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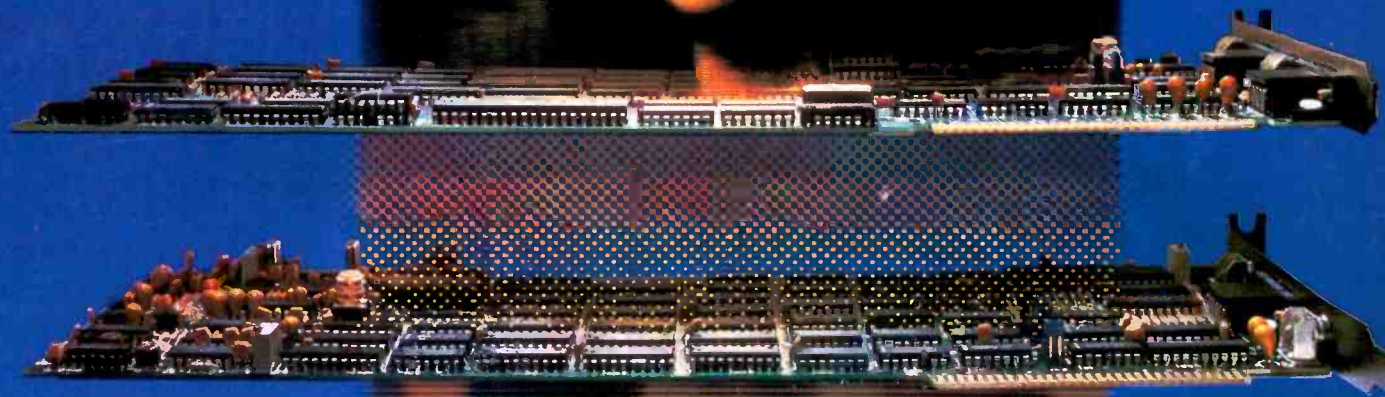
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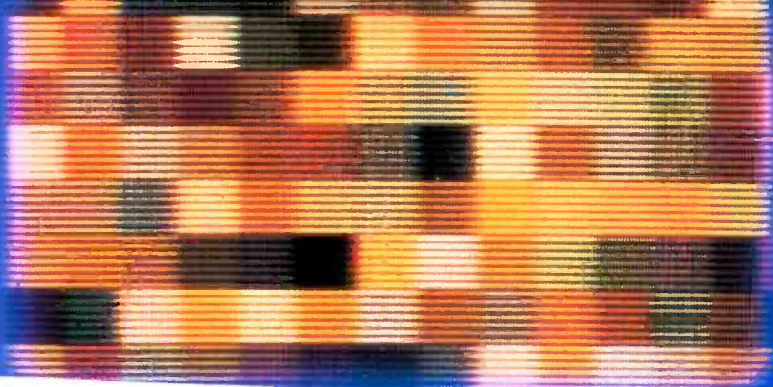


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Features



46 Hard Disk Drives for the Masses

By Tom Badgett
Surprisingly affordable hard disks offer more capacity than floppies.

52 Getting the Most out of Your Hard Disk

By Winn L. Rosch
Manage your hard disk properly and get more use out of it.

57 Buyer's Guide to Hard Disks

60 High Color Resolution Comes to Graphics

By Winn L. Rosch
New AT&T adapters get picture-like images from micros.

64 The Bottom Line on Accounting Software

By Michael Guttman & David Frankel
What to look for in the new accounting software packages.

68 Ink Jet Printers

By Roger Snyder
Quiet alternatives to impact printers at the speed of an office copier or duplicator.

Reviews

24 The NCR Personal Computer

By Paul Bonner

26 Qubie Hard Disk

By Joseph Desposito

30 DisCache

By Jon Pepper

32 Savvy PC

By Michael Guttman & Craig Krum

36 ZyIndex

By Ron White

40 Smart Series

By Lee D. Zimskind



COVER BY BARRY BLACKMAN
ART BY LEONARDO DA VINCI

Columns

8 The Computer Scientist

By Forrest M. Mims, III
Creating characters with an xy plotter.

20 Bits & Bytes

By Sol Libes



73 Guest Column

By Russell Griffin & Victor Miller
The How-to-Choose-a-Computer-Book Book

Departments

4 Editorial

By Peter Costa
On Innovation

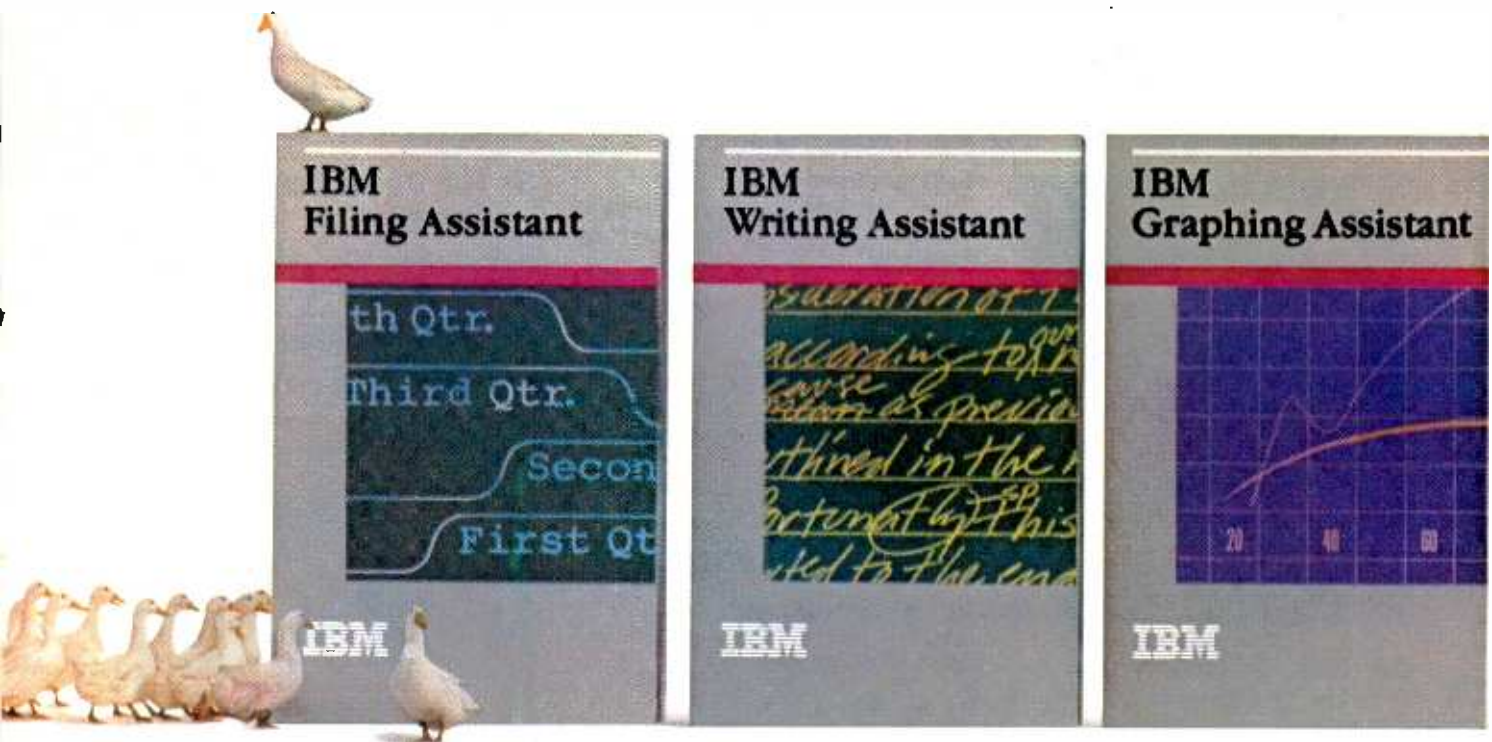
6 Letters

73 New Products

86 Computer Mart/ Electronics Classified

94 Advertisers' Index

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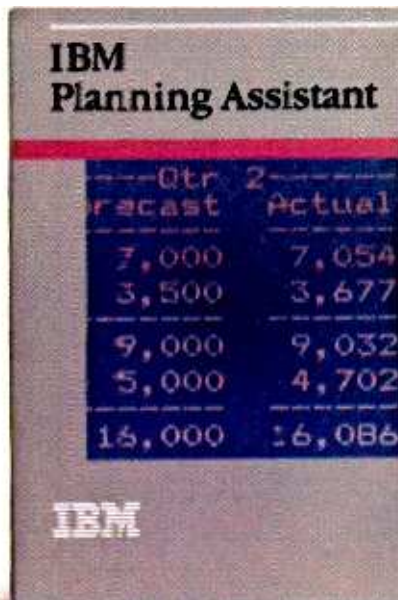
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BY PETER COSTA EDITORIAL

ON INNOVATION



THE microcomputer industry is increasingly dominated by corporate monoliths. No longer can independent nonconformists work out of their garages with \$1000 and a dream and design the face of tomorrow. Even Apple's young chairman, Steve Jobs, who with Steve Wozniak helped pioneer the personal computer movement, seems to have changed his look and outlook. He has traded his sport shirt and blue jeans for dark suit and bowtie and talks more about microcomputers for the "office environment."

As almost everyone readily agrees, the Apple Computer Company has been a leader in designing computers that were easy to use, displayed imaginative design and sold at reasonable prices. The IIe, the IIc and the Macintosh provide alternatives to a Big Blue world. But many fear that Apple is becoming co-opted by the exigencies of the big corporation—big budgets, big inventories, bigness in general.

Many software and hardware companies today find themselves having to ask a question posed by playwright Edward Albee: Have the dice become too big to toss? It's difficult to take as many risks if the risks involve millions of dollars. And then there is the compatibility question. Can a non-IBM-compatible product survive in a Sargasso sea solid with clones?

But there is hope. There are similarities, I think, between the present microcomputer climate and the history of automobile manufacturing. In the early days of the mass-produced, affordable

auto, Henry Ford's 1905 Model T was the industry "standard." But by 1912, Cadillacs started appearing with the first electric self-starters that made the hand crank—and broken thumbs—things of the past. Later, Oldsmobile introduced the first completely automatic transmission, the legendary Hydramatic. It did not take long before there were cars with features and options that were as desirable, or even more desirable, than Henry's any-color-as-long-as-it-is-black machine.

So it may be with today's micro industry. MS-DOS may indeed be the unleaded gasoline deemed as the fuel of choice to power microcomputers. IBM may be causing a "chilling effect" on small companies trying to participate in the microcomputer revolution.

But all of this is not meant to imply that just because a company is huge it cannot be innovative. Ford did produce the incredibly popular Mustang; IBM leads the desktop micro world with its powerful and extremely well-regarded PC AT. But my concern is whether people who would have tried to develop new products are now daunted by the high costs of admission.

To believe that real innovation is forever dead, however, is to underestimate the inventiveness and the entrepreneurial spirit of contemporary America. Certainly, it is true that developing hardware is becoming almost prohibitively expensive. It costs millions to design a chip, more millions to market it. It takes hundreds of thousands of workhours to write a major software package and hundreds of thousands of dollars to sell and distribute it. But there are still dreamers and innovators out there as well as an army of soon-to-be-graduated computer science majors who have the intellectual tools and training to make major advances in personal computing. And there is something else that has always been a powerful incentive: the profit motive.

If "The Graduate" were filmed today instead of the late 1960s, the one word which Dustin Hoffman would have had whispered in his ear as the key to the future would not be plastics but computers. A lot of graduates are out there listening. ◇

PHOTO BY DONNA DAY

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LETTERS

Next Time, A Fox Jumps

As a public school secretary, I could not resist telling you that your guest columnist, William F. Buckley, Jr., is in error when he "teaches" your "uneducated" reader that "The quick brown fox jumped over the lazy dog" has every letter of the alphabet!

Did his 12-year-old son or his friend Dick miss an s in Buckley's lesson?

—MARGARET POLEDGE SAMUELS
Chicago, IL

More Precision About Randomness

In "The Computer Scientist" column on "Random Numbers" in your November issue, there is a fundamental error about the nature of randomness. The author judges the randomness of a coin flip by how nearly equal are the numbers of heads and tails obtained. He seems to think that a perfectly random flip would end up with equal numbers every time.

In fact, a truly random flip produces exact equality only rarely. Vicky's experiment with 1327 tosses has an "ideal" result of 664 heads, but should produce that result only about 1/62 of the time. Half the time one expects results more than 17 heads away from ideal in either direction. This is no failure, but an inevitable expression of true randomness. Only if the deviation is too wide, too narrow, or one way too often should one suspect an unfair coin. Unfortunately the basis of these claims won't fit in a letter, but it is taught in every course on probability and statistics.

The term "pseudo-random" refers to a fixed sequence which nonetheless is chaotic and exhibits the kind of average behavior that a truly random sequence does. This must include the deviations from ideal equality, etc., just mentioned. For example, the standard deviations shown in Table I of the article are about right. One expects about ten. The "pseudo" says that it is a fixed sequence that can be run again and will turn out the same. A truly random sequence would never (hardly ever) repeat.

The dot pattern test, Fig. 3, is a very cute one, useful for picking out some kinds of short-term correlations in a supposedly random sequence. The slanted bars indicate an awkward problem in the PCjr generator. The Randomize Timer operation is not entirely effective in erasing that structure when called from a freely running program because it compares two good clocks (the program exe-

cutation rate and the real-time clock), which are both keeping time. Only when you have its execution involve a really bad clock, like a human pressing keys, does the Randomize Timer really randomize things. Radioactive decay is an even better randomizer.

Hot and cold spots in the form of irregular blotches without pattern are to be expected, again as an expression of true randomness. It is either a too-smooth field or a regular pattern that indicates nonrandom (not pseudo-random) behavior.

—PHILIP A. EKSTROM
Shaw Island, WA

About the Sr. Partner

Your review of the Panasonic Sr. Partner in your November issue contains some technical inaccuracies that we would like to clarify for your readers.

The article mentioned that "multicolored images put on the monochrome screen can look somewhat washed out." This is misleading: Any monochrome screen will exhibit that characteristic when displaying color information.

Further along, it says "Each drive holds 320K, and each writes and reads data in IBM standard 9 sectors per track. . ." MS- or PC-DOS version 2.0 and above default to 360K storage with 9 sectors per track format. The 320K format is an option, 8 sectors per track, to maintain downward compatibility with DOS version 1.xx. The maximum capacity is understated.

The problems the author encountered with dBase II and Friday! are a function of the application software, not hardware or operating systems software. The ability to input data to a newly created structure is possible at the end of the structure's creation. The "Index file cannot be opened" message will occur if the file in "use" has not been indexed on some field in the file. The messages encountered only indicate that the dBase II commands were not implemented correctly.

In the closing section the author mentioned that "you'll need to spend about \$60 on an IBM DOS disk if you want to use software that requires it." This statement is incorrect and misleading to our growing base of dealers, end users, and potential customers. Panasonic's MS-DOS 2.11 has been tested with hundreds of software titles and runs flawlessly.

Most importantly, Panasonic does not

recommend purchasing PC-DOS for use with the Sr. Partner. The supplied MS-DOS 2.11 is operationally compatible with software designed for the IBM PC.

—BOB GREGORY & STEVE RUMMEL
Panasonic
Secaucus, NJ

Too Much Blue in Display

Regarding Bob Margolin's "New Flat Panel Displays" in the February 1985 issue: Why did the IBM Model 581 gas plasma display deserve three views in the article, whereas the Industrial Electronic Engineers, Planar Systems, and Interstate Electronics displays enjoyed only one view each; and less fortunate—PlasmaGraphics, Nippon Electric Company (NEC), etc.—receive none?

Did IBM's commercial "featuring its Model 3290 Information Panel" shown during the Olympic Games convince the author that the IBM offering must be three times better than the Industrial Electronic Engineers, Planar Systems, and Interstate Electronics displays and perhaps infinitely better than the PlasmaGraphics and NEC, etc., displays?

I am becoming increasingly annoyed by the apparent advantage that the press gives to IBM. I know that it is difficult to give equal time to the "minority candidates," but please try. We will all be better served if there is fair competition between the computer products producers. The press has an extremely critical role in this regard and has an important obligation to both the readers and the competitors.

—C. ALFRED SPENCER
Framingham, MA

Reversed 1000

I have been an avid reader of your magazine for several years and always enjoyed its excellent content. It is informative and interesting. However, I did notice an error in your December issue that I would like to call to your attention. In the review of the Radio Shack Model 1000, on page 71, the photograph has been reversed (or "flopped").

—JOHN P. SMITH
Ellsworth AFB, SD

Correction

In the sidebar about on-line systems, entitled "The Big Four" (Feb. 1985), the number of subscribers to the Dow Jones News/Retrieval service was misstated. The correct number is 185,000.—Ed.



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FORREST M. MIMS III

THE COMPUTER SCIENTIST

CREATING CUSTOM CHARACTERS WITH AN XY PLOTTER

USERS of *xy* plotters never cease to be impressed by the very high resolution of these amazing machines. Therefore, it's a little disconcerting when a plotter labels a perfectly smooth curve on a precisely drawn grid with stick-like characters having segmented, angular outlines.

Characters formed from straight line segments (like A, E, F, K, L) appear perfectly normal when drawn by a plotter. But letters having curved segments (like B, C, D, O, R) appear crude and child-like, especially when used to label the professionally drawn images for which plotters are so ideally suited.

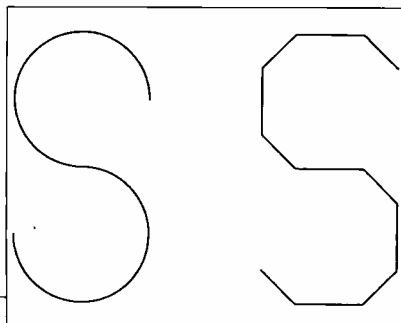
Fortunately it's possible to create your own custom characters by taking advantage of a plotter's drawing instructions. Once you learn the basics, you can even create entire character sets complete with special symbols not ordinarily available.

Getting Started

More than a dozen companies make *xy* plotters, and most of these machines can be used to generate custom characters. Several of these companies make machines that support HPGL (Hewlett-Packard Graphics Language), one of the most popular plotter languages. The programs in the accompanying listings are given in HPGL, but they can be revised for other plotter languages.

Almost any computer with an appropriate interface can control an *xy* plotter. Depending upon the capacity of the plot-

Fig. 1. A smoothly drawn, custom letter "S" (left) and a standard letter "S," both drawn by an HP7470A *xy* plotter.



ter's internal buffer memory, the data transmission speed, and the existence of two-way communications, it may be necessary to insert time-delay loops or other special features in your plotter programs. Otherwise, once you determine the proper communications protocol for your combination of computer and plotter, learning to use a plotter is relatively painless.

The plotter driver programs given below, which are written in Microsoft BASIC, were developed on a TRS-80 Model 100 for a serial-connected Hewlett-Packard HP7470A *xy* plotter. The compact size of the Model 100 makes it ideal for use with a plotter, particularly since the price of the 8K version of this portable computer is now under \$400.

All the programs that follow can be easily revised for other computers, particularly those that use Microsoft BASIC. The major difference will be the communications protocol. If you use the Model 100-HP7470A combination, the eight status switches on the back panel of the plotter should have these settings:

B1=0	US=1
B2=0	Y=0
B3=1	S1=0
B4=1	S2=0

For information about the communication protocol for other combinations of computers and plotters, see the instruction manuals for the machines. For additional information about plotters and HPGL, see the March 1984 installment of "The Computer Scientist" in this magazine ("Learning to Use an *x-y* Plotter,"). In the same issue, also see "Inexpensive Plotters." Finally, refer to last month's installment of this column for details on how to print formatted and centered text with a plotter.

Creating Custom Characters

There are two primary methods for creating custom characters using HPGL and similar plotter languages. The first is to use *plot relative* instructions to draw straight lines and *circle* and *arc* commands to draw curved lines. The result-

LISTING 1. PROGRAM FOR CREATING AND PRINTING A CUSTOM LETTER "S" AND A STANDARD LETTER "S"

```
10 CLS
20 'MODEL 100-HP7470 PLOTTER
   'PROTOCOL FOLLOWS
30 COM ON: OPEN "COM:48N2E" FOR
   'OUTPUT AS 1
40 PRINT #1, "SC0,28,0,19;SP1;"
50 'CUSTOM (SMOOTH) LETTER "S"
60 PRINT #1, "PD;AR3,0,270;AR0,3,
   '-270;PU;"
70 'STANDARD (STEPPED) LETTER "S"
80 PRINT #1, "PR5,-9
90 PRINT #1, "SI3.8,7.6;LBS"CHR$(3)
100 PRINT #1, "SP0;"
```

ing characters can be enlarged or reduced in one or both dimensions simply by altering the plotter's scale under program control or via the front panel switches. The principal disadvantage of this method is that the characters cannot be made to respond to the commands that manipulate the dimensions, direction, and slant of the plotter's label instructions.

The second method is to use the HPGL *user character* (UC) command. The resulting characters can then be manipulated exactly as if they were a part of the plotter's standard character set. In other words, they can be slanted and printed in various directions and sizes. The chief drawback of this method is that generating smooth curves is made difficult since it's not possible to embed circle and arc commands within the user character instruction.

Creating Characters with Smooth Curves

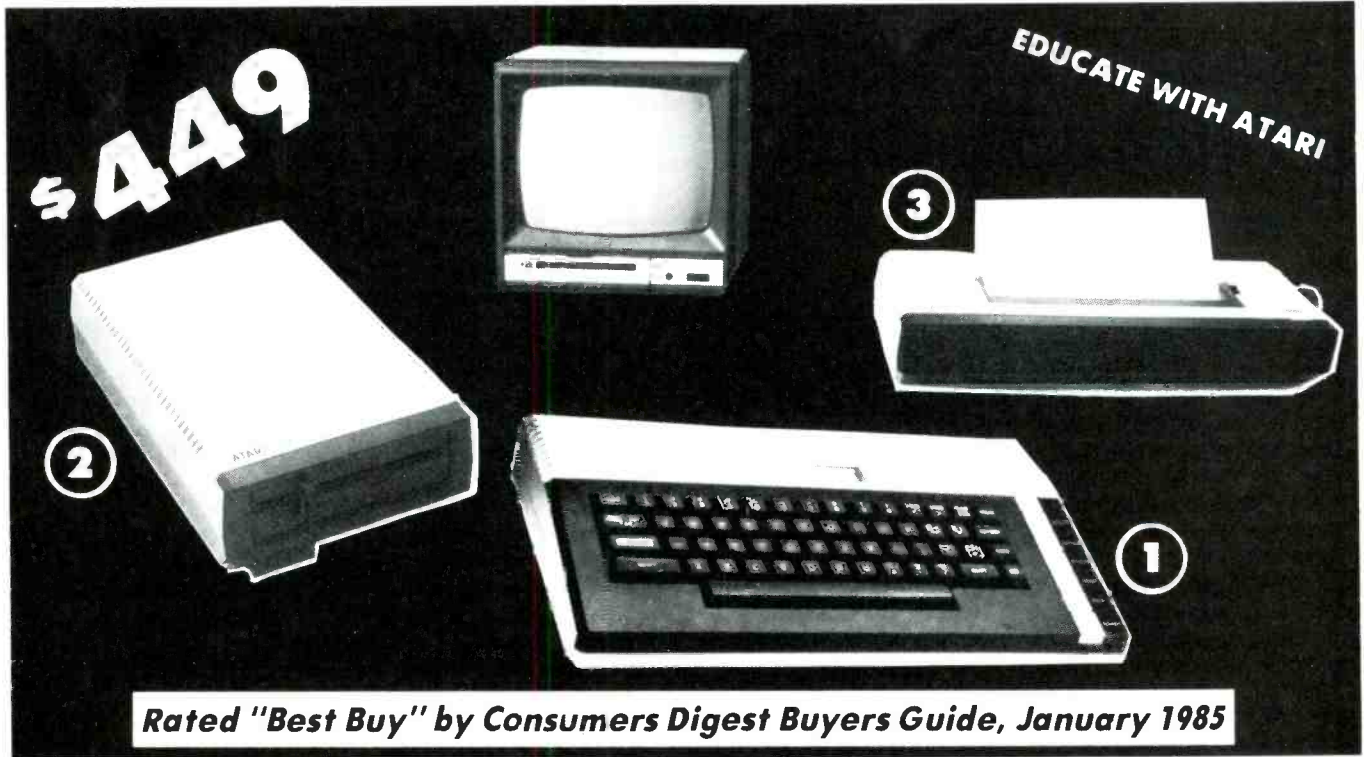
The letter "S" has more curves than any other letter of the alphabet. Figure 1 shows a smoothly drawn "S" and a segmented version drawn by a plotter. When the letters are reduced in size, the harsh-appearing segments of the "S" on the right are somewhat less objectionable, in part, because the width of the line becomes much larger in proportion to the overall size of the letter. Nevertheless, it would be nice to generate a smoothly drawn "S" with a plotter.



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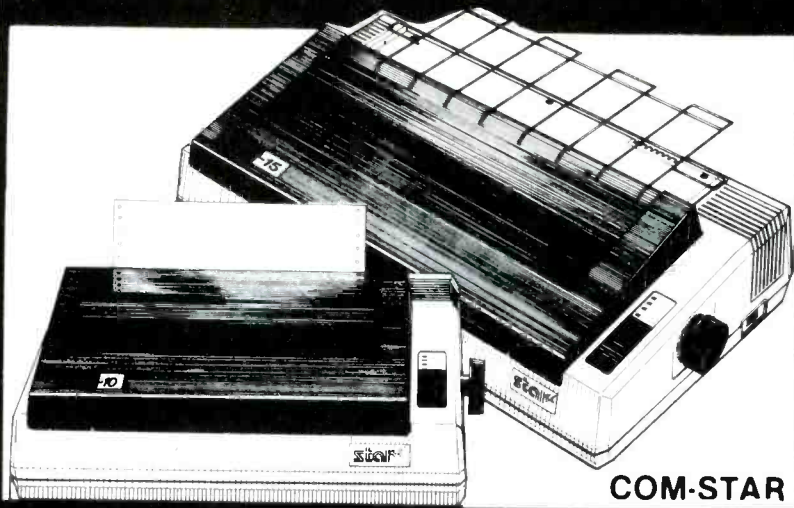
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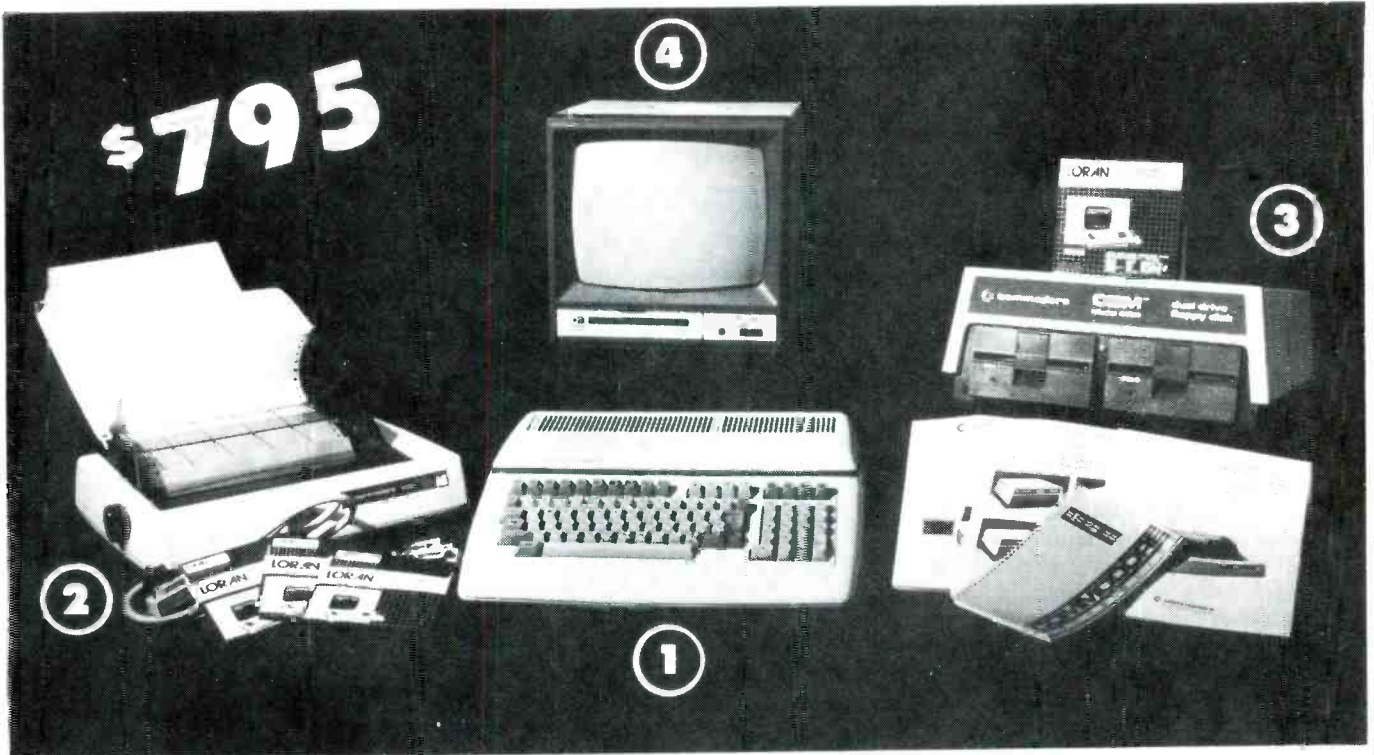
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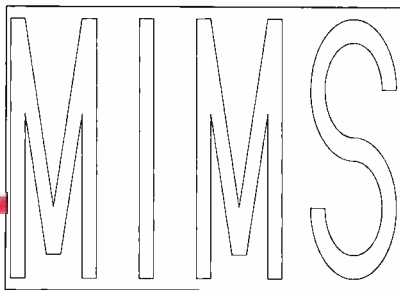


Fig. 2. Example of custom, outlined characters formed by the program in Listing 2.

It so happens that a relatively simple sequence of HPGL code will draw a perfect letter "S," just like the one in Fig. 1. In fact, *both* characters in Fig. 1 were drawn by an HP7470A plotter controlled by the Model 100 program in Listing 1. Here's how the program works:

Line 30 enables serial communications between the Model 100 and the HP7470A and opens a file that designates the plotter as output number 1. Strings of HPGL commands can then be sent to the plotter by means of a PRINT 1, HPGL string statement. The first such HPGL string, which is given in line 40, establishes the plotter's scale (0 to 28 in the x direction and 0 to 19 in the y direction). Line 40 of Listing 1 also selects pen 1 (SP1).

Incidentally, should you interrupt or break this and other plotter driver programs after the communications protocol and plotter control instructions have been processed by the computer, it may be necessary to run the program from the beginning to reestablish proper communications. Be sure to keep this in mind when trying this and the following programs.

Referring back to Listing 1, you see the smooth letter "S" is drawn by the HPGL string in line 60:

```
PD;AR3,0,270;AR0,3,
-270;PU;
```

PD (pen down) places the pen down on the paper. The first AR (arc relative) then draws a 270 degree arc centered at the x,y coordinates that follow (3,0). The second AR then draws another 270 degree arc centered at the second pair of x,y coordinates (0,3). After the second arc is drawn, PU (pen up) removes the pen from the paper.

Line 80 moves the pen to a new location relative to the end point of the second arc in line 60, and line 90 then draws a standard letter "S." The size (SI) of the standard "S" is made equal to that of the smooth letter "S" (3.8 x 7.6 centimeters). Finally, pen 100 returns the pen to its stall.

LISTING 2. TYPICAL PROGRAM FOR CREATING AND PRINTING A STRING OF OUTLINED, BOLD-FACED CHARACTERS

```
10 CLS
20 PRINT "-----STENCIL-----"
30 PRINT ""
40 'COPYRIGHT 1985 BY FORREST M.
MIMS III
50 'MODEL 100-HP7470 PLOTTER
PROTOCOL FOLLOWS
60 COM ON: OPEN "COM:48N2E" FOR
OUTPUT AS 1
65 INPUT "MAXIMUM X SCALE" :XX
70 INPUT "MAXIMUM Y SCALE" :YY
75 PRINT #1, "SC0",XX,"0",YY,"SP1;"
80 'LINE 90 ASSIGNS START
LOCATION (OK TO CHANGE)
90 PRINT #1, "PA2,1"
100 GOSUB 200:'M
110 GOSUB 400:'I
120 GOSUB 200:'M
130 GOSUB 300:'S
135 PRINT #1, "SP0;"END
140 END.
150 'CHARACTER SUBROUTINES
FOLLOW:
200 'SOLID LETTER M
210 PRINT #1, "PD;PR0,11,1,0,2,-8,
2,8,1,0,0,-11,-1,0;"
220 PRINT #1, "PR0,7,-1.5,-6,-1,0,-1.5,6,0,
-7,-1,0,PU,8,0;"
230 RETURN
300 'SOLID LETTER S
310 PRINT #1, "PR0,3,PD;AR3,0,
270;AR0,2,-270;PR1,0;"
320 PRINT #1, "AR-3,0,270;AR0,-2,
-270;PR-1,0,PU,8,-3;"
330 RETURN
400 'SOLID LETTER I
410 PRINT #1, "PR1,0,PD,0,11,1,0,0,-11,
-1,0,PU,4,0;"
420 RETURN
```

It's possible to create an entire character set using the principle given in line 60 of Listing 1. The custom characters, however, will not respond to the character-manipulation commands of HPGL.

Creating Custom Stencil Letters

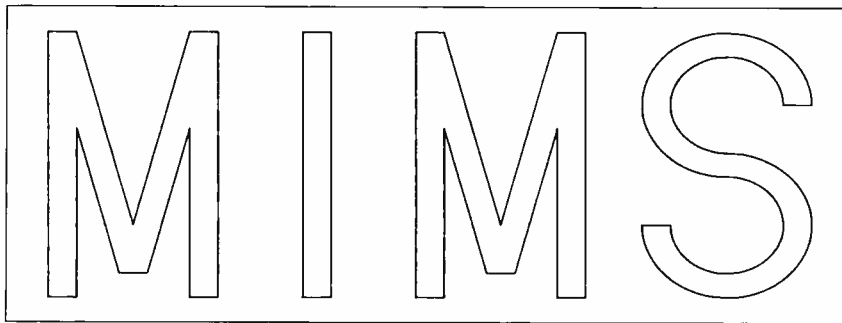
Programs like Listing 1 can be expanded to create outlined, bold-faced characters. Listing 2, for instance, includes HPGL subroutines for creating outlined versions of "M," "I" and "S." The complete alphabet can be formed by adding additional subroutines.

Lines 65 and 70 of Listing 2 allow the user to set the plotter's scale prior to a drawing session. Line 75 sends the selected scale information to the plotter. Line 90 then moves the pen to a predetermined (and easily revised) starting location (PA2,1). Lines 100-130 call the subroutines for "M," "I," "M" and "S." Figure 2 shows the result.

Figure 3 was also drawn by the program in Listing 2, but to a different scale. The superimposed grid, which is identical to the rough grid I used while planning the characters when the program was written, was drawn by adding the following routine to the program:

```
1000 'DRAW GRID
1010 FOR X=0 TO XX
1020 PRINT #1, "SP2;PA",
X,"0,PD",X,YY,"PU;"
1030 NEXT X
1040 FOR Y=0 TO YY
1050 PRINT #1, "PA0",Y,
",PD",XX,Y,"PU;"
```

Fig. 3. This results when Listing 2 is run with a modified scale from Fig. 1 and the addition of a superimposed grid routine.



