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Page-description languages—such as Interpress and Postscript—turn laser printers into powerful publishing tools, but system integrators must learn to harness them.

**Robert E. Peterson Jr.**
Freehold Corp.

Page-description languages offer the key to the power and versatility of laser printers and other high-resolution hard-copy devices. By learning how to use the languages, system integrators obtain control of a dazzling array of printing capabilities.

The power to manipulate a printer’s output has traditionally rested in the hands of applications developers. And these developers will eventually offer many programs to take full advantage of the 300 or more dots per inch (dpi) available from laser printers. For the time being, however, users will find few such applications on computer store shelves.

System integrators are responsible for enabling users to tap the laser printers’ power. You can do this in two ways. The simplest is to adapt existing application packages to drive the printers. However, this technique is unlikely to push the printers’ capabilities very far, due to the inherent limitations of most of today’s applications.

A more versatile method is to create software tools that give users easy access to the power of page-description languages. This approach essentially forces you to take on the job of applications programming, but the effort can pay off for markets that require powerful graphics and/or typographical functions.

Bear in mind that page-description languages aren’t well-suited for end users. The languages should be thought of as a formalized set of printer interface commands rather than general-purpose programming languages. You can write programs in a page-description language very much as you would any high-level programming language, but that is not necessarily the most practical approach.

**Interpress can transform scanned images, such as this hummingbird, by arbitrarily rotating the image. One image of the bird has been scaled and rotated to create all three, while the background was added graphically.**
efficient way to generate page images.

The philosophies behind the two major page-description languages now available differ greatly in their allowances for direct programming. Postscript, from Adobe Systems Inc., Palo Alto, Calif., permits you to write graphics-producing programs with about the same effort as writing a BASIC or Pascal program. Interpress, from Xerox Systems Institute, Palo Alto, on the other hand, embodies the attitude that an application program should take responsibility for generating graphics, and the page-description language should concentrate on translating those graphics efficiently into a form printers can deal with.

These differences and others make the two languages difficult to compare directly. However, this article employs examples of direct graphics coding to demonstrate how the languages work. It is crucial to bear in mind that the code presented here does not truly indicate how you would use Interpress to build a system. The code simply shows the concept behind the language. In any case, this article does not endeavor to prove one language more powerful than another. The goal here is to demonstrate how the page-description languages work, and to outline some of their major differences in purpose.

There are also important differences in how the two companies market their languages. Adobe manufactures no printers but adapts Postscript to other concerns’ machines for a fee and collects royalties for every Postscript-using printer sold. Xerox, in contrast, has placed Interpress in the public domain so that any manufacturer can implement the language in any printer at no cost for the language. Xerox also uses Interpress in its own printers.

Adobe has implemented Postscript in several manufacturers’ printers, including Apple Computer Inc.’s Laserwriter. Further, Adobe says it will implement the language for two dozen more output devices this year. So far, Xerox’s Interpress is available only in Xerox printers, but even these machines do not yet offer the entire Interpress command set. Xerox reports, though, that several vendors have promised printers and/or systems that incorporate Interpress. The vendors include Burroughs Corp., Dataproducts Corp., Digital Equipment Corp., Imagen Corp. and Siemens Information Systems Inc.

Will Postscript’s current lead in the market result in the language’s establishment as the de facto standard? Maybe not. In this case, both Postscript and Interpress could be accepted as standards due to their philosophic differences.

The differences between the two languages grow out of the assumptions that underlie their projected use. Xerox assumes that most of the work done on high-resolution printers involves mostly text and must be produced rapidly. Monthly phone bills are an example of this type of application. While typical pages might include the local phone company’s logo, some dividing lines and several sizes of typography, the primary goal is to print two or three pages per second. In this view, printer overhead must be kept to a minimum so the printer can run as fast as possible.

Adobe, on the other hand, is more concerned about overhead on the computer than on the printer. In fact, Adobe’s approach places a great deal of the computational burden on the printer so as to off-load the host. This approach also stems from the company’s belief that the same file should be able to drive different output devices—a 300-dpi laser printer or a 1,250-dpi typesetting machine, for example—without the host knowing the peripherals’ capabilities. Any differences among the output devices should be...
resolved within the devices and not in the host. If a document calls for a font that is not available in the target Postscript printer, for instance, the printer decides which available font will serve as a suitable substitute.

These philosophical differences derive from the two companies’ primary markets. While Xerox’s stable of printers includes the giant Model 9700, which produces pages at the blinding rate of 120 per minute, the fastest Adobe target printers run at 26 pages per minute. Xerox contends that, at the higher rates, printers cannot afford the time to handle much overhead; the documents to be printed should be prepared appropriately by the creating device.

Other contrasts between the two languages take an interesting twist when it comes to describing entire documents in addition to single pages. Xerox’s customer base forces the company to pay attention to issues such as how a document will be bound (you can specify that a document is to be stapled, for instance) and in what order the pages will be printed. (Printing on both sides of each page, for example, might be expedited in a large printer by printing one side of several pages before cycling them back through to print the other side, or a printer might need to print pages in reverse order to stack them correctly). The latter consideration prompted Xerox to specify that every page described by Interpress must be independent.

Postscript allows page independence, but does not enforce it; a page can derive parameters, such as the specifications for a coordinate system, from other pages. The “other pages” are assumed to be previous pages so that the printer will have received the appropriate parameters. If that document goes to a printer that produces the pages out of order, though, the effort will fail.

How Postscript works

In addition to deciphering the philosophical issues, you must understand how page-description languages deal with typography, graphics and scanned images. The example of pie-chart generation (Fig. 1), involving both text and graphics demonstrates basic page-description language concepts.

The Postscript coding appears in three routines that construct individual pie slices, calculate the gray shade for each slice and then put the slices together. The program begins by allocating storage space in the printer for the necessary procedures. As with all Postscript routines, round brackets open and close the routine that constructs the slices. The routine, DrawSlice, also contains other information delimited by round brackets. It begins by specifying its four operands: the slice’s label, starting angle, ending angle, start of the slice’s label string and the slice’s label string width. The Postscript coding appears in three routines that construct individual pie slices, calculate the gray shade for each slice and then put the slices together. The program begins by allocating storage space in the printer for the necessary procedures. As with all Postscript routines, round brackets open and close the routine that constructs the slices. The routine, DrawSlice, also contains other information delimited by round brackets. It begins by specifying its four operands: the slice’s label, starting angle, ending angle, start of the slice’s label string and the slice’s label string width.
Consider the languages as a formalized set of printer interface commands rather than general-purpose programming languages.

angle and gray shade. Later, the pie-drawing routine, DrawPieChart, specifies its operands as the pie’s title, the title’s point size, the slice labels’ point size, an array containing slice sizes and names, the pie’s X-Y center and the pie’s radius.

The next small section of code, beginning with “newpath,” creates a path in the shape of a pie slice. Once you have created such a path to define a shape, you can fill the shape and/or draw its outline. The Postscript operator used to create the slice’s path is “arc.” Starting from the origin (0,0), this command uses operands “radius,” “startangle” and “endangle” to make a line segment as long as the value defined for the operand radius and to extend an arc across the angle specified by startangle and endangle. The operand “closepath” then creates the line segment needed to complete the slice. Finally, “setmiterlimit” prevents spikes from occurring on the slice’s interior angles when the slice is outlined.

Next, the program fills the slice with the appropriate gray shade. First, though, you must save the current path with “gsave.” After filling the slice, you restore its path and use “stroke” to outline the path.

The rest of DrawSlice draws the slice’s label and its accompanying tick mark. To find the correct place for the label and tick mark, the “rotate” operator finds the center of the slice’s arc and rotates Postscript’s coordinate system counterclockwise so that the X axis coincides with the arc’s center. “Translate” then shifts the origin out to the arc’s center.

From this point, you can create the path that will be the tick mark. Because the coordinate system has been rotated and translated, you simply start at the origin (using “moveto”) and make the tick mark 80 percent of the label’s point size in length. The “stroke” operator places the tick mark on the X axis extending from the origin in a positive direction.

You can place the slice’s label at the current origin, but, in the rotated coordinate system, the label would also come out rotated. Thus, you want to return to the previous unrotated system. Before doing that, however, you must save the rotated system. Using the operator “transform” on the rotated origin pushes the coordinates of the origin in device space onto Postscript’s operand stack. Operand “grestore” returns you to the previous unrotated coordinate system, and “itransform” determines where the coordinates on the stack are in the current coordinate system. These coordinates are defined as Y and X.

Finally, some adjustments are made so that the label doesn’t collide with the pie slice. Part of this procedure employs the “It” operator, which returns the Boolean value “true” if the first operand from the stack is less than the second and “false” otherwise. Given the coordinates involved and the length of the label, Postscript thus determines where to place the label.

The rest of the pie-chart-generating program continues in the same vein. There are a few other interesting procedures, however. Note in the middle of the routine DrawPieChart, for instance, that Helvetica has been specified for

--- Things between double dashes are comments --
-- Source File: Pie.interpress --

BEGIN
-- Preamble --
{ Xerox xcl-1-1 Modern-bold 3 makevect findfont
  10 scale modifyfont 0 set
  Xerox xcl-1-1 Modern-bold 3 makevect findfont
  20 scale modifyfont 1 set
}
-- Page 1 --
1 5 --priorityimportant-- set
-- Set up transformation --
31/87874 scale concat
-- work in units of 72 to the inch --
306 396 translate concat
-- origin at center of page --

-- Do the filled segments --
4/5 setgray
0 0 moveto 100 lineto
16643/179 74987/203 7185/126 34022/497 arcto
1 makeoutline maskfill
3/5 setgray
0 0 moveto 9185/126 34022/497 lineto
-16005/1277 27680/279 -15423/176 10165/211 arcto
1 makeoutline maskfill
2/5 setgray
0 0 moveto -15423/176 10165/211 lineto
-1305/142 -7321/234 -6557/154 -65419/723 arcto
1 makeoutline maskfill
3/10 setgray
0 0 moveto -6557/154 -65419/723 lineto
9293/1480 -29841/299 6805/127 -20995/238 arcto
1 makeoutline maskfill
7/10 setgray
0 0 moveto 6805/127 -20995/238 lineto
4207/66 -46539/604 16256/222 -37034/541 arcto
1 makeoutline maskfill
0 setgray
0 0 moveto 16256/222 -37034/541 lineto
16643/179 -50249/1365 100 0 arcto
1 makeoutline maskfill

Fig. 2. The Interpress code for producing Fig. 1 takes a different tack than that employed in the Postscript version. The code shown here is a human-readable form of the real Interpress token sequence, which consists of hexadecimal values only.
both the title of the chart and the slice labels. You can just as easily specify any other of the 13 fonts available in Postscript printers. (The number of possible fonts has recently been expanded by 45.) This doesn’t mean that every Postscript printer will have all the fonts, but the printer will automatically make a substitution if your choice is not currently resident.

Note, too, that the array at the program’s end is actually an array of arrays containing the labels and size percentages for the slices. Another part of the program (starting with “/perangle”) converts the percentages into degrees of angle. This portion of Postscript performs general-purpose math, as does the procedure described earlier that locates the middle of a slice’s arc. Further, the routine “findgray” selects gray shades for each slice so that no adjacent slices have the same shade. Other procedures in the program—such as the one that uses “/it” to help position the slice labels—employ logical operators.

These computational features are absent from Interpress because Xerox believes that such operations should be handled by a page’s creator. Avoiding this overhead on the printer allows it to run faster. One of the prices you pay for this speed is the inability to write an Interpress program that will, say, choose the slices’ gray shades for the user. (Of course, Xerox never intended for you to write programs in Interpress anyway!) If you want to automatically choose gray shades, you must construct an application program that will do it, then pass the results to the printer in Interpress code.

### How Interpress works

A “written encoding” form of an Interpress program (Fig. 2) that generates the same pie chart shown in Fig. 1 differs greatly from the Postscript coding. The form of the code that an Interpress printer expects to see is a sequence of hexadecimal values. Unlike Postscript, which employs operators and operands made up of ASCII characters, Interpress operators and operands are made up of tokens. Each numerical token represents a command. One of the values of this approach is that you can send tokens to a printer much faster than you can send ASCII-based words.

Because Interpress is not designed for direct coding, the program shown in Fig. 2 is a brute-force method. For example, the code specifies the coordinates to follow in drawing the complete six-piece pie chart. If the user wants to create a seven-piece pie, for instance, the program would have to be significantly modified.

As noted earlier, one approach to using a page-description language is to design an application program that interfaces between the user and the language. This method is particularly appropriate in Interpress’ case. The application would essentially be a program that generated another program in Interpress and would also display the desired image on a screen. You can do this with an existing application, but translating it to the page-description language is likely to be clumsy, despite Interpress’ versatility.

Along the same lines, when you use a page-description language to code an image directly, you have no guarantee that the user’s display system will graphically show what the image looks like—unless you make specific provisions for translating the page-description language code to a form the display system understands. Without this translation, you must write the code and print it to see what you made.
Fig. 3. Color can be specified in both Postscript and Interpress. This Interpress image was created and produced on a commercially unavailable Xerox printer, but it shows transformation capabilities you can take advantage of now, as well as color capabilities you can plan for the future.

There are a number of important points to notice in the Interpress coding. First, in the Preamble, you define the fonts you want to use and their sizes. The operator “MAKEVEC” makes a vector out of the character strings represented by each font. It’s interesting to note, too, that Interpress not only provides different fonts for the Roman alphabet (the characters you’re reading now are from the Roman alphabet), but also furnishes a way to represent every character in every major language. Interpress assigns a 16-bit code to each character in languages such as Chinese and the katakana representation of Japanese.

In the section that handles the creation and filling of the pie, the “SETGRAY” operators do just what they purport to do based on the specific operands given for each pie slice. The “MOVETO” and “LINETO” operators work as they do on a pen plotter: the former moves to a set of coordinates, and the latter draws lines between coordinates.

The operators “MASKFILL” and “MASKVECTOR” rely on an Interpress concept of how marks are placed on a page. For an area fill or outline, Interpress pushes a mark through the defined pattern onto the page. The pattern can represent a line, a shape or a set of typographic characters, and the mark can be solid black, a gray shade or a color.

This program was written in the recently released Interpress version 3.0. However, the only operator used in this program that has not been available in version 2.1 is “ARCTO.” This operator draws an arc through the coordinates given. In addition to this capability, version 3.0 incorporates features such as dashed lines and outlined (rather than bit mapped) fonts. The latter permits more flexibility in transformations.

Get ready to add color

Using Interpress, you can manipulate characters as well as use multiple colors (Fig. 3). The characters used in the figure were created especially for this example, but you could do the same manipulations using a standard font. As with many dazzling Xerox products, you can’t buy the printer that produced this image; the machine is at the Xerox Palo Alto Research Center (PARC). But the Interpress provisions are in place to handle color when printer manufacturers, including Xerox, are ready to market machines based on page-description languages.

Color introduces some new challenges to page-description languages that will take some careful definitions to work out. One issue is whether the printer should produce “artificial” colors, such as you might see in silk-screened art, or photographic colors (see figure on first page of article). This consideration can be summed up in the question: What color do you mean when you say “green?” Although the figure was also generated on a Xerox PARC machine that you can’t buy, it shows how a scanned four-color image can be scaled (only one hummingbird image was used to create all three birds in the image) and arbitrarily rotated. A straightforward algorithm handles the transformation from the page’s orthogonal coordinate system.

A more immediate event to look forward to than color availability is the implementation of the full Interpress command set. With the introduction of version 3.0, Xerox divided Interpress into three Sets to meet the requirements of different printing applications. The Commercial Set handles text, fonts and scanned images; the Publication Set adds some features that help produce office and technical publications; and the Professional Graphics Set includes the grayscale elements for process color, rotation of text and graphics at any angle and image clipping in any shape. So far, Xerox has implemented only the Commercial Set, but it has plans to introduce the other two Sets later this year or early next year.

Some critics have knocked earlier versions of Interpress for characteristics such as a lack of flexibility in transforming fonts. Many of these objections stemmed from the specific implementations evaluated, however, and not from inherent Interpress limitations. Xerox’s main problem
Fig. 4. A series of straightforward scaling operations makes text appear to stretch and contract in these Postscript images produced on Linotype's Linotron 100. Included here are graphics, font characters and scanned images.

seems to be slow implementation rather than any barriers in the language itself.

Adobe also provides for color with two Postscript models: hue-saturation-brightness and red-green-blue. Operators are available in the language to switch between the two models according to the NTSC video standard.

Until color hard copy attains a higher priority level on users' wish lists, however, dealing well with monochrome applications will be more important. For example, consider the possibilities of an image combining font characters, graphics (the background grid) and scanned images (Fig. 4). There is really only one scanned image in the figure, because one hand image was given a negative skew to reverse it and thus create the other hand. The hands' thumbs were handled separately so they could overlay the first and last characters.

To alternately stretch and compress the text, the characters were scaled appropriately. Note the "shadows" behind the characters, which are the same characters greatly skewed.

Capabilities such as these are transforming the way people think about graphics. The system integrators and application developers who think about such things in creative and practical ways will come to dominate the surging market in high-resolution printing.

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REFERENCES


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GRAPHICS DEVICE DRIVERS

DRIVERS FREE USERS FROM DEVICE DEPENDENCE

Device drivers provide graphics applications with peripheral independence and system integrators with a clearer route to completed applications.

Jeff Scott, Precision Visuals Inc.

So long as system integrators employ terminals, pen plotters, film recorders and other graphics-display devices that have different performance characteristics, device drivers will serve as an essential part of many graphics applications. Device drivers reside beneath the application code, translating device-independent requests into device-dependent control sequences.

To access the driver, program developers often write software to address a virtual graphics device. This programmer interface is then translated into a set of codes passed across a virtual device interface (VDI) to the device driver. The size of the VDI proves critical: If it is too small, it acts as a bottleneck by requiring more software overhead at the device-independent level; if too large, it requires the support of complex drivers.

The device driver, which is usually divided into distinct modules, converts the application

Application requests made through the programmer subroutine interface are translated at the VDI into a number of opcodes, which are then passed to the device driver. A large VDI is less of a bottleneck, but it requires a more robust device driver capable of supporting more hardware intelligence.
program's graphic request into a device-specific command string and routes it from the host computer to the output device. How these graphics requests are handled by the driver depends on whether they can be accessed as a hardware feature or must be simulated in software.

Graphics applications abound

Device drivers vary greatly in their complexity and sophistication. Simple drivers are often built into such basic software applications as word processing and electronic spreadsheets. The UNIX TERMCAp facility, which determines how UNIX interfaces with terminals, supports a number of devices at the operating-system level.

But it is in the realm of graphics applications that device drivers undergo the acid test. Relatively simple, full-screen text applications usually require only that the driver load the cursor, directing it to any X-Y-coordinate position. These drivers must clear the screen or a single line and support a limited number of attributes—reverse field, half-intensity, underline, etc.

Graphics-applications programmers, by contrast, face a bewildering number of choices: selection of foreground and background colors; filling polygons with solid colors or patterns; and repositioning, enlarging, shrinking and rotating images. A single graphics application may be called upon to operate monochrome and color displays, eight-pen plotters and raster printers, and mouse or graphics tablets as well as the function keys on several terminals.

One well-established approach to achieving device independence is to utilize a library of graphics "tools" with the application program. Graphics-tools packages, such as GK-2000 and DI-3000 from Precision Visuals Inc., Boulder, Colo., permit developers to address non-specific virtual-graphics devices. The source code is compiled and linked to one or more device drivers, each supporting a different output device. The two products differ in that the GK-2000 supports the graphical kernel system (GKS) graphics standard promoted by ANSI, whereas DI-3000 supports the "Core" graphics standard promoted by the American Association of Computing Machinery.

Subroutines yield an interface

In using a graphics-tools package, the developer addresses a programmer subroutine interface, selects a subroutine from a library and passes it to the appropriate arguments. This program interface defines graphics information in either a 2-D or 3-D world-coordinate system with such user-definable units as inches, ergs, meters or pounds.

The device-independent level of the tools package translates these world coordinates into a generic-coordinate system, specific neither to the application nor to the output devices being driven. Under the Core system, for example, the
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virtual coordinate space extends from (-1.0,-1.0) to (1.0,1.0).

The device driver translates these virtual device coordinates into device-specific coordinates e.g., 1,024 by 1,024 for many raster devices, 8,500 by 11,000 for an 8.5-by-11-inch plotter, etc.

**VDI is the borderline**

The VDI becomes important in designing a device driver. It constitutes the borderline between the device-independent code and the device-dependent driver.

The VDI used by Precision Visuals includes opcodes (operational codes) that set color and line style, define color tables, initialize devices and accept current coordinate positions from input devices. About 80 opcodes are defined, although only 50 to 60 are generally used in most drivers.

The VDI can be a bottleneck because the full range of subroutine calls available to the programmer must be reduced to a set of opcodes that can be accepted by the driver.

The number of opcodes making up the VDI determines how "device intelligent" the driver is and, hence, how wide the bottleneck. But trade-offs exist in both directions—the optimal VDI is neither too large nor too small.

