super- and subscripts can be mixed in the same printed line. Paper can be either friction or pin fed. Supplied with the printer is an accessory kit that contains appropriate connector cables for Apple II and III printers. \$749.

Circle No. 85 on Free Information Card

NEW PRODUCTS

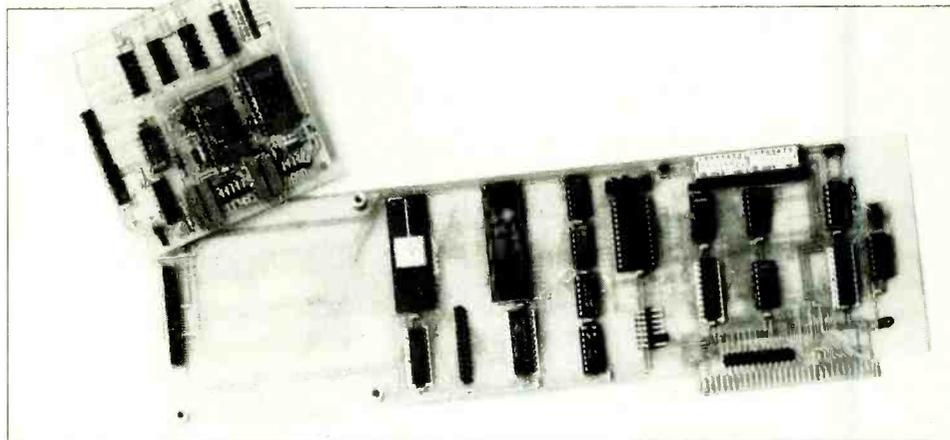
INTELLIGENT SWITCH

A new automatic printer switch that permits up to three Digital Equipment DECmate systems to share a single printer is available from Gold Key Electronics. The SWITCHmate is an intelligent switch that enables up to three DECmate systems to function simultaneously with one LQP02 printer. Switching is transparent, and the compact unit instructs each system to hold data until printer time is available, then automatically prints. LEDs indicate which DECmate is printing and which are on hold. SWITCHmate can be located up to 250 ft from the DECmate systems. From \$449, depending on quantity and options. **Address:** Gold Key Electronics, Inc., PO Box 186, Goffstown, NH 03045.



UNINTERRUPTIBLE POWER SUPPLY

The new Model 1350 uninterruptible power supply from Dymarc is claimed to provide up to 10 minutes of power for personal computers during power failures. The system is rated to deliver 120 volts ac at 350 VA, 60 Hz and has a transfer time of 12 milliseconds. (A 50-Hz version is also available.) The UPS contains Dymarc's patented Clipper circuit that provides on-line surge protection for both normal- and common-mode transients, while rfi suppression is provided by Sprague filters. The Model 1350 is also available with a choice of four new load-regulator/conditioner Clip Cubes. \$750 for Model 1350; \$299 and up for Clip Cubes. **Address:** Dymarc Industries, 21 Governor's Ct., Baltimore, MD 21207.



MULTIFUNCTION CONTROLLER

An IEEE 488 GPIB multifunction board that provides an interface between the IBM PC and GPIB-compatible instruments for automated measurements and data acquisition applications has been introduced by Qua Tech, Inc. The board can be connected to up to 15 devices to

allow the PC to act as a GPIB system controller. The other devices on the GPIB can be programmed as talkers, listeners, or controllers. The board also has a programmable interval timer and one parallel port that will accept any one of the Qua Tech modules, such as an A/D or D/A converter, reed relay, or stepper motor controller. An avail-

able software package supplies all the routines required to implement the GPIB functions. It contains more than 30 macro commands and routines for using BASIC, assembly, and other languages. \$395 for controller; \$100 for software drivers; \$75 to \$495 for modules. **Address:** Qua Tech, Inc., 478 E. Exchange St., Akron, OH 44304.

DATA COMMUNICATIONS/MODEM

Concord Data Systems' CDS 224 Superduplex high-speed modem offers a statistical multiplexer with ARQ error correction and autodialing. The full-duplex modem connects multiple asynchronous devices to a standard two-wire switched telephone line for 2400- and 1200-baud transmission. The statistical multiplexer provides three user-programmable RS-232C ports and a choice of 14 asynchronous speeds (50 to 9600 bps) or automatic matching of port speed to the speed of the user's device. Protocols include XON/XOFF and CTS. An adaptive prioritizing technique maximizes throughput, minimizes delay, and ensures that interactive traffic has priority over batch traffic. Automatic dialing supports both tone and pulse dialing systems. Other operating modes include automatic answer and originate and/or manual answer modes. \$1695. **Address:** Concord Data Systems, 303 Bear Hill Rd., Waltham, MA 02154.

SOFTWARE SOURCES

Macro Assembler. A cartridge version of MAC/65 with DDT (Digital Research's Dynamic Debugging Tool), a fast macro assembler with editor and debugger for Atari computers, is available from Optimized Systems Software. It features a macro assembler that can handle source code in memory or on disk and object code in memory or on disk. It can do memory-to-memory assemblies at a rate of thousands of lines per minute. MAC/65's editor uses line orientation, with every source line checked for proper assembly-language syntax during entry. DDT includes all the features the user would expect in a debugger, plus the ability to preserve screen graphics while presenting a usable display of the state of the user's program. \$99. **Address:** Optimized Systems Software, Inc., 1173-D Saratoga/Sunnyvale Rd., San Jose, CA 95129.

Desk Organizer. The Desk Organizer, developed by Conceptual Instruments and marketed by Warner Software, is an integrated software package for business users of the IBM PC. It provides seven office functions: filing, telephone dialing, data organizing, numerical calculating, appointment scheduling, time and work-flow managing, and correspondence and memo writing. A unique "Meta" capability allows the package to co-reside in the computer with virtually any other applications program. The user can work on the Desk Organizer alone or switch back and forth between it and almost any other IBM-compatible program. Meta also enables the Desk Organizer to interrupt another program with chimes and an on-screen display to present a previously scheduled reminder or call-up. \$250.

Circle No. 86 on Free Information Card

Software Reviews

(Continued from page 43)

time of our testing, Ashton-Tate says that many advanced graphics features will be available when Framework is released. Among these are vertical and horizontal display and plotter support.

Databases

You can create Framework databases within the program or import them from foreign systems. The program contains filters that permit a user to select imported data by key or type and to translate these data into Framework format. Filters already exist for files created under dBASE II and Friday! (both Ashton-Tate products). A filter for Lotus 1-2-3 files is expected to be ready by the time Framework is available.

The main reason for using the database form rather than the spreadsheet is ease of entry of data. Each row is a record in the database. You can also customize forms to make input easier.

Output

You can output frames to a printer or save them on disk. Owing to the outline structure of a containing frame, the program can automatically create a table of contents with page numbers. Printer controls such as page lengths and offsets

were not available in our test version, but full implementation of these features is expected before release. Formatted output can also be directed to an ASCII file on disk.

DOS Access

At any point it is possible to exit to DOS, perform any DOS command or execute virtually any program—including dBASE II—and return to the same point in Framework. It is this facility that enables the user to load data from external programs into spreadsheets or workframes. We were successful in capturing an ASCII file into an empty workframe on the desktop and performing word processing functions upon it.

Integration

The product has extensive capabilities that are well, although not completely, integrated. You cannot copy or move a spreadsheet or database into a word processing frame or vice versa. This means that to write a memo with a table in the middle you must create three frames: one for the text preceding the table, one for the table itself, and another for the text following the table. While the three

frames can be viewed or printed out as one document, they are still separate within the structure of Framework. If you must make changes, you will have to exit one frame to work on another. This restriction makes Framework less convenient to work with than it might be.

Conclusion

Framework is a very powerful package, with an enormous number of features. The concept is excellent, especially the outline feature for developing and organizing ideas. Some of the function implementation is a bit clumsy, but in a package of this magnitude one cannot expect to be able to invoke every function with a single keystroke. Framework's greatest weakness is that it does not tightly integrate the word processing and spreadsheet functions. We hope that the communications function will be as well integrated as the spreadsheet and graphics features are.

We think Framework is a most exciting package, worthy of your consideration. It will be most useful for people who do a lot of writing and can use its outlining capabilities and for people who develop applications that use spreadsheets and graphics. ◇

TASKWARE FOR CONVERGENT'S WORKSLATE

Software enhances the utility of Convergent's portable

BY TOM HAUGHNEY

UNLIKE some lapsed computers that are carbon copies of each other, Convergent Technologies' Workslate is unique in design and function. Now, further enhancing its functionality is Taskware—the Workslate's applications software. Taskware packages range from financial marketing programs to sales and expense reporting forms and have a suggested retail price of \$49.95 per tape. Taskware comes in a small, clear plastic box less than an inch thick. Accompanying the software microcassette is an instruction booklet that measures only 3½" × 4½"—very thin. I was skeptical.

I thought: "There is no way that little booklet accompanying a package like

1984 *Personal Tax* can cover the bases." The IRS cannot explain how to peel and paste a label in less than 11 pages.

I was wrong

More importantly, the Workslate is designed to handle a series of worksheets. Each task included in a software package is one element. And each element is brought to its conclusion in a manner that is elegantly easy to follow. A short audio preamble describes the function of each element so the user can anticipate its thrust and organization. The rest is just filling in the blanks. For example, the "Withholding" program quickly allows the user to calculate the number of exemptions that can be claimed without the strain of reading the new "simplified" bureaucratise of the ever popular W-4.

The cornerstone around which the Workslate is built is the spreadsheet. This is a marvelous device for keeping track of a variety of factors that the user defines, and it allows him to then interrelate these factors as a problem dictates. Most frequently this type of presentation is used to show the financial effect, over time, of proposed or implemented strategic decision.

Taskware concentrates on financial modeling. Rudimentary, perhaps, but modeling which is neither easily avail-

able, nor is it easy to use. The tax programs, for example, allow the user to estimate one's tax position and alter variables without reiterating a string of tedious arithmetic.

The basic spreadsheet function is built into the Workslate and is ready to go. Although the built-in software lacks the sophistication of more advanced applications software available for bigger in-place systems, it is more than adequate for use on the fly. Convergent overcomes any shortcomings here with a good deal of interesting financial-based software. Any dyed-in-the-wool "pro forma" person will find he can get 95% of the bang for 5% of the bulk with the Workslate. There are 16,384 cells available in the spreadsheet; that's only about 16,000 more than I've ever used. Cell sizes are adjustable and formulas handle well. The basics for numbers manipulation are all present and accounted for.

The nice thing about this spreadsheet orientation is that it quite neatly lends itself to some very interesting additional software packages. With the Workslate, planning, co-ordination, and convenient record keeping are all available in a portable and easy-to-use package.

The *Financial Statements* package is certainly not intended for production accounting, even on a small scale. It does

Software Reviews

offer a wide variety of analytical formats, including a five-year income statement analysis, comparative balance sheet, comparative income statement, and a variety of personal financial analysis forms, including personal balance sheet, a projected personal balance sheet (ahh, sweet dreams!), cash flow and projected personal cash flow (harsh reality!). A particularly nice format is the ratio analysis which is a nice tool to use to help gauge a company's health relative to industry standards.

The *Consultant Taskware* package is designed for use by professionals who time-bill their clients. Auditors and lawyers, as well as consultants, could effectively utilize this package. The software features a very easy-to-use system of tracking billable time by client/project on a daily and weekly basis. The expense spreadsheets will please even the IRS, but billable expenses are handled in a separate program. (One expense spreadsheet would save users time and effort.) The accounts receivable software is complete but bare bones.

Sales Reporter might prove to be a really great software package. Only sales will tell. In any company with a mobile sales force, the problems of co-ordination and constant communication are critical. Paperwork is a pain for everyone. The Taskware includes a very convenient contact sheet which contains call report information. Good reliable call reports, properly coordinated, are a powerful means for management to stay plugged into the real world, and therefore, able to respond quickly to the marketplace—perhaps even a leg up on the competition. When the salesman calls in each day, his Workslate could dump the call information, allowing it to be used more quickly and at the same time relieving the need to waste half a day regurgitating the prior week's activity. A half a day saved could be a 10% increase in time available for sales activity—that is a considerable increase for under \$1,000. Companies with a limited amount of inventory items could refresh the *Sales Reporter's* inventory routine, and allow the sales representative to enter a customer's place of business armed with the latest information. The "Sales Expense Analysis" worksheet is perfectly adequate, but I thought the version in the *Travel* package (reviewed later in this article) was a bit more complete. One flaw is the "Lease Borrow/Lease Purchase" program which doesn't consider the "Investment Tax Credit." The ITC counts as tax dollars paid to Uncle Sam allowed to the purchaser of hard capital assets.

Its impact is substantial on the investment decision, so these two elements really aren't too useful.

Marketing Management doesn't represent the full potential of the *Sales Reporter* package, but it's good nevertheless. Gross margin analysis is available and a good sales analysis is there. "Pricing Analysis" is specious, at best. The analysis is flawed, and it doesn't recognize that prices are developed in the marketplace. One uses analysis to make the decision to sell at the prices so determined.

The *Travel* package is a nice complement to the *Sales* package. It is very convenient and offers a complete travel and expense records layout. Also offered are currency conversion, time conversion, and metric conversion routines.

Both the *Loan Analysis* and the *Cash Management* packages include "Internal Rate of Return Analysis" which are extremely helpful to those who seek to avoid the drudgery associated with the mathematics of finance. *Loan Analysis* also includes the expected payment and amortization calculation formats. The *Cash Management* program allows for budget versus actual analysis and has the same currency feature as *Travel*.

The *Inventory Analysis* package concentrates on "economic order quantities." The software is quite good for those who would like to practice this fine art without having to deal with exponential functions with five thumbs poking into a tiny \$4.99 calculator. Vendor comparisons and quantity discounts can be integrated into the process too.

Real Estate features heavy cash flow analysis as one might expect, with separate breakdowns of revenue and expense. "Projected Income" and a "Sell Analysis" routine allow the user to aid in making strategic decisions.

Conclusion

The Workslate comes into its own when considered in light of the Taskware available to it. Many of these applications could be developed by the user, but it would be wasteful, I think, to do so because the time one would otherwise devote to recreating the wheel could be better spent fine tuning the applications to make them most productive.