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LISTING 3. PROGRAM FOR PRINTING CUSTOM EXIT SIGNS IN USER-SPECIFIED SIZE, SLANT AND ORIENTATION

```

10 CLS
20 PRINT "-----EXIT SIGN-----"
25 PRINT ""
30 'COPYRIGHT 1985 BY FORREST M.
  MIMS III
40 'MODEL 100-HP7470 PLOTTER
  PROTOCOL FOLLOWS
50 COM ON: OPEN "COM:48N2E" FOR
  OUTPUT AS I
55 INPUT "HORIZONTAL (H) OR
  VERTICAL (V) FORMAT";FS
60 INPUT "CHARACTER HEIGHT (IN
  CM)";H
70 INPUT "CHARACTER WIDTH (IN
  CM)";W

80 INPUT "CHARACTER SLANT (0 TO
  +/-2)";S
90 PRINT #1, "SP1;SI";W,H;"SL";S;"
100 'BOX LETTER "E"
110 PRINT #1, "UC99,4,0,0,1,
  -3,0,0,2.5,2,0,0,1,-2,0,0,2.5,3,0,0,1,-4,0,0,
  -8;"
120 IF FS="V" OR FS="v" THEN 130
  ELSE 200
130 PRINT #1, "CP-1,-1;"
200 'BOX LETTER "X"
210 PRINT #1, "UC99,1.5,4,-1.5,4,1,0,1,
  -2.5,1,2.5,1,0,-1.5,-4,1.5,-4,-1,0,-1,2.5,-1,
  -2.5,-1,0,-99;"
220 IF FS="V" OR FS="v" THEN 230
  ELSE 300
230 PRINT #1, "CP-1,-1;"
300 'BOX LETTER "T"
310 PRINT #1, "UC1.5,0,99,0,8,1,0,0,-8,
  -1,0,-99;"
320 IF FS="V" OR FS="v" THEN 330
  ELSE 400
330 PRINT #1, "CP-1,-1;"
400 'BOX LETTER "T"
410 PRINT #1, "UC1.5,0,99,0,7,
  -1.5,0,0,1,4,0,0,-1,-1.5,0,0,-7,-1,0,-99;"
500 'RECYCLE FOR ANOTHER "EXIT"
  SIGN
510 PRINT #1, "SP0;"
520 PRINT "";GOTO 55

```

1060 NEXT Y

Note that this routine selects pen 2 (SP2 in line 1020). This permits the grid to be drawn with a color and line width different from those used to draw the characters.

The HPGL instructions in the subroutines may appear incomprehensible if you have never before used a plotter. Actually, the instructions are really quite simple, and, with a little patience, even a novice can understand them with the help of the individual characters in Figs. 4-6. After each of these characters was drawn, the plotter drew a superimposed grid. The *x,y* coordinates of each turning point relative to the previous point were then manually indicated on the grid.

Refer to the character generation subroutines in Listing 2, and you'll note that a lengthy string of numbers separated by commas follows each PR (plot relative) instruction. Each pair of numbers designates the *x,y* coordinates to which the pen should be moved *relative* to its present position.

Knowing this, you can refer to the letter "I" in Fig. 5 and the subroutine in lines 400-420 and follow the pen as it draws the four lines that form an outlined letter "I." The first coordinate pair in line 410 is 1,0. After the pen moves to this starting location, it is then placed on the paper and advances to the second coordinate pair (0,11). The pen then moves

to the third coordinate pair (1,0), and so forth until the letter is completely outlined. Finally, the pen is moved away from the paper and placed at the starting point for the next character.

The HPGL instructions for the "M" and especially the "S" are much longer, but you can determine exactly how they work simply by following the coordinate pairs marked on Figs. 4 and 6. After you understand how the characters are drawn by the HPGL instructions, you can design your own custom characters with only a little help from a plotter's instruction manual. For best results, start with a simple letter (like "T" or "L"). Then tackle a letter with curves.

The dimensions of the characters created by the programs in Listings 1 and 2 can be changed by altering the plotter scale under program control or by manually moving the front panel switches. You can see the effect of different scales by comparing Figs. 2 and 3. Figure 7 is even more dramatic. It was produced by manually changing the plotting limits of the HP7470A to different portions of the paper by means of the front panel controls and then running the program in Listing 2.

Creating Fully Programmable Characters

HPGL, as was noted above, includes a user character (UC) instruction for the design of custom characters that re-

spond to all the standard HPGL character modification and manipulation instructions. The program in Listing 3 illustrates the use of the UC instruction to form bold, outlined versions of the letters of the word "EXIT."

Referring to Listing 3, notice that the program allows you to specify whether the word will be drawn horizontally or vertically (line 55). It also asks for the character height and width in centimeters (lines 60-70) and the degree of character slant (line 80). These specifications are then sent to the plotter by the HPGL instructions in line 90.

The actual letters are drawn by the UC instructions in lines 110 (E), 210 (X), 310 (I) and 410 (T). If the word is to be printed vertically (FS="V"), lines 130, 230 and 330 employ the HPGL character plot (CP) instruction to move the pen one character space back and one character space down after each letter is drawn.

The *x,y* coordinate pairs following each UC instruction are plotted relative to the previous coordinates. Pen up and pen down commands are replaced, respectively, by the numbers 99 and -99. Each character is designed to occupy the lower left corner of a standard HPGL character space field divided into 6 horizontal units and 16 vertical units. The characters themselves have a width of 4 units and a height of 8 units.

Figure 8 shows a typical EXIT sign

Figs. 4-6. Individual characters with superimposed grids and relative *x,y* coordinates for each turning point.

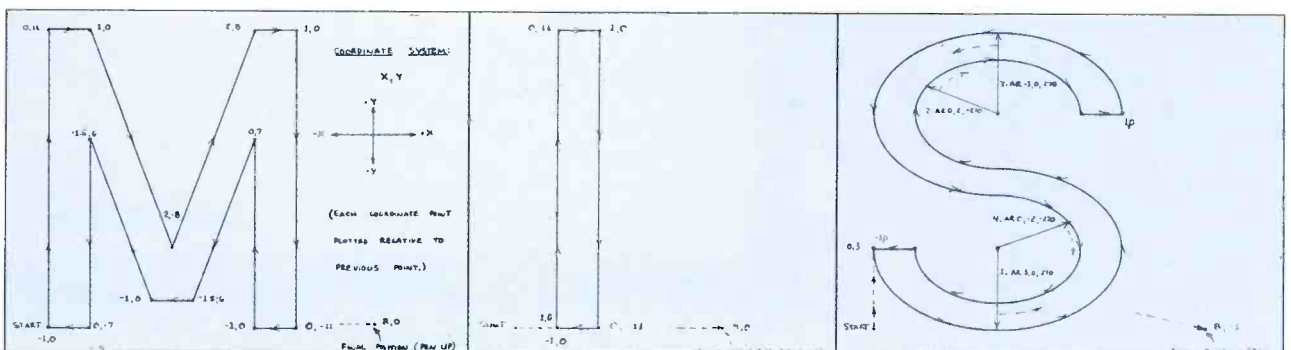
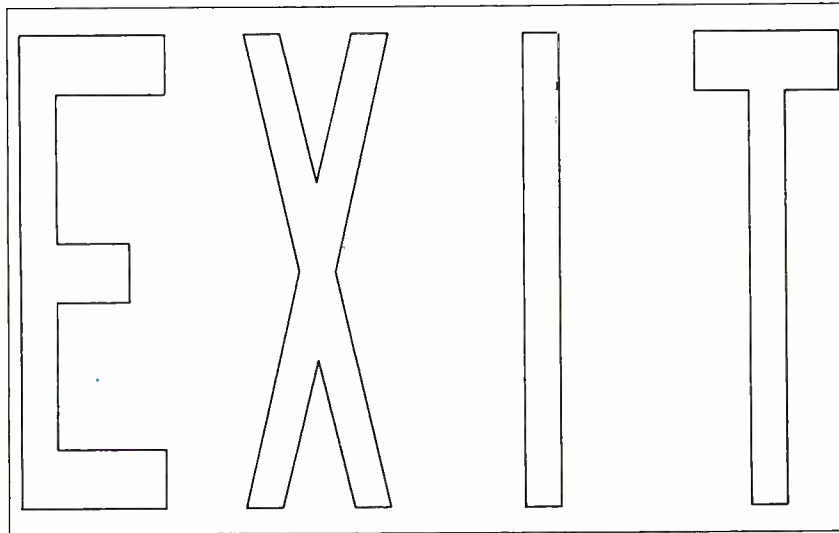




Fig. 7. Changing the plotter's scale under program or front panel control alters the dimensions of the letters drawn by the program in Listing 2.

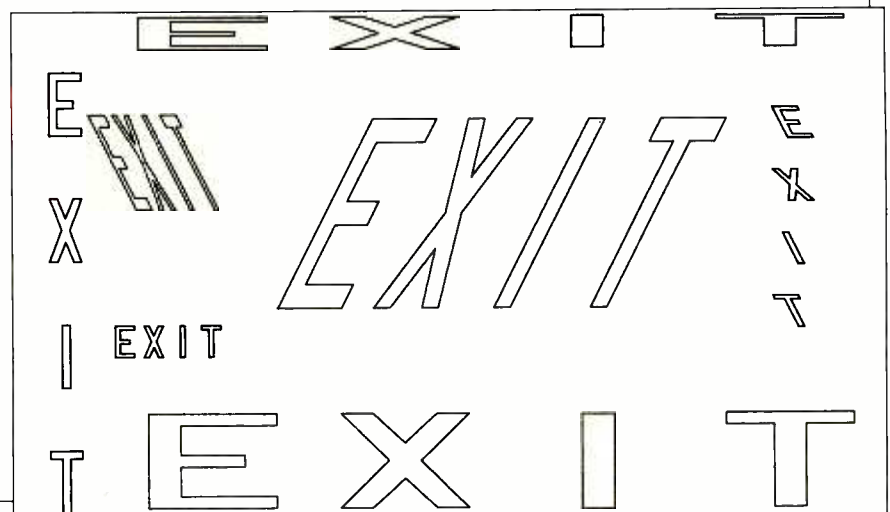
Fig. 8. An EXIT sign created by the program in Listing 3.



drawn by this program. The original has characters measuring 15 centimeters high and 4.5 centimeters wide. The letters are unslanted (S-0). Of course innumerable variations are possible, which is nicely illustrated by the assortment of EXIT signs in Fig. 9. In each case, the pen was moved by means of the plotter's front panel controls to the desired starting point. Of course the program can be easily revised to permit program or keyboard input of the starting location.

Though the characters created by the UC instruction can be altered in size and shape by all the standard HPGL character control instructions, designing characters with smooth curves is difficult and requires very long lists of coordinates. On the other hand, the UC instruction permits symbols, foreign language characters and logos to be designed and added to a plotter's charac-

Fig. 9. Since the letters in the EXIT sign were created by a special user character instruction, they can be manipulated and modified as if they were part of the plotter's standard character set.



ter set. Furthermore, the dimensions of a custom symbol or character relative to those of a standard character can be much larger or smaller. All that's necessary is to modify the position of the character or symbol within the assigned character space field or to extend a character across two or more fields.

Going Further

The obvious next step in generating custom characters is to design a complete custom character set, and I intend to do just that when time permits. Many other possibilities also exist.

For instance, why let the program decide which letters will be drawn in an unchangeable sequence when you can input custom characters directly from the keyboard? When added to the program in Listing 2, the following routine does just that:

```

92 Z$=INKEY$: IF Z$=""
   THEN 92
94 IF Z$="M" THEN 200
96 IF Z$="S" THEN 300
98 IF Z$="I" THEN 400
230 GOTO 92
330 GOTO 92
420 GOTO 92

```

This simple keyboard input routine doesn't trap errors, so it's important to enter the correct character. But it nicely illustrates how simple it is to revise a character generator program for a plotter. Although the original program prints my last name, the revised program can be used to direct the plotter to print such words as MISS, IS and SIS. Add a subroutine for the letter E to Listing 3, and many other words can be printed. ◇

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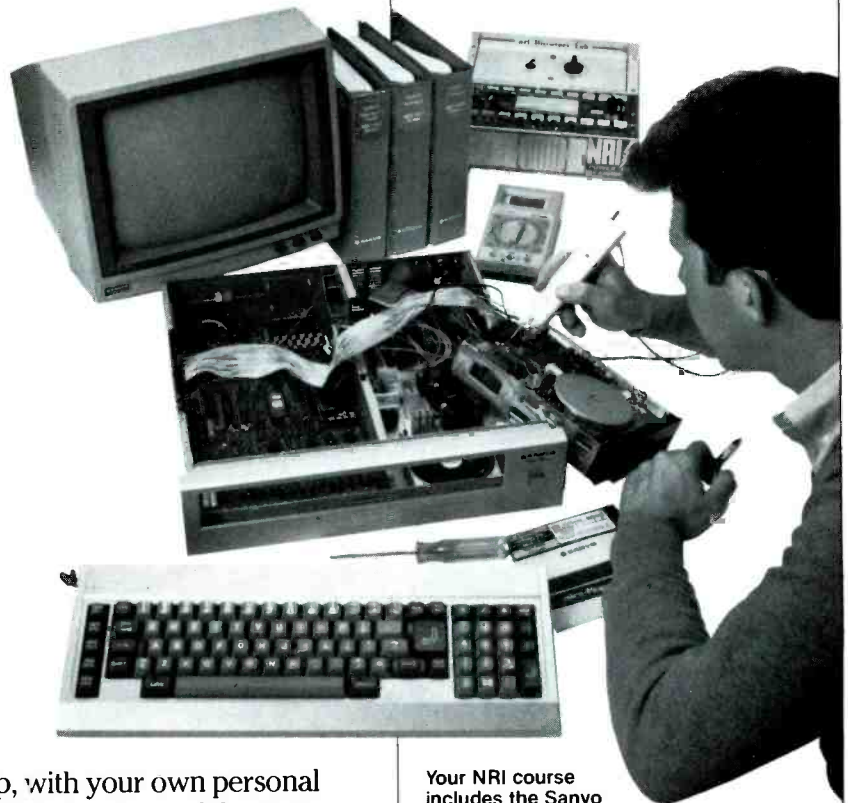
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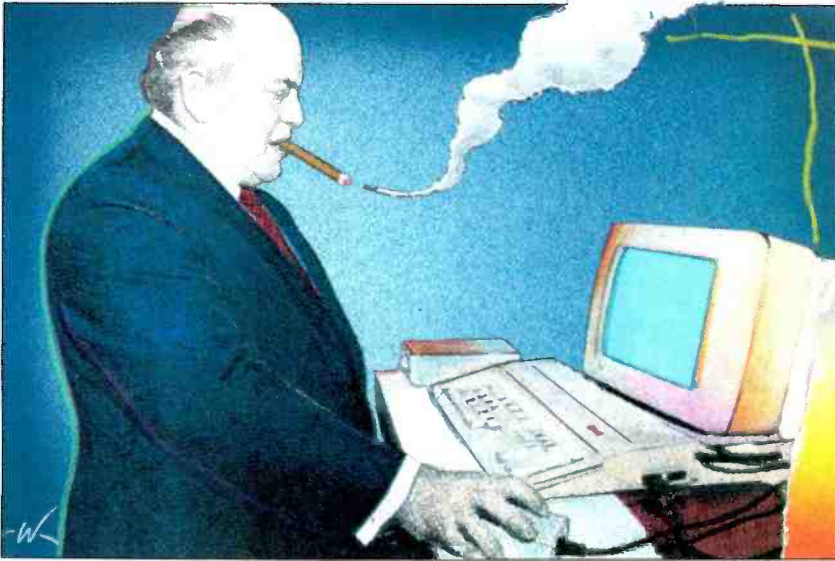
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Rumors & Gossip

► In January, Atari showed its first 16-bit computers at the Winter Consumer Electronics Show in Las Vegas. The 130ST (\$400) and 520ST (\$600) look like fast, color Macintoshes, with 68000 CPUs, 128K or 512K of RAM, and optional 3½", 500K floppies (\$200). The back panel sports serial and parallel interfaces, a high-speed parallel hard disk port (1.33M-bytes/sec transfer rate) for a promised 10M-byte hard disk (\$600) and a music (MIDI) interface. Atari CEO Jack Tramiel promises to make 5 million computers in 1985. All he wants in return is the support of the software industry. The one package shown with the computers, Matrix software's Infinity, seems almost unbelievable: a spreadsheet with up to 65,000 × 65,000 cells, word processing with a spelling checker, graphics, a relational database with unlimited capacity, and communications, all for \$50.

Look for Atari to introduce a true 32-bit micro at the Hanover Fair in Germany late this month. Will it be a 68029 machine? What are the "additional surprises" Atari promises for June? And will the company really be able to sell \$100 million of Atari products before the year is out? With its most expensive computer selling for \$600 and its promise to set a \$50 limit on software it sells in 1985, Atari will have to move tremendous quantities to reach that sales goal.

Software producers and a few select

others have seen Commodore's newest 16-bit machine. Most proclaim it excellent, especially the color graphics. It apparently is a Z8000-based unit that uses a UNIX-based operating system and will sell for under \$1000.

Predictions are that IBM will ship 200,000 PC ATs this year, up from an estimated 40,000 last year. . . . A laser printer for the Mac seems to be coming from Apple. Although it will use the same print mechanism as the Hewlett-Packard LaserJet printer, which has been out for almost a year, its very high degree of intelligence will make it twice as expensive as the HP unit.

We hear that 3M will introduce an erasable laser disk that can store 500M bytes. However, it will probably be incompatible with the read-only compact disk units beginning to appear from Japan.

British Telecom, England's public telephone company, wants to follow in AT&T's footsteps and go private to enter the computer and office-automation markets. BT generated profits of \$1 billion on sales of \$10 billion last year for the British government. The government has sold 51% of the stock in the company for about \$6 billion. And the Japanese government is also pushing legislation to sell off its major holding in the Nippon Telegraph and Telephone Public Corporation. NT&TPC has almost twice the sales of BT. When BT and NT&TPC go private and enter the com-

puter markets, they aim to compete directly with the likes of AT&T and IBM in the U.S.

Optical Disk Drives Being Shipped

► Sony and Hitachi are the first companies to ship optical-disk drives for personal computers. The units store 550M bytes on a read-only disk the size of a 45-rpm record. Units are expected to start appearing in stores in the last quarter of this year. Panasonic, Matsushita, Philips, IBM and Digital Equipment Corp. might also announce units this year.

IBMT&T

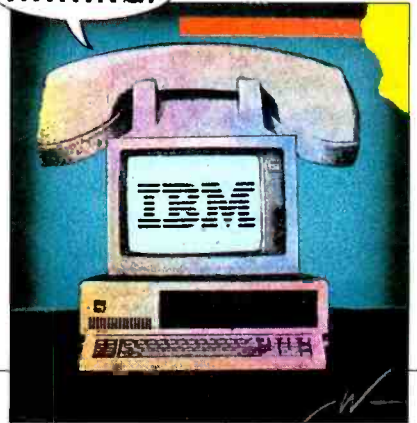
► Venture Development Corp., a Wellesley, MA, market research outfit, recently counted 3000 separate commercial programs for the IBM PC: 10% were accounting programs, 6% word processing, 5% database managers, and 3.6% spreadsheets. By contrast, Apple claims there are about 5000 Apple programs. The largest portion of these, however, are games.

It has been estimated that IBM sold 270,000 PCjr's, worth \$230 million, last year. Most of the sales occurred in the last quarter of the year. By contrast, Apple reportedly sold close to 750,000 IIE and IIC systems, worth about \$800 million. Apple had sold 580,000 IIEs the previous year (the IIC had not been introduced).

By the time you read this, IBM's new TopView windowing user-interface software should be out. Although more limited in capability than Digital Research's GEM package and Microsoft's Windows (which is not expected until June, at the earliest), it is expected to dominate the PC graphics user-interface market.

Be warned, however, that IBM is well

RRRING!



along with TV version II. Expect it to make the PC look just like an Apple Macintosh, with icons, mouse and graphics. Also look for TV II to have enhancements for networking.

Computer Memories has disclosed that it has received an order from IBM for 240,000 hard disk drives for the new PC AT machine to be delivered this year. IBM will no doubt place similar orders with other hard disk drive makers and will also sell many ATs without hard disk drives. Therefore, it appears that IBM expects to ship about one-half million ATs this year.

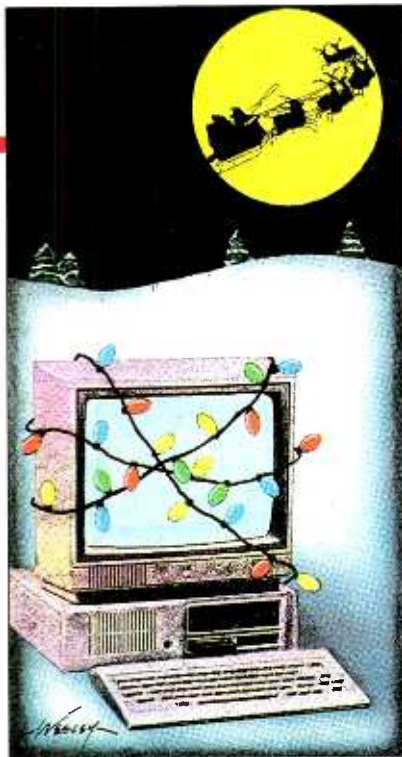
IBM has filed lawsuits against 11 Taiwanese companies, charging violation of copyrights on the IBM PC. There are reports that several dozen system copiers are operating in Taiwan, most Mom-and-Pop operations, turning out 10 to 20 machines a month. Almost all these machines are being sold in the Far East; few come to the U.S., because the prices of PC clones in the U.S. are so low that it is not profitable to sneak these machines into this country.

With AT&T moving into computers, it was only natural for IBM to enter telecommunications. IBM began by acquiring Rolm Corp., a maker of computerized telephone systems. Now IBM is reorganizing its entire corporate structure to give increasing emphasis to telecommunications. IBM has created a new Information Systems & Products Group (IS&PG) that joins the already existing Information Systems & Communications Group (IS&CG). These groups, developing new products that integrate computers and communications, will probably become quite significant in IBM.

Santa Favored the PCjr and IIc

► Christmas 1984 saw big changes in the home computer market. Previously Commodore, Atari and Coleco dominated. This year, IBM and Apple, cutting prices on the PCjr and IIc, moved in. Coleco, for one, has dropped out entirely. Second, while sales of the Commodore 64 were good, they weren't greater than those of the previous year. Moreover, the new Commodore Plus/4 machine sold far below the company's expectations. Atari has slashed prices on the 600XL and 800XL, which stimulated sales.

But the Christmas hit was the IBM



PCjr. The jr, long an IBM embarrassment, was transformed over the summer—with a new keyboard, memory expansion and the Lotus 1-2-3 cartridge—into a hot seller. Sales started to pick up in September, and just about doubled each month up through Christmas. Of course spending about \$40 million of promotion in the last quarter, offering dealers a \$250 rebate, including a free color monitor, throwing in \$200 worth of software and mailing about 10 million \$100 discount coupons helped. The net result lowered the price of a complete PCjr system to under \$800, about \$100 less than a comparably equipped Apple IIc, and only about \$300 more than a Commodore 64 system.

IBM and Apple have thus emerged as two of the players in a four-way battle between them and Commodore and Atari (the Japanese are still waiting in the wings with their MSX machines). Neither IBM nor Apple has yet tapped the discount-oriented mass merchandise chains that carry Commodore and Atari machines. Rather, they continue to sell through the traditional computer stores and selected department stores. However, I expect they will change later this year.

MSX Update

► Several Japanese makers of consumer-oriented personal computers last year introduced machines based on the

Microsoft MSX operating system. It appears that MSX has become a standard in Japan.

Now these companies are introducing disk-based versions of these machines, typically using the Sony 3½" floppy disk storing about 360K bytes. MSX-DOS is file compatible with MS-DOS and CP/M. Since these machines use the Z80 microprocessor, they will run most CP/M programs and allow access to most MS-DOS ASCII files.

So far no U.S. manufacturer has introduced an MSX machine. However, IBM is known to have purchased a large number of MSX machines for evaluation. Marketing such a machine is a move IBM is considering.

To date the highly competitive and chaotic U.S. consumer computer market has discouraged the Japanese from introducing these machines into the U.S.

In the meantime, cassette-based MSX systems are selling well in Europe, although the European computer store dealers are complaining about their distribution. Sony, Sanyo, Hitachi, Mitsubishi, JVC, Toshiba, and Spectravideo are currently selling systems. The problem is that these companies, seeing the machines as part of home entertainment systems, are ignoring the computer stores. Teleton, National and Canon are also expected to begin shipping MSX machines soon.

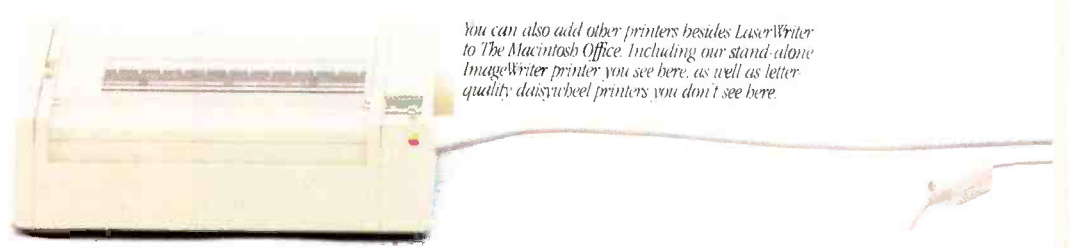
Commodores Staying at the Stores

► Commodore, with over a billion dollars in personal computer sales, is number 2 in the industry, just behind IBM and ahead of Apple. Sales figures of its equipment form an important indicator. Although its sales of personal computers increased in every quarter since it started selling systems in '77, they decreased in the last quarter of '84, the company disclosed.


Sales of the C-64, which has been on the market for three years, have begun to slacken, and sales of the new Plus/4 and Commodore 16 have been disappointing.

Commodore has about 60% of the under-\$500 computer market. But IBM, Apple and Atari, reducing their prices, have cut into Commodore's sales. Further, Sanyo, with its MS-DOS machine, has been quietly increasing its share of the under-\$1000 market. ◇


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You can also add other printers besides LaserWriter to The Macintosh Office. Including our stand-alone ImageWriter printer you see here, as well as letter-quality daisywheel printers you don't see here.




The LaserWriter printer has its own built-in type styles and sizes, and it can be shared by everyone in The Macintosh Office.



Right now, IBM PCs can use our new LaserWriter printer. Later this year, we'll be introducing the AppleLink card that fits into an IBM PC, allowing it to trade information with Macintosh and access file servers. As well as serve as a gateway between the IBM PC network and our AppleLink network.

The AppleLink protocol converter lets you talk directly to your mainframe via 3270 emulation.



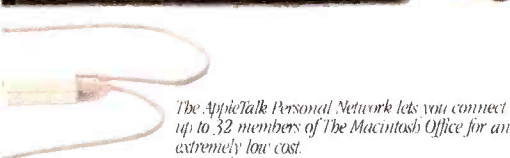
Our entry-level workstation in The Macintosh Office is, naturally enough, the Macintosh 128K.

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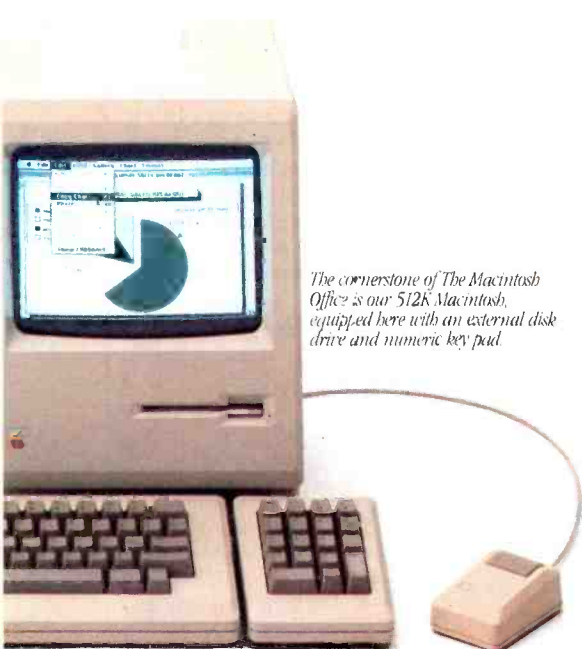
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The idea that people, not mainframes, are the most important information centers in an office. And that most things in business are really accomplished by teams of 5 to 25 people who need to share information with each other. What we call the *workgroup*.

That's why we put Macintosh at the heart of The Macintosh Office. Its powerful, 32-bit technology reduces the time it takes to become productive with a computer from well over a work week, to just under a lunch hour.

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presentations, reports and overheads more persuasive.

We've even found a way for The Macintosh Office to share offices with IBM.™ An AppleTalk card that slips into an IBM PC, allowing it to trade information with Macintosh and access file servers.

Third party developers are also working on The Macintosh Office. Next month,



Our LaserWriter produces publication quality text and graphics.

they'll be offering shared storage devices that let your workgroup share information. And they're writing a whole new generation of business software to go along with the 350 programs Macintosh already runs. Including Microsoft® Word, ThinkTank™ 512 and the new Jazz™ from Lotus.®

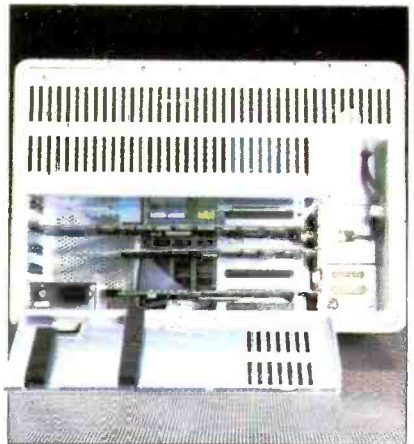
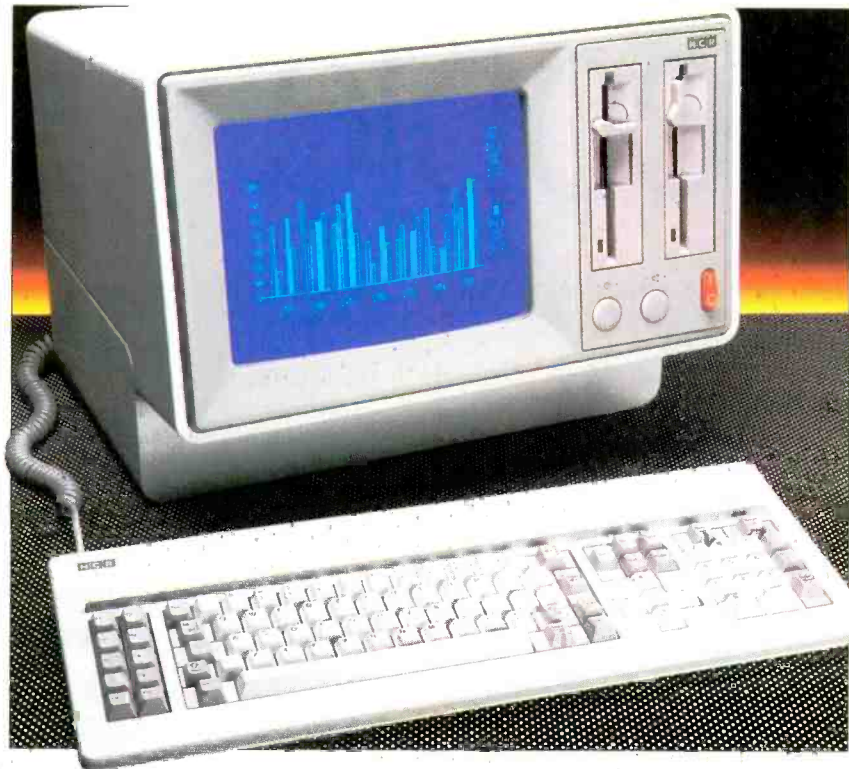
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We'll tell you how to get everything you need to turn your office into a Macintosh Office.

People not included.



HARDWARE REVIEWS



THE NCR PERSONAL COMPUTER

A well-designed 8088-based IBM clone

BY PAUL BONNER

THE NCR PC Model 4 is an 8088-based MS-DOS computer that boasts a high degree of software and peripheral hardware compatibility with the IBM Personal Computer. In that respect it is hardly unique—in fact the computer market is drenched with dozens of “IBM clones” that offer the same level of compatibility. What makes this machine unique is the approach that NCR has taken to distinguish it from its competition. Most compatibles compete with IBM and each other by providing equipment equivalent to the IBM PC but at a lower price or by offering enhanced

equipment (higher-resolution graphics, higher-capacity disk drives, faster microprocessors than the IBM PC). The NCR PC Model 4, on the other hand, with its 4.77-MHz CPU, 360K drives, and IBM standard graphics, is chiefly distinguished by a number of unique aesthetic and ergonomic design features.

External Design

The most obvious of these is the shape of the computer itself. With its pedestal mount and built-in monitor, the PC Model 4 looks more like a Lisa than an IBM PC. This shape gives it a smaller footprint (18" × 16") than the IBM PC and makes it easier to use in some respects. The two vertically mounted half-height 360K disk drives are unusually accessible, and the placement of the power switch and monitor brightness switch on the front of the machine is handy. Even more welcome, though, next to those switches, is one that controls the volume of the computer's speaker—a feature missing from most computers that is bound to please anyone who believes that the world is noisy enough without computers beeping the day away.