The smaller the VDI, the more software overhead emerges at the device-independent level. Consider, as an extreme example, a VDI consisting of just the four most universal opcodes: DRAW, COLOR, TEXT and MOVE. These basic graphics building blocks map directly onto five counterpart programmer-subroutine calls.

If, then, the VDI contained no opcode to support a terminal's hardware text capability, a request for a large font size on a plotter would not be translated into the command string necessary to produce that font on the device. Instead, fonts would be created from data files residing at the device-interface level and then implemented through a succession of pen moves and draws. Software simulation accomplishes this but does so much more slowly. In effect, VDI tends to treat an intelligent device as a dumb one.

**Vendors make decisions**

The advantage of a small VDI is that it permits vendors and integrators to write new drivers easily and quickly. Small VDIs make the most sense in a traditional mainframe installation where high-speed response is not critical. But, as vendors build more hardware capability into graphics devices, the VDI must be enlarged to allow the driver to use those resources.

By the same token, the larger the VDI, the more demands placed on the driver. Theoretically, as many subroutine calls at the programmer-interface level as possible should have an equivalent VDI opcode. But there is a limit to a VDI's potential growth. At some point, a large VDI requires a driver that is too unwieldy to write

**Put code into skeleton drivers**

Skeleton device drivers are supplied by vendors to system integrators wishing to target an unsupported device. Such drivers consist of source code in which the device-specific information has been omitted. To the integrator falls the task of filling in the blanks.

In customizing a skeleton driver, a system integrator's best chances for success are with those supporting low- to medium-end devices. More complex device drivers, particularly those that support 2-D or 3-D display lists, local hidden-line removal, wire-frame shading, and enhanced input capabilities, should be approached more gingerly. In the long run, it may be better to ask the graphics-tools vendor to write such a driver, rather than undertake it yourself.

A few rules of thumb can make the process easier:

- Be certain that the hardware or firmware interface is stable. If the manufacturer is still tinkering at this level, your driver will soon become obsolete.
- Be familiar enough with the device-independent programmer interface so that you know what kinds of device features you are trying to support. You should know the driver's programming language and should understand the structure at both ends of the driver—the virtual device interface (VDI) and the device-level interface.

In graphics applications, device drivers undergo the acid test.
Too large a VDI requires a driver that is too unwieldy to write and too wasteful of computer resources.

For example, imagine that a terminal manufacturer has incorporated the hardware to draw the symbol for an electrical transformer on the screen—a useful feature in a few applications, but otherwise superfluous. Should the programmer interface contain a subroutine—and the VDI an opcode—to support it? If so, the driver of every device, including those not supporting the feature would have to simulate it in software—hardly a practical arrangement.

A vendor designing a customized VDI must, therefore, find a middle ground. The nucleus of every VDI is composed of the capabilities shared by all devices. The vendor must go on from there to determine what additional capabilities to put into the devices. The hardware capability of polygon fill, for example, is not supported by most plotters but is becoming a standard feature of many raster terminals.

In designing device drivers, Precision Visuals' philosophy is to support a given feature in hardware wherever possible and to simulate it in software whenever practical. In those rare instances where software simulation is impractical, the request is ignored unless hardware can support it.

Much effort has gone into standardizing the VDI. If hardware behaved uniformly, no device driver would be needed. It is unlikely that situation will evolve in the near future—not because software developers wouldn't support it, but because hardware manufacturers, anxious to differentiate their products from the competition, would never tolerate it.

Drivers' levels differ

The purpose of all device drivers is to translate device-independent requests from the application into command structures that can be understood by the target device. Precision Visuals accomplishes this translation by dividing the driver architecture into four distinct layers:

- The parser layer that serves as a traffic cop, passing VDI opcodes to appropriate parts of the driver
- The device-dependent layer that converts device-independent commands into device-dependent commands
- The "lower level" layer that constructs device-dependent command strings meaningful to the target device
- The I/O level that sends the device-dependent commands to the device.

To illustrate the interrelationship between these four layers, consider a program request to draw a line from a given starting point to the center of a display screen on a typical 1,024-by-1,024 raster terminal.

The programmer begins in application-specific, world-coordinate space. If this space extends from (0,0) in the bottom, left-hand corner to (100,100) at the upper left, the DI-3000 graphics-tool command is JDRAW (50,50).

DI-3000 then maps the (50,50) coordinates into virtual coordinates (0,0) and sends the request to the VDI.
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CIRCLE NO. 13 ON INQUIRY CARD

ROAD TEST RESULTS

DATA TRANSFER RATE (KB/SEC)
 Sometimes requirements for software simulation are so complex that it makes more sense to isolate the simulation code outside the driver.

How to produce polygons

A simple line drawing represents one of the most fundamental tasks performed by a device driver. A more complex task is drawing a polygon. In DI-3000, for example, the routine JPOLGN (X,Y,...,Nth) defines a move to the first point (X), a line to the following point and a final line from the Nth point back to the first point.

Some output devices understand what a polygon is, i.e., they have an explicit polygon mode that accepts an array of vertices and automatically connects them. Other devices lack this intelligence—the creation of a polygon in this case amounts to only a set of independently drawn lines, constructed in software. Hence, the request to draw a triangle is handled by the driver in one of two ways, depending on the type of device it is supporting.

If a polygon mode is available on the device, the driver translates the request into a series of command strings to implement the image in hardware. Otherwise, the request is shunted to a separate routine within the device-dependent level, which processes the request into three separate draw commands that the device can understand.

Sometimes the requirements for software simulation are so complex that it makes more sense to isolate the simulation code outside the driver. This is the case when dealing with retained segments.

Retained segments are designated portions of a graphics display (e.g. the symbols, menu items and objects) that are assigned an identification number and can be manipulated on the screen as independent graphics entities. Most high-end graphics terminals and workstations incorporate a display list, i.e., a dedicated area of local memory in which retained segments are stored and transformed. This allows the user to rotate, move or enlarge retained segments.

In cases where a hardware display list is present, retaining a segment in the display list is straightforward. The program opens a segment, passes graphics coordinate sets to the driver and closes the segment. The driver, in turn, stores the coordinates in the display list of the device.

But, what if the program requests a retained segment on a device lacking a display list? In this case, the driver relies solely on a device-independent data structure known as segment storage, which resides on the host computer. When the driver receives the opcode request to open a retained segment, it passes control one level up to an external routine, which performs the tasks in software.

Segments escape their limits

Segment storage represents the limit of what is usually simulated in graphics software. But there are graphics tasks that lie beyond this limit. Hidden line removal, for example, and the shading of wire-frame images—both required in solid-modeling applications—are so complex to calculate that software simulation is impractical. For this reason, neither the GKS standard nor the Core system dedicates a subroutine for these types of tasks.

For such complex requirements, as well as for other tasks proprietary to specific devices, a device driver may have a series of escape functions. This code pops the application out of the

---

quest across the VDI to the parser layer. Because the request to the VDI contains a "DRAW" opcode, the parser level simply passes the request to the routine in the device-dependent layer that handles draws.

At the device-dependent level, the virtual coordinates (0,0) are translated into device-dependent coordinates on the raster device: (511,511). These coordinates are then passed to a lower level routine designed for draw commands, which prepares the appropriate command string and passes it to the I/O level.

The I/O level sends the command string through the host machine to the device, taking into account the operating system and computer dependencies. The I/O layer differs from the layers above in that it is device-independent but host-machine dependent. As a result, the entire driver can be ported from, say, a Digital Equipment Corp. VAX-11/750 to an IBM Corp. Model 4381 by simply modifying or interchanging this bottom layer.

Graphics device drivers give rise to products like the DI-3000 graphics system from Precision Visuals. Here an application for the petro-chemical industry displays alternative drilling paths.
more limited graphics capabilities of the driver and into the proprietary function. Escape functions are numbered and are applicable only to a given device. If an escape function is passed to a different device, the driver ignores the request. Escape functions allow the device-independent programmer safe, predictable access to desirable, but non-standard, device features.

**Vendors balance trade-offs**

System integrators derive two principle benefits from a graphics-tools package: productivity and device independence. The program developer can concentrate on the application, not the intricacies of a particular graphics device. Existing applications can support new graphics devices, with little or no modification, simply through installation of a new device driver.

There is a trade-off, however. Device drivers, even intelligent ones, require some software overhead. As applications become more demanding, the system integrator walks a tightrope between being locked into a device on one side and sacrificing too much performance on the other.

This is not to say, however, that drivers cannot be made more efficient. One technique is to shield the device from redundant application-program requests—e.g., repeated requests to change a displayed color to red, or for pen moves to reach some specified point. Such requests are filtered out by maintaining within the driver a set of status flags, which serve as reference points.

But redundancy trapping is only a beginning. The biggest challenge in driver architecture is still in providing device independence with only negligible reduction in performance—even in highly interactive engineering and design applications. Achieving this goal will require new techniques that are only now beginning to emerge.

**Jeff Scott** is the engineering product manager at Precision Visuals Inc., Boulder, Colo. He holds a bachelor of arts degree in information systems design and development from the University of Colorado at Boulder.
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Why a new cartridge

With the significant increases in tape drive capacity, system reliability demands a tighter tolerance cartridge. Most tape drive users aren't aware that all of the tensioning, tolerance, and data reliability issues are virtually all a function of the tape cartridge.

When 3M announced its cartridge in 1971, it was designed for a low capacity tape drive with less than 3 megabytes—2.88 to be exact. The tape was low in density—1600 bits per inch with only 4 tracks and 300 feet of tape.

The tolerances required for the tape drives of the early 1970's were fine for then, but today's tape drives require much tighter tolerance. Today's tape cartridges must work with drives that have 9 or more tracks and bit densities as high as 12,000 bits per inch on 600 feet of tape. That means capacity increases of 2,000 percent packed into the same cartridge.

The reasons that yesterday's cartridge technology simply won't work properly in today's high capacity drives is inherent in the cartridge design. The three culprits that make cartridge tolerances so important are fluctuating tape tension, redeposit nodules, and instantaneous speed variations (or ISV).

Tape Tension

Tape tension at the read-write head is important because the tape drive's electronics expect data to arrive at a constant rate. Consistent tape tension is a function of the cartridge tensioning mechanism. The new Cartrex cartridge design, based on a mechanical differential between two stiff belts, provides very predictable results. The historic 3M design—used by 3M and DEI—uses an elastic belt coupled with drag friction at the rear pulley to create tension. The accompanying graph shows the significant improvement the Cartrex cartridge design offers over the conventional design.

Redeposit Nodules

Redeposit nodules are the insidious flakes of tape media that break off from the edge of the tape and get dragged to the edge of the read-write head. If the tension is low, or becomes low as the tape starts or reverses, the flakes slide past the edge, get smeared across the head, and reduce its ability to read data.

The free play in the two tape reels combined with the tape guides are the primary culprits in creating these redeposit nodules. As the tape enters the guide from the tape pack, the tape guide aligns the tape by balancing the tension at the edge of the tape. Uneven edge tension not only causes media to flake off causing redeposit nodules, but data is lost due to the "coining" or "scalloping" effect.

Cartrex eliminated the cause of the coin or scalloping with a barrel-shaped roller placed in front of the tape guide. The roller positions the tape and drops the edge tension to zero. By using this roller, the possibility of media flaking off and creating redeposit nodules is virtually eliminated.

Instantaneous Speed Variation (ISV)

Instantaneous speed variation is exactly what it sounds like—small, instantaneous changes in tape speed as it crosses the tape head. At slow tape speeds and low bit densities—like the 1971 standard of 30 inches per second and 1,600 bits per inch—ISV wasn't as big a problem. At that time, the bits were crossing the head at 48,000 bits per second.

Today, however, the story has changed. Ninety inches per second and 8,000 bits per inch mean that 720,000 bits cross the head every second. A 1.500% increase. As you may have guessed, 1971 speed fluctuations in the 48,000 bits per second range made reading data difficult for tape drive electronics. But today, when the electronics have to guess whether or not the bit rate of 720,000 bits per second is accurate, the electronics can become overwhelmed.

The Cartrex tensioning mechanism relieves the overload placed on the electronics with respect to ISV. The longitudinally stiff belts ensure tension at all times. The stiff belt overpowers variations that exist with the 3M elastic belt cartridges. The barrel roller guides, in addition to reducing the edge pressure to zero, tend to dampen out any residual ISV effects.

Never a Single Issue

Your tape drive seldom has the luxury of dealing with an isolated problem. It's usually a combination of ISV, redeposit nodules, and tension problems all together. Now you understand why Cartrex developed a modern cartridge alternative.

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Not only has Cartrex improved on the industry's 15 year old technology, they have done it for a competitive price.

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Dealer Inquiries Invited.

The Cartrex cartridge provides predictable and stable tension. Compare it to the tension variation of the conventional cartridge design. The consistent Cartrex tension virtually eliminates data errors and data loss from head-to-tape separation and redeposit nodules that can occur with fluctuating, low-to-high tension performance.
DISK FORMATS FOR YOUR FILES

Carl Warren, Western Editor

A list of flexible disk formats, including the number of file-allocation tables (FAT), sector size and reserved sectors, can be helpful, especially if you're trying to figure out which is the best format for your application.

Have you solved a hardware or software integration problem lately? *Mini-Micro Systems* readers would like to hear about it. We pay up to $100 for each published solution. Contact: Carl Warren, Western Editor, *Mini-Micro Systems*, Cahners Publishing Co., Suite 109, 2041 Business Center Drive, Irvine, Calif. 92715 (714) 851-9422 or MCI-Mail ID 270-5505.

Interest Quotient (Circle One)
High 757 Medium 758 Low 759

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### CURRENT MS-DOS 1.xx - 2.xx DISK FORMATS

<table>
<thead>
<tr>
<th>Disk type</th>
<th>Type code</th>
</tr>
</thead>
<tbody>
<tr>
<td>single-density, single-sided, 8-inch</td>
<td>(SD128)</td>
</tr>
<tr>
<td>double-density, single-sided, 8-inch</td>
<td>(DD1024)</td>
</tr>
<tr>
<td>double-density, double-sided, 8-inch</td>
<td>(DD1024-2)</td>
</tr>
<tr>
<td>IBM Displaywriter system disk</td>
<td>(SD256)</td>
</tr>
<tr>
<td>IBM Displaywriter system disk</td>
<td>(SD256-2)</td>
</tr>
<tr>
<td>IBM PC 8-sector, single-sided</td>
<td>(IBM8)</td>
</tr>
<tr>
<td>IBM PC 9-sector, single-sided</td>
<td>(IBM9)</td>
</tr>
<tr>
<td>IBM PC 8-sector, double-sided</td>
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<tr>
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<td>(IBM9-2)</td>
</tr>
<tr>
<td>single-density, double-sided, 8-inch</td>
<td>(SD128-2)</td>
</tr>
</tbody>
</table>

### FORMAT ATTRIBUTE TABLE

| Type code | Max. no. entries in directory | Disk size (4K bytes) | # files | No. of reserved sectors | Sector size (bytes) | No. of FATs | FAT ID | Tracks | Sectors track | Max. no. reserved sectors | Min. total FAT size | Directory size | 1st FAT size | 2nd FAT size | 1st directory | 2nd directory | Total data block | No. of heads |
|-----------|-------------------------------|----------------------|---------|-------------------------|--------------------|-------------|--------|--------|----------------|------------------------|-------------------|---------------|--------------|--------------|--------------|---------------|---------------|----------------|-------------|
| SD128     | 68                            | 251                  | 2       | 512                     | 1                  | 128          | FE      | 77     | 26             | 1                      | 6                 | 17            | 1            | 7            | 13           | 30            | 2,002         | 1             |
| DD1024    | 96                            | 612                  | 2       | 1,024                   | 1                  | 1,024        | FE      | 77     | 8              | 1                      | 1                 | 3             | 1            | 2            | 3            | 6             | 616           | 1             |
| DD1024-2  | 192                           | 1,232                | 2       | 1,024                   | 1                  | 1,024        | FF      | 77     | 8              | 1                      | 2                 | 6             | 1            | 3            | 5            | 11            | 1,232         | 2             |
| DD256-2   | 80                            | 287                  | 2       | 512                     | 2                  | 256          | FA      | 77     | 15             | 17                     | 4                 | 10            | 2            | 6            | 10           | 20            | 1,155         | 1             |
| DD256-2** | 172                           | 1,001                | 2       | 1,024                   | 2                  | 256          | FB      | 77     | 26             | 54                     | 6                 | 20            | 2            | 8            | 14           | 34            | 4,004         | 2             |
| IBM8      | 64                            | 162                  | 2       | 512                     | 1                  | 512          | FE      | 40     | 8              | 1                      | 1                 | 4             | 1            | 2            | 3            | 7             | 320           | 1             |
| IBM9      | 64                            | 180                  | 2       | 512                     | 1                  | 512          | FC      | 40     | 9              | 1                      | 2                 | 4             | 1            | 3            | 5            | 9             | 360           | 1             |
| IBM8-2    | 112                           | 320                  | 2       | 1,024                   | 1                  | 512          | FF      | 40     | 8              | 1                      | 1                 | 7             | 1            | 3            | 5            | 10            | 640           | 2             |
| IBM9-2    | 112                           | 360                  | 2       | 1,024                   | 1                  | 512          | FD      | 40     | 9              | 1                      | 2                 | 7             | 1            | 3            | 5            | 12            | 720           | 2             |
| SD128-2   | 68                            | 2                    | 512     | 4                       | 128                | FC            | 77     | 26     | 12            | 4                      | 12                | 17            | 4            | 16           | 28           | 45            | 4,004         | 2             |

* FAT-file-allocation table
** 15-sector bias in BIOS
*** 52-sector bias in BIOS

MINI-MICRO SYSTEMS/April 15, 1986
TO JAPANESE, THE PRODUCT IS EVERYTHING.

When our American product managers told us you wanted faster drives, our Japanese design engineers improved access times on our 5 1/4" drives from 30ms to 25ms. And 20ms to 18ms on our 8" drives, making them the fastest in the industry.

And when you asked for higher capacities, we responded with a 50% improvement by making our drives work with RLL-controllers. Which, because of our conservative design approach, we were able to accomplish without making any changes to the drive. At no extra cost to you.

We were able to react so easily to market demand because Toshiba America Disk Products Division is a living example of the benefits of international cooperation.

Without the design and manufacturing expertise of the Japanese side of our company, we couldn't build such exceptionally high quality and capability into our product line.

And without the intimate knowledge of the needs of the American market contributed by our American side, our Japanese factories wouldn't know what features to build into the products.

At Toshiba, no drive gets built for the American market unless it's been approved by our American product managers. With a Product Requirement Statement that they've signed.

TOSHIBA AMERICA, INC.
TO AMERICANS, THE MARKET IS EVERYTHING.

Because we're in touch with the latest market trends, we're in tune with your changing requirements and need for industry compatibility.

So we make it easy for you to integrate our drives with your system for better performance. At a better price.

It's a conservative approach to a market that in the past has been anything but. It means that although we're not always the first with the latest, when we do release a product you can count on it being totally reliable and reasonably priced.

That's not to say we've stinted on R&D. In fact, we spend more on R&D than some of our smaller competitors realize in total revenues.

Our R&D is focused on fielding a broad product line. From floppy to Winchester to optical. Guided by input from our American product people. And because we have a broad line, we can serve all your storage needs. So you can take higher quantity discounts than if you went to several different suppliers.

For complete information on our line of high-performance, high-capacity 5¼" and 8" drives, call 408-727-3939 (Telex: 510-100-9764). Or write 3910 Freedom Circle, Suite 103, Santa Clara, CA 95054.

Toshiba America Disk Products Division. Where Japanese know-how is combined with inscrutable American wisdom.

JAPANESE QUALITY. AMERICAN SUPPORT.

DISK PRODUCTS DIVISION
Memory Problems?

Call TRW.

1-800-922-0897

• Winchester & Floppy Disk Drives
• Add-on Memory Cards
• Experienced, Factory-Trained Technicians
• Prompt, Professional, Price-Competitive
• Class 100 HEPA Environment

TRW Repair Services

TRW Customer Service

15 Law Drive
Fairfield, NJ 07007-2078

Floppy Disk Drives. Winchesters. Add-on Memory Cards. Whenever you need a reliable source for fast, professional repair of memory products, remember TRW.

In particular, remember TRW's toll-free repair service number. It's an incredibly easy way to initiate dependable TRW Repair Service.

Just call our toll-free number for the latest pricing and shipping information. Then send your units to one of TRW's state-of-the-art repair facilities. Upon arrival, your equipment is tested, professionally repaired and re-tested to ensure that our "No Questions" 90 day warranty is never, ever required.

TRW even created a special, shock-resistant container to drastically reduce shipping damage. Add to this TRW's very attractive pricing, and you have one of the industry's best repair values.

So, don't forget. For fast, professional repair of your critical memory products, call TRW at 1-800-922-0897. (In New Jersey, call 201-575-7110, ext. 4231.)

TRW. The one number worth remembering when you need a quality service solution.