The Taskware precisely targets this machine's reason for existence—spreadsheet dexterity in a very complete portable package. ◇

EXECUVISION

High-powered graphics
for presentations

BY JACK BISHOP

VCN ExecuVision, Prentice-Hall's new business graphics program, seems to have been developed from the premise that ordinary business graphics are dull, dull, dull and should be made powerful and eye-catching. Since you're using a CRT, why shouldn't it look like television? If you have lackluster figures to present, why not use ExecuVision to create graphics that at least communicate your message with pizzazz (or obscure some best-neglected reality)?

What It Does

Most business graphics consist of line, bar or pie charts. While intended for more elaborate presentations, ExecuVision can do these too. To create a simple chart, you select a box or circle from the menu at the bottom of the screen, scale it to the dimensions you require, select a plot option from the menu, and enter data. The process is simple and straightforward but takes much longer

to accomplish with ExecuVision than it would with a program designed to create simple charts.

It's when you proceed to add labels and titles to your graphs that you begin to exercise the flexibility and ease of placement that are ExecuVision's strong points. You can make a selection from among a number of type styles, create a label, and place it wherever you wish.

You can draw more complex images using pixels or strings of pixels (a pixel—a contraction of "picture element"—is the smallest dot of light that your CRT screen can display). Once you draw a figure, ExecuVision permits you to move it, replicate it, and, in general, play around with it until it is exactly what you want.

But who wants to be imprisoned by
(Continued on page 82)

Bar graph made with ExecuVision



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Computer Scientist

(Continued from page 22)

appropriate file name. The program in Listing 2 does this and more as you will see from the details below.

Though Listing 2 is designed to run on the PCjr, with modification it will work on many other machines with analog joystick ports. The most compatible machines are those such as Radio Shack's Color Computer that use Microsoft BASIC.

begin one or more light meter readings (line 50), retrieve from disk a previous series of readings (line 60) or exit the program (line 70).

If you select the light meter option, the program asks you to enter a file name for the test session (110-140), the number of samples you wish to make (160) and the interval (in seconds) between

session. Say we've asked Junior to make five light readings separated by intervals of sixty seconds. Line 240 prints a test heading on the monitor and lines 260-280 actuate Junior's internal timer.

Junior's built-in timer can be set to transfer program execution to the light measurement subroutine after any interval of from 1 to 86,400 seconds (1 second

LISTING 2. PCjr STORAGE LIGHT METER AND OSCILLOSCOPE

```

10 'PCjr DATA STORAGE LIGHT METER
AND OSCILLOSCOPE
20 'COPYRIGHT 1984 BY FORREST M.
MIMS III
30 CLS:SCREEN 1,0:COLOR 1:KEY OFF
40 PRINT " PCjr DATA STORAGE LIGHT
METER"
50 LOCATE 10,1:PRINT "PRESS 1 TO SE-
LECT STORAGE MODE."
60 PRINT:PRINT "PRESS 2 TO RETRIEVE
DATA."
70 PRINT:PRINT "PRESS Q TO QUIT."
80 VS=INKEY$:IF VS="1" THEN 110
90 IF VS="Q" OR VS="q" THEN CLS:END
100 IF VS="2" THEN 440 ELSE 80
110 LOCATE 16,1:PRINT "CONNECT Cds
PHOTOCELL TO STICK(0)."
120 LOCATE 18,1:PRINT "LIGHT METER
READINGS WILL BE"
130 PRINT "SAVED ON DISK. SELECT A
FILE NAME"
140 INPUT "AND ENTER IT NOW: ";
LITES$:PRINT
150 IF LITES$="" THEN 120
160 INPUT "ENTER NUMBER OF SAMPLES:
";N
170 INPUT "ENTER SECONDS BETWEEN
SAMPLES: ";S
180 OPEN LITES$ FOR OUTPUT AS #1
190 PRINT:PRINT "PRESS ANY KEY TO
BEGIN."
200 IF INKEY$="" THEN 200
210 TS=TIME$:DS=DATE$
220 WRITE #1, DS,TS,S:SAVE DATE, TIME
& SAMPLE INTERVAL
230 CLS:PRINT
240 PRINT "SAMPLE          LIGHT
LEVEL (0 TO 100)"
250 C=1:Z=1:PRINT
260 ON TIMER(S) GOSUB 290:INITIALIZE
TIMER
270 TIMER ON
280 GOTO 280

```

```

290 'LIGHT MEASUREMENT SUBROUTINE
300 Y=STICK(0):'RETRIEVE PHOTOCELL
VALUE
310 Y=INT((Y/255)*100):Y=100-Y
320 PRINT:PRINT " ";C;
" ";Y
330 WRITE #1,Y:BEEP: 'SAVE SAMPLE ON
DISK
340 C=C+1:IF C=N+1 THEN 360
350 RETURN
360 CLOSE#1:PRINT
370 BEEP:FOR I=1 TO 200: NEXT I:BEEP
380 PRINT "MEASUREMENT CYCLE
COMPLETE."
390 PRINT:PRINT "PRESS D TO RETRIEVE
DATA." :PRINT
400 PRINT "PRESS R TO RERUN
PROGRAM."
410 OS=INKEY$:IF OS="R" OR OS="r."
THEN 30
420 IF OS="D" OR OS="d" THEN 440 ELSE
410
430 CLS:Z=1
440 'RETRIEVE DATA FROM DISK
450 PRINT:PRINT
460 ON ERROR GOTO 960: 'CATCH FILE
ERROR
470 INPUT "ENTER FILE NAME: ";
LITES$:CLS
480 IF LITES$="" THEN 470
490 OPEN LITES$ FOR INPUT AS #1
500 INPUT #1,DS,TS,S:CLS
510 PRINT:PRINT "PRESS 1 TO VIEW DATA
LIST." :PRINT
520 PRINT "PRESS 2 TO PLOT FIRST 13
DATA SAMPLES"
530 PRINT "ON SCOPE GRATICULE."
540 LOCATE 12,1:PRINT "AFTER DATA
LIST OR TRACE HAS BEEN"
550 PRINT "DISPLAYED, PRESS R TO RE-
RUN PROGRAM."
560 AS=INKEY$:IF AS="1" THEN 580
570 IF AS="2" THEN 690 ELSE 560
580 'PRINT DATA LIST ON MONITOR
590 CLS:PRINT "TEST: "; LITES$; " ";DS;
" ";TS

```

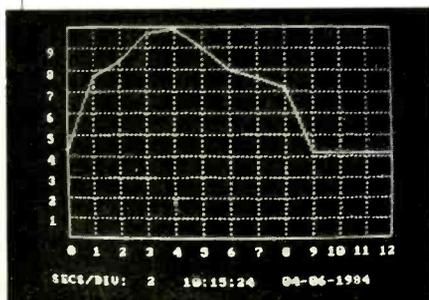
```

600 PRINT "SAMPLE INTERVAL: "; S; "SEC-
ONDS" :PRINT
610 PRINT "SAMPLE          LIGHT
LEVEL (0 TO 100)" :PRINT
620 INPUT #1,Y: 'RETRIEVE DATA FROM
DISK
630 PRINT:PRINT " ";Z; " ";Y
640 Z=Z+1
650 IF EOF(1) THEN 670
660 GOTO 620
670 BEEP:CLOSE#1
680 KS=INKEY$:IF KS="R" OR KS="r"
THEN 30 ELSE 680
690 'PLOT DATA ON GRATICULE
700 GOSUB 780
710 FOR X=26 TO 314 STEP 24
720 INPUT #1,Y:Y=(Y*.01)*160:Y=160-Y
730 LINE -(X,Y): 'DRAW TRACE SEGMENT
740 IF EOF(1) THEN 760
750 NEXT X
760 CLOSE #1:BEEP
770 KS=INKEY$:IF KS="R" OR KS="r"
THEN 30 ELSE 770
780 'GRATICULE SUBROUTINE
790 CLS:J=0
800 LOCATE 25,2:PRINT "SECS/DIV: "; S; " ";
TS; " ";DS
810 LINE (314,8)-(26,168),B
820 FOR C=26 TO 314 STEP 24
830 LINE (C,8)-(C,168),, &HCCCC
840 NEXT C
850 FOR R=8 TO 168 STEP 16
860 LINE (26,R)-(314,R),, &HCCCC
870 NEXT R
880 LOCATE 23,4
890 PRINT "0 1 2 3 4 5 6 7 8 9 10 11 12"
900 FOR L=19 TO 3 STEP -2
910 LOCATE L,1
920 J=J+1:PRINT J
930 NEXT L
940 PSET (26,150): 'MOVE CURSOR TO LEFT
GRATICULE BORDER
950 RETURN
960 IF ERR=53 THEN PRINT "NO SUCH
FILE. TRY AGAIN.":PRINT:RESUME
470

```

Listing 2 is menu driven so you can select any of its principle operating modes. When the program is entered and has been run, the first menu allows you to

Sweep of light across sensor.



samples (170). After the program opens a disk communications file (180), the entire test session, including the date, time, sample interval and the light meter reading, is automatically saved on disk (see 210-220, etc.).

If you select the program's data retrieval option, the program firsts asks for the file name (470) and then whether you wish to see a list of the stored data samples (510) or a graph of the first thirteen samples superimposed on a simulated oscilloscope graticule (520). In any case, you can return to the main menu to rerun the program by pressing R (400-410).

Let's review a typical measurement

to 24 hours). This means you don't have to waste time inventing calibrated delay loops to provide accurate sample intervals.

Back to our sample run, when the first sixty seconds have elapsed, program control is transferred to the light measurement subroutine at lines 290-350.

Line 300 retrieves the photoresistor reading ($Y=0$ to 255). Line 310 provides a correction factor that converts the raw reading to a scale of from 0 to 100 [$Y=INT((Y/255)*100)$].

The photoresistor's resistance is *inversely* proportional to the incident light (i.e. its resistance *decreases* as the light level *increases*). Therefore, line 310 also

complements the reading ($Y = 100 - Y$) so it will increase when the light level increases. However, line 310 does *not* supply a correction factor to compensate for the photoresistor's nonlinearities.

After the corrected and complemented (but not calibrated) reading is printed on the screen (320) and saved on disk (330), Junior emits a beep and program control returns to the timer routine. After the five samples have been measured, Junior beeps twice. The data tabulated on the screen might resemble this:

| SAMPLE | LIGHT LEVEL (0 TO 100) |
|--------|---------------------------|
| 1 | 17 |
| 2 | 21 |
| 3 | 37 |
| 4 | 43 |
| 5 | 52 |

Pressing D tells Junior to retrieve the data from disk. You can then request a tabulated list or a plot of the first thirteen samples superimposed on an oscilloscope graticule, both annotated with file name, date, time and sample interval.

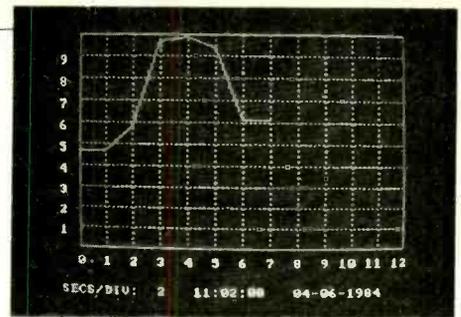
If you request a tabulation of the stored data, lines 580-670 in Listing 2 re-

trieve the data and print it on the screen. If you request that the data be plotted on a superimposed graticule, lines 690-760 are run.

Incidentally, line 460 catches the error should you attempt to retrieve a non-existent data file. You can then re-enter a correct file name. This error-trapping feature works for only one cycle, however. If you enter a *second* non-existent file name Junior exits its error-trapping mode and flashes a "Bad file name" error notice. You then have to rerun the program.

The program's graph option is complicated by the need to reconvert the retrieved data to the scale of the graph. To provide as large a graticule as possible in the space above the caption area, I selected a vertical scale of 0 to 160. Line 720 converts the retrieved data (0 to 100) to a scale of 0 to 160. The data is then complemented to match Junior's inverted graphic coordinate system.

The graticule itself is drawn by the subroutine at line 780. Line 820 draws the graticule outline. The grid is drawn by lines 830-880. Notice the ".,,&HCCCC" appended to lines 840 and 870. This causes the grid to be drawn with dashed rather than solid



Eight light level readings.

lines. Omit ".,,&HCCCC" if you prefer a solid grid.

Going Further

This column is merely a preliminary look at what can be accomplished by adding external sensors to Junior's joystick ports. Many other sensor options are also possible. In future columns we'll examine additional sensors and address the tricky question of sensor calibration.

In the meantime, remember that the basic principles described in this month's column apply to machines other than the PCjr. For additional information on applying these principles, see "Analog Sensors for Personal Computers" and "Use Your TRS-80 Color Computer as a Storage Oscilloscope" (COMPUTERS & ELECTRONICS, February 1984). ◇

DO-IT-YOURSELF COMPUTER-SIMULATED INSTRUMENTS

DURING the past year I've developed several programs that transform computers into various kinds of electronic test equipment and measuring instruments. Eric Mims, my fifteen-year old son, has joined me in this endeavor. His latest program, which won a couple of science fair awards, transforms Radio Shack's CoCo into a digital thermometer that stores temperature samples at any specified interval. Later, the program retrieves the stored data and produces a bargraph of a series of measurements.

Though the programs Eric and I have developed provide capabilities as sophisticated as a storage oscilloscope, I didn't fully recognize the enormous significance of do-it-yourself computer-simulated test instruments until running, for the first time, Listing 1, which is, by comparison, a *very* simple program.

The ethereal image of the simulated light meter on the monitor raised my level of computer consciousness to a new high. Sure, no great skill was required to

arrive at the program in Listing 1. But that's just the point. Unless you've spent the better part of a day assembling with a soldering iron and assorted hand tools a traditional light meter, it's difficult to fully appreciate the power provided by that relatively simple program.

Imagine, the computer-simulated light meter in Fig. 5 is a product of a quick sketch on a graphics worksheet, a few minutes of orchestrated keystrokes and little else! The meter can be easily modified to add extra features. For example, a correction factor that compensates for sensor nonlinearities can be easily inserted. Tired of its labels or color? Both can be easily changed. Bored with a conventional 0 to 100 readout? Change it, with a few extra keystrokes, to 100 to 0. Or -100 to +100. Or *any* scale you can imagine.

When it's not in use, the light meter wastes no space gathering dust on a shelf. Instead, it can be electronically vaporized by pressing a few keys. When it's time to make another light measure-

ment, the meter can be reconstructed in seconds from the instructions previously saved on a few inches of magnetic tape or a tiny piece of floppy disk.

