AT&T

999-801-305IS
For use with 3.51 Software

AT&T UNIX® PC
Virtual Device Interface

Programmer's Guide

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1 Overview

Overview

This section is an overview of the features and benefits of GSS-DRIVERS. It explains how you can use it to create a device-independent as well as an operating system-independent graphics environment for the AT&T UNIX™ PC.

Background

Let's begin with a little background on computer graphics standards and the products related to GSS-DRIVERS to clarify its role on the UNIX PC.

Graphics Standards

Standards organizations in both the United States and in Europe have been working for over a decade to generate both a graphics model for understanding and communicating graphics information, as well as a formal specification for the implementation of computer graphics.

At first, progress was slow due to the complexity of the subject of computer graphics and its many specific applications. Also, at that time, computer graphics was expensive and primarily relegated to institutions with large budgets—aerospace firms or prestigious universities. Since the market for computer graphics was limited, and there were only a few manufacturers of graphics equipment, the need for standardization was satisfied by "de facto" standards established by the dominant manufacturers.

With the emergence of integrated circuits powerful enough to support graphics and inexpensive enough to be available to the masses came the widespread use of computer graphics. Now graphics is employed in virtually every application area that can use a computer because it is a much more effective and pleasant way to represent information. In some cases, entirely new applications are enabled by computer graphics, such as computer-aided drafting and engineering.

The result of this development is a strong desire for standardization to create order in an industry rapidly expanding with new products and suppliers. Standardization of computer graphics makes programmers more productive by providing them with a stable graphics programming model. It also provides the opportunity to develop application programs that are independent of the computer system and the graphics input and output devices employed.

The Association for Computing Machinery (ACM) and specifically SIGGRAPH (Special Interest Group on Computer Graphics) became involved early in the standardization effort. They published a pseudo-standard in 1979 called the CORE System paving the way for later work by American and international standards organizations.

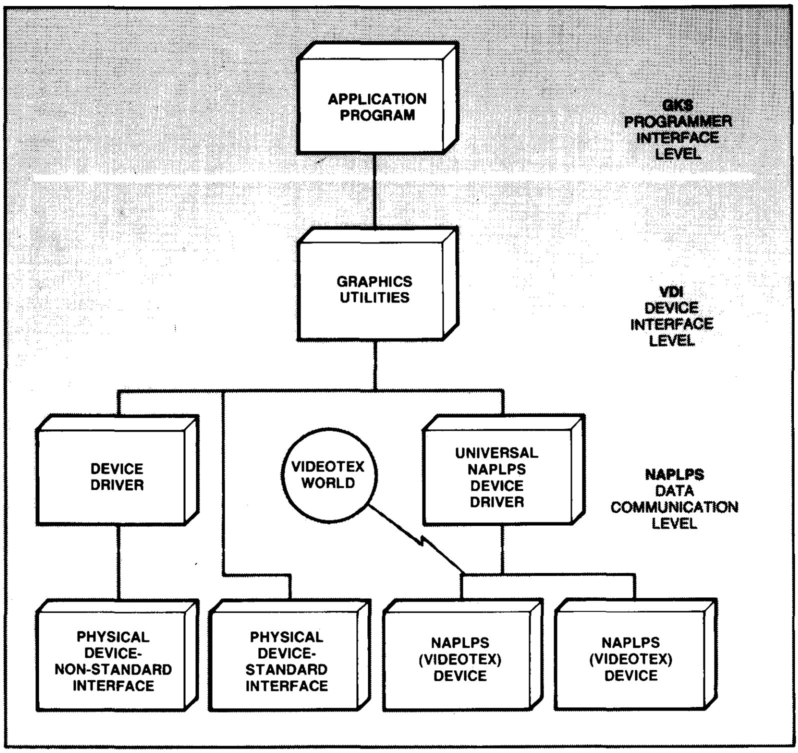
The efforts of the American National Standards Institute (ANSI) and the International Standards Organization (ISO) are now resulting in standards that create a uniform conceptual model of computer graphics for system designers, programmers and users, making device-independent graphics a viable goal. The standards are structured around three main interfaces—one at the programmer level, one at the device level and one for communications between computers (see Figure 1-1).

The Graphical Kernel System, or GKS, defines a programmer interface to graphics. It provides source code portability by standardizing the functions and calling conventions of graphics subroutine libraries used by programmers to develop graphics applications.

At the device level, the Virtual Device Interface, or VDI, allows device-independence by creating a logical graphics device interface. This interface allows a computer to control any graphics peripheral without regard for its individual peculiarities. Specific devices can then be matched to the generalized device interface by means of individual device driver programs, one driver for each device.

A similar scheme is employed for graphics data transfer between processors over communications channels. Again, a logical interface allows different computers to communicate by employing interface programs that are compatible with the standard protocol. In this case, the standards are the Virtual Device Metafile (VDM) and Presentation Level Protocol (PLP).

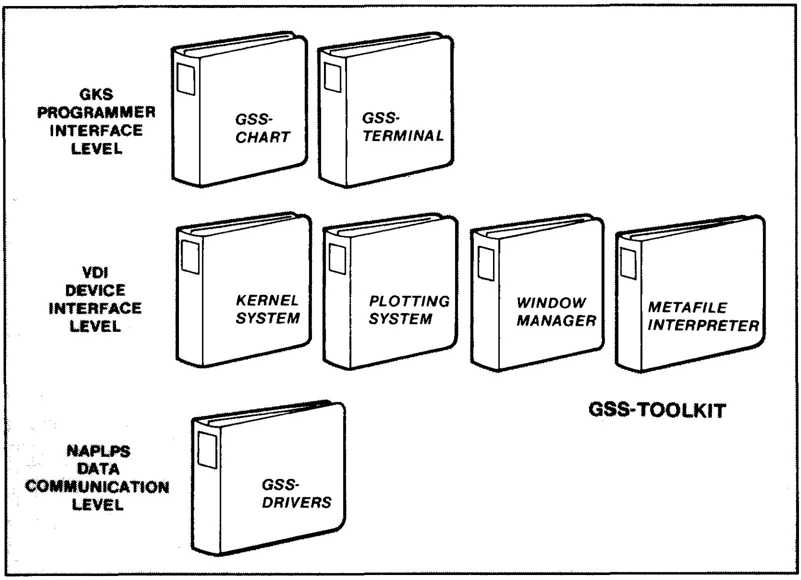
FIGURE 1-1 Graphics Standards



Standards Implementation

GSS-DRIVERS provides device-specific drivers based on the VDI standard for graphics peripherals. Besides standardizing graphics applications, GSS-DRIVERS greatly reduces the programming effort required to create a graphics program. The low level primitive operations and device peculiarities are transparent to the programmer. Language bindings (interfaces) enable the programmer to incorporate graphics as subroutine calls based on the VDI standard interface.