The back of the PC Model 4 shows equally thoughtful design. The machine features built-in parallel and serial ports,

which are located in a recessed well on the rear right-hand side of the machine. The keyboard plugs into a socket in the same well. The machine has five expansion slots, four of which accept standard full-size expansion boards for the IBM PC. (The fifth slot is reserved for the disk drive controller. In addition, one of the four remaining slots must be used for a display adapter.) Access to the expansion slots is gained by removing a 14" × 5.5" panel held in place by a single screw. The boards inside are mounted horizontally and can be reached easily. All in all, installing an expansion board in the PC Model 4 is easier and more

(Continued on page 82)

Specifications

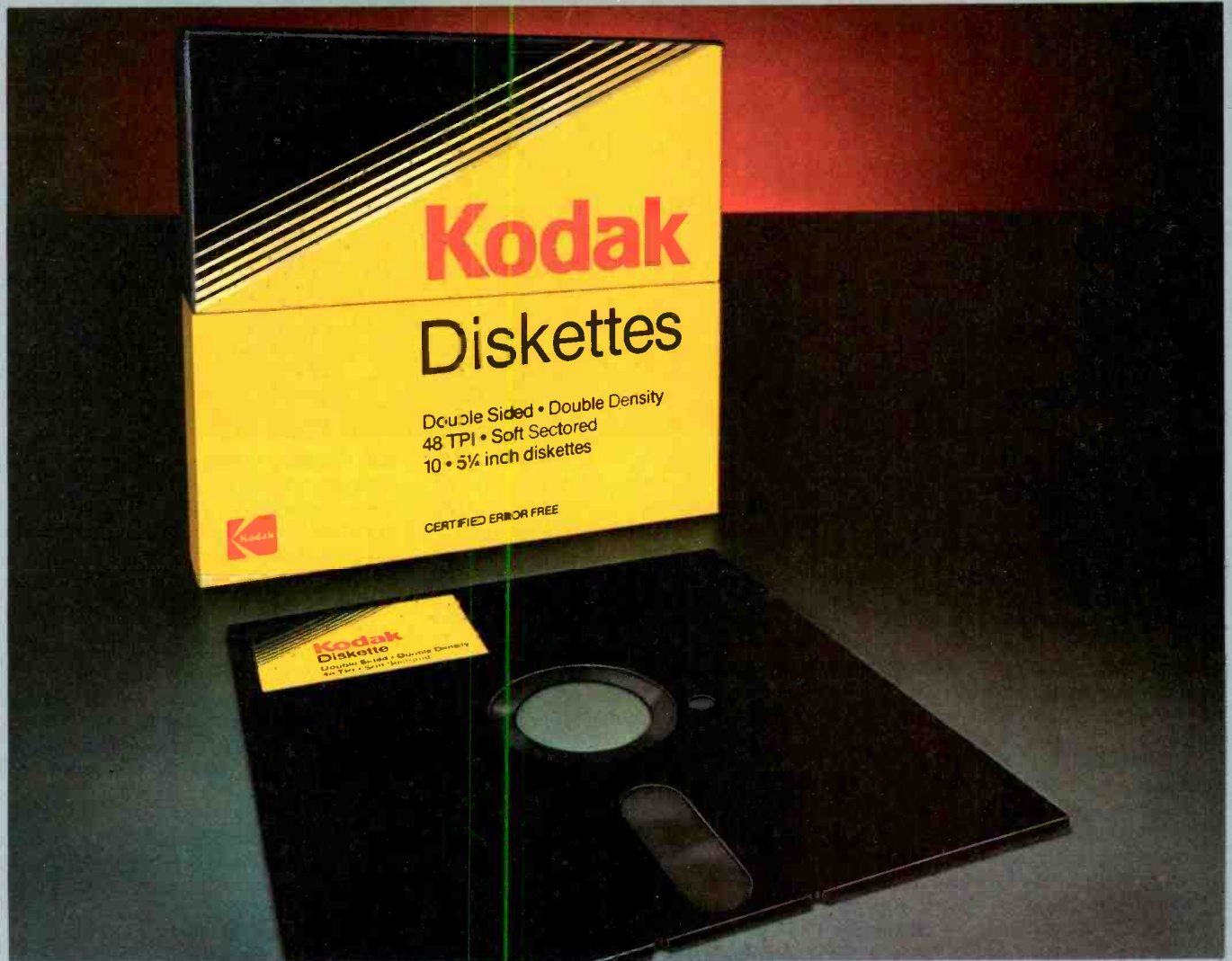
Product: NCR PC Model 4

Mfr: NCR Corporation
Dayton, OH 45479
513-445-2075

Price: \$2825

Features: 8088 CPU, 128K bytes of RAM (expandable to 640K), dual 360K half-height floppy disk drives (internal hard disk available), monochrome monitor (color available), serial and parallel ports

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QUBIÉ HARD DISK

A mail-order
10M-byte hard
disk for
under \$700

BY JOSEPH DESPOSITO

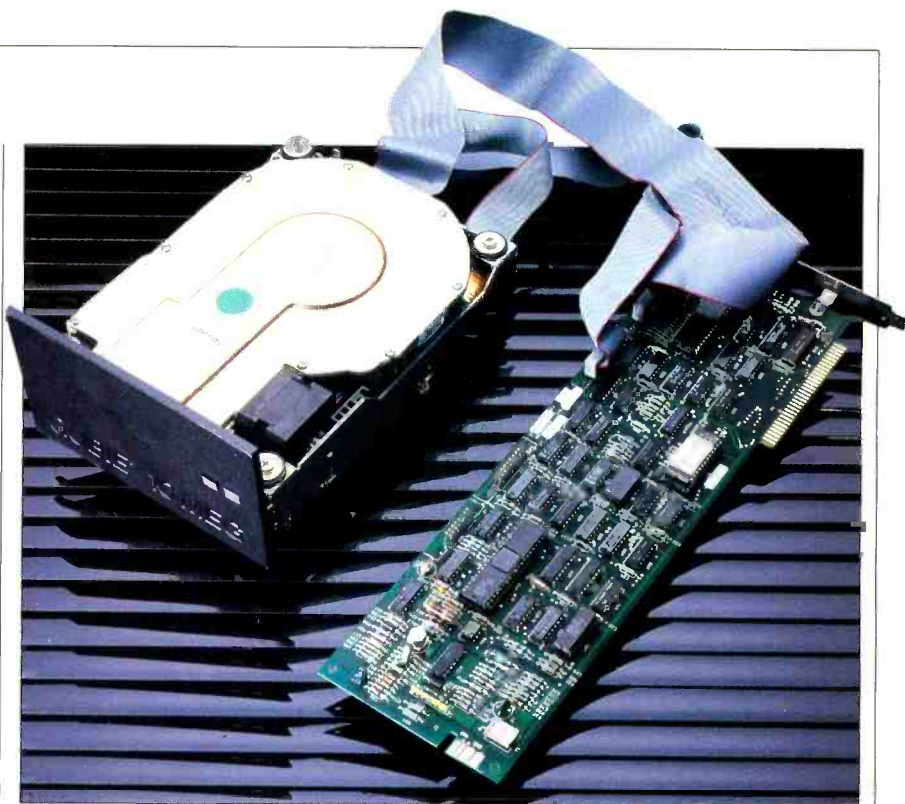
A HARD disk is generally regarded as a desirable though costly upgrade to a personal computer system. A new product from Qubié, however, makes this attractive option more affordable than ever; Qubié offers a 10M-byte hard drive for just \$699. The complete package includes the drive, an interface card, cables, and software. The drive can be installed in the IBM PC and hardware-compatible machines.

Hardware

The Qubié PC10 is a half-height hard disk drive that fits inside an IBM PC. Installation is simple: We just removed a full-height floppy B drive from the IBM PC and replaced it with the Qubié. A full-height bezel for the hard disk is included (a half-height bezel is available as an option). The interface card, which uses a Western Digital controller, fits into one of the IBM expansion slots and connects to the hard disk via two cables. In most cases, power for the drive is taken from

Specifications

Product: Qubié PC10 Hard Disk
Mfr: Qubié
Dept. HRD
4809 Calle Alto
Camarillo, CA 93010
Dimensions: 1 $\frac{1}{8}$ "H x 5 $\frac{3}{4}$ "W x 8"L
Weight: 3 lb
Price: \$699
Features: 10M-byte storage capacity, interface board, software utilities



the IBM's supply. However, if there are too many add-on boards in the computer, there may not be sufficient power to run the drive. You'll know this because the drive has an overload protection circuit that automatically shuts down the entire system. An auxiliary power supply is available from Qubié for \$88.

Qubié does not actually manufacture the hard disk—it is a Microscience International drive. The disk uses a specially plated media that protects the disk surface from damage should the read/write heads come in contact with magnetic media.

The Western Digital hard disk controller enables you to boot your computer from the hard disk if your PC is a PC-2 model. You can check to see whether it is with the Debug program by typing DFFFF:0005 L8 and pressing the enter key. If the date returned by the computer is 10/27/82 or later, you have a PC-2; if not, you have a PC-1. With these early PCs that do not provide for the addition of a hard disk, you must either use the Qboot utility provided by Qubié or else do a ROM upgrade.

Software

Before using the hard disk, suggests the manufacturer, you should format it into sectors, even though it is preformatted at the factory. Qubié provides a utility for doing it called Qubiéfmt. Otherwise, you partition the disk and format it for PC DOS with the usual PC DOS utilities, Fdisk and Format.

Qubié also provides an interactive command system, or "visual shell," called *Idir* that simplifies the use of the

disk operating system. Though it makes the system easier to use, you do not require it to use the hard disk. One of its nicer features is letting you perform multiple file tasks, for example, selecting a group of files to be copied to a floppy for backup.

Performance

The Qubié hard disk, though inexpensive, is not cheap in any other respect. We used it for over two months and found it to be fast and reliable. The autoboot function is a particular convenience that even some more expensive units lack.

Documentation

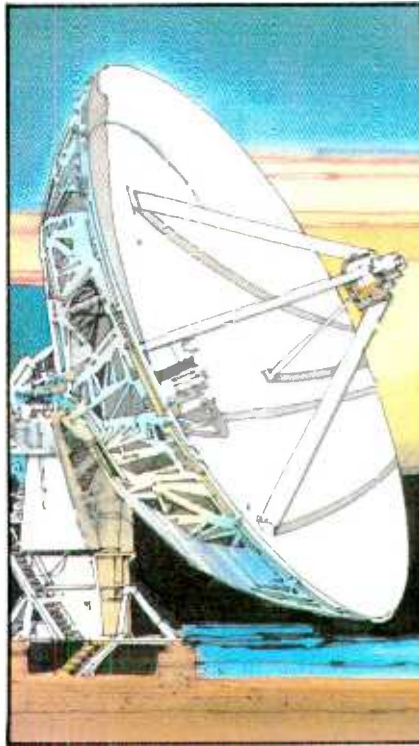
The disk comes with a 29-page user's guide. The guide is straightforward, clear, and filled with photographs that lead you by the hand through the installation procedures. In addition, there is a short booklet that describes the use of the *Idir* software. It is also well-written and easy to understand. Another pamphlet that comes with the unit cannot be classified as documentation but will be appreciated. It has eight pages of helpful suggestions on developing a file management system for the hard disk.

Conclusions

The Qubié is an outstanding value, and I recommend it highly. It adds speed and significant storage capacity to an IBM PC system at a moderate cost. It's fairly easy to set up, although the procedure might intimidate a novice.

If the Qubié is typical of the inexpensive hard disks coming on the market, we'll soon see one in every PC. ◇

PHOTO BY BOB LORENZ



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DISCACHE

Ultra-fast hard disk subsystem supports multiple use

BY JON PEPPER

AFTER you've finally acquired the right microcomputer, a bookcase full of software, and the perfect printer, what's there left to wish for? How about hard disk storage, faster execution speed, a print spooler, cache RAM, and networking—all in one package! That's what you get with DisCache, a high-performance Winchester disk subsystem from Eicon Research.

DisCache offers quite a lot in a small package—10M bytes of hard disk storage, a 256K RAM cache memory, a 1M-byte print spooler and a dedicated internal microprocessor. Plus, the unit is the basis for an inexpensive, highly efficient networking system.

About the Hardware

DisCache comes with an interface card for your computer (currently an IBM PC or compatible, NEC APC, or Apple II) and an appropriate cable.

DisCache itself is 9" × 17½" × 5" and includes connectors on the rear panel for parallel printer, computer, and ac power. An RS-232 port and a second

parallel printer port are optional. The front panel contains five pushbuttons: three for operating systems (CP/M, DOS, P) and reset and message buttons. These buttons can be used in combination to put DisCache through self-test procedures, to "park" the heads (prior to shutting the unit off), and to repeat messages that are displayed on the four-character LED display. Normally, the operating system of choice is indicated on the display, but error messages also scroll across it to alert the operator to the status of the unit.

Performance

DisCache is fast. While many other hard disks have an access time of about 40 ms, DisCache claims an average access time of about 8 ms! This speed results chiefly from the ingenious way it uses the RAM cache.

The intelligent processor in DisCache monitors the sectors requested and automatically keeps those frequently used in the RAM cache for immediate access. A "caching algorithm" anticipates which sectors are most likely to be called next.

How well does this work? I ran a number of programs under both CP/M-86 and MS DOS—Wordstar, dBASE II, Multiplan, Microplan—and a number of disk-intensive graphics programs—DR Graph, AutoCad and Graphstation. Whenever the RAM cache becomes effective, operations run exceptionally fast. However, in some instances, for example, the first time you access a file, speed slows to typical "hard disk only" performance.

Formatting the Disk

Once you make the physical connections, you boot the operating system disk on drive A, insert the CacheNet System Creator disk (supplied with DisCache) on drive B, and run the Setup program.

You then enter the system as the Manager, and divide the unit into volumes. (A-F are permitted on the hard disk, with G and H reserved for your floppy disk drives.) Any volume can be from 1M to 10M bytes, up to the limit of your storage. The rest of the procedure, the same most hard disk units use, involves the transfer of any of your application programs to the hard disk.

Networking

You can turn DisCache into a file server for a multi-user system by using the associated CacheNet software.

The possibility of sharing access turns single-user software into multi-user through the use of dynamic record locking, which prevents two users from working the same files at the same time.

With the System Creator disk, you can assign access names and security codes for users and control which files they can read and/or write to. You are given a number of ways to protect sensitive data in a multi-user environment, for example, exclusive read/write access, or read/write access for one user combined with read-only access for others.

During the course of my review, I had two PCs running on the DisCache with no decrease in speed and no problems at all. While not everyone will need the multi-user feature, those who can benefit by it will find the increased job throughput to be a big bonus—and the cost per workstation is very justifiable with DisCache.

Connecting several computers is simple. If each has an interface board installed, they can be connected in a daisy chain. (Note: A jumper on the interface

(Continued on page 84)

Specifications

Product: DisCache

Mfr: Eicon Research, Inc.

520 Fifth Ave.

New York, NY 10036

Price: \$3350

Features: 10M-byte hard disk, 256K cache RAM, 1M-byte print spooler, parallel printer port, and multi-user capability

Options: Interface board (for IBM, NEC APC or Apple II) \$395; CacheNet multi-user access software \$525

Other

configurations: 20M-byte disk \$4250; 40M-byte disk \$5650

PHOTO BY BOB LORENZ

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SOFTWARE REVIEWS

SAVVY PC

Database manager has English-like front end

BY MICHAEL K. GUTTMAN & CRAIG KRUM

AT the circus the "world's fattest man" and the "smartest elephant ever in captivity" may not be what the Barker claims. But we're not bothered. We expect some harmless hyperbole.

When buying software, we are likely to have a different reaction to exaggeration. Savvy, from Excalibur Technology, comes with some strong claims in its pitch. According to the product's manual, this is the ultimate database program, with features that are "phenomenal" and "unique." The manual also makes frequent criticisms of more traditional application development systems.

Does Savvy measure up? Well, it may not be the end-all its makers claim, but it definitely offers some very noteworthy features. Unfortunately, it also has some regrettable weaknesses that cry out for correction.

How Savvy Works

Savvy creates its own environment, a kind of operating system that guides the

user's every move. Initially, you manipulate this environment in a simple conversational mode, typing in simple words that Savvy is preprogrammed to respond to. For example, if you type <ADD>, Savvy will respond:

ADD the _____ to the _____

prompting you to fill in the blanks. In this case you could reply with either a constant or a variable name, for example, <DOGS> or <CATS>. To see the result, you would type <DISPLAY>, and Savvy would respond:

DISPLAY the _____

again waiting for you to fill in the blank. In this case, you could type <SUM>, a reserved word used to hold the results of an add operation.

As experienced programmers, we found this method of interacting with the system a bit cumbersome at first, but eventually we adjusted to it and almost got to like it. It certainly boosts the learning curve, particularly for users new to computers.

In an attempt to underscore this "user friendliness," Savvy provides a special pattern recognition feature to catch simple typos and suggest the correct input. For example, if you had typed in <DAD> instead of <ADD>, Savvy would have acted as though you had typed <ADD>. Excalibur emphasizes this feature in its ads; but, in practice, we found it to be of limited help and sometimes downright annoying.



PHOTOS BY STEVE BORNIS

Specifications

Product: Savvy PC
Mfg.: Excalibur Technology Corp.
800 Rio Grande Blvd. NW,
Suite 21
Albuquerque, NM 87104
505-242-3333
Price: \$395.00
Requirements: IBM PC, XT, AT or compatible, 128K RAM, PC/MS DOS 2.x, 3.0, one double-sided drive

First of all, Savvy only seems to catch simple transpositions in the first seven or so letters, hardly a brilliant example of "artificial intelligence," another marketing claim. Second, it's possible to invoke a totally unwanted (and perhaps destructive) command with a misspelling that Savvy incorrectly interprets. Worse yet, it may not be obvious what command Savvy has just executed! Mercifully, Savvy allows you to disable this feature.

Savvy, however, does make life easier by allowing the user to create aliases for key words and to "attach," or assign, words to function keys, both very useful features not always found in other products. It also provides the ability to redirect input normally taken from the keyboard. The input can originate from a disk file, which allows the user to automate processing sequences and mimic keyboard input for demos.

Manipulating Data and Files

Using the conversational mode, the user can create new memory variables (called "items") and manipulate them at will. For example, we might type the following commands:

```
COPY the 20 to Oranges
COPY the 10 to Apples
ADD the Apples to the Oranges
COPY the SUM to Fruit
```

If Savvy encounters an item not previously defined, it will allow the user to add it immediately to the program's vocabulary. Unlike most database managers, Savvy does not require that data be preclassified by length or by type (such as real numbers, integers, characters, etc.). Further, Savvy provides several functions to edit and transform information so that it can be accepted and displayed in a variety of formats.

(Continued on page 34)

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BASF

Savvy PC

(Continued from page 32)

This flexibility extends to Savvy's disk-based filing system, where each record in a file can contain up to 254 nontyped items of variable length. Therefore, a user can easily define files and move information between the memory-based items and files without worrying about type mismatches or truncations, a common problem in many other products.

Programming

The conversational mode can be very powerful, but Savvy begins to come into its own when the user enters the programming mode. This mode is used to create what Savvy calls "tasks" and "functions," new procedures, made out of existing ones, that are then added to Savvy's vocabulary of key words. Here again, Savvy makes it very easy for the user, giving the same type of prompting help in its programming editor that is available in the conversational mode.

A Savvy "task" is simply a set of Savvy statements given a name of its own. A "function" is a special kind of task that allows up to nine operands to be passed from the keyboard or another task. Savvy uses a threaded interpretive structure like the Forth and LOGO languages to add new tasks to its vocabulary quickly and efficiently. Because of this structure, Savvy programs work best when they are created as a series of small modular tasks (each doing a single operation) that are in turn called by other modules. In fact, Savvy only accepts tasks and functions that are no more than 1000 bytes long, or about 100 program statements.

Threaded interpretive structures take a little getting used to, but they tend to yield very good results. Each module can be tested and debugged interactively, added to the vocabulary, and then immediately used to create other modules. This sort of "bottom-up" programming tends to reduce run-time errors and produce very tight code. It also allows the programmer to create vocabularies and structures tailored to the application being developed. Savvy does a good job of introducing this approach and making it very easy to learn.

Savvy also provides some goodies for more advanced programmers. For example, it allows the user to set a timer to execute a task at some later time, interrupting the then-current task if required. The timer could be used to allow an application to execute a specific task at a specific time (such as sending documents at night by modem) or to check the system status periodically for external events (such as receipt of an incoming message).

Another nice feature for applications programmers is the ability to "lock," or prevent end-users from directly invoking programmer-specified tasks and functions from the keyboard. This capacity makes it possible to protect proprietary software. A user can also define a "startup" task to be invoked immediately after Savvy is called from DOS, which, in effect, permits the creation of a turnkey system.

Savvy and DOS

Savvy functions semi-independently from DOS, storing its vocabulary and all user data in a single DOS file with its own self-contained structure called a "data environment" file. In fact, it's possible for the user to create one or more versions of Savvy, starting with the base vocabulary of 250 words and adding to each a set of customized tasks, functions, and data to be saved in a separate environment file. As intended, this makes creating custom applications a breeze.

Using Savvy for any serious database applications requires a hard disk

You choose the environment file to work with by entering its name when Savvy is started. If you specify a new file, it will be created and initialized in the starting environment, which occupies around 48K of disk space. Savvy already comes with an environment file called DATABASE.SVY, which contains the programs for its database manager. As with any environment file, DATABASE.SVY can be copied, and the copies can be tailored to meet the needs of specific applications.

A potential disk space problem with this type of file structure becomes apparent when you take a look at the directory of Savvy's master disk. The starting size of DATABASE.SVY is almost 180K bytes. Once file definitions, custom programs, and user data are added to this environment, it quickly becomes too large to fit on a floppy disk. A test case with one internal data file containing around 900 records occupied over 400K bytes in an environment file. Since IBM's DOS is unable to split a single file across disk boundaries, using Savvy for any serious database applications requires a hard disk.

Another problem involves porting data files created in one data environment to those of another. Savvy provides no direct facility for this function, so the user must write a porting program that transfers the data first to and then from an intermediate ASCII file. Although we did not try this, it would appear to be a slow and clumsy process at best.

An odd and frustrating situation arose when the disk with our environment file had less than 11K bytes of free space remaining: Savvy wouldn't let us in! It displayed a "DISK FULL" message, and we were forced to exit to DOS. In order to get back in we had either to delete some other DOS files to free up enough space or else move the environment file to a disk with more room. Once we did get back into Savvy, however, we were able to use a procedure called "Janitor" to release any space in the environment file that wasn't being used to allow more room on the disk. This procedure, however, took a long time, since apparently Savvy had to reorganize all its internal files.

Despite its own somewhat cryptic environment, Savvy does allow a certain amount of interaction with DOS and DOS-based files. If its structure is known, a DOS file can be read as a series of ASCII bytes, and an ASCII file can also be created and written to. Savvy provides special tasks to set the default drive, designate read-only and read/write statuses for DOS files, and read the DOS directory into a file for later manipulation. Savvy also includes a function called "Execute External," which passes a command line to DOS.

Interestingly, Savvy provides a set of tasks and functions specifically dedicated to communicating through the logical serial ports provided by DOS. Besides generic "Peek" and "Poke" commands (used for polling ports, not memory), Savvy's functions include "Baud Rate," "Data Bits," "Protocol," which can be used to write quite sophisticated communications programs. We think this is a useful feature—it's seldom seen in data management products.

Problems and Weaknesses

Savvy offers some very clever, useful, and sophisticated features, but unfortunately it falls short in a key few. While these faults would not be fatal in every instance, we think prospective users should be well aware of them before trying to use Savvy for any particular application.

One problem is that Savvy offers very little support for graphics, either for the

(Continued on page 83)

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ZYINDEX

Any word or group of words—even from 15,000 files

BY RON WHITE

LYING on your desk in front of you is a stack of disks. One contains a text file with a very important letter. It's been six months or so since you wrote Stanislov Bros., Inc., threatening to sue them for the batch of malfunctioning widgets they delivered. Since that time you've been corresponding with Stanislov, and each time you've saved the letter on your computer's disks under filenames such as STANIS.LTR, STANIS2.LTR, SUIT.LAW, WIDGETS.-LAW—whatever struck you at the time

as being as descriptive a filename as you could manage under the limitations of MS-DOS: eight characters plus a three-character extension.

Now your attorney wants a copy of the letter. It's there among the hundred or so you've written Stanislov during the last half year. But how do you find it? Even if you've bothered to list all the filenames on a floppy disk label, filenames that seemed like inventive descriptions only a few weeks ago may read like hieroglyphics today.

Usually, you have no recourse but to insert floppies one by one and use your word processing software to call up each file one at a time.

ZyINDEX, a product from ZyLab, makes the search a breeze. Not only does it find the correct file for you, but it highlights the phrases you want. The program also allows you to mark selected portions of the file to save under a different file name and to print selected files. The program works with standard ASCII format. It also can be set up to

work with some word processors that use nonstandard text formats, including WordStar, Multimate, WordPerfect and Microsoft Word.

How It Works

A series of menus guides you through ZyINDEX. Pressing the appropriate function key allows you to enter the combination of words that you want to search for in your text files. You may change the request, perform the search, take a look at the files that contain the words you want, or simply display a disk directory. Pressing the H key at any time produces a context-sensitive help screen.

With complex search requests you can target one specific file or retrieve several files that contain similar information—for example, files that contain "Stanislov" and "widgets." If you want to see only the letters to Stanislov Bros. in which you complained about the defective products, you can specify a search request in which "widget" and "defective" appear within 10 words of each other (or anywhere from within two to 30,000 words). Searches can also include wild cards (* and ?), so that if you've forgotten how to spell Stanislov, you can do a search for "Stanis*." The search specifications of wildcards, of "and," "or," and "not" and of words within a certain number of words of each other may be mixed for nearly endless combinations to ferret out the most obscure reference. The only limitation is that ZyINDEX does not do searches on what the manual calls "noise words," such as "the," "were," "get" and "have," which are not likely to be of help in a search anyway because they may be included in all text files.

ZyINDEX saves on disk shuffling, too. It does *not* search your original files. Instead, it searches a facsimile of your file that is created with one of its utility programs. The program uses a special compression technique so that the equivalent of 400 files averaging 700 words each—a total of about 1680K bytes—can be stored on a double-sided double-density floppy. The exact number of files depends on the average length of the words and the frequency with which "noise words" are used. The compressed files are stored on a separate "index" disk that can include the contents of roughly five fully stuffed floppies. You can create as many different index disks as you need.

If you are working with a hard disk, you can create a single index of up to 1500 files with ZyINDEX's standard version (and up to 15,000 files with a

(Continued on page 85)

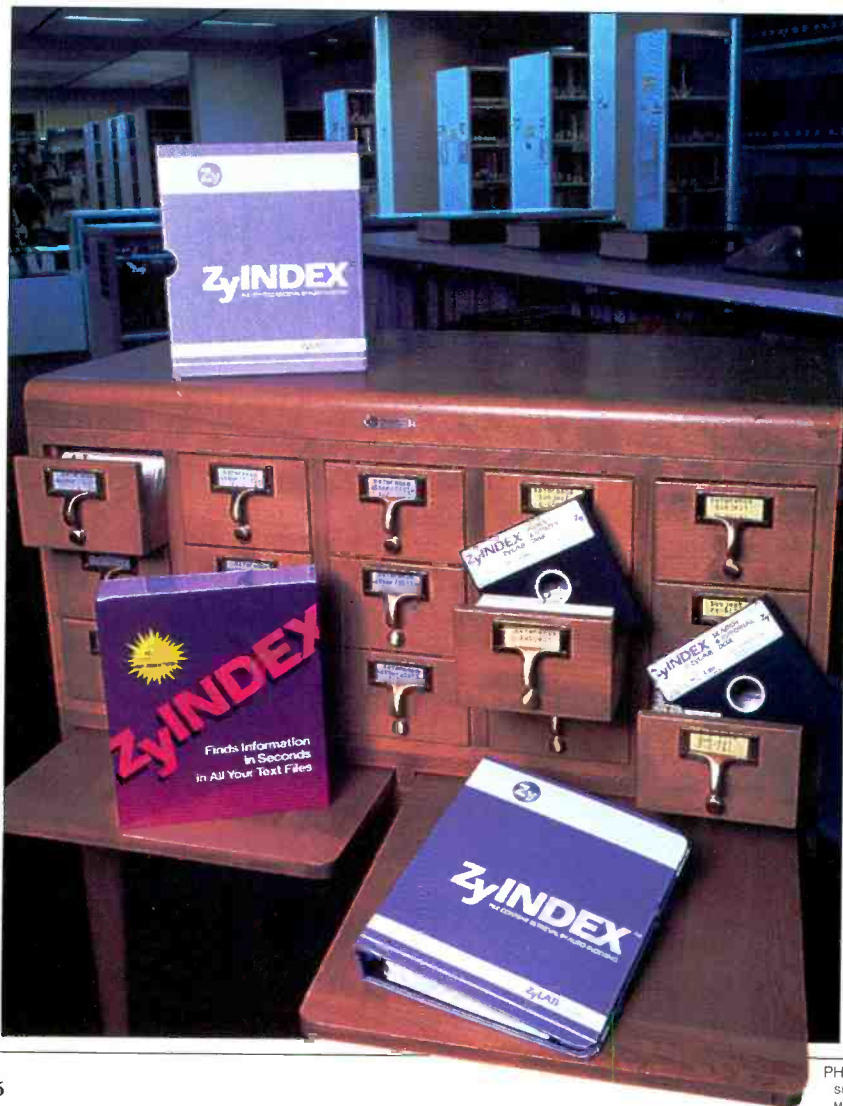


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SMART SERIES

Productivity packages that operate in an integrated environment

BY LEE D. ZIMSKIND

THERE seem to be as many integrated software packages as there are definitions for integrated software, and most of these products claim to meet a user's every need. Symphony, from Lotus Development, for instance, gives a user a single work space with different views for word processing, spreadsheets and communications. Another package, Ashton-Tate's Framework, lets the user define different types of working areas for different applications, view them concurrently on a screen, and combine them within a document. The most loosely integrated packages are composed of what are actually independent programs for each application—word processing, spreadsheet, data manager, etc.—linked by a controlling program.

The Smart Software System, from Innovative Software, is one of the loose integrators. The system consists of three software packages—Smart Word Processor, Smart Spreadsheet with Graphics, and Smart Data Manager—which may be purchased individually or together. Innovative claims that this approach makes its individual modules as effective as any single-application product, yet allows the user to move easily from one application to another.

Starting Smart

The Smart System comes with program and tutorial disks for each module,

Specifications

Product: The Smart System
Mfr: Innovative Software, Inc.
9300 W. 110th St. Suite 380
Overland Park, KS 66210
913-383-1089
Price: Complete set, \$895; Data Manager, \$495; Spreadsheet with Graphics, \$495; Word Processor, \$395
Requirements: IBM PC, XT, AT or compatible; two disk drives, 256K RAM



a graphics disk and a systems disk. The package also contains manuals for each module, a useful quick-reference pamphlet, and a keyboard template.

When you start Smart, up comes the main menu, with graphics for the various applications. You select the desired one by pressing its first letter or by moving the cursor to highlight the choice and then pressing the ENTER key.

The default screen for all applications is a 19-line work area outlined by a border (you can remove the border and gain two lines of work space if you like). I liked using the borders—they formed a separation between the work area and the system area, that is, the bottom four lines on the screen. In all applications the user toggles (with the ESC key) between two modes of operation: the data entry mode for entering information into the work area and the command mode for selecting various system options.

The top two lines in the system area contain a control section for selecting commands and responding to prompts. The third line is a status line that contains information that varies with the application being used. The last line is used for an optional display of help information.

These bottom lines, by the way, are used by all applications in the Smart System in the same way. This consistency of commands is one of the strengths of the Smart System. There are always five lists of commands. You choose one of the lists (1 to 5) and then, either by highlighting the command with the cursor and pressing the ENTER key or by typing the first letter, you invoke the command. In addition, you can select among many

commands by using a "quick key" method, which means using either the CTRL or the ALT key in conjunction with a letter. For example, the file handling commands for loading and saving data are always on command list 4 or are invoked by a "quick key"—ALT L for loading and ALT S for saving.

The Smart System's help screens—invoked by pressing the F1 key—are context-sensitive. In most cases, pressing the key a second time gives more help information.

A more innovative aid allows the user to select the degree of complexity in operating the system from among three "confidence levels." The first level contains only the most basic commands, while the third level allows access to the full spectrum of commands, ideal for the advanced user. I found that the lowest confidence level did not allow access to enough of the commands to be useful for anyone but a beginner.

Smart Modules: Word Processor

Upon entering the Smart Word Processor, you see a blank work space, ready for entering text. At the bottom of the work space a format line shows default settings for margins (normal and decimal), spacing, and justification.

Most of the common text manipulation features are available: copy, move, insert, delete, search, and replace. The FIND command allows the user to specify a perfect match or to ignore the case. It is also easy to merge text from other documents. I particularly liked the "flying reform" feature—the program auto-

(Continued on page 42)

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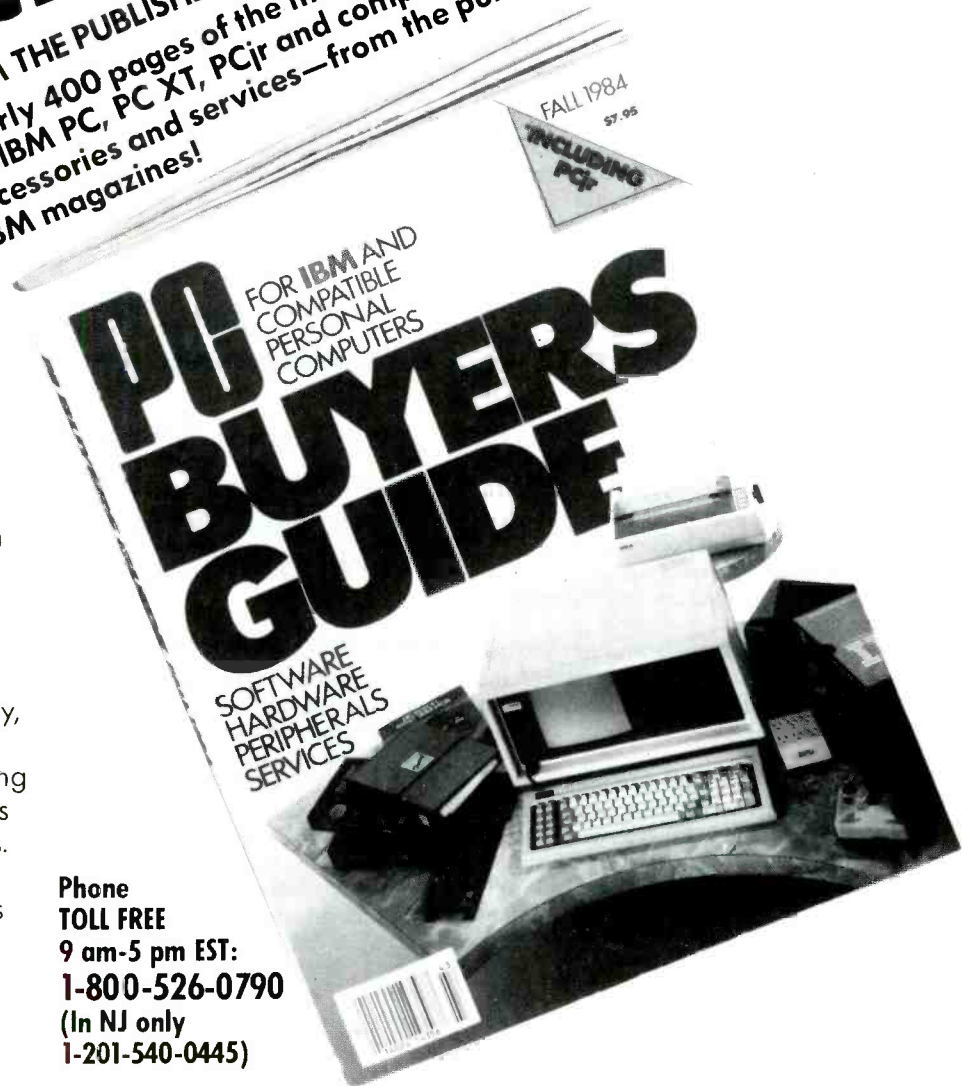
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Smart Series

(Continued from page 40)

matically reformats the text whenever the cursor is moved to a new line. Another useful command, UNDELETE reinstates whatever text was last removed using the DELETE command (not the delete key). It's also helpful that the system creates a backup of the file when the SAVE command is issued (you can override this feature).

A unique feature of the Smart Word Processor is its ability to incorporate graphs and charts—created by other Smart applications—into a document. For example, to incorporate a graph within the text, you specify the size of the graph—small, medium, or large—and the text is automatically wrapped around it. Unfortunately, the graph is not displayed on the screen, but a shaded area indicates the space on the page that the graph will occupy when printed.

The Smart System allows the user to select the display mode for a file—black & white, color, or graphics. In the graphics mode, underlining, boldface, and such fonts as italics are actually displayed (the Smart System supplies ten font choices and allows you to create two more). In the color mode, you have complete control over the colors of the background, data, and borders. Special fonts are shown as different colors, but underlining and boldface are only indicated by the status line.

The word processor also lets you put footnotes either at the bottom of the page or at the end of the document (endnotes).

Smart Spreadsheet

The Smart Spreadsheet program has a unique storage management scheme. Conventional memory management techniques reserve space for blank cells in a spreadsheet. Thus a spreadsheet that is blank except for one entry in the 30th row and 10th column uses the same amount of RAM as would 300 full cells. Only space for one cell would be reserved for the same spreadsheet in Smart. Also, most spreadsheet programs require that the entire spreadsheet fit in memory. The Smart Spreadsheet program uses the disk as well as RAM for the worksheet. This means that a "memory full" condition only occurs when both RAM and the disk are full. However, this method of storage makes calculation slightly slower than other spreadsheet programs. I found that I worked faster if I turned off the automatic calculation feature when entering data.

The Smart Spreadsheet has all of the standard features of spreadsheets—moving, copying and erasing cells or blocks of cells. One small annoyance is

that all numeric values are entered in a single user-defined format for the whole spreadsheet. It would be easier if one were able to specify the value-entry formats for different blocks within the worksheet instead of for the whole worksheet. However, the various blocks or rows or columns or even single entries can be reformatted after entry.

Like other spreadsheet programs, the Smart Spreadsheet allows you to define formulas for a cell or group of cells. Formulas may be up to 1920 characters long, and a special formula editor makes it easy to create and edit them. Formulas may use absolute or relative cell references or combinations of both. Cells in other spreadsheets may be referenced also.

Graphics

The graphics facility is part of the spreadsheet package. With it, you can

The Smart System provides a powerful capability for creating macros

set up various graphs and labels, shade, and color them. It includes an "edit screen," with which you can draw lines and characters on existing graphs or a blank screen. In addition, there is a Slideshow command for creating, editing, and viewing presentations.

The graphics program is more flexible and capable than most other graphics programs integrated with spreadsheets. I have just one complaint: I'd like more control over printing the graphs—Smart won't let you print the graphs vertically instead of horizontally or print two to four graphs per page.

Data Manager

The Smart Data Manager supports files of up to 100,000 records, with 255 fields per record. Records may all be the same length or vary in length, and files may be indexed by as many as 15 key fields for sorting.

Up to 10 screens of 15 pages each may be defined—for either viewing or entering data—for each file. Input screens may contain "read only" fields and "must enter" fields. Fields may also be calculated from other fields. Both files and screens may be password-protected, and files may be linked together for pro-

ducing reports or for on-screen viewing.

