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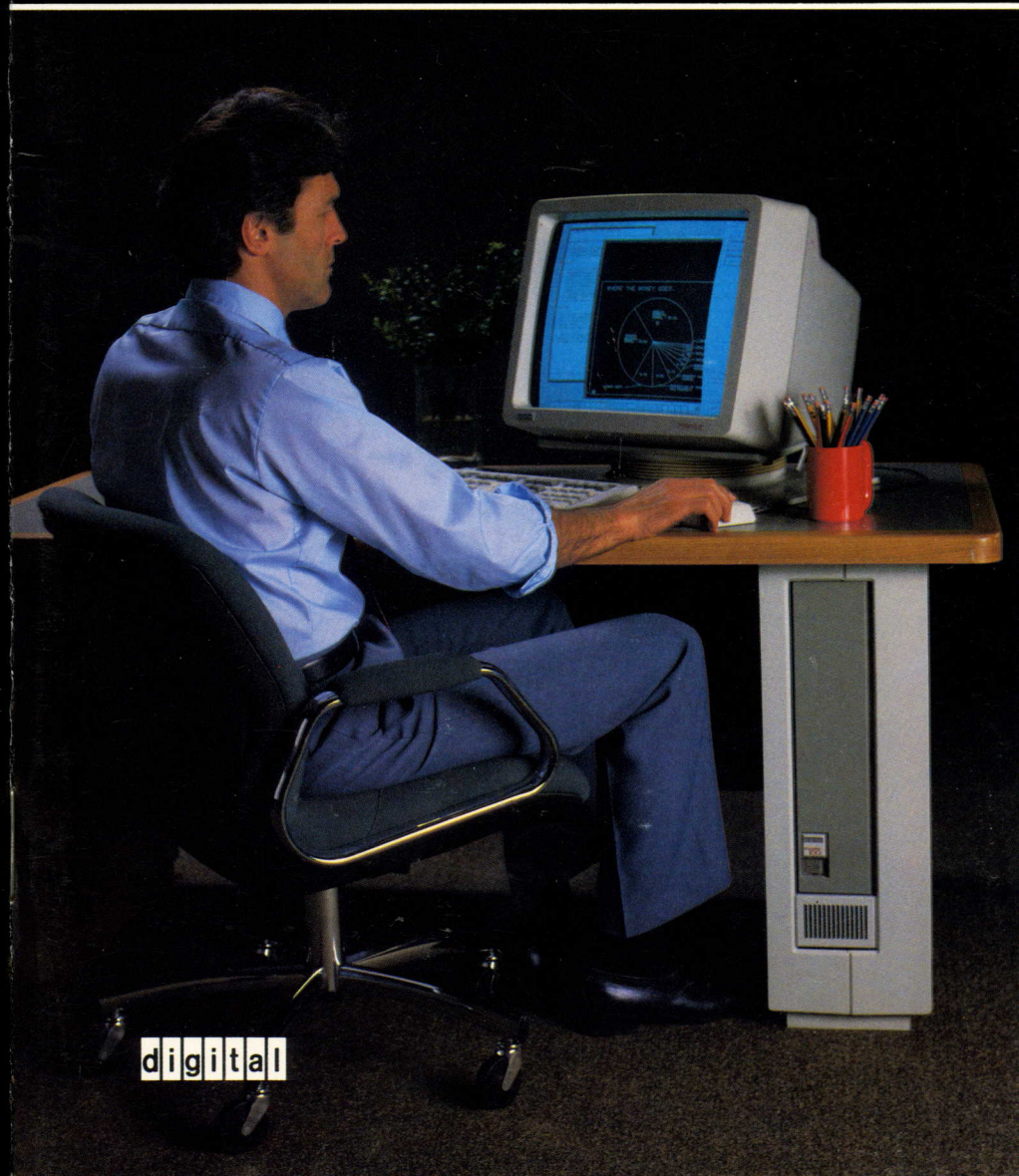
VAXstation 100 Technical Summary



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Introduction

You already own the best possible foundation for a technical workstation—a VAX computer. The VAXstation 100 workstation terminal is a subsystem you can add to your VAX system as a low-cost, practical alternative to a stand-alone workstation.

You can integrate a VAXstation 100 workstation into your current VAX computing environment easily and economically. It comes complete with display subsystem, fiber-optics link to your VAX UNIBUS, and layered workstation software for the VMS operating system. You don't have to operate it in an air-conditioned computer room; you can keep it in your office. It's quiet, compact, and unobtrusive.

The VAXstation 100 offers features of the most advanced workstations, like a high-resolution, 19-inch, monochrome monitor and the ability to operate on multiple jobs through multiwindowing. The human interface for the VAXstation 100 workstation is unequalled in the industry, with unique capabilities that enhance productivity and make the workstation easy to operate. With a VAXstation 100, you can concentrate on the task, not the tool.

So now you have a choice: buy new systems and software and spend many hours developing your applications to acquire the benefits of a technical workstation, or get the most out of what you already have by adding a VAXstation 100 workstation subsystem.

This book will help you make that choice. It provides an overview of the technical aspects of the VAXstation 100, including the many features that make this add-on workstation environment such an exciting productivity tool. But to really appreciate the VAXstation 100 workstation terminal, you have to try one. Call your local Digital sales office and ask for a demonstration.

VAXstation 100 Workstation Components

The VAXstation 100 is a package of hardware and software that includes everything you need to add state-of-the-art workstation capabilities to a UNIBUS VAX system. It's not a stand-alone system; it's a subsystem. (You could, however, combine a VAXstation 100 workstation terminal with a VAX-11/725 to form a stand-alone workstation system.)