FIGURE 1-2 GSS Product Line



GSS-DRIVERS Features

GSS-DRIVERS provides the following graphics capabilities through the standard VDI interface:

- Normalized coordinate to device coordinate transformation
- Drawing of graphics primitives (objects)

polylines	circles
polymarkers	arcs
text	pie slices
bars	cells

- Specification of attributes

  color
  fill
  style
  line style
  line width

- Text manipulation (Three text options are available: alpha text, graphics text and cursor text. Manipulations possible with each mode are listed in Table 1-1.)

  location
  size
  rotation
  font
  color
  underlining
  overstrike
  super- and subscripting
  alignment

- Cursor positioning
- Graphics input
- Status inquiry
- Generates standard metafiles

Since capabilities vary among graphics devices, GSS-DRIVERS is designed to emulate certain features. It also provides feedback to the caller about the actual capabilities of the currently open device.

TABLE 1-1 Text Options

Manipulations	Cursor Text	Alpha Text	Graphics Text
Positioning	Character Cell Boundary	Anywhere on display surface	Anywhere on display surface
Scaling	No	Yes*	Yes
Rotation	No	No	Yes
Multiple Fonts	No	Yes	Yes
Bold Text	Yes	Yes	No
Color Selection	Yes	Yes	Yes
Underlining	Yes	Yes	Yes**
Overstriking	No	Yes	No
Super- and Subscripting	No	Yes	No
Quality Levels	No	Yes	No
Line Spacing	No	Yes	Yes
Reverse Video	Yes	No	Yes***
Blink Text	Yes	No	No
Text Alignment	No	No	Yes
Variable Text Height	No	Yes*	Yes
Control Mode	Cursor Addressing Mode	Graphics Mode	Graphics Mode

* The size of alpha text can be changed via the SET ALPHA TEXT FONT AND SIZE function.

** Graphics text can be underlined by specifying polyline primitives underneath the character string.

*** Reverse Video can be selected for graphics text via the SET WRITING MODE function.

GSS-DRIVERS Functions

GSS-DRIVERS provides an environment for the creation of graphics applications that can be transported to any system conforming to graphics standards. GSS-DRIVERS' high-level language bindings incorporate system-independent interfaces for file and character I/O to insure that graphics applications will be completely portable.

The device drivers are stored as executable files on system mass storage. When a workstation is opened, the appropriate driver is spawned as a new process that lives until the workstation is closed.

Specifically, GSS-DRIVERS provides these functions:

- device driver management
- coordinate transformation
- character and file I/O for high-level languages
- emulation of certain graphics primitives
- error reporting

These functions are discussed in more detail in Part 3, "System Architecture."

Device Driver Management

A system may potentially have many graphics input and output peripherals attached, each requiring a specific device driver to interface it to the system. GSS-DRIVERS receives requests for graphics peripherals from an application and spawns the proper device driver process when the workstation is opened.

GSS-DRIVERS also incorporates a metafile driver that generates ANSI standard metafiles. This capability is invoked simply by assigning "METAFIL" as the output device. The metafile device driver creates a metafile that is saved on the system storage device.

Metafiles may be read using a separate product called Metafile Interpreter. See the *AT&T UNIX PC GSS-TOOLKIT Metafile Interpreter Programmer's Guide.*

Coordinate Transformation

Graphics information is passed to GSS-DRIVERS in normalized device coordinates (NDC 0-32767) that are independent of any particular device. The system uses information obtained from the device driver to scale the normalized coordinates to device coordinates that are consistent with the values used by a particular graphics device (for example, raster steps). It also transforms device coordinates into normalized coordinates on input.

Character and File I/O

Even though graphics device calls are standardized, it is still difficult to transport graphics applications across operating systems because of differences in the way a program performs character I/O (for example, when communicating with another computer). Therefore, GSS-DRIVERS' high-level language bindings provide a set of generic character I/O routines that standardize this interface as well.

GSS-DRIVERS also provides a file I/O subsystem. Again, the goal is to make graphics applications completely portable to many systems. The file system is modeled after the UNIX hierarchical file structure including multilevel directories.

Graphics Emulation

The VDI is a robust standard that incorporates many advanced graphics capabilities. Frequently, the capabilities offered by a graphics device are only a subset of the total VDI possibilities. To insure application portability, some functions that are not supported by the device directly are emulated by GSS-DRIVERS.

Creating Graphics Applications

The graphics functions of GSS-DRIVERS can be employed in two ways. The first way is to access them directly through low-level assembly language routine calls with the appropriate parameter lists. However, the calling mechanism is system dependent. The result is applications which are device-independent, but operating system-dependent.

A second, preferred method insures computer-independence. This method uses language bindings that access graphics functions directly as high-level language calls with formal parameters. The C language binding provides an interface between the language source and the VDI interface. Calls in the source conform to the binding function definitions. The binding interface is linked in as an external subroutine library, insuring that your application will be completely portable across any GSS-DRIVERS-compatible system.

After linking, the graphics application may be loaded and run just like any other program.

The exact process for generating a new application is system specific. See Part 4, "Installation and Operation" for detailed information. Appendix A, "Conventions and Example," contains an example program.

Error Codes

GSS-DRIVERS returns a set of error codes to inform the application program of any unusual conditions. A detailed summary and explanation of error messages is contained in Appendix B, "Error Codes."

2 The GSS Graphics Reference Model

The GSS Graphics Reference Model

This part describes the graphics reference model for computer graphics on which GSS-DRIVERS is based. An understanding of this model will clarify the organization of the later parts of this manual and will help you to use GSS-DRIVERS in an application program.