You can even make custom light meters and give them to your friends. Or, as I've done here, you can share them with literally thousands of fellow computer users in the pages of a magazine.

Yes, my computer-simulated gadgets require a power cord and they don't fit in a shirt pocket... yet. With *today's* technology, however, one can easily envision a pocketable computer about the size of Radio Shack's PC-3 equipped with a couple of analog-to-digital input ports and a liquid-crystal screen having a few thousand resolution points.

A machine like this would be a universal measuring instrument. Depending upon the resident program and the external sensor, it could function as a full-featured, programmable thermometer, light meter, pressure gauge, pulse-rate monitor and many other applications for which sensors are available. ◇

3M Floppy Disks (Continued from page 61)

the landing zone, or landing strip. As the disk rotates and comes up to running speed it pulls air molecules between the surface of the disk and the head. Eventually, the density of the air molecules causes the head to lift minutely off the disk and fly about 5 microinches above the surface of the disk. Once airborne, the head can be safely positioned anywhere above the disk to read or write data.

If we had only hard disks, we'd probably still be waiting for PCs

But even—as illustrated in Fig. 1—the most minute particle, such as a grain of dust or a particle of cigarette smoke, is taller than the air cushion under the head. If the foreign particle gets under the head, it can momentarily interrupt the air cushion—causing the head to crash into the disk. The particle can also cause the head to rise sharply and, since anything that goes up must come down, the head does—right into the magnetic coating on the disk. Both conditions produce the infamous “head crash,” so called because the head shaves the magnetic medium off the metal platter.

As you might expect, in order to keep airborne particles off the hard disk it's necessary to enclose the disk in a hermetically sealed cartridge or use a well-filtered air supply; and to prohibit the smoking of cigarettes, cigars, etc., in the disk-drive area. Early hard disk systems were intolerant of anything airborne, were expensive to purchase and maintain, and were priced well beyond the budget of the user of home and small business computer systems. If hard disks were all that were available for data storage, we would most likely still be waiting for the development of the personal computer.

Fortunately, IBM developed the floppy disk, which consists of a magnetic coating on a flexible plastic substrate (backing). Other considerations aside, the major feature of the floppy disk is a reduced platter speed that permits the read/write head to be in full-time contact with the magnetic coating on the disk. No longer is there the possibility of the dreaded head crash.

Of course, there were performance tradeoffs in the development of the flop-

py disk, the main one being that of storage capacity for reliability. While we have worked our way up to dependably storing almost 400K on both sides of a 5¼" floppy disk, the same technology that increased 5¼" floppy disk storage from 80K to 400K was also used for the hard disk. The modern 5¼" hard disk mechanism can store up to 10 megabytes (5 per side), so a hard disk drive is often used as a direct physical replacement for a 5¼" floppy drive.

Unfortunately, the 5¼" hard disk returns us to the problems of the flying head. A landing zone must be provided on the disk, and some form of software is required to ensure that the head is automatically parked on the landing zone when the computer is shut down.

Keystone Technology

And this brings us back to 3M's “Keystone” Stretched Surface Recording. Somewhere along the line someone must have wondered what would happen if the magnetic medium of a hard disk were deposited on a flexible film rather than on a rigid metal platter. After all, the problem of the magnetic material being stripped by a head crash is due primarily to the rigid substrate under the oxide coating; the head has no place to go but through the oxide.

But imagine what would happen if the hard disk's oxide coating were deposited not on an unyielding metal surface, but on a compliant film. Foreign particles sucked between the head and the medium could squeeze through because the film would “give” and permit the particle to flow between the head and the disk. There would be no oxide-stripping head crash.

If simply making the medium compliant can eliminate the head crash, how come we're still using metal hard disks? The answer, of course, is that until 3M developed the Stretched Surface disk a compliant-medium equivalent of the hard disk didn't exist.

Unlike the rigid metal platter used as a substrate for the hard disk's medium, the oxide coating of a Stretched Surface Recording (SSR) disk is applied to a plastic film that is stretched across a concave surface so it is taut but has some degree of compliance or give. The hard substrate never touches the active area of the medium.

The construction of the Stretched Surface disk is shown in Fig. 2. The substrate is a dished plastic disk having a raised outer rim and a raised hub. The 1.5 mil (0.0015") film medium, which is nothing more than an oxide coating on a conventional plastic film, is tautly

stretched and secured to the rim and hub, thereby forming a drum: a taut yet compliant magnetic medium. Push your finger into it and you can feel it give way.

The cushion of air created when the disk rotates still causes the head to fly, but the compliant medium attempts to equalize the cushion and forms a dimple (Fig. 3) under the head. Any particle such as dust or cigarette smoke trapped in the air stream or its cushion is simply flushed out from under the head. If the particle needs room to pass under the head, the compliant medium moves one way and the head the other. If, for some reason, the particle should cause the head to bounce, the resiliency of the medium absorbs the shock without the magnetic coating being gouged away.

Except for the compliant medium, the Stretched Surface disk resembles a conventional hard disk, and it can be employed as a substitute for a conventional metal substrate disk. An experimental 5¼" Stretched Surface disk installed in a Seagate Model 412 hard disk drive unit—such as used for personal computers—yielded 5 Mb of storage capacity (2.5 Mb per side), though 3M envisions as much as 50 Mb from 5¼" drives specifically designed for Stretched Surface Recording. (Expect to see announcements of 10 M6 SSR systems around the time you read this.)

According to a 3M spokesman, Stretched Surface Recording disks can be manufactured in different sizes to accommodate all computers, from personal micros to mainframe maxis.

A 3½" disk could hold almost 20 megabytes

The Stretched Surface disk's reduced sensitivity to head crashes also raises the interesting possibility of high-density plug-in cartridge disks. Without the need for a filtered air supply beyond what's provided by the conventional fiberglass filters presently being used for computer cooling fans, an SSR disk could be enclosed in a plastic case that slid into the drive, much like an ordinary floppy disk. For portability, the SSR disk could be shrunk to 3.5". Since the SSR's storage capacity is linear, a 3.5" disk could hold almost 20 Mb—and that's a lot of data to be carried around in a shirt pocket. ◇

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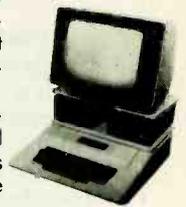
For example, with less than \$3 and very little time, you can add a feature to your keyboard that lets you automatically repeat a character by holding down a key. Or you might want to build a circuit that lets you match a 600-baud CoCo to a 300-baud printer.

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Service Organizations

(Continued from page 55)

ment before, during and after a warranty. Bob Wolff, of Wolff Computer, says that many of his customers' service problems can be taken care of over the telephone. Service technicians are able to trouble-shoot and diagnose without the need of a service call, saving time and money for both the customer and the dealer.

But not all service problems result from something as simple as misreading documentation or operating a software program incorrectly. That's where a service contract can be invaluable. But how does one determine whether the \$300 or so expenditure per year is really cost-efficient?

Holton Walker, a New York-based computer consultant, says the best way to determine whether a service contract is worth the money, is to weigh how important the use of the machine is.

If down time can mean lost business or revenues, then the reassurance of a service contract, especially one that offers replacement or exchange, can relieve many worries and be well worth the price. But, "if the owner is just a weekend hacker, quick service and replacement are less crucial." Walker says.

Preferred Treatment

An important feature of most service contracts is that those with them usually receive preferred treatment, most often exhibited in quick turn-around time.

Once the need for a service contract has been determined, the next decision is whether to opt for a contract with a TPM, a manufacturer or a dealer. That choice is often determined by the type of system. IBM owners, who've created multi-vendor systems, are forced to look beyond IBM for service. Even though this can be frustrating, the rise of blended contracts, single contracts written by one TPM to cover a variety of equipment and vendors, have made being a multi-vendor owner tolerable.

One IBM XT user, Paul Somerson, a computer magazine editor, says that even though IBM won't service all his peripherals, his service contract with them "is the most valuable thing I own." Somerson has had complaints about certain facets of IBM service—technicians coming to do on-site work ill-equipped and having to borrow diagnostic and DOS disks from the customer, for example—but the fact that IBM replaces rather than repairs boards and other equipment is a plus, he says.

As the Frost and Sullivan study showed, the perception that manufacturers, servicing is the best is changing. As technicians leave the larger compa-

nies, either as a result of lay-offs due to the industry shake-down or to set out on their own, qualified technicians are fairly plentiful, unlike in the 1960s when trained personnel were hard to find. Even if manufacturer service is inadequate, it's possible that the parties transporting repaired equipment from the service center to the customer will be less than careful, undoing all the expert repair. You should always make sure the repair service guarantees its work—all the way to your home and office—or you might find yourself trying to get reimbursement from a courier service which knows nothing about computers and may not care.

Although on-site back-up plans are the most expensive in actual costs, the cost of paying a courier or an employee to transport equipment to a carry-in service center can send costs soaring, as in television repair.

Which kind of equipment a user has is also a factor in deciding on what kind of contract to choose. Printers and disk drives, because they have moving, mechanical parts, are more likely to experience malfunctions. Moving parts, unlike most microprocessors, do wear out with use. If you don't have, or need, the use of a printer, a service contract may not be worth the price. It is possible to purchase separate agreements on each component, which can be a saving.

Another important, although not necessarily problematic, fact about service contracts is that although you may sign with a manufacturer to supply you with service, you might not be guaranteed that that particular firm will be doing the repairs. Kaypro and Apple, for example, are strictly manufacturers—no service—and therefore subcontract with a third party to provide service for their customers, much the way a dealer does.

Compaq

(Continued from page 45)

however, is somewhat different, and LEDs light up when NUM LOCK and CAPS LOCK keys are used. Because the keyboard is connected to the front of the unit by a plug-in connector, it can be replaced by a third-party keyboard.

In conjunction with the new computers, Compaq announced peripherals (two 12" monitors—an amber and a green—and an asynchronous communications/clock board) and accessories (a tilt and swivel monitor stand and a computer stand that allows users to tuck the key-

board in under the system unit when not in use).

Apple offers Appletcare, a carry-in service plan; according to Kathleen Dixon, an Apple spokeswoman. The company services equipment through the RCA Service Corp. and prices each contract per component. They also offer other plan options as well as maintenance through dealers with Apple-trained technicians.

Charges for the Appletcare program range from \$84 a year per component for the Macintosh to \$48 per year for the Apple IIe.

Kaypro, in addition to offering service through Xerox service centers, also has an agreement with MAI/Sorbus. Sorbus offers a monthly or annual rate for a service contract, according to spokeswoman Margaret Phanes. While a machine is still under warranty, service is up to the individual dealer who sold the computer, but must be performed by certified Kaypro technicians. Some loaned machines are available through selected dealers.

Radio Shack on-site or carry-in contracts are based on which model is covered. Onsite servicing ranges from about \$350 per year for an average configuration. Chuck Chenault of Radio Shack says that leasing customers as well as owners should also plan on purchasing a service contract. He says it is difficult to predict when and how service needs will crop up. "With all-electronic parts, use alone doesn't mean it's going down more," he said.

But as any user whose printer has jammed or screen has gone blank knows all too well, finding help fast can be a nightmarish experience. That's why knowing the options before an emergency happens can help get your micro running again without your having to pay a ransom or wait weeks for the serviceman to come. ◇

board in under the system unit when not in use).

To support the production of the new series of computers without affecting the production of the existing models, Compaq has set up a new Houston plant and is in the process of adding 100 people to its staff of 800. Compaq believes its new line will allow it to continue its rapid growth, which in 1983 made it the first United States manufacturer to achieve more than \$100 million in sales in its first year of production. ◇

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ExecuVision (Continued from page 74)

limited artistic talents? ExecuVision sells six libraries of pictures and picture elements available to help you break your creative bonds. Each library contains 30 to 70 images: maps of the world, of the United States and of European countries; "artistic" borders; initials and decorative design elements; industry and business scenes; face's and figures; and international symbols.

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The program allows you to combine these library images, or images you create yourself, with standard charts. The combination makes for a more vivid presentation than just the chart alone.

Creation of a combined image is merely a cut-and-paste process. You load a picture with an element you like from the disk, wipe away the irrelevant portions, then enclose and move what remains.

Rescaling of images does not seem to be in ExecuVision's bag of tricks, so it is necessary for you to conform to the program, rather than have it conform to your purpose. Even with this limitation, though, the creative potential is enormous.

ExecuVision also gives you the ability to take a drab black-and-white image and apply to it the full flower of color. You can fill white-on-black images with color and also add background color simply and easily by running through a cycle of keys.

While your business colleagues may view the range of colors as extensive, your artistic friends will consider them rather limited. From either perspective, the ability to explore easily a range of colors for an effective on-screen presentation is a useful feature of ExecuVision.

Once you have your graphics just the way you want them, you can store them on disk for later use in embellishing charts.

One of ExecuVision's strongest points is its ability to animate chart elements. You can place an object on a "slide" with a "move" option that will move the object from one point to another in a straight line. This is an excellent attention-getting device. It is useful, though, only when you make a "live" presentation direct from the computer (through a video projector or monitor). Obviously, you won't be able to dazzle clients who only have a paper copy of your report.

Finally, ExecuVision provides features to allow you to compose and run through a programmed series of slides. Using a secondary menu you can select slides for presentation and order (or re-order) their sequence. You can preset the time each slide is to remain on the screen or trigger slide changes manually. You can also pick any slide from the collection for review (during a question-and-answer session, for example) either by repeatedly pressing an arrow key to step through the slides or by entering a number to indicate how many slides are to be skipped to reach the one desired.

But Wait . . .

So far, ExecuVision looks like the answer to the prayers of anyone who has ever had to create an attention-getting graphic presentation. Before you rush out to buy it, though, there are a few more things about the program you should know.

Many users will create terrific charts and then look vainly for a means to transfer them to a less volatile medium than the screen of a CRT. ExecuVision—at least in its current release—does not support a plotter or equivalent hard-copy device. Nor is the Polaroid Palette (a device for making Polaroid color prints from screen images) supported. This is such an obvious limitation that a driver for either the Polaroid product or a competing device is sure to be in the works.

ExecuVision's color facilities are useless with regular printers. In fact, it is quite possible to create an image that does not print on a dot-matrix printer at all! That leaves you with the choice of either a photo of the screen or the output of a multi-colored-ribbon or ink jet printer. Either way, the animation capabilities also are lost unless you use a CRT hookup or videotape.