The Smart Data Manager has a flexible report generator that allows the user to print reports in form, table, or combination formats.

The program also lets you easily translate dBase II files to Smart files. I had a 500-record library in dBase II that was converted to a Smart database in about 15 minutes.

Integration

Any module of the Smart System can send or receive data from any other module in the system. Sending data from the spreadsheet, graphics or data manager to the word processor works quite smoothly. Going the other way can be a problem. I tried to send a spreadsheet to the word processor, use the word processor commands to edit a column of text, and send the updated document back to the spreadsheet program. The problem I had was that each word of text was loaded into a different cell in the spreadsheet. The solution was to write a macro (see below) in the word processor that surrounded each of the text entries with quotation marks and then send the document back to the spreadsheet.


Uncommon Common Features

The Smart System allows the work area to be split into different windows. Windows cannot overlap each other, but any window may be made to occupy the full work area by use of the ZOOM command. The windows may contain different parts of the same file or different files. One feature I liked allows the user to choose colors for each window when using the color display mode.

The Smart System has other notable features. One of the most powerful is the calculator, which can be invoked by selecting G-CALCULATOR on command list 5 in any of the applications. The calculator can be operated as either a formula calculator, an algebraic calculator, or a Reverse Polish Notation (RPN) calculator. The calculator has four storage registers and ten variables accessible by the user. In addition, it can do octal or hexadecimal figuring as well as decimal. It's also a programmable calculator with the usual arithmetic functions. I found it very convenient to be able to use my PC as a calculator without losing other work I was doing.

The Smart System provides a powerful capability for creating, editing, and saving macros. Any key, except ESC, CTRL and F10, either alone or in combination with the ALT, CTRL or SHIFT keys, can be assigned a macro name.

(Continued on page 85)



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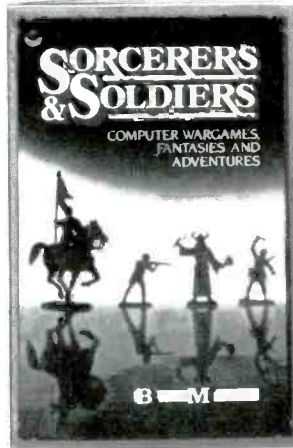
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QUARK, OCTIO for Ict/IIe/III/MAC	\$1995	\$1595	CREATIVE SOLUTIONS, MacDraw Level 2	\$249	\$159	Bank St. Writer or Speller ea (spec +/e/c)	\$140	\$85
OTHER HARDWARE								
CCS, 7711 Serial Interface	\$150	\$90	DOW JONES, Market Manager	\$50	\$33	BANK ST. COMBO (Writer & Speller)	\$140	\$85
CP/EASTSIDE, Word Card II (cover +/e)	\$140	\$99	HUMAN EDGE, Sales or Mgmt. Edge, ea	\$250	\$159	CONTINENTAL, GL, AR, AP or PR, each	\$250	\$165
COMX, 80 col. +64K RAM Card (Ite)	\$179	\$99	KENSINGTON, Starter Pak	\$90	\$60	CDEX, for Visicalc, Multiplan, Apple Ite, ea	\$60	\$40
16K RAM Card (Ite) 1 yr. Ltd. Wty.	\$179	\$99	LOTUS, Jazz	\$199	\$125	DOW JONES, Market Manager	\$300	\$189
HAYES, Mach II Joystick (+/e)	\$45	\$29	LIVING VIDEOTEK, Think Tank	\$145	\$85	MARKET ANALYZER or MICROSCOPE, ea	\$350	\$219
KENSINGTON, System Server Fan	\$90	\$65	LOTUS, Jazz	\$199	\$125	HAYDEN, Pie Writer (v 2.2)	\$150	\$89
KEY TRONIC, KB200 Keyboard	\$298	\$188	MAXELL, 3 1/2" Diskettes, 10 pak	\$145	\$85	HOWARD SOFT, Tax Preparer for 84 taxes	\$250	\$165
KOALA, Muppet Keys	\$80	\$49	MEGAHAUS, Megawriter	\$150	\$95	HUMAN EDGE, Sales Edge	\$250	\$165
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KRAFT, Joystick (II/III+)	\$65	\$39	MICROSOFT, Word File or Multiplan, each	\$39	\$25	MECA, Managing Your Money	\$200	\$125
Game Paddles (II/III+)	\$50	\$29	MILES, Mac the Knife	\$39	\$25	MEGAHAUS, Megawriter	NEW	\$100
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Z80 Softcard Premium (e)	\$395	\$275	PENQUIN, Graphics Magician	\$50	\$32	WordStar Professional, 4 Pak	\$495	\$265
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16K Buffer Board for Grappler Plus	\$119	\$79	PROVUE, DverVue	\$295	\$195	WordStar Professional, 4 Pak	\$495	\$265
Buffered Grappler Plus, 16K	\$239	\$159	SCARBOROUGH, MasterType	\$35	\$19	WordStar Professional, 4 Pak	\$495	\$265
2 Chg. Set for Buffered Grappler	\$28	\$12	SIMON & SCHUSTER, Typing Tutor III	\$50	\$33	WordStar Professional, 4 Pak	\$495	\$265
PAYMAR, Lower Case Chg. Rev. 7 (+)	\$35	\$19	SOFTW. PUB., PFS File or PFS Report, ea	\$125	\$79	WordStar Professional, 4 Pak	\$495	\$265
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TITAN, Accelerator Ite	\$319	\$219	T/MAKER, Clickart	\$50	\$32	WordStar Professional, 4 Pak	\$495	\$265
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10 ea. DS/DD (IBM, H/P) 48 Trk comes w/flip pak	\$15	Smartmodem 1200 (AP)	\$329	\$239	JX100-144 cps, 120 cps, para	\$1995	\$1499
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100 ea. 48 Track (IBM, H/P)	\$95	ProModem 1200 (MAC)	\$549	\$429	93-136 col, 160 cps, para	\$799	\$649
1000 ea. 48 Track (IBM, H/P)	\$229	QUADRAM, Quadmodem, Internal (IBM)	\$595	\$425	2410P-Facemark, 350cps para	\$2995	\$1995
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HARD DISK DRIVES FOR THE MASSES

Offering more storage and better throughput than floppies, hard disks have become surprisingly affordable

BY TOM BADGETT

ONE computer industry trend is clear. Whether you own a computer or you'd like to own one, you're already thinking about fast, large-capacity, external storage. Today that means a fixed, hard disk drive.

The so-called Winchester technology has been around since the 1960s on large, expensive computer systems, but in the past few years the devices have gotten smaller and cheaper, until now everybody wants one.

It's easy enough to see why. A 5 $\frac{1}{4}$ " floppy disk device commonly stores 300-400K bytes of data and transfers information to and from the disk at 300,000 to 500,000 bits/sec. (bps). A hard disk drive can put 10M, 20M, or more bytes in the same physical space, uses the same power, and can transfer data at 5 million

bits/sec. or faster. Five or six years ago such a device cost \$4000, but today the average price of a no-frills unit with 10M bytes of storage is under \$1000.

Convenience is another reason that hard disks are so desirable. Even if you regularly use only four or five separate software packages, it is a real joy to be able to call up any of them without changing disks or worrying about your data disk filling up.

If you use your computer for a business that requires large data files for customer accounts, inventory, or accounting, then you have to have a hard disk. While some business software will keep track of how much room you have left on a data disk and tell you when to insert another, changing disks often isn't very handy.

Hard Disks and Floppies

In storage and retrieval there isn't too much difference between hard disks and the more familiar floppies. Both devices store data on sectors of concentric circular tracks on magnetic media.

A floppy drive may have from 40 to 80 tracks per surface. Some floppies have one read/write head and use only one side of the disk. Others, with two heads, can store information on both sides.

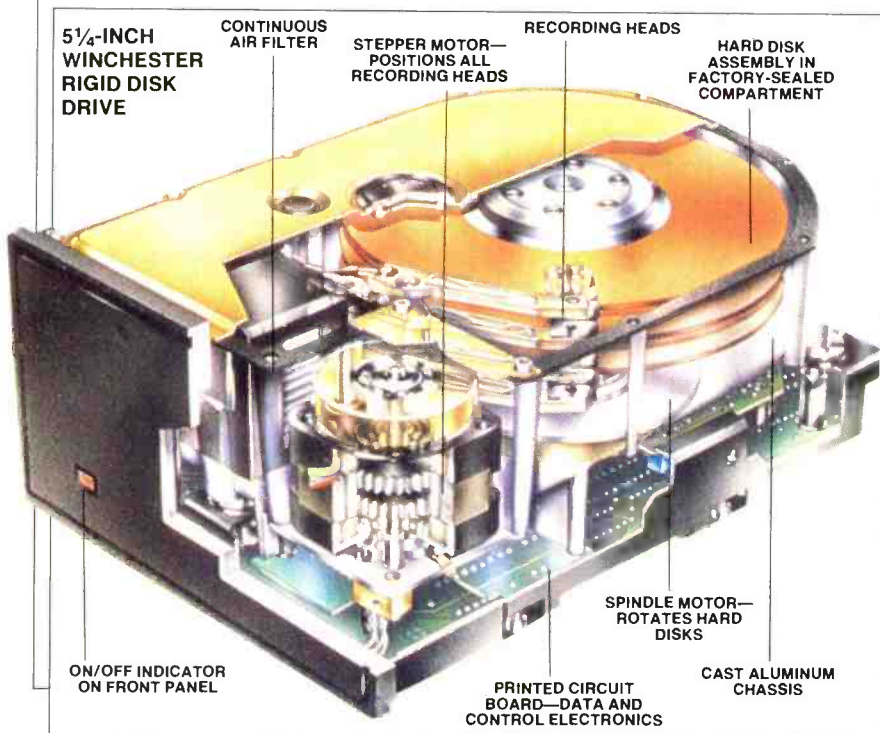
Each track is logically divided into sectors of, typically, 256 or 512 bytes each. On a floppy, there are from 8 to 15 sectors per track. A hard disk will put 17 or more sectors per track.

The floppy disk rotates at about 360 rpm, while the fixed disk spins at 3600 rpm. The higher speed gives the hard disk its faster data transfer.

Both devices have some on-board intelligence to position read/write heads and transfer information between the media and the computer's memory. For hard disk drives, the present interface standard is the ST-506 (and its upgraded variations the ST-412 and ST-419), named after Seagate's ST-506 drive that sold in such large numbers the interface became a *de facto* standard. While the ST-506 interface was adequate for early devices, with today's faster and more powerful computers, disk designers are hampered by its low level of intelligence and slow data transfer rate. Computers are capable of transfer rates at last two or three times the 5 million bits/sec. specified by the ST-506, but we temporarily are stuck with the standard to maintain compatibility among drive and interface manufacturers.

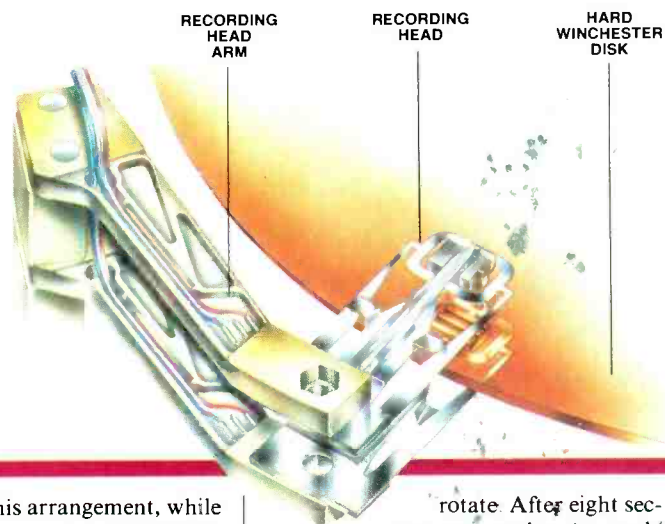
The Hardware

Today's common Winchester disk for microcomputers is a 5 $\frac{1}{4}$ " device in a package the same size as either a full- or



Courtesy Tandon Corp.

MULTIPLE RECORDING HEAD ASSEMBLY WINCHESTER DISK DRIVE



Courtesy Tandon Corp.

half-height floppy drive. Inside is one or more aluminum platters coated with magnetic material similar to that on a floppy disk or cartridge tape. The platter is held by a rigid, central spindle, driven by a small precision motor. Information is accessed via tiny read/write heads mounted at the ends of metal arms that traverse the disk surface radially, track-by-track at the command of a high-speed stepper motor that can change tracks in 2–20 ms (milliseconds). Typically, data anywhere on the disk can be accessed randomly in about 85 ms by sending the on-board electronics the track and sector number to fetch.

To reduce the number of head movements required to read all the data on a disk, information usually is organized into logical cylinders. If there is only one platter, as is usually the case in a 10M-byte drive, a cylinder consists of two tracks of information, one on top of the disk and one on the bottom. The first cylinder is formed by track 1 on the top of the disk and track 1 on the bottom. The second cylinder is track 2 up and down, etc. When there are multiple platters, which are positioned on top of each other, the size of each cylinder grows correspondingly.

Information usually is read or written to a small RAM buffer inside the computer to which the drive is attached; the disk operating system or application software accesses data from this buffer. At 3600 rpm it takes a 5¼" disk about 16 ms to make a full rotation. Information is read from the disk one sector at a time, but it usually takes several sectors to get all the data requested by the computer. Because some time is required to process the information in each sector, the sectors usually are placed on the track out of order; that is, logically sequential sectors are interrupted by a fixed number of oth-

er sectors. With this arrangement, while the computer is processing information in one sector, the disk will have rotated enough to place the next logical sector under the head. The number of sectors interleaved in this way is a function of the computer's controller and associated software. An interleave factor of six or eight—meaning six or eight sectors separate logically contiguous sectors—seems common with today's 10M-byte hard disks. With 17 sectors per track, which is the number IBM uses, an interleave factor of eight produces a track loop with this sequence:

1:16:14:12:10:8:6:4:2:17:15:13:11:9:7:5:3

Sector 1 is read into the computer for processing while the disk continues to

Cobalt and nickel on Tandon disks give six times the storage of conventional oxide-coated media.

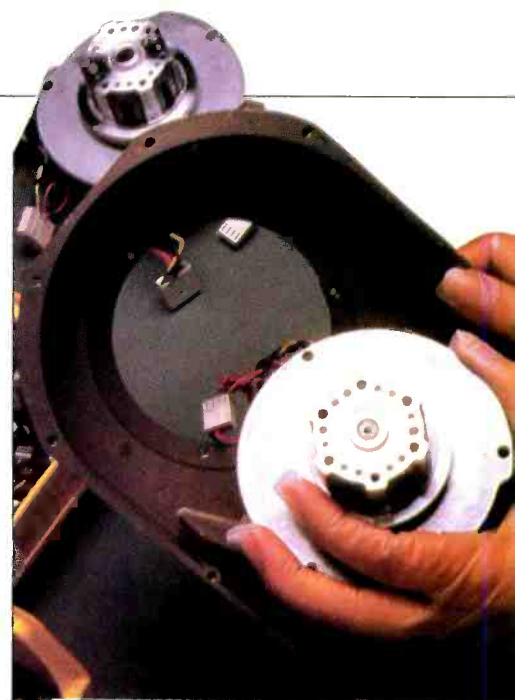


rotate. After eight sectors pass under the read/write head, sector 2 is ready for access. Eight sectors after that, sector 3 is under the head for processing, etc. While this illustration is linear, in reality the track is an endless loop that stays under the head until the positioning mechanism moves the head to another track. It takes one-half revolution for eight sectors to pass under the head, which puts about 8 ms between sector accesses. This waiting time for the correct data to appear under the stationary head is called latency, and is fairly constant for 10M-byte drives that use the ST-506 interface standard.

The ST-506 interface standard requires that the media be formatted by the end user. That means that the computer and controller write information on the disk to define the tracks and sectors. That's why the manufacturer's drive specifications may say the disk holds 12.6M bytes *unformatted* and 10M bytes *formatted*. Some of the disk space is used to tell the controller what the tracks look like and where they are on the disk.

Most of the low-priced, 10M-byte disks use what might be considered a "brute force" head positioning scheme. The controller instructs the drive to get information from a specific track and sector. The stepper motor is pulsed the correct number of times to step the head to the track requested, and a read or write is conducted. While the hardware associated with head positioning is fairly precise, factors such as temperature variations and bearing wear can cause track positioning to slip. Since single-density tracks are only about 1100 mi-

Tom Badgett is a Technical Editor of Computers & Electronics.



Tandon's aluminum disks are "bathed" in solution to form thin-film cobalt and nickel coatings, smoother and more rugged than oxide-coated media.

Spindle motor that rotates disks is mounted into the base casting.

cro-inches (millionths of an inch) wide (double-density drives use tracks only about 700 micro-inches wide), there is little room for error. With the ST-506 interface there isn't much that can be done about this problem, except careful engineering design with components tolerant of temperature variations.

To reduce the chance of losing data because of bearing wear and other mechanical factors, many hard disk users periodically reformat the disk and re-write all the data from backup media. Doing this ensures that all information is laid down within present hardware tolerances and takes into account any mispositioning that may have occurred with hardware age.

A more precise method of positioning is a "closed loop" servo, which uses information either between track sectors or on a separate surface dedicated to servo information to tell the positioning mechanism how far from an exact posi-

tion it is. Then small incremental adjustments can be made to position the read/write head exactly on the desired track, even if mispositioning has occurred. This scheme is more costly than the "dumb" interfaces more common in today's 10M-byte drives, and it is potentially slower because of the extra processing time required for repositioning, which also makes it incompatible with the ST-506 standard.

Picking a Drive Subsystem

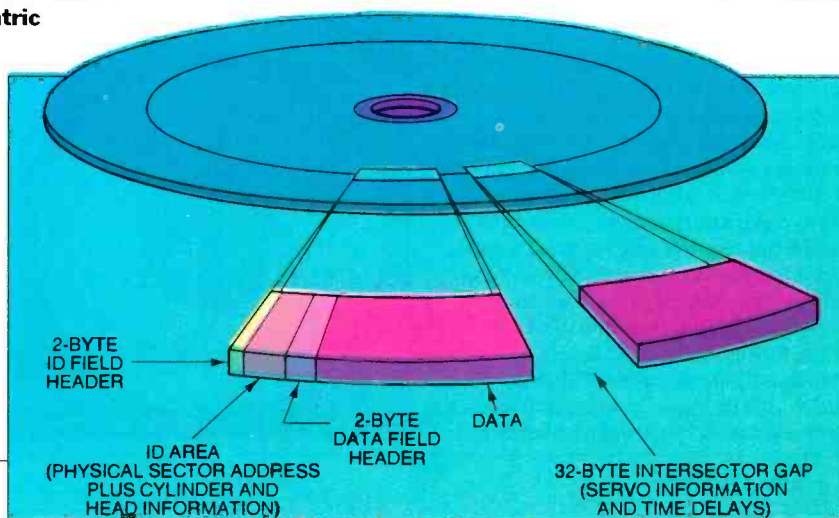
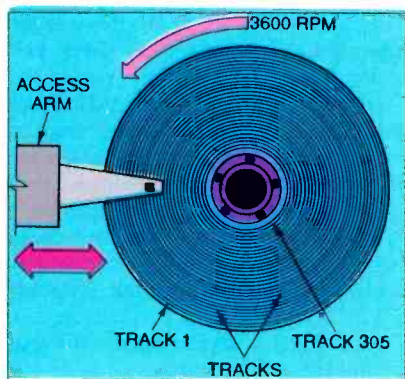
The more you learn about hard drive construction, the harder it is to choose a drive. "When you add up all the factors, you can prove pretty conclusively that the darn things simply won't work," quips Herb Ragle, vice president for engineering at Lapine Technologies, a California drive manufacturer. "But a bumblebee flies, and the disk drives do work. Some just work better than others."

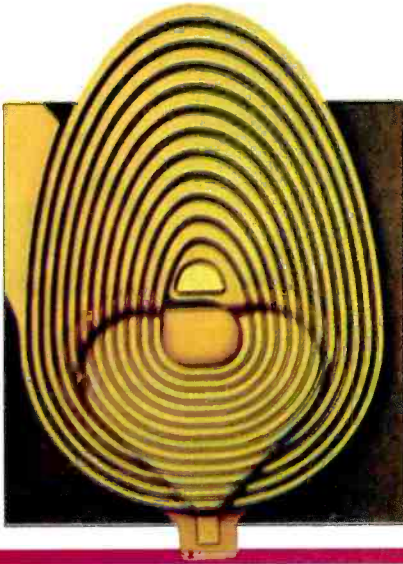
The place to start, however, is decid-

ing how large a drive to buy. For a rough estimate of the proper disk size, add up the storage requirements of all the software you want to keep on the drive, and try to make a sensible estimate of the amount of space you'll need for the data files associated with them. Add the amount you calculate for future expansion, then double the total. Experience has shown that such a figure should give you just about enough space for a reasonable time if you're willing to take off unnecessary programs and data periodically. Your storage needs will expand to fill the available space.

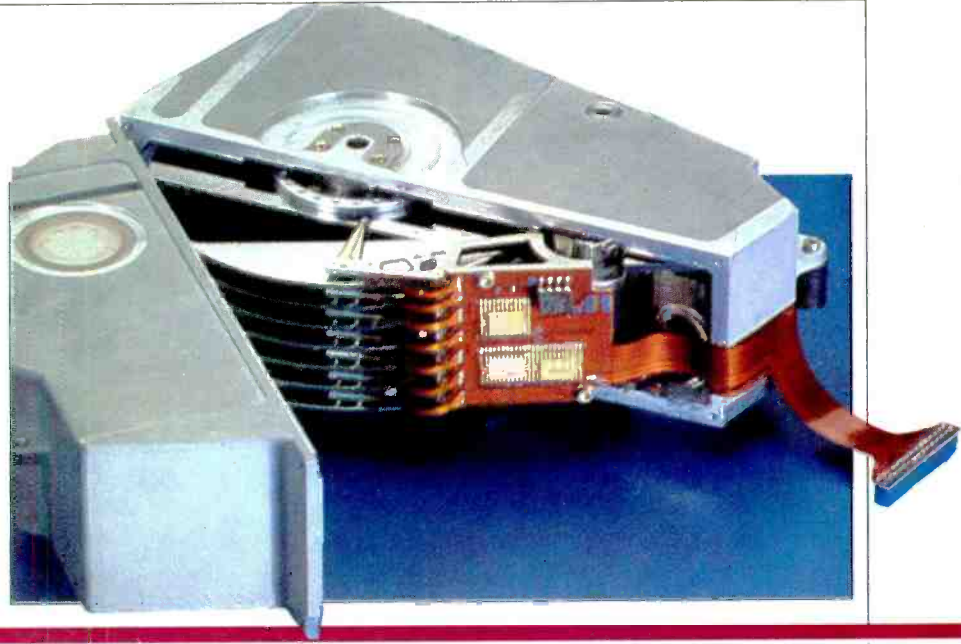
Another important consideration for selecting a hard disk system is tolerance to temperature variation. There may be six to ten different materials in the head position linkage, for example, each with a different temperature coefficient. During product design, engineers must take into account the different rates of expansion and contraction that occur with

Read/write heads move across concentric tracks of recording surface.





Photomicrograph of thin-film read/write head.



This seven-platter Siemens unit stores 300M bytes in the space of a standard 5 1/4" drive.

temperature variations. That's why Ragle advises purchasers to study the specifications from different manufacturers, especially operating and non-operating temperature limits. Approximately 5 to 50 degrees C (40-122 F) seems to be the common operating limit in the industry, a wide range when you consider the complex design of temperature-sensitive components. Unfortunately, some industry experts claim many manufacturers don't meet their published specifications. All you can do is study the published information and check with other users about how well the brands you're considering do what the manufacturers say they will.

Also check power consumption, especially for internally mounted drives. An IBM PC, for example, with 512K of RAM, an internal modem, serial port, and color graphics card, may be pushing the limits of its internal power supply when you install a hard disk and its con-

troller. Power consumption will be especially high if you use a pair of floppies with your hard disk, a common configuration with half-height floppies. Now you're running three drives instead of two, and with the power drain of the other add-ons, you may experience problems simply because the power supply is being asked to provide more than it was designed to. Quadram and others get around this problem by including an external power supply with internally mounted disks.

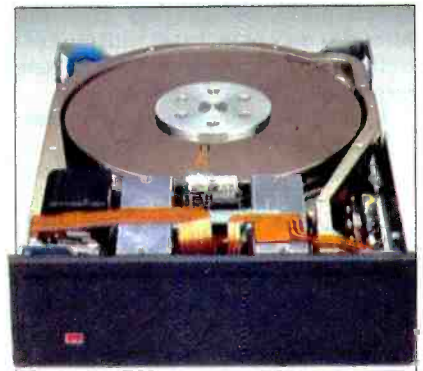
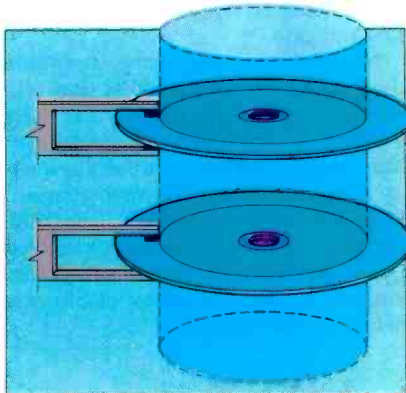
You also should consider stress tolerance. The hard drives of a few years ago were intolerant of physical abuse. Before moving the computer you had to remove the hard drive and lock the spindle and heads with a metal bracket. Designs are better now, with manufacturers quoting stress tolerance from 10 to 40 g. In other words, the drive is supposed to function even after it is hit hard enough to subject it to the gravitational force it

would have at up to 40 times its weight. (g stands for gravities, a single g is the downward force an object has at the Earth's surface.)

These figures can mislead. While a Winchester disk is operating, the heads ride on a rigid air bearing formed by the high-speed disk rotation. The possibility of external forces causing head or media damage is fairly remote in this configuration. While the disk is slowing down or coming up to speed, however, the air bearing may not be fully formed, and the chance of causing the head to slap down against the disk is greater. When the platters stop turning, most drives rest the read/write heads on the disk surface. In this state there is nothing but the mechanical design of the head mounting mechanism to keep the heads from bouncing off the platter and crashing back down hard enough to damage the media or the heads.

It is this "at rest" stress tolerance you

Tandon's logical cylinders, at left, contain all the data on parallel tracks on all recording surfaces. A 10M-byte drive, with 305 tracks, would have 305 cylinders.





Hard disk drives from left to right. Top row NEC, Tallgrass, Tecmar; middle: Legacy, Davong; bottom: TeamMate, Iomega, IBM.

need to question when evaluating mechanical reliability of drives. Lapine Technologies, which specializes in 3 $\frac{1}{4}$ " drives for portable computers, claims its patented head mechanism that lifts the head off of the disk when rotation stops enables its drives to absorb up to 100 g of force in the non-operating mode. Other manufacturers claim 40 g, but 10-20 seems to be the norm. Virtually anybody's drive will operate with good mechanical integrity on a desktop. But if you're planning an installation in a portable machine, stress tolerances become very important.

Another problem to keep in mind is that most systems are composed of disk drives from one manufacturer and controllers from another. Most subsystem packagers use more than one drive source to be sure of a good supply. They may manufacture their own controller, or they may buy it. Some companies, such as Tallgrass Technologies, on the other hand, design and manufacturer the whole package. When comparing subsystem prices, consider any extra features that may be included with the controller, such as serial ports or system memory.

Also be aware of potential limitations built into the ST-506 interface and the way designers implement it. The ST-506 interface will support drives of 10M or 20M bytes or larger. Most controllers will handle two to four drives. But make sure the company you're buying from supports add-on drives in case your stor-

age needs change. And there's still the problem of backup. Even though you can store 10M bytes of information in one place, you still have to keep backup copies. With the right utility software you can do it fairly conveniently with floppies, but you'll still end up with 30 backup disks (60 disks if you follow recommended procedure and backup "two deep"). If handling that many floppies for backup proves inconvenient, you may have to consider tape or another backup subsystem. That can more than double the cost of your hard drive installation.

The current wholesale price on the average 10M-byte drive is \$300-\$400, and the computer controller should sell for another \$100-\$150 or so. Because of the ST-506 interface standard, and pressure within the industry to conform to informal standards of drive performance, drives from reputable companies may be fairly similar. Look especially carefully at any 10M-byte system that costs more than \$1000. With today's market, if the price goes much higher, you should be getting a number of extra features to justify it. An integral backup floppy or tape system, for example, could make a higher price worth the difference.

You also should consider the possibility that you don't need a hard disk right now. These fast storage systems are popular and convenient, and the prices are coming down. But if you carefully consider your computing needs, even \$1000 may not be cost effective.

"Once you have a hard disk you can do some spectacular things you couldn't do before: program chaining, complex batch files, sharing of data," consultant Larry Epstein notes. "But you have to weigh your needs. It may not be the thing for a lot of users."

Support

"Buy from a known, stable company," is the general advice most industry experts give, even though you may have to pay a little more. A number of drive manufacturers, including the well-known Shugart Associates, a Xerox company, have gone out of business lately. A broad-based dealer with ample drive sources and the willingness to support you with service and drive swaps, if necessary, is your best insurance.

"There have been too many drive suppliers for the market," observes Al Shugart, CEO of Seagate Technologies. "The survivors are going to be the ones that have the customer base, the off-shore manufacturing, vertical integration and cash."

Many retailers, even though they have the resources to service what they sell, won't help you with a drive/controller combination purchased elsewhere. Many mail-order houses are selling quality subsystems that you install yourself, but make sure the company will back the product. One company recently offered a two-year warranty on their subsystem, but the company went out of business before the two years were up.

PHOTO BY BOB LORENZ

Some companies say they will get you a replacement within 48 hours of a problem. Others promise to *ship* within 48 hours. Sometimes you have to return the defective drive before a replacement will be sent. Some companies make no warranty beyond the one offered by the manufacturer. If you're depending on your hard disk for important data, you can't afford to be without it while you wrangle for warranty replacement.

"More often than not when you try to save money, you lose," says R. W. Stallings, president of Industrial Technologies, a North Carolina consulting and design firm. "For a business user, actual equipment cost is trivial. You have to figure your time into the equation: the time it takes to enter the data in the first place and the time you may lose when your disk goes down."

The Future

Lower Prices. High-capacity fixed-

disk storage technology still is evolving. Prices have fallen dramatically in the past few years while performance and reliability have risen. The near future promises more of the same. Says Seagate's Al Shugart: "For the past 25 years the disk drive industry has given us continually more capacity and cheaper prices. The cost per bit continues to go down, and I don't see any end in sight."

Larger Capacity, Smaller Size. Indeed, the 10M-byte drive that everyone sought only a year ago is growing to 20M bytes. And the drives are getting smaller. Most industry experts we consulted think the 3 $\frac{1}{2}$ " drive is destined to become the new standard. Within two years, some observers believe, half-height, 20M-byte 3 $\frac{1}{2}$ " drives may be common.

Tony Lapine points out the advantages: "A 3 $\frac{1}{2}$ " drive takes half the space of a half-height 5 $\frac{1}{4}$ " unit. It uses less power, takes less metal to make it, and

has better access time."

Seagate's Al Shugart agrees, but believes that doesn't mean an end to the 5 $\frac{1}{4}$ " drive: "The 5 $\frac{1}{4}$ " and the 3 $\frac{1}{2}$ " drives will live together, but once there is a 20M-byte 3 $\frac{1}{2}$ ", the 5 $\frac{1}{4}$ " will have higher capacity."

Indeed, Siemens already is showing a 300M-byte 5 $\frac{1}{4}$ " drive, and is promising 500M bytes or more in a single package. Drives like this are designed for high-capacity, stand-alone workstations in engineering design and in networking.

Networking. "We're going to see more internal hard disks and with that move, the next trend is going to be the network," predicts Larry Epstein, whose consulting business has installed hundreds of micro network systems. The major deterrent to network expansion now, he believes, is software designed only for a single user. But "by the end of 1985 most software packages will come

(Continued on page 83)

OPTICAL STORAGE

COMPUTER technologists have been predicting the demise of magnetic storage for years. A more appealing alternative, they maintain, is optical memory: laser-read and written disks that don't suffer from magnetic errors and can store up to a gigabyte on a platter the size of an LP.

Optical storage, so far, has been seen only in audio (compact discs) and video (laser discs) consumer electronics. Although these products can be interfaced with micros, they suffer from an irrefutable drawback: They can only play back.

However, that limitation is about to be overcome. Optical storage devices will soon be available to consumers.

"You will find write-once optical disks on the market in the next year or two," predicts Edward S. Rothchild, publisher of the monthly newsletter *Optical Memory News*. "By 1990 erasable optical disks will impact the Winchester market, since they will be able to store up to 50 times more information than the standard Winchester drive."

As the name implies, write-once optical disks, unlike magnetic disks, can be used to record data—once. They cannot be erased and reused. Toshiba, Hitachi, Sanyo, and N. V. Philips are all known to be working on them. Meanwhile, erasable optical disks have been shown in prototype form in Japan by both Nikon and Canon, and Matsushita has introduced a 12" erasable optical disk for large office automation applications. Erasable optical technology, however, is still too expensive for general use.

Despite the scarcity of U.S. companies, laser record technology actually began in the U.S. about 20 years ago, and some of the companies leading the technology are still located stateside. Ironically, they were created by manufacturers of magnetic storage devices.

For example, Information Storage Inc. (ISI) of Colorado Springs, CO, is an offshoot of Tallgrass Technologies of Overland Park, KS, a leading supplier of fixed disk storage and cartridge-tape backup systems. In May 1984, ISI received a second capital infusion from CPT Corporation of Minneapolis, MN, a leader in word processor and office automation systems.

What attracted these two companies to invest in this small Rocky Mountain start-up is ISI's first optical disk drive. It offers high-capacity write-once/read-indefinitely storage in an optical disk the size of a 5 $\frac{1}{4}$ " floppy. Their first product was demonstrated to the press at last winter's Comdex show in Las Vegas. The 525 WC has a user capacity of 100M bytes, a data transfer rate of 2.5 million bits/sec, and an average access time of less than 200 msec. Otherwise, the 525 WC closely resembles a removable Winchester drive. Its size, mounting points and footprint are identical to full-height hard disk or floppy disk drives.

Unlike compact discs or laser discs, however, the ISI product isn't stamped out on a press like records or donuts. Rather, it is an encapsulated optical medium that offers a clean environment with air space in which a laser can burn

holes to record digital information.

According to Art Connor, marketing and sales director at ISI, the write-once limit permits numerous computer applications. Instead of threatening the predominance of the Winchester, write-once optical disk technology may fill a convenient and complementary niche:

"I don't think nonerasable media will replace the Winchester. But . . . since it is nonerasable, it could be used to create a master copy to distribute software throughout a company. It could work well for shared databases or for leaving audit trails, where erasable media can cause serious problems."

In fact, because it's nonerasable, it may even someday saddle up as the Winchester's partner. "One of the things I can see in the future is a computer user having both a Winchester drive and a write-once optical disk drive," explains Rothchild. "I can't think of a better way to back up a Winchester than with an optical drive of this type."

However, cost is still a major limitation. Higher prices for optical storage is why the Winchester might preside over pc mass storage for years.

ISI expects, however, to sell its 100M-byte, 5 $\frac{1}{4}$ " optical disk drives on an OEM basis for \$1000 by late 1985, about double the price of a 10M-byte magnetic disk. And Connor emphasizes that for "cost per megabyte," its optical disk is the lowest-priced storage available.

"Ten times the capacity at twice the price is quite a bargain, don't you think?"

BY MARTIN PORTER

GETTING THE MOST OUT OF YOUR HARD DISK DRIVES

Unless properly managed, a hard disk can leave you adrift in a sea of data

BY WINN L. ROSCH

A HARD disk boosts the speed and storage capacity of your personal computer, but it also can cause calamity and confusion. With a single error you can wipe out weeks of work. And without proper organization, you may find yourself drowning in a sea of unusable data.

To avoid hard disk hardships you need to have the proper software and to know how to use it. The right operating system will help you to organize your hard disk memory and to use it with more convenience and speed. Planning your backup needs before you commit irreplaceable data to a fragile technology will save you time and headaches.