The Reference Model

The Reference Model is a result of the standards effort described in Part 1. It is built on the following basic concepts:

- graphics output
- graphics input
- transformations
- workstations

Graphics Output

Graphics output functions are abstractions of the basic actions an output device can perform, such as drawing a line or displaying text. Output functions include two groups of basic elements called output primitives and output attributes. Primitives result in visible images on the display surface. Attributes modify the appearance of displayed objects, by changing their color, for example. Later in this part how GSS-DRIVERS implements these functions is discussed.

Graphics Input

Information input from a device as a result of an operator action is called graphics input. For example, graphics input occurs when an operator "picks" a location on the display surface with a mouse or crosshair cursor, or types in text at a keyboard.

Transformations

The point coordinates of graphics images must often be translated between different coordinate systems. This occurs at the application level when an operator wishes to scale or rotate an image. It also occurs when coordinates must be modified so that an image can be reproduced on graphics display devices of different sizes.

The VDI standard is based on a special coordinate system called the Normalized Device Coordinate (NDC) System. In NDC space, locations are expressed as Cartesian coordinates with values between 0 and 32767 representing the full coordinate space for all devices. GSS-DRIVERS then transforms the NDC points into the appropriate device coordinates.

Workstations

The graphics reference model employs the concept of a "workstation" to mean zero or more display devices, and zero or more input devices such as a keyboard and a mouse. At upper levels of the graphics system hierarchy (programmer level), workstations can be used to refer to a complete worksite, eliminating the need to reference each device explicitly. The VDI level deals with each individual device explicitly, so "workstation identifiers" are used to refer to a single generic graphics device such as a display, printer or plotter.

Additional Elements

Other concepts included in the reference model such as windows, viewports, clipping and segments are implemented at higher levels (in the Kernel System, for example) and will not be discussed in connection with GSS-DRIVERS. Refer to *AT&T UNIX PC GSS-TOOLKIT Kernel System* for a discussion of these standard graphics functions and their implementation.

GSS-DRIVERS Graphics Functions

The graphics functions, supported by GSS-DRIVERS, can be divided into five functional areas:

- Control functions
- Output functions
- Attribute functions
- Input functions
- Inquiry functions

Control Functions

The control functions allow the application program to control various aspects of the graphics subsystem. The major control functions are:

Open Workstation	Initializes a graphics device and sets defaults for attributes. It also returns information to the caller about the characteristics and capabilities of the device. This must be the first graphics operation performed in a program.
Close Workstation	Terminates graphics operations to a device. This must be the last graphics operation performed in a program.
Clear Workstation	Clears the surface of the workstation. It clears a CRT screen, prompts for new paper on a plotter, or displays all pending graphics to a printer and advances to top-of-form.
Update Workstation	Displays all pending graphics.

Output Functions

Output primitives are functions that generate graphics objects on the display surface. Point locations are specified by giving X,Y coordinates in Normalized Device Coordinate (NDC) space—a

Cartesian space with values ranging from 0 to 32767 on each axis. (Locations outside this range may generate unpredictable and device-dependent results.) Output primitives include:

Polyline	Draws single vector or series of connected vectors specified by their vertices. A polyline must have at least a beginning and end point specified.
Polymarker	Draws a marker symbol at specified locations.
Graphics Text	Displays a text string at a specified location. Characters come in multiple fonts, and may be rotated or scaled (unlike alpha or cursor text).
Cursor Text	Displays a text string on a fixed rectangular grid. For form fill-out, cursor text is available in only one size and font, is not rotatable, and cannot be combined with graphics text, alpha text, or graphics. Cursor text is typically positioned on a discrete, device-dependent grid of rows and columns. (Typical values are 24 rows by 80 columns.)
Alpha Text	Displays a text string at a specified location. Alpha text has multiple fonts, variable interline spacing, underlining capabilities and other attributes used for generating formal documents.
Filled Area	Causes an area bounded by a specified set of vertices to be "painted" with a fill pattern.
Bar	Draws a bar (rectangular area) defined by two diagonally opposite vertices. The interior is painted with a fill pattern.
Arc	Draws an arc defined by a center point, the radius, and the starting and ending angles.
Pie Slice	Draws a pie slice defined by the center, radius and starting and ending angles. The interior is painted with a fill pattern.
Circle	Draws a circle defined by a center point and the radius. The interior is painted with a fill pattern.
Cell Array	Draws a rectangular array of pixels of a specified size at a specified position. The pixel colors that make up the array are defined by a set of color indices.

Attribute Functions

Primitive attributes modify the appearance of output primitives. GSS-DRIVERS provides the following groups of primitive attribute functions:

Character Attributes

Character attributes fall into two groups: graphics text attributes and alpha text attributes.

Graphics text attributes control:

- height
- base line rotation
- color
- font
- alignment

Alpha text attributes control:

- position
- line space
- font and size
- color
- subscript/superscript
- underline
- overstrike
- output quality (draft or final)

Polyline Attributes

Polyline control:

- type
- width
- color

Polymarker Attributes

Polymarker control:

- type
- size
- color

Fill Attributes	Fill control: □ type □ style □ color
Color Representation	Assigns color values specified in red, green and blue primaries to color index numbers. Color attributes are then selected by index number.
Background Index	Sets color index for display background.

Input Functions

Input functions return information from the operator. Input functions operate in two modes: sample and request mode. In the sample mode, the input, if any, is returned immediately. In the request mode, the operator must complete the input function by actuating some control on the graphics input device (such as a button on a mouse). There are five types of graphics input:

Input Locator	The Input Locator Function returns the point location of the graphics input device (mouse, crosshair, joystick, trackball, cursor, etc.) in NDC units.
Input Valuator	The Input Valuator Function returns a scalar value between 0 and 32767, corresponding to the status of a valuator device (potentiometer, slide control, etc.).
Input Choice	The Input Choice Function returns the status of a choice device (switch, function key, etc.) as an integer between 0 and 32767.
Input String	The Input String Function allows text input from the keyboard.
Read Cursor Movement Keys	The Read Cursor Movement Keys function returns the direction of cursor movement.

Inquiry Functions

Inquiry functions return information about the current state of the graphics subsystem including device capabilities and current attributes. Inquiry functions are provided to determine:

Graphics primitives

- current polyline attributes
- current polymarker attributes
- current fill area attributes
- current graphics text attributes

Cursor addressable text

- the number of addressable character cells
- the current cursor address

Alpha text

- alpha text capabilities
- alpha text position
- alpha text font availability
- alpha text string length

Additional functions control

- cursor text position (direct cursor text addressing—relative and absolute cursor text movement)
- cursor text string and screen erase
- reverse video
- graphics input cursor display
- hard copy output
- plotter pen speed
- raster writing mode (sixteen Boolean operations between source and destination are supported)

The details of all the GSS-DRIVERS graphics functions are provided in the subsequent reference parts.