Another problem is that you are limited to creating images that fit onto a single screen. Since typefaces can be expanded (and only in fairly large increments—not continuously) but not reduced, the amount of information you can put on a chart is restricted. For an organization chart, for example, it is essential that the staff be small and its members have rather short names.

And, while ExecuVision images exist on three different levels—text, library graphics, and objects you draw yourself pixel-by-pixel—limitations restrict how you can manipulate them. While you can move and scale a library object at will (until it is set in place), you cannot move the other two image types with equal ease. Often you must move pic-

tures to the text, rather than the text to the picture.

The ExecuVision license agreement in the manual might surprise you. It omits any mention of what remedies are available to you if the program doesn't perform. However, there are four pages describing what Prentice-Hall *won't* do should you have the temerity to ask. A toll-free number is provided, though, for ordering, customer inquiries, and technical support.

The ExecuVision User

Who, exactly, will want to use ExecuVision? Probably not the executives the product is named for (after?). They're too busy. They won't want to do all the adjusting required to make their charts come out exactly the way they want, and they may feel that the manual is talking down to them.

On the other hand, the pixel-by-pixel approach is likely to be scorned by commercial artists in favor of schemes with

Overview

| |
|---|
| Product: VCN ExecuVision |
| Vendor: Prentice-Hall 200 Old Tappan Road Old Tappan, NJ 07675 |
| Price: \$395; Library Modules \$80-90 each |
| Operating System(s): PC-DOS Version 1.0, 2.0 or 2.1 |
| System Requirements: IBM PC (two drives) or XT; 256K RAM |
| Comment: VCN ExecuVision would not be the only graphics package in this reviewer's library, nor would it be the first. But for under \$1000 (including all the libraries), it is a pretty impressive piece of software that will pay for itself with the first presentation created in-house rather than by an outside graphics service. |

true vector-graphics image creation, even though such systems are considerably more expensive (and not generally available for microcomputers).

That leaves as ExecuVision's audience artistic, do-it-yourself types in, say, a company's marketing department. With ExecuVision they can develop special displays that are unique to them. No more lines or bars marching in staid monotony across the screen. With an ExecuVision chart, a simple line can be transformed into either a minor character or embellished into the lead in a fully realized drama. The potential is there; it simply needs exploiting. ♦

Software Arts (Continued from page 67)

Software Arts' computer network. One small margin involves communication speeds. In particular, signals from remote locations, such as employee homes, could be quicker.

Leased Lines

Bob Frankson has a high-speed leased line tying his home units into the system; all other units come in at standard communication speed (300/1200 baud). Another improvement would be introduction of high-speed optical scanning devices to input research material from periodicals, for example, right into the system.

This would be possible, of course, only if and when such devices become economically feasible and if copyright law is reinterpreted to permit such action. Otherwise, the network works effectively and efficiently, utilizing current technology nearly to its fullest. It suits an environment in which staff members feel at home and, at the same time, succeed in tapping their own internal resources in getting the job done. ◇

SX-64 (Continued from page 35)

with all C-64 software except those programs on cassette tape. What prevents the SX-64 from running the programs is that it has no provision for cassette input/output.

One game I used during the review is "International Soccer." It is the first in Commodore's "Gold Medallion" series. The perspective is great; the game even has the shadow of the ball growing larger and smaller as the ball rises and falls. I loved it, and ordinarily I am not what you would call a soccer fan.

Summary

Microcomputers can take up a lot of room, especially in an apartment or a small house. Where space is tight, the SX-64 might be a good choice. This machine certainly has lots of economical peripherals and can run all of the vast library of Commodore software available on cartridge or diskette.

There are practically no technical differences between the C-64 and the SX-64. The connectors are the same; the diskette drive is no faster; the functions are the same. The package is the difference, and it is a very practical difference. I like this—quite portable—machine a lot.

At about \$800, the SX-64 is a winner, even without an r-f modulator. ◇

#1 Rating (spreadsheet configuration)
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Guest Column (Continued from page 26)

of operating. So they took the system more or less half way, with the Q W E R T Y protocol. It has the typist alternating from one hand to the other hand about half the time. Often he is required to use the same hand to type two, or three—even four, sometimes five—successive strokes, thus slowing down.

Anyway, the purpose of an exercise book is to give you practice in using the same keys—getting you used to them. Right under Q W E R T, for instance, comes A S D F G. So that an exercise book might say,

Type the following combination of letters with your left hand:

“as sad daf fad fass.”

Do that a few times, and you become accustomed, looking up at your chart, to putting your fifth finger down on the middle row when you want an “a,” the fourth when you want an “s,” the third when you want a “d,” the second when you want an “f.” Then the exercise book will go on and combine letters from the first row, the Q W E R T Y row, and the second row. Telling you, for instance,

Type the following:

“red rad raf eaf ead eas was wad waf qas qaf qea qef”—etc.

Finally, to complete your left-hand learning, try exercises combining all three rows, for example: zer baf vew bea qeb gax exr. Practice those for about an hour. Then you can make up—or take from the exercise book—similar simple workouts for your right-hand.

You get the idea, and my point is exactly that—anyone can get the idea. But meanwhile, very important things are happening. You are not looking at the keys on your typewriter, for the very simple reason that there is nothing there to see except black blot-out paper. What is happening, slowly—well, not so slowly, really—and surely—absolutely surely—is that you are not merely learning to type, you are learning to touch-type. And concerning the difference between the two, I can only think, as analogous, the difference playing the piano while your eyes are on the sheet music ahead of you, or needing every time to look down to the piano keys to find the key that corresponds to the note you wanted to play.

But back to my own schoolboy experience. For two or three late afternoons and evenings, during study periods, I would look at the piece of paper ahead of me and cause my fingers to descend on the position that corresponded to the position on that facsimile sheet of a typewriter keyboard. After three days I did not need the sheet of paper. I had learned to touch type. I would guess I had put four, maybe five hours into the whole

process of learning. My initial speed was very slow, but within a couple of weeks I was typing better than forty words per minute.

Experience Number Two. At age 12, my son was idling an hour during the late afternoon having come in from skiing. Because we were in Switzerland, he had no recourse to television, so impulsively I said to him, “If you like, I’ll teach you how to type. But there is one condition. You have to do it my way.”

“Okay.”

This time, typewriter caps having disappeared, I needed to bring out some black paint which, with a little brush, I applied to the keys, causing the letters to

My 12-year-old son learned touch typing in an hour and a half

disappear. It was an acrylic paint, so it dried within twenty minutes. I used that time to type a facsimile, and to draw the finger zones. I posted them on a wooden wall opposite the desk, and began dictating. “Type ‘sad.’ Type ‘fad.’” And so on.

Now brace yourself. One hour and one half later, I said to my son, “Type, ‘The quick brown fox jumped over the lazy dog.’” He made a few mistakes, but he got it. He had every letter of the alphabet using the correct finger.

He had learned touch typing. Oh sure, he couldn’t go out the next day and get a job as a typist. But if he had practiced two hours a day, in two or three weeks he could have.

Children, it is notoriously known, learn more quickly than adults, so I don’t expect I’ll do as well with Dick.

Who is Dick?

Well Dick Clurman is close to sixty years old, and one of the senior journalists in America. He has been typing since he was eight years old, editing successively a grammar school, high school, college and army newspaper. He has served as editor of *Newsday*, as chief of correspondents of *Time-Life*, and in a number of other jobs, and is never far removed from a typewriter. But like ninety-five percent of those who “type,” he never got around to gluing those circular

black dots over the keys and forcing himself, every time he struck an “r” or an “f” or a “v” to use only the second finger of his left hand. Like a lot, perhaps most, of his professional colleagues, including the editor of this magazine, he is very proficient in the sense that he can type at great speed. But his head needs to be bent over the keyboard to make sure that he is striking the right key.

What does it matter?

It matters like this. You can’t, unless you touch type, copy anything with any fluency. Let us say that the story you are writing requires you to copy the first three sentences of the Gettysburg Address. So you dig it out, prop it up, bend over the pages of the book, turn your head left and begin:

“Four score and seven years ago, our forefathers brought forth a nation conceived in liberty, and dedicated to the proposition that all men are created equal. Now we are engaged in a great civil war, testing whether that nation or any other nation so conceived can long endure.”

The touch-typist can reproduce that passage—and the whole speech—without once turning the head from the page being copied. The non-touch-typist needs to memorize a few words from the text, then turn to the typewriter to reproduce them, then turn back to the book, find exactly where in the text he left off, then back to the typewriter, and so on. This may not be so painful when writing down Lincoln’s Gettysburg Address, because, already familiar with the text, you can commit a longer sequence of letters and words to memory. But imagine that you are quoting unfamiliar or dense material; a speech by Professor Galbraith on economics; or a foreign language.

Well, that is the end of the lesson. Never in the history of the world was it easier to achieve proficiency in any discipline than touch typing. But because people think it’s hard, they never get around to it. They think of fortnight after fortnight in a classroom with an instructor.

And before you know it, they are sixty years old and, like Dick, still they don’t know how! I swear, it’s like reaching sixty and not learning how to open a window or turn on a television set! You ask, Okay, so it took your 12 year old son an hour and a half to learn touch typing, how long will it take your friend Dick?

I don’t know. He’s going to start this very afternoon, he tells me. I’d guess four or five hours.

P.S. It actually took six. He had a lot of bad, old hunt and peck habits to get rid of. ♦

LCDs

(Continued from page 51)

forming a twisted structure like a spiral staircase. The spiral polarizes any light passing through it.

You can see this polarization effect only when you look at the display through a polarizer with another polarizer behind the liquid-crystal panel (Fig. 2A). When the liquid crystal is off—in its twisted arrangements—the panel acts as a crossed polarizer that blocks the passage of light.

Turning the liquid crystal on is a matter of setting up a field across the thickness of the panel. In the presence of such an electric field, the twisted crystals line up in the direction of the field—parallel to the thickness of the panel so that you're looking at the ends of the molecules (Fig. 2B). The crystals therefore no longer polarize the light passing through. Thus, the portions of the display affected by the field look different from the rest of the panel. Depending on how the polarizers are oriented, you can make areas that are turned on appear dark on a light background or vice versa.

The field is applied to the panel by using two sets of electrodes on the glass plates that contain the liquid crystal. The electrodes on the display's face are made of a transparent conductor; and, if the panel uses back lighting, the rear electrodes are transparent too. In general-purpose displays, one set of electrodes runs horizontally, the other vertically. You create a field in the crystal by putting a voltage across one horizontal electrode and one vertical electrode at a time; where the electrodes cross, the resulting field turns the crystal on. LCDs use very little power because almost no current flows through the panel. The whole thing works on the field alone.

Guest-Host Eases In

One alternative to twisted nematic panels is the guest-host type, which doesn't need polarizers. Because the entire display consists of the liquid crystal panel itself, it provides a wider viewing angle and has the potential of costing less than the twisted nematic LCD. Research on guest-host panels has gotten off to a slow start, though, so it will take some time to find out if these displays can deliver on their promise.

Guest-host displays work by incorporating a dye into the liquid-crystal material. The liquid crystal is the host, and the dye is the guest. When the display is off, the nematic crystals in the panel line up parallel with the front and back sheets of glass and force the dye molecules to line up too (Fig. 3A). When they're lined up this way, the dye molecules block any light that tries to pass

through the panel. When you apply an electric field, however, the crystals act just as they do in a twisted nematic display: they line up at right angles to the front and back glass (Fig. 3B). The dye stays lined up with the crystals and no longer blocks the light. You can turn on any part of the panel by using the same kind of electrodes that are used in the twisted nematic panel.

There are several kinds of guest-host LCDs, one of which works like a twisted nematic panel without polarizers. But all use a dye combined with the liquid crystals. The panels tend to need higher voltages than twisted nematic types, to work somewhat slower at low temperatures, and to be a little less reliable. But they do offer some advantages, including single-color displays. Producing the color is a simple matter of using a colored dye. So far, though, these displays are very small—only a few digits or special graphics for applications such as automobile dashboards.

More Colors

What about multicolor displays? Knowing how LCDs work makes it difficult to see how a full-color panel could be made, but Seiko claims to have done just that. The panel uses the standard twisted nematic effect in what is called the transmissive mode: a light source behind the display transmits its light through the panel to your eye. Colors are produced by use of a three-color filter placed over the front of the panel. Each of the 57,600 dots (pixels) in the LCD corresponds to either a red, blue or green spot on the color filter. Thus, turning on a pixel behind a red spot results in a red dot on the display. By controlling this dot's intensity and the intensities of the green and blue dots next to it, you can generate any color just as on a CRT.

One other interesting thing about this Seiko display is the technique used to control the pixels. Although all currently available LCDs use integrated circuits (drivers and multiplexers) to turn pixels on and off by directly driving row and column electrodes, Seiko uses a different method.

In this approach, active circuit elements (polysilicon field effect transistors) are deposited along with the electrodes on the back sheet of glass. The result is a smaller package that doesn't need to interface to control electronics through all 480 of its row and column lines—an obstacle with large panels. A display using this method might only require the generation of a code on a few input lines to tell the panel which pixels to turn on. Seiko will sell the color panel

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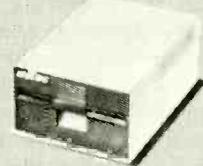
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LCDs

in the US as the display for a small television receiver later this year.

A New LCD Technology

Although CrystalVision's LCD doesn't display color, it does have other appealing characteristics, which are derived from a remarkable new technology. The display's characteristics include 25 rows of 80 columns in the same 9" diagonal size of many CRTs, nonvolatile operation, and high contrast. The size of this display is significant; other LCDs might display as many characters, but they do it in a much smaller area.

CrystalVision's LCD uses several different liquid-crystal phases. And instead of relying on an electric field alone to control the pixels, these LCDs also use heat. When heat is applied to the crystal material, the crystals go from the smectic to the cholesteric to the isotropic phase. When the material reaches the isotropic phase—a normal unorganized liquid state—applying an electric field will align the crystals, which then allows light to pass through and reflect from the display's backing plate. Pixels not affected by the electric field absorb light and appear dark; aligned crystals appear light. Arranging the heating and field electrodes in a grid allows heating up one row at a time and applying a controlling field to any pixel.

There's more to this display, though. When the crystal material cools back to the smectic phase (a waxy solid), with or without an electric field applied, the crystals stay in the alignment they were given. You can therefore unplug the unit without losing the information.