TRW Customer Service
15 Law Drive
PO. Box 2078
Fairfield, NJ 07007-2078

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CIRCLE NO. 18 ON INQUIRY CARD
# 8-inch and larger rigid disk drives and subsystems

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Model</th>
<th>Disk Size (inch)</th>
<th>Capacity (M bytes)</th>
<th>Average Access Time (ms)</th>
<th>Number of Data Surface</th>
<th>Number of Read/Write Heads</th>
<th>Actuator Type</th>
<th>Dimensions (inches)</th>
<th>Interface</th>
<th>Price $ (quantity)</th>
<th>Notes, Features, Options</th>
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<td><strong>ALPHA DATA INC.</strong></td>
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<tr>
<td>20750 Marilla St., Chatsworth, CA 91311-4488, (818) 882-6500</td>
<td>Atlas 128/Atlas 160</td>
<td>14</td>
<td>128/160 U</td>
<td>18</td>
<td>5</td>
<td>50</td>
<td>closed-loop rotary</td>
<td>7x19x23</td>
<td>SMD</td>
<td>10,315/10,500/11,400-11,585/Q1; 5,540-5,700/6,100-6,260/Q500</td>
<td>includes power supply</td>
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<td></td>
<td>Atlas 520</td>
<td>14</td>
<td>520 U</td>
<td>18</td>
<td>8</td>
<td>76</td>
<td>closed-loop rotary</td>
<td>7x19x23</td>
<td>SMD</td>
<td>13,000-13,100/Q1; 7,130-7,290/Q500</td>
<td>includes power supply</td>
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<td><strong>CENTURY DATA SYSTEMS</strong></td>
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<tr>
<td>1270 N. Kraemer Blvd., Anaheim, CA 92806, (714) 632-7500</td>
<td>AMS 315/AMS 513 (subsystems)</td>
<td>14</td>
<td>315/514 U</td>
<td>25</td>
<td>10</td>
<td>19</td>
<td>linear</td>
<td>10.5x19x28</td>
<td>SMD</td>
<td>4,900/Q1; 3,840/Q500</td>
<td>fixed/removable cartridge</td>
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<td>AMS 571 (subsystem)</td>
<td>14</td>
<td>615 U (fixed)</td>
<td>19</td>
<td>10</td>
<td>19</td>
<td>linear</td>
<td>10.5x19x28</td>
<td>SMD</td>
<td>5,100/Q1; 4,060/Q500</td>
<td>fixed/removable cartridge</td>
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<td></td>
<td>C2075</td>
<td>8</td>
<td>53.5 U (fixed)</td>
<td>32</td>
<td>6</td>
<td>6</td>
<td>linear</td>
<td>7x8.55x18.5</td>
<td>SMD, LMD</td>
<td>5,100/Q1; 4,060/Q500</td>
<td>fixed/removable cartridge</td>
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<td>C2120 (subsystem)</td>
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<td>87.8 U (fixed)</td>
<td>32</td>
<td>7</td>
<td>7</td>
<td>linear</td>
<td>7x8.55x18.5</td>
<td>SMD, LMD</td>
<td>5,100/Q1; 4,060/Q500</td>
<td>fixed/removable cartridge</td>
</tr>
<tr>
<td></td>
<td>C2400</td>
<td>8</td>
<td>408 U</td>
<td>15</td>
<td>12</td>
<td>24</td>
<td>linear</td>
<td>9x8.5x18.5</td>
<td>SMD</td>
<td>10,315-10,500/Q1; 5,540-5,700/Q500</td>
<td>fixed/removable cartridge</td>
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<td></td>
<td>C2476/C2600</td>
<td>8</td>
<td>476/613 U</td>
<td>15</td>
<td>12</td>
<td>20/24</td>
<td>linear</td>
<td>9x8.5x18.5</td>
<td>ESMD</td>
<td>11,300-11,485/13,100-13,290/Q1; 6,300-6,460/7,220-7,390/Q500</td>
<td>fixed/removable cartridge</td>
</tr>
<tr>
<td><strong>CHRYSLIN INDUSTRIES INC.</strong></td>
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<tr>
<td>31352 Via Colinas, #101, Westlake Village, CA 91362, (818) 991-2254</td>
<td>CI-1220-TF (subsystem)</td>
<td>8</td>
<td>2 F (removable)</td>
<td>RX02</td>
<td>2,445/Q1</td>
<td>removable cartridge, Mitsubishi drive, dual controller,DMA</td>
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<tr>
<td></td>
<td>CI-1270-MT/CI-1270-WF (subsystems)</td>
<td>8</td>
<td>70/70 F (fixed)</td>
<td>FSCP/SMD</td>
<td>8,295/7,095/Q1</td>
<td>fixed/removable cartridge, Prim drive, MT ¾-inch streaming tape backup, power supply; WF: dual 8-inch, 2M-byte flexible drive, power supply</td>
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<tr>
<td></td>
<td>CI-1340-MTA/CI-1340-MTB (subsystems)</td>
<td>8</td>
<td>200/300 F (fixed)</td>
<td>FSCP</td>
<td>9,895/10,995/Q1</td>
<td>fixed/removable cartridge, ¾-inch, 70M-byte streaming tape backup, power supply; Prim drive</td>
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</tr>
</tbody>
</table>

MINI-MICRO SYSTEMS/April 15, 1986
## 8-inch and larger rigid disk drives and subsystems

### 8-INCH DRIVES

<table>
<thead>
<tr>
<th>Company/Model</th>
<th>Disk Size (Inches)</th>
<th>Capacity (MB)</th>
<th>Average Write Time (ms)</th>
<th>Number of Data Surfaces</th>
<th>Number of Read/Write Heads</th>
<th>Actuator Type</th>
<th>Dimensions (WxHxD in.)</th>
<th>Interface</th>
<th>Price &amp; Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI-1340-MT/CI-1340-WF (subsystems)</td>
<td>8</td>
<td>130/140 (fixed)</td>
<td></td>
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<td>MSCP/SMD</td>
<td>9,295/8,095(Q1)</td>
</tr>
<tr>
<td>CONTROL DATA CORP.</td>
<td>80231-60 (subsystem)</td>
<td>14</td>
<td>126 (fixed)</td>
<td></td>
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<td></td>
<td></td>
<td>modified SMD</td>
<td>15,425(Q1); 10,800(Q100)</td>
</tr>
<tr>
<td>CONTROL DATA CORP. (OEM PRODUCT SALES)</td>
<td>80270-10/80270-30</td>
<td>14</td>
<td>63/240 (removable)</td>
<td></td>
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<td></td>
<td>modified SMD</td>
<td>12,850/22,395(Q1); 9,000/15,675(Q100)</td>
</tr>
<tr>
<td>CONTROL DATA CORP.</td>
<td>9710 RSD</td>
<td>9</td>
<td>62.9 U (removable)</td>
<td>27</td>
<td>5</td>
<td>5</td>
<td>closed-loop linear voice coil</td>
<td>10.2 x 8.5 x 24.25</td>
<td>SMD</td>
</tr>
<tr>
<td>DATAPPOINT CORP.</td>
<td>9348</td>
<td>9</td>
<td>67 (removable)</td>
<td>27</td>
<td>5</td>
<td>5</td>
<td>closed-loop linear voice coil</td>
<td>10.2 x 8.5 x 24.25</td>
<td>SMD</td>
</tr>
<tr>
<td>FUJITSU AMERICA INC. (STORAGE PRODUCTS DIV.)</td>
<td>9349</td>
<td>9</td>
<td>67 (removable)</td>
<td>27</td>
<td>5</td>
<td>5</td>
<td>closed-loop linear voice coil</td>
<td>10.2 x 8.5 x 24.25</td>
<td>SMD</td>
</tr>
<tr>
<td>HEWLETT-PACKARD CO. (DISC MEMORY DIV.)</td>
<td>7907A (subsystem)</td>
<td>8</td>
<td>41 (fixed)</td>
<td>20</td>
<td>5</td>
<td></td>
<td></td>
<td>MSCP</td>
<td>7.1 x 12.8 x 18.4</td>
</tr>
</tbody>
</table>

### Notes:
- Some drives and subsystems are fixed/removable cartridge, Toshiba drive: MT, 1/4-inch, 70M-byte streaming tape backup, power supply; WF: dual 8-inch, 2M-byte flexible drive, power supply.
- Includes modified SMD and SMD power supply.
- Includes removable cartridge, includes power supply, controller.
- Includes removable cartridge, includes controller.
- Includes parallel data transfer: M2351 has opt. dual port.
- Includes fixed/removable cartridge, Amcodyne 71105 drive, ruggedized, includes CS/80 controller.
Some Things Never Change.

No matter who made it, Macrolink makes it better.
We've got the highest performance controllers made for the new generation of disks: SMD (3MB/sec), Optical, SCSI, and 5.25". We also have Tape adapters (800 to 6250 BPI, Cartridge & Streaming), Solid State Disk, Memory, Communications, and just about anything else you might need for your 3200 CPU. In fact, we build more Concurrent Computer compatible products than anyone else.

Call today for our catalog, and find out why OEMs and End Users make Macrolink their first choice. Service and installation is available world-wide, and from Concurrent Computer.

Not all the news comes from Oceanport, N.J.
YOU ASKED FOR A FAST MULTIBUS H-SMD DISK CONTROLLER THAT WOULD ALSO OPTIMIZE YOUR SYSTEM’S PERFORMANCE

WE RESPONDED WITH THE RIMFIRE 1200

FAST AND FLEXIBLE

We designed the Rimfire 1200 with your operating system in mind. A significant increase in throughput is gained through the implementation of a large segmentable cache (up to 32K). By means of a least-recently-used algorithm we cache frequently used files while looking ahead for next potential requests. Subsequent "cache hits" eliminate disk access time and related overhead. Thus, operating system bottlenecks are opened and you achieve the optimum integration of a disk controller in your system.

We then coupled this caching architecture with a high-speed dual DMA, fast enough to run up to four H-SMD disk drives (at 2.5 megabytes/second). This combination of high speed and intelligent data management places the Rimfire 1200 a step beyond older straight pipeline designs and into a new, higher performance generation of Multibus disk controllers.

Other Rimfire 1200 features include:
- 48 bit ECC
- Defect mapping of bad sectors or tracks
- Programmable head and cylinder skewing
- Zero latency track read
- Scatter/Gather read/write commands
- Reads flaw map from disk drive
- Statistics commands
- Driver support for UNIX III, V, 4.2, and iRMX-86

For information about our full line of Rimfire and Tapemaster products contact us at the following locations:

Ciprico Inc.
2955 Xenium Lane
Plymouth, MN 55441
612/559-2034

European Office:
United Kingdom
Phone (0252) 712-011

...where people listen—and respond.*
### 8-inch and larger rigid disk drives and subsystems

<table>
<thead>
<tr>
<th>Company Model</th>
<th>Drive Size (inches)</th>
<th>Caching (inches)</th>
<th>Average Access Time (microseconds)</th>
<th>Number of Servo Gaps</th>
<th>Number of Rev. Surfaces</th>
<th>Actuator Type</th>
<th>Dimensions (H-W-D Inches)</th>
<th>Interface</th>
<th>Pick/Place (inches)</th>
<th>Notes/Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>HP-18 (subsystems)</td>
<td>35/90/170 U</td>
<td>28.1/65.5/132.1</td>
<td>35.5/36.4</td>
<td>2/4.4</td>
<td>3/7/7</td>
<td>closed-loop</td>
<td>28 x 14 x 28</td>
<td>HP-IB</td>
<td>10,300/11,300/13,850(Q1)</td>
<td>includes ¼-inch, 67M-byte tape cartridge backup; power supply; controller</td>
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<td>HITACHI AMERICA LTD.</td>
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<td>DK812S/DK814S Series</td>
<td>170.1/340 U</td>
<td>25/20</td>
<td>3/10/3-10</td>
<td>5/10/3-10</td>
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<td>closed-loop</td>
<td>5.12 x 8.55 x 14.96</td>
<td>ESMD</td>
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<td>IBIS SYSTEMS INC.</td>
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<td>1400 (subsystem)</td>
<td>1416 U</td>
<td>1250 F</td>
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<td>linear voice coil</td>
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<td>IBM CORP.</td>
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<td>Old Orchard Rd., Armonk, NY 10504, (914) 765-1900</td>
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<td>80, 186, 212 U</td>
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<td>3, 7, 8</td>
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<td>991 Knox St., Torrance, CA 90502, (213) 515-3993</td>
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<tr>
<td>M4870F</td>
<td>5200(Q1); 46,800(Q500)</td>
<td>SMD, Norden, Roim, NTDS, military</td>
<td>17.47 x 19 x 25</td>
<td>SMD, Norden, NTDS, military</td>
<td>12.25 x 19 x 24</td>
<td>52,000(Q1); 40,500(Q500)</td>
<td>removable cartridge; includes power supply, MIL specifications</td>
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<td>NCR CORP. (OEM PRODUCTS)</td>
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<tr>
<td>3718 N. Rock Rd., Wichita, KS 67226, (316) 688-8510</td>
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<tr>
<td>6098 (subsystem)</td>
<td>40-400 F</td>
<td>35.5-43.45</td>
<td>10</td>
<td>4-10</td>
<td></td>
<td>rotary</td>
<td>29 x 9 x 27</td>
<td>SCSI</td>
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<td>fixed/ removable cartridge; 60M-byte, ¼-inch streaming tape backup</td>
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<tr>
<td>6099 (subsystem)</td>
<td>275-1.6G F (fixed)</td>
<td>28.3-43.45</td>
<td>12</td>
<td>4-24</td>
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<td>linear voice coil or rotary</td>
<td>29 x 22 x 35</td>
<td>SCSI</td>
<td>fixed/ removable cartridge; ¼-inch streaming tape backup</td>
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</tbody>
</table>
# 8-inch and larger rigid disk drives and subsystems

## 8-inch drives

<table>
<thead>
<tr>
<th>Company</th>
<th>Model</th>
<th>Disk size (inch)</th>
<th>Capacity (MB)</th>
<th>Average access time (ms)</th>
<th>Number of heads</th>
<th>Actuator type</th>
<th>Dimensions (WxHxD)</th>
<th>Interface</th>
<th>Price &amp; Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Northern Telecom Inc. (Memory Systems Div.)</strong></td>
<td>8212X</td>
<td>8</td>
<td>350 U</td>
<td>21</td>
<td>12</td>
<td>12</td>
<td>closed-loop rotary</td>
<td>4.62\times8.5\times14.25</td>
<td>SMD, SCSI</td>
</tr>
<tr>
<td></td>
<td>8310</td>
<td>8</td>
<td>378 U</td>
<td>20</td>
<td>10</td>
<td>10</td>
<td>closed-loop rotary</td>
<td>4.62\times8.5\times14.25</td>
<td>SMD, SCSI</td>
</tr>
<tr>
<td></td>
<td>8312</td>
<td>8</td>
<td>563 U</td>
<td>21</td>
<td>12</td>
<td>12</td>
<td>closed-loop rotary</td>
<td>4.62\times8.5\times14.25</td>
<td>SMD, SCSI</td>
</tr>
<tr>
<td><strong>Peritec Peripherals Corp.</strong></td>
<td>DX199/ DX265/DX332</td>
<td>8</td>
<td>199/265/332 U</td>
<td>22</td>
<td>6/8/10</td>
<td>6/8/10</td>
<td>rotary voice coil</td>
<td>4.62\times8.5\times14.25</td>
<td>ANSI, SMD, SCSI, ESDI</td>
</tr>
<tr>
<td></td>
<td>DX368/DX548</td>
<td>8</td>
<td>368/548 U</td>
<td>18/20</td>
<td>10/11</td>
<td>10/11</td>
<td>rotary voice coil</td>
<td>4.62\times8.5\times16.06</td>
<td>SMD</td>
</tr>
<tr>
<td><strong>Priam Corp.</strong></td>
<td>803/806/807/808</td>
<td>8</td>
<td>85.68/227/334/516 U</td>
<td>35/20</td>
<td>5/11/11/12</td>
<td>5/11/11/12</td>
<td>closed-loop linear voice coil</td>
<td>4.62\times8.5\times14.25</td>
<td>ANSI, Priam, SMD, Priam, SCSI, SMD/ESMD</td>
</tr>
<tr>
<td></td>
<td>7050</td>
<td>8</td>
<td>70 U</td>
<td>45</td>
<td>5</td>
<td>5</td>
<td>closed-loop linear voice coil</td>
<td>4.63\times8.5\times14.25</td>
<td>SMD, Priam</td>
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<tr>
<td></td>
<td>15450</td>
<td>14</td>
<td>156.5 U</td>
<td>46</td>
<td>3.5</td>
<td>7</td>
<td>closed-loop linear voice coil</td>
<td>6.9\times16.6\times20</td>
<td>Priam, SMD</td>
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<tr>
<td></td>
<td>DT01-03/ DT01-06/DT01-07 (subsystems)</td>
<td>8</td>
<td>75/160/292 F</td>
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<td>7,995/9,995/12,995/Q1</td>
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<tr>
<td><strong>Quantum Corp.</strong></td>
<td>Q2020/Q2030/ Q2040</td>
<td>8</td>
<td>21.33/32/42.66</td>
<td>60/60/60</td>
<td>4/6/8</td>
<td>4/6/8</td>
<td>rotary voice coil</td>
<td>4.5\times8.5\times14.25</td>
<td>SA1000</td>
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<tr>
<td><strong>Racet Computers Ltd.</strong></td>
<td>PCMS-150 (subsystem)</td>
<td>8</td>
<td>199 U</td>
<td>60 F</td>
<td>22</td>
<td>6</td>
<td>6</td>
<td>rotary</td>
<td>28\times11\times28</td>
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<tr>
<td></td>
<td>PCMS-250 (subsystem)</td>
<td>8</td>
<td>322 U</td>
<td>275 F</td>
<td>22</td>
<td>10</td>
<td>10</td>
<td>rotary</td>
<td>28\times22\times28</td>
</tr>
</tbody>
</table>
Does A True ESDI Controller Really Exist?

If today’s claims and counterclaims leave you unsure of just what constitutes a true ESDI controller, you are not alone. Still, from all the confusion one fact is clearly emerging: simply put—"a fully effective ESDI controller has to be one that allows your system to take maximum advantage of the SCSI bus."

To achieve this, the controller must offer these performance features: A 64-Kbyte continuous circular buffer. Burst rates of 1.5 to 1.85 megabytes per second. Full through-parity, connector to connector. Capability to format while off the bus. Programmable sector sizes. Full support of write/verify commands. 48-bit ECC. And the ability to format the drive with redundant ID fields to increase error recoverability.

Any ESDI controller that does not offer at least these features will compromise your system. The ADSI D200 ESDI controller most assuredly provides all these features plus others, thereby enabling your system to live up to its fullest potential.

So next time someone talks to you about an ESDI controller, be sure to ask about its speed, data integrity and functionality. Or better still, ask ADSI first. Call 714-594-5858 for full information on the D200 and all our disk and tape controllers and VLSI custom chip sets.
At Northern Telecom's Memory Systems Division, we can give your computers the highest memory capacity available today. And even more tomorrow. How? It's simple. We're experts.

We have 17 years of design and manufacturing experience, and we're well-versed in all the latest disk drive technology. Take embedded servo. We pioneered it. With its precise track following, embedded servo minimizes improper registration and track runout. The result: High capacity and high reliability.

You'll find embedded servo in our Mercury family of 8-inch Winchester drives. You'll also find that no one else today can offer you such a complete range of 8-inch Winchesters, with capacities of 234, 378, and 563MB and SCSI or SMD interfaces.

Find out what we can do for you—today and tomorrow. Call us at 1-800-521-3278. With the help of our Mercury drives, your customers just might "forget" about the competition.