Besides creating a basis for development of graphics standards, the Reference Model provides the programmer with a conceptual framework to aid in organizing an application. It also aids the programmer in communicating with other programmers and users and to interpret graphics tools, such as GSS-DRIVERS, by providing a structural context. The rest of this manual is based on the organization defined by the Graphics Reference Model.

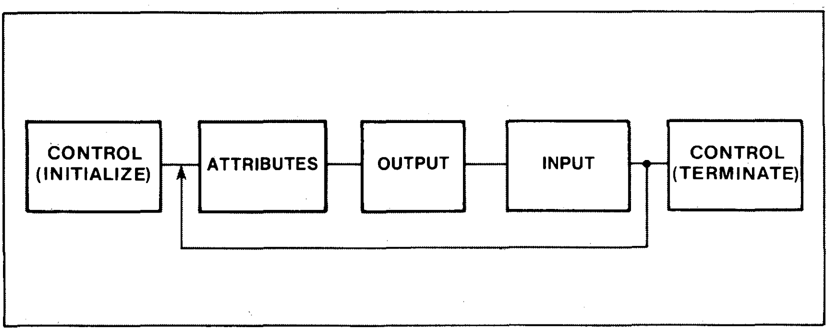
Programming Tips

A typical graphics application will consist of the following five steps:

- Set up graphics control
- Define graphics primitive attributes
- Output graphics primitives
- Input primitives or inquire on status
- Terminate graphics

The intermediate three steps may be repeated numerous times prior to the last step. The general flow of a graphics application program is illustrated in Figure 2-1.

FIGURE 2-1 Graphics Program Flow



Control

The first command the application should invoke is Open Workstation. This command defines the type of device to be used, loads the device into memory if necessary, and returns information to the user regarding the capabilities of the device.

Coordinate Transformation Flag

A key parameter specified by Open Workstation is the coordinate transformation flag. This flag indicates the aspect ratio of the display surface. The user may specify a display surface with 32767 addressable locations in both directions or one with 32767 addressable locations on the longest side (axis) and a lesser amount on the shorter side (axis). The number of addressable locations on the shorter side will be proportional to the actual aspect ratio of the physical display.

The benefit of having the number of addressable locations match the aspect ratio of the display surface is that a "unit distance" is the same length along both axes. The disadvantage is that not all devices have the same display surface aspect ratio, and portions of the output may not fit on all displays.

The advantage of specifying 32767 locations along both axes is that the aspect ratio of the working display surface is always the same, no matter what the shape of the physical display surface. A programmer's application output will always fit on the display surface if his parameters stay within the range 0 to 32767. This provides for device-independent graphics applications.

Prompting Flag

Another parameter the user must provide to the Open Workstation command is the prompting flag. The use of this flag is important when the graphics output device is a plotter, printer, or other device possibly requiring user attention. For example, on a two-pen plotter, the user may wish to display a chart containing four colors. When colors three and four are needed, the device driver will prompt the user to change the pens. The prompting flag indicates whether the user is prompted or whether the device driver ignores the color change commands. This may be useful for preliminary debugging runs of a program when the actual number of colors output is not important.

Device-Specific Data

Open Workstation also returns an array of information detailing the capabilities of the device requested. This information includes the number of colors available, the number of text sizes available, the number of line styles available, etc. The application programmer can apply these facts to utilizing a device to its best advantage. For example, if a device has multiple colors, different lines of data on a chart can be represented with solid lines in different colors. If black and white are the only colors available, different line styles (combinations of dashes, dots and spaces) can be used to differentiate the lines of data on the same chart output to a different device.

Another important device-specific parameter returned by Open Workstation is the number of different text sizes available. A few devices allow for text to be continuously scaled from one unit high to 32767 units high. Most other devices only provide four to six different text sizes. The programmer should consider the number of scaling options and the actual text sizes needed for the application.

Control Mode

After opening the workstation, the programmer should make sure the device is in the proper mode. The default condition sets Graphics Mode to "on" and Cursor Addressing Mode to "off." Certain functions only work when Cursor Addressing Mode is on, and other functions only when Cursor Addressing Mode is off. Cursor Addressing Mode is only applicable to CRT devices.

Cursor-addressable text is mutually exclusive with graphics text and alpha text. Graphics text and alpha text are compatible and can be displayed simultaneously on the same display surface. The user should remember to call Enter Cursor Addressing Mode prior to executing any cursor addressable commands.

If the device is not in Cursor Addressing Mode when a cursor-addressing command is executed, the exact results are not defined. This may "hang" the device and require restarting. In some instances, the device may ignore the cursor addressing command. On rare occasions, it may actually execute the desired function. All possible side effects are not listed here since the actual effect depends on the state of the device prior to the cursor addressing command. Similarly, if graphics commands are issued when Cursor Addressing Mode is on, the results are not well defined.

Error Handling

Open Workstation and all other routines also return a value that indicates whether the requested command was completed successfully. A zero or positive value indicates a success; a negative value indicates unsuccessful. When using GSS-DRIVERS high-level language bindings, if a negative value is returned after issuing a call to Inquire VDI Error can be invoked to identify the specific error. Errors are described in Part 3, "System Architecture," and a table of error values is provided in Appendix B.

Device drivers seldom return errors. They are programmed to perform the operation requested to the best of their ability. However, they will return file and communication I/O errors. Such errors prevent the driver from completing an operation.

Cursor Addressing Mode has no effect on printers. It does not return errors but rather the functions are ignored. Inquire Current Cursor Text Address will return that the cursor text is not available.

Setting Attributes

Attribute setting routines always return the attribute value selected. This is either the closest value to the one requested or the specified default in cases where the requested value is out of range. For example, when the default line style is index 1 (solid), out of range line types are mapped to 1.

Color Indices

Color index attribute setting routines select the closest index to the one requested. This can have interesting side effects. If a negative color index is requested, the closest index that will be selected is 0. However, the default value for color index 0 is black. If the CRT background color is black, all subsequent primitives with the default index are invisible on the CRT.