Updating Your Operating System

Programs and data are stored on hard disks in files the same way that they are on floppy disks. A special program called a disk operating system (or DOS) helps manage either chore. Not all operating systems are equally adept at handling hard disks, however. Some of them—particularly those originally written for floppy disks (including CP/M 2.2, PC-DOS 1.1 and Apple DOS 3.3)—suffer major limitations in the amount of disk memory and number of files that they can handle. Often such systems severely limit your ability to organize your files and use the full capacity of a hard disk.

Most operating systems keep track of where information is stored by writing onto each disk a chart, called a *block or file allocation table* (BAT or FAT), that specifies where information is stored and that disk space (block, allocation unit, or

cluster) is available for new data. Because only a limited amount of disk space is reserved for the FATs and the size of each block is fixed, the maximum number of blocks that can be tracked and the amount of memory they can record is similarly limited. Hence, early operating systems may not be able to handle the huge number of hard disk blocks now possible without some modifications to either the block size or the size of the FAT itself.

Moreover, all popular personal computer operating systems match the file name that you put information into with the specific blocks in the FAT by using a *disk directory or catalog*, essentially a map that tells the operating system how to get to the data. Most early operating systems automatically assign a limited amount of disk space for a directory. As with the FAT, this limited directory space necessarily imposes a limit on the number of files that the operating system can find and use. Because early operating systems were designed before anybody thought hard disks would become popular for personal computers, their designed-in directory capacity was modest (64 files for IBM's original PC-DOS), indeed ludicrously small, when compared to a hard disk.

To get around the limitations of older operating systems, most suppliers of add-on hard disk systems include software to partition or divide up a single physical hard disk into a number of "vir-

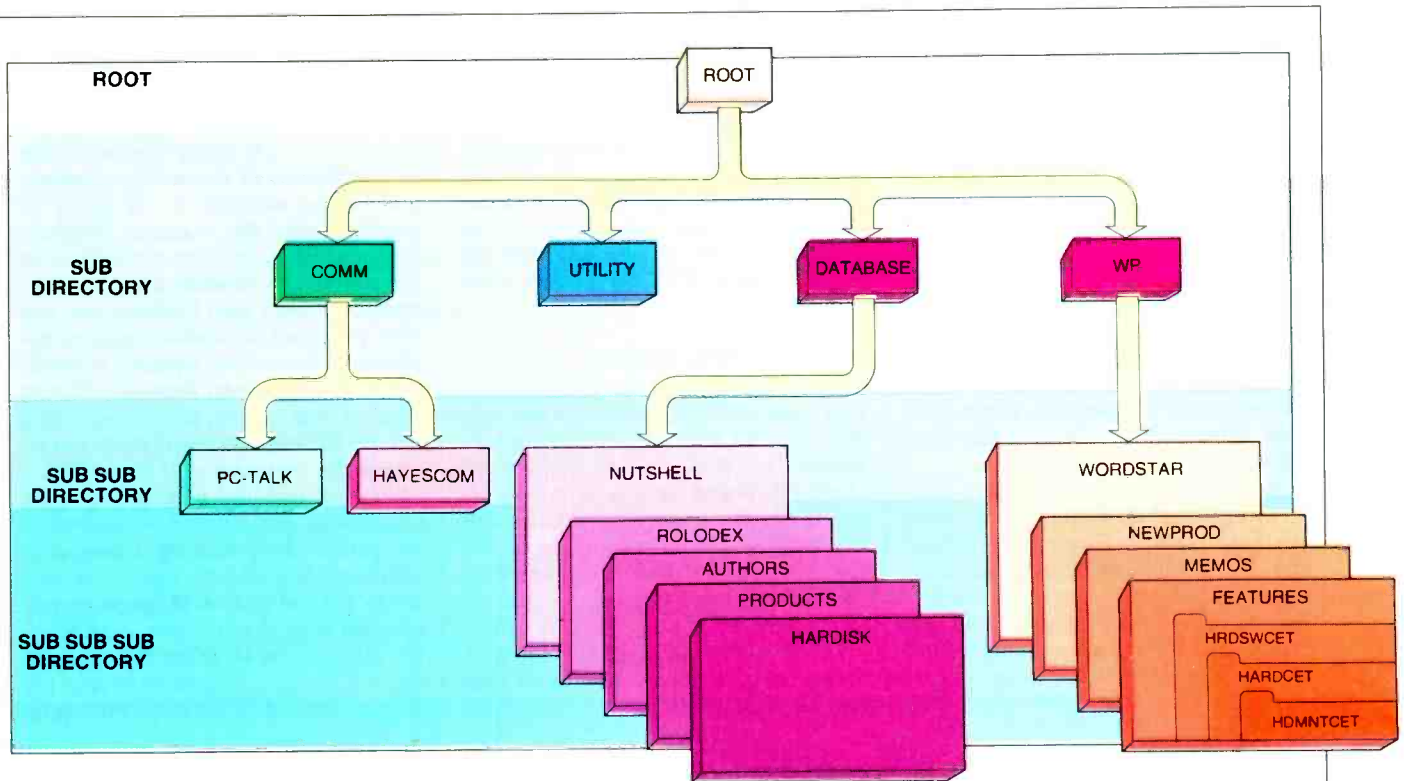
tual" volumes. The operating system is fooled into thinking each virtual volume is a different physical drive, and each volume gets its own FAT and its own directory. In such systems, organizing your disk files is simply a matter of continuing to distribute them as if they were on separate floppy disks. Often, such a management scheme is workable, but it leaves you without some of the organizational advantages of a hard disk.

Organizing Hard Disks with Trees

Advanced operating systems—like PC-DOS and MS-DOS versions 2.0 and higher or Apple's ProDOS—share a common influence, AT&T's well-publicized UNIX operating system. Although UNIX is so rich in features as to be confusing and more than most personal computer users want or need to tangle with, its hierarchical file organizational scheme has immense power. Based on "tree-structured" directories, UNIX is so powerful that it has been either copied or faked by most other pc disk operating systems.

Tree-structured directories allow you to divvy up a hard disk to avoid facing an arm's length of file names every time you read the directory. Rather than listing all files in one place, tree-structured operating systems use directories-within-directories called subdirectories, and even sub-subdirectories of subdirectories. (The "tree" in the name refers to a schematic representation of what grows from an acorn: the subdirectories and files are arranged like offspring on a family tree or the branches of an oak turned upside-down.)

Winn L. Rosch is a lawyer who now devotes his time to free-lance writing about computer hardware.



A sample hard disk directory with subdirectories. The directories subordinate to WordStar and Nutshell are shown differently because they contain only data files that are supported by application software in their parent directories. The Features directory is expanded to show some of its data files.

In true UNIX form (and as adapted to PC-DOS and MS-DOS), each subdirectory is essentially a data file that contains nothing but file information. The root directory—the only directory to have a fixed location on the disk, corresponding to the only directory in older operating systems—lists only its immediate subdirectories and the files that the root directory manages itself. The root directory does not list the files managed by its subdirectories, nor will a listing of files in a subdirectory show anything contained in its sub-subdirectories.

Each subdirectory functions independently but exactly like the root directory. You log onto one directory at a time, and the operating system works only with the files of the logged directory. You can duplicate file names in different directories. You can copy files from one directory to another as if they were separate disks. You also can use special commands to make the operating system search with an elaborate “path” through the tree-structure for commands and files in other directories. The path tells DOS what route to take through the hard disk directories to find the file you specify. It is necessary because most operating systems assume the file you want is located in the currently active directory. If that’s not the case, you precede the file name with the list of directories

through which DOS must move to get to the one with the file you’re seeking. Usually the path includes drive assignments so you can search more than one storage device as part of the path structure.

The tree-structured approach has two important advantages. It allows you to organize your disk into manageable arrangements of related files stacked, if you want, in order of importance, while it increases the number of files that the operating system can manage almost to infinity. The current PC-DOS, for example, will permit 512 separate files in the root directory of a hard disk, but any or all of these may be subdirectories, and there’s no limit to the number of files that may be contained in each subdirectory. Apple’s ProDOS uses a similar arrangement, except the root (volume) directory is limited to 51 entries, forcing the hard disk user to be somewhat more careful in directory management.

Sapling-Structured Directories

Sometimes a system that appears to have real directory trees, for instance, Apple’s Macintosh, lacks their underlying software structure. Although the Finder, what the user sees of the Mac operating system, gives you the organizational benefits of tree-structured directories by letting you put files in folders and folders within folders, the operating sys-

tem itself does not organize its memory with a tree-structure. Rather, it maintains a special file to tell the Finder what’s where.

Because the Finder maintains the names of all the files in the directory in one fixed place, the Macintosh presents the same limitation that earlier operating systems did on the possible number of files that can be stored, no matter how they are arranged in folders. Moreover, because the Mac reads all the directories of all disks available to it into its random access memory (RAM) to sort out the file and folder arrangements, the memory capacity of the original 128K (non-fat) Mac puts another limitation on the number of files you can manage. Without some means of “deassigning” virtual disks, the entire capacity of an add-on hard disk might not be available to you. If the software supplied with a Mac hard disk does not work around these inherent limitations, you may be surprised to find that you cannot use the entire capacity available on the hard disk! A little planning in setting up the file relationships in such systems, however, can make more efficient use of space and allow you to use more of the hard disk.

Moving Up

The add-on software “fixes” that might be supplied with hard disk sys-

Hard Disk Drives

tems to make them work with Apple DOS 3.3 or PC-DOS 1.1 do not add the full tree-structure to the systems that lack it. Rather, such programming patches merely allow you to break the hard disk up into a number of virtual disk drives or user areas, each of which functions entirely independently and has its own directory. These multiply the number of files you can have to a useful amount. Even with such patches, the tree-structure is incomplete, however, in that subdirectories and path-following commands are not allowed.

If you've never worked with a tree-structured system, you might not miss the absent features. However, in the long run, the advantages of such advanced designs might make your hard disk system so much more efficient that it's worth considering a newer operating system. All of IBM's operating systems

are upwardly compatible, so disks made by version 1.1 can still be used, unmodified, with versions 2.1 and 3.0, though you may have to copy over old files under the new operating system. Apple supplies a utility to convert DOS 3.3 applications to ProDOS to ease your transition.

Why Trees?

The intricacies of the tree-structure may seem hard to fathom when you first start out, but after you've had some experience you'll be glad you chose to use them. File access speed is improved, for one thing. Without tree directories, the operating system must search up to 512 file names on an IBM hard disk to locate the one you want. By using subdirectories you can reduce the number of files handled for any one application to a necessary handful. Subdirectory trees help

keep programs and data separate, and they allow you to group files according to application: all the word processing files in one subdirectory or group of subdirectories, for example, database files in another, and communications in still another. By carefully using your operating system's path facilities, you can store programs in subdirectories by application, then create separate, subordinate directories under them for different types of data. Again, such categorizing reduces file access time and helps you visualize the organization of stored files.

As hard disk use is becoming more economical and popular, a number of companies are producing utility software to make it easier to use the expanded storage and associated operating system features. It sometimes is difficult, for example, to visualize the relation-

(Continued on page 56)

TAKING CARE OF YOUR HARD DISK

TODAY'S hard disk drives are a lot tougher than they used to be. Most 5¼" Winchesters don't need any maintenance or oiling, but they do need to be kept off some bumpy roads. Here are some tips for proper preventive maintenance and service that will save you time and money.

Preventive Maintenance

1. *Don't move the drive while the platters are rotating.*

The most common mistake is moving the drive during start-up or shut-down, while the heads are starting to fly freely over the disk surface or while they're landing. Even a minor bump at this time can cause the heads to touch the disk surface, and gouge the medium permanently. You'll lose any data residing on the disk at the point of contact, and you won't be able to use that portion of the disk for storage again. A good rule is to wait at least 1 minute after shutting off the drive before trying to move it.

2. *Avoid forces in excess of 20 g.*

After rotation stops, head crashes (sometimes termed "head slaps") can be caused by forces over 20 g. A jolt equivalent to dropping the drive 1" onto a hard surface probably will exceed the 20-g limit and cause the heads to lift off the stationary medium surface and slap down with enough energy to damage the medium.

While some manufacturers advertise limits up to 40 g, others stress in their equipment specifications that forces above 10 g should be avoided. Rough

handling accounts for more Winchester drive damage than all other factors combined.

3. *Don't position any of the drive's movable components by hand.*

Rotating the spindle (the weighted metal shaft attached to the platters) or the track zero interrupter (the mechanical device that senses the head return to track zero) by hand subjects the head/medium interface to forces outside their design limits. A Winchester head is designed only for forward motion. The front edge of the head is chamfered to provide the proper aerodynamics for flying, take-off and landing stability. The sides and back edges aren't chamfered, so lateral or reverse motion can cause head or media damage.

4. *Maintain current backups.*

Software backup doesn't have anything to do with keeping your hardware in shape, but it can help you recover quickly from a hardware problem. Most users simply won't take the time to do a complete backup regularly until they have a hardware failure and lose important data. By keeping data backup current you can minimize the effects of hardware malfunctions.

5. *Pack properly any drive to be shipped.*

If you have to ship your drive for maintenance, make sure it is packed properly. Even computer dealers don't always follow the correct packing procedure for hard drives, so if your dealer is handling shipping details for you, make sure they are done correctly. The worst

thing you can do is to ship your drive in a wooden box and bolt it down. This type of packing transfers all dropping forces directly to the drive, causing head slap and surface damage. Correct packing should consist of a large box (at least 16" on a side for 5¼" drives) with soft foam to protect the drive. Factory packing frequently consists of a box within a box, the inner box suspended on soft foam legs or frames. Some operating systems offer utility software to park the heads before shipping. If you have access to such software, use it, but remember this procedure doesn't take the place of proper packaging.

Service

Most dealers provide some degree of service. They can, for example, replace circuit boards, cables and plugs and repair power supplies. If the drive malfunctions, the controller board, power supply, cables and other external components should always be checked first, and your local dealer probably can test these for you. When it comes to repairing the hard disk itself, most retailers prefer to use factory service or a professional drive repair facility. There probably are a few exceptions, but generally you should insist that your dealer use outside service. Here's why.

Information is recorded on a Winchester disk at relatively high density. That is, bytes are a lot closer together than they are on floppy disks. The read/write heads that transfer informa-

(Continued on page 77)

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Getting the Most

(Continued from page 54)

ships among various files and directories. Products such as IBM's DOS Tree Display utility and Direct Tree from Micro-Z are examples of software that graphically display the hard disk's directory tree and allow you to select programs to run and conduct some file maintenance without having to interface directly with DOS. While IBM's DOS includes a Tree command to list directories and subdirectories, its scrolling display is virtually useless with a complicated hierarchical directory. Some hard disk suppliers also offer DOS enhancements to make the using of their products easier.

Sometimes you may need even more help. As the directory structure becomes more complicated and the amount of available storage gets larger, it is easy to lose files or to waste disk space by storing the same file in several directories. Programs such as Locate and File Facility from IBM enhance DOS's file-searching abilities. Locate will search all devices and directories for specific files or groups of files specified with wild card characters and show you the correct path to each file. File Facility enhances the PC-DOS Path command so that the operating system will look for any file in the specified path, making it easier to store application programs separately from data files that you may want to group by category.

DOS front-end software is available at varying levels of sophistication. Some products simply provide a menu of DOS commands so you can use DOS without learning all about it. Others provide a plethora of utilities for hard disk file maintenance, including a graphic tree-directory utility.

Experienced users probably won't find the menu variety packages particularly helpful because even if you've never used a hard disk before, all you need is a little practice to make it work efficiently. Programs that draw hierarchical directories on the screen or printer are helpful for anyone, however, because they give an instant picture of what's on the disk and how to get to it. Jim Harlan, Cogitate president, believes directory management is the hardest part of learning to use a hard disk. "As the directories grow, performance is degraded, and you don't realize it," he says. "The hierarchical directories are the key to efficient hard disk use, but you can't visualize them, so it is important to have something that will let you see them and move around them quickly."

Backing Up

Although mechanical repairs to a

Winchester may be costly, that expense is dwarfed by the cost in time and effort required to rebuild your records. A regular hard disk backup regimen will help you get back to business as soon as the repairer gives your hardware a clean bill of health. Backing up is simply keeping a spare copy of your important data just in case the worst happens to your original.

Most software packages advise you to make a backup copy and use it rather than the original for safety's sake, a process that takes a simple command and no more than a few minutes. Moreover, a single floppy disk is just the right size for holding all the information from another floppy disk.

But backing up a hard disk to floppies is an entirely different proposition. If it takes 60 seconds to fill up a floppy, the typical Winchester, which holds roughly 30 times as much information, will take

Proper management of hierarchical directories is the key to efficient hard disk use

half an hour—at best—to pour out to disk. The actual time required will usually be substantially longer because of system overhead and the time required to shuffle floppies in and out. Moreover, you're then stuck with 30 floppies to store somewhere safe. And of course, bigger Winchesters take correspondingly longer to back up—and give you even more floppies to worry about.

To make backing up more convenient, many hard disk manufacturers include backup systems that use a medium other than floppy disks. Among the various alternatives today, streaming tape systems are preferred because they use a technology proved reliable. Anyone who has ever faced an audio or video cassette probably feels on familiar turf when confronted with a data tape. Alas, few popular computer systems—with the exception of the Compaq Deskpro—have built-in facilities for tape handling, so day-to-day backup must be suited to each supplier's system. (See COMPUTERS & ELECTRONICS, September 1984, for a discussion of tape backup.)

IBM's Cost-Effective Backup System

The right software can make hard disk backup with floppies manageable.

Rarely will you change the entire hard disk. Likely, only a few files will be modified during any one day. Therefore, it can be fairly easy to keep backups current, even on floppies, without sacrificing data integrity.

Modern disk operating systems, like the latest versions of MS-DOS, make the task easier with selective backups. A special bit in the directory, called an "archive" bit, is set whenever a file is modified. When that file is backed up—using the standard DOS floppy backup system—the archive bit is reset. By giving DOS the proper backup command, only those files that have changed since the last backup will be sent to floppy.

The selective backup should take only a few minutes, which isn't such a big penalty for peace of mind. Large-capacity floppy systems, like IBM's 1.2M-byte and Kodak/Data Technology's 3.3M-byte make this process even more convenient.

If the worst does happen, just restore all the floppy backup disks to the repaired hard disk in the same order you made the backups—the overall set first, then the selective periodic updates in the order you made them.

Other Considerations

Notice that different approaches to hard disk backup serve different needs. One obvious method to keep copies of files current as they are changed is simply to use the standard copy features of your DOS to transfer the files you just changed to a floppy. For people working with a relatively small number of files and on a limited range of jobs in any given day, this method has some advantages over standard hard disk backup routines. It stores the backup file in a standard, named, directory format so that you can load the file on other machines or access it directly from the floppy. Most backup routines lay down information in a special packed format that can only be accessed with separate restore software as it is put back on a hard disk. That means hard disk mechanical problems that take a while to repair leave your backup files inaccessible until you get a hard disk functioning again.

Manual DOS commands or utility software that backs up to named files eases this problem, but this method only works on files small enough to fit on a single floppy. Businesses working with large data files have to use a backup routines that can store one file on multiple floppies.

Hard disk manufacturers and other

(Continued on page 82)

BUYER'S GUIDE TO HARD DISKS

COMPARING hard disk subsystems isn't easy. You'll need more information than we can give you in one buyer's guide to make a purchase decision, but capacity, price, and access times can help you narrow down your choice.

We've grouped devices according to the computers they support and also noted whether drives are internal or ex-

ternal, whether the internal ones are full or half height, and what are the dimensions of the external ones.

While we were primarily interested in 10-20M-byte fixed disks, we included some removable cartridges and tape backup equipment. One column shows whether a unit is a (F)ixed Winchester, (T)ape backup, (R)emovable cartridge or a combination of those.

With few exceptions, the companies listed here offer more than one hard disk system. They usually purchase their hard disk drives from other manufacturers. Especially in the 10M-byte arena, the hardware is very similar. Subsystem differences come in controller design and software. The special features column lists significant options or operational features for each subsystem. ◊

Alloy Computer Products, Inc.

100 Pennsylvania Ave.
Framingham, MA 01701
617-875-6100

Alpha Omega Computer Products

18612 Ventura Blvd.
Tarzana, CA 91356
818-345-4422

Ampex Computer Products Division

200 N. Nash St.
El Segundo, CA 90215
800-421-6863
213-640-0150

Apparat, Inc.

4401 S. Tamarac Pky.
Denver, CO 80237
303-741-1778

AST Research, Inc.

2121 Alton Ave.
Irvine, CA 92714
714-863-1333

BC Systems, Inc.

1016 E. 31st St.
LaGrange Park, IL 60525
312-579-0672

Chrislin Industries, Inc.

31352 Via Colinas # 101
W. Lake Village, CA 91362
818-991-2254

CMC International

1720 130th Ave. N.E.
Bellevue, WA 98005
800-262-4685
206-885-1600

Corvus Systems, Inc.

2029 O'Toole Ave.
San Jose, CA 95131
408-559-7000

Data Technology

2525 Walsh Ave.
Santa Clara, CA 95051
408-986-9545

Davong Systems, Inc.

217 Humboldt Ct.
Sunnyvale, CA 94089
408-734-4900

Disc Tech One, Inc.

849 Ward Dr.
Santa Barbara, CA 93111
805-964-3535

Falcon Technology, Inc.

6644 S. 196 St. # T-101
Kent, WA 98032
206-251-8282
800-722-2510

First Class Peripherals

PO Box 6187
Lehigh Valley, PA 18001
800-538-1307

Genie Computer Corp.

31117 Via Colinas # 402
W. Lake Village, CA 91362
818-991-6210

Genoa Systems Corp.

73 E. Trimble Rd.
San Jose, CA 95131
408-945-9720

Great Lakes Computer Peripherals, Inc.

220 W. Higgins Rd. # 245
Hoffman Estates, IL 60195
800-323-6836
312-884-7272

I² Interface, Inc.

21101 Osborne St.
Canoga Pk., CA 91304
818-341-7914

Interphase Corp.

2925 Merrell Rd.
Dallas, TX 75229
214-350-9000

Iomega Corp.

1821 W. 4000 S.
Roy, UT 84067
800-556-1234
801-773-9452

Kammerman Labs

8054 S.W. Nimbus—Bldg. 6
Beaverton, OR 97005
503-626-6877
800-522-2237

Legacy Technologies, Ltd.

4817 N. 56th St.
Lincoln, NE 68504

800-228-7257

402-466-8108

Maynard Electronics

400 Semoran Blvd.
Casselberry, FL 32707
305-331-6402

Mercury Megabank Corp.

311 W. Superior St.
Chicago, IL 60610
800-551-7666
312-951-0616

Micro Design International

6586 University Blvd.
Winter Park, IL 32792
305-677-8333

Microcode Corp.

45277 Fremont Blvd. # 4
Fremont, CA 94538
415-657-4411

MNC International

2817 Anthony Lane S.
Minneapolis, MN 55418
612-788-1099

Mountain Computer

300 El Pueblo
Scotts Valley, CA 95066
408-438-6650
408-438-4933

North Atlantic Quantex

60 Plant Ave.
Hauppauge, NY 11788
800-645-5292
516-582-6060

Pacific Datanet Ltd.

4801 Patrick Henry Dr.
Santa Clara, CA 95054
408-980-0693

Peachtree Peripherals

3020 Business Pk. Dr.
Norcross, GA 30071
404-662-5158

Percom Data

11220 Pagemill Rd.
Dallas, TX 75243
800-527-1222
214-340-5800

Quadram

4355 International Blvd.

Norcross, GA 30093

404-923-6666

Quark Peripherals

2525 W. Evans
Denver, CO 80219-5554
800-543-7711
303-934-2211

Qubié

4809 Calle Alto
Camarillo, CA 93010
800-821-4479

Santa Clara Systems, Inc.

560 Division St.
Campbell, CA 95008
408-729-6700

Standard Data Corp.

3040 S.W. 10th St.
Pompano Beach, FL 33069
305-971-2800

Sysgen, Inc.

47853 Warm Springs Blvd.
Fremont, CA 94539
415-490-6770

Systems Peripherals Consultants

9747 Business Park Ave.
San Diego, CA 92131
619-693-8611

Tallgrass Technologies

11100 W. 82nd St.
Lenexa, KS 66214
913-492-6002

Tecmar, Inc.

6225 Cochran Rd.
Cleveland, OH 44139-3377
216-349-0600

Thoughtworks, Inc.

21636 N. 14th Ave.
Phoenix, AZ 85027
602-581-0669

Vufax, Inc.

5301 Covington Hwy.
Decatur, GA 30035
404-981-6778

Xcomp

4223 Ponderosa Ave.
San Diego, CA 92123
619-573-0077

BUYER'S GUIDE TO HARD DISKS

Product	Manufacturer	Capacity (M bytes)	Computers (A, Apple; PC, IBM PC; RS, Radio Shack; TI, Texas Inst.; etc., compatibles)	Price (\$)
Mac Disk	Davong	10	A Mac	1950
MacDrive	Tecmar	10	A Mac	1995
QC10	Quark	10	A IIe,IIc,III,Mac	1999
Megabank 10	Mercury Megabank	10	A II,II+,IIe	995
Plato	Disc Tech One	20	A II,II+,IIe	1500
The Sider	First Class	10	A II+,IIe	695
INFAX	Vufax	10	A II,IIe,II+,III/PC etc.	2595
Bernoulli Box	Iomega	5	A II+,Mac/PC etc.	1895
Mini-Mega 12/6	Santa Clara	12/6	A IIe,III/PC etc.	3044
Superior Ex	Great Lakes	10	A IIe/PC	1350
Omni Drive	Corvus	11.1	A IIe/PC etc.	1995
BC-10	BC	10	A II/PC etc./S-100/Victor 9000	2995
Hard Disk Syst.	Mountain	10	A II,IIe,III/PC,XT/Franklin	1995
PHD-10	Percom Data	10	A II,II+/PC/RS III,4	1270
PC Megastore	Ampex	20/25	A II,Mac/PC etc./S-100/TI/RS	4295
11 + 11	Genie	11/11	A IIe,Lisa,Mac/PC/TI Pro/S-100	3995
Targa2+ Tape	CMC	10/55	PC etc./Kaypro/Intertec/Televideo	3135
Diskit	Systems Periphs.	10/10	PC etc./PCjr/all Z-80s	2990
Hard Disk Sys.	Apparat	10	PC etc./RS I,III	1495
Datafile	Thoughtworks	10	PC etc./Sanyo/Zenith	1295
TG-5025	Tallgrass	25/60	PC TI Pro/Columbia	3495
MNC 10	MNC	10	XT etc.	2195
AT Disksystem	I ² Interface	20	AT	1495
Masterflight	Kammerman	10	PC	3095
TeamMate 1213-1	Data Technology	10/3	PC	2595
Colossus	AST Research	67/60	PC, AT	7499
First Mate	Standard Data	10	PC, AT, XT	2795
PC-Disk-20	Alloy	20	PC etc.	2295
Disc-File	Sysgen	10	PC etc.	2795
IS00	Micro Design	10	PC etc.	715
PC Mate 40200	Tecmar	10	PC etc.	2795
Gemini W/Floppy	Maynard	10/.3	PC etc.	1595
PC eXTender	Falcon	10	PC etc.	2295
CI-PCHD	Chrislin	10	PC etc.	1295
5212IM	Microcode	10	PC etc.	795
PC10	Qubie	10	PC etc.	794
QuadDisk	Quadram	10	PC etc.	1695
Turbo 10	Alpha Omega	10	PC etc.	949
Genoa 10 (2110)	Genoa	10	PC etc.	825
Vision 20	Pacific Datamet	20	PC etc.	2095
RDS 350	Interphase	20/20	PC etc.	7995
10-n-10	Xcomp	10/10	PC etc.	3495
RamTape-PC	N. Atl. Quantex	18	PC etc.	1995
Fixed Disk	Davong	10	PC etc.	1950
P10-XT	Peachtree	10	PC XT	995
Legacy III	Legacy	10	PCjr	1895

(1) Under 1 minute for any file, then access at RAM speed.

Fixed or Remov. or Tape	Internal or External	Access Time (msec)	External: Size (in.) Internal: Type	Special Features
F	E	73	5x15x12	Auto head park after 7 sec. inactivity
F	E	70	Half	Memory management software for full memory access
F	E	85	4x15x9	Multiple volumes and operating systems possible
F	E	90	5x10x14	30-day trial period
F	E	77	10x6x13	ROM software for password protection, backup
F	E	155	8x3x16	Menu install software, 4 op. sys. simultaneously
R	E	35	5x9x21	Removable 8" floppy cartridge
R	E	50	6x20x19	5¼" floppy cartridge, not Winchester disk
F/R	E	77.5	7x7x22	3.9" removable cartridge
F	E	90	5x14x14	Optional tape backup
F	E	45	6x10x14	Plated media drive, network ready
R	E	35	8x9x22	8" floppy cartridge, not Winchester disk
F	E	85	14x5x12	3-day warranty replacement
F	E	35	5x12x12	45-day trial period, 4-drive controller
F/T	E	90	15x16x6	Bootable/addressable tape system
F/R	E	40	6x11x16	Auto head retract at power off, 11M-byte cart \$159
F/T	E	N/A	5x14x14	Opt. 5-slot expansion chassis, 5M-byte cartridge
F/R	E	85	4x7x14	4-drive ctrl, free ctrl swap w/computer change
F	E	45	14x6x13	Opt. serial port
F	E	75	8x8x12	Backup & utility software included
F/T	E	85	15x6x13	PC/T format, backup & utility software included
F	E	N/A	6x11x16	RS-232 port included
F	I	85	Half	Plug compatible with standard PC AT computer
F/T	E	70	3x15x20	Power management & protection included
F/F	E	85	8x5x17	Integral Kodak 3.3M-byte floppy
F/T	E	30	6x15x15	Backup/restore in background while computer in use
F/T	E	77	5x14x16	Bootable hard disk w/32M-byte tape backup
F	E	85	9x16x5	48-hour replacement warranty
F	I	83	10x6x2	Can use image and file backup and is verifiable
F	I	70	Half	Ctlr supports 2 floppies & 1 hard disk
F	E	72	Half	8-slot expansion chassis, opt. 5M-byte cartridge
F/R	I	75	Full	1-year warranty, 48-hour replacement, int. floppy
F	I	68	Full	Clock, calendar, RAM, RS-232, backup software
F	E	75	5x9x12	Device driver and format utility included
F	I	65	Half	12,000-hour MTBF estimated
F	I	105	Half	1-year warranty, 30-day full refund
F	I	80	Half	Utility software, power supply included
F	I	80	Half	300% faster than IBM XT hard disk
F	I	85	Half	30-day trial, 1-year full warranty
F	E	80	5x8x16	Menu-driven installation software
F/R	E	30	12x11x21	300% speed of 5¼" drive
R/R	E	97	5x19x11	Boots like XT, runs multiple operating systems
T		(1)	12x7x16	Image mode stores 32 floppies/tape with RAM access
F	E	100	5x15x12	Short slot ctrl, XT disk emulation software
F	I	85	2x7x11	Hard carbon overcoat, uses XT ctrl. & power supply
F	E	99	11x14x3	Boots off hard disk, box has 4 expansion slots

HIGH COLOR RESOLUTION COMES TO GRAPHICS

New products from AT&T permit micros to process picture-like images

BY WINN L. ROSCH

THE computer graphics most people use are humdrum. Most graphics boards can display a maximum of only 15 colors, with a relatively limited resolution. Shadings and tints are virtually nonexistent; transitions from one color to another are abrupt. Even the most versatile graphics programs generate images that are little more than line drawings.

Now AT&T has developed a high-resolution color graphics system that finally permits the digital creation of screen displays almost as sophisticated as images obtained from analog video cameras.

A part of this system already available to product developers is a Video Display Adapter, or VDA. It can put analog-video-like images created by or stored in an AT&T 6300 or IBM PC-compatible computer on the screen of an analog RGB monitor, composite color monitor, or television set.

Features and Function

The AT&T Video Display Adapter

has three separate modes of operation: a pass-through mode, which makes the VDA "transparent" and allows normal use of the computer's color/graphics card; a special AT&T high-spatial-resolution mode (512 × 200 dot resolution) for high-quality text; and a high-color-resolution mode, which can generate pixels with any one of 256 color/intensity variations selected from a 32,768-color palette. In this mode, the VDA stores an image field of 256 × 256 pixels, of which 51,200 (256 × 200) pixels are actually displayed, completely filling the monitor screen. The VDA's on-board RAM can be jumper-addressed to occupy any unused 64K block of memory space in the computer.

Moreover, images generated using both the high-color and high-spatial-resolution modes can be combined in a single display. For instance, software can define a rectangle covering all or part of the screen as a menu drawn in high-spatial-resolution characters while the rest of the screen is devoted to a high-color-resolution image.

Unlike most "graphics" adapters designed for personal computers, the VDA does not replace the IBM—or any other manufacturer's—color/graphics adapter. Instead, it works in conjunction with it. The RGB output of a standard PC color board is externally cabled to the input of the VDA, which resides in its own expansion slot in the computer chassis. The VDA converts this signal into analoglike form, allowing it to be displayed on the same analog monitor used for high-color-resolution images. A fringe benefit is that the composite color signal can be viewed on a composite *monochrome* monitor should that be desired.

Although the VDA will drive both analog RGB and composite-input monitors, high-color-resolution images are nearly identical on both, and no benefit accrues from using the more expensive analog RGB monitors with it. In fact, the AT&T VDA was designed with the limited capabilities of the ordinary color television set in mind—hence, its spatial resolution limit of 256 horizontal lines.

AT&T's Video Display Adapter (foreground) and Image Capture Board (background) constitute a reasonably priced system for high-quality video digitization and storage.

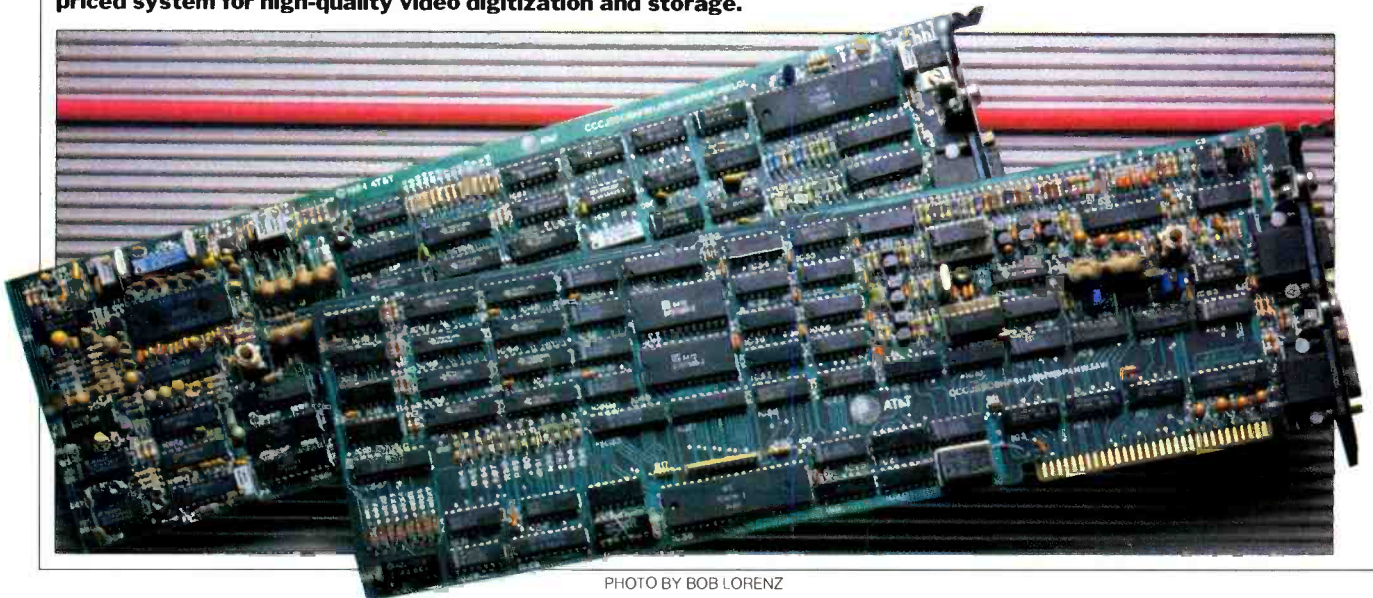
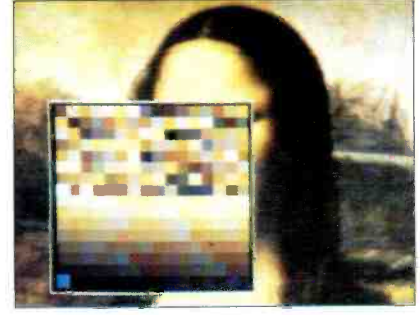


PHOTO BY BOB LORENZ



From left to right: image as displayed from VDA board; first-level pop-up VDA menu; 256-color palette used to create VDA image on screen.