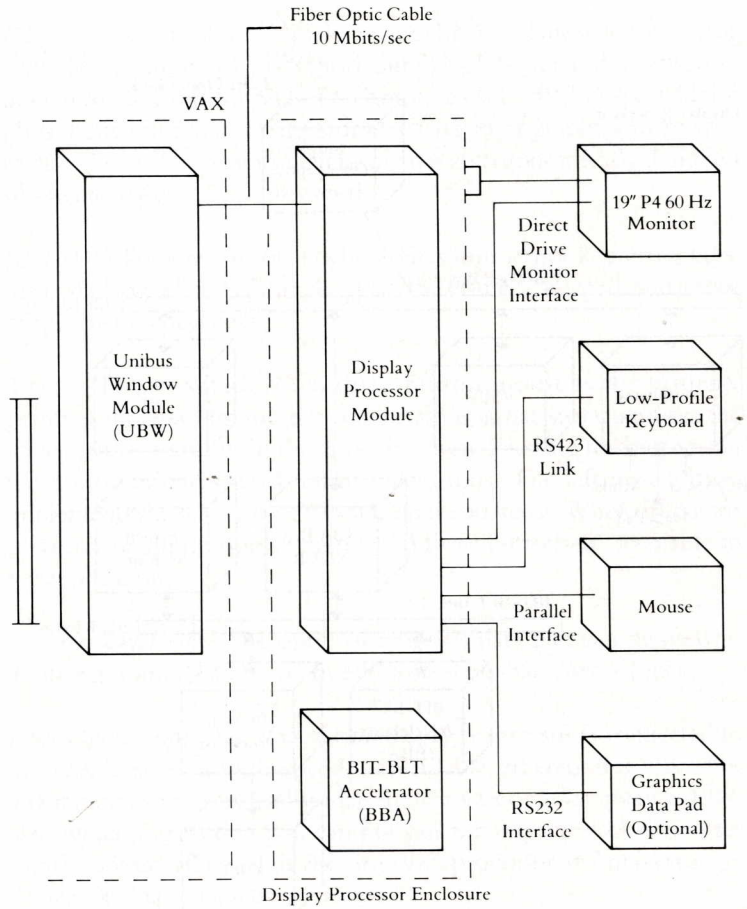
The workstation can be attached to any UNIBUS VAX processor: a VAX-11/725, VAX-11/730, VAX-11/750, VAX-11/780, VAX-11/782, or VAX-11/785 system. This gives you an extraordinary range of computer power, from a small single-user system that can sit in your office under your desk, to a large multiprocessing system supporting a cluster of workstations.

Hardware

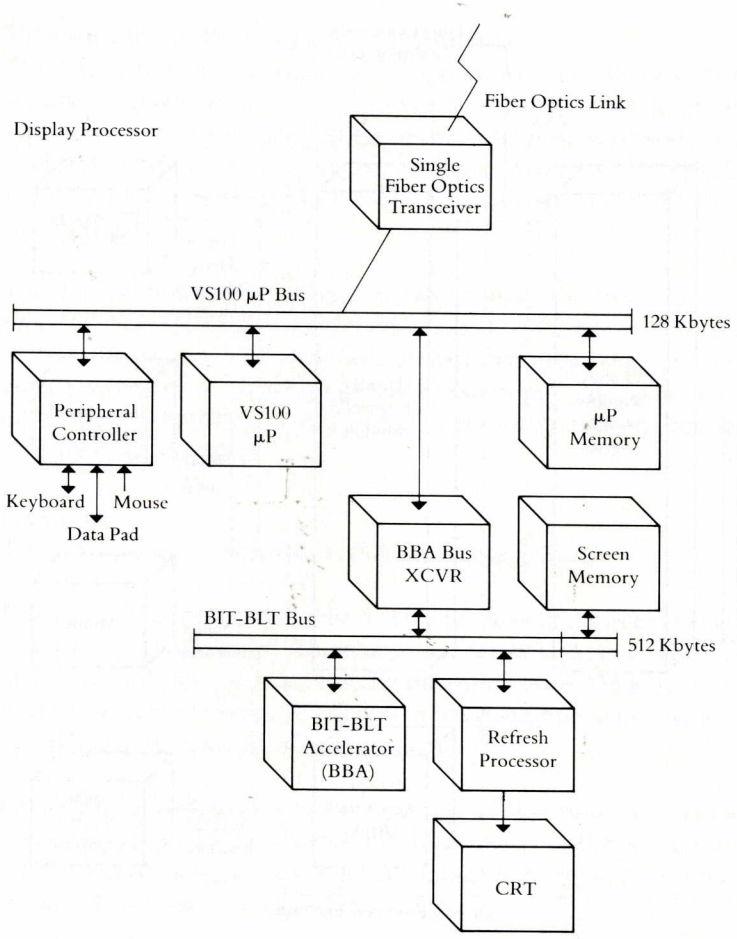
The VAXstation 100 includes the following components:

Display Processor Subsystem—The display processor subsystem generates text and graphics and maintains local screen memory. The display processor consists of a powerful microprocessor, 128 Kbytes of microprocessor memory, 512 Kbytes of screen-refresh memory, and a 16-Kbyte bootstrap and diagnostic ROM.

Instructions and data are stored in a portion of microprocessor memory. One quarter of the screen-refresh memory, or 128 Kbytes, is used for updating the screen. The remaining memory is used for the storage of text fonts and off-screen images.



VAXstation 100 Hardware Components



Internal Structure of the Display Processor Subsystem

Display Monitor–The 19-inch, monochrome, landscape monitor provides resolution of 1,088 (horizontal) by 864 (vertical) pixels, non-interlaced, at a refresh rate of 60 hertz. It uses a P4 low-persistence phosphor to eliminate image smear when text or graphics are moved on the screen. The monitor enclosure has an ergonomically designed tilt-swivel base.

Keyboard–The low-profile keyboard has four major key groupings: the main keypad, the editing keypad, the numeric keypad, and a row of special-function keys.