If the programmer wants a specific color associated with a particular pen station, he must inform the user. This can be done several different ways, depending on the device. The programmer could document desired colors in the application manual. Alternatively, a message could be sent to the CRT at the beginning of the program informing the user of the colors expected for each color index and pen station.

Text Rotation

Another attribute, text rotation, is specified via the function Set Graphics Text String Baseline Rotation.

Graphics Primitive Output

Output functions are available to define graphics primitives including polylines, polymarkers, arcs, circles, bars and pie slices. Functions are also provided to describe alpha, graphics and cursor text. Locations are specified in Normalized Device Coordinates. In general, GSS-DRIVERS will honor any graphics primitive output specifications supplied by the programmer.

However, when using the aspect ratio preservation mode, scaling primitives may be partially or totally clipped. For text and markers, the entire character or marker must be visible for it to be displayed.

Also, when specifying fill, remember that filled areas are not outlined unless the fill interior style is hollow. To display a filled area (polygon, bar, circle, pie slice) with an outline, first fill the area with the fill style of solid, pattern or hatch. Then specify fill interior style of hollow for the same area.

Another point to remember is that the radius specified for circles and arcs is assumed to be along the x-axis. The specified radius takes priority over the radius that is determined by the center point and an arbitrary point of the arc/circle. Since circles and arcs are specified by a centerpoint and a radius, a circle cannot be displayed if its center point is not on the display surface.

Input and Inquiry

Functions that return arrays of data may overwrite application data, if the amount of space allocated is smaller than the size given to the VDI. For example, when invoking either Input String (request mode) or Input String (sample mode), the user may specify a different value via the maximum-length parameter than required by the defined array. If the maximum-length parameter indicates that forty characters can be input and the user only defines an array that is ten elements long, an additional thirty characters may overwrite a portion of memory not intended by the user. The results of this situation depends on the application. In some cases, the error may never be detected.

Pseudocode Example

To help you understand the logical sequence of creating a graphics application with GSS-DRIVERS, we have included a programming example. The object of the example is to create a Gantt Chart representation of a processing plant construction project.

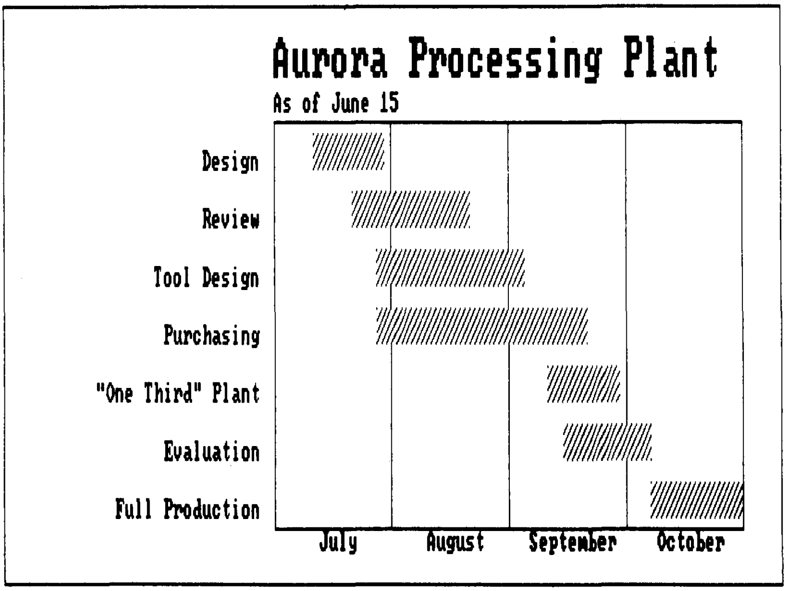
A Gantt Chart shows the component activities of a project by functional area along with their relationship in time. They are conveniently shown in a horizontal bar format where each bar shows the duration of a particular activity. Figure 2-2 shows the desired graphics output. The required GSS-DRIVERS calls are described in pseudocode below.

```
   { This is a pseudocode program to generate a Gantt Chart. Lines within
   the braces are comments. }
program gantt;
   { Initialize and dimension variables for use in the rest of the program.
   This is done as in any other program. The required data types and
   allocations are indicated in the function specifications in the
   subsequent reference Part.}
OPEN.WORKSTATION;
   { Opening the workstation sets defaults and returns information like size
   of plotting surface, pixel heights and colors that can be used by the
   application program to best draw the chart. This is device-specific
   information reflecting the characteristics of the device being opened. }

   { Note that OPEN.WORKSTATION returns a "device handle," a number that
   uniquely identifies the open device. This is used in subsequent calls
   to the device by including it as the first argument in the parameter list.
   For simplicity, this will not be shown explicitly in the following
   pseudocode. }

for (every grid line)
  begin;
   { Create an array that contains the points that define a vertical grid line
   in NDC space (beginning and end points of each grid line). The maximum
   extent in each axis is 32767 assuming we opened the device in coordinate
   transformation mode 0. }
  POLYLINE(grid line);
   { Use POLYLINE to draw the line }
  end;
SET.ALIGNMENT(top center);
   { SET.ALIGNMENT changes the text attribute defining how GSS-DRIVERS
   places text with respect to the points specified in following graphics
   output routines. We use this call to center the text below the point
   specified. }
for (every horizontal axis tick)
  begin;
  GRAPHIC.TEXT(x position,y position,month[i]);
   { Output the text for the horizontal axis using the default character
   size. Month[i] represents the character string identifying each month. }
  end;
```

```
SET.ALIGNMENT(right center);
   { We use SET.ALIGNMENT here to position text's right side center line
   at the graphics text position. }
for (every vertical axis label)
  begin;
  GRAPHIC.TEXT(x position,y position,ylabel[i]);
   { Output the text for the vertical axis at the specified points. }
  end;
SET.ALIGNMENT(bottom left);
   { Set the alignment point to the lower left of the text string }
GRAPHIC.TEXT(x position,y position,"As of June 15");
   { Write the subtitle out }
SET.TEXT.HEIGHT(size of title text);
   { Set the height for the title }
GRAPHIC.TEXT(x position,y position,"Aurora Processing Plant");
   { GRAPHIC.TEXT is used to write out the title text }
SET.FILL.INTERIOR(hatch patterns);
   { SET.FILL.INTERIOR is an attribute routine that determines how any area
   is filled. Valid fill types are empty, solid, hatch and pattern.
   Hatch is used to fill the Gantt bars. }
SET.FILL.STYLE(45% narrow);
   { Choose 45% narrow shading }
for (every bar)
  begin;
  BAR(lower left,upper right);
   { Draw the bars }
  POLYLINE(frame);
   { Draw the frame around the axis system }
  POLYLINE(border);
   { Draw the border around the page }
  REQUEST.STRING(2 characters,echo,echo location,input string);
   { Wait before we close work station so viewer has a chance to see picture
   if output device is a CRT. Program continues when carriage return or at
   least two characters are entered. }
  CLOSE.WORK.STATION;
   { Close down workstation }
  end.
```

Language-specific code for this example is shown in Appendix A.