© 1985 Northern Telecom

CIRCLE NO. 22 ON INQUIRY CARD
8-inch and larger rigid disk drives and subsystems

<table>
<thead>
<tr>
<th>Company/Model</th>
<th>Disk Size (inches)</th>
<th>Capacity (kibytes)</th>
<th>L-read/write heads</th>
<th>Average access time (msec)</th>
<th>Number of tape surface</th>
<th>Number of read/write heads</th>
<th>Actuator type</th>
<th>Dimensions (H x W x D) (Inches)</th>
<th>Interface</th>
<th>Price @ (quantity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCMS-411</td>
<td>14</td>
<td>513</td>
<td>U</td>
<td>25</td>
<td>10</td>
<td>19</td>
<td>linear voice coil</td>
<td>28 x 13.5 x 29</td>
<td>SMD, SASI</td>
<td>24,900 (Q1); 17,400 (Q100)</td>
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<tr>
<td>FWT80004/</td>
<td>8</td>
<td>20,408/85</td>
<td>U</td>
<td>40</td>
<td>4/8/7</td>
<td>4/8/7</td>
<td>rotary</td>
<td>5.25 x 19 x 21</td>
<td>SA1000</td>
<td>6,100/7,000/ 7,900 (Q1)</td>
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<td>FWT80006</td>
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<tr>
<td>SCIENTIFIC MICRO SYSTEMS INC.</td>
<td>339 N. Bernardo Ave., Mountain View, CA 94043, (415) 964-5700</td>
<td></td>
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<tr>
<td>STORAGE CONCEPTS INC.</td>
<td>31980 Airport Loop Dr., Costa Mesa, CA 92626, (714) 557-1862</td>
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<tr>
<td>Concept 15/</td>
<td>10.5</td>
<td>474-948</td>
<td>U</td>
<td>20</td>
<td>10</td>
<td>20</td>
<td>rotary</td>
<td>10.5 x 19 x 28.2</td>
<td>SMD</td>
<td>10,130-12,000 (Q1); 5,680-6,500 (Q100)</td>
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<td>Concept 21</td>
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</tr>
<tr>
<td>TECSTOR INC.</td>
<td>16161 Gothard St., Huntington Beach, CA 92647, (714) 842-0077</td>
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<tr>
<td>Series 3/3XX</td>
<td>14</td>
<td>315</td>
<td>U</td>
<td>29</td>
<td>10</td>
<td>20</td>
<td>rotary</td>
<td>10.5 x 19 x 28.2</td>
<td>SMD</td>
<td>10,130-12,000 (Q1); 5,680-6,500 (Q100)</td>
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<tr>
<td>Series 4/168,</td>
<td>8</td>
<td>168/337</td>
<td>U</td>
<td>20</td>
<td>10</td>
<td>20</td>
<td>rotary</td>
<td>5.5 x 8.6 x 16.5</td>
<td>SMD</td>
<td>4,400-4,550 (Q100)</td>
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<tr>
<td>Series 4/330</td>
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<tr>
<td>Series 4/4520</td>
<td>9</td>
<td>520</td>
<td>U</td>
<td>15</td>
<td>10</td>
<td>20</td>
<td>rotary</td>
<td>10.2 x 8.5 x 29</td>
<td>ESMD</td>
<td>8,600 (Q1); 7,600 (Q100)</td>
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<tr>
<td>Series 4/520</td>
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<tr>
<td>TOSHIBA AMERICA INC. (DISK PRODUCTS DIV.)</td>
<td>3910 Freedom Circle, Suite 103, Santa Clara, CA 95054, (408) 727-3939</td>
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<tr>
<td>MK-182FB</td>
<td>8</td>
<td>83/116/1</td>
<td>U</td>
<td>18</td>
<td>5/7</td>
<td>5/7</td>
<td>rotary voice coil</td>
<td>5.1 x 8.5 x 15</td>
<td>SMD</td>
<td>2,345 (Q1); 2,455 (Q100)</td>
</tr>
<tr>
<td>MK-184FB</td>
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<tr>
<td>MK-186FB</td>
<td>8</td>
<td>165/337/4</td>
<td>U</td>
<td>18</td>
<td>10</td>
<td>10</td>
<td>rotary voice coil</td>
<td>5.1 x 8.5 x 15</td>
<td>SMD/ESMD/</td>
<td>2,680/4,125 (Q100)</td>
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<td>MK-286FA</td>
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<td>MK-286FB</td>
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</tr>
</tbody>
</table>

Information was solicited but not received from the following manufacturers:

Amcodyne Inc.  
1301 South Sunset St.  
Longmont, CO 80501  
(303) 772-2601

Bull Peripherals Corp.  
766 San Alessly Ave.  
Sunnyvale, CA 94086  
(408) 745-0855

Charles River Data Systems  
983 Concord St.  
Framingham, MA 01532  
(617) 626-1000

Data General Corp.  
4400 Computer Dr.  
Westboro, MA 01580  
(617) 366-8911

Datrex Inc.  
3536 W. Osborn Rd.  
Phoenix, AZ 85019  
(602) 272-9491

Digital Equipment Corp.  
146 Main St.  
Maynard, MA 01754  
(617) 897-5111

Disc Tech One Inc.  
849 Ward Dr.  
Santa Barbara, CA 93111  
(805) 964-3535

Eicon Research Inc.  
1226 W. Broadway  
Hewlett, NY 11557  
(516) 374-6667

Harris Corp.  
(Computer Systems Div.)  
2101 Cypress Creek Rd.  
 Ft. Lauderdale, FL 33309  
(305) 974-1380

IONEGA Corp.  
1821 W. 4000 South  
 Roy, UT 84067  
(801) 778-1000

Modular Computer Systems Inc.  
P.O. Box 6099  
 Ft. Lauderdale, FL 33310  
(305) 974-1380

National Semiconductor  
Datacheck/DTS  
1050 Stewart Dr.  
 Sunnyvale, CA 94086  
(408) 749-7880

NEC Information Systems Inc.  
1414 Massachusetts Ave.  
Boxborough, MA 01719  
(617) 264-8000

Newbury Data Recording Ltd.  
Hawthrone Rd., Staines, Middlesex, TW18 3BJ, England  
(0784) 61500

Qualogy Inc.  
2214 Lundy Ave.  
San Jose, CA 95131  
(408) 946-5800

System Industries  
1855 Barber Lane  
Milpitas, CA 95035  
(408) 942-1212

Tecmar Inc.  
1226 W. Broadway  
Sunnyvale, CA 94086  
(408) 749-7880

Data General Corp. (Computer Systems Div.)  
4400 Computer Dr.  
Westboro, MA 01580  
(617) 264-8000

Wang Laboratories Inc. One Industrial Ave.  
Lowell, MA 01851  
(617) 459-5000

Century Data Systems drive; includes flexible drive backup, power supply, controller; system software

Circle 246

Circle 247

Circle 248

Circle 249
Discover All The Addresses On Your Block
Now systems integrators using Data General minicomputers can discover significantly more addressable disk storage capacity than ever before through a new feature on Zetaco disk controllers: Virtual Mapping. This true block address translation technique yields higher formatted capacities (100% increase in some cases!) on popular SMD drives that ordinarily map out inefficiently under RDOS, AOS and AOS/VS parameters. All under true emulation without software patching of any kind! Zetaco lets you choose from a wider variety of drives, to exactly fit your subsystem needs.

Virtual Mapping is available now on our two new disk controllers: Model BMX-3, compatible with the high-speed Burst Multiplexor Channel on DG's MV series, and Model DC-297, designed for Data Channel interface on Nova & Eclipse. Both support up to four SMD and/or HSMD drives, with data transfer rates up to 2.5 MB/sec, so you can integrate the latest high speed technology.

Tired of juggling three or more separate devices to meet your printing needs? Confused about which technology—daisywheel, dot-matrix, plotter, ink-jet, thermal or laser—is right for you?

The all-in-one AMT Office Printer does the job of all these devices with superb print quality, speed, and the ability to mix text with multicolor high-resolution graphics. In fact, this exciting printer has a set a new standard in functional versatility.

How can one printer do so much? With an ingenious print mechanism, unrivaled font, graphic and color flexibility, plus widespread hardware and software compatibility.

And the AMT Office Printer is applications-oriented. For word processing, there is letter- and memo-quality text, with both fixed and proportionally-spaced fonts, scientific and technical character sets, and built-in features that italicize, color, bold, shadow, underscore, expand, center, and justify text. For data processing, there is high-speed, draft-quality text with up to 225 characters per line. For business graphics, CAD/CAE plots, and other precision graphic applications, there are full-color graphic modes providing resolutions up to 240V x 480H dots per inch. And for technical applications, there is software for custom font generation, plotter emulation, and VDI/GDI graphics compatibility.

And most importantly, the AMT Office Printer can be configured to be fully compatible with software that drives the IBM Color Printer™, Epson™, Diablo 630™, Diablo C-150™ or Qume Sprint 11™. So just plug the AMT Office Printer into your computer's serial or parallel port, load your favorite software, and begin printing.

Isn't it about time to solve all your printing problems? The all-in-one AMT Office Printer!

1157 Tourmaline Drive
Newbury Park, CA 91320  (805) 499-8741
European sales office UK  (0) 7356-71464

Advanced Matrix Technology, Inc.
CIRCLE NO. 24 ON INQUIRY CARD
## Line/page printers

<table>
<thead>
<tr>
<th>Company/Model</th>
<th>Print method</th>
<th>Print Speed</th>
<th>Characters per line</th>
<th>Simultaneous copies</th>
<th>Features with Teletype (keypad)</th>
<th>Interfaces (protocols)</th>
<th>Price &amp; Quantity</th>
<th>Noise, features, options</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADVANCED TECHNOLOGIES INTERNATIONAL</td>
<td>LaserPRINT 2670</td>
<td>Laser (page printer)</td>
<td>26 ppm</td>
<td>Programmable</td>
<td>None</td>
<td>RS232C; Centronics, Dataproducts parallel (X-on/X-off, DTR, ETX/ACK); Diablo 630; NEC 3550; DEC LN01; Epson FX80, MX80; Wang 5573; Dataproducts; up to 19.2K bps</td>
<td>11,400(Q1)</td>
<td>bit-mapped, block, raster graphics; diagnostics; power paper puller; variable forms unit; noise level less than 55 dB(a)</td>
</tr>
<tr>
<td>AMERICAN COMPUTER HARDWARE CORP.</td>
<td>ACB-300/ACB-600/ACB-1000</td>
<td>Band (line printer)</td>
<td>300/650/1025</td>
<td>132, 136</td>
<td>6</td>
<td>RS232C, Centronics, Dataproducts (X-on/X-off, DTR, up to 19.2K bps)</td>
<td>Self-test, noise level 60 dB(a)</td>
<td></td>
</tr>
<tr>
<td>AT&amp;T TELETYPETE CORP.</td>
<td>40</td>
<td>Belt (line printer)</td>
<td>220-300 lpm</td>
<td>80-132</td>
<td>6</td>
<td>RS232C, Centronics, Dataproducts (X-on/X-off, DTR, up to 19.2K bps)</td>
<td>4,485-7,830(Q1)</td>
<td>Diagnostics, opt. controller</td>
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<tr>
<td>BULL PERIPHERALS CORP.</td>
<td>6050</td>
<td>Non-impact magnetographic (page printer)</td>
<td>50 ppm</td>
<td>Programmable</td>
<td>1-99</td>
<td>Dataproducts</td>
<td>30,000(Q1)</td>
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<tr>
<td>CENTRONICS DATA COMPUTER CORP.</td>
<td>Linewriter 400</td>
<td>Band (line printer)</td>
<td>400 lpm</td>
<td>132-136</td>
<td>6</td>
<td>RS232C, RS422, RS423, RS449, Centronics, Dataproducts</td>
<td>Noise level 55 dB(a)</td>
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<tr>
<td></td>
<td>Linewriter 800</td>
<td>Band (line printer)</td>
<td>800 lpm</td>
<td>132-136</td>
<td>6</td>
<td>RS232C, RS422, RS423, RS449, Centronics, Dataproducts</td>
<td>Noise level 55 dB(a)</td>
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<tr>
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<td>Lineprinter 1200</td>
<td>Band (line printer)</td>
<td>1200 lpm</td>
<td>132-136</td>
<td>6</td>
<td>RS232C, RS422, RS423, RS449, Centronics, Dataproducts</td>
<td>Noise level 55 dB(a)</td>
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MINI-MICRO SYSTEMS/April 15, 1986 47
## Line/page printers

<table>
<thead>
<tr>
<th>Company Name</th>
<th>Model(s)</th>
<th>Print Method</th>
<th>Print Speed</th>
<th>Characters/Line</th>
<th>Simultaneous Codes</th>
<th>Forms Width (inches)</th>
<th>Interface (Protocol)</th>
<th>Price - Monthly</th>
<th>Price - Initial</th>
<th>Notes, Features, Options</th>
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<tbody>
<tr>
<td>CIE TERMINALS INC.</td>
<td>Cl-300+</td>
<td>matrix (line printer)</td>
<td>85-300 lpm</td>
<td>200</td>
<td>3.5-16</td>
<td>Centronics parallel, Dataproductions (ACK/NAK, 19.2K bps)</td>
<td>4,495(Q1)</td>
<td>bar codes, dual microprocessors with RAM and ROM; opt. synch data communications protocols</td>
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<td>CI-600+</td>
<td>matrix (line printer)</td>
<td>170-600 lpm</td>
<td>200</td>
<td>3.5-16</td>
<td>Centronics parallel, Dataproductions (ACK/NAK, 19.2K bps)</td>
<td>6,795(Q1)</td>
<td>bar codes, dual microprocessors with RAM and ROM; opt. synch data communications protocols</td>
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<td>LIPS 10</td>
<td>laser (page printer)</td>
<td>10 ppm</td>
<td>none</td>
<td>Centronics parallel, RS232C serial</td>
<td>3,495(Q1)</td>
<td>graphics and forms generation, industrial graphics</td>
<td></td>
<td></td>
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<tr>
<td>CONCEPT TECHNOLOGIES INC.</td>
<td>ConceptWriter</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td>none</td>
<td>RS232C, Centronics (X-on/X-off, DTR, 9600 bps)</td>
<td>4,495(Q1)</td>
<td>bit-mapped graphics</td>
<td></td>
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</tr>
<tr>
<td>CORDATA (FORMERLY CORONA DATA SYSTEMS INC.)</td>
<td>CP-300</td>
<td>laser (page printer)</td>
<td>8 ppm programmable</td>
<td>none</td>
<td>IBM PC-compatible buses (1.8M bps, Epson)</td>
<td>3,395(Q1)</td>
<td>color printing</td>
<td></td>
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<tr>
<td>DATA GENERAL CORP.</td>
<td>4300 Series Band Printers</td>
<td>band (line printers)</td>
<td>220, 300, 460, 600 lpm</td>
<td>132</td>
<td>6</td>
<td>3-16 parallel</td>
<td>8,700-13,300(Q1)</td>
<td>diagnostics, power paper stacker, acoustic cabinet</td>
<td></td>
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<tr>
<td></td>
<td>4373/4374</td>
<td>band (line printer)</td>
<td>890/1200 lpm</td>
<td>132</td>
<td>6</td>
<td>4-16.75 parallel (proprietary)</td>
<td>29,500/27,000(Q1)</td>
<td>diagnostics, power paper stacker, acoustic cabinet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4557/4558</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td>132</td>
<td>none</td>
<td>RS232C, RS422A (proprietary)</td>
<td>3,500/5,995(Q1)</td>
<td>4558 has graphics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATAPOINT CORP.</td>
<td>9257</td>
<td>band (line printer)</td>
<td>300 lpm</td>
<td>132</td>
<td>3-16</td>
<td>RS232C</td>
<td>9,500(Q1); 8,075(Q100)</td>
<td>acoustic cabinet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9258</td>
<td>band (line printer)</td>
<td>600 lpm</td>
<td>132</td>
<td>3-16</td>
<td>RS232C</td>
<td>13,000(Q1); 11,060(Q100)</td>
<td>acoustic cabinet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9660</td>
<td>laser (line printer)</td>
<td>1300 lpm programmable</td>
<td>RS232C</td>
<td>47,500(Q1); 40,375(Q100)</td>
<td></td>
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</tr>
<tr>
<td>DATAPRODUCTS CORP.</td>
<td>B-1000/BB-1500/BB-2000</td>
<td>band (line printers)</td>
<td>1100/1500/2000 lpm</td>
<td>6</td>
<td>3-16/18.75</td>
<td>Dataproductions parallel (up to 19.2K bps)</td>
<td>13,200/22,500/30,000(Q1)</td>
<td>self-test, acoustic cabinet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LB-300/LB-600</td>
<td>band (line printer)</td>
<td>300/600 lpm</td>
<td>6</td>
<td>3-16</td>
<td>Dataproductions parallel (up to 19.2K bps)</td>
<td>4,995/6,795(Q1)</td>
<td>direct access VFU, universal power supply</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LZR-2630/2650/2655</td>
<td>laser (page printer)</td>
<td>up to 26 ppm</td>
<td>none</td>
<td>RS232C, Dataproductions, Centronics</td>
<td>14,900/17,900-19,900(Q1)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>DELPHAX SYSTEMS</td>
<td>S3000/S6000/2490</td>
<td>ion deposition (page printer)</td>
<td>30/60/90 ppm</td>
<td>S600 has optional Dataproductions, IBM 3211 emulation</td>
<td>diagnostics, page counter; opt. base cabinet/option DFU/OEM print engine, continuous speed paper</td>
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<tr>
<td>FUJITSU AMERICA INC.</td>
<td>M03040/M041</td>
<td>band (line printer)</td>
<td>300/600 lpm</td>
<td>132, 136</td>
<td>3-17</td>
<td>RS232C, Centronics, Dataproductions (up to 19.2K bps)</td>
<td>6,435/7,735(Q1); 3,800/4,280(Q100)</td>
<td>noise level under 55 dB(a)</td>
<td></td>
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<tr>
<td></td>
<td>M0342/M0343</td>
<td>band (line printer)</td>
<td>900/1200 lpm</td>
<td>132, 136</td>
<td>3-17</td>
<td>RS232C, Centronics, Dataproductions (up to 19.2K bps)</td>
<td>11,635/15,860(Q1); 6,750/8,100(Q100)</td>
<td>noise level under 55 dB(a)</td>
<td></td>
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</tr>
<tr>
<td>Company Model</td>
<td>Print method</td>
<td>Print speed</td>
<td>Characters per line</td>
<td>Simultaneous Copies</td>
<td>Forms width (inch)</td>
<td>Interface (protocols)</td>
<td>Paper $ (capacity)</td>
<td>Notes, features, options</td>
<td></td>
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<tr>
<td>GENERAL BUSINESS TECHNOLOGY INC.</td>
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<tr>
<td>3220LP</td>
<td>band (line printer)</td>
<td>720 lpm</td>
<td>132, 198</td>
<td>6</td>
<td>4-16.75</td>
<td>IBM System /34, /36, /38 (twin-ax)</td>
<td>11,500(Q1)</td>
<td>diagnostics, acoustic cabinet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3310LP</td>
<td>band (line printer)</td>
<td>450 lpm</td>
<td>132, 198</td>
<td>6</td>
<td>4-18</td>
<td>IBM System /34, /36, /38 (twin-ax)</td>
<td>8,800(Q1)</td>
<td>diagnostics, acoustic cabinet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6630XP</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td>up to 198</td>
<td>none</td>
<td></td>
<td>IBM System /34, /36, /38, Displaywriter, 327X (twin-ax)</td>
<td>4,995(Q1)</td>
<td>diagnostics, raster graphics</td>
<td></td>
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<tr>
<td>GENERAL OPTRONICS CORP.</td>
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<tr>
<td>Holoscan 28</td>
<td>laser (page printer)</td>
<td>28 ppm</td>
<td>275, programmable</td>
<td>none</td>
<td></td>
<td>RS232C, Centronics, Dataprints, X-on/X-off, DTR, ETX/ACK</td>
<td>14,500(Q1); 8,500(Q100)</td>
<td>bit-mapped, raster, vector graphics; diagnostics</td>
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<tr>
<td>GENICOM CORP.</td>
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<tr>
<td>4410</td>
<td>impact matrix (line printer)</td>
<td>300 lpm</td>
<td>programmable</td>
<td>6</td>
<td>3-16.54</td>
<td>RS232C, Centronics, Dataprints, Printronix (ANSI X3.64, Printronix, 500K bps)</td>
<td>6,195(Q1)</td>
<td>line drawing; block, raster graphics</td>
<td></td>
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<tr>
<td>4440</td>
<td>impact matrix (line printer)</td>
<td>600 lpm</td>
<td>6</td>
<td>3-16.54</td>
<td>RS232C, Centronics, Dataprints, Printronix (ANSI X3.64, Printronix, 500K bps)</td>
<td>7,795(Q1)</td>
<td>line drawing; block, raster graphics</td>
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<tr>
<td>5010</td>
<td>laser (page printer)</td>
<td>10 ppm</td>
<td>none</td>
<td></td>
<td></td>
<td>(Diablo 630, IBM Graphic Printer, Hewlett-Packard LaserJet)</td>
<td>3,000(Q1)</td>
<td>bit-mapped graphics</td>
<td></td>
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<tr>
<td>HARRIS CORP. (COMPUTER SYSTEMS DIV.)</td>
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<tr>
<td>PB 4337</td>
<td>band (line printer)</td>
<td>600 lpm</td>
<td>132, 136, programmable</td>
<td>6</td>
<td>3-17</td>
<td>RS232C (X-on/X-off, 19.2K bps)</td>
<td>14,000(Q1)</td>
<td>self-diagnostics</td>
<td></td>
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<tr>
<td>PL 4508</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td>none</td>
<td></td>
<td></td>
<td>RS232C (RTS/CTS, X-on/X-off, 19.2K bps)</td>
<td>7,495(Q1)</td>
<td>bit-mapped, raster, vector graphics; self-diagnostics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PM 4430</td>
<td>impact matrix (line printer)</td>
<td>300 lpm</td>
<td>132, 176, 220, programmable</td>
<td>6</td>
<td>3-16</td>
<td>RS232C (19.2K bps)</td>
<td>12,960(Q1)</td>
<td>raster graphics</td>
<td></td>
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<tr>
<td>HETRA COMPUTER AND COMMUNICATIONS INDUSTRIES INC.</td>
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<tr>
<td>3024</td>
<td>laser (page printer)</td>
<td>24 ppm</td>
<td>programmable</td>
<td>none</td>
<td></td>
<td>RS232C, Centronics, RS422, RS423, Dataprints, MIL-188-114 (X-on/X-off, DTR, DSR, ETX/ACK, 19.2K bps)</td>
<td>21,500(Q1)</td>
<td>diagnostics; communications graphics scanner; raster, vector graphics</td>
<td></td>
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</tr>
<tr>
<td>3100</td>
<td>band (line printer)</td>
<td>600 lpm</td>
<td>132-136</td>
<td>6</td>
<td>3.5-18</td>
<td>RS232C, Centronics, RS422, RS423, Dataprints, MIL-188-114 (X-on/X-off, ACK/NAK, 19.2K bps)</td>
<td>12,000(Q1)</td>
<td>diagnostics, power paper puller, variable forms unit, acoustic cabinet</td>
<td></td>
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<tr>
<td>3300</td>
<td>band (line printer)</td>
<td>1200 lpm</td>
<td>132-136</td>
<td>6</td>
<td>3.5-19</td>
<td>RS232C, Centronics, RS422, RS423, Dataprints, MIL-188-114 (X-on/X-off, ACK/NAK, 19.2K bps)</td>
<td>24,000(Q1)</td>
<td>diagnostics, power paper puller, variable forms unit, acoustic cabinet</td>
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<tr>
<td>HEWLETT-PACKARD CO. (BOISE DIV.)</td>
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<tr>
<td>LaserJet/LaserJet Plus</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td></td>
<td></td>
<td></td>
<td>RS232C, RS422/RS232, RS422, Centronics (X-on/X-off, up to 19.2K bps)</td>
<td>2,995/3,995(Q1)</td>
<td>raster graphics/bit-mapped, raster graphics</td>
<td></td>
<td></td>
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<tr>
<td>2563A/2564B</td>
<td>impact matrix (line printer)</td>
<td>300/600 lpm</td>
<td>66-120</td>
<td>6</td>
<td>3-16.7</td>
<td>RS232C, RS422A, Centronics, Dataprints, IEEE 488 (X-on/X-off, ETX/ACK, ENQ/ACK, DTR, up to 19.2K bps)</td>
<td>5,780/9,995(Q1); 3,930/6,597(Q100)</td>
<td>raster graphics; opt. bar codes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Company</td>
<td>Model</td>
<td>Print Method</td>
<td>Print Speed</td>
<td>Characters</td>
<td>Simultaneous Copying</td>
<td>Sources</td>
<td>Interface (Protocol)</td>
<td>Price &amp; (Penny)</td>
<td>Notes, Features, Options</td>
<td></td>
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<tr>
<td>HP</td>
<td>2689A</td>
<td>laser (page printer)</td>
<td>45 ppm</td>
<td>none</td>
<td>6.5-12.7</td>
<td>(IBM 3211)</td>
<td></td>
<td>99,950(Q1)</td>
<td>diagnostics</td>
<td></td>
</tr>
<tr>
<td>HONEYWELL INFORMATION SYSTEMS INC.</td>
<td>65 Walnut St., Wellesley, MA 02181, (617) 431-6000</td>
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<tr>
<td>PPSII</td>
<td>electrostatic</td>
<td>140-210 ppm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RS232C, Centronics, Dataproducts (X-on/X-off, DTR, Centronics, XNS, TCP-IP, up to 19.2K bps)</td>
<td>265,000-325,000(Q1)</td>
<td>diagnostics</td>
<td></td>
</tr>
<tr>
<td>PPSII</td>
<td>ion deposition</td>
<td>90 ppm</td>
<td></td>
<td></td>
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<td></td>
<td>RS232C, Centronics, Dataproducts (X-on/X-off, DTR, Centronics, XNS, TCP-IP, up to 19.2K bps)</td>
<td>280,000-350,000(Q1)</td>
<td>diagnostics</td>
<td></td>
</tr>
<tr>
<td>IMAGEN CORP.</td>
<td>2650 San Tomas Expwy., Santa Clara, CA 95052-8101, (408) 986-9400</td>
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<td></td>
<td>RS232C, Centronics, Dataproducts (X-on/X-off, DTR, Centronics, XNS, TCP-IP, up to 19.2K bps)</td>
<td>8,950(Q1)</td>
<td>color printing, bit-mapped graphics</td>
<td></td>
</tr>
<tr>
<td>K-2</td>
<td>belt (page printer)</td>
<td>12 ppm</td>
<td></td>
<td></td>
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<td></td>
<td>RS232C, RS422, Centronics (X-on/X-off, Diablo 630; Epson MX80; Tektronix 4014, PLOT 10; up to 38.4K bps)</td>
<td>7,995(Q1)</td>
<td>self-diagnostics; bit-mapped, vector, raster graphics, opt. envelope feeder</td>
<td></td>
</tr>
<tr>
<td>KENTEK INFORMATION SYSTEMS INC.</td>
<td>6 Pearl Ct., Allendale, NJ 07401, (201) 825-8500</td>
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<td></td>
<td>RS232C, RS422, Centronics (X-on/X-off, Diablo 630; Epson MX80; Tektronix 4014, PLOT 10; up to 38.4K bps)</td>
<td>7,995(Q1)</td>
<td>self-diagnostics; bit-mapped, vector, raster graphics, opt. envelope feeder</td>
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<tr>
<td>MANNESMANN TALLY CORP.</td>
<td>8301 S. 180th St., Kent, WA 98032, (206) 251-5500</td>
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<td>RS232C, RS422, Centronics (X-on/X-off, Diablo 630; Epson MX80; Tektronix 4014, PLOT 10; up to 38.4K bps)</td>
<td>21,000(Q1); 19,500(Q100)</td>
<td>dot-addressable graphics, diagnostics</td>
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</tr>
<tr>
<td>MILTOPE CORP.</td>
<td>1770 Walt Whitman Rd., Melville, NY 11747, (516) 420-0200</td>
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<td></td>
<td>RS232C, Centronics, Dataproducts (MIL-STD 188, 1397 NDTS, 1397 ANEW (up to 9600 bps)</td>
<td>21,000(Q1); 19,500(Q100)</td>
<td>dot-addressable graphics, acoustic cabinet</td>
<td></td>
</tr>
<tr>
<td>HSP 3609-212A</td>
<td>impact matrix</td>
<td>600 lpm</td>
<td>6</td>
<td>4-16</td>
<td>RS232C, RS422, Centronics, Dataproducts parallel (X-on/X-off, BUSY/READY, ENQ/ACK, ETX/ACK, ACK/NAK, up to 19.2K bps)</td>
<td>21,000(Q1); 19,500(Q100)</td>
<td>dot-addressable graphics, diagnostics</td>
<td></td>
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<td></td>
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<tr>
<td>TP 2000</td>
<td>impact matrix</td>
<td>900 lpm</td>
<td>6</td>
<td>4-16</td>
<td>RS232C, Centronics, Dataproducts parallel (X-on/X-off, BUSY/READY, ENQ/ACK, ETX/ACK, ACK/NAK, up to 19.2K bps)</td>
<td>8,500(Q1); 8,000(Q100)</td>
<td>dot-addressable graphics, acoustic cabinet, power paper puller</td>
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<tr>
<td>NEC INFORMATION SYSTEMS</td>
<td>1414 Massachusetts Ave., Boxborough, MA 01719, (617) 264-8000</td>
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<td></td>
<td>RS232C, Centronics, Dataproducts (MIL-STD 188, 1397 NDTS, 1397 ANEW (up to 19.2K bps)</td>
<td>17,900(Q1); 17,000(Q100)</td>
<td>dot-addressable graphics, acoustic cabinet</td>
<td></td>
</tr>
<tr>
<td>LC-800</td>
<td>non-impact</td>
<td>8 ppm</td>
<td></td>
<td></td>
<td>serial, parallel</td>
<td>(up to 19.2K bps)</td>
<td>RS232C, Centronics, Dataproducts (MIL-STD 188, 1397 NDTS, 1397 ANEW (up to 19.2K bps)</td>
<td>2,995(Q1)</td>
<td>bit-mapped graphics</td>
<td></td>
</tr>
</tbody>
</table>