Mouse–The VAXstation 100 three-button mouse is the primary pointing device. Moving the mouse along a flat surface causes the screen cursor to move in the same direction. Pressing the buttons on the mouse initiates workstation operations. The leftmost button implements the selection of VAXstation menu items. When the cursor is within an application's window, all three buttons are available to the application.

Graphics Data Pad–The optional graphics data pad can be used to digitize graphics data via its five-button cross-hair cursor (puck).

Fiber-Optics Link–The VAXstation display processor is connected to the VAX host by a high-speed, dependable, fiber-optics link. The VAXstation can be physically adjacent to a VAX or as far away as 1,000 feet, which means that you can put quiet, compact workstation terminals in your office while the large VAX processor and mass storage devices are kept in a separate room.

Software

The workstation software for the VAXstation 100 is layered onto your VMS operating system, as a language like VAX FORTRAN or an application like DECgraph would be. It is available on the primary distribution media of every UNIBUS VAX system.

VAXstation 100 software has been designed to take advantage of the features of the display processor subsystem, the VMS operating system, and the abundance of world-class software developed for VAX/VMS systems. The software includes support for screen management, graphics operations, text manipulation, and the menu-driven human interface. Through software, the VAXstation 100 workstation can also emulate Digital's ASCII terminals and the Tektronix* 4014 graphics terminal.

Indeed, it's the software that makes the VAXstation 100 workstation such an extraordinary productivity tool. The rest of this book describes the basic design of the software and the remarkable capabilities it gives you.

VAXstation Display System Software

The VAXstation 100 workstation terminal is designed to help you use your computer as efficiently and productively as possible. It does that by letting you work on as many different tasks as necessary without having to stop one task to begin another. In computer terms, it lets you have all your jobs running at the same time. And any or all of those jobs can be displayed on the screen through the use of multiple windows.

You, the user, control what is displayed and where it appears on your screen. You can have windows side-by-side or overlapping. You can interact with only one job at a time, but you can move easily from one job to another, and all jobs remain active whether or not you are interacting with them. It's like having a bank of terminals on your desk – but less cluttered.

How does the VAXstation 100 perform this juggling feat? The System Display Architecture (SDA) defines how program and user operations interact with the VAXstation software. The human interface software makes this inherent complexity transparent to the user and provides tools to help them take full advantage of the enormous power it gives them.

System Display Architecture

In the case of a typical one-job-at-a-time terminal, programs can output directly to the terminal display. That's not a problem because the user is concerned with only that one program. The VAXstation 100 user can be running and viewing any number of programs. To manage that situation the System Display Architecture isolates the processing of program applications from the display of data on the screen.

Instead of writing to a physical display, system and application programs write to "virtual" displays created through the VAXstation 100 software. Whether or not the program output appears on the screen is up to the user.

Programs can create virtual displays, write information (text or graphics) to one or more virtual displays, and define spatial relationships of virtual displays by pasting them on a pasteboard. They also can inform the system-level VAXstation software – the human interface – that an image is ready for viewing by creating a window into a pasteboard.

Virtual displays, pasteboards, and windows, which are described here in physical terms, are actually logical creations of the VAXstation software. Detailed definitions follow:

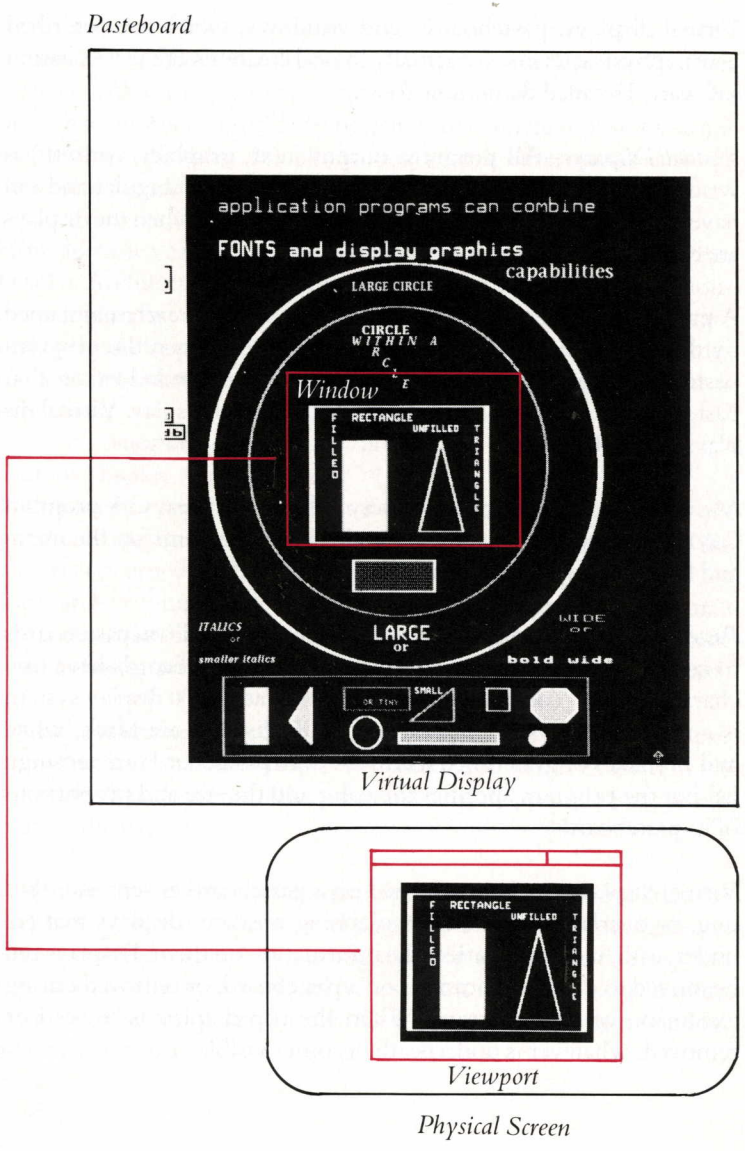
- *Virtual Displays* – All program output (text, graphics, or both) is written to a virtual display. Virtual displays are rectangular and can have different sizes. Size is defined by the program when the displays are created.