FIGURE 2-2 Gantt Chart



3 System Architecture

System Architecture

This part is a description of the architecture of GSS-DRIVERS and a summary of the graphics functions available. A detailed listing of each graphics call, its arguments and operation is contained in the subsequent reference part.

The Components of GSS-DRIVERS

GSS-DRIVERS consists of a set of executable device drivers that form the interface between the VDI and specific graphics peripheral devices.

It allows your program to access the hardware on the system in a standard way, thereby eliminating operating system dependencies. This is true of character and file I/O as well as graphics functions. Your application programs will be truly portable between various systems employing GSS-DRIVERS as the graphics subsystem.

GSS-DRIVERS provides several functions for the graphics subsystem:

- device driver management
- coordinate transformation
- character and file I/O
- graphics emulation
- error reporting

GSS-DRIVERS on UNIX is part of the application and is loaded when the application is executed.

Device-driver Management

The UNIX PC software provides drivers for several graphics devices. Select how to install the necessary drivers with the procedure explained in your *AT&T UNIX PC Owner's Guide* for the Set 1 device drivers, and *AT&T UNIX PC GSS-DRIVERS+ User's Guide* for the optional Set 2 device drivers.

The device driver file names must be unique, but there are no other constraints other than making sure they are descriptive. For example, the device driver file name for an AT&T Model 455 Printer is "att455."

Under the UNIX operating system, GSS-DRIVERS is part of the application and is loaded when the application is executed. When GSS-DRIVERS receives a request for a specific device driver via an Open Workstation call, it spawns the appropriate device driver process. This process will remain available to the application until Close Workstation is invoked.

Coordinate Transformation

All graphics coordinates are passed to GSS-DRIVERS in Normalized Device Coordinates (NDC). Here all locations are measured in Cartesian coordinates between 0 and 32767. This lets graphics information be passed to all devices in an identical way regardless of the device size or coordinate system.

GSS-DRIVERS uses information returned from the device driver when the workstation is opened to transform the normalized coordinates into device-specific coordinates (such as raster lines, plotter steps, etc.). This frees an application from performing any device-dependent transforms.

Transformation Modes

There are two user-selectable ways the NDC-to-device coordinate transformation can take place. In the first mode the NDC range of 0-32767 is mapped to the full extent of the physical display surface in each direction. Using this mode insures that all the graphics information will appear on the display surface since all NDC points are displayable.

However, distortion will occur if the display device does not map NDC units to equal physical distances in both directions. (This happens on devices with non-unity aspect ratios.) A result of this situation is squares that turn into rectangles.

To avoid this distortion, use the second transformation mode. It preserves the aspect ratio of the image by mapping NDC units to equal physical distances in both directions. To do this, the full NDC space is mapped to the longest axis of the device. The other axis displays as much of the NDC space as possible, but some information at the edges will be lost. Compensation is provided for devices with non-square pixels so that circles appear as circles and squares look like squares. The application program is responsible in this case for sending only displayable NDC units to the system (otherwise they will be lost). This can result in device- and system-dependencies. However, drivers automatically take device dependencies into account when using the bar, pie slice, arc and circle GDP's.

The first mode unburdens the application from doing a specific device-dependent transform. The advantage of the second mode is that pictures can be easily transported between devices with the assumption that a unity (square) aspect ratio is used. GSS-DRIVERS will make the adjustment for the actual aspect ratio of the display device.

Character I/O

Although the VDI standardizes access to graphics facilities, various operating systems have different ways to access the ports that control graphics peripherals. To insure that graphics applications written using GSS-DRIVERS are truly portable, the C language bindings include functions that provide a standardized way to do character I/O. The character I/O facility includes functions to open, initialize and close the I/O system, to obtain status, and to read and send characters. Characters can be read and written with or without waiting for completion.

File I/O

A system-independent way of accessing files is also needed to make applications portable. GSS-DRIVERS provides a generic file I/O system based on the UNIX file model. A pointer associated with the file indicates the next byte position to be read or written. Each operation (read or write) causes the pointer to be updated. A seek operation allows the current position in the file to be set without reading or writing data.

Directories and File Names

All files reside in distinct areas called directories. A particular directory is specified by name—a null terminated string of bytes. A file is also referred to by name. A fully qualified file name consists of a directory name and a file name with a maximum of eighty characters.

Functions are provided to associate a file name with a file descriptor—an integer number that uniquely identifies an open file. Up to sixteen file descriptors (open files) may exist simultaneously. All file operations require a file descriptor to identify the object file. A file's descriptor must be obtained before any operations can be performed on it.

Graphics Emulation

The VDI is a robust standard that incorporates many advanced graphics capabilities. Often the capabilities offered by a graphics device are only a subset of the total VDI possibilities. To insure application portability, some functions that are not supported by the device directly are emulated by GSS-DRIVERS.

Error Reporting

GSS-DRIVERS functions always return to the caller whether or not the requested operation was successful. Each function returns an error status that indicates the results of the request. However, no errors are displayed by GSS-DRIVERS. The application program is made aware of the condition of the graphics subsystem and can take appropriate action without losing control of the system. This places a responsibility on the application program for checking error status and attempting error recovery, or at least informing the user.

An explanation of the status codes returned is included in the detailed descriptions of GSS-DRIVERS functions in the subsequent reference part.