50 MINI-MICRO SYSTEMS/April 15, 1986
Leadership Is Being One Step Behind

Hot on the heels of the latest computer printer hardware. World leadership in replacement ribbons means consistently coming out with the caliber of ribbon product that sets the industry standard.

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COMDEX/Spring '86

CIRCLE NO. 25 ON INQUIRY CARD
Our belief in distinctive features endures in our latest VT220 emulator.

With whitened face and elegant kimono. In the past, she was a fashion innovator. Now she is a curator of tradition.

It is our respect for such features that leads us directly to the CIT 224 terminal, a product renowned for distinctive features.

You can, if you wish, take the CIT 224 directly from its carton and employ it anywhere you'd use a DEC VT220.

The moment you begin using it, however, the CIT 224 makes a grand leap from mere compatibility to clear superiority. Because, as you would expect, we designed it with many features not found in the DEC terminal.

There is our larger 14-inch display. Two more inches on a tilt and swivel monitor with 10 x 16 character cells, giving you greater resolution and character definition. Not to mention less strain on your eyes after a long day.

The CIT 224 delights many users with twice as many function keys. It also has eleven set-up screens—four more than the competition.

But there is yet one more feature that DEC has found impossible to craft into their terminals. CIE Terminals reliability. It is our dedication to reliability that helps us keep our warranty repair incidents under one percent. And keeps our prices so fiercely competitive.

And that may just be the most distinctive, most beautiful feature of all.

CIE TERMINALS
Where craftsmanship is still a tradition.

CIE Terminals, Inc., 2505 McCabe Way, Irvine, CA 92714-6297. 1-800-624-2516

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CIRCLE NO. 26 ON INQUIRY CARD
## Line/page printers

<table>
<thead>
<tr>
<th>Company Model</th>
<th>Print method</th>
<th>Print Speed</th>
<th>Characters per line</th>
<th>Simultaneous copies</th>
<th>Font size (points)</th>
<th>Interfaces (protocols)</th>
<th>Price $ (quantity)</th>
<th>Noise features, options</th>
</tr>
</thead>
<tbody>
<tr>
<td>NEWBURY DATA INC.</td>
<td>850</td>
<td>impact matrix (line printer)</td>
<td>300 lpm</td>
<td>226</td>
<td>5</td>
<td>4-15.31</td>
<td>RS232C, current loop, Centronics (X-on/X-off, DTR, ETX/ACK, EOA, IDLE), Centronics 350, ANSI, 50-9600 bps</td>
<td>3,800(Q1)</td>
</tr>
<tr>
<td></td>
<td>8905/8926</td>
<td>impact matrix (line printer)</td>
<td>110-150 lpm</td>
<td>220</td>
<td>5</td>
<td>4-15.31</td>
<td>RS232C, Centronics, current loop (X-on/X-off, DTR, ETX/ACK, 9600 bps)</td>
<td>1,800/2,400(Q1)</td>
</tr>
<tr>
<td></td>
<td>8933/8935</td>
<td>impact matrix (line printer)</td>
<td>150-120 lpm</td>
<td>220</td>
<td>5</td>
<td>4-15.31</td>
<td>RS232C, Centronics, current loop (X-on/X-off, ETX/ACK, Diablo 630, ANSI, 50-9600 bps)</td>
<td>3,800/3,500(Q1)</td>
</tr>
<tr>
<td>OASYS (OFFICE AUTOMATION SYSTEMS INC.)</td>
<td>LaserPro 805-C/LaserPro 805-R</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td>80-187</td>
<td>none</td>
<td>Centronics parallel, RS232C (X-on/X-off, DTR, ETX/ACK, 300-19.2K bps)</td>
<td>3,295/3,795(Q1)</td>
<td>limited vector graphics, page counter</td>
</tr>
<tr>
<td></td>
<td>LaserPro 810-C/LaserPro 810-R</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td>80-220</td>
<td>none</td>
<td>Centronics parallel, RS232C (X-on/X-off, DTR, ETX/ACK, 300-19.2K bps)</td>
<td>4,995(Q1)</td>
<td>bit-mapped, block graphics: page counter</td>
</tr>
<tr>
<td></td>
<td>LaserPro 820-C/LaserPro 820-R</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td>80-220</td>
<td>none</td>
<td>Centronics parallel, RS232C (X-on/X-off, ETX/ACK, Diablo 630, ANSI, 300-19.2K bps)</td>
<td>5,995(Q1)</td>
<td>bit-mapped, block graphics</td>
</tr>
<tr>
<td>OUTPUT TECHNOLOGY CORP.</td>
<td>OT-700</td>
<td>impact matrix (line printer)</td>
<td>200 lpm</td>
<td>68, 81, 116, 136, 163, 226</td>
<td>6</td>
<td>3-16</td>
<td>RS232C, Centronics (X-on/X-off, ETX/ACK, DTR, up to 9600 bps)</td>
<td>1,795(Q1)</td>
</tr>
<tr>
<td></td>
<td>OT-700e</td>
<td>impact matrix (line printer)</td>
<td>200 lpm</td>
<td>68, 81, 116, 136, 163, 226</td>
<td>6</td>
<td>3-16</td>
<td>RS232C, Centronics (X-on/X-off, ETX/ACK, DTR, up to 9600 bps)</td>
<td>1,995(Q1)</td>
</tr>
<tr>
<td></td>
<td>OT-777</td>
<td>impact matrix (line printer)</td>
<td>200 lpm</td>
<td>68, 81, 116, 136, 163, 226</td>
<td>6</td>
<td>3-16</td>
<td>IBM System /34, /36, /38 (X-on/X-off, ETX/ACK, DTR, IBM System 3X, up to 9600 bps)</td>
<td>3,195(Q1)</td>
</tr>
<tr>
<td>PARADYNE CORP.</td>
<td>8550 Ulmerton Rd., Largo, FL</td>
<td>33540, (813) 530-2000</td>
<td>8360 Page Printer</td>
<td>ion deposition (page printer)</td>
<td>60 ppm</td>
<td>none</td>
<td>IBM channel</td>
<td>54,000(Q1)</td>
</tr>
<tr>
<td>PRINTRONIX INC.</td>
<td>L150</td>
<td>impact matrix (line printer)</td>
<td>80, 150, 200 lpm</td>
<td>none</td>
<td>6</td>
<td>Centronics</td>
<td>3,995(Q1)</td>
<td>raster graphics; opt. Dataproducts, RS232C, IBM 3287</td>
</tr>
<tr>
<td></td>
<td>LP20</td>
<td>laser (page printer)</td>
<td>20 ppm</td>
<td>none</td>
<td>Centronics, Dataproducts</td>
<td>11,995(Q1)</td>
<td>opt. RS232C</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MV150B</td>
<td>impact matrix (line printer)</td>
<td>200 lpm</td>
<td>none</td>
<td>6</td>
<td>Centronics</td>
<td>3,745(Q1)</td>
<td>raster, block graphics</td>
</tr>
<tr>
<td>QMS INC.</td>
<td>KISS</td>
<td>laser (page printer)</td>
<td>6 ppm</td>
<td>none</td>
<td>RS232C, Centronics, (up to 19.2K bps, X-on/X-off, DTR, RTS)</td>
<td>1,995(Q1)</td>
<td>bit-mapped graphics</td>
<td></td>
</tr>
</tbody>
</table>

MINI MICRO SYSTEMS/April 15, 1986
### Line/page printers

<table>
<thead>
<tr>
<th>Company</th>
<th>Laser</th>
<th>Print Speed</th>
<th>Characters per line</th>
<th>Signatures per page</th>
<th>Forms with (check)</th>
<th>Interface (protocol)</th>
<th>Price &amp; Quality</th>
<th>Notes, features, options</th>
</tr>
</thead>
<tbody>
<tr>
<td>LASERGRAPHIX</td>
<td>laser (page printer)</td>
<td>8 1/2:24 ppm</td>
<td>programmable</td>
<td>none</td>
<td>RS232C, current loop; Centronics; Dataproducts; IBM 3271, 3272, 3274 A&amp;B, 3276, System/34, 36, 38, synch 2780, 3780; Burroughs; Sperry DCT-1000; up to 19.2K bps, X-on/X-off, ETX/ACK, DTR, BUSY, ACK, SNA SDLI, BSC</td>
<td>7.995/ 19.995/ 29.995(Q1)</td>
<td>vector, business, bit-mapped, plot/pixel graphics; opt. Tektronix 4010, 4014 emulation; bit-mapped graphics are optional on LASERGRAPHIX 2400</td>
<td></td>
</tr>
<tr>
<td>SmartWriter</td>
<td>laser (page printer)</td>
<td>8 ppm</td>
<td>programmable</td>
<td>none</td>
<td>RS232C, Centronics (up to 19.2K bps, X-on/X-off, DTR, RTS)</td>
<td>3.850(Q1)</td>
<td>bit-mapped graphics, supports ANSI X3.64 graphics</td>
<td></td>
</tr>
<tr>
<td>RICOH CORP.</td>
<td>5 Dedrick Place, NJ</td>
<td>8 ppm</td>
<td>programmable</td>
<td>none</td>
<td>RS232C, Centronics (DTR, ETX/ACK)</td>
<td>4.000(Q1); 3.000(Q100)</td>
<td>raster graphics</td>
<td></td>
</tr>
<tr>
<td>WANG LABORATORIES</td>
<td>4080 R</td>
<td>8 ppm</td>
<td>programmable</td>
<td>none</td>
<td>RS232C, Centronics (DTR, ETX/ACK)</td>
<td>4.000(Q1); 3.000(Q100)</td>
<td>raster graphics</td>
<td></td>
</tr>
<tr>
<td>INC.</td>
<td>101 Continental Blvd.</td>
<td>8 ppm</td>
<td>programmable</td>
<td>none</td>
<td>RS232C, Centronics (DTR, ETX/ACK)</td>
<td>4.000(Q1); 3.750(Q100)</td>
<td>bit-mapped, raster graphics</td>
<td></td>
</tr>
</tbody>
</table>

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### Four 8" disk drives

#### No one develops techno

For the first time, you can design a high-performance disk subsystem with multiple drives using only one connection on your SCSI bus.

With the Fujitsu Model M1053A Intelligent Disk Controller (IDC) you can put up to four of our 8" disk drives—1.3 gigabytes of storage—on a single SCSI connection. In a multi-drive configuration, that represents significant savings in controller cost. And you can build in expansion capacity without using up valuable connections to your SCSI bus.

You'll also find that the Fujitsu IDC keeps pace with the most sophisticated multi-host, multi-tasking SCSI-based system you can design. With it, you can at last take full advantage of the extended performance features of SCSI, including the disconnect/reselect and arbitration commands.

But that's just part of the story.

You'll be able to achieve even better system throughput and performance because the IDC handles all your device level chores. And you can do it in either synchronous or asynchronous mode, with a synchronous data transfer rate of 2.4 MB/second.

Equally important is the performance of the Fujitsu disk drive itself. Just take a look...
Information was solicited but not received from the following manufacturers:

Apple Computer Inc.  
20525 Mariani Ave.  
Cupertino, CA 95014  
(408) 996-1010

Canon USA Inc.  
One Canon Plaza  
Lake Success, NY 11042  
(516) 488-6700

Diconix Inc.  
3800 Space Dr.  
Dayton, OH 45414  
(513) 259-3100

Digital Equipment Corp.  
146 Main St.  
Maynard, MA 01754  
(617) 877-5111

Fertex Corp.  
48571 Milmont Dr.  
Fremont, CA 94538  
(415) 639-0800

IBM Corp.  
900 King St.  
Rye Brook, NY 10573  
(914) 934-4839

Minolta Corp.  
101 Williams Dr.  
Ramsey, NJ 07446  
(201) 925-4000

NCR Corp.  
3718 N. Rock Rd.  
Wichita, KS 67226  
(316) 688-8536

Philips Peripherals Inc.  
385 Oyster Point Blvd.  
So. San Francisco, CA 94080  
(415) 952-3000

Printacolor Corp.  
2830 Peterson Place  
Norcross, Ga 30071  
(404) 448-2675

Printer Systems Corp.  
9055 Comprint Ct.  
P.O. Box 6020  
Gaithersburg, MD 20877  
(301) 258-5060

QMS Inc.  
P.O. Box 81250  
Mobile, AL 36689  
(205) 633-4300

Quadram Corp.  
One Quad Way  
Norcross, GA 30093  
(404) 233-666

Siemens Communications Systems Inc.  
240 E. Palais Rd.  
Anaheim, CA 92805  
(714) 991-9700

Taliris Systems Inc.  
5160 Carroll Canyon Rd.  
P.O. Box 261580  
San Diego, CA 92126  
(619) 587-0787

Toshiba Corp.  
1-1 Shibaura,  
1-Chome, Minatoku  
Tokyo, 105, Japan  
(03) 457-3219

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**Line/page printers**

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One SCSI controller.