  A program can create a number of virtual displays, each maintained by the system. Virtual displays become visible when the program pastes the display on a pasteboard and creates a window on that pasteboard that includes part or all of the virtual display. Virtual displays do not have to be visible to accept output operations.

  Menus are actually a special variety of virtual displays. A program can request creation of a menu, and specify the items on the menu and the actions to take when an item is selected.

- *Pasteboards* – Virtual displays are arranged or "pasted" on pasteboards to construct an image for potential viewing. Pasteboards have two characteristics: "color" and size. (The VAXstation 100 display system is a monochrome device; the "colors" it displays are black, white, and 15 shades of gray called halftones.) All pasteboards are rectangular, but the program specifies the color and the size and proportions of its pasteboards.

  Virtual displays can be positioned on a pasteboard as separate, abutting, or overlapping. While overlapping obscures displays that are underneath, it does not affect the information on them. Displays can be moved to different locations on a pasteboard, or removed during execution of the program. When the top display is moved or removed, whatever is underneath becomes visible.



Pasteboards are both output devices and input devices. As output devices, they define the spatial relations of virtual displays and windows. As input devices, they define the location of the pointer on the screen that is meaningful to a program, and determine which process can read user input from the mouse, keyboard, and optional graphics data pad.

- *Windows*–Windows define rectangular areas on pasteboards for viewing. When a program creates a window, a viewport is created containing the image defined by the window. In the viewport, you see the information written to virtual displays that are under the window and you control the placement of these viewports on the screen.

- *Viewports*–The actual display of a window is called a viewport. Viewports are created and initially displayed on the screen by the System Display Architecture Software when the program defines and positions a window on a pasteboard. The user controls the subsequent positioning of these viewports. One viewport is created for each window defined by an application program. The viewport itself is often referred to as a "window."

- **Display Graphics Operations**

The VAXstation Display System implements five basic bitmap graphics operations: Copy Area, Draw Curve, Print Text, Fill Area, and Flood Area.

Copy Area

Copy Area is a fundamental bitmap operation (sometimes referred to as bitblt or raster-op). It moves a source image to a destination image. The source and destination are rectangles of identical size.

Each source pixel replaces the destination pixel at corresponding pixel points. The exact outcome of the Copy Area operation is determined by:

- *Source*–The source is an image whose pixel values are used to update the destination. The source can be a constant value that replaces all pixels in the destination or it can be a program-controlled bitmap.
- *Source offset*–The source offset specifies the point at which the upper left corner of the source mask is placed.
- *Source mask*–The source mask restricts the set of source pixels to be used in the copy operation and defines the rectangular subset of the source to be used to modify destination pixels. There are three types of source masks: rectangle, virtual display, and bitmap.
- *Destination*–The destination image can be a virtual display or a bitmap. While the destination can be a bitmap, the bitmap must be copied to a virtual display before the image is visible.
- *Destination offset*–The destination offset determines the placement of source pixels in the destination image. The source offset and source mask define a set of source image pixels whose origin is relative to the upper left corner of the source image. The destination offset specifies where that origin should be placed in the destination image.
- *Map*–The map defines the values used to replace the selected destination pixels.

Draw Curve

Draw Curve is similar to Copy Area. Both operations specify the source with a source image, source offset, and source mask; both specify the destination with a destination image and destination offset. Draw Curve can also use a map to modify the way pixels are replaced.

Draw Curve requires a path, a list of points (or segments) in the destination that defines the line or curve to be drawn. Each path segment is described by the x and y coordinates of its end point and a flag word. The flag word describes the characteristics of the segment (such as curved or straight and draw or move). The starting point for the first segment is the destination offset. The starting point in all other cases is the end of the previous segment.