Because the crystal material has to be heated and then cooled every time something is written on the display you might suspect that these panels don't respond as fast as other LCD types. That's true. But the slow response is not an acute problem for two reasons. First is that screen refresh isn't necessary. Other

LCD types, such as twisted nematic panels, must be refreshed at regular intervals. CrystalVision LCDs retain whatever is written to them.

The second reason that speed is not critical involves the nature of computer displays. The next time you use your computer, notice how much of the screen actually changes from moment to moment. In editing a text file, for instance, you might move the cursor from one place to another. The CrystalVision panel would have to heat up one line to erase the cursor and another line to display the cursor's new position. But the rest of the screen remains unchanged. This is true for most operations.

One of the few common activities that alters the whole screen at once is scrolling. It might look like you're seeing mostly the same information from moment to moment when you scroll through a file, but think about it from the display's point of view. Nearly all the pixels have to change every time you scroll up or down a line. CrystalVision's panel is fast enough to do very credible scrolling. In fact, seeing it makes you wonder why speed should be a question at all. Nevertheless, don't expect to see CrystalVision's LCD in a TV; the display couldn't keep up with the constantly changing image.

One of the most apparent benefits of this technology is the display's contrast ratio, which is impressive to see. CrystalVision promises a contrast of about 10:1 in production models. That's better than you get with newsprint (about 7:1) and much better than any other LCD. The high contrast results from use of a special crystal material that contains a lot of dye and doesn't depend on external polarizers. Getting rid of the polarizers gets rid of some contrast problems and also helps the viewing angle. This LCD's viewing angle—about 120 degrees—is much wider than that of other types. Further, the panel's

back reflector prevents ghosting in images. The reflector consists of the heating and field electrodes that are on the *inside* of the back glass rather than the outside like most LCDs.

Unfortunately, CrystalVision's design doesn't run on the same minuscule current that powers other LCDs. Although the long-term power level might average out to only 3 W (when you consider that most of the display rarely changes), you have to be ready to supply the power needed to change the entire screen whenever needed. Thus, this LCD ends up needing about as much power as a CRT (about 30 W).

On the positive side, if no major manufacturing problems arise in volume production you can expect to see these displays in computers before long. The time from production to use should be short because CrystalVision is packaging the LCD with all the necessary electronics to make a moderately intelligent terminal. Just add power supply and housing. At prices as low as \$600 for quantity orders of the display and driver boards, it will be interesting to see who puts this LCD in a box first and how they use it.

How long will it be before you can buy a computer or terminal with a big LCD in it? That depends entirely on how fast computer manufacturers react. It takes some time to design a product around a new display, but market pressures should speed things up in this case. The pressure is so great, in fact, that at least one manufacturer is leap-frogging itself. Gavilan announced a nifty portable with an 8-line LCD a year or so ago, then later promised a 16-line display before producing the smaller version.

The technology is moving so fast, it's hard to tell where to place your bet. Are 40-line LCDs right around the corner with a \$1.98 price tag? You'd better not bet on that, but you can expect some impressive displays to show up on your lap in the near future. ◇

Communications Software

(Continued from page 59)

or two keys on your keyboard. A simple macro would be your password for a particular service; when the service requested your password, you would hit the correct key to transmit the password macro.

Some programs allow more sophisticated macros—for example, macros that transmit one string of characters, pause for a half-second, then transmit another, or macros that trigger other macros. But typically, with macros, you control the logic—you watch what's coming in from the remote service, and choose to trigger

the macro at the appropriate time.

A *script* approach lets you set up a little program that can run unattended once it has been initiated: dial the number; wait five seconds; transmit the account number; wait two seconds; transmit the password; wait another second; transmit a command; and so on.

Sophisticated macro facilities equal the power of unsophisticated script facilities, but typically a script approach allows more flexibility and a greater degree of automation. Creating either a script or a complex macro requires you

to study carefully exactly what the sign-on sequence is (does it say "YOUR PASSWORD?" or "your password please?") and much trial and error.

Script facilities can be classified according to the kind of testing they do on what comes in from the remote computer. The least powerful scripts only allow a time delay between sending strings. More powerful programs make it possible to wait for a particular character (like the "?" or ":" in the examples).

Better still is a string test that could watch for the whole query "PASS-

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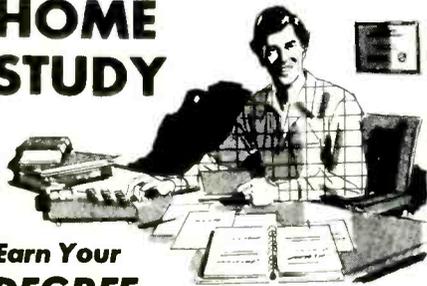
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Communications Software

WORD?" and not be confused by other question marks. The final, most complete script facility will allow the script to make a decision, or branch, depending on what is transmitted to it—for example, if the response coming in is "service busy, try another number," the script could go on to try another number; otherwise, it would proceed with the normal sign-on.

A script feature that has access to your computer's built-in clock also makes possible completely unattended operation. You could, for example, set up your computer to dial the one in your branch office at 4 a.m. (that one, of course, will have to be able to act as a host), fetch yesterday's accounting records, and print them out for your study first thing in the morning.

Break Key

Computer terminals always have a key labelled, **BREAK**, which does what it says: it causes the remote computer to break from whatever it is doing, and wait for another command. It is most commonly used on larger systems when you discover that the information you've just asked to have printed is the wrong stuff, or that the program you've just set to execute isn't working the way it was supposed to.

Unless you can be sure you'll never find yourself in that position, be sure your communications software implements the **BREAK** function. Technically, pressing the **BREAK** key (whichever one is assigned to that function) should cause the computer to send (via the modem) a signal equivalent to a logic-0 lasting 150-250 ms.

Data Capture

Data capture is the computer equivalent of tape-recording a telephone call. It means recording—on disk or in memory—all the characters you type in at your end plus all the characters received from the other end. The use of data capture when receiving information from another computer is often called "downloading".

Data capture is a useful feature no matter what your application is. If you're working with databases or electronic mail, it will also save you money—you don't have to read what you've retrieved while you're on-line and paying for line charges and connect time.

Some programs save data in memory, some on disk, and some offer the option of either or both.

Memory capture can offer a number of conveniences, like backing up in the data you've captured to re-read some-

thing, even while the remote computer is still transmitting. But it has the same weakness as any other memory-based function: if something happens during the process, like a static spark or a power failure, you can lose everything.

Of course, memory capture must allow you to write to disk later, for permanent storage. A capture feature should warn you about data you've left in memory when you decide to quit the program, and also warn you when memory is nearly full. Saving directly to disk is safer, although with some programs it may slow down the whole operation.

Printer Toggling

It often is useful to be able to print out what is coming in as it is coming in—especially in database searching or electronic mail.

Programs that implement this feature well make it easy to turn the printer on and off so you can print selected parts of your session. If you have a slow printer or a fast modem, watch for a buffered printing feature that allows the incoming data stream to get ahead of the printer without losing anything. (The data is stored in the buffer and channeled out to the printer at the printer's speed.) Of course, if you capture to disk, you can always print later.

Text File Transmission

Most remote computer systems assume that they are receiving characters as they are being typed on your keyboard. Many on-line services charge you by the minute to connect to them. Consequently, you are often better off doing the typing before you go online, then signing on, sending everything quickly and perfectly, and signing off as quickly as possible. To do this, your software needs a text file transmission feature. It's essential with electronic mail applications, often useful in transactional or programming situations. (In contrast to "downloading," this process of transferring data from your computer to another is often called "uploading".)

Ideally, a text file transmission feature will let you simply say "Sendfile MYTEXT," or something similar, and "MYTEXT" will be taken from the disk drive and transmitted. To the computer at the other end, it will appear exactly the same as characters typed on your keyboard. A useful auxiliary feature is a "throttle," a feature that lets you control the character-to-character and line-to-line delay in this transmission; some remote systems can't take full-throttle 1200-baud text.

If you intend to transmit text files, you

must also be sure you have the software to create them. In particular, your word processing software must be able to produce a standard ASCII file; not all word processing software does. You should also be aware that some non-text characters, especially the Control-S and Control-Q characters, have special meanings to many on-line systems. If your word processing software uses them (Wordstar, for example, does) leave them out of anything you plan to transmit.

Protocol Transfers

A *protocol transfer* is the transfer of a file using a special, error-checking procedure between two computers that know the same procedure (protocol).

Protocol transfers are necessary for error-free transmission of binary program files. If you are transmitting a piece of text, and a single bit doesn't get through correctly, nothing serious has happened: a "B" may come out as an asterisk, and it just looks like a minor typo. But a single erroneous bit in a program file can mean disaster, so error checking is important.

Protocol transfers work with any type of file. If both you and another office use the same word processing software, or the same spreadsheet program, a protocol transfer can transmit documents or spreadsheet data with all the special codes and binary numbers you want.

There are a couple of protocols that are in the public domain—notably the Ward Christensen or Xmodem protocol, and the Kermit protocol which can also be used by mainframe computers. These are implemented by a number of different micro communications programs. Communications programs using Xmodem protocol are also available for the taking from a number of RBBSs (Remote Bulletin Board Systems). Other programs implement their own proprietary protocol, forcing both you and the person at the other end to buy the same program.

The Xmodem protocol is typical of the others. The Christensen protocol software chops the data up into 128-byte chunks, sequentially numbers them, and sends them one at a time. With each chunk, it sends an 8-bit checksum, a number that it calculates based on the binary value of all the data in the chunk. At the other end, the receiving computer verifies that it's getting the right chunk (by the number), gathers up the data, and recalculates the checksum. If it gets the same value as the one that was transmitted with the data, it concludes that the data got through unscathed, saves it,

and sends back a signal requesting the next chunk. If it calculates a different checksum, it concludes that something got transmitted incorrectly, and requests that the same chunk be sent again.

If you expect to want to do protocol transfers, then you should either opt for software that uses a common protocol or agree with everyone you deal with that you'll all use the same program.

Terminal Emulation

Different computer terminal models use different codes for things like cursor positioning, highlighting, and control of scrolling. They may also use particular keys in particular ways, other than simply as generators of ASCII characters.

Most information services that invite a broad public clientele assume you will have a lowest-common-denominator, plain ASCII terminal. But many corporate mainframes, and other computers that have traditionally been able to control their user bases and terminals closely, will require a particular type of terminal, such as an IBM 3101 or a DEC VT100.

Now, with microcomputers proliferating among these closed user groups, there is an increasing demand for terminal emulation features in communications software—features that let the micro respond to control signals as if it were the terminal in question and send the right signals when various keys are pressed.

Be careful about claims of terminal emulation: it's difficult to do well, and some features of some terminals are nearly impossible to duplicate on some microcomputers. Before you commit substantial resources on the assumption you'll be able to use a micro as a special terminal, be sure you've tested it in real situations.

In particular, if you want to emulate the very popular IBM 3270 terminal, you need not only special 3270 software, but special hardware that replaces an ordinary serial port and modem for communications. If it's 3270 you want, you're reading the wrong article!

Software Packages

The accompanying table shows how ten popular software packages for microcomputers stack up in their implementation of the features described above. The table is not meant to be complete. It is meant only as an indication of some of the products that are available for a variety of machines. Not all of these programs have been tested; some features are described on the strength of the producer's claims. ◇

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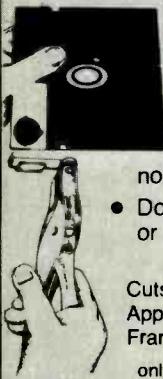
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HP 110

(Continued from page 38)

Mass Storage Options

The HP 110 includes two solid-state, *electronically simulated* disk drives. In addition, up to eight *conventional* floppy disk drives can be connected to the computer's HP-IL serial bus.

Drive A is the random-access memory (RAM) disk. Programs and data can be written onto and retrieved from Drive A as if it were a conventional mechanical drive. Drive B is the read-only memory (ROM) disk. It contains permanent version of the machine's operating system (MS-DOS) and the bundled application programs (MemoMaker, Lotus 1-2-3 and Terminal Emulator).

When an application program is selected, it is downloaded from Drive B into RAM just as if the ROM that comprises Drive B were a mechanical disk drive. Of course the solid-state nature of the electronic drives considerably speeds up the loading process.

Up to eight single or four dual external disk drives can be connected to the HP 110. These conventional drives are consecutively labeled C through J.

The contents of Drive B are perma-

As for the conventional mechanical disk drive, one was not available in time for this review. Hewlett-Packard, however, supplied detailed specifications.

The drive, which sells for under \$700, is designated the HP 9114A Portable Disk Drive. Its media is a double-sided 3½" microfloppy with a formatted capacity of 630K bytes. The Sony drive mechanism has a rotation speed of 600 rpm and an average access time of half a second.

The drive is interfaced with the HP 110 via a common HP-IL bus. Like the HP 110, the drive is powered by a lead-acid battery pack. In part because of the battery pack, the drive is somewhat bulkier than expected. It weighs 5½ lb and measures 11½" W × 8" D × 3" H.

Other Features

The HP 110 includes a built-in 300-baud full-featured, direct-connect modem with ring detect, automatic answer, and both manual or automatic dialing (pulse or dual-tone). External modems can also be used.

The machine's built-in clock can provide up to eight alarms and appointment reminders. Files can be organized according to name *or* time and date.

The alarm feature can even be used to switch the computer on. For instance, the machine can be instructed to wake-up at any specified time, dial a telephone number, and download information into a remote terminal.

In a particularly wise move, Hewlett-Packard has made it possible for HP 110 owners to interface their machines with desktop models like the touch-screen HP 150 and IBM's PC. In both cases, HP supplies an appropriate HP-IL interface card.

Some Parting Comments

The HP 110 isn't everyone's perfect portable. Though I'm sure many users will buy the machine for its Lotus 1-2-3, I would have preferred bundled BASIC. Though I found the liquid crystal display easy to read, users who prefer the brightly glowing phosphor characters of a CRT to the gray shadows of an LCD will be disappointed that the HP 110 does *not*, at least yet, include any provision for connecting an external CRT monitor.