**Technology like Fujitsu.**

at the specs we've included here.
We've achieved performance levels that set the industry standard.
And because we've done it using proven technologies, you can be sure Fujitsu drives will keep performing.
For more information about Fujitsu's IDC and 8" drives, call (408) 946-8777. Or write Fujitsu America, Inc., Storage Products Division, 3055 Orchard Drive, San Jose, CA 95134-2017.
If you want to get the highest performance from your SCSI design, you'll need to talk to us—Fujitsu America.

**We're developing technology for you.**

CIRCLE NO. 27 ON INQUIRY CARD
AutoCAD™ plotting as easy as A-B-C with the JDL-750e Color Matrix Printer/Plotter

- Accepts up to 17" wide media (C-size)
- Prints on standard paper and vellum
- 15.1" print width in graphics
- 14 colors selectable
- 180 x 180 dpi resolution
- .01" minimum line width
- Semi-automatic A through C-size sheet insertion

The new JDL-750e prints A through C-size drawings yet costs less than the best-selling A/B size plotter. Producing high quality plots at speeds that rival a pen plotter, the 750e delivers superior line quality, highly accurate position repeatability, and no end-of-line pen drift or blotting.

Compatible with AutoCAD™ and FutureNet Dash™ II, the 750e gives you the choice of high speed draft plots, or high resolution plots, in black and white or full color.

For PC engineering workstation versatility, the 750e emulates the Diablo 630 and the IBM Model 5182 Color Printer for text and graphics compatibility with nearly every popular word processing, spreadsheet, and business graphics program, including Lotus 1-2-3, Symphony, SuperCalc III, Chart and Chart-Master.

For more information and an AutoCAD™ plot sample contact the JDL, Inc. office nearest you.

WESTERN REGION: 1335 Camino Del Rio South Suite 303 San Diego, CA 92108 (619) 291-8330
CENTRAL REGION: 14683 Midway Road Suite 202 Dallas, TX 75244 (214) 934-0535
EASTERN REGION: 7301 Carmel Executive Park Suite 206 Charlotte, NC 28226 (704) 541-6352

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<table>
<thead>
<tr>
<th>Company</th>
<th>Display area (diagonal)</th>
<th>Display resolution (in pixels)</th>
<th>Screen format</th>
<th>Color available</th>
<th>Interface (protocol)</th>
<th>Emulator</th>
<th>Unit price</th>
<th>Notes/Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACCEL INC.</td>
<td>19-inch, 16-, 256-color, 4096-color palette</td>
<td>1024 x 800</td>
<td>132 x 80</td>
<td>HS232C, Ethernet (X-on X-off)</td>
<td>DEC VT100, Tektronix 4115</td>
<td>4,490 arc, circle/rectangle generation; polygon fill; 4 or 8 bit planes; rackmount; RGB video output; diagnostics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADAGE INC.</td>
<td>19-inch, 16.7-million-color palette</td>
<td>1024 x 1024</td>
<td>(7 x 9)</td>
<td>RS232C</td>
<td></td>
<td>20,900 arc, circle/rectangle generation; concave polygons; 32 bit planes; Q-bus, Unibus compatible; rackmount; RS170, RS343 video output</td>
<td></td>
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</tr>
<tr>
<td>AED INC.</td>
<td>19-inch; 256-color, 4096-color palette</td>
<td>1024 x 1024</td>
<td></td>
<td>RS232C</td>
<td>IBM 5080</td>
<td>18,000-22,000 8 bit planes, VMEbus compatible, start-up diagnostics</td>
<td></td>
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<tr>
<td>ANN ARBOR TERMINALS INC.</td>
<td>19-inch, red, 256-color, 16.7-million-color palette</td>
<td>512 x 483</td>
<td></td>
<td>RS232C (X-on X-off)</td>
<td></td>
<td>9,045 8 bit planes, Q-bus compatible, rackmount, RGB video output; opt. printer, mouse</td>
<td></td>
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<tr>
<td>APPLIED DIGITAL DATA SYSTEMS INC. (ADDS)</td>
<td>15-inch, green</td>
<td>768 x 600</td>
<td>80 x 60</td>
<td>RS232C (X-on X-off)</td>
<td>ANSI X3.64</td>
<td>3,090/3,590 arc, circle/rectangle generation; polygon fill; Tektronix 4010, 4014 compatible; rackmount; diagnostics; programmable keys, vector graphics; GXL+Plus has Greek, math and user-defined character set</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASEA INDUSTRIAL SYSTEMS INC.</td>
<td>19-inch, 256-color, 16.7-million-color palette</td>
<td>1024 x 768</td>
<td>1280 x 1024</td>
<td>RS232C (X-on X-off)</td>
<td>DEC VT100, Tektronix 4014</td>
<td>13,295/17,950 8 bit planes, Q-bus compatible, rackmount, RGB video output; opt. printer, mouse; 8 bit planes, Q-bus compatible; 4 serial ports; opt. mouse</td>
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<tr>
<td>MINI-MICRO SYSTEMS/April 15, 1986</td>
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<tr>
<td>Company/Model</td>
<td>Display Size (diagonal) Color</td>
<td>Display Resolution (in pixels)</td>
<td>Screen Fonts/Alphanumeric Character Size</td>
<td>Interface (Protocol)</td>
<td>Emulations</td>
<td>Unit Price $</td>
<td>Notes, Features, Options</td>
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<tr>
<td>Tesselator 8010</td>
<td>13-, 16-, 19-, 25-inch; 16-color, 64-color palette</td>
<td>720 x 336</td>
<td>120 x 56 (6 x 6, 6 x 9, 9, 12 x 9, 18 x 15)</td>
<td>RS232C, RS422</td>
<td></td>
<td>9.675</td>
<td>bar chart, 1 bit plane, RS170 video output, built-in modem, printer buffer, foreign-language version</td>
<td></td>
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<tr>
<td>AT&amp;T</td>
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<tr>
<td>555 Touhy Ave., Skokie, IL 60077, (312) 982-2000</td>
<td>15-inch, green</td>
<td>132 x 24</td>
<td>RS232C</td>
<td>AT&amp;T 4410</td>
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<td>AYDIN CONTROLS</td>
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<tr>
<td>414 Commerce Dr., Ft. Washington, PA 19034, (215) 542-7800</td>
<td>19-inch, 16-, 25-inch; red, green, blue, yellow, orange, cyan, magenta, white; 6-color</td>
<td>512 x 256</td>
<td>80 x 48 (5 x 5, 7 x 9)</td>
<td>RS232C (X-on/X-off)</td>
<td>Intecolor 80016</td>
<td>3,100</td>
<td>RGB video output, 19-inch is rackmount</td>
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<tr>
<td>2411 W. La Palma, Anaheim, CA 92801, (714) 831-2000</td>
<td>19-inch, 16-, 25-inch; red, green, blue, yellow, orange, cyan, magenta, white; 6-color</td>
<td>1024 x 1024</td>
<td>80 x 48</td>
<td>RS232C</td>
<td></td>
<td>9,300</td>
<td>pan, zoom, rubber banding, windowing, scaling, 8 bit planes, RGB video output</td>
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<tr>
<td>CHROMATICS INC.</td>
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<tr>
<td>2558 Mountain Industrial Blvd., Tucker, GA 30084, (404) 493-7000</td>
<td>19-inch, 16-, 25-inch; red, green, blue, yellow, orange, cyan, magenta, white; 6-color</td>
<td>1024 x 1024</td>
<td>80 x 48</td>
<td>RS232C</td>
<td></td>
<td>9,300</td>
<td></td>
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<tr>
<td>CIFER PLC</td>
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<tr>
<td>Avroway, Bowerhill, Melksham, Wiltshire, SN12 9TP, England, (0225) 706361</td>
<td>19-inch, 16-, 25-inch; red, green, blue, yellow, orange, cyan, magenta, white; 6-color</td>
<td>1024 x 1024</td>
<td>80 x 48</td>
<td>RS232C</td>
<td></td>
<td>9,300</td>
<td></td>
<td></td>
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<tr>
<td>DATAMEDIA CORP.</td>
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<tr>
<td>11 Trafalgar Square, Nashua, NH 03063, (603) 886-1570</td>
<td>19-inch, 16-, 25-inch; red, green, blue, yellow, orange, cyan, magenta, white; 6-color</td>
<td>1024 x 1024</td>
<td>80 x 48</td>
<td>RS232C</td>
<td></td>
<td>9,300</td>
<td></td>
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<tr>
<td>ERICSSON INFORMATION SYSTEMS AB</td>
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<tr>
<td>S-16398 Stockholm, Sweden, (4687) 520000</td>
<td>19-inch, 16-, 25-inch; red, green, blue, yellow, orange, cyan, magenta, white; 6-color</td>
<td>1024 x 1024</td>
<td>80 x 48</td>
<td>RS232C</td>
<td></td>
<td>9,300</td>
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<tr>
<td>EVANS &amp; SUTHERLAND</td>
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<tr>
<td>580 Arapeen Dr., Salt Lake City, UT 84108, (801) 582-5847</td>
<td>19-inch, 1800-color</td>
<td>8192 x 8192</td>
<td>RS232C, DEC parallel, IEEE 488</td>
<td>DEC VT100; IBM 3250, 3278, 5080, Tektronix 4014</td>
<td></td>
<td>40,000</td>
<td>3D, diagnostics; opt. color raster display</td>
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## Graphics terminals

<table>
<thead>
<tr>
<th>Company/Made</th>
<th>Model</th>
<th>Display size (diagonal)</th>
<th>Screen resolution (in pixels)</th>
<th>Screen format (font character size)</th>
<th>Interface (Protocol)</th>
<th>Emulations</th>
<th>Unit Price $</th>
<th>Notes, Features, Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>GENISCO COMPUTERS CORP.</td>
<td>HS30/HS50/HS60</td>
<td>19-inch; green, 16-, 4096-color; 16.7-million, 4096-color palette</td>
<td>1280 × 1024</td>
<td>160 × 1024</td>
<td>DMA, RS232C, RS422 (X-on/X-off)</td>
<td>DEC VT100</td>
<td>1.925</td>
<td>polymarker, polygon, curves, 4-12 bit planes, rackmount, RGBK video output, diagnostics</td>
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<tr>
<td>GRAPHON CORP.</td>
<td>GO-230</td>
<td>14-inch, green</td>
<td>1024 × 390</td>
<td>80 × 24, 132 × 24</td>
<td>RS232C, RS423 (X-on/X-off, DTR)</td>
<td>DEC VT52, VT100, VT220; Tektronix 4010, 4015</td>
<td>1.895</td>
<td>arc, circle generation; 2 bit planes; pan; zoom; 3 communications ports</td>
</tr>
<tr>
<td>HEWLETT-PACKARD CO. (ROSEVILLE TERMINALS DIV.)</td>
<td>8020 Foothills Blvd., Roseville, CA 95678, (916) 786-8000</td>
<td>12-inch, green</td>
<td>640 × 400</td>
<td>80 × 27</td>
<td>RS232C, Centronics, HP-IB (X-on/X-off, ENQ/ACK)</td>
<td>DEC VT100; Tektronix 4010, 4014; HP 2632A</td>
<td>2.095</td>
<td>polygon fill, rectangle generation, rubber banding, line drawing, italics, double-high/double-wide characters</td>
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<tr>
<td>HMW ENTERPRISES INC.</td>
<td>604 Salem Rd., Etters, PA 17319, (717) 938-4691</td>
<td>19-inch; green, red, blue, yellow, magenta, cyan, black, white</td>
<td>384 × 480</td>
<td>80 × 48</td>
<td>RS232C, current loop (X-on/X-off, ASCII)</td>
<td>ADDS 980, DEC VT100, ISC 8001G</td>
<td>5.000/7.000</td>
<td>arc, circle/rectangle generation; opt. rackmount, RGB video output, printer buffer and ports</td>
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<tr>
<td>IMALAC CORP.</td>
<td>5000</td>
<td>19-inch, green</td>
<td>2048 × 2048</td>
<td>80 × 50</td>
<td>RS232C (X-on/X-off)</td>
<td>Tektronix 4014</td>
<td>17.325</td>
<td>calligraphic, bit pad; opt. light pen, Multibus compatible</td>
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<tr>
<td>INTECOLOR CORP.</td>
<td>225 Technology Park/Atlanta, Norcross, GA 30071, (404) 449-5961</td>
<td>19-inch; green</td>
<td>2048 × 2048</td>
<td>80 × 50</td>
<td>RS232C (X-on/X-off)</td>
<td>Tektronix 4014</td>
<td>5.895</td>
<td>arc, circle/rectangle generation; points; polyline; super pixel; pattern generation; 3 bit planes</td>
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<tr>
<td>INTEGRAPH CORP.</td>
<td>One Madison Industrial Park, Huntsville, AL 35807, (205) 772-2000</td>
<td>19-inch; blue, yellow, magenta, cyan, black, white</td>
<td>1024 × 768</td>
<td>96 × 48, 160 × 80, 16 × 24, 8 × 12</td>
<td>RS232C, Centronics (X-on/X-off, asynch)</td>
<td>DEC VT100, Tektronix 4014</td>
<td>6.495</td>
<td>arc, circle/rectangle generation; points; polyline; super pixel; pattern generation; 6 bit planes</td>
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<tr>
<td>DSP055-Interact</td>
<td>19-inch; blue, yellow, magenta, cyan, black, white</td>
<td>1280 × 1024</td>
<td>80 × 40, 160 × 80, 16 × 24, 8 × 12</td>
<td>RS232C, RS432 (X-on/X-off, RTS/CTS)</td>
<td>DEC VT100, Tektronix 4014</td>
<td>48.000</td>
<td>zoom, pan; rotate; arc, circle, ellipse, curve generation; synch modem support</td>
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<tr>
<td>DSP071-InterPro</td>
<td>15-inch; green, yellow, magenta, cyan, black, white</td>
<td>1184 × 864</td>
<td>RS232C (X-on/X-off)</td>
<td>DEC VT100, VT220; IBM 372X series; Tektronix 4105</td>
<td>20.000</td>
<td>arc, circle, curve generation; window clipping; vector and raster test; polygon fill</td>
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<tr>
<td>Company Model</td>
<td>Display size (diagonal)</td>
<td>Display resolution (in pixels)</td>
<td>Screen length</td>
<td>Screen width</td>
<td>Character Pitch</td>
<td>Interface (Protocol)</td>
<td>Emulations</td>
<td>Unit price $</td>
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<tr>
<td>ITT QUME</td>
<td>14-inch: monochrome, 4 shades of grey</td>
<td>640 × 480</td>
<td>80 × 34 (8 × 14)</td>
<td>RS232C</td>
<td>DEC VT100, VT125; Tektronix 4010, 4014</td>
<td>1.995</td>
<td>arc, circle, polygon fill, 2 bit planes</td>
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<tr>
<td>QVT-311GX</td>
<td>14-inch; 8-color, 64-color palette</td>
<td>480 × 360</td>
<td>80 × 30 (6 × 12)</td>
<td>RS232C, Centronics (X-on-X-off)</td>
<td>Tektronix 4015, ANSI X3.64</td>
<td>2.995</td>
<td>arc, circle, polygon fill, 3 bit planes</td>
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<tr>
<td>KEL INC.</td>
<td>1024 × 780</td>
<td>146 × 64 (5 × 7, 10 × 14)</td>
<td>RS232C, current loop, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT100; Tektronix 4010, 4014</td>
<td>2.950</td>
<td>vector, circle, rectangle fill, digitizer tablet, mouse, J1014C has 4 bit planes</td>
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<tr>
<td>J1014/J1014C</td>
<td>12-inch; green, amber, 14-inch, 8-color palette</td>
<td>512 × 240</td>
<td>24 × 122 (6 × 9)</td>
<td>RS232C, current loop, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT100; Tektronix 4010, 4014</td>
<td>6.750</td>
<td>vector, circle, rectangle fill, 4 bit planes, digitizer tablet, mouse</td>
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<tr>
<td>J1019C</td>
<td>1024 × 780</td>
<td>146 × 64 (5 × 7, 10 × 14)</td>
<td>RS232C, current loop, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT100; Tektronix 4010, 4014</td>
<td>6.950</td>
<td>vector, circle, arc, polygon fill, 4 bit planes, zoom, pan digitizer tablet, mouse</td>
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<tr>
<td>J2014C</td>
<td>640 × 480</td>
<td>80 × 24</td>
<td>RS232C, current loop, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT100; Tektronix 4017, 4109</td>
<td>4.950</td>
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<tr>
<td>KEYNOTE COMPUTER PRODUCTS INC.</td>
<td>13-inch: 16-color</td>
<td>640 × 480</td>
<td>80 × 24 (7 × 8)</td>
<td>RS232C, current loop, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT100; Tektronix 4010, 4014</td>
<td>2.995</td>
<td>arc, circle/rectangle generation; polygon and pie segment drawing; opt. mouse</td>
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<tr>
<td>7105/7107</td>
<td>14-inch, 64-color, 4096-color palette</td>
<td>512 × 256</td>
<td>80 × 32 (9 × 9)</td>
<td>RS232C, current loop, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT52; Tektronix 4010, 4014</td>
<td>4.340</td>
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<tr>
<td>LEANSHIRE LTD.</td>
<td>1024 × 780</td>
<td>80 × 48 (12 × 8)</td>
<td>RS232C, current loop, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT100; Tektronix 4010, 4014</td>
<td>5.593</td>
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<tr>
<td>LEXIDATA CORP.</td>
<td>1280 × 1024</td>
<td>160 × 85 (7 × 9, 14 × 18, 21 × 27, 28 × 36)</td>
<td>RS232C</td>
<td>DEC VT100; Tektronix 4014, PLOT 10</td>
<td>6.625</td>
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<tr>
<td>2040/2410</td>
<td>640 × 480</td>
<td>34 × 80</td>
<td>RS232C</td>
<td>Tektronix 4027</td>
<td>4.100</td>
<td>arc, circle, polygon, string macro generation; 3 bit planes</td>
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<tr>
<td>LUNDY ELECTRONICS &amp; SYSTEMS INC.</td>
<td>1024 × 1024</td>
<td>16-bit parallel</td>
<td>RS232C, 16-bit parallel</td>
<td>DEC VT100</td>
<td>14.175</td>
<td>arc, circle, rectangle fill; 4 bit planes, multibus compatible; RGB video output; diagnostics, opt. rackmount</td>
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<tr>
<td>MATROX ELECTRONIC SYSTEMS LTD.</td>
<td>1024 × 768</td>
<td>80 × 25 (7 × 9)</td>
<td>RS232C, current loop, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT100</td>
<td>14.175</td>
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<tr>
<td>GXT-1000</td>
<td>19-inch, 16-color, 4096-color palette</td>
<td>1024 × 1024</td>
<td>16-bit parallel</td>
<td>DEC VT100</td>
<td>14.175</td>
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MINI-MICRO SYSTEMS/April 15, 1986
<table>
<thead>
<tr>
<th>Company</th>
<th>Model</th>
<th>Display size (resolution, color)</th>
<th>Display resolution (in pixels)</th>
<th>Scan lines x character cells</th>
<th>Interface (protocol)</th>
<th>Emulations</th>
<th>Unit price</th>
<th>Notes/Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEGATEK CORP.</td>
<td>9200</td>
<td>19-inch; 64-; 4096-color; 16.7-million-color palette</td>
<td>128 x 24 (8 x 12)</td>
<td>RS232C, Centronics (X-on-X-off)</td>
<td>DEC VT100</td>
<td>39,000</td>
<td>points, lines, meshes, polygon fill, 12 bit planes; opt. rackmount</td>
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<td>8200</td>
<td>19-inch; 64-; 4096-color; 16.7-million-color palette</td>
<td>128 x 24 (8 x 12)</td>
<td>RS232C, Centronics (X-on-X-off)</td>
<td>DEC VT100</td>
<td>23,000</td>
<td>4 bit planes, Unibus compatible, zoom, pan, surface fill; opt. rackmount</td>
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<tr>
<td>METHEUS CORP.</td>
<td>335</td>
<td>15-, 19-inch; 16-color; 16.7-million-color palette</td>
<td>128 x 48 (up to 8 x 16)</td>
<td>RS232C, IEEE 488 (X-on-X-off)</td>
<td>Tektronix 4010, 4014</td>
<td>8,950</td>
<td>arc, rectangle, polygon generation; polygon, rectangle fill; 4 bit planes</td>
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<td>277</td>
<td>15-, 19-inch; 16-color; 16.7-million-color palette</td>
<td>128 x 48 (up to 8 x 16)</td>
<td>RS232C, IEEE 488 (X-on-X-off)</td>
<td>Tektronix 4010, 4014</td>
<td>11,950</td>
<td>16-bit planes</td>
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<td></td>
<td>2500</td>
<td>15-, 19-inch; 16-color; 16.7-million-color palette</td>
<td>128 x 48 (up to 8 x 16)</td>
<td>RS232C, IEEE 488 (X-on-X-off)</td>
<td>DEC VT100</td>
<td>19,950</td>
<td>segmented display list, hierarchy, editing, polylines, pixels; 8 bit planes</td>
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<tr>
<td>MODGRAPH INC.</td>
<td>GX-1000</td>
<td>15-, 19-inch; monochrome</td>
<td>128 x 48 (up to 8 x 16)</td>
<td>RS232C, current loop (X-on-X-off)</td>
<td>DEC VT52, VT100; Lear Siegler ADM 3A; Tektronix 4010, 4014</td>
<td>2,195-3,495</td>
<td>line, arc, circle, rectangle fill; 1 bit plane; built-in diagnostics</td>
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<tr>
<td>NEWBURY DATA RECORDING LTD.</td>
<td>GW-100</td>
<td>15-, 19-inch; 16-color; 16.7-million-color palette</td>
<td>128 x 48 (up to 8 x 16)</td>
<td>RS232C, Centronics (X-on-X-off)</td>
<td>DEC VT100, Tektronix 4010</td>
<td>4,995</td>
<td>16-bit planes; built-in diagnostics; foreign-language version</td>
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<tr>
<td></td>
<td>9510</td>
<td>14-inch; amber, green</td>
<td>128 x 60 (up to 8 x 16)</td>
<td>RS232C, current loop (X-on-X-off, DTR)</td>
<td>DEC VT52, VT100; Lear Siegler ADM 3A; Tektronix 4010, 4014</td>
<td>800</td>
<td>2 bit planes</td>
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<tr>
<td>NEW GEA CORP.</td>
<td>NW235/</td>
<td>19-, 25-inch; 16-color; 16.7-million-color palette</td>
<td>128 x 60 (up to 8 x 16)</td>
<td>RS232C, RS 422</td>
<td>DEC VT100, IBM 3270, Tektronix 4014</td>
<td>17,500</td>
<td>arc, circle/rectangle generation; zoom; pan, rubber banding; polygon fill; 4 bit planes; rackmount; RGB video output/arc, circle/rectangle generation; 16 bit planes; rackmount; RGB video output</td>
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<td>NW237</td>
<td>25-inch; 16-color; 16.7-million-color palette</td>
<td>128 x 60 (up to 8 x 16)</td>
<td>RS232C, RS 422</td>
<td>DEC VT100, IBM 3270, Tektronix 4014</td>
<td>27,500</td>
<td>2 bit planes</td>
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<tr>
<td>NORTHWEST DIGITAL SYSTEMS</td>
<td>GP-29</td>
<td>14-inch; green, amber</td>
<td>128 x 60 (up to 8 x 16)</td>
<td>RS232C, RS 422</td>
<td>DEC VT100, IBM 3270, Tektronix 4014</td>
<td>1.695</td>
<td>pan, zoom, vector, erase, area erase, area fill, seed fill, arc drawing, 2 bit planes</td>
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<td>GP-220</td>
<td>14-inch; green, amber</td>
<td>128 x 60 (up to 8 x 16)</td>
<td>RS232C, RS 422</td>
<td>DEC VT100, IBM 3270, Tektronix 4014</td>
<td>2.195</td>
<td>pan, zoom, vector, erase, area erase, area fill, seed fill, arc drawing, 4 bit planes</td>
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<tr>
<td>PLESSEY PERIPHERAL SYSTEMS</td>
<td>PT 100G</td>
<td>14-inch; amber, green</td>
<td>128 x 60 (up to 8 x 16)</td>
<td>RS232C, RS 422</td>
<td>DEC VT100, IBM 3270, Tektronix 4014</td>
<td>1.295</td>
<td>arc, circle/rectangle generation; polygon fill; zoom; DEC compatible; printer port</td>
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<tr>
<td>Company/Model</td>
<td>Display size (diagonal)</td>
<td>Display resolution</td>
<td>Screen formats</td>
<td>Interface (protocols)</td>
<td>Emulations</td>
<td>Unit price $</td>
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<td><strong>PRIME COMPUTER INC.</strong></td>
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<tr>
<td>PW153/PW200</td>
<td>19-inch, 16-color/19-inch, 8-color</td>
<td>1152 x 860</td>
<td>RS232C/RS322C/RS322C/RS343</td>
<td>DEC VT52/VT100, Lear Siegler ADM 3A; Tektronix 4010/4010/1027</td>
<td>18,750/61,000/106,000</td>
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<td><strong>PSITECH INC.</strong></td>
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<tr>
<td>GTC 314/GTC 327</td>
<td>13-inch, 8-color, 4096-color palette</td>
<td>512 x 480</td>
<td>85 x 48 (6 x 10/80 x 34 (8 x 14)</td>
<td>RS232C (X-on-X-off, RTS/CTS)/RS232C (X-on-X-off)</td>
<td>DEC VT52, VT100, Lear Siegler ADM 3A; Tektronix 4010/4010/4027</td>
<td>2,895/4,200</td>
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<tr>
<td>GTC 329A</td>
<td>13-, 15-, 19-inch, 16-color, 4096-color palette</td>
<td>512 x 480</td>
<td>85 x 48 (6 x 10)</td>
<td>RS232C (X-on-X-off)</td>
<td>DEC VT52, VT100, Lear Siegler ADM 3A; Tektronix 4010</td>
<td>5,300</td>
<td></td>
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<tr>
<td>GTC 600 Series/</td>
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<tr>
<td>VME3</td>
<td>13-, 15-, 19-inch, 6-color, 4096-color palette</td>
<td>640 x 480</td>
<td>80 x 32 (8 x 15)</td>
<td>RS232C (X-on-X-off, RTS/CTS)/RS232C (X-on-X-off)</td>
<td>DEC VT100/VTektronix 4115</td>
<td>6,925/8,150/6,200</td>
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<tr>
<td><strong>RASTER TECHNOLOGIES INC.</strong></td>
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<tr>
<td>Two Robbins Rd., Westford, MA 01886, (617) 692-7900</td>
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<tr>
<td>One-10</td>
<td>13-inch, 256-color, 16.7-million-color palette</td>
<td>640 x 480</td>
<td>80 x 24 (5 x 7)</td>
<td>RS232C (X-on-X-off)</td>
<td>DEC VT100, Tektronix 4014</td>
<td>6,925/10 bit planes</td>
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<tr>
<td>One-75</td>
<td>19-inch, 256-color, 16.7-million-color palette</td>
<td>1280 x 1024</td>
<td>80 x 24 (5 x 7)</td>
<td>RS232C, DMA (X-on-X-off)</td>
<td>DEC VT100, Tektronix 4014</td>
<td>16,300/ bit slice, 8 bit planes</td>
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<tr>
<td><strong>RCA DATA COMMUNICATIONS PRODUCTS</strong></td>
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<tr>
<td>New Holland Ave., Lancaster, PA 17604, (800) 722-0094</td>
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<tr>
<td>VP4801/VP5801</td>
<td>12-inch, green</td>
<td>640 x 510</td>
<td>80 x 24 (6 x 8)</td>
<td>RS232C, Centronics (ASCII async)</td>
<td>DEC VT52, Lear Siegler ADM 3A, ADM 5; TeleVideo 910</td>
<td>498/798/built-in modem, printer port; VP5801 has 1 bit plane</td>
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<tr>
<td><strong>SAI TECHNOLOGY</strong></td>
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<tr>
<td>4224 Campus Point Court, San Diego, CA 92121-1513, (619) 452-9150</td>
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<tr>
<td>Plasmascpe Series 5000</td>
<td>8-inch, orange</td>
<td>512 x 512</td>
<td>80 x 50 (5 x 7, 7 x 9)</td>
<td>RS422</td>
<td>Intel</td>
<td>vectors, dots, circles, rectangles, arcs, ellipses, scrolling, split screen, Multibus compatible</td>
<td></td>
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<tr>
<td>Plasmascpe Series 7000</td>
<td>orange</td>
<td>256 x 512</td>
<td>5 x 7, 7 x 9</td>
<td>RS422</td>
<td>Intel</td>
<td>vectors, dots, circles, rectangles, arcs, ellipses, scrolling, split screen, Multibus compatible</td>
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<td><strong>SEIKO INSTRUMENTS USA INC.</strong></td>
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<tr>
<td>1623 Buckeye Dr., Milpitas, CA 95035, (408) 943-9100</td>
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<tr>
<td>GR-1104</td>
<td>14-inch, 8-color, 512-color palette</td>
<td>1024 x 780</td>
<td>80 x 48 (12 x 16)</td>
<td>RS232C, Centronics (X-on-X-off, ENQ/ACK, DTR)</td>
<td>DEC VT100, Tektronix PLOT 10</td>
<td>4,350/ arc, circle, line, rectangle generation; 4 bit planes; Multibus compatible</td>
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<tr>
<td>GR-2414</td>
<td>20-inch, 1024-color, 16.8-million-color palette</td>
<td>1024 x 1280</td>
<td>134 x 64 (10 x 14)</td>
<td>RS232C (X-on-X-off, ENQ/ACK, DTR)</td>
<td>Tektronix PLOT 10</td>
<td>15,950/ arc, circle, line, rectangle generation; 10 bit planes; Multibus compatible</td>
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<td><strong>SOUTHWEST TECHNICAL PRODUCTS CORP.</strong></td>
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<tr>
<td>219 W. Rhapsody, San Antonio, TX 78216, (512) 344-0241</td>
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<tr>
<td>X-12</td>
<td>12-inch, green</td>
<td>246 x 198</td>
<td>123 x 66 (5 x 7, 7 x 9)</td>
<td>RS232C, Centronics (X-on-X-off, DTR)</td>
<td>DEC VT100</td>
<td>1,495/ arc, circle/rectangle generation; polygon fill, 1 bit plane; diagnostics</td>
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<tr>
<td><strong>SPECTRAGRAPHERS CORP.</strong></td>
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<tr>
<td>10260 Sorrento Valley Rd., San Diego, CA 92121, (619) 450-0611</td>
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<tr>
<td>DS1080/DS1500</td>
<td>19-inch, 16-256-color, 16.8-million-color, 4096-color palette</td>
<td>1024 x 1024</td>
<td></td>
<td>RS232C, Centronics/Intel</td>
<td>IBM 3270, 5080/IBM 3250, 3270, 5080/DEC VT100</td>
<td>16,400/27,300/polygon fill, zoom, pan, up to 8 bit planes; diagnostics/polygon fill, pan, zoom, up to 12 bit planes</td>
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## Graphics terminals