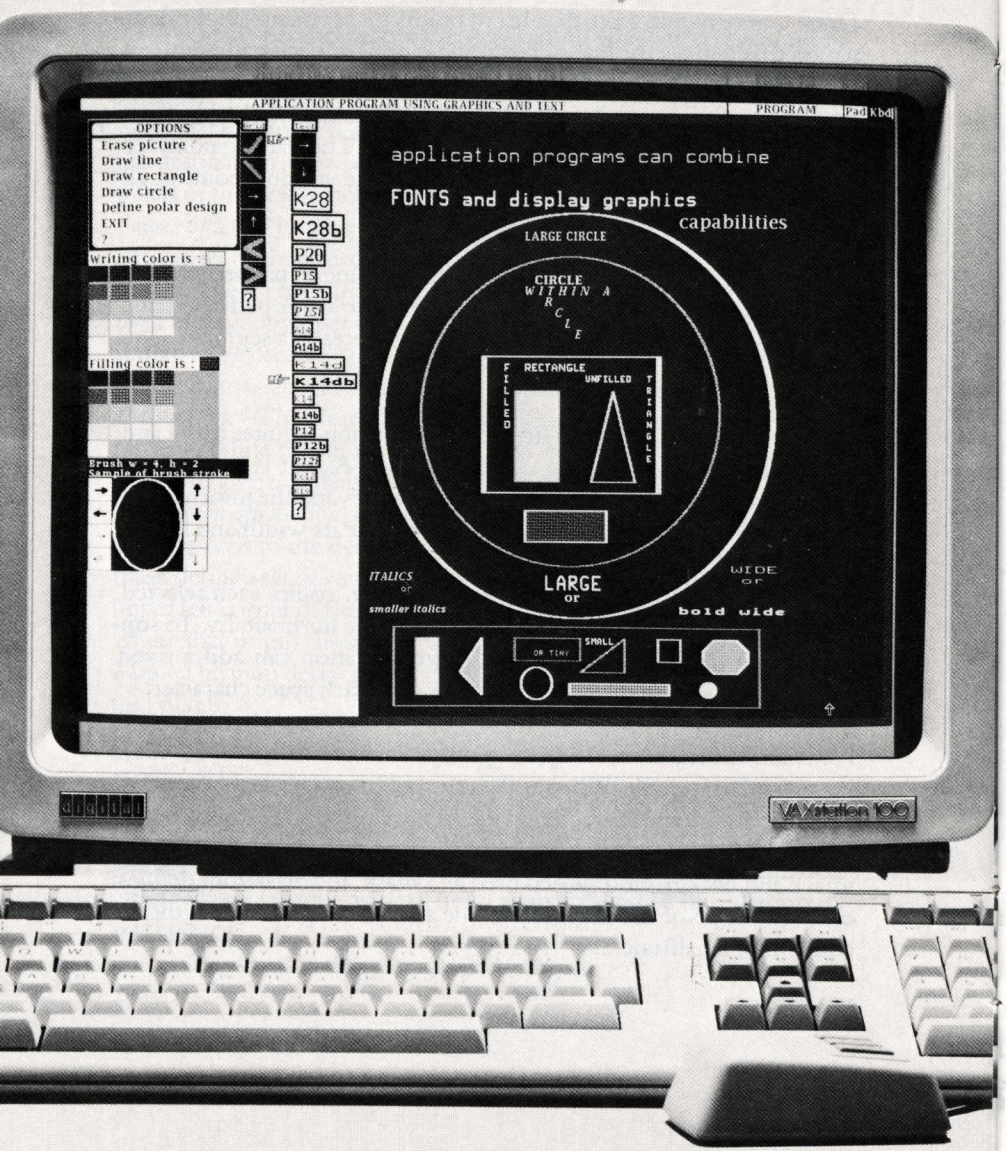
Draw Curve can use a pattern for drawing the line. A pattern string is used to draw dashed or patterned lines and curves. A patterned line alternates between writing and not writing pieces of a segment.

Print Text

Print Text writes a character string. The operation requires a font and a character string containing character codes. A font is a data structure containing bitmap images of the characters and the information required to locate each image and to determine its width and height.

The Print Text operation scans the text string, copies each selected character to its destination, and writes each one horizontally. To support string justification, the Print Text operation can add a fixed number of pixels after each character or after each space character.

Fonts can be used in two ways to specify character images: as a source image and as a mask. When used as a source image, each character containing both the character image and background is copied to the destination. A map can be used to transform the pixel values for the image and background. When used as a mask, the mask font defines only the shape of the characters. The source image can be either a constant or a halftone.



Fill Area

Fill Area uses a halftone source image to fill one or more closed shapes, then copies the shapes to the specified location in the destination image. This operation is used when the boundary of the area to be filled is known and can be defined by a list of straight or curved segments.

The source image for Fill Area is either a constant or halftone. A path specifies the closed area in the destination image. Fill Area causes one or more areas of a destination image to be filled with one or more halftone shapes.

Flood Area

Flood Area is used when the boundary is not completely known, but the user can specify one internal point of the closed area.

The Flood Area operation floods bounded areas of a destination image with a single halftone. The area to be flooded depends on the current state of the destination image and is determined by a flood algorithm.

The flood algorithm determines the area of the destination to be flooded. It locates the inside and outside portion of the closed area and selects those pixels inside the flooded area. The determination of the bounded area requires a seed point and a boundary map.

The seed point specifies a single pixel in the destination image and must be in the bounded area. The boundary map determines whether points are interior points or boundary points. The algorithm examines the seed point and internal adjacent pixels, until all have been examined. The inside area floods until it reaches the boundary points.

VAXstation Libraries

VAXstation software includes two subroutine libraries: the VAXstation Display Management Library (VSTA) and the VAXstation CORE Graphics Library (CGL). They are indispensable tools for developing application programs to take advantage of the features of the VAXstation 100.

The VAXstation Display Management Library is the *native graphics interface* to the VAXstation system; that is, these routines are specific to the VAXstation bitmap graphics. It contains procedures for performing the display graphic operations described in the previous section. It also has the procedures for creating and controlling the VAXstation display objects (virtual displays, pasteboards, and windows), displaying text, and reading input from the keyboard, the mouse, and the optional graphics data pad.

The VAXstation CORE Graphics Library is a general-purpose graphics subroutine library that is based on the CORE Graphics Standard. CGL separates the description of an object to be drawn (such as a graph or a diagram) from the physical details (for example, size and resolution). That way, you can use the application you develop for VAXstation on any other display supporting CORE with little or no modification.

CGL uses the following procedures:

- *Control procedures* start and stop the graphics system, clear all or a portion of a virtual display, and report errors.
- *Viewing transformation procedures* describe the data manipulated by the program and control how CGL displays it on a virtual display. For example, scaling can reduce or enlarge the information within a win-

dow by modifying dimensions to CGL. The window doesn't change, only the information within the window.

- *Output primitive procedures* draw the lines, curves, markers, and graphics text.
- *Attribute procedures* control colors, styles, modes, and fonts.

Even though VSTA and CGL are two unique interfaces, providing two ways of communicating graphics, an application program can use both on the same virtual display.

Using the VAXstation 100 Workstation

The advanced software of the VAXstation 100 human interface has been designed to make the complexities of a sophisticated workstation uncomplicated for the user. By way of its mouse, menus, and unique utility area, the VAXstation 100 workstation offers more power than you'll probably ever have to call upon; yet it's so simple to operate that a novice can begin using it productively almost at once.