No, the HP 110 isn't the last word in notebook portables. But it's a major step along the way. It provides unprecedented memory capacity and bundled software for a portable. And when connected to a disk drive and ThinkJet printer, it provides an enormously powerful processing capability. ♦

Provides unprecedented memory capacity

nently stored in ROM and cannot be written over, erased or otherwise amended or altered. However, the number of RAM bytes allocated to Drive A is user selectable. Here's how: Selecting the System Configuration menu option displays the various user-alterable machine parameters, the first of which reads "Memory/Edisc: 96K/176K." These numbers, which are the computer's default values, allocate 96K bytes of RAM to the machine's system memory and 176K bytes of RAM to Drive A (*Edisc* means *Electronic Disk*).

The bytes assigned to either segment of RAM can be quickly altered in 4K-byte increments by pressing one of two function keys. The values range from 256K/16K to 96K/176K. Take it from an experienced 32K Model 100 user; these memory capacities are nothing less than phenomenal.

Since CMOS RAM chips are used, the machine provides a continuous memory capability even when the power is switched off. When the battery pack is fully charged, the contents of RAM are retained for a full year when the computer is powered down.

Zenith Z151

(Continued from page 33)

nith appears to have addressed both objections with some very subtle changes to the IBM PC keyboard, overcoming the awkwardness without seriously affecting compatibility.

First of all, Zenith has added LED status lights to the CAPS LOCK and NUM LOCK keys that light to indicate when the main keyboard is in the upper-case or the numeric/arrow pad is in the numbers mode. Secondly, Zenith has moved the backslash key away from the SHIFT key and sized this key to be more like that on a typical office typewriter. Finally, Zenith provides a standard L-shaped RETURN key that is much easier to find than the smaller vertical key on the IBM PC, and an ENTER key on the numeric keypad.

Other than the enumerated simple improvements, the Zenith keyboard is functionally identical and plug-compatible with that of the IBM PCs. In fact, Zenith is selling the keyboard as a separate item for those who wish to upgrade the IBM PC with a more comfortable keyboard.

We should also mention that the Zenith keyboard is completely electronic, a decided improvement over the IBM PC's mechanical design. The Zenith keyboard requires less pressure on the keys and, unlike the IBM keyboard, fully supports auto-repeat on each key, with the repeat rate increasing the longer the key is held down. An audible keyboard "click" is heard with each character sent to the computer.

In general, we were very pleased with the Z-151's keyboard. It had a great feel and excellent response, and it required no adjustments to operate.

The Video

Not surprisingly, Zenith has applied its tremendous expertise in the television field to jazz up the video display functions of its computers. The Z-151 sacrifices much of the dazzling graphics characteristic of the Z-100 Series in order to remain compatible with the more limited capabilities of the IBM PC. Nevertheless, the Z-151 does offer some distinct advantages over the IBM PC and many of its imitators.

The most obvious advantage is the complete absence of video flickering and a substantial improvement in the speed at which text is displayed. In addition, the Z-151 offers smooth and jump scrolling, a high-resolution graphics cursor, and multiple character fonts, all of which are absent from the IBM PC.

In our view, the greatest single video advantage offered by the Z-151 is the ability to run high-resolution, dot-ad-

dressable color graphics on a monochrome display. In this mode, the "colors" are displayed as different intensities of grey. Otherwise, the display is much the same as an RGB monitor. This means that individuals no longer have to choose between a monochrome or color configuration, as they do with the IBM PC, and can upgrade to color simply by changing monitors.

Other Features

The Z-151 offers some features not found in the IBM PC and many PC compatibles. One particularly important feature is its heavy-duty power supply, which is rated at 165 watts and is about twice as powerful as that in the IBM PC. With the Z-151, the user can populate all expansion slots without fear of running out of power. Hence, the same configurations that might require an expansion

An exciting alternative for the discriminating buyer interested in compatibility

cabinet with auxiliary power supply for the IBM PC will run in the standard internal bus slots in the Z-151. Similarly, the Z-151 floppy-based model will support an upgrade to a hard disk system internally, while the PC requires an expansion cabinet and power supply for the same upgrade.

The Z-151 also offers an extensive and easy-to-use set of diagnostics. Besides the power-up diagnostics mentioned earlier, there is a set of menu-driven diagnostics in ROM, accessible any time from the keyboard by typing a key sequence similar to a system reset. These functions permit booting from different disks or disk partitions, examining and manipulating memory and machine registers, controlling input/output functions, setting video scrolling, and tracing program execution. According to Zenith, further diagnostics on disk are available to allow technicians and hobbyists to identify system operations and malfunctions down to the level of IC chips.

Documentation

Both the engineering and documentation of Zenith computers are performed at the company's Heath division. The

documentation we received was comprehensive, detailed, and very easy to read. Unfortunately, not all the documentation was ready at review time. But we did receive a 25-page user's guide and a 2"-thick MS-DOS 2.0 manual, which comes with the MS-DOS 2.0 and 1.2 disks at no additional cost.

The user's guide is intended to be the first section of a more comprehensive operations manual, with additional sections on hardware, software, service, and operation. The user's guide is excellent. It is well organized, profusely illustrated, completely indexed, and set in a very readable type.

The MS-DOS manual follows similar exacting standards and is filled with helpful examples of how to use this operating system.

Service

Like most other manufacturers, Zenith offers a 90-day warranty on its computers. However, unlike most others, the Zenith warranty is good for *on-site* service. The company claims it can offer this because its overall design and extensive on-board diagnostics should reduce average service time to less than 30 minutes.

Fortunately, we had no need to check out Zenith's claim, as the computers operated flawlessly over the two-week period during which they were undergoing tests. We did, however, check out the ROM diagnostics and removed and inserted some component boards. Our general impression was that this machine would be very easy to service, should it ever need it.

Compatibility

Zenith claims that its Z-151 is totally compatible with the IBM PC, except for programs that make direct calls to the IBM PC's ROM BIOS (basic input/output system). In effect, almost all PC software not written in IBM's proprietary BASICA language will run on the Z-151, right off the shelf. This includes such popular programs as Lotus 1-2-3 and Microsoft Flight Simulator, which both ran flawlessly, and thousands of business and personal software packages.

Obviously, it would have been impossible to check out the thousands of IBM PC software packages available in the marketplace for this report. But we did try out several dozen packages of various kinds and encountered no apparent problems in running them under MS-DOS, PC-DOS, and even the UCSD p-System, as long as the software did not directly call the IBM PC ROM BIOS. In

fact, the improved speed and functions of the Z-151 made many of the programs seem more impressive than when they ran on the IBM PC. As expected, packages written in BASICA did not run.

By not attempting to emulate the IBM PC's ROM BIOS, Zenith has protected itself from copyright infringement. On the negative side, though, users who already own a PC and have purchased software in a version that uses the ROM BIOS will not be able to run this software in the Zenith computer. New buyers who have no investment in PC software will not have much of a problem in this area, since they have the option of buying most business software in non-IBM-dependent versions.

At the hardware level, the five right-most slots in the Z-151 are totally compatible with the IBM PC. We tested this with a network board designed to run in the IBM PC and encountered no problems. We also tested compatibility on the CPU board by successfully adding and testing an 8087 coprocessor chip.

It appears to us that the Z-151 can be safely added to an IBM-based office environment in place of or in conjunction with the IBM PC or PC/XT. In fact, since the Z-151 comes standard with serial and parallel ports, color graphics, and a hefty power supply, it may actually be able to work into IBM-compatible networks or configurations with oth-

er peripherals better than an IBM PC loaded with expansion cards.

It should come as no surprise that Zenith has elected not to include a cassette interface in the Z-151. We have never seen anyone actually using this interface on an IBM PC, so we do not think it will be missed by Z-151 users.

Buying Considerations

Computer shoppers eyeing the Z-151 will be looking at many of the same tradeoffs they would be if considering an IBM PC. Both computers are considerably more expensive than most 8-bit desktops and less powerful than some of the new 32-bit machines. Most users who buy a Z-151 or IBM PC will be swayed by the rapidly growing volume of software and hardware and overwhelming move by manufacturers and large institutions to embrace the IBM PC "standard."

Compared to the IBM PC, we feel the Z-151 represents a substantial improvement in quality, performance, and features, and a distinct advantage in price (except perhaps for some individuals and institutions eligible for substantial discounts from IBM). Compared to other IBM PC compatibles, the Z-151 offers a high degree of name recognition and a reputation for quality and dependability that is absent from most other entries in this marketplace. No matter what the

eventual success of the Z-151 in the marketplace will be, we suspect that Zenith will be there to support it until the last unit is retired.

Perhaps because of its already solid reputation, Zenith has shied away from "bundling" software with the Z-151, a strategy used by some lesser-known vendors to overcome consumer objections to purchasing an unknown "compatible" product. As with the IBM PC, consumers who purchase the Z-151 will be passing up "bargain" computer systems of varying price and compatibility to stand under the umbrella of a large company like Zenith.

Summing Up

Zenith is the first major, well-known American company we know of that is both manufacturing and distributing its own highly IBM-compatible computers. It appears to have done an excellent job in creating a *new* line of computers that both conform to the de facto standards of the dominant IBM PC and offer significant improvements in both price and performance.

The Z-151 gets high marks from us for its engineering and performance, opening up a new range of options for discriminating buyers who require IBM PC compatibility. Barring an unlikely industry move away from the IBM PC, the Z-151 should travel well in its wake. ♦

Heath HS-151

(Continued from page 33)

sider that some 3000 solder connections must be made on these cards.

The HS-151 requires considerably less mechanical assembly time than other computer kits in the Heath line. Part of the reason is that there is no built-in video display system, as there are in the company's all-in-one desktop computers. In fact, if you're familiar with Heath's Models H-89 8-bitter and H-120 8/16-bitter, you'll be surprised that the HS-151 has virtually no chassis work to be performed. What little there is can all be accomplished in an hour or less.

Assembly Details

Leaving nothing to chance, the typically well-written and profusely illustrated assembly manual begins with a section titled "Assembly Notes" that identifies the tools required to build the kit (standard slip-joint and long nose pliers, diagonal cutters, phillips screwdriver and solder pencil) and a short section on how to identify the coding on resistors and capacitors. A detailed short course on soldering follows.

Accompanying the soldering course

for practice use is a small, printed circuit board very similar to those used in the kit, plus IC sockets and a handful of components. Successful assembly and checkout of this board, as described in the manual, qualifies even a beginner with no previous experience in assembling a Heath kit to assemble the HS-151 confidently.

In number of connections to solder, the backplane board is the easiest of three circuit board assemblies to wire. This board contains the eight bus connectors for the CPU, memory, video graphics controller, disk drive controller, and any other cards you wish to add to the system.

With eight 62-pin connectors on this board, you might become bored with soldering and make errors if you aren't careful about how much solder you feed to any given connection. (All three circuit boards that must be wired are clad with multi-layer conductors and have plated-through holes. Feeding too much solder to a connection can create solder bridges, due to capillary action, between closely spaced circuit board conductors.

Many connections, especially those under the backplane connectors and under the numerous IC sockets used in this kit, won't show up even under careful visual inspection. It's important, therefore, that you exercise care when soldering.)

The remaining two circuit cards that must be wired consume the lion's share of the job of assembling the kit. While the backplane board takes about 1½ hours to wire, the memory and disk drive controller cards each require 4½ hours. These add to 10½ hours out of the total of 15 spent on the kit consumed just in wiring the three printed circuit assemblies. The remaining time is spent assembling the keyboard unit and in chassis construction, preliminary tests, and drive controller adjustments.

Kit assembly proceeds logically through wiring of the three printed circuit board assemblies and on through preliminary chassis work. The latter involves installing the preassembled power supply/cooling fan module (which you simply rop into place over captive screws and fasten down with lockwashers and machine nuts), the mounting of the plug-

in card guides on the main chassis, and assembly of the keyboard unit. At this point, you perform the resistance and voltage tests, as detailed in the assembly manual. Heath supplies everything necessary, including solder and an inspection magnifier, but not tools or the high-impedance multimeter needed to make the resistance and voltage checks and to adjust the disk drive controller card.

Once everything checks out, the floppy disk drive(s) are coded with A: and B: assignments and are mounted in a metal bracket that, in turn, is mounted on the main chassis in the same manner as the power supply.

The checkout procedure requires making resistance and voltage checks *before* installation of any of the plug-in cards. If no problems are encountered at this stage, the various cards are installed one at a time, and built-in diagnostics are run to make sure that everything is operating according to plan. Difficulties encountered anywhere along the way can be looked up in a detailed troubleshooting section of the user's manual to determine possible causes and solutions. Since everything is spelled out in detail in the manuals, there is absolutely no need for the person assembling the computer to have a technical background to perform tests and diagnostics.

Builder Comments

Assembling the HS-151 desktop computer was interesting and fun to do. I wouldn't hesitate to recommend this kit to anyone with a little mechanical ability who can read and follow directions. Except that I had to be careful about feeding too much solder, I encountered no pitfalls. Instructions and illustrations were always clear. Having previously assembled the H-89 8-bit and the H-120 8/16-bit computers, both from Heath, I would rate the difficulty (or ease) of assembling the HS-151 about midway between the two.

These new computer kits show that Heath has learned its lesson well. Whereas the early H-89 required considerable skill and patience to assemble and the H-120 was too simple a project to be called a "real" kit, the HS-151 offers a good balance of interesting tasks that will satisfy even an inveterate hobbyist.

To make the kit as foolproof as possible, Heath has made every effort to help the builder identify parts and the locations for them. The assembly instructions organize the circuit boards for components into easy-to-follow sections. The components themselves are easy to identify except for the disk drive controller package, in which the resistors, ca-

pacitors, and chokes are arranged in taped-together strips in the proper order for installation. Heath cautions against removing the tape from these strips, a caution that I echo. It would be easy to confuse the tiny capacitors that all appear to be the same size, but have different values. Another way Heath has simplified assembly is by making almost all hardware captive, which eliminates the fumbling that usually arises in situations

where you have to make do with two hands when three or four are needed.

Saving money on the purchase of a computer like the HS-151 is a good incentive to go with the kit. The \$800 or \$900 you don't have to lay out can go toward the purchase of other things you'll need for your system, like a monochrome or color video display, software, a printer, a modem, or any of a number of other add-ins and/or add-ons. ◇



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- The terminals were designed to be daisy chained around a central host computer and used as individual work stations • Hall effect switching • numeric and cursor keypad • 10 user definable keys • 50 interface cable with 9-pin sub-miniature connector • 7 LED function displays • Security lock • N-key roll-over • Automatic key repeat function • Color: (case) white w/black panel—(key caps) grey and blue • Weight: 6 1/2 lbs. • Data Included.