<table>
<thead>
<tr>
<th>Company/Model</th>
<th>Display size (diagonally, color)</th>
<th>Display resolution (in pixels)</th>
<th>Screen format (character size)</th>
<th>Interface (protocol)</th>
<th>Emulations</th>
<th>Unit price $</th>
<th>Notes, features, options</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SPERRY CORP.</strong></td>
<td>Township and Jolly Rd., Blue Bell, PA 19424, (215) 542-4011</td>
<td>14-inch; green</td>
<td>1056 x 300, 800 x 300</td>
<td>RS232C, CCITT V.24</td>
<td>795-895</td>
<td>foreign-language version, self-test</td>
<td></td>
</tr>
<tr>
<td>SVT 1120</td>
<td>12-inch, green</td>
<td>132 x 24, 80 x 24 (7 x 11, 5 x 9)</td>
<td>RS232C, RS242, current loop</td>
<td>DEC VT52</td>
<td>495-895</td>
<td>DEC graphics characters</td>
<td></td>
</tr>
<tr>
<td>SVT 1210</td>
<td>12-inch, green</td>
<td>132 x 24, 80 x 24 (7 x 11, 5 x 9)</td>
<td></td>
<td>DEC VT220</td>
<td></td>
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<tr>
<td>SVT 1220</td>
<td>12-inch, green</td>
<td>132 x 24, 80 x 24 (7 x 11, 5 x 9)</td>
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<tr>
<td><strong>TANDBERG DATA INC.</strong></td>
<td>1590 S. Sinclair, Anaheim, CA 92806, (714) 978-6771</td>
<td>15-inch; green, b&amp;w</td>
<td>720 x 336</td>
<td>RS232C, RS422, current loop (X-on/X-off, DTR)</td>
<td>DEC VT100</td>
<td>1,795</td>
<td>arc, circle generation; 1 bit plane, built-in modem, foreign-language version, printer buffer</td>
</tr>
<tr>
<td>TDV2230S</td>
<td>15-inch; green, b&amp;w</td>
<td>80 x 250</td>
<td>RS232C, RS422, current loop</td>
<td>DEC VT220, ANSI X3.64</td>
<td>windowing, pan, 2 bit planes, mouse</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TDV2441</td>
<td>15-inch; green, b&amp;w</td>
<td>80 x 250</td>
<td>RS232C, RS422, current loop</td>
<td>DEC VT220, ANSI X3.64</td>
<td>windowing, pan, 2 bit planes, mouse</td>
<td></td>
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</tr>
<tr>
<td><strong>VG SYSTEMS INC.</strong></td>
<td>21300 Oxnard St., Woodland Hills, CA 91367, (818) 346-3410</td>
<td>19-inch; 16-color, 4096-color palette</td>
<td>1024 x 1024, 100 x 68 (IBM channel)</td>
<td>IBM 3250</td>
<td>22,000</td>
<td>digitizers, plotters</td>
<td></td>
</tr>
<tr>
<td>MG8000</td>
<td>14-inch, green</td>
<td>300 x 400, 80 x 24</td>
<td>IBM channel (SDLC)</td>
<td>IBM 3250</td>
<td>25,000</td>
<td>circle generation, polygon fill, 4 bit planes</td>
<td></td>
</tr>
<tr>
<td><strong>WICAT SYSTEMS INC.</strong></td>
<td>1875 South State St., Orem, UT 84058, (801) 224-6400</td>
<td>14-inch, 16-color, 4096-color palette</td>
<td>1024 x 480, 80 x 30</td>
<td>RS232C, (X-on/X-off)</td>
<td>DEC VT52</td>
<td>2,360</td>
<td>arc, circle, ellipse generation; polygon fill; 2 bit planes</td>
</tr>
<tr>
<td>WIT</td>
<td>14-inch, 16-color, 4096-color palette</td>
<td>840 x 480, 80 x 30</td>
<td>RS232C, (X-on/X-off)</td>
<td>DEC VT52</td>
<td>6,150</td>
<td>arc, circle, ellipse generation; polygon fill; 2 bit planes</td>
<td></td>
</tr>
</tbody>
</table>

Information was solicited but not received from the following manufacturers:

Burroughs Corp.  
Burroughs Place  
Detroit, MI 48232  
(313) 972-7350

Colorgraphic Communications Corp.  
2379 John Glenn Dr.  
P.O. Box 80448  
Atlanta, GA 30366  
(404) 455-3921

Control Data Corp. (OEM Product Sales)  
P.O. Box O  
Minneapolis, MN 55440  
(612) 853-8100

Dacoll Ltd.  
Dacoll House, Gardener's Lane, Bathgate, W. Lothian  
EH48 ITP, Scotland  
(0506) 56565

Data General Corp.  
4400 Computer Dr.  
Westboro, MA 01580  
(617) 366-8911

Digital Engineering Inc.  
640 Bercut Dr.  
Sacramento, CA 95814  
(916) 447-7600

Human Designed Systems Inc.  
20 Pickering St.  
Needham, MA 02192  
(617) 449-6446

IBM Corp.  
900 King St.  
Rye Brook, NY 10573  
(914) 934-4822

ID Systems Corp.  
6175-Shamrock Ct.  
Dublin, OH 43017  
(614) 766-0440

Japan Computer Corp.  
Mabuchi LK Bldg.  
Higashi-Chiyoda-Ku  
Tokyo, 101, Japan  
(03) 864-8111

Lanpar Technologies Inc.  
85 Torbay Rd.  
Markham, Ontario  
L3R 1G7, Canada  
(416) 475-9123

Liberty Electronics  
625 Third St.  
San Francisco, CA 94107  
(415) 543-7000

Micro-Term Inc.  
512 Rudder Rd.  
St. Louis, MO 63026  
(314) 343-6515

Techex Ltd.  
Roundways, Elliott Rd.  
W. Howe Industrial Estate  
Bournemouth, Dorset  
BH11 8JJ, England  
(0202) 571181

Tektronix Inc.  
P.O. Box 1000  
Wilsonville, OR 97070  
(503) 685-3617

Telex Computer Products Inc.  
6422 E. 41st St.  
Tulsa, OK 74135  
(800) 351-2623

Thomas Engineering Co.  
2440 Stanwell Dr.  
Concord, CA 94520  
(415) 680-8640

Vector Automation Inc.  
Village of Cross Keys  
Baltimore, MD 21210  
(301) 433-4200

Visual Technology Inc.  
1703 Middlesex St.  
Lowell, MA 01851  
(617) 459-4903

MINI-MICRO SYSTEMS/April 15, 1986
EVEN IF YOU'VE NEVER HEARD OF IT, WE'LL TAKE IT THERE.

DELTA AIR FREIGHT TO OVER 100 U.S. CITIES.
10,000 U.S. COMMUNITIES.

Even if your package has to go to Oshkosh, bygosh, you know that Delta Air Freight takes it there.
To almost anywhere in the country and usually on the most direct flight.
We don't waste your freight's time by sending it to a central location.
Then re-ship it to its destination.
Delta Air Freight gets your shipment on the next available flight.

DOOR TO DOOR PICK UP AND DELIVERY.

But what about the time you waste taking your freight to the airport? Or arranging for a courier service?
We've got that covered.
Delta Air Freight offers you door to door pick up and delivery. As well as airport to airport. Leaving you time for more profitable matters.
And taking the load off your back.
Plus, we offer you other reliable freight services—like Delta DASH* for same day delivery of small packages (under 70lbs.)
And Delta Air Express for packages over 70lbs. guarantees your shipment on the flight specified.
Because with Delta, time is always on your side. Isn't it time you put Delta to work for you? Call your local Delta Air Cargo Office.
With Delta Air Freight, you know your shipment will get there.
No matter where there is.

AIR FREIGHT. DELTA TAKES IT THERE.
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See P. 71 for Mini-Micro Marketplace

MINI-MICRO SYSTEMS/April 15, 1986
Why should you evaluate Chinon disk drives?

Japanese OEM's are the toughest and most critical in the world. They demand zero-defect quality, on-time delivery and excellent support—at the right price. So do you. For the past four years, Chinon has been supplying the most demanding of Japanese manufacturers with high-quality floppy disk drives. Now that same level of excellence is available to you.

Any disk-drive manufacturer can claim to give you this kind of quality. Talk is cheap. But the true test is in your own tough evaluation process. Next time you evaluate disk-drives, evaluate Chinon.

CHINON
The name for disk-drive quality.