The primary way of interacting with the workstation is with a mouse. You use it to control the movement of a pointer on the screen (an up-arrow, sometimes called a cursor), and to select an object for a particular purpose.

For example, you would use the mouse to move from one running job to another. You simply move the pointer from its current position in one window to the window displaying the desired job and press the select button. All input from your keyboard or your data tablet now goes to that job.

The point-and-do action of a mouse is a lot easier than typing in lengthy commands – and less prone to error.

Start-up Procedures

A clear illustration on the screen shows you how to start your VAXstation session by pressing one of the three mouse buttons. You gain access to the VAX/VMS host by entering your user name and password. After authorization, the monitor displays a vertical utility area along the right side of the screen.

VAXstation Menus

Almost all of the commands you give to the VAXstation 100 workstation (as distinguished from your applications) are given by selecting menu items with the mouse. By selecting a menu item, you execute a particular action. Menus disappear after you select an item or when you move the pointer off the menu.

The hierarchy of menus offered by the VAXstation 100 human interface provides a simple and efficient way of directing workstation activity.

The Main Menu–If you press the Main Menu key on the keyboard or select the border of the utility area, you can:

- *Create job (DEC terminal)* displays a logged-in Digital terminal, a welcome message (system-dependent), and the VAX/VMS dollar-symbol ($) prompt, indicating that the terminal is logged in and ready for a command. You can now communicate with VAX/VMS system using this terminal just as you would use a VT100 terminal.
- *Create job (TEK4014)* displays a logged-in Tektronix 4014 terminal, a welcome message (system-dependent), and the VAX/VMS dollar-symbol ($) prompt, indicating that the terminal is logged in and ready for a command. You can now communicate with VAX/VMS using this terminal just as you would use a Tektronix 4014 terminal.
- *The Auxiliary Menu–Other Choices* lets you create a Digital terminal or a TEK4014 and login as another user, conceal or display the utility area (HIDE/SHOW utility area), or access the help document opened to a description of the Other Choices menu (Help).

- *End session* aborts all jobs that are currently running, removes and discards all terminals, logs the user off the VAXstation 100, and displays the start session graphic illustration.
- Selecting *Help* from the Main Menu displays the help document opened to a description of the Main Menu.

The Terminal Menu—If you select the border of an emulated terminal display, you can position it on top of other jobs *(Pop to top)*, store the job in the utility area *(Store job)*, move the terminal anywhere on the screen *(Move)*, remove the job from the screen *(Logout job)*, access the Terminal-settings document to change certain terminal characteristics *(Terminal settings)*, clear the terminal from the screen *(Terminal RESET)*, print a screen display if you have the printer option *(Print)*, or access the help document opened to a description of the Terminal Menu *(Help)*.

Document Menus—If you select the border of the notices, profile, or help document, you can position the selected document on top of other jobs *(Pop to top)*, clear the document from the screen *(Store)*, move the document anywhere on the screen *(Move)*, print a screen display if you have a printer *(Print)*, or access the help document opened to the preface, notices, or profile section *(Help)*.

Other Menus—In addition to these menus, programs can create their own menus. Using this feature your application programs can benefit from the same ease-of-use features as the VAXstation workstation and integrate better with the workstation environment.

The Utility Area

One of the goals in designing the VAXstation 100 human interface was to simplify the task of managing the screen while keeping track of several jobs at the same time. The utility area does just that. It lets you manage your screen as you would manage a desktop.

Similar to a stack of inboxes, the utility area provides convenient receptacles for documents or jobs that don't require your immediate attention. It lets you keep your "desk" from getting too cluttered with unnecessary displays, while making it easy to find and retrieve them quickly. A few of the boxes are labeled and used by the VAXstation 100 software; the rest you can use to store jobs off-screen.

The VAXstation displays a representation of the utility area on the far right-hand portion of the screen in a vertical column the length of the screen.

At the top of the utility area is displayed your name, the time, and the date. Each of these is displayed in the format specified in your user profile (the area where you can define and confirm the operating characteristics for the VAXstation).

Beneath the date display is a series of boxes we refer to as the job storage area. Each compartment in the job storage area can contain an icon that identifies a stored job. Storing a job removes it from the screen, places it in the utility area (where it continues to process), and displays a job icon. A stored job can be recalled for display by selecting its icon in the job-storage-area display.

The last three compartments are used to store workstation documents. Specifically, they are the notices, help, and user profile documents.

The notices document handles announcements and system messages that arrive during a VAXstation session. If a message arrives while this document is stored in the utility area, the notices icon is highlighted and the VAXstation keyboard beeps.

The help document contains information on how to use your VAXstation system. It is normally stored in its utility-area slot and is organized with a table of contents, chapters, an index, and cross-references for related sections. This document provides very handy reference material. By pressing the help key on the keyboard or selecting the help item from any VAXstation menu, the help document opens to the relevant page.