Error Codes

If a function returns an error status, the Inquire VDI Error function can be invoked to obtain the applicable error code. Messages associated with each error value are provided in Appendix B, "Error Codes." Error codes are organized into generic and system-dependent information based on the following rules:

- A negative return from a function always implies an error
- An error code greater than or equal to zero indicates no error occurred
- The generic part of the code is in the form "GGxx" (in decimal)
- The system-dependent part is always in the form "xxDD" (in decimal).

4 Installation and Operation

Installation and Operation

This part describes how to install GSS-DRIVERS on the UNIX PC. This part also discusses how to link your application programs with the GSS-DRIVERS application library.

Overview

The GSS-DRIVERS installation procedure requires you to define the following system environmentals:

- Set the default directory for the device driver files to be used by GSS-DRIVERS
- Select which device drivers correspond to logical device names
- Assign logical graphics devices to physical channels

Once these environmentals are defined, you can incorporate graphics operations into your application programs by calling GSS-DRIVERS functions in your source code. The operations and parameters for all GSS-DRIVERS graphic functions are detailed in Part 5. These are referred to as the language "bindings" because they show explicitly how GSS-DRIVERS interfaces to the C programming language. The bindings for the character and file I/O functions are also provided.

Distribution Files

GSS-DRIVERS distribution files contain the C language bindings library, a header include file, and test files.

libcvdi.a	C language binding library.
types.h	Header include file.
vditest	Test programs that verify proper operation. Both the source and the executable files are included.

Installing the VDI Software

This section contains a guide to installing the software for the AT&T UNIX PC Virtual Device Interface C Binding. Depending upon the version of the operating system being used, some procedures and screen displays may vary from those shown here. Typical variations in the procedure are addressed within this guide, although others may exist.

Before you begin the installation procedure, locate the following floppy disk:

GSS-DRIVERS C Binding Version 1.01

1 When prompted by **Please login:**

- Type your user login or you can type ***install.***
- Press (Enter).

If a password is required for system access, the **Password:** prompt will appear and you must continue with the following instructions. Otherwise proceed with the instructions in step 2.

- Type the password exactly as it was defined to the system. As a security measure, the password will not be displayed on the screen when it is typed.
- Press (Enter).

2 The system briefly displays a message that shows the amount of available storage space.

If there is less than 15% of the storage space available, you may want to choose one of the following options:

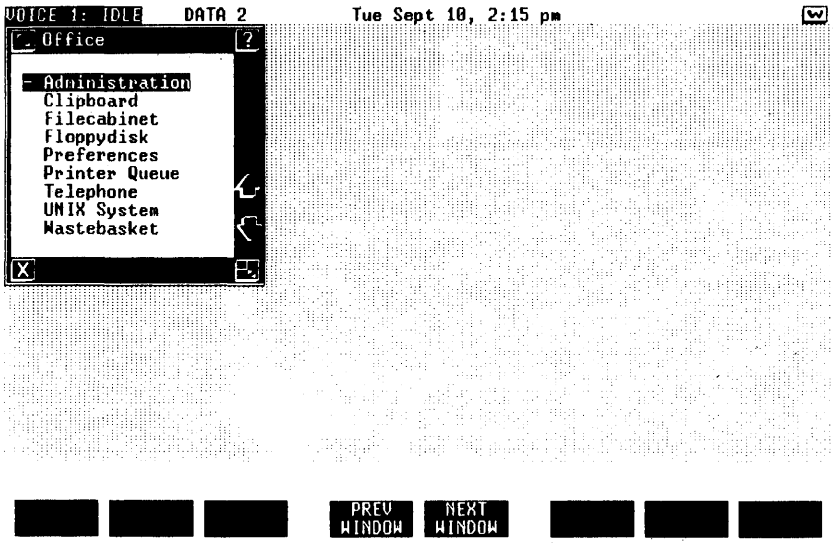
— Delete unnecessary files from the Wastebasket.

— Backup files from the hard disk onto floppy disks and delete these files from the hard disk.

— Remove software that is no longer required.

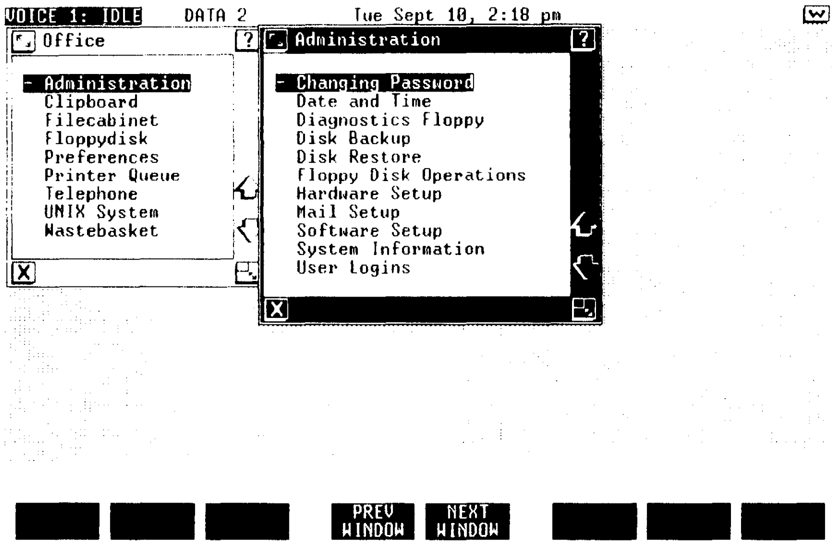
See the AT&T UNIX PC Owner's Manual for details on performing these operations.

3 After a few seconds, the system displays the following Office Window with the **Administration** selection highlighted.



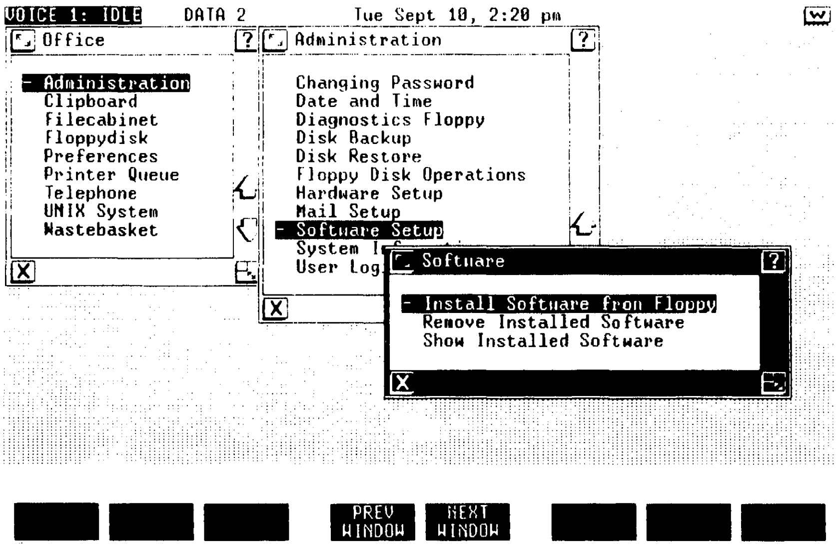
- Press (Enter).