Few home television sets can do better than that.

(Because the VDA creates what is essentially an analog signal, its output is *not* compatible with that of the IBM Personal Computer Color Display, which has a TTL-level digital input. Furthermore, the VDA's sync signals are inverted with respect to those required by the IBM display.)

The on-screen performance of the VDA is impressive. Although a range of only 256 colors might seem restrictive, the demonstration images provided by AT&T are rich in a variety of hues, almost picture-postcard perfect. Contouring, an abrupt change from one brightness level or color to another, is nearly undetectable.

The different colors and intensities blend together so well that it's nearly impossible to see a digital "step" in a waveform. Only when a text window in high-spatial-resolution mode is displayed on the screen does computer-like bunching of signal levels become apparent in the signals.

A Signal Difference

The difference between the PC color/graphics adapter and VDA signals is as much philosophical as physical. In the digital realm of computers, the traditional approach to improving the quality of graphics has been to increase the number of picture elements (pels or pixels) used to form the on-screen image. More and smaller pixels in a digital display smooth out the rough edges in the same way that a finer screen makes a printed half-tone picture more lifelike. As the on-screen digital pixels get smaller and more numerous, those rough edges and abrupt changes in shading or color become less noticeable—but they never disappear completely.

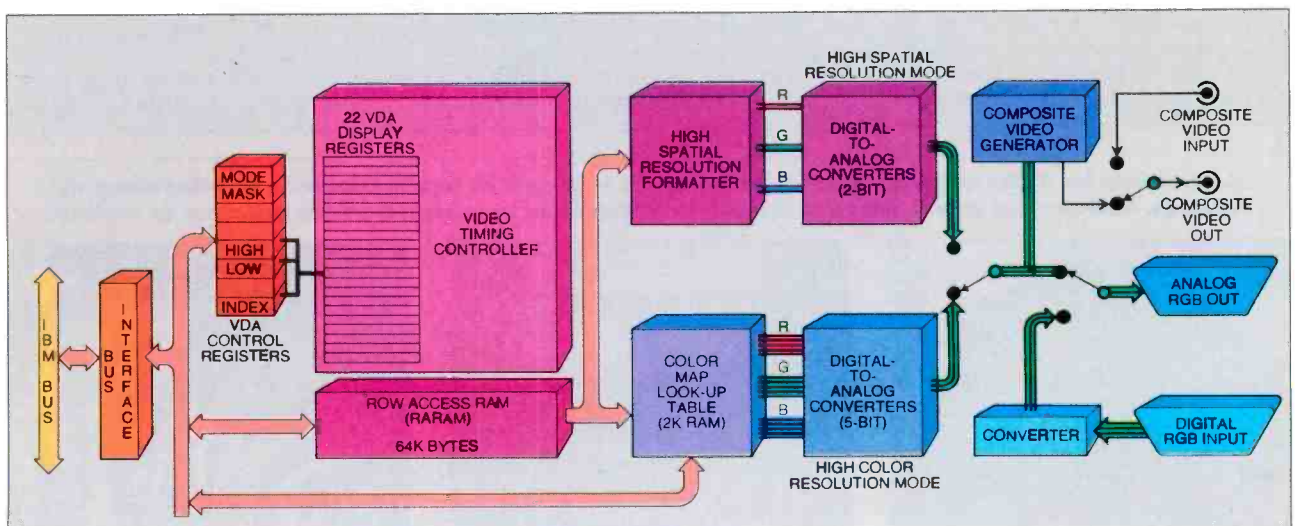
Even though the resolution of today's typical personal computer display—640 to 800 horizontal dots—is enough to make television engineers envious, the abrupt transitions of color and intensity make the individual pixels stand out. Hence, computer displays look less realistic than ordinary television pictures, which (due primarily to the constraints

of the NTSC color system used in the United States, Canada and Japan) have to struggle to resolve more about 200 dots.

Moreover, increasing spatial resolution—that is, adding more pixels to each picture—introduces nonaesthetic shortcomings. Properly displaying those higher-spatial-resolution images requires expensive, wide-bandwidth monitors. Resolving smaller pixels requires costly color cathode ray tubes (CRTs) with finer dot-pitches. More pixels means that more data must be stored and transmitted for each picture, so every increase in spatial resolution requires more memory to hold the digital representation of the image. And, as the amount of data increases, so does the time required to transmit it.

According to AT&T, attempts to put analog video-quality digital images on computer displays by increasing spatial resolution are misdirected. Analog video images look better and more realistic not because of their spatial resolution but because of the infinite variety of intensities

Block diagram of VDA board. Digitized image information is converted to analog form and can be displayed on either analog RGB or composite video monitor.



APPLICATIONS OF DIGITIZED VIDEO BY DAVID MCCUNE

A COMPUTER graphic is a methodically designed and executed illusion. It is created when abstract data structures are massaged by hardware into thousands of flickering, colored dots on a video monitor. The gullible human eye and brain succumb to electronic sleight of hand, and an image appears.

Like a magician, the graphics programmer needs tools and props to deceive the audience. The AT&T Video Display Adapter (VDA) is a powerful addition to the graphics magician's bag of tricks, one that enables the programmer to show a viewer photographs on a color monitor.

By offering a large number of simultaneous colors and foregoing high spatial resolution, AT&T has created an inexpensive board that can display photographic images. In fact, some graphics programmers may find that the VDA is overspecialized for their needs. As a graphics board it may prove awkward to use in some applications. Still, for many applications it is very well suited and easy to use.

Significance of the VDA

The most important thing about the VDA is not that it can display digitized photographic images. After all, the technology to do that has existed for years and is still evolving. What makes the VDA significant is that it does the job inexpensively and well.

When AT&T's video display system becomes available to the public late this spring or during the summer, it will provide the owners of AT&T and IBM computers an affordable way to integrate photographic-quality images and relatively high-resolution graphics with their programs.

The suggested retail price for the Video Display Adapter is \$695 and for the Image Capture Board (ICB) is \$1295. Add to that about \$500 for a consumer-

quality color video camera and another \$500 for an inexpensive analog RGB monitor, and the total cost of the imaging system (less computer) will be about \$3000. This cost will put the system within the reach of many small and medium-sized businesses that have never before been able to afford graphics of this quality.

Potential Applications

While no applications software for use with the VDA yet exists, it is not difficult to envision several uses that will be easy to implement when the software is available.

Photographic Databases. With the ICB and VDA, an existing computer system could be used to create and access a relational database of photographic images. For example, a database entry might contain one or more half- or quarter-screen images accompanied by descriptive text and keywords.

A realtor might use such a system to select properties for a client according to certain criteria and then to show pictures of the results of the search. A videodisc-based system like this is already in operation. The ability to do the same thing using a portable VCR and AT&T's boards would not only make such a service more widely available, but would also facilitate the updating of listings.

A similar technique could be used for merchandise and inventory cataloging and personnel databases (either within a company or at an employment agency).

Graphic Design. An inexpensive package that mixed video imaging with a "paint" program would be a godsend to many small graphic design shops. An artist could capture an image from a physical design mockup or even a photograph and then modify and enhance the original and insert new text and computer-generated graphics. Such a package is expected later this year from AT&T.

Videotex. Most current videotex data-

bases present data either in simple ASCII format or by using the NAPLPS (North American presentation level protocol syntax) standard. One of the early hopes for videotex was that advertisers and consumers would use it for shopping at home. Perhaps one of the reasons for the somewhat lackluster response to videotex so far has been its inability to display high-quality images that would interest consumers.

The VDA could possibly solve this problem. A videotex user could use a home computer and a color TV receiver, along with a VDA board, to browse through a photographic-quality catalog.

(Note that AT&T will have NAPLPS software for the VDA board later this year. How it will fare, though, depends on the acceptance of NAPLPS videotex.)

Bad News

The biggest obstacle in the way of widespread and easy use of the VDA at the moment is the lack of suitable end-user software. AT&T does provide some primitive programmer's tools, but they will be of no use to most real estate agents, for example. And, even for programmers, there is yet very little support. However, it appears that several standard graphics libraries, such as HALO, Graphical Kernel System (GKS) and Virtual Device Interface (VDI) may be available for the VDA by the end of the year.

And, of course, as uses for the AT&T system become more apparent, more effort will be devoted to producing software for it. The AT&T graphics package mentioned above will do much to make the features of the system more accessible.

Another potential impediment to widespread VDA usage is the large amount of disk space required for each image—more than 64K. A 360K floppy

(Continued on page 85)

Applications for AT&T imaging system include storage of images for use in databases or online shopping catalogs. As described in text, images can easily be transmitted by modem from one computer to another.



and hues that can be represented by analog signals. While a personal computer's digital display shows only one or two distinct brightness levels and perhaps seven or eight different hues, analog video pictures draw from an enormously greater palette.

In a system using a TTL-level (logic-level) RGB display such as IBM's, the three electron guns in the color CRT are switched on and off in combination to generate up to eight colors (if you include black). Normally there is no control over intensity—the guns are either on or off. If you make provision for half-intensity, which requires another control signal, the number of colors increases to 15 (you're not permitted to count black twice!).

The VDA, by converting the digital video information into analog form, allows much greater flexibility. As we shall see later, 5 bits are used to store the brightness, or intensity, information to be supplied to each electron gun of the CRT. This means that 32 brightness levels are available for each primary color. By converting the numeric values represented by the digital information into an analog voltage, the VDA modulates the intensity of the electron beams, and thus of the glowing phosphors on the face of the CRT, over a wide range.

How It Works

Digitally encoding the 32,768 different colors that can be generated by the VDA does not require any special technology in itself. In fact, 15 bits—5 for each primary color—are sufficient to store the necessary information for each pixel. Hence each could easily be represented by 2 bytes (with a bit to spare). A full 256×256 pixel VDA image would therefore require 128K bytes of memory (256×256 pixels \times 2 bytes per pixel).

To conserve address space, memory and transmission time, however, AT&T uses just a single byte to represent each pixel in the VDA's memory. That byte serves as a pointer to a location in memo-



C&E staff members evaluate performance of AT&T imaging system.

ry that contains a full 16-bit value—of which 15 bits contain color information—coded in one of four look-up charts or "color maps." Each color map can contain 256 16-bit values, hence the availability of 256 colors (from one color map) from the palette of 32,768 (the number of codings possible using 15 bits). Each of the 256 locations in the color map can be filled with any of the colors available in the full palette, and it is possible to jump from one color map to another with a simple operation.

The memory on the VDA board consists of 64K bytes of special chips, termed RARAM (row access random access memory) by AT&T, which store the value of each pixel, and an extra 2K bytes for storing the color maps. The difference between RARAM and ordinary RAM is the internal structure of the memory chips. The RARAM is based on Texas Instruments' 4161 64K-bit chip, which is internally arranged as 256 rows by 256 columns of memory elements (fortuitously matching the video display format). A 256-bit shift register on the chip allows unloading one full row of memory with a single instruction from the controlling microprocessor.

The 64K RARAM and 2K color map

share the same address area, and a form of bank switching selects which is active at any given time.

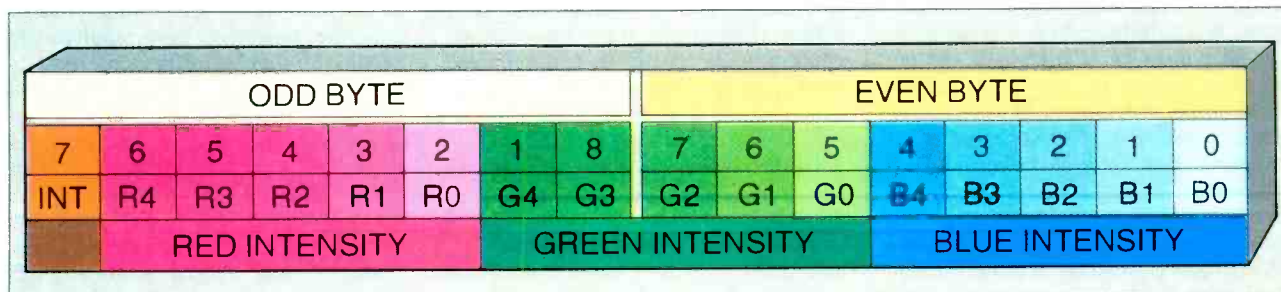
The unusual RARAM makes the VDA (and its companion Image Capture Board discussed below) extremely fast—particularly when compared to conventional computer video interfaces—and cuts down the microprocessor time that must be devoted to processing the VDA image.

The 16-bit values in the color map pointed to by the RARAM are sent to a Color Map Interpreter, which converts them into three separate 5-bit values. Each value specifies one of the 32 possible intensities for the red, green and blue elements of each pixel. A digital-to-analog converter translates these 5-bit values into voltages that are sent to an analog RGB display or to a composite video generator (and thence to a composite video monitor).

The leftover 16th bit in each color-map byte can be used to generate a signal for the host computer's processor, so that any pixel on the screen can issue a system interrupt. For instance, a pixel anywhere on the screen can issue an interrupt to display a menu (or anything

(Continued on page 84)

One of the 256 double-byte words making up the VDA color map. Each primary color is represented by 5 bits, which permits 32 intensity levels for each.





THE BOTTOM LINE ON ACCOUNTING SOFTWARE

What to look for in accounting packages, and what's wrong with most of them

BY MICHAEL K. GUTTMAN & DAVID FRANKEL

Now that word processors, spreadsheets and database managers are well established, attention is turning to a product for personal computers—the integrated accounting package. Actually, accounting software is not really new; it is standard on many mainframe and minicomputer installations. But until recently it was generally considered to be a high-end, custom product.

Within a short time, however, hundreds of off-the-shelf microcomputer accounting packages have surfaced in magazine ads and at computer shows. Products are coming from small specialty companies as well as from such giants as IBM and Dow Jones. A battle is clearly shaping up to attempt to satisfy what

vendors perceive as a huge demand.

Computerized accounting certainly sounds like a great idea, but how feasible is it for most microcomputer users? While computerizing may yield many benefits, most systems in the mass market cannot meet the needs of all prospective users. Buyers should act cautiously before committing their business accounting to any particular computerized accounting package.

Can One Size Fit All?

Off-the-shelf accounting packages are

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sold on the premise that most small to medium-sized businesses have much the same accounting problems and that these can be solved by a generalized set of programs the same way that a word processor can ease the work of typists. Unfortunately, although most businesses do have many accounting needs in common, nearly all have requirements peculiar to their industry or business.

For example, methods of allocating various overhead costs to expense accounts vary so widely among firms that it is almost impossible to generalize about them. Methods of accounting for and valuating inventory also differ considerably. Sometimes a firm is so accustomed to doing things a certain way that its staff may not realize that their meth-

SELECTED PUBLISHERS OF ACCOUNTING SOFTWARE

All products include general ledger, accounts payable and accounts receivable.

Business Library

The Business Library Corp.
PO Box 9363
Walnut Creek, CA 94598
800-221-1985

Includes payroll, inventory, sales order, purchase order, tax planner, time accounting, fixed assets. \$350—\$895 per module.

Champion Business Accounting

Champion Software Corp.
17301 W. Colfax Ave., No. 250
Golden, CO 80401
303-278-8666

Includes payroll, inventory, purchase order, order entry and point of sale. Written in dBase II, but source code not provided. \$595 per module.

Dow Jones Software Accounting

Dow Jones Software
PO Box 300
Princeton, NJ 08540
800-257-5114

Includes inventory, sales order, and purchase order. \$1000 per module.

EasyBusiness Series

Sorcim/IUS Micro Software
2195 Fortune Dr.
San Jose, CA 95131
408-942-1727

Includes payroll, inventory, and order entry. Interfaces to EasyWriter II and EasyPlanner. \$595—\$745 per module.

Excalibur Plus

Armor Systems, Inc.
324 Orlando Ave.
Maitland, FL 32751
305-629-0753

Includes payroll, counter sales, work in progress, billing, purchase orders, depreciation and customer information. Multi-user version available. Most modules \$695 each.

Harddisk Accounting Series

Great Plains Software
1701 S.W. 38th St.
Fargo, ND 58103
701-281-0550

Includes payroll, inventory, job costing, point of sale. Multi-user version available. \$695 per module.

IBM Business Management Series

IBM Corp.
Information Programming Services
PO Box 720576
Atlanta, GA 30358-9990
800-426-3333

Includes payroll, data editor, and report writer. \$695 per module.

Open Systems

Open Systems, Inc.
6477 City West Pky.
Eden Prairie, MN 55344
800-328-2276

Includes payroll, sales order and purchase order processing, inventory, job costing, and fixed assets. Comes with source code in Business BASIC, supports multi-user systems. \$695 per module.

Peachtree Business Accounting

Peachtree Software
3445 Peachtree Rd. N.E.
Atlanta, GA 30326
800-554-8900

Includes inventory, job costing, fixed assets, and sales invoicing. Comes with source code in BASIC. \$595 per module.

RealWorld Integrated Accounting

RealWorld Corp.
Dover Rd., Willow Hill Bldg.
Chichester, NH 03263
800-255-1115

Includes payroll, inventory. Comes with source code in RM Cobol, multi-user version available. \$695 per module.

SBT Accounting Software

SBT Corp.

1140 Mountain View-Alviso Rd.
Sunnyvale, CA 94089
408-980-8880

Includes payroll, purchase orders, fixed assets, sales orders, invoicing, project (job) costing. Source code in dBase II or III. \$195—\$395 per module.

Sensible Solution

O'Hanlon Computer Systems, Inc.
8383 158th Ave. N.E.
Redmond, WA 98052
206-885-2502

Includes payroll and wholesale distribution. Source code in proprietary high-level database language and multi-user versions available. \$400—\$1395 per module.

Solomon III

TLB
267 Great Valley Pky.
Malvern, PA 19355
215-765-6666

Includes payroll, sales order entry, sales analysis, job costing, fixed assets, inventory, and purchasing. Highly integrated and based around a sophisticated database manager. Not modifiable. \$295—995 per module.

TCS Total Accounting System

TCS Software, Inc.
6100 Hillcroft, No. 600
Houston, TX 77081
713-771-6000

Includes payroll, inventory, materials, fixed assets, and sales. Also proprietary word processor, report writer, and network software. \$600—\$900 per module.

Thoroughbred Business Software

SMC Software Systems
312 N. Adamsville Rd.
Bridgewater, NJ 08807
201-647-7000

Includes payroll, fixed assets, purchase order, and order processing. Comes with source code in SMC BASIC, multi-user version available under SMC Thoroughbred/Q.S. Most modules \$595.

ods are theirs alone. Such differences in accounting procedures constitute the major obstacle to using off-the-shelf accounting programs. Even if the initial installation is satisfactory, a time may come when changes in the firm's needs require customized alterations.

Unfortunately, an accounting package, unlike a word processor or spreadsheet, cannot be somehow finessed to fit just any task. An accounting system must correspond exactly to the way the firm actually does business or it may run the firm financially off course and, very possibly, afoul of the law. A company with an accounting system that can be extensively modified, of course, has a better chance for successful computerization.

It Takes Time and Effort

New users should also be aware that the cost of automating far exceeds the purchase price of the software even if modifications are not required. Considerable time and energy must be spent learning and configuring the new system, which may impose requirements for entering and organizing data that were not necessary with a manual system. It will also be necessary to enter all existing data from the company books, which can take a lot of time and may also uncover accounting errors and omissions that might have to be corrected before the new system will operate properly. Finally, both the manual and the computerized system will have to be run in parallel for several months until the

new system is performing adequately.

Timing a conversion is important, too. Don't try to convert to a computerized system in the midst of your busy season. Avoid starting when key people are on vacation. If you are automating in several accounting areas, consider converting them one at a time so that you and your staff won't be overwhelmed. Make as few changes as possible to your existing operations—wait until you have substantial confidence in your abilities to operate the new system before abandoning the old.

What You Can Expect in an Accounting Package

Most accounting software is divided into separate but coordinated modules

that correspond to the following subject divisions:

General Ledger
Accounts Receivable
Accounts Payable
Inventory
Payroll

General Ledger

The general ledger module is the core of an accounting system. It summarizes all of your firm's economic activity, including activities dealt with more specifically in the other accounting modules. The general ledger is used to maintain a chart of accounts and account balances, make bookkeeping journal entries, and print financial statements. Some businesses require only a general ledger module.

Chart of Accounts. One of the first things you should consider is how you organize your chart of accounts. How do you group your accounts? For example, do your income and expense accounts precede your balance sheet accounts? Do you group all your income and expense accounts together or do you have separate ranges in the chart for general income and other income? Develop a comprehensive list of your existing and projected chart of accounts. This information can help you (or your consultant—see sidebar) choose a system that will not require you to make fundamental changes in the way you handle your ledger.

Financial Statements. In assessing what the general ledger must do for you, you must consider the type and format of financial statements you require. You probably need to print balance sheets and profit and loss statements; but do you need only monthly and annual statements? How about quarterly statements? Do you need statements that compare figures for different periods or that compare actual versus budgeted amounts? Do you need a column on the profit and loss statement that shows the percentage of total income and expenses attributed to each income and expense line item? Do you need more sophisticated analysis, such as a statement of changes in financial condition or special financial ratios?

Gather and analyze samples of all the types of financial statements that you have been producing or that you would like to produce. Most general ledger systems allow you to customize your financial reporting somewhat, but make sure that the system you buy allows you to tailor your statement formats to your needs.

Recurring Journal Entries. Do you have a large number of journal entries to make each period, such as rent and depreciation? If so, you may need a system that allows you to list these recurring entries once and have them generated automatically each period.

Departmentalization. Some companies divide their business into separate departments or cost centers. If your firm does so, do you assign subaccounts to each account, where the subaccounts correspond to the different departments? Or do you assign entirely separate account numbers for similar accounts that are associated with different departments? Your system should be able to cope with your style. Consider also how you plan to allocate overhead

An accounting system should correspond exactly to the way the firm actually does business

costs, such as rent or utilities, among the various departments.

Entries to Other Periods. Be aware of another issue that has frustrated many users: Most general ledger systems have a procedure to close out an accounting period, but some of these systems provide no convenient way to make correcting journal entries to past "closed" periods or entries to a new period before the preceding period is closed out. Be sure that the system you select handles these smoothly.

Accounts Receivable

Many businesses consider automation of accounts receivable to be critical, since it can have a profound effect on controlling cash flow. Successful computerization of this function is likely to ensure that your billings go out in a timely fashion and also help you identify nonpayment quickly.

Open Item Versus Balance Forward. Many receivables software systems store each customer's purchases in detail until paid ("open item"), while some just summarize the detail at the end of each month, carrying forward only the total balance for the customer ("balance forward"). The open item method is more complex, requiring that each payment be credited specifically against the items purchased. Some systems allow you to

make a choice between the two methods initially, and then use the same method for all customers. Others allow you to make the choice separately for each customer.

Invoicing. All receivables systems allow you to print monthly statements to customers, listing charges and credits. Some systems also allow the printing of invoices for individual purchases—if you send out many invoices, this may save time. If you choose such a system, be sure that it allows you to record handwritten invoices, too.

Printing by Zip Code. Another feature that may help you cope with numerous invoices and statements is a system's ability to print documents in zip code order so that you can use bulk-mail postage rates. If you plan to do other mass mailings, you should look for a system that also prints customer mailing labels.

Late Charges. If you impose a late charge on overdue balances, you need software that at least allows you to enter such charges as extra debits. More sophisticated systems calculate the charges for you. You should be able to alter the late charge rate as well as the definition (in days) of "overdue." You also must be able to specify minimum and maximum late charges.

Be sure also that the system allows you to inspect the results of its automatic late charge calculations so that you can make adjustments easily. You should be able to rerun the calculations entirely if they are interrupted by a system failure or if you need to change the rate or the overdue definition.

Discounts. If you allow cash discounts to customers who pay their bills promptly, your software should either allow you to calculate discounts yourself and enter them as credits or it should calculate discounts for you. If you obtain a package that calculates discounts, you must be able to specify the discount rate and to define, in days, the period following initial billing during which the customer is eligible for a discount. Most systems that allow discounts use the gross method when they link to the general ledger. Briefly, the gross method uses a ledger account called "discounts taken" to accumulate discounts for management purposes. Some businesses, however, prefer to accumulate discounts forfeited instead of discounts taken. This latter approach is called the net method. If you use the net method you may have difficulty—unless your software can be properly modified.

Credit Limits. Do you maintain credit limits for individual customers? If so,
(Continued on page 75)

PERFORMANCE ISSUES

FINDING a system that meets your specific accounting needs is challenging. Finding one that meets these needs but operates slowly or clumsily can end up frustrating your best efforts to use it. Here are a few general characteristics that can make a huge difference in how well a system actually performs.

Sorting and Indexing. The better systems do not make you wait for lengthy sorts. Using a technique called indexing, proper sequencing of the data is quickly updated every time new information is entered into the system or old informa-

tion is altered. If the indexing is well implemented, the operator should not even be aware that an update is occurring.

Data Entry. It's important that the entry of data be easy for the operator and that there be no obstacles to correcting typographical and other errors. The only way to assess this aspect of a system is to try it. If the data entry system is good, you should be able to learn to enter data easily within half an hour.

Recovery from System Failures. The accompanying article identifies several procedures that are prone to problems when the system fails during their opera-

tion. In general, steps that process batches of data must be able to be restarted without complication if they fail to complete for whatever reason. Examples of these kinds of operations are posting a batch of general ledger journal entries, generating purchase orders for back-ordered items, or calculating gross pay and withholdings for payroll.

Interface to Word Processors and Spreadsheets. Some systems have the ability to send reports of fragments of them to word processor and spreadsheet programs for any special formatting, presentations, or analysis you may require. ◊

HELP AND PREPARATION

MOST prospective users need knowledgeable consultants to help them select and install accounting systems and to provide them with training and ongoing support. Even an accountant or a computer consultant should probably seek the advice of another expert when automating, just as a wise lawyer hires another attorney to represent him or her in court. The cost of hiring a consultant to analyze the changes required—and to program the necessary alterations—can be substantial, however, especially if the expert is not completely familiar with the idiosyncrasies of the system to be modified. Certainly, a novice will find computerized accounting too involved to just go out and buy a package mail order or from a computer store, no matter how attractively the advertising represents it.

Of course, choosing a consultant is a major task in itself. A good consultant should have a substantial and verifiable track record in both accounting and computers, not just a few months selling canned software packages in a computer store. In addition, a consultant should be able to talk intelligently to the new user in understandable terms. If a prospective consultant sounds like an accounting textbook or a computer manual, look elsewhere. Remember, also, that if you find your expert's manner threatening or obnoxious, you and the people in your company will be unlikely to communicate with him or her easily and the results are not likely to be very satisfying.

Preparing Your Firm for Automation

The first step in the process of com-

puterizing your firm's financial accounting is assessing its needs and assigning your priorities. You should prepare yourself so that when you sit down with the consultant you don't waste time. You should write the information down into a coherent report accompanied by supporting documents. Although the consultant is also likely to prepare a report, your homework can get things off to a quicker start.

The second step is to identify every member of your firm who is likely to be affected and decide how they can best participate in the process.

The next step is to budget sufficient time for you and your staff to discuss the relevant issues and to work with the consultant. Make sure also that enough time will be available for everyone who needs to participate in the steps of the installation process, including familiarization, training, data conversion, and testing. Many installations are unwittingly sabotaged by users who did not anticipate the time requirements of automating.

Next, you will need to gather information about your business for each accounting module you want to automate. When looking at the special problems of any particular area, you and your consultant will have to decide (1) how much data you will need to store online, (2) how the various modules should be integrated, and (3) whether you will need to have more than one workstation operating at once.

How Much Data Storage

Knowing the amount of data you will need to store online will help a knowledgeable consultant determine how

much disk capacity you will require. Usually, even for small businesses, at least a 10M-byte hard disk is necessary if you are going to be computerizing several areas. If you'll need much more storage, you should consider an efficient method of data backup, such as streaming tape, rather than floppy disks.

To get a handle on storage requirements answer the following questions.

For General Ledger: How many accounts are there on your chart? How many journal entries do you have to make to the general ledger per accounting period? How long would you like to retain all the detail of the journal entries after closing out the accounting period for which they were entered? Will your financial reports require the online storage of historical data, and for how far back? How many recurring journal entries do you have per accounting period?

For Accounts Receivable: How many invoices do you send out per month? How many customers do you have? How many finance charges and discounts do you record per month? If you are automating point-of-sale or order-entry, how many sales or orders do you process per month? What is the average number of payments each customer takes to pay off a bill? Are you keeping long-term historical data on each customer?

For Accounts Payable: How many vendors do you expect to have? How many invoices do you process per month? What is the average number of payments you make per invoice?

For Payroll: How many employees work for your business for any time at all during the course of a year? How many

(Continued on page 76)



INK JET PRINTERS

Speedy, quiet alternatives to impact printers

BY ROGER SNYDER

PRINTERS slow down microcomputers because they generally rely on electro-mechanical impact. It simply takes more time to move a lever or fire a coil than it does to switch a gate, so mechanical systems are thousands of times slower than the computers that run them. When printing systems operate with more direct electronics, they are quicker.

One candidate for high-speed output is the ink jet printer. Ink jets have the potential for printing text at the rate of an office copier or perhaps a duplicator. Today, prototype ink jet printers produce high-resolution graphics at speeds measured in full-page column inches per second instead of characters per second (cps). Before long, draft-quality speeds might reach 300 to 600 cps and letter-quality printers will accelerate proportionately.

What Today's Ink Jet Offers

Current production ink jet printing rates begin at approximately 20 cps for color and run up to 150 cps for black and white, about the range for low-cost impact printers.

Their prices are also comparable with their impact counterparts, though ink jets, especially color models, listed for thousands more only 18 months ago.

But ink jet printers offer other advantages over impact printers. Because they don't depend on impact, ink jet printers are quieter and mechanically simpler than daisy wheel and electro-mechanical dot matrix printers. They also can produce extremely fine dots (have high resolution), and are dot addressable (permit complex graphics).

Ink Jet Basics

If you have used a child's squirt gun, you have seen the fundamentals of ink jet. In a printer, however, the fluid stream must be precisely controlled and the drops must be of uniform size and

shape. Moreover, if multiple jets are firing simultaneously, all drops must form at the same time, at the same distance from the orifice, and with the same drive energy. Otherwise, drop placement is inexact and image quality suffers.

An ink jet system includes an ink reservoir, a driver to form the drops under controlled conditions, an orifice for releasing the stream of drops, and either of two mechanisms to control the position of the drops: One method deflects the wide horizontal array of drops like the beam deflection system in a CRT. The other method moves the entire print head across the paper in the usual fashion.

Before ink is ejected onto the paper, tiny droplets must be formed from the mass of ink in the reservoir. Two methods are common: thermal shock and mechanical vibration. Thermal techniques form the drops either within the ink reservoir or within the capillary tube, just behind the jet opening. Fast-acting, thin film resistors are heated to vaporize a small spot of ink. This sudden increase in fluid pressure (vapor pressure) explodes a chunk of ink, forcing it out of the opening. This glob forms into a sphere before it strikes the paper.

Mechanical vibrations from piezo-crystals are used to create shock waves. Vibrations occur when a change in electrical potential across the crystal causes a dimensional change in one plane. Since the crystal is tightly connected to the assembly, the driver mechanism shakes with each change in the crystal's dimension. This shock wave is minute, but it is effective. It is a little like tapping the side of a water barrel with a hammer, creating ripples in the fluid. A free-running crystal oscillator produces continuous, multiple streams of ink. In drop-on-de-

Roger Snyder is an electronic designer who was influential in the development of ink jet subsystems.

mand systems, single drops are ejected as needed.

In continuous stream systems, unused drops are electronically deflected into an ink-recirculating system. Since the driver frequency is generally higher than in drop-on-demand systems, a high percentage of drops is unused during low-density printing.

High-resolution ink jet systems require complex control over drop dynamics to overcome unique, aerodynamic problems the process can introduce. For instance, one drop following closely behind another is "drafted" by the first. The follower is similar to a race car, riding close behind a leader, using less energy as it is pulled along as the lead car breaks the air barrier.

With ink jets being driven with identical energy, the second drop, using less energy, rapidly catches the lead drop. This means the original spacing is reduced by the time the drops reach the paper. They may even collide in mid-air.

Such a collision is undesirable. First, it reduces resolution because the drops are twice as big as intended. Second, the collision may alter the drop's direction and make it wobble, distorting the shape of the ink spot.

Four Inks Equal Many Colors

Color ink jet printers add another complexity, a system similar to photographic color mixing.

Three subtractive colors (yellow, cyan, and magenta) are combined with black and three additional hues formed by mixing yellow with cyan (green), yellow with magenta (red) and cyan with magenta (blue).

Additional colors are available by further intermixing these seven colored dots. Thus, a red dot is created by overprinting a yellow dot with a magenta dot (or vice versa) or orange is created by interspersing yellow dots between the red dots. The proximity of the red and yellow

Ink Jet Printers

low dots causes the eye to see orange (red + yellow). With more complex intermixing, a rich palette is possible. The addition of black dots darkens the apparent hue. Open spaces on white stock lightens it. Thus, a color ink jet can produce half-tones by varying dot density and draw from a very large color palette.

Canon's PJ-1080A Color Ink Jet Printer

Canon's PJ-1080A Color Ink Jet Printer is a bidirectional, drop-on-demand system using the subtractive primary system, along with black, to produce the seven basic colors.

Print rates for the PJ-1080A vary according to the type of printing. For example, it prints in draft quality at 37 cps with any single color. Using bold print drops the rate to 16 cps, about the speed of some daisy wheels.

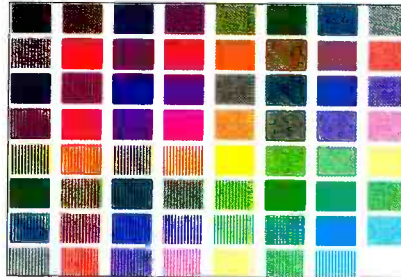
The difference in print speed occurs because the print head has only four nozzles. These are uniformly spaced in a single horizontal row: yellow, magenta, cyan, black. Since the full range of colors requires mixing, dots must be placed on top of each other to produce red, blue, or green. If, for instance, a green dot is needed, the printer must place a yellow drop and a cyan drop in precisely the same spot on the paper.

Because the magenta nozzle is between the yellow and cyan, the sequence for printing green is different for each direction. If the print head moves left to right, the cyan nozzle reaches the desired position first, followed by magenta and then yellow. Printing right to left, the situation reverses. Thus, the printer must know which direction it is traversing and the color makeup of the dot it is creating.

The Canon PJ-1080A has enough flexibility and versatility to satisfy al-



The unique print-head/ink-bladder design of HP's Thinkjet.



Xerox 1770's multihead design reproduces sharp color images.

most any user requirement. It incorporates several DIP switches to provide the following: black characters on white paper or white characters on black background; auto line feed; 1" skip over paper perforations; and characters for U.S., British, French, German, Japanese, Danish, Italian, and Swedish printing requirements.

In addition, there are three print modes. Normal print mode incorporates 96 alphanumeric and symbols, plus 64 "peculiar" characters in a matrix 5h x 7v. DIP switches assign 28 characters to the languages as required. In this mode, each character on any line can be desig-

nated as an enlarged character (10h x 7v matrix) or assigned a color.

Image print mode can be controlled to the individual byte, with 560 bytes available for each jet nozzle.