Chinon America, Inc., 6374 Arizona Circle, Los Angeles, CA 90045. (213) 216-7611 FAX: (213) 216-7646
<table>
<thead>
<tr>
<th>Company</th>
<th>Model</th>
<th>Display size (diagonal), color</th>
<th>Phosphor number</th>
<th>Input signals</th>
<th>Display resolution (horizontal x vertical)</th>
<th>Refresh rate</th>
<th>Price &amp; (quality)</th>
<th>Notes &amp; Features Options</th>
</tr>
</thead>
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<tr>
<td>AMDEK CORP.</td>
<td>Color 600</td>
<td>13-inch, two 16-color palettes</td>
<td>P22, standard</td>
<td>TTL</td>
<td>640 x 240</td>
<td>60 Hz, non-interlaced</td>
<td>599(Q1)</td>
<td>16-MHz bandwidth; cabinet; FCC, UL approved; opt. tilt, swivel; non-glare screen</td>
</tr>
<tr>
<td></td>
<td>Color 722</td>
<td>13-inch, 16-color, 64-color palette</td>
<td>P22, standard</td>
<td>TTL</td>
<td>720 x 240, 720 x 350</td>
<td>60 Hz, non-interlaced</td>
<td>799(Q1)</td>
<td>25-MHz bandwidth; cabinet; FCC, UL approved; opt. tilt, swivel</td>
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<td>Video 300GIA</td>
<td>12-inch, green or amber</td>
<td>P31/P134, standard</td>
<td>NTSC</td>
<td>60 Hz, non-interlaced</td>
<td>179(Q1)</td>
<td>18-MHz bandwidth; cabinet; FCC, UL approved</td>
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<tr>
<td>AYDIN CONTROLS</td>
<td>8815</td>
<td>13-inch, infinite colors</td>
<td>P22, standard</td>
<td>RGB</td>
<td>1024 x 1024</td>
<td>2,300(Q1)</td>
<td>40-MHz bandwidth, cabinet</td>
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<td>8830/8831</td>
<td>19-inch, 16-color</td>
<td>P22, standard</td>
<td>RGB, TTL</td>
<td>640 x 480</td>
<td>2,300/2,450(Q1)</td>
<td>25-MHz bandwidth, cabinet</td>
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<td>8835/8836</td>
<td>19-inch, infinite colors</td>
<td>P22, standard</td>
<td>RGB</td>
<td>1280 x 1024</td>
<td>3,050/3,200(Q1)</td>
<td>40-MHz bandwidth, cabinet</td>
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<td>8864/8865</td>
<td>19-inch, infinite colors</td>
<td>P22, standard</td>
<td>RGB</td>
<td>1280 x 1024</td>
<td>4,200/4,350(Q1)</td>
<td>100-MHz bandwidth, cabinet</td>
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<tr>
<td>C. ITOH DIGITAL PRODUCTS INC.</td>
<td>CM1000/CM2000</td>
<td>13-inch, 16-color</td>
<td>NTSC, TTL/TTL</td>
<td>640 x 240</td>
<td>non-interlaced</td>
<td>499/599(Q1)</td>
<td>15-MHz bandwidth; opt. tilt, swivel</td>
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<td>CD-52011</td>
<td>19-inch, red, green, blue</td>
<td>B22, standard</td>
<td>RGB</td>
<td>1280 x 1024</td>
<td>3,000(Q1); 2,300(Q100)</td>
<td>120-MHz bandwidth, bare chassis</td>
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<td>ICM-14</td>
<td>14-inch, red, green, blue</td>
<td>B22, standard</td>
<td>RGB, TTL</td>
<td>1280 x 374</td>
<td>924(Q1); 805(Q100)</td>
<td>25-MHz bandwidth, bare chassis, tilt, half-tone</td>
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<td>QCD-1455AR</td>
<td>14-inch, red, green, blue</td>
<td>B22, standard</td>
<td>RGB</td>
<td>1280 x 790</td>
<td>924(Q1); 828(Q100)</td>
<td>50-MHz bandwidth, bare chassis, tilt, non-glare screen</td>
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<tr>
<td>CONNEX DATA SYSTEMS INC.</td>
<td>7111C19</td>
<td>19-inch, infinite colors</td>
<td>P22, standard</td>
<td>RGB</td>
<td>1024 x 768</td>
<td>30-60 Hz; non-interlaced</td>
<td>2,525(Q1)</td>
<td>25-MHz bandwidth; cabinet; FCC, UL, CSA approved</td>
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<td>7211C19</td>
<td>19-inch, infinite colors</td>
<td>P22, standard</td>
<td>RGB</td>
<td>1280 x 1024</td>
<td>30-60 Hz; non-interlaced</td>
<td>3,745(Q1)</td>
<td>40-MHz bandwidth; cabinet; FCC, UL, CSA approved</td>
</tr>
<tr>
<td></td>
<td>7351C19/7400C19</td>
<td>19-inch, infinite colors</td>
<td>P22, standard</td>
<td>RGB</td>
<td>1280 x 1024</td>
<td>60 Hz; non-interlaced</td>
<td>3,310(Q1)</td>
<td>110-MHz bandwidth; cabinet; FCC, UL, CSA approved; 7400C19 has Sony Trinitron CRT</td>
</tr>
<tr>
<td>CORDATA (FORMERLY CORONA DATA SYSTEMS INC.)</td>
<td>Color Monitor</td>
<td>14-inch, 16-color</td>
<td>B22, RGB, NTSC, TTL</td>
<td>640 x 480</td>
<td>non-interlaced</td>
<td>895(Q1)</td>
<td>cabinet</td>
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<tr>
<td>Company</td>
<td>Model</td>
<td>Display size (inch)</td>
<td>Display color</td>
<td>Monitor number</td>
<td>Resolution</td>
<td>Refresh rate</td>
<td>Price (Q1)</td>
<td>Notes/Features/Options</td>
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<tr>
<td>HONEYWELL INFORMATION SYSTEMS INC.</td>
<td>DMU 0793</td>
<td>12-inch; monochrome, amber</td>
<td>NTSC</td>
<td>640 x 200</td>
<td>60 Hz, non-interlaced</td>
<td>175(Q1)</td>
<td>cabinet; FCC, UL, CSA approved</td>
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<td></td>
<td>DMU 0794</td>
<td>12-inch; amber, monochrome</td>
<td>TTL</td>
<td>720 x 350</td>
<td>50 Hz, non-interlaced</td>
<td>275(Q1)</td>
<td>acid etch</td>
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<td></td>
<td>DMU 0795</td>
<td>13-inch, 16-color</td>
<td>RGB</td>
<td>640 x 200</td>
<td>60 Hz, non-interlaced</td>
<td>595(Q1)</td>
<td>dark glass</td>
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<tr>
<td>ITT INFORMATION SYSTEMS</td>
<td>Monochrome Display</td>
<td>13.5-inch; green, amber</td>
<td>standard, long persistence</td>
<td>TTL</td>
<td>720 x 348</td>
<td>50 Hz, non-interlaced</td>
<td>225(Q1)</td>
<td>non-glare screen, tilt, swivel</td>
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<tr>
<td></td>
<td>Color Graphics Monitor</td>
<td>13.5-inch, 16-color</td>
<td>standard</td>
<td>TTL</td>
<td>640 x 200</td>
<td>60 Hz, non-interlaced</td>
<td>545(Q1)</td>
<td>tilt, swivel</td>
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<td>Dual Frequency</td>
<td>13.5-inch; green, amber, 16 monochrome shades</td>
<td>standard, long persistence</td>
<td>TTL</td>
<td>640 x 200, 320 x 200</td>
<td>50-60 Hz, non-interlaced</td>
<td>275(Q1)</td>
<td>tilt; swivel; non-glare, etched screen</td>
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<tr>
<td>MICRO DISPLAY SYSTEMS INC.</td>
<td>401/402</td>
<td>15-inch, white</td>
<td>standard</td>
<td></td>
<td>720 x 990/728 x 1008, 640 x 200</td>
<td>60 Hz, non-interlaced</td>
<td>1,395/1,795(Q1)</td>
<td>100-MHz bandwidth, cabinet, FCC approved, tilt, swivel</td>
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<tr>
<td>MICROTOUCH SYSTEMS INC.</td>
<td>ENHANCED Touch</td>
<td>13-inch; 16-, 64-color</td>
<td>RGB, TTL</td>
<td>350 x 640</td>
<td>50-60 Hz, interlaced</td>
<td>1,945(Q1); 1,445(Q100)</td>
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<td>MONO Touch</td>
<td>12-inch; amber, monochrome</td>
<td>NTSC, TTL</td>
<td>240 x 640</td>
<td>50-60 Hz</td>
<td>1,145(Q1); 795(Q100)</td>
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<td>NTSC Touch</td>
<td>13-inch, 16-color</td>
<td>RGB, NTSC</td>
<td>480 x 640</td>
<td>1,896(Q1); 1,375(Q100)</td>
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<td>MICROVITEC INC.</td>
<td>895 DN</td>
<td>14-inch, infinite color</td>
<td>long persistence</td>
<td>RGB</td>
<td></td>
<td>48-74 Hz, interlaced</td>
<td>995(Q1)</td>
<td>cabinet, FCC approved, direct etch</td>
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<td>901 DI</td>
<td>14-inch, 16-color</td>
<td>B22, standard</td>
<td>TTL</td>
<td>930 x 550</td>
<td>48-74 Hz, interlaced</td>
<td>845(Q1)</td>
<td>40-MHz bandwidth, plastic cabinet, FCC approved, anti-glare screen</td>
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<tr>
<td></td>
<td>945 CN</td>
<td>20-inch, color</td>
<td>B22, long persistence</td>
<td>NTSC</td>
<td>1365 x 870</td>
<td>48-74 Hz, interlaced</td>
<td>1,995(Q1)</td>
<td>40-MHz bandwidth, metal cabinet, anti-glare screen</td>
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<tr>
<td>MONITERM</td>
<td>VX-Series</td>
<td>19-inch; white, green, amber, orange</td>
<td>P4, standard</td>
<td>TTL</td>
<td>1500 x 1500</td>
<td>60 Hz, non-interlaced</td>
<td>1,330(Q1); 850(Q100)</td>
<td>up to 200-MHz bandwidth; cabinet; CSA, TUV, UL, FCC approved; opt. tilt, swivel</td>
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<tr>
<td>MONITRON CORP.</td>
<td>EK Series</td>
<td>5- to 19-inch, monochrome</td>
<td>standard, long persistence</td>
<td>TTL</td>
<td>up to 1280 x 1024</td>
<td>up to 180 Hz, interlaced, non-interlaced</td>
<td>up to 180-MHz bandwidth; rackmount; CSA, UL approved</td>
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<tr>
<td></td>
<td>CL9140</td>
<td>14-inch, 4096-color</td>
<td>standard, long persistence</td>
<td>RGB</td>
<td>640 x 480</td>
<td>30 Hz, interlaced, 60 Hz non-interlaced</td>
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<tr>
<td>MOTOROLA DISPLAY SYSTEMS</td>
<td>HS4000/3000 Series</td>
<td>12-, 15-inch; white, green, monochrome</td>
<td>P4, P31, P39</td>
<td>TTL</td>
<td>1050 x 512</td>
<td>47-63 Hz, non-interlaced</td>
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<td>MD1500/1700 Series</td>
<td>7-inch; white, green, monochrome</td>
<td>P4, P31; standard</td>
<td>TTL</td>
<td>650 x 290</td>
<td>47-63 Hz, non-interlaced</td>
<td>22-MHz bandwidth</td>
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<tr>
<td></td>
<td>MD3570/3970 Series</td>
<td>12-inch; white, green, monochrome</td>
<td>P4, P31, P39</td>
<td>TTL</td>
<td>800 x 320</td>
<td>47-63 Hz, non-interlaced</td>
<td>25-MHz bandwidth</td>
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<tr>
<td>Company/Monitor</td>
<td>Display size (diagonally)</td>
<td>Phosphor color</td>
<td>Input signals</td>
<td>Display resolution (horizontal) x (vertical)</td>
<td>Vertical refresh</td>
<td>Price $ (Month)</td>
<td>Notes, Features, Options</td>
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<tr>
<td><strong>PANASONIC CO.</strong></td>
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<tr>
<td>Panasonic Way, Secaucus, NJ 07094, (201) 348-7000</td>
<td>Circle 345</td>
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<tr>
<td>CTF-1465 R</td>
<td>14-inch, color RGB, TTL</td>
<td>80 x 25</td>
<td>60 Hz, non-interlaced</td>
<td>749(Q1)</td>
<td>non-glare screen, tilt, swivel</td>
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<tr>
<td>CTF-1495 R/CTF-2095 M</td>
<td>20-inch, color RGB, TTL</td>
<td>80 x 25</td>
<td>60 Hz, non-interlaced</td>
<td>699/499(Q1)</td>
<td>non-glare screen</td>
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<tr>
<td>CTH-2690 R</td>
<td>26-inch, color RGB, TTL</td>
<td>1,300(Q1)</td>
<td>60 Hz, non-interlaced</td>
<td></td>
<td>non-glare screen</td>
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<tr>
<td><strong>PRINCETON GRAPHIC SYSTEMS</strong></td>
<td>Circle 346</td>
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<tr>
<td>601 Ewing St., Piscataway, NJ 08850, (609) 683-1660</td>
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<tr>
<td>HX-9E</td>
<td>9-inch, 16-, 64-color standard NTSC 640 x 350, 640 x 200</td>
<td>60 Hz, non-interlaced</td>
<td>750(Q1)</td>
<td>non-glare screen, tilt, swivel</td>
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<tr>
<td>HX-12E</td>
<td>12-inch, 16-, 64-color standard RGB 640 x 350, 640 x 200</td>
<td>60 Hz, non-interlaced</td>
<td>789(Q1)</td>
<td>non-glare screen</td>
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<tr>
<td>SR-12P</td>
<td>12-inch, 4096-color standard RGB 640 x 480, 640 x 400</td>
<td>60 Hz, non-interlaced</td>
<td>999(Q1)</td>
<td>non-glare screen</td>
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<tr>
<td><strong>QUADRAM CORP.</strong></td>
<td>Circle 347</td>
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<tr>
<td>One Quad Way, Norcross, GA 30093, (404) 923-6666</td>
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<tr>
<td>Amberchrome</td>
<td>12-inch; amber, monochrome P134 TTL 720 x 350</td>
<td>50 Hz, non-interlaced</td>
<td>250(Q1)</td>
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<tr>
<td>Quadchrome II</td>
<td>14-inch, 16-color standard TTL 640 x 200</td>
<td>60 Hz, non-interlaced</td>
<td>499(Q1)</td>
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<tr>
<td>Quadscreen</td>
<td>17-inch, b&amp;w, monochrome P4 TTL 968 x 512</td>
<td>60 Hz, non-interlaced</td>
<td>1,995(Q1)</td>
<td>split screen, cable, software</td>
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<tr>
<td><strong>SYSTEMS RESEARCH LABORATORIES INC.</strong></td>
<td>Circle 348</td>
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<tr>
<td>2800 Indian Ripple Rd., Dayton, OH 45440-3696, (513) 426-6000</td>
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<tr>
<td>2106-13-AF</td>
<td>13-inch; red, green, blue standard, long persistence RGB, TTL 1024 x 768</td>
<td>60 Hz; interlaced, non-interlaced</td>
<td>4,200(Q1); 3,024(Q100); 100-MHz bandwidth, FCC Class A approved</td>
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<tr>
<td>2106-19-AF</td>
<td>19-inch; red, green, blue standard, long persistence RGB, TTL 1280 x 1024</td>
<td>60 Hz; interlaced, non-interlaced</td>
<td>4,200(Q1); 3,024(Q100); 100-MHz bandwidth, rackmount or cabinet, FCC Class A approved</td>
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<td>2142-19</td>
<td>19-inch; red, green, blue standard, long persistence RGB, TTL 1280 x 1020</td>
<td>60 Hz; interlaced, non-interlaced</td>
<td>4,500(Q1); 3,240(Q100); 100-MHz bandwidth, ruggedized</td>
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<tr>
<td><strong>TATUNG CO. OF AMERICA INC.</strong></td>
<td>Circle 349</td>
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<tr>
<td>2850 El Presidio St., Long Beach, CA 90810, (213) 637-2105, (213) 979-7055</td>
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<tr>
<td>CM-1322</td>
<td>13-inch; red, green, blue, 16-color B22, standard TTL 640 x 200</td>
<td>50-60 Hz, non-interlaced</td>
<td>679(Q1); 318(Q500); 12-MHz bandwidth; cabinet; FCC Class B, UL, CSA approved; dark glass</td>
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<tr>
<td>CM-1376</td>
<td>13-, 22-inch; green, amber, 4096-color palette B22, standard RGB 640 x 480</td>
<td>50-60 Hz, non-interlaced</td>
<td>999(Q1); 499(Q250); 25-MHz bandwidth; cabinet; FCC Class A, UL, CSA approved; dark glass</td>
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<tr>
<td>CM-1380</td>
<td>13-inch; green, amber, 16-color, 64-color B22, standard RGB 640 x 350, 640 x 200</td>
<td>50-60 Hz, non-interlaced</td>
<td>849(Q1); 425(Q250); 20-MHz bandwidth; cabinet; FCC Class B, UL, CSA approved; dark glass</td>
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<tr>
<td><strong>TECMAR INC.</strong></td>
<td>Circle 350</td>
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<tr>
<td>6225 Cochran Rd., Solon, OH 44139, (216) 349-0600</td>
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<tr>
<td>811400/811401</td>
<td>13-inch; red, green, blue, 16-color long persistence TTL 720 x 480, 640 x 400</td>
<td>58-62 Hz, interlaced</td>
<td>789(Q1); 20-MHz bandwidth; FCC, UL approved; non-glare screen</td>
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<tr>
<td><strong>TXX GROUP</strong></td>
<td>Circle 350</td>
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<tr>
<td>306 Paseo Sonrisa St., Walnut, CA 91789, (714) 595-6146</td>
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<td>1201 A-G</td>
<td>12-inch; green, amber P31, standard NTSC non-interlaced</td>
<td>195(Q1); 20-MHz bandwidth; CSA, FCC approved</td>
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<tr>
<td>1221</td>
<td>12-inch, 16-color standard RGB 680 x 240</td>
<td>589(Q1); 18-MHz bandwidth; CSA, FCC approved</td>
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<tr>
<td>1421</td>
<td>14-inch, 16-color standard RGB 720 x 240</td>
<td>629(Q1); 18-MHz bandwidth; CSA, FCC approved; anti-glare screen</td>
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<tr>
<td><strong>XTRON COMPUTER EQUIPMENT CORP.</strong></td>
<td>Circle 351</td>
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<tr>
<td>19 Rector St., New York, NY 10006, (800) 854-4450</td>
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<tr>
<td>AA12</td>
<td>12-inch, amber long persistence NTSC 1000 x 350</td>
<td>non-interlaced</td>
<td>119(Q1); FCC approved, 4-way tilt and swivel, non-glare screen, dark glass</td>
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</table>
Monitors

<table>
<thead>
<tr>
<th>Company/Model</th>
<th>Display size (Diaper, color)</th>
<th>Persistence</th>
<th>Video Signal</th>
<th>Diagonal resolution (V/H)</th>
<th>Vertical refresh</th>
<th>Persistence &amp; Display</th>
<th>Notes/Capabilities</th>
</tr>
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<tbody>
<tr>
<td>IA12C</td>
<td>12-inch, amber</td>
<td>long persistence</td>
<td>TTL</td>
<td>1000 x 350</td>
<td>50 Hz</td>
<td>169 (Q1)</td>
<td>20-MHz bandwidth, FCC approved, 4-way tilt and swivel, non-glare screen, dark glass</td>
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<tr>
<td>HR14C</td>
<td>14-inch, 16-color</td>
<td>long persistence</td>
<td>720 x 400</td>
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<td></td>
<td>599 (Q1)</td>
<td>20-MHz bandwidth, FCC approved</td>
</tr>
</tbody>
</table>

Information was solicited but not received from the following manufacturers:

Amtron Corp.
2260 De la Cruz Blvd.
Santa Clara, CA 95050
(408) 748-8500

Audiotronics Corp.
7428 Bellaire Ave.
Hollywood, CA 91605
(818) 765-2645

Datacopy Corp.
1215 Terra Bella Ave.
Mountain View, CA 94043
(415) 965-7900

Dynax Inc.
6070 Rickenbacker Rd.
City of Commerce, CA 90040
(213) 727-1227

Electrohome Ltd.
809 Wellington St. North
Kitchener, Ontario
N2G 4J6, Canada
(519) 744-7111

Hitachi Corp.
of America Ltd.
50 Prospect Ave.
Tarrytown, NY 10591
(914) 332-5800

IBM Corp.
(Entry Systems Div.)
P.O. Box 1328-C
Boca Raton, FL 33432
(305) 998-2000

Ikegami Electronics
USA Inc.
37 Brook Ave.
Maywood, NJ 07607
(201) 366-9171

Mitsubishi Electronics
America Inc.
991 Knox St.
Torrance, CA 90502
(213) 515-3993

NEC Home Electronics
USA Inc.
1401 Estes St.
Elk Grove Village, IL 60007
(312) 228-5900

Sanyo Electric Inc.
1200 W. Artesia Blvd.
Compton, CA 90220
(213) 537-5830

Sharp Electronics Corp.
10 Sharp Plaza
Paramus, NJ 07652
(201) 265-5600

Sony Corp. of America
16450 W. Bernardo Dr.
San Diego, CA 92127
(619) 487-8500

Robert K. Singer
National Sales Manager
275 Washington St.
Newton, MA 02158
(617) 964-3030

NEW ENGLAND
John J. Fahey
Regional Manager
Susan Rapaport
Regional Manager
275 Washington St.
Newton, MA 02158
(617) 964-3030

NEW YORK/MID-ATLANTIC
Stephen B. Donohue
Regional Manager
1873 Route 70, Suite 302
Cherry Hill, NJ 08003
(609) 751-0170
In N.Y.: (212) 972-0058

SOUTHEAST
Larry Pullman
Regional Manager
6540 Powers Ferry Rd.,
Suite 170
Atlanta, GA 30339
(404) 955-6500

MIDWEST
Robert D. Wentz
Regional Manager
Marianne Majerus
Sales Coordinator
Cahners Plaza
1350 E. Touhy Ave.
P.O. Box 5080
Des Plaines, IL 60018
(312) 635-8800

SOUTHWEST
Don Ward, Regional Manager
15740 Midway, Suite 515
Dallas, TX 75234
(214) 980-0318

MOUNTAIN STATES
John Huff
Regional Manager
270 St. Paul St.
Denver, CO 80206
(303) 388-4511

SOUTHERN CALIFORNIA/NEVADA
Len Ganz
Regional Manager
18618 Teller Ave.
Irvine, CA 92715
(714) 851-9422

NORTHERN CALIFORNIA/NORTHWEST
Frank Barbagallo
Northwestern Regional Sales Manager
Rick Jamison
Regional Manager
Kathleen Maxwell
Sales Coordinator
Sherman Building, Suite 100
3031 Tisch Way
San Jose, CA 95128
(408) 245-9887

AUSTRIA/WEST GERMANY
Elan Marketing Group
Neutor g. 2
P.O. Box 84
1013 Vienna
Tel: 43-222-683012

BENELUX
Elan Marketing Group
BOSCHDUX, 1986
5612 HB Eindhoven
The Netherlands
Tel: 31-40-455724

ISRAEL
Elan Marketing Group
13 Hatefutsoth St., P.O. Box 33439
Tel Aviv
Tel: 972-3-252967
Telex: 341667

JAPAN
Koichiro Hata
General Manager
Dynaco International Inc.
7-28 Minamiyama
Minato-ku, Tokyo 107
Tel: 011-81-3-499-4569
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