4 The system displays the Administration Window.



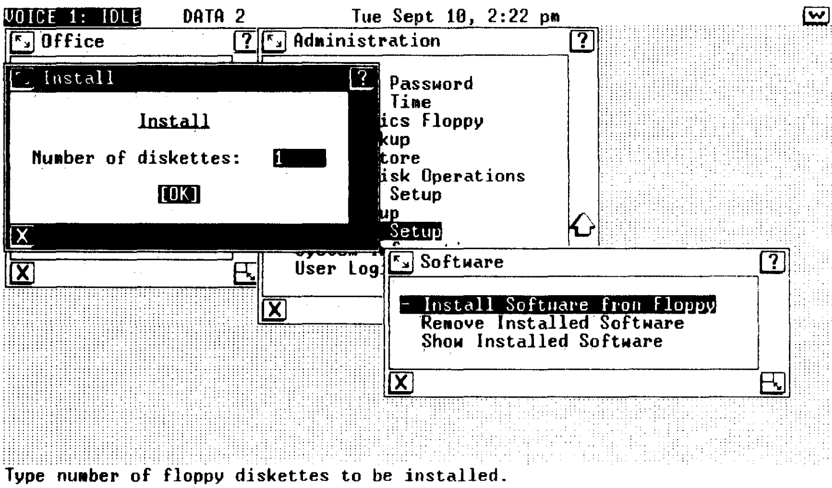
- Press (Next) until you have highlighted **Software Setup**.
- Press (Enter).

5 The System displays the Software Window with the **Install Software from Floppy** selection highlighted.



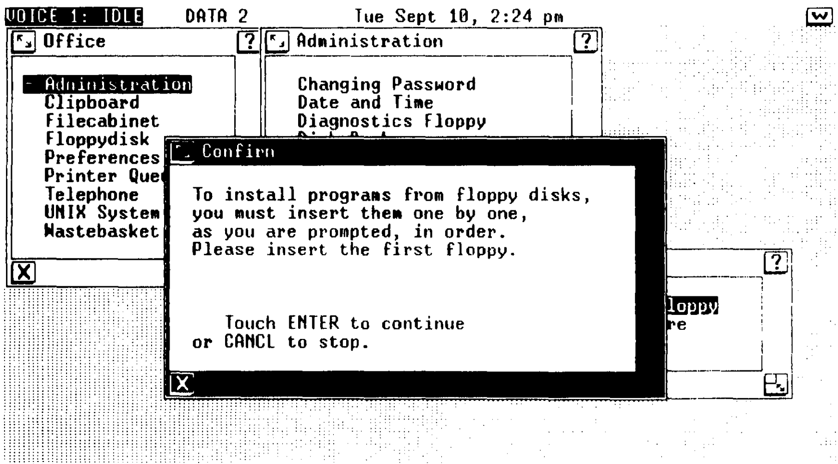
- Press (Enter).

6 At this point, depending upon the version of the operating system being used, the system may display the Install Window with the cursor positioned at the prompt **Number of diskettes:** as shown below. If so, continue with the following instructions. Otherwise, proceed with the instructions in step 7.



- Enter 1 for the number of diskettes that are to be installed.
- Press (Enter).

7 The system displays the Confirm Window with the following message or a similar message instructing you to insert the diskette:

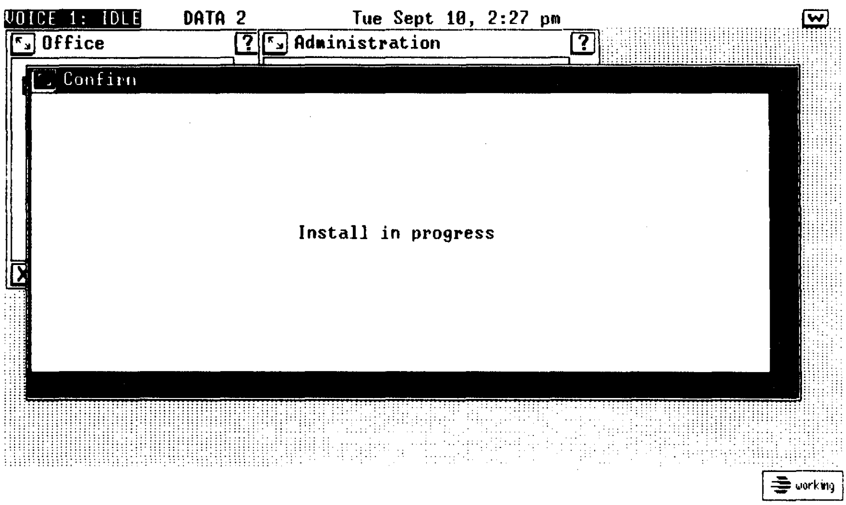


- Insert the **GSS-DRIVERS C Binding Version 1.01** into the diskette drive with the label facing up.
- Close the drive by flipping the lever down.
- Press (Enter).

Note

If an error message appears on the screen during installation, check that the diskette is in good working condition and inserted correctly in the drive.

8 Depending upon the version of the operating system being used, the system may display the Confirm Window with the **Install in progress** message as shown below. If so, continue with the following instructions. Otherwise, a screen message informs you of the storage space available on your system and offers you the opportunity to continue by pressing (Enter) or to cancel the installation by pressing (Cancl). If not enough space is available, see the options listed under step 2.



- Do not open the diskette drive until it is safe or data can be lost or destroyed.

9 When the installation is complete, the system displays the following message:

The installation of the GSS-DRIVERS C
C Language Binding Version 1.01 package
is now complete.

Please press Enter to continue.

- Press (Enter) as