KB139 \$59.95

68-Key Keyboard with Numeric Keypad for Apple II and II+

- Plugs directly into Apple II or II+ motherboard with 16-pin ribbon cable connector • 26 special functions • Color (keys): white/grey • Weight: 2 lbs.

KB-A68 \$99.95

POWER SUPPLIES

TRANSACTION TECHNOLOGY, INC.
5VDC @ 1 AMP Regulated Power Supply

- Output: -5VDC @ 1.0 amp (also +30VDC regulated) • input: 115VAC, 60 Hz
- Two-tone (black/beige) self-enclosed case • 6 foot, 3-conductor black power cord • Size: 6 1/2" L x 7" W x 2 1/4" H • Weight: 3 lbs.

PS51194 \$14.95

Power/Mate Corp. REGULATED POWER SUPPLY

- Input: 105-125/210-250 VAC at 47-63 Hz • Line regulation: ±0.05% • Three mounting surfaces • Overvoltage protection • UL recognized • CSA certified

| Part No. | Output | Size | Weight | Price |
|----------|-------------------|--------------------------------|--------|---------|
| EMA5/6B | 5V @ 3A/6V @ 2.5A | 4 1/2" L x 4 1/4" W x 2 1/4" H | 2 lbs. | \$29.95 |
| EMA5/6C | 5V @ 6A/6V @ 5A | 5 1/2" L x 4 1/4" W x 2 1/4" H | 4 lbs. | \$39.95 |

NEW! **ASTECH SWITCHING REGULATED POWER SUPPLY**

- Apple III Power Supply • Multiple outputs for bench top uses and other applications • Input: 115VAC, 50-60 Hz @ 3.0 amps • Output: +5VDC @ 1.0 amp, +12VDC @ 1.0 amp, -12VDC @ 1.0 amp, +24VDC @ 2.5 amp, -24VDC @ 2.5 amp
- Size: 15" L x 3 1/2" W x 2 1/4" H • Weight: 2 1/2 lbs.

AS1155 \$39.95

POWER SUPPLY +5VDC @ 7.6 AMP 12VDC @ 1.5 AMP SWITCHING

- Input: 115VAC 50 bulbs @ 3 amp/240VAC, 50Hz @ 1.6 amp • Fan volt./power supply select switches (115/230VAC) • Output: 5VDC @ 7.6 amp, 12VDC @ 1.5 amp • 8 foot black power cord • Size: 11 1/2" L x 13 1/4" W x 3 1/4" H • Weight: 6 lbs.

PS94VOS \$39.95

KEPCO/TDK 4-OUTPUT SWITCHING POWER SUPPLY

- Ideal for disk drive needs of CRT terminals, microcomputers and video games • Input: 115/230VAC, 50/60Hz • Output: +5V @ 5 Amp, +12V @ 1.8 Amp, -12V @ 2 Amp, -12V @ 0.5 Amp • UL recognized • CSA certified • Size: 7 1/4" L x 6.3/16" W x 1 1/4" H • Weight: 2 lbs.

MRM 174KF \$59.95

4-CHANNEL SWITCHING POWER SUPPLY

- Microprocessor, mini-computer, terminal, medical equipment and process control applications • Input: 90-130VAC, 47-440Hz • Output: +5VDC @ 5A, -5VDC @ 1A, +12VDC @ 1A, -12VDC @ 1A • Line regulations: ±0.2% • Ripple: 30mV p-p • Load regulation: ±1% • Overcurrent protection • Adj: 5V main output • 100% • Size: 6 1/4" L x 1 1/4" W x 4-1/16" H • Weight: 1 1/2 lbs.

FCS-604A \$69.95 each

Switching Power Supply for Apple II, II+ & IIe™

- Can drive four floppy disk drives and up to eight expansion cards
- Short circuit and overload protection • Fits inside Apple computer
- Fully regulated +5V @ 5A, +12V @ 1.5A, -5V @ 5A, -12V @ 5A
- Direct plug-in power cord included • Size: 9 1/4" L x 3 1/4" W x 2 1/4" H • Weight: 2 lbs.

KHP4007 \$79.95

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4-Digit Fluorescent Alarm Clock Kit

NEW! 

- AM/PM Indicator
- Automatic display dimmer

The JE750 Clock Kit is a versatile 12-hour digital clock with 24-hour alarm. The clock has a bright 0.5" high blue-green fluorescent display. The display will automatically dim with changing light conditions. The 24-hour alarm allows the user to disable the alarm and immediately re-enable the alarm to activate 24 hours later. The kit includes all documentation, components, case and wall transformer. Size: 6 1/4" L x 3 1/4" W x 1 1/4" D.

JE750 Alarm Clock Kit . . . \$29.95

DISK DRIVES AND SUPPLIES

5 1/4" APPLE™ Direct Plug-In Compatible Disk Drive

- Uses Shugart SA390 mechanics • 143K formatted storage • 35 tracks — compatible with Apple controller • Complete with connector and cable — just plug into your disk controller card • Size: 6 1/2" L x 3 1/2" W x 8-9/16" D • Weight: 4 1/2 lbs.

ADD-514...\$195.95

+5VDC @ 6 Amps
+12VDC @ 4 Amps
-12VDC @ 0.5 Amps

Microcomputer Power Inc. Regulated Power Supply

- Perfect for computer or disk drive systems • Supply has AMP connectors for direct connection to two 5 1/4" disk drives
- Cooling fan • Input: 100/115/200/230VAC, 47-63Hz • Output (above) • Weight: 9 lbs.

13 1/4" L x 6 1/4" W x 5 1/4" H

CP167... \$59.95

INDUSTRIES Protect Yourself..

DATASHIELD® Surge Protector

- Eliminates voltage spikes and EMI-RFI noise before it can damage your equipment or cause data loss • 6 month warranty • Power dissipation (100 microseconds): 1,000,000 watts • 6 sockets • 6 foot power cord • Normal line voltage indicator light • Brown out/black out reset switch • Weight: 2 lbs.

Model 100 . . . \$69.95

Protect Yourself... **DATASHIELD® Back-Up Power Source**

Provides up to 30 minutes of continuous 120 VAC 60Hz power to your computer system (load dependent) when you have a black out or voltage sag • Output rating: 200 watts • Six month warranty • Weight: 24 lbs.

Model 200 (PC200) . . . \$349.95

IBM MEMORY EXPANSION KIT COMPAQ COMPATIBILITY

SAVE HUNDREDS OF \$\$\$ BY UPGRADING MEMORY BOARDS YOURSELF!

Most of the popular memory boards allow you to add an additional 64K, 128K, 192K, or 256K. The IBM64K Kit will populate these boards in 64K byte increments. The kit is simple to install — just insert the nine 64K RAM chips in the provided sockets and set the two groups of switches. Directions are included.

IBM64K (Nine 200ns 64K RAMs) \$49.95

TRS-80 MEMORY EXPANSION KIT

TRS-80 to 16K, 32K, or 48K

**Model I = From 4K to 16K Requires (1) One Kit
Model 3 = From 4K to 48K Requires (3) Three Kits
Model 4 = From 4K to 16K Requires (1) One Kit

*Model 1 equipped with Expansion Base up to 48K Two Kits Required
One Kit Required for each 16K of Expansion —

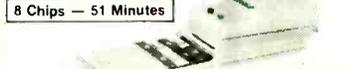
TRS-16K3 *200ns for Color & Model III . . . \$12.95
TRS-16K4 *250ns for Model I . . . \$10.95

TRS-80 Color 32K or 64K Conversion Kit

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

TRS-64K2 \$44.95

UV-EPROM Eraser

8 Chips — 51 Minutes 

1 Chip — 37 Minutes

Erases 2708, 2716, 2732, 2764, 2512, 2532, 2584. Erases up to 8 chips within 51 minutes (1 chip in 37 minutes). Maintains constant exposure distance of one inch. Spectral constructive. Bare. Uses eliminates static build-up. Built-in safety lock to prevent UV exposure. Compact — only 9.00" x 3.70" x 2.60". Complete with holding tray for 8 chips.

DE-4 UV-EPROM Eraser . . . \$79.95
UVS-11EL Replacement Bulb . . . \$16.95

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| 7400 TTL | | 74LS00 TTL | | 7450 TTL | | 4000 CMOS | | Linear | | Linear | |
|----------|-------|------------|-------|----------|-------|-----------|-------|--------|-------|--------|-------|
| Part | Price | Part | Price | Part | Price | Part | Price | Part | Price | Part | Price |
| 7400 | 1.20 | 74LS00 | 1.20 | 7450 | 1.20 | 4000 | 1.20 | 741 | 1.20 | 741 | 1.20 |
| 7401 | 1.20 | 74LS01 | 1.20 | 7451 | 1.20 | 4001 | 1.20 | 742 | 1.20 | 742 | 1.20 |
| 7402 | 1.20 | 74LS02 | 1.20 | 7452 | 1.20 | 4002 | 1.20 | 743 | 1.20 | 743 | 1.20 |
| 7403 | 1.20 | 74LS03 | 1.20 | 7453 | 1.20 | 4003 | 1.20 | 744 | 1.20 | 744 | 1.20 |
| 7404 | 1.20 | 74LS04 | 1.20 | 7454 | 1.20 | 4004 | 1.20 | 745 | 1.20 | 745 | 1.20 |
| 7405 | 1.20 | 74LS05 | 1.20 | 7455 | 1.20 | 4005 | 1.20 | 746 | 1.20 | 746 | 1.20 |
| 7406 | 1.20 | 74LS06 | 1.20 | 7456 | 1.20 | 4006 | 1.20 | 747 | 1.20 | 747 | 1.20 |
| 7407 | 1.20 | 74LS07 | 1.20 | 7457 | 1.20 | 4007 | 1.20 | 748 | 1.20 | 748 | 1.20 |
| 7408 | 1.20 | 74LS08 | 1.20 | 7458 | 1.20 | 4008 | 1.20 | 749 | 1.20 | 749 | 1.20 |
| 7409 | 1.20 | 74LS09 | 1.20 | 7459 | 1.20 | 4009 | 1.20 | 740 | 1.20 | 740 | 1.20 |
| 7410 | 1.20 | 74LS10 | 1.20 | 7460 | 1.20 | 4010 | 1.20 | 741 | 1.20 | 741 | 1.20 |
| 7411 | 1.20 | 74LS11 | 1.20 | 7461 | 1.20 | 4011 | 1.20 | 742 | 1.20 | 742 | 1.20 |
| 7412 | 1.20 | 74LS12 | 1.20 | 7462 | 1.20 | 4012 | 1.20 | 743 | 1.20 | 743 | 1.20 |
| 7413 | 1.20 | 74LS13 | 1.20 | 7463 | 1.20 | 4013 | 1.20 | 744 | 1.20 | 744 | 1.20 |
| 7414 | 1.20 | 74LS14 | 1.20 | 7464 | 1.20 | 4014 | 1.20 | 745 | 1.20 | 745 | 1.20 |
| 7415 | 1.20 | 74LS15 | 1.20 | 7465 | 1.20 | 4015 | 1.20 | 746 | 1.20 | 746 | 1.20 |
| 7416 | 1.20 | 74LS16 | 1.20 | 7466 | 1.20 | 4016 | 1.20 | 747 | 1.20 | 747 | 1.20 |
| 7417 | 1.20 | 74LS17 | 1.20 | 7467 | 1.20 | 4017 | 1.20 | 748 | 1.20 | 748 | 1.20 |
| 7418 | 1.20 | 74LS18 | 1.20 | 7468 | 1.20 | 4018 | 1.20 | 749 | 1.20 | 749 | 1.20 |
| 7419 | 1.20 | 74LS19 | 1.20 | 7469 | 1.20 | 4019 | 1.20 | 740 | 1.20 | 740 | 1.20 |
| 7420 | 1.20 | 74LS20 | 1.20 | 7470 | 1.20 | 4020 | 1.20 | 741 | 1.20 | 741 | 1.20 |
| 7421 | 1.20 | 74LS21 | 1.20 | 7471 | 1.20 | 4021 | 1.20 | 742 | 1.20 | 742 | 1.20 |
| 7422 | 1.20 | 74LS22 | 1.20 | 7472 | 1.20 | 4022 | 1.20 | 743 | 1.20 | 743 | 1.20 |
| 7423 | 1.20 | 74LS23 | 1.20 | 7473 | 1.20 | 4023 | 1.20 | 744 | 1.20 | 744 | 1.20 |
| 7424 | 1.20 | 74LS24 | 1.20 | 7474 | 1.20 | 4024 | 1.20 | 745 | 1.20 | 745 | 1.20 |
| 7425 | 1.20 | 74LS25 | 1.20 | 7475 | 1.20 | 4025 | 1.20 | 746 | 1.20 | 746 | 1.20 |
| 7426 | 1.20 | 74LS26 | 1.20 | 7476 | 1.20 | 4026 | 1.20 | 747 | 1.20 | 747 | 1.20 |
| 7427 | 1.20 | 74LS27 | 1.20 | 7477 | 1.20 | 4027 | 1.20 | 748 | 1.20 | 748 | 1.20 |
| 7428 | 1.20 | 74LS28 | 1.20 | 7478 | 1.20 | 4028 | 1.20 | 749 | 1.20 | 749 | 1.20 |
| 7429 | 1.20 | 74LS29 | 1.20 | 7479 | 1.20 | 4029 | 1.20 | 740 | 1.20 | 740 | 1.20 |
| 7430 | 1.20 | 74LS30 | 1.20 | 7480 | 1.20 | 4030 | 1.20 | 741 | 1.20 | 741 | 1.20 |
| 7431 | 1.20 | 74LS31 | 1.20 | 7481 | 1.20 | 4031 | 1.20 | 742 | 1.20 | 742 | 1.20 |
| 7432 | 1.20 | 74LS32 | 1.20 | 7482 | 1.20 | 4032 | 1.20 | 743 | 1.20 | 743 | 1.20 |
| 7433 | 1.20 | 74LS33 | 1.20 | 7483 | 1.20 | 4033 | 1.20 | 744 | 1.20 | 744 | 1.20 |
| 7434 | 1.20 | 74LS34 | 1.20 | 7484 | 1.20 | 4034 | 1.20 | 745 | 1.20 | 745 | 1.20 |
| 7435 | 1.20 | 74LS35 | 1.20 | 7485 | 1.20 | 4035 | 1.20 | 746 | 1.20 | 746 | 1.20 |
| 7436 | 1.20 | 74LS36 | 1.20 | 7486 | 1.20 | 4036 | 1.20 | 747 | 1.20 | 747 | 1.20 |
| 7437 | 1.20 | 74LS37 | 1.20 | 7487 | 1.20 | 4037 | 1.20 | 748 | 1.20 | 748 | 1.20 |
| 7438 | 1.20 | 74LS38 | 1.20 | 7488 | 1.20 | 4038 | 1.20 | 749 | 1.20 | 749 | 1.20 |
| 7439 | 1.20 | 74LS39 | 1.20 | 7489 | 1.20 | 4039 | 1.20 | 740 | 1.20 | 740 | 1.20 |
| 7440 | 1.20 | 74LS40 | 1.20 | 7490 | 1.20 | 4040 | 1.20 | 741 | 1.20 | 741 | 1.20 |
| 7441 | 1.20 | 74LS41 | 1.20 | 7491 | 1.20 | 4041 | 1.20 | 742 | 1.20 | 742 | 1.20 |
| 7442 | 1.20 | 74LS42 | 1.20 | 7492 | 1.20 | 4042 | 1.20 | 743 | 1.20 | 743 | 1.20 |
| 7443 | 1.20 | 74LS43 | 1.20 | 7493 | 1.20 | 4043 | 1.20 | 744 | 1.20 | 744 | 1.20 |
| 7444 | 1.20 | 74LS44 | 1.20 | 7494 | 1.20 | 4044 | 1.20 | 745 | 1.20 | 745 | 1.20 |
| 7445 | 1.20 | 74LS45 | 1.20 | 7495 | 1.20 | 4045 | 1.20 | 746 | 1.20 | 746 | 1.20 |
| 7446 | 1.20 | 74LS46 | 1.20 | 7496 | 1.20 | 4046 | 1.20 | 747 | 1.20 | 747 | 1.20 |
| 7447 | 1.20 | 74LS47 | 1.20 | 7497 | 1.20 | 4047 | 1.20 | 748 | 1.20 | 748 | 1.20 |
| 7448 | 1.20 | 74LS48 | 1.20 | 7498 | 1.20 | 4048 | 1.20 | 749 | 1.20 | 749 | 1.20 |
| 7449 | 1.20 | 74LS49 | 1.20 | 7499 | 1.20 | 4049 | 1.20 | 740 | 1.20 | 740 | 1.20 |
| 7450 | 1.20 | 74LS50 | 1.20 | 7500 | 1.20 | 4050 | 1.20 | 741 | 1.20 | 741 | 1.20 |