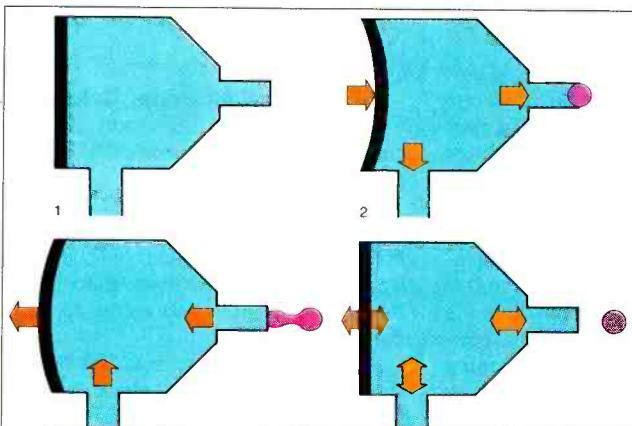
In color mode each dot can be assigned a color, with 80 bytes by 2 lines available for each nozzle.

The PJ-1080 prints cut sheet, roll paper (removable cutter built-in) and overhead projection film.

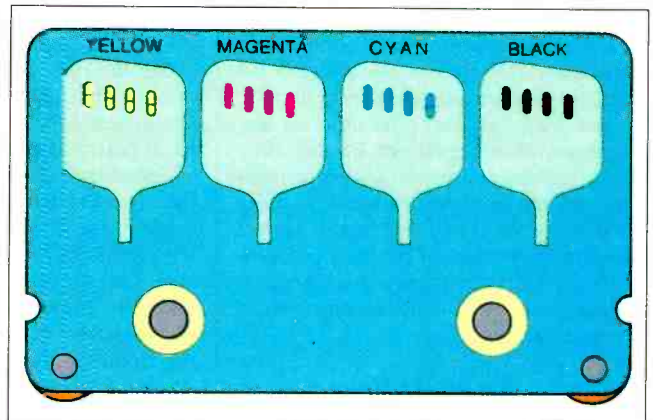
Canon has built-in self test and maintenance procedures. At "power on," the print head seeks home position and each nozzle is fired 128 times into a waste system. If the unit remains "on" without data entry for approximately 3 to 5 minutes, the system is purged by 33 firings from each nozzle. A manually operated waste pump cleans out paper dust and helps remove potential obstructions, such as air bubbles.

Printer timing is adjusted by comparing main clock timing with photo-optical readings of a series of fine slits and large slots in a bar across the carriage width. The fine slits indicate character position, while the larger slots indicate column position. And because the PJ-1080A does not guide the free-flying drops, they have an angular trajectory. Since the PJ-100A is bidirectional, the trajectory is different for each print head pass. Delay timing adjustments are provided to ensure proper vertical dot alignment under these conditions. Other adjustments compensate for such variables as differences in replacement parts.

The PJ-1080A has a 2.63 kHz driver clock rate, which enables it to fire a maximum of 2630 drops/second, each dot having a diameter of 250 to 300 microns (0.010"). This size allows the Canon to print 640 dots across a page. The PJ-1080A is rated with a mean of 30,000,000 characters before failure.



The Xerox drop-on-demand ink jet is similar in operation to an oil can. Ink is pulsed out by a transducer electrically energized.



Each of the Xerox 1700's four print heads has four nozzles, for the three colors and black, to provide high resolution.

Apple has announced a new software package that includes drivers for the Canon PJ-1080A. Called Lisa 7/7, it combines seven office business functions into an integrated package. Using Lisawrite, Lisadraw, and Lisagraph, PJ-1080A users can integrate an exceptional variety of color drawings and text with built-in cut-and-paste techniques.

The Hewlett-Packard Thinkjet

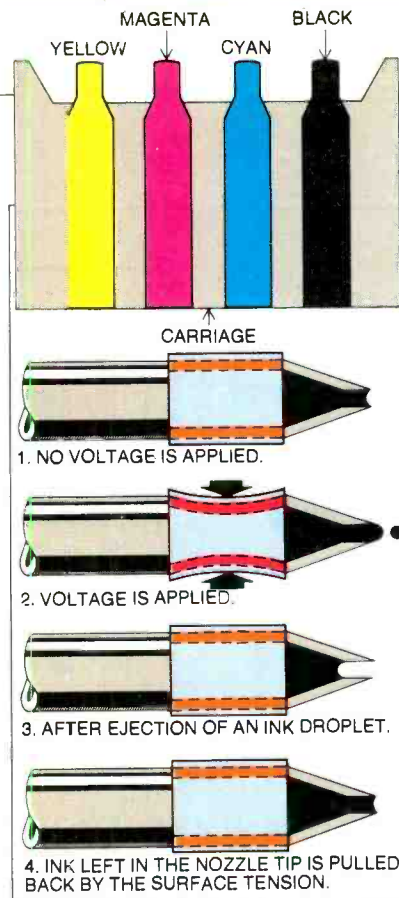
HP makes three Thinkjet models. All are about the size of a 500-sheet ream of typing paper (11.5" x 8.1" x 3.5") and all weigh between 5.5 and 7.5 lb, depending on the interface. Each prints 150 cps in bidirectional, logic-seeking fashion in a large variety of built-in text and graphics fonts.

Thinkjets are impressive on several counts: First, they list for only \$495.00. Second, they are quiet (< 50 dB). Third, all models have simple, user-replaceable print heads that cost about as much as a printer ribbon (\$7.50). With a print head producing about 500 sheets of text without changes in print quality, the price is excellent. Printer life is rated for 100,000 pages, the equivalent of 200 print heads. Finally, model 2225B is battery operated. HP claims about 200 pages of printing per battery charge. (See COMPUTERS & ELECTRONICS, August 1984, for more on the HP Thinkjet printer.)

The Xerox 1770 Color Ink Jet Printer

The current Xerox entry in this field is the model 1770 Color Ink Jet Printer, built for Xerox by Sharp and also marketed as the Diablo C-150.

The Xerox 1770 shares some features with the Canon PJ-1080A. For instance,



The Canon PJ-1080A has a single nozzle for each color.

both use the same four ink colors and end up with seven solid colors. Both printers also use replaceable ink cartridges. However, while Canon uses a single cartridge for cyan, yellow and magenta, plus a second cartridge for black, Xerox uses four separate cartridges. A major difference between the Xerox and Canon printers lies in the print heads. Xerox uses four nozzles for each color, giving the 1770 a total of sixteen nozzles. The nozzle orifices are also different. Canon uses larger orifices and a higher

print rate to attain greater throughput, at less resolution. This exchange is similar to the one between quick draft-quality impact dot matrix printers and slower letter-quality daisy wheels.

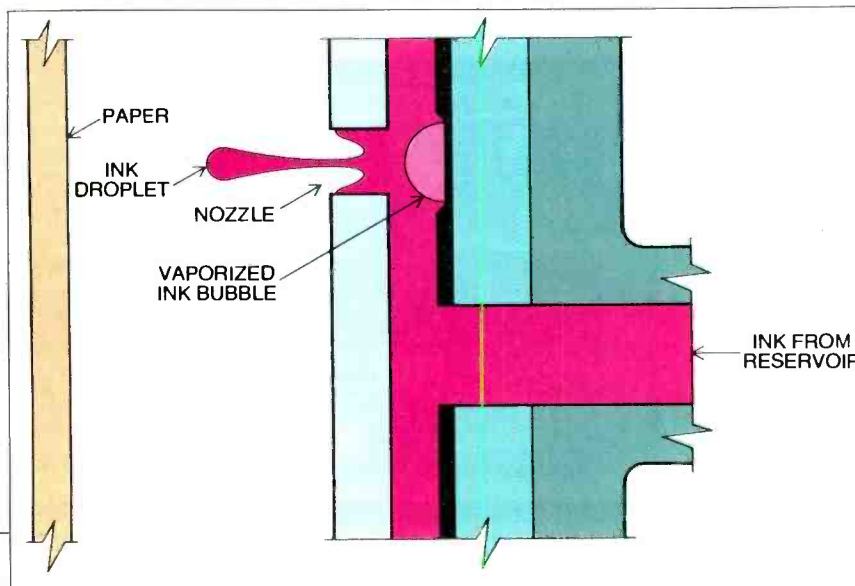
The difference in image quality is obvious. In fact, the Xerox image is sharp enough that most people probably require a five-power eye piece to detect the dot pattern in the 1770 images. At first glance, it is difficult to distinguish the ink jet alphanumeric/symbol output from a normal letter-quality machine.

Quality doesn't come without cost, however. The multiple nozzle system must be carefully maintained to prevent ink clogging and ultimate print head destruction. The printer is difficult and messy to install. In addition to the four ink cartridges, you must fill a reservoir with print head maintenance fluid and clean the print head regularly. The printer comes with a confusing array of bottles, syringes, and liquids for preparation and maintenance. Average print speed is about 10 cps. Indeed, Tektronix markets its own version of the Sharp mechanism, but calls the device a "copier" instead of a printer, because it is designed to copy computer screen graphics. The printer does not perform well as a text printer.

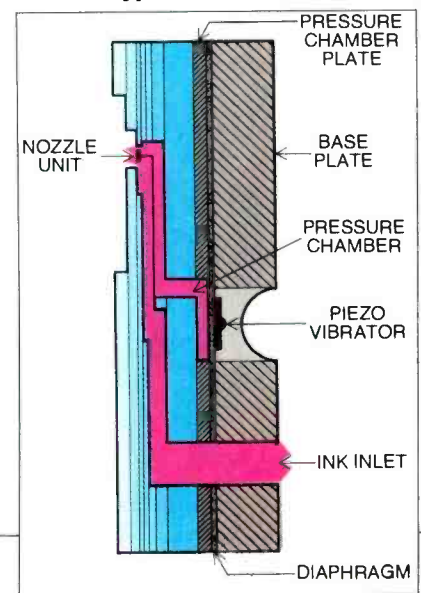
According to Ann Lutz, Xerox Printing Systems analyst, "the 1770 can produce up to 1000 shades. This, of course, depends largely on the limits of the host computer, but the capability is there." She added, "the printer can also handle halftones, with five levels of gray . . ."

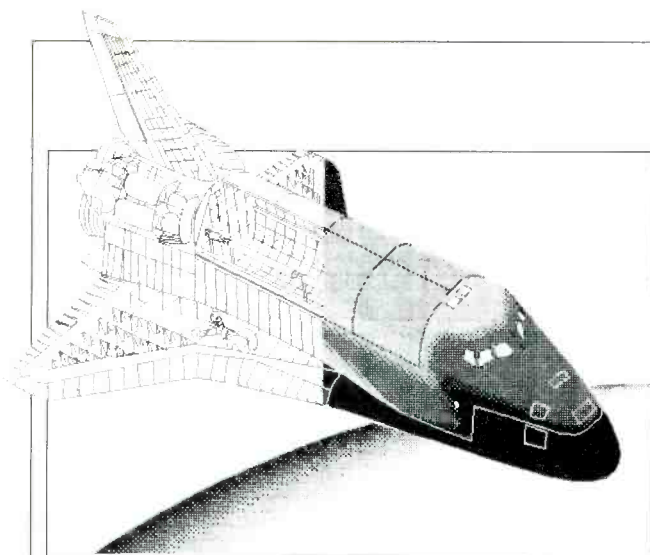
The 1770 also has the ability to mix alphanumeric and graphics on the same line, with a resolution of 120 dots/inch (1024 x 1024 per page). Canon's does 640 dots/line. In its second printing

Ink droplets are forced from printer nozzles in elongated spurts that form spheres before striking paper.

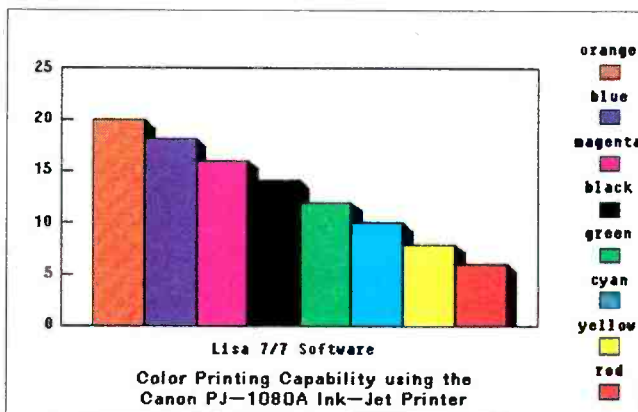


Detailed view of the Xerox type of ink nozzle.





Space shuttle drawing shows graphics capability of Thinkjet printer.



Lisa 7/7 software and Canon PJ-1080A team up for color graph demonstration.

mode (bit-mapped color) the 1770 can translate any screen image into hard copy.

Ginger Finnegan, Xerox Product Marketing specialist, says, "the 1770 has a wide variety of support. It can operate from Lotus 1-2-3, Colorware, IMSI and Infographics packages, just for a start. We have demonstrated it using an IBM PC, PC compatibles, a Xerox 16/8 and an 820 II."

Colorware offers a package including software and a color board for the 820 II. With this package the user can merge text, design structured graphics and create free-form screen images.

With the Infographics business package the user picks color palettes using 150 decision rules, and the software automatically designs the output. The graphics never appear on the screen. Future Infographics packages are expected to add more user options in image creation.

The 1770 can lay down these versatile

images on plain, clay-coated, or fanfold paper and on transparencies. The stock can be either cut sheet or a 10" wide roll of paper.

The 1770 is priced at \$1250.00, offers an expected life of 10,000 hours (five years) and has a mean time to repair of 30 minutes.

Ink Jets of the Future

The ink jet printers discussed in this article are only the beginning. The next five years will show dramatic improvements—not only in speed. Printer driver software will be greatly improved and available for a wider range of printers, for one thing. While almost any software package will drive just about any standard printer, most color printers currently have only narrow support.

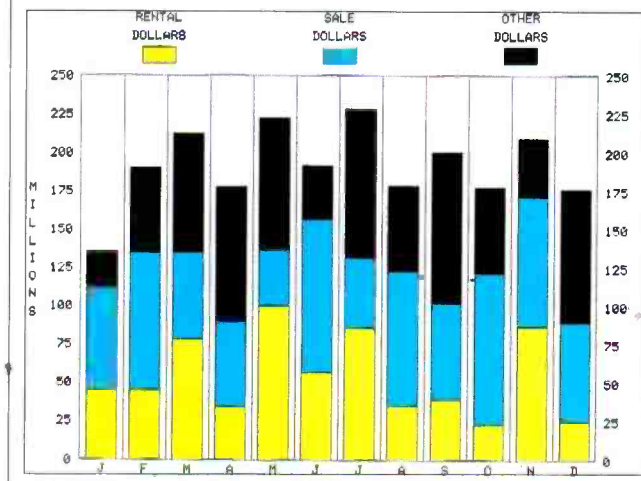
For example, it is currently possible to print a full page of (8.5" × 11") b/w graphics in a couple of seconds. When a print head such as the HP is combined

with other existing technologies, fast high-resolution ink jet printers will arrive at prices within the reach of most computer consumers.

Combining other printing methods with ink jet principles should yield other improvements. One method would increase driver frequency. With a decrease in drop size, a drop-on-demand system at high frequencies would simulate a continuous stream system.

If the number of continuously firing streams were increased dramatically, it would be possible to increase the number of available drops by orders of magnitude over the present rates. Since many more drops would be formed than could be used at once, each jet stream could provide area coverage. As a result, fast high-resolution printing would be possible. The decrease in drop size would produce high resolution, and the increase in drop formation rate, accompanied by an increase in available jets, would increase the effective throughput rate. ◇

A colorful bar chart drawn by the Xerox 1770 ink jet printer.



Inside view of the Xerox 1770 showing four color ink reservoirs atop the print head.

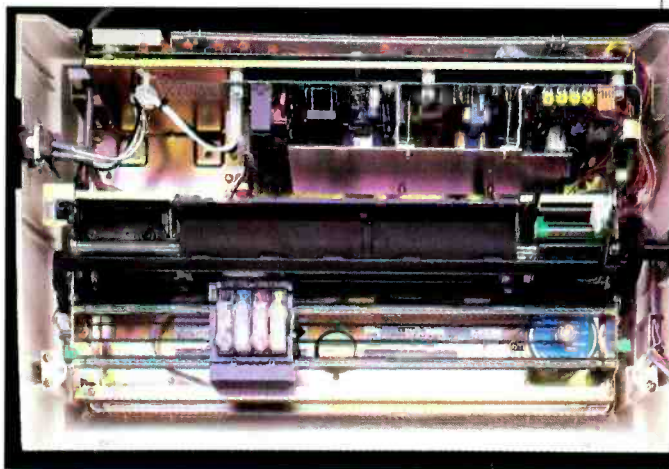
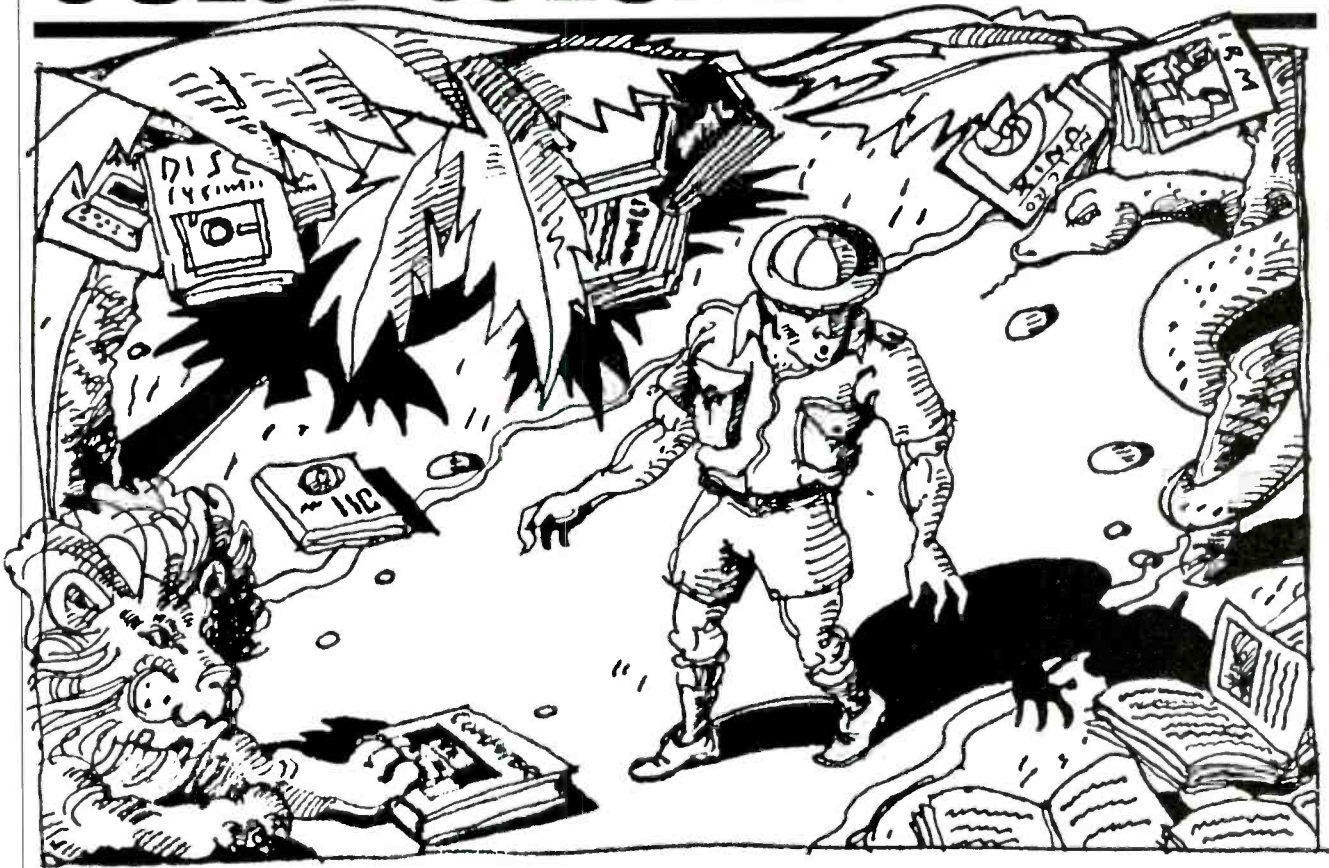


PHOTO BY BOB LORENZ

GUEST COLUMN



THE HOW-TO-CHOOSE-A-COMPUTER-BOOK BOOK

BY RUSSEL GRIFFIN & VICTOR MILLER

WE know it's hard to know where to start when you're buying that first computer. There are so many, you need a book to help you pick one. But if you check out the bookstore window, there are so many books to help you select a computer, you need a computer to pick which book! Big, small, thin, short, tall, and every color, it's a real jungle, and it's no snap deciding which one's right for you.

And that's where we come in, to help you over the rough spots to that proud moment when you walk out of the bookstore ready to face the world with your brand new how-to-buy-a-computer book under your arm. So take a deep breath and relax. Buying a book's like riding a bicycle—first time's the hardest. All you do is follow our Ten Simple Steps.

Dressing the Part. The most important thing is to dress comfortably. We're not here to tell you what—you know

what feels good and says you're *you*. But do wear running shoes or comfortable laced Oxfords with real support—you could be standing at the computer-book shelf for a good long time! And if you're lucky enough to have a job or profession, jot it down on a 3 × 5 card and slip it in your shirt pocket before you leave home. We'll tell you why later!

Being There. Walk right on in. It's that simple. Chances are you'll find yourself in the middle of the computer books. Roughly 93% of all books published these days are about computers or by Peter McWilliams or both. But if you find yourself drowning in a broth of cookbooks, don't panic. Ask a clerk.

Next, assume a natural stance, hands

Russell Griffin is a university professor and also writes science fiction. Victor Miller, a screen writer and novelist, wrote the horror film Friday the 13th.

in your pockets or outside them with your thumbs along your seams, and pick a shelf—the top one or the next down is best if you don't want a crick in the old neck. And look. Enough to make your head spin, isn't it? But don't lose heart. We're right behind you.

Now a lot of people in the field say the next step is to divide them all into two piles—books by Peter McWilliams and books by people who wish they were Peter McWilliams. But frankly, we don't see the point. Aside from the neat white covers on Pete's pile, they're both the same and you're no closer to knowing which book is for you. That's why we prefer our *own* next step:

Scoping the Spine. Before you've even touched a book, you can start narrowing the field. Those things facing you are called "spines," and you've probably noticed already that they're different from each other. Some books have straight glue binding, and some are spiral bound in shiny plastic or spiffy wire.

Which is right for you? A glue-bound book's likely to flip shut instead of lying conveniently flat next to that computer it's going to help you buy, but it'll only collect half the dust of an open spiral job after the first month or two. On the other

ART BY YVONNE BUCHANON

hand, you can yank the wire out of a metal binding for emergency rewiring or lunchtime flossing.

Finding Your Niche. Take a look at the titles on those spines (remember, they're backwards from the ones on the backs of your videotapes, so you've got to tip your head to the right)—*Microcomputers for the Legal Profession*, *Microcomputers for the Medical Profession*, *Microcomputers for the Executive Profession*, *Microcomputers for the Oldest Profession*.

Now, remember that 3 × 5 card you jotted your job on back home? Well, this is where that advanced planning pays off. Take it out and compare it with what you see (or, if you picked the right kind of comfortable shirt, you can read it right through your pocket without taking it out at all). Does it match any of the titles? If so, the how-to-buy-a-computer book you need is an arm's length away, and you can skip straight to the end of this article. If it doesn't, go to the next paragraph.

Hefting the Book. This is the "hands-on" part. With fingers extended and together, reach out with either hand—whichever is your favorite—and grasp firmly any of the books with the binding that's right for you. Heft it, get the "feel." Does it feel important? Weighty? Helpful? If it doesn't, slap it back and try again.

Getting the Copyright Right. Okay, fine, now, so turn the book unit around so that the writing is right side up and toward you—the opposite of how you load a disk—and with one hand under the spine of the book, grasp the cover firmly with the other and leaf through till you find the copyright date. This is crucial. After years of study and heartbreak, we've found that anything copyrighted before 1985 is, well, just plain "out of date." You don't want something that's already "obsolete." You want "state of the art" or nothing. Luckily, 89% of what's on that shelf was probably written last month.

Making Sure It's User-Friendly. There's nothing worse than getting home and finding out you've got a book that makes you feel like you tracked in something on the bottom of your shoe. One way to avoid that is to check for graphics. We've found a picture can be worth a thousand words, so any computer book without lots of pictures isn't worth talking about.

And not just pictures. You want *funny* pictures. Face it—you don't want some computer nerd ordering you around, you want someone neat, with a sense of humor who isn't afraid to Poke

A Little Fun or take on computer-dom's Sacred Cows if it's going to put you at your ease.

One of our all-time favorites is this cartoon we saw of sixteen little girls named Kay, with one guy saying to the other "When I said 'K', that wasn't the kind I meant!" Great stuff, right?

Some of the best graphics are steel engravings from old books of, say, Acteon being torn apart by Diana's hounds, with a speech balloon that says, "When I said 'byte,' that wasn't the kind I meant!"

You might also run across graphics that look like steel engravings but are actually "collages"—pictures made by pasting together weird stuff cut out of etchings and parts catalogues. These can be real riots, like the example we've included in Figure 1.

Getting to Know Your Author. Now's the big moment—time to take a look at the printed page and even read a sentence or two. What's the guy sound like? (You'll notice it's almost always a guy.) Does he know his stuff? Is he full of tidbits of the real inside computer dope like knowing where they hid the off switch on this year's models?

Maybe he's somebody who's been around since "computer" meant a ten-ton Univac with 4500 tubes. Sure, at first he's like having an uncle in the computer business, but sooner or later he'll turn into "Uncle Know-It-All" and get overbearing and "technical" on you.

Personally, we prefer an author more like you and me, somebody who's only a week or two ahead and won't try to put on airs. Look for tip-offs like "Till last week, the nearest I'd even been to a computer was the one that sent me my K-Mart statement every month." After all, you don't just want an author who respects you as a person, you want one who *has* to.

Buzzwords. A lot of people think there's too much jargon in the computer world, but frankly, we don't think there's enough. Buzzwords are part of the magic of computing. What's the point if you can't dazzle your friends? When we first got into computers, we asked the used-car salesman how many "K" that Ambassador was going to set us back, and boy, was he confused!

Anyway, you want something with lots of them. Look for things like "ergonomics," or "footprint," "windowing," "software integration," or "transparent" to make sure you're getting your money's worth.

But watch out if you happen to come across "Numatrons," "core memories" or 'nixie tubes." Same for chapter titles.

Cute ones are fine—can't have too many of things like "Bits, Bytes, and Bottoms Up." But if you see anything like "Punch Cards or Magnetic Tape—The Eternal Question," "Keeping Memory Cool—A Good Fan Can Save Your Tubes," "Neon Indicators—Better Safe Than Sorry," or "The TI-99: A Sensible Low-Cost Alternative," you may not have been holding up your end when you were supposed to be checking that copy-right page. Better flip back and reboot!

Facing the Music. So, okay, by now the manager is beginning to stare, but hang on, we're almost home. Close the book (that'll make the manager relax a little) and check the front and the back for a bunch of numbers preceded by something that looks like this: "\$." That's the price.

If the cost is way below the price range of the actual computer you're interested in, then you've probably picked the wrong book. This is no time to cut corners or be satisfied with "just getting by." You want something that, if you don't wind up getting that computer, will at least give you the sense of well-being that comes from making a substantial investment.

So, hey, okay, last "but not least," let's review:

ARE YOU DRESSED FOR
DECIDING?
ARE YOU AT THE BOOKSTORE?
IS THE BACKSIDE FOR YOU?
DO YOU HAVE THE RIGHT JOB?
IS IT FRESH?
IS IT HEAVY ENOUGH?
DOES IT HAVE PLENTY OF
PICTURES?
WOULD YOU INVITE THE AU-
THOR HOME TO DINNER?
DOES IT HAVE ENOUGH
BUZZWORDS?
DOES IT COST ENOUGH

For each "yes," score 10 points, for each "no" score 5, and for each "not sure," score 15. If you score over 100, you've got a book that's not afraid to ask the hard questions like whether or not you need a computer, and can be counted on to come up with hard answers like *yes*. If you score at least 50, you're probably still all right. Turn around and head for the cash register; the clerk will talk you through the paying part.

We've held up our end and given you all the help you need, so if you don't wind up with a really good book, you've got nobody to blame but yourself! Next time we'll tell you how to pick which computer magazine to subscribe to, cause it's dizzying array out there, a real jungle. Meantime HAPPY PRECOMPUTING! ◇

Accounting Software

(Continued from page 66)

look for software that allows you to set limits for each customer but allows you to override the limit if you so desire.

Professional Billing. If you sell services rather than products, many of the systems on the market will be inadequate, especially if you want the system to print invoices. Most systems rigidly insist on structuring billing items in terms of quantity sold and price, rather than time spent and rate. In such cases your invoices will look embarrassingly inappropriate.

Billing for medical services presents special complications because of the need to handle insurance billing and reimbursements. Generic accounting systems do not come close to addressing these problems. If your organization proffers medical services, you'll need specialized billing software.

Interface to Other Modules. Accounts receivable functions are often integrated with other functions, notably order-entry, point-of-sale, and inventory. Point-of-sale systems, for instance, record a sale with the computer acting as a smart cash register. A receipt is printed, entries

are made to accounts receivable (if the purchase is on credit), and inventory is relieved.

Order-entry systems allow sales orders to be entered. They usually print invoices and packing slips for items that have been ordered and are in inventory. Some even automatically create purchase orders to suppliers of ordered items that are not in inventory, functions that are useful to companies that specialize in mail and telephone orders.

Be cautious when purchasing off-the-shelf order-entry software. Your business may process and prioritize orders in a unique way. Some companies prefer not to ship until all items on the order are in inventory, while some would rather partially fill orders, then fill the back orders when the remaining items are in stock. Some prioritize on a first-ordered first-served basis, while others assign priority levels to individual customers or individual orders.

Interface to General Ledger. Integrated accounting packages generally interface accounts receivable to the general ledger by posting journal entries that re-

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Check Writing. Ma-
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computer. While this ability ca-
time-saver, be sure that if you exp-
a paper jam or other problem du-
printing, you can start the printing over

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Management. Some systems automatically analyze discount terms and prioritize inventory. You should be able to handle these priorities. Remember, these systems probably handle items only by the gross method, as noted above.

Recurring Entries. With many systems you can enter payments that you have to make on a regular basis. If you have many recurring payments, this feature could save time and trouble.

Inventory

Many integrated financial accounting software systems have an inventory module. It's vital to understand that these systems are usually designed for retail inventory, and are thus not generally suitable for use in wholesale and manufacturing businesses. If your inventory system is not precisely matched to your method of doing business, you may soon wish you had never automated.

Retail Inventory. Retail inventory tends to lend itself to general solutions, because each item of merchandise in a retail operation has a precise cost to the retailer and a retail price. You should be able to maintain back orders and define reorder points for each item. Some systems automatically create purchase or-

ders for back-ordered items.

Some retail businesses need to track every item in their stores, while some sell items largely in bulk. For example, a store that sells washing machines must track every item, while a hardware store need not track every nail sold.

Wholesale Inventory. Wholesale inventory systems must handle far more complex discount structures, scheduling, and ordering functions than do retail systems. For example, retailers tend to sell from stock, while wholesalers usually backorder. You probably need software that can handle pricing and discount levels that differ among customers and among products.

Manufacturing Inventory. Manufacturing inventory is even more complex because inventory must be separated into finished goods, work in progress, and raw materials, and labor must be figured into the cost of goods produced. These and other complications make it very difficult for a canned system to handle manufacturing inventory. Custom software development is almost always required.

Inventory Evaluation. Most firms assign value to finished goods by such standard methods as FIFO (first-in, first-out), LIFO (last-in, first-out) or average. Your firm, however, may well have special requirements, which means custom software, particularly if you regularly revalue inventory to account for shrinkage or shelf life.

Payroll

Payroll is a controversial area. Some financial accounting experts insist that most small and medium-size businesses

would be best off submitting their payrolls to banks or service bureaus for batch processing. The big problem is periodic changes in tax rates and related government regulations.

However, many businesses prefer to keep their payroll information private, and they may also want tight, automatic interfaces between payroll and general ledger, which the batch services cannot provide. They should make sure, however, that any software they buy will be supportable when the inevitable changes occur.

Virtually all payroll systems compute gross pay, government tax withholdings, and common types of employee deductions for a variety of standard pay periods. Most will also print checks, which may be more trouble than it's worth for smaller firms. In addition, information required for reporting to government agencies is accumulated and consolidated. Make sure your system handles state and local tax requirements and any special deductions you require.

The Payoff

Automating your accounting is a major project. There is very little glamour here, only hard and unrelenting work. However, if you are careful and realistic, computerizing can more than pay for itself in the long run.

The right system will save time, effort, and money in keeping the books, and it will help you to exercise greater and more timely control over every aspect of your business. In the long run, it will allow you to focus more of your attention on the more rewarding and creative aspects of your business. ◇

Help and Preparation

(Continued from page 67)

pay periods do you have per year? What is the maximum number of time card entries you make per period?

For Inventory: How many items do you have in your inventory? How is your inventory accounted for? Using LIFO and FIFO, for example, requires that detailed information on each individual inventory lot be maintained until sold, while other methods may allow consolidation to conserve space.

Integrating Different Modules

The "ideal" accounting system integrates all modules, so that any transaction occurring in one module will affect

all other relevant ones. Unfortunately, this arrangement can be a headache as well, especially if the update of all modules is simultaneous. You may find it hard to back out of an erroneous entry. Make sure that those modules that need integration have it and those that don't need it can be operated independently.

Multiple Workstations

Lastly, you will have to decide whether you will need more than one workstation in operation on the system simultaneously. This decision is particularly critical for point-of-sale or order-entry systems where many operators

may be accessing and updating the same data concurrently. There are special technical problems that arise when simultaneous access to the same accounting data is required. If you will ever need such access, you will have to purchase an accounting package designed to operate properly in a multi-user system. Otherwise your financial database could suffer serious damage from such multi-user access, as when two people attempt to update the same data at the same time. If you already own a computer, you or your consultant should check the specifications of a multi-user package to be sure that it works with your hardware. ◇

Taking Care of Hard Disks

(Continued from page 54)

tion to and from the disk surface don't actually touch the media as they do in floppy drives; rather they ride very close to the surface on a cushion of air. The clearance between the head and the medium is typically 12 to 15 micro-inches (millionths of an inch) or less. That means that even very tiny foreign particles inside the air plenum with the platters can damage the heads or media. If parts of the drive inside the plenum have to be repaired or replaced, extreme care must be taken to avoid chamber contamination.

Clean rooms generally are rated as class 10,000, 1000, and 100. The smaller the number, the cleaner the room. Class 100 is the minimum requirement for working on the sealed chamber of a disk drive.

The filters in a class 100 system remove particles as small as 0.3 microns (millionths of a meter), or about 12 micro-inches. Obviously, opening the bubble outside a clean room is sure to bring you trouble, including voiding any warranties.

Typical service costs that include opening the bubble run from about \$250 to \$450 for a 5M- or 10M-byte drive. Figure anywhere from \$160 to \$310 if

the problem can be fixed without opening the drive. For most companies, these also represent minimum charges. Sometimes you'll have to pay the minimum even if no overt problem can be isolated. Other companies offer a testing-only service, typically under \$100. But remember that it takes a lot more testing and effort to prove that a drive has nothing wrong with it than it does to repair one with an obvious failure. That's one reason to make sure that the controller card or other external part isn't at fault before sending the mechanical mechanism off for service.

Typical industry warranties on repair work generally run 30 to 90 days, though you may get up to one year on major repairs such as clean room work, especially if the recording media or heads were replaced.