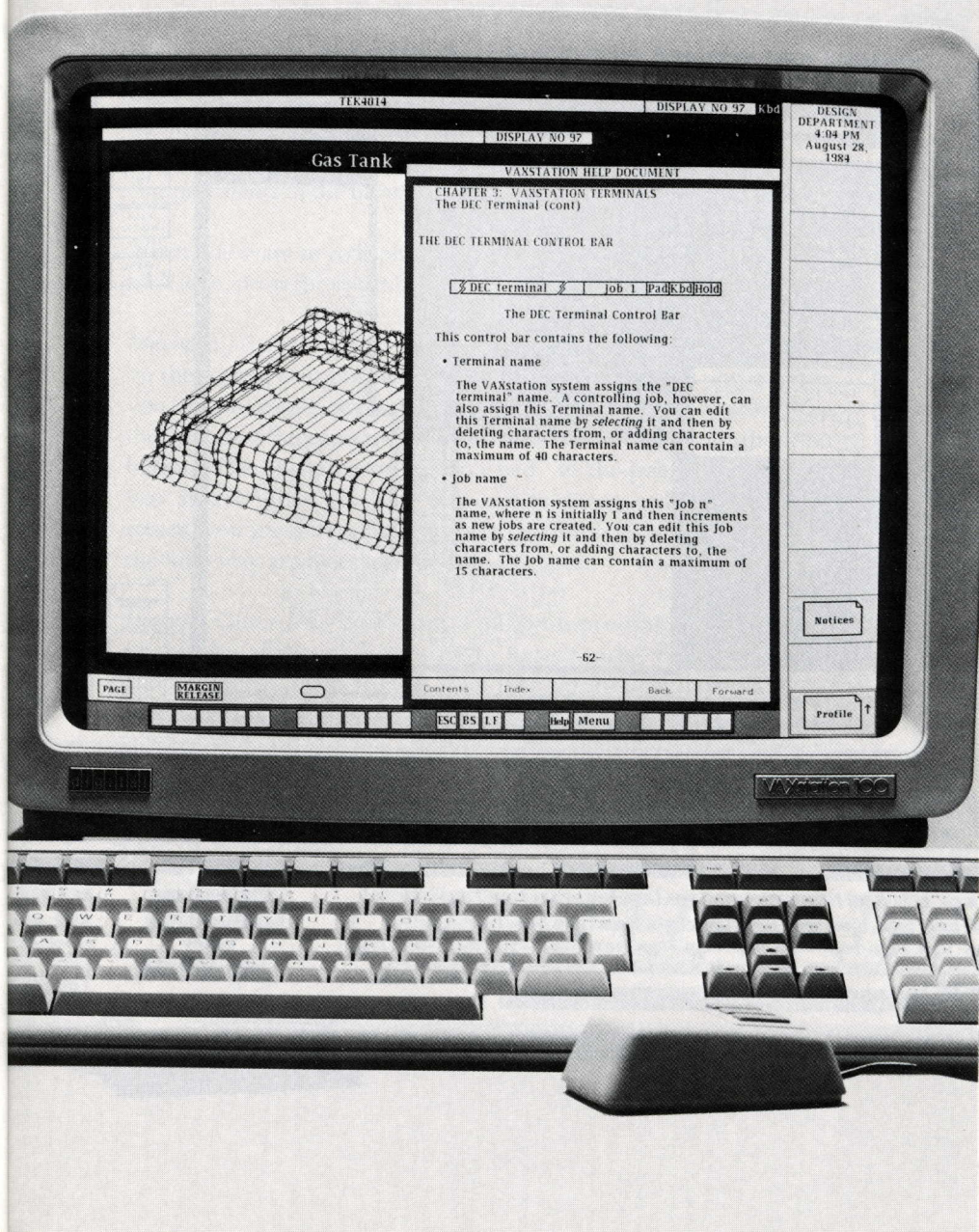
Selecting the profile icon gives you access to the profile document to review and modify your VAXstation characteristics. For example, you can change the type of terminal the system creates at session startup, your name, and the format for the time of day and date. These changes are implemented immediately and remain in effect from session to session until they are changed again.