TEXAS INSTRUMENTS

I.C. SOCKETS

Accommodates standard ICs with 40-pin DIP and 16-pin SOIC packages. Designed and oriented to the user for low insertion and high retention forces. Socket is designed to achieve maximum dependability on boards.

SOLDER TAIL DIP SOCKETS

- Single beam
- Low profile
- YOUR CHOICE: TIN OR GOLD

Part No. Description Price

| | | | |
|------|--------------------------|------|-----|
| CS14 | 16 pin solder tail, tin | 1.18 | 181 |
| CS15 | 16 pin solder tail, gold | 1.18 | 181 |
| CS16 | 18 pin solder tail, tin | 1.18 | 181 |
| CS17 | 18 pin solder tail, gold | 1.18 | 181 |
| CS18 | 20 pin solder tail, tin | 1.18 | 181 |
| CS19 | 20 pin solder tail, gold | 1.18 | 181 |
| CS20 | 24 pin solder tail, tin | 1.18 | 181 |
| CS21 | 24 pin solder tail, gold | 1.18 | 181 |
| CS22 | 28 pin solder tail, tin | 1.18 | 181 |
| CS23 | 28 pin solder tail, gold | 1.18 | 181 |
| CS24 | 32 pin solder tail, tin | 1.18 | 181 |
| CS25 | 32 pin solder tail, gold | 1.18 | 181 |

DISC CAPACITORS

NEW! KIT

210 DISC CAPACITORS

Includes 210 disc capacitors with 18 pin headers. All disc capacitors are 18 pin headers. All disc capacitors are 18 pin headers.

Value MV Actual Rating

| | | | |
|------|------|------|------|
| 10 | 10 | 10 | 10 |
| 15 | 15 | 15 | 15 |
| 22 | 22 | 22 | 22 |
| 33 | 33 | 33 | 33 |
| 47 | 47 | 47 | 47 |
| 68 | 68 | 68 | 68 |
| 100 | 100 | 100 | 100 |
| 150 | 150 | 150 | 150 |
| 220 | 220 | 220 | 220 |
| 330 | 330 | 330 | 330 |
| 470 | 470 | 470 | 470 |
| 680 | 680 | 680 | 680 |
| 1000 | 1000 | 1000 | 1000 |

NEW! KIT

210 DISC CAPACITORS

Includes 210 disc capacitors with 18 pin headers. All disc capacitors are 18 pin headers. All disc capacitors are 18 pin headers.

Value MV Actual Rating

| | | | |
|------|------|------|------|
| 10 | 10 | 10 | 10 |
| 15 | 15 | 15 | 15 |
| 22 | 22 | 22 | 22 |
| 33 | 33 | 33 | 33 |
| 47 | 47 | 47 | 47 |
| 68 | 68 | 68 | 68 |
| 100 | 100 | 100 | 100 |
| 150 | 150 | 150 | 150 |
| 220 | 220 | 220 | 220 |
| 330 | 330 | 330 | 330 |
| 470 | 470 | 470 | 470 |
| 680 | 680 | 680 | 680 |
| 1000 | 1000 | 1000 | 1000 |

TANTALUM

Includes 210 disc capacitors with 18 pin headers. All disc capacitors are 18 pin headers. All disc capacitors are 18 pin headers.

Value MV Actual Rating

| | | | |
|------|------|------|------|
| 10 | 10 | 10 | 10 |
| 15 | 15 | 15 | 15 |
| 22 | 22 | 22 | 22 |
| 33 | 33 | 33 | 33 |
| 47 | 47 | 47 | 47 |
| 68 | 68 | 68 | 68 |
| 100 | 100 | 100 | 100 |
| 150 | 150 | 150 | 150 |
| 220 | 220 | 220 | 220 |
| 330 | 330 | 330 | 330 |
| 470 | 470 | 470 | 470 |
| 680 | 680 | 680 | 680 |
| 1000 | 1000 | 1000 | 1000 |

WIRE WRAP KIT

Includes 210 disc capacitors with 18 pin headers. All disc capacitors are 18 pin headers. All disc capacitors are 18 pin headers.

Value MV Actual Rating

| | | | |
|------|------|------|------|
| 10 | 10 | 10 | 10 |
| 15 | 15 | 15 | 15 |
| 22 | 22 | 22 | 22 |
| 33 | 33 | 33 | 33 |
| 47 | 47 | 47 | 47 |
| 68 | 68 | 68 | 68 |
| 100 | 100 | 100 | 100 |
| 150 | 150 | 150 | 150 |
| 220 | 220 | 220 | 220 |
| 330 | 330 | 330 | 330 |
| 470 | 470 | 470 | 470 |
| 680 | 680 | 680 | 680 |
| 1000 | 1000 | 1000 | 1000 |

WIRE WRAP KIT

Includes 210 disc capacitors with 18 pin headers. All disc capacitors are 18 pin headers. All disc capacitors are 18 pin headers.

Value MV Actual Rating

| | | | |
|------|------|------|------|
| 10 | 10 | 10 | 10 |
| 15 | 15 | 15 | 15 |
| 22 | 22 | 22 | 22 |
| 33 | 33 | 33 | 33 |
| 47 | 47 | 47 | 47 |
| 68 | 68 | 68 | 68 |
| 100 | 100 | 100 | 100 |
| 150 | 150 | 150 | 150 |
| 220 | 220 | 220 | 220 |
| 330 | 330 | 330 | 330 |
| 470 | 470 | 470 | 470 |
| 680 | 680 | 680 | 680 |
| 1000 | 1000 | 1000 | 1000 |

WIRE WRAP KIT

Includes 210 disc capacitors with 18 pin headers. All disc capacitors are 18 pin headers. All disc capacitors are 18 pin headers.

Value MV Actual Rating

| | | | |
|------|------|------|------|
| 10 | 10 | 10 | 10 |
| 15 | 15 | 15 | 15 |
| 22 | 22 | 22 | 22 |
| 33 | 33 | 33 | 33 |
| 47 | 47 | 47 | 47 |
| 68 | 68 | 68 | 68 |
| 100 | 100 | 100 | 100 |
| 150 | 150 | 150 | 150 |
| 220 | 220 | 220 | 220 |
| 330 | 330 | 330 | 330 |
| 470 | 470 | 470 | 470 |
| 680 | 680 | 680 | 680 |
| 1000 | 1000 | 1000 | 1000 |

WIRE WRAP KIT

Includes 210 disc capacitors with 18 pin headers. All disc capacitors are 18 pin headers. All disc capacitors are 18 pin headers.

Value MV Actual Rating

| | | | |
|-----|-----|-----|-----|
| 10 | 10 | 10 | 10 |
| 15 | 15 | 15 | 15 |
| 22 | 22 | 22 | 22 |
| 33 | 33 | 33 | 33 |
| 47 | 47 | 47 | 47 |
| 68 | 68 | 68 | 68 |
| 100 | 100 | 100 | 100 |
| 150 | 150 | 150 | 150 |
| 220 | 220 | 220 | 220 |
| 330 | | | |

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STATIC RAMS

| | | | |
|-------------|----------|-------------------|---------|
| 2114 | 1024 x 4 | (450ns) | 8/9.95 |
| 2114-25 | 1024 x 4 | (250ns) | 8/10.95 |
| 2114L-2 | 1024 x 4 | (200ns)(LP) | 8/13.95 |
| TMM2016-200 | 2048 x 8 | (200ns) | 4.15 |
| TMM2016-150 | 2048 x 8 | (150ns) | 4.95 |
| TMM2016-100 | 2048 x 8 | (100ns) | 6.15 |
| HM6116-4 | 2048 x 8 | (200ns)(cmos) | 4.75 |
| HM6116-3 | 2048 x 8 | (150ns)(cmos) | 4.95 |
| HM6116LP-4 | 2048 x 8 | (200ns)(cmos)(LP) | 5.95 |
| HM6116LP-3 | 2048 x 8 | (150ns)(cmos)(LP) | 6.95 |
| HM6264 | 8192 x 8 | (150ns)(cmos) | 39.95 |

DYNAMIC RAMS

| | | | |
|-------------|-----------|-------------|---------|
| 4116-250 | 16384 x 1 | (250ns) | 8/7.95 |
| 4116-200 | 16384 x 1 | (200ns) | 8/12.95 |
| 4116-150 | 16384 x 1 | (150ns) | 8/14.95 |
| 4164-200 | 65536 x 1 | (200ns)(5v) | 6.95 |
| 4164-150 | 65536 x 1 | (150ns)(5v) | 5.95 |
| TMS 4164-15 | 65536 x 1 | (150ns)(5v) | 8.95 |

EPROMS

| | | | |
|----------|-----------|---------------------|-------|
| 2708 | 1024 x 8 | (450ns) | 3.95 |
| 2716 | 2048 x 8 | (450ns)(5v) | 3.95 |
| 2716-1 | 2048 x 8 | (350ns)(5v) | 5.95 |
| TMS2532 | 4096 x 8 | (450ns)(5v) | 5.95 |
| 2732 | 4096 x 8 | (450ns)(5v) | 4.95 |
| 2732-250 | 4096 x 8 | (250ns)(5v) | 8.95 |
| 2732-200 | 4096 x 8 | (200ns)(5v) | 11.95 |
| 2732A | 4096 x 8 | (250ns)(5v)(21vPGM) | 9.95 |
| 2732A-2 | 4096 x 8 | (200ns)(5v)(21vPGM) | 13.95 |
| 27128 | 16384 x 8 | (300ns)(5v) | 29.95 |

SPECTRONICS CORPORATION
 EPROM ERASER PE-14, 9 chip capacity 83.00

8000

| | |
|------|-------|
| 8039 | 5.95 |
| 8080 | 3.95 |
| 8085 | 4.95 |
| 8087 | CALL |
| 8088 | 29.95 |
| 8155 | 6.95 |
| 8748 | 24.95 |

8200

| | |
|--------|-------|
| 8203 | 39.95 |
| 8205 | 3.50 |
| 8212 | 1.80 |
| 8216 | 1.75 |
| 8228 | 3.49 |
| 8237-5 | 21.95 |
| 8243 | 4.45 |
| 8250 | 10.95 |
| 8251 | 4.49 |
| 8253 | 6.95 |
| 8253-5 | 7.95 |
| 8255 | 4.49 |
| 8255-5 | 5.25 |
| 8259 | 6.90 |
| 8259-5 | 7.50 |
| 8275 | 29.95 |
| 8279 | 8.95 |
| 8282 | 6.50 |
| 8284 | 5.50 |
| 8286 | 6.50 |

Z-80

| | |
|------------|-------|
| Z80-CPU | 3.95 |
| Z80-PIO | 3.95 |
| Z80A-CPU | 4.49 |
| Z80A-CTC | 4.95 |
| Z80A-PIO | 4.49 |
| Z80A-SIO/0 | 12.95 |
| Z80B-CPU | 9.95 |

6500

| | |
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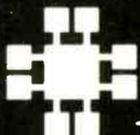
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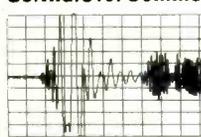
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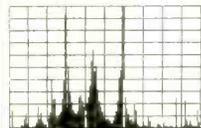
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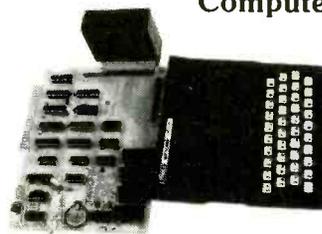
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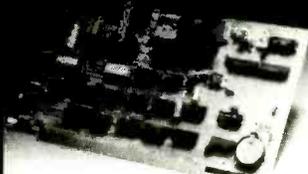
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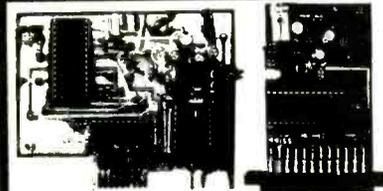
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