Even though you'll want to get your equipment functioning again as quickly as possible, avoid the temptation to rush it off to repair. Investigate the company you'll be working with first. Make sure you understand probable costs and that you know something about their experience in the field. ◇

HARD DISK DISPLAY & BACKUP SOFTWARE

Direct Tree (\$50)

Micro Z Company
4 Santa Bella Rd.
Rolling Hills East, CA 90274
213-377-1640

Dump/Restore-XT (\$130)

Cogitate Bus. & Mgmt. Serv.
24000 Telegraph Rd.
Southfield, MI 48075
313-352-2345

Fastware TMS 3.0 (\$60)

Thesys Memory Products
7345 E. Acoma Dr.
Scottsdale, AZ 85260
602-991-7356

File Facility

Utilities I (Retrieve, Compress, Expand) \$20
Utilities II (DOS Tree Display, Locate, Backup) \$20
IBM Personally Developed Software
PO Box 3280
Wallingford, CT 06494
800-426-7279

Sav Key (\$150)

Business-Pro
PO Box 44075
Phoenix, AZ 85084
802-996-6547



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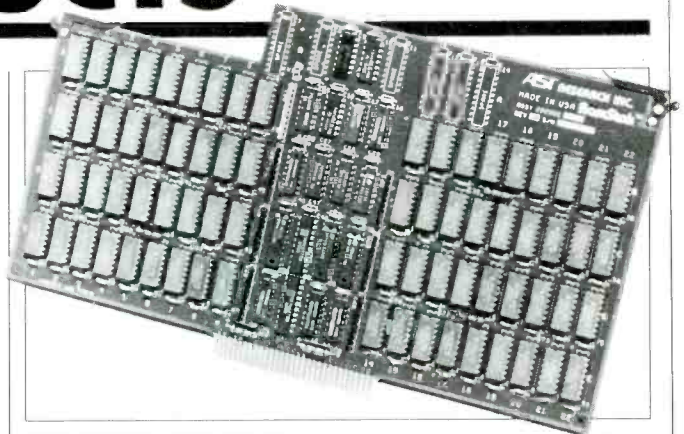
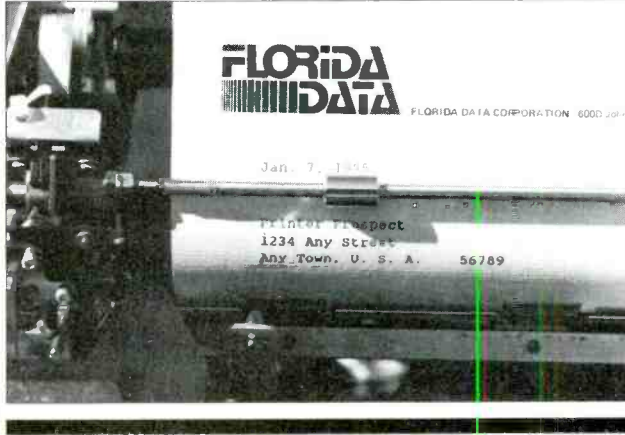
NEW PRODUCTS

NEW PRINTER POINTER SHEDS LIGHT ON PAGE PROBLEMS

Florida Data's newest dot matrix printers now come with a red light emitting diode (LED) attached to the print-

head. The LED throws a spot of light on the page at the bottom of the next character line to be printed. The new feature should make it easy to align preprinted forms or any paper before doing any printing.

Circle No. 71 on Free Information Card



2M-BYTE LISA RAM BOARD

The new RamStak single-slot memory expansion board from AST Research can add up to 2M bytes to the Apple Lisa. The product uses 256K DRAMS and is available as a 512K, 1M, 1.5M, or 2M board. AST officials say they

hope their product will "help breathe new life into the Lisa," and spark multi-user applications and operating systems such as Unix and Xenix on the Lisa. A 512K RamStak is \$1395. Expansion in 512K increments starts at \$1000.

Circle No. 72 on Free Information Card

SOFTWARE SOURCES

Keyboard Capture. When you test software, one of the most frustrating events is finding a bug and then not remembering the keystroke sequence that caused it. CapBak from Software Research Associates claims to cut down the frustration. It captures keystrokes and screens so that you can play back the session to see what actually happened. The program resides in memory, recording what happens and then dumping it to disk on command. CapBak, claims the company, works as long as DOS internal conventions and assignments are not modified by the program being tested. For IBM PC/XT. \$500 Address: Software Research Assoc., PO Box 2432, San Francisco, CA 94126.

Super Lister. Label Express is the name of a printer program from Rolodex Corp. designed to create labels, address envelopes, or print out Rolodex cards. It combines a simple file manager with a print utility so you can sort, search, merge, or edit a list of names and select those that you want to print. The program, says the company, lets you lay out the labels, cards, etc., in any form you want. For the IBM PC/XT and compatibles of Apple IIe, two disk drives, 64K RAM. \$49.95.

Circle No. 78 on Free Information Card

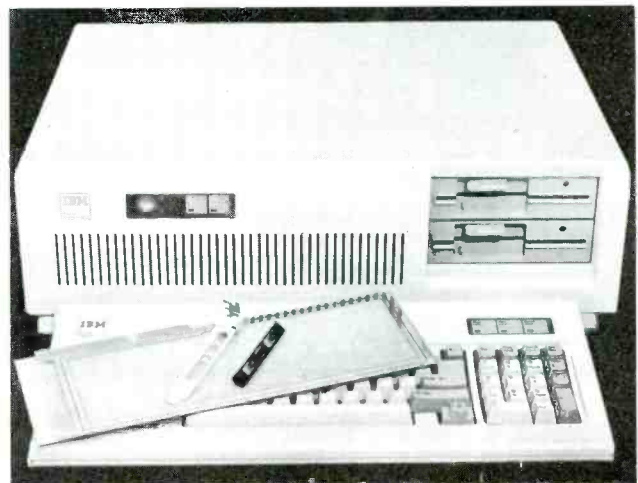
Keyless Disk. It's sometimes inconvenient to use a software program that requires a key or system disk in the primary drive, especially if your machine has a hard disk. Products from Cybex Corp. let users call up Lotus 1-2-3 programs without the key. The programs are called Key O and Key LAS. To use, you load them onto the hard disk with the 1-2-3 files, enter Key O or Key LAS, and the 1-2-3 program starts. There is no modification to the Lotus files. For the IBM PC/XT and compatibles. \$19.95. Address: Cybex Corp., PO Box 1067, Huntsville, AL 35807.

APPLE COLOR PRINTING

Texprint has an enhanced version of their Print-It! pushbutton Apple printer interface. The newest card supports full color printing on the Apple Scribe and Epson color printers, including the mixed graphics and text modes of Apple's new 80-column Text/

Apple Color Adapter Card. The unit's self-contained 64K ROM automatically decides whether to print in black and white or color and interprets how to handle the graphics or text screen image. A new ribbon-saving feature halts the ribbon when blank space is encountered. \$200.

Circle No. 80 on Free Information Card



ROLL YOUR OWN PC AT BOARDS

Vector Electronic Company has a prototype board for the IBM PC AT that'll hold up to

108 16-pin DIPS. Total board surface is 52 sq in. and connectors are provided for the 98-pin AT bus. \$30.55.

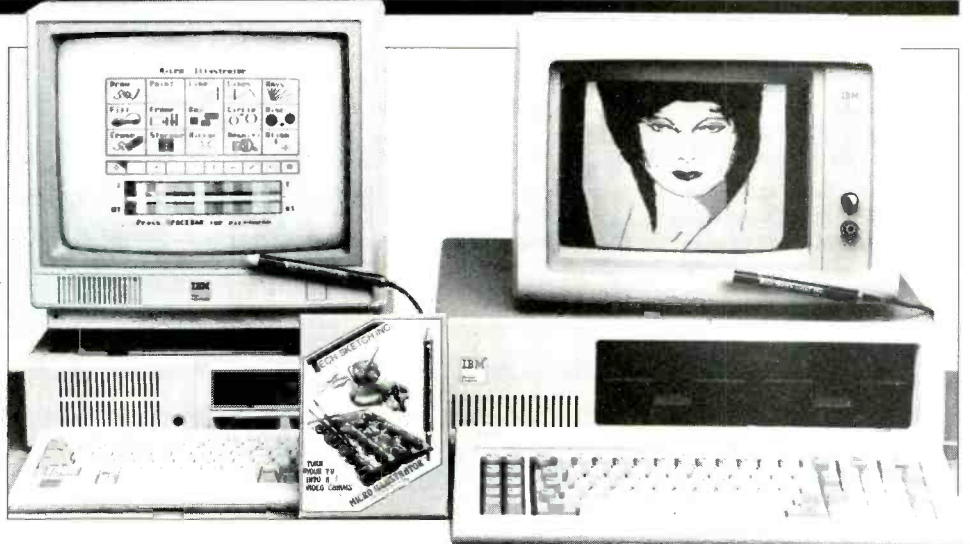
Circle No. 73 on Free Information Card

NEW PRODUCTS

IBM PC INTERACTIVE VIDEO

Visage has announced a board to turn an IBM PC into an interactive video development station. The V:Link 1500 comes with a special version of MS-DOS and other support software for most consumer grade or industrial video disc players. Interactive video systems are being used increasingly for training programs, point-of-sale demonstrations, simulations, and visual archives. The V:Link 1500 supports 80-column text (640 x 200 pixels in one color), or 320 x 200 pixel graphics in four colors. It can execute frame-specific instructions by stripping frame number digital data from the video signal. \$1500.

Circle No. 74 on Free Information Card



LOW-PRICED LIGHT PEN

Tech Sketch has introduced a light pen color graphics system for the IBM PC and PCjr. The accompanying Micro Il-

lustrator software offers full-featured screen drawing capabilities, with preprogrammed features. Tech Sketch officials maintain that light pen input is more natural and easy to

use than a mouse or other popular devices. The package comes with a lifetime warranty. Light Pen and software \$70.

Circle No. 75 on Free Information Card



HEATH CAD TRAINING AVAILABLE

AutoCAD is a microcomputer-based course to teach computer-aided drafting and design, from Heathkit/Zenith Educational Systems. The package includes a plotter, digitizing tablet, and software

for the Heath/Zenith Z-100 series computer. The system will display architectural drawings, mechanical or electrical layouts, and printed circuit board parts layouts. An unlimited number of layers and eight colors can be used.

Circle No. 76 on Free Information Card

SOFTWARE SOURCES

Deals in the Making. If you're facing a job interview, home sale, labor-management dispute or complex business agreement, you need all the help you can get. The Art of Negotiating, from Experience in Software, aims to provide that extra edge. According to the company, the software helps you organize and think through any type of negotiation you may encounter—step by step and point by point. You answer questions about your objectives and their importance and priority; the software guides you in unfolding a plan of action, creating an agenda and considering the other party's point of view. \$495.

Circle No. 79 on Free Information Card

DEC-COMPATIBLE MICRO

The new Chrislin Industries CI-Micro-11 computer system uses LSI-11/23+, LSI-11/73, or MicroVAX CPUs and comes standard with dual floppy backup. Winchester storage ranges from 10M bytes to 40M bytes and can

emulate RL02, RL01 or RD51 DEC drives. The CI-Micro-11 operates under RSTS/E, RSX11/M, RT11, and Unix operating systems. With LSI-11/23+ CPU, 256K memory, 2M bytes of dual 8" floppy storage, and 20M-byte Winchester. \$7695.

Circle No. 77 on Free Information Card



NCR PC

(Continued from page 24)

convenient than it usually is in the IBM PC. The exception to this rule comes when you attempt to install an expansion memory board or to add memory to the motherboard. (While the standard configuration PC Model 4 comes equipped with 128K of RAM, the motherboard has a total capacity of 256K.) In both cases, you have to adjust a DIP switch that is awkwardly placed between the first and second expansion slots. Those with any but the nimblest of fingers may be forced to remove a board or two to reach the switch.

Keyboard

One final area where the NCR's design differentiates it from its competition is its keyboard. A group of dedicated cursor control keys has been added between the main body of the keyboard and the numeric keypad. In theory these keys should allow the user of a spreadsheet program such as 1-2-3 to leave NUMLOCK on and use the numeric keypad for entering numbers while using the separate cursor control pad to move the cursor about the screen. Unfortunately, the designers of the keyboard did not duplicate the layout of the cursor control keys on the numeric keypad in the new cursor control pad. Instead they came up with a strange layout that finds the HOME key at the center of a cross made up of the four arrow keys, and the other cursor control keys (DEL, END, PGUP, PGDN) and a control key grouped in no particular order at the top of the keyboard.

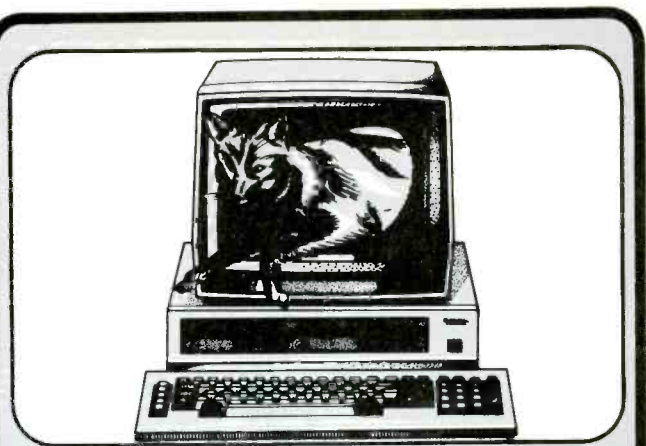
The result is so awkward that the new cursor control keypad is of little use, and the cursor control keys on the numeric keypad are harder to use than ever, since they are now well over 3" away from the main body of the keys. Although spreadsheet users might adapt to the arrangement of the new cursor control pad in order to reap the benefits of having a real numeric keypad, it's doubtful that many word-processing touch typists will appreciate it. Touch typists might also object to the feel of the keyboard itself—the keys have so little springiness that fast typists may run the risk of bruising their fingers as they bounce off the keys.

The keyboard is provided with a generous amount of cord, but, as is true of the IBM PC and most of its compatibles, much of the length of the cord is wasted because the keyboard plugs into the back of the computer, leaving you with only a little more keyboard mobility than you would have with an attached keyboard. No matter how much keyboard cord is supplied, this arrangement is less satisfactory than having a plug socket in the front of the computer, as the Compaq DeskPro and the Leading Edge Personal Computer have.

The NCR PC Model 4 is supplied with a version of MS-DOS 2.11 called NCR-DOS and GW-BASIC (both from Microsoft), a RAMDisk utility, and two tutorial programs: NCR Pal and NCR Tutor. The former gives the neophyte computer user a good introduction to computer terminology and key hardware, software, and DOS concepts, as well as a brief introduction to BASIC programming and an overview of the more common types of applications programs. NCR Tutor provides detailed lessons about MS-DOS commands, batch files, and the DOS line editor.

Portability isn't one of the strong suits of this computer. Indeed, at 54.5 lb for the processor and keyboard, this is one of the heaviest of PC compatibles we've seen. However, what it lacks in totability it makes up for in ease of setup. Even a total newcomer to personal computers will probably find it simple to plug in the keyboard and power cord into their respective sockets and then turn on the power switch. As stated earlier, adding expansion boards to the PC Model 4 is also quite simple.

(Continued on page 82)



The Silver Fox™ Trots through Lotus like 1,2,3

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NCR PC

(Continued from page 81)

Software

Overall, the PC Model 4 seems to have a high degree of software compatibility with the IBM PC. It ran such tough tests of compatibility as Microsoft's Flight Simulator, Lotus 1-2-3, and RoseSoft's ProKey without problem. In fact, the only program that gave us problems with the NCR was CorrectStar, which hung up the machine each time it was called when we were using NCR-DOS. However, it ran flawlessly when we switched to PC-DOS 2.1. Thus, as with many compatibles, it would probably be a good idea to acquire a copy of PC-DOS for use with the NCR, although use of the manufacturer-supplied DOS is recommended whenever possible.

The standard PC Model 4 configuration, which includes a monochrome (non-graphics) display, 128K of RAM, GW-BASIC, NCR-DOS, NCR Pal and NCR Tutor, and two double-sided, double-density 360K floppy disk drives, is priced at \$2825. The same configuration equipped with a color graphics display costs \$3299. ◇

Getting the Most

(Continued from page 56)

software producers offer enhanced backup software to make the task easier. IBM offers a set of utilities to facilitate marking files to be backed up and to copy them into named directories. Such routines that know which files have been changed since the last backup are helpful when you're working with a large number of files. Current versions of MS-DOS have Backup and Restore utilities that use the compressed, multiple floppy technique as part of the operating system. Complicated software, such as an integrated accounting package, may work with a large number of relatively big files in a manner transparent to the user. It would be hard to do a manual backup of such files because you probably wouldn't know exactly which files were being used and updated at any given time. Multiple subdirectories frequently are involved, which makes the job even harder. Cogitate's Dump/Restore-XT includes a number of backup options to help you keep adequate reserve data. The flaw with many of these approaches is that you still have to remember to do the backup yourself.

Some large computer operating systems automatically maintain backup files for you on separate sections of the active hard disk or on other devices. Now some vendors are offering "intelligent" backup software for micros. Business-Pro's Sav Key for IBM users is one example.

"The biggest problem we were seeing with our clients is that they simply forgot to back up or they refused to spend the time necessary to maintain data security," said Roger Birks, vice president for marketing at Business-Pro, a Phoenix consulting firm. That's why the company developed Sav Key, a software product that reminds hard disk users to back up at the end of the day, then pretty much automates the process, to make it as easy as possible. Says Birk: "With our software, if you don't do a backup, it is because you have made a conscious effort not to do it."

Some companies establish a strict shutdown policy that operators must follow each day. A printed check list posted at the computer or a large calendar that shows at a glance which back up functions were performed when can also be helpful.

Getting It Together

The first step in getting the most out of your hard disk is to make certain that you've made the best possible hardware choice. Next, move your applications to the new storage medium slowly. Plan your directory structure; investigate any additional utility software you may need to help use your disk; and understand any special needs for each application package you plan to use with it before you start dumping everything over. Different software packages may require slightly different transfer techniques. Applications such as Symphony, for example, cry for the additional storage afforded by a hard disk, but these copy-protected programs require that the signature disk remain in the floppy disk drive while the software is running. Depending on your individual needs, such a limitation may require rethinking how you'll set up your hard disk.

And, above all, establish immediately a realistic backup procedure that will work for your installation. The key is to set goals and procedures that you will follow regularly. As Business-Pro's Roger Birks observed: "If you own a hard disk system, someday you will lose information off it. It will happen. It may not happen this week or this month, but it will happen." A little planning in advance could turn a potential disaster into a minor inconvenience. ◇

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Savvy

(Continued from page 34)

screen or the printer. Our impression is a user doing a lot of programming could overcome this limitation partially, but only as it applies to generating character graphics, and not to dot-addressable graphics.

The absence of true graphics support is strange, because Savvy does work in the color mode and even allows the user to change the background and foreground colors of its character-oriented screen. What's more, there are no provisions for independent windowing of the screen, particularly odd since Savvy provides very straightforward functions for saving and restoring any number of whole screens ("Pop Screen" and "Push Screen").

Arithmetic computations are also a weak area. Savvy supports only addition, subtraction, multiplication, division, and integer truncation. These are certainly enough for many applications, but hardly represent a robust set of computational tools. Once again, Savvy surprised us by its lack of trigonometric and logarithmic functions and its inclusion of a full set of bit manipulation functions such as AND, OR, and XOR.

Our biggest disappointment, however, was Savvy's filing system, a key element of the product. We were dismayed to discover that Savvy only supports one index per file and that this index always uses the file's first field as the sole indexing key. This is a real inconvenience and a serious shortcoming, especially since database managers that support multiple indexes and allow multiple-field keys are now the norm. Add to this Savvy's inability to access files on more than one volume, and you have a set of limitations that might not be noticed by a novice user, but would drive even a minimally experienced programmer up the wall.

Another major weak point is Savvy's support of applications development. Savvy does not provide an integrated set of tasks to help the user create input

screens and report formats or to design processing steps, etc. It does provide what it calls a "Database Manager" that performs some of these functions, but it is not sufficiently flexible and does not make it easy to customize its output. Most users would soon be frustrated with this approach and might seek to go back to programming from scratch.

Documentation and Support

Savvy comes with a huge user's manual, some 580 pages in a 9" ring binder. The manual was fairly readable and certainly comprehensive but, like the product, was somewhat spotty, offering extensive detail in some areas and not really enough in others. Unfortunately, it did not include an index. We were able to figure out most of what we needed by thumbing through the reference section, where the commands are listed in alphabetical order. We think, however, that a novice would be rather daunted. Excilibur does supply a separate and much shorter tutorial-style manual for the database manager, but it lacked not only an index but also the clear examples and graphics one would expect in a good tutorial for beginners. Excilibur also has a toll-free line for all users. We tried it out on two occasions and found the staff helpful both times.

Summing Up

At \$395, Savvy is priced reasonably enough to compensate for some of its faults. It is certainly not alone among its competitors in its having serious shortcomings, and it is definitely a more interesting and innovative product than most. We grew to like Savvy, and wish that it could be altered to eliminate our biggest criticisms. Unless the product improves substantially, however, its current weaknesses will, we think, limit it to a very small market. Novices will soon outgrow it, and more advanced programmers will pass it by. ♦

Hard Disk Drives

(Continued from page 51)

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More Intelligent Controllers and Interfaces. Look for more intelligent controllers and perhaps the end of a controller standard, as such. Developers are tired of designing down to ST-506, and manufacturers want higher profits than they're getting with drive-only sales.

"The trend is to take all the controller functions off the external board, the one inside the computer, and move them

onto the disk drive," says Lapine Technology vice president Herb Ragle. Then all you need to hook it to a computer are data lines and a few control lines to attach to the computer bus.

"It eliminates the transfer rate problem and the speed problems associated with a servo mechanism," Ragle continues. "And there are economic advantages. There are very high profit margins in the controller, so this kind of integration gives the drive manufacturer an op-

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Improved Backup. And, we'll see changes in backup methodology. Backup hardware is destined to get cheaper and easier to use. Tallgrass Technologies, for example, has introduced an 11-track tape format and software to make

hard disk software maintenance easier. The company hopes its PC/T format (personal computer/tape) will become an industry standard.

Moreover, as hard disk hardware becomes more reliable, the driving need to back up a disk daily may be overcome.

High-capacity storage is still the exception rather than the rule. But that's changing rapidly. An Intel official told a New York conference recently that a user's excited declaration about using a 10M-byte disk will soon be met with an expression of sympathy as 20M-byte and larger drives gain in popularity. ◇

High Color Resolution

(Continued from page 63)

else). It can even switch from one palette to another.

In high-spatial-resolution mode, the VDA's memory is used more conventionally. Each byte stores color information for 2 pixels; the 4 bits per pixel allow encoding 16 colors.

Unlike other display adapters, no character-generator ROM is used in the high-spatial-resolution mode. Instead, AT&T includes software that can generate characters in several different fonts.

Creating Pictures

Because the VDA departs from existing technologies, few ways of creating images for it currently exist. AT&T does provide demonstration software programs and tools written in the C programming language to companies developing hardware and software products based on the VDA. Additional sources of images for the VDA include remote databases, which can be accessed with the AT&T NAPLPS (North American Presentation Level Protocol Syntax) videotex decoder. Or, live or recorded video images can be stored using AT&T's Image Capture Board (ICB).

The ICB is a video digitizer that can capture and display continuous-tone, television-quality images from any conventional composite video source. Like the VDA, its resolution is limited to 256 × 256 pixels (of which 200 pixels are displayed vertically). Each pixel can be drawn directly from the full 32,768 color palette, so storing the captured image requires 128K bytes of on-board RAM.

This digitized image can be translated by AT&T-supplied software to VDA format. The program scans the image, determines how many colors it contains, and selects the 256 predominant ones. It then creates a color table and another file containing the index information for

use by the VDA.

Software is also available to compress or decompress image size, and even to manipulate the picture, all the way down to changing the color or intensity of individual pixels.

The ICB benefits even more from using AT&T's RARAM technology than does the VDA. Compared to other personal computer video digitizers, the ICB is fast. It can record a full-screen image in real time—1/60 second.

Moving Pictures

VDA (or ICB, for that matter) format images can be transmitted by modem from one computer to another simply by sending the appropriate files, which can be captured to disk at the receiving end.

Another clever AT&T innovation is an image-coding algorithm that allows a pleasing quarter-screen-sized VDA-compatible image to be transmitted in just 15 seconds at 1200 bits per second. A conventional line-by-line transmission would take 2 minutes.

Rather than sending individual lines, the algorithm breaks the entire picture into a small number of large blocks—for instance, four. A color value is first transmitted for each block.

Each block is then subdivided into smaller blocks, and their color values are sent. Each of the smaller blocks is further subdivided, and so on. The blocks get steadily smaller, and the image gets steadily more detailed.

High-color-resolution imaging is unlikely to replace conventional display methods for most applications—word processing, spreadsheeting or database management. Undoubtedly, however, the new technology will spawn new applications, particularly in visual communications and personal-computer-based art and video imaging. ◇

DisCache

(Continued from page 30)

board can be set in 21 different positions, indicated in the manual, to identify workstations as 1-21.)

Drawbacks

While the unit performed beautifully, I have a couple of minor quibbles. First, although the LED display reports error messages, the documentation doesn't explain what significance they have or how to respond.

Fortunately, the few error messages I received didn't seem to affect the operation of the system. I was able to continue after they were displayed with no loss of data. A list of error messages in the manual would have been helpful in clearing up the user's confusion when one does appear on the display.

Second, the print spooler had an annoying trait of sometimes pausing for about 30 seconds before printing out the last page of a document. Although it's not a devastating flaw, it is frustrating. At no point, however, did the spooler ever lose anything.

Summary

DisCache/CacheNet isn't the cheapest hard disk on the market (see spec box), but considering all you're getting, I conclude it's priced fairly.

The system certainly performed well under heavy use for the several months that I tested it. It never lost data; it gave me "low-cost" networking; and its print spooling and superfast access speed saved me lots of time.

The unit is as much at home with users who seek the mass storage, the increased speed and the spooler, as with users who want an inexpensive and very efficient multi-user system. It also offers the possibility of such diverse computers as an IBM PC, a compatible, and an NEC APC sharing data files easily.

A few features that are scheduled for release in the near future will increase the functionality of DisCache even further. These include partitioning software, which will allow MS-DOS and CP/M to be resident concurrently on disk, and an enhanced backup facility called Diskback, for incremental backup.

According to Eicon, Diskback will make it easy to back up only material changed since your last backup, a big time saving that you will certainly appreciate if you have ever backed up a hard disk before.

Does DisCache do all that it claims? It does. Does it take care of my entire hardware wish list? Well, almost. If I only had the 20M-byte unit with a laser printer.

All in all, DisCache is a product to be highly recommended. ◇

Digitized Video

(Continued from page 62)

disk can only hold five such images. A 20M-byte hard disk, though, could contain over 350 frames, and the prices of these drives are approaching \$1000.

Furthermore, a full-frame image will not always be necessary. Half- or quarter-frame pictures will suffice for many applications, and image files can be made smaller using data-compression techniques. Ultimately, a compressed quarter-frame image file may require no more than 6 or 7K.

In the case of videotex usage, transmission time is important. However, the block-compression technique described in the article can send a recognizable image at 1200 baud in 15 seconds.

Smart Series

(Continued from page 42)

This means that the user can completely customize the keyboard. Libraries of macros can be defined and loaded automatically via the applications.

One of the most powerful features of the Smart System, called Project Processing, enables the user to write simple programs. The language is relatively simple, but contains commands for accepting input, calculating, producing output, and invoking other projects. For example, using the spreadsheet function, I created a project to perform a set of calculations that depended on the contents of a row in a specific column. There is a drawback, however: Although I have no basis for comparison, the project seemed slow. I have another criticism, too: Creating projects would be easier if one were able to see the worksheet while creating the commands. Innovative Software promises to solve this problem in a future release, but even in its present form, the Project Processing capability is very useful—and easy to use.

ZyIndex

(Continued from page 36)

higher-priced "professional version") of the program. Both versions recognize path names in DOS 2.0 or higher.

Minuses and Pluses

I found that creating the index disk was the only drawback this otherwise extremely helpful program had. You cannot, of course, take advantage of ZyINDEX's abilities unless you have created at least one index disk. The time required to make the index disk(s) depends on how many files you want to search. ZyINDEX's manual says that it

Summing Up

The VDA is not the answer to everyone's needs. A photographic database that requires digitization of architectural drawings, for example, would need an imaging board with much higher spatial resolution than AT&T's. And a CAD/CAM system that performed intensive graphics manipulation would run much more efficiently on a more intelligent graphics processor.

Nevertheless, the VDA is an important development. It makes inexpensive photographic imaging on microcomputers possible. Without a doubt it will rank as one of the more significant microcomputer products of 1985. ◇

Summing Smart Up

The Smart System is still a developing product. Innovative Software has a policy of providing registered users with free software updates for a year. A new version of the software was distributed fall, 1984, and a major revision is scheduled for early this year. The 1985 update will include a communications package and expanded memory paging for speeding up the system. Also planned is a spelling checker.

I think that Innovative Software is certainly correct in its claim that each of the modules in the Smart System is more full-featured than its counterpart in a more integrated package. The main advantage of more integrated packages is the capability of asking "what-if" questions and displaying graphical results dynamically on the screen. Nonetheless, I think that the Smart System modules are worthy of consideration if you are in the market for any or all of the applications. ◇

takes about a minute to index a file of "two or three pages." Indeed, it took me 10 minutes to index 18 files that totaled about 150K bytes. Still, if you have a substantial collection of files on either a hard disk or several dozen floppies, you will have to devote a few hours to properly index them. Thereafter, as you create new text files, you should plan on setting aside some time at the end of each work session to add them to an index disk.

ZyINDEX's manual and on-disk tutorial—which are otherwise very thor-

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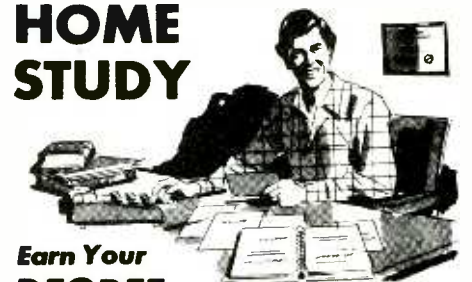
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ZyIndex

ough, especially on the search procedures—give scanty treatment to the indexing procedure.

ZyINDEX comes on three floppy disks. (The one containing the main program is copy-protected, although a back-up copy is available for \$15.) The install program requires you to create two additional disks. The process of setting up the program for indexing takes a lot of switching of floppies—at one point it took me three tries to figure out which disk was supposed to go in which drive. Once I had the procedure mastered, the program's menus stepped me through indexing easily enough, but I wish the manual and tutorial were more precise about this essential procedure.

My irritation quickly subsided, however, when I used ZyINDEX to search through several disks that contained files I had downloaded from CompuServe. Most of the files contained only a few lines of messages I really wanted to save and screen upon screen of sign-ons, menu selections, and assorted garbage. With ZyINDEX I was able to search all the files for any subject. The searches were nearly instantaneous, and the words I had included in my search criteria appeared highlighted. I could jump from one occurrence of a key word to another with the single push of a function key and transfer the small blocks of information I really wanted to more concise files. What had been a laborious process of editing the downloaded files with a word processor became a snap.

If you create any sizable quantity of

Specifications

Product: ZyINDEX

Mfr: ZyLAB Corporation

233 E. Erie St.

Chicago, IL 60611

Price: Standard version, \$145

Professional version, \$295

Requirements: IBM PC or compatible with 192 K, two double-sided, double-density floppy disk drives or hard disk or RAM disk equivalent under DOS 2.x

Optional Hardware Supported: Printer

text files with your computer, there may come a day when you will want a program like ZyINDEX. My only advice is to get it now and to start indexing your files as you create them so that when the time comes, ZyINDEX and a set of indexed files will be waiting to do an afternoon's job in seconds.

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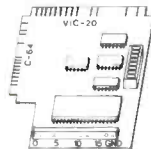
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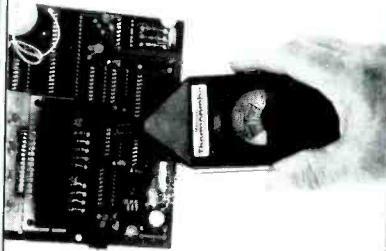
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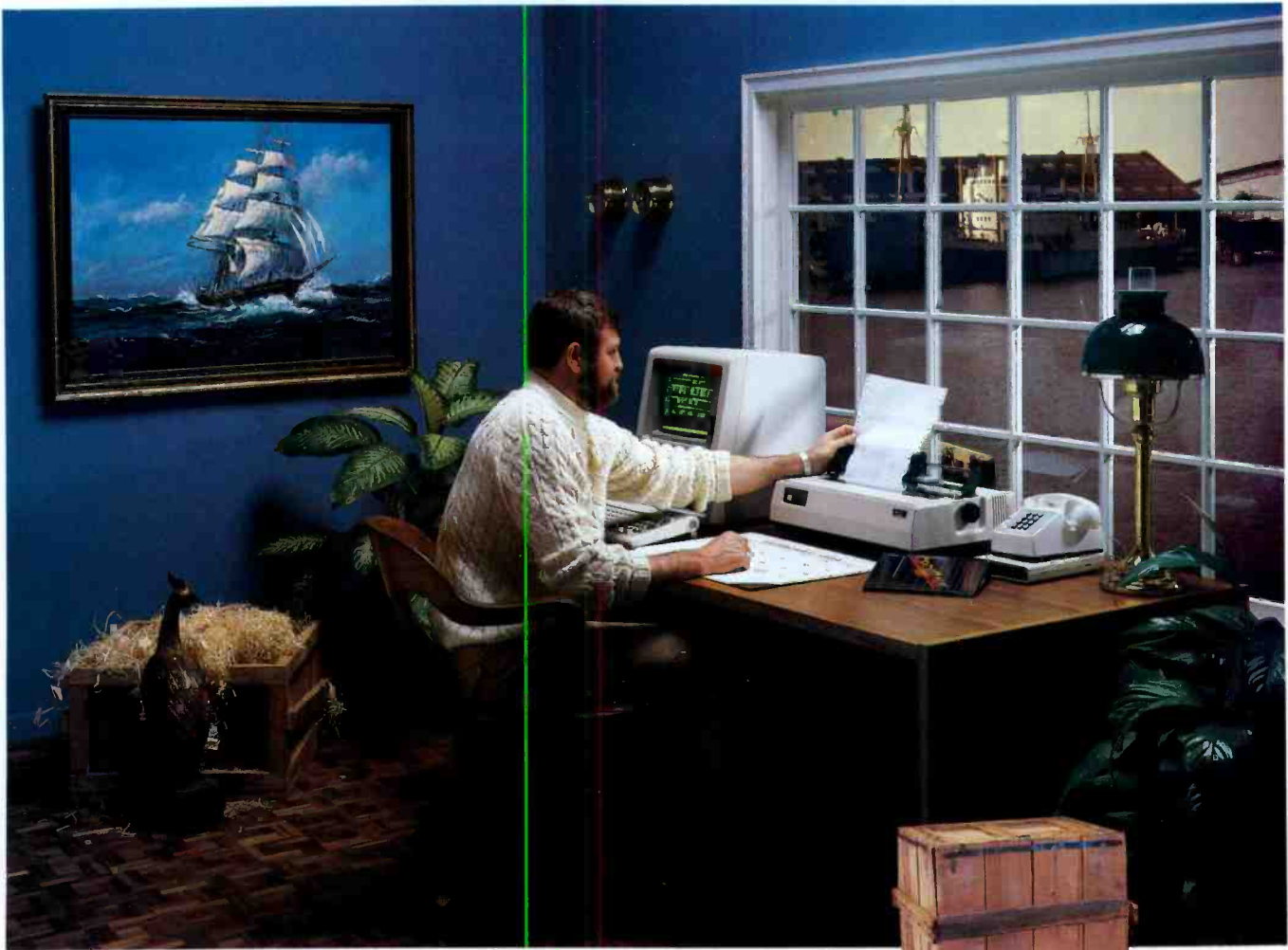
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ADVERTISERS INDEX

RS no.	ADVERTISER	PAGE no.
	Active Electronics	86
	Apple	22-23
	Classified Advertising	90-94
	Cleveland Institute of Electronics, Inc	29
60	CompuServe	7
10	Conroy La Pointe	44-45
14	Digi-key Corp.	89
25	Eastman Kodak	25
	Grantham College of Engineering	85
8	Hayes Microcomputer	35
26, 27	Heath Co.	39
41	IBM Corporation	2, 3
12	INMAC	82
21	Jameco Electronics	88
22	JDR Microdevices	87
23	J & R Music World	83
20	Leading Edge	C-4
4	Microstuf, Inc.	C-3
67	NCR	C-2
	NRI Schools	19
38, 39, 40	Protecto	9, 10, 11
	Radio Shack	41
	Scottsdale Systems	81



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