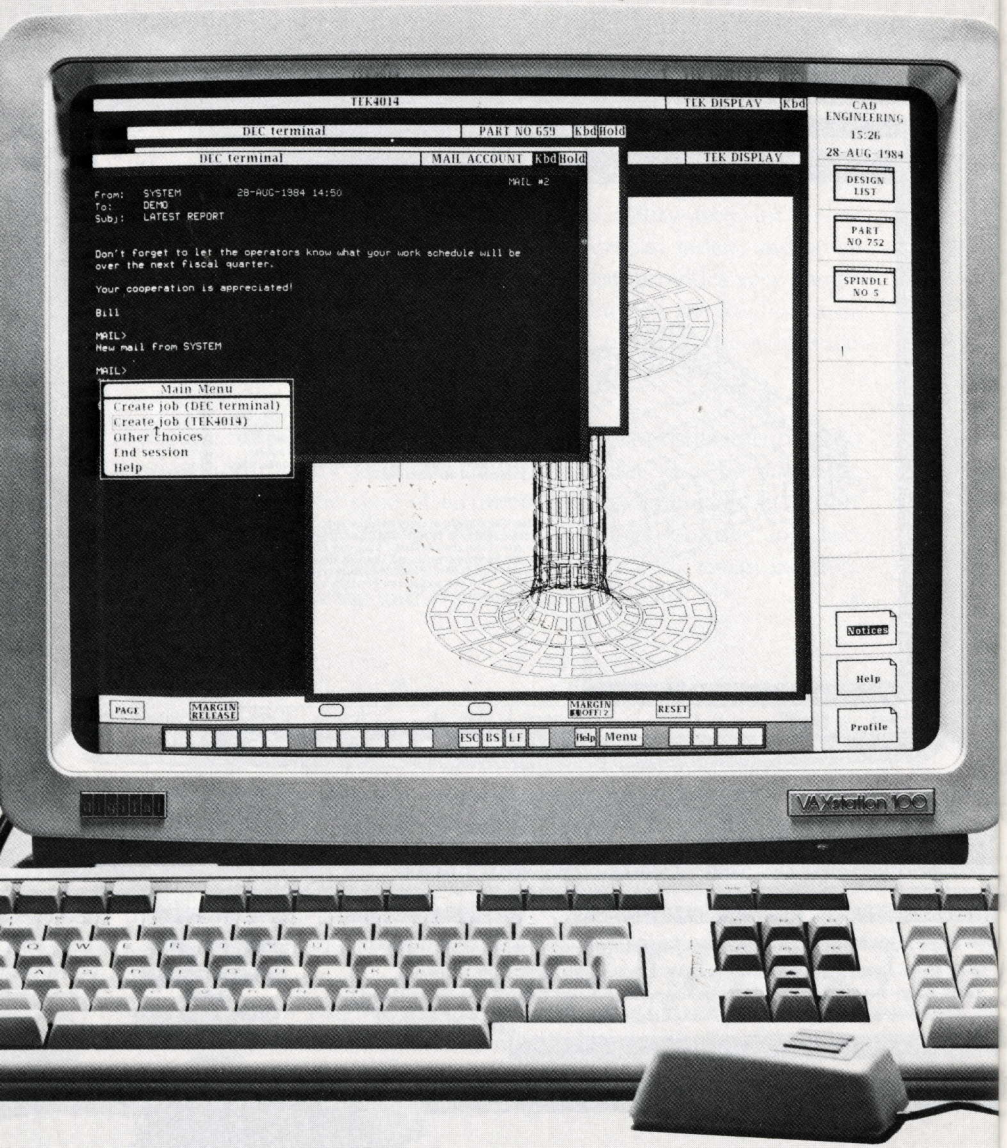
Some Basic Operations

What follows are descriptions of some of the fundamental operations of the workstation. They will illustrate how easy the VAXstation 100 workstation is to use.

Creating a Job

To create a job, you press the main-menu key on the keyboard. The Main Menu appears on the screen. Using the mouse, you position the pointer on the item you want (for example, *Create Job DEC terminal* or *Create Job TEK4014*), press the mouse button, and the system displays the appropriate terminal type already logged into your account with an assigned job name. You are now ready to run your application from this emulated terminal.





Storing a Job Off the Screen—To temporarily store a job off the screen, you position the pointer on the border of your viewport, press the select button, and a menu appears. You then position the pointer on the menu item *Store job*, and press the select button. The job disappears from the screen and an icon appears in one of the job-storage compartments in the utility area display.

When you want to redisplay the job, you position the pointer on the job's icon, press the select button, and the job reappears on the screen.

Moving a Job on the Screen—To move an object to a different location on the screen, you position the pointer on the border of the object you want to move, press the select button, and a menu appears. You then position the pointer on the menu item *Move*, and press the select button. The object becomes "attached" to the pointer with a four-way arrow. When you have moved it to the desired location on the screen, you press the select button to establish its new position, and the four-way arrow reverts back to a pointer.

Logging Out a Job—To logout a job, you position the pointer on the border of the job you want to logout, press the select button, and a terminal menu appears. You then position the pointer on the menu item *Logout job,* press the select button, and the VAXstation system logs out the job and the associated viewport disappears from the screen.

Printing an Object—If you have a printer, you can print an object displayed on the screen by selecting the *Print* menu item.

Support and Service

Digital provides single-vendor support for the VAXstation 100. Our customer services organization has grown to more than 18,000 people worldwide, dedicated to supporting and training our users. VAX/VMS and VAXstation system software specialists are trained to help you tailor your VAXstation 100 to fit your computing needs.

The VAXstation 100, an investment in computing versatility, is supported by a company that has been a leader in professional computing for over 25 years—a company that will protect your investment now and for a long time to come.

Required VAXstation Hardware

Model Number	Description
VS100-AA	VAXstation 100 processor, UNIBUS interface model, 19-inch monochrome monitor with tilt-swivel base
LK201-CA	Keyboard and power cable (U.S./Canada version)
VS10X-EA	Three-button mouse
BN25B-*xx*	Fiber-Optics cable—connects VAXstation 100 to VAX host. (Length must be designated.) **Cable lengths available:**

	Feet	Meters
BN25B-15	49	15
BN25B-30	98	30
BN25B-60	197	60
BN25B-90	295	90
BN25B-A5	492	150
BN25B-EO	984	300

Optional Hardware

VS10*x*-BA	Graphics Data Pad (optional tablet) (11 x 11 in), five-button puck

Required VAXstation Software

Q*434-UZ	License with Warranty (for first system)
Q*434-H*x*	Documentation and Media (specify type)

x Denotes variable
* Denotes processor type

Specifications

Display Monitor

Screen Size	48.3 cm (19-inch diagonal)
Orientation	landscape (horizontal)
Format	1,088 horizontal by 864 vertical pixels
Pixel aspect ratio	1:1
Resolution	78 pixels per inch
Active display area	28.19 by 35.4 cm (11.1 by 13.95 in)
Refresh	60 Hz noninterlaced
Phosphor	P4 low-persistence monochrome
Ergonomics	tilt-swivel base, antiglare screen
Controls	brightness, contrast
Power	70 W
Weight	20.2 kg (45 lbs)

Graphics Processor

- MC68000 10 MHz microprocessor
- 16 bit wide 2901 bit-slice processor (Bit-Blt Accelerator BBA)
- 128 Kbytes local MC68000 program memory
- 16 Kbytes bootstrap and diagnostics ROM
- 512 Kbytes frame buffer

Detached Keyboard

- 105 sculptured keys
- Typewriter-style main array

- Editing keypad
- Numeric keypad
- 12 programmable function keys

Profile	30 mm (1.2 in), palm rest to home row
Cord length	3.6 m (12 ft) coiled
Weight	2 kg (4.5 lbs)

Mouse

Output	100 pulses per inch (X and Y relative displacement)
Cable length	3.6 m (12 ft)
Function buttons	3

Graphics Data Pad

Area	27.9 by 27.9 cm (11 by 11 in)
Resolution	1,000 points per inch
Accuracy	.010 inch
Repeatability	.001 inch
Pointer	5-button cursor puck
Cable length	3.6 m (12 ft)

Power Supply
210 W
120/220 V, 60/50 Hz
3-wire

Fiber-optics Cable

Length	300m (984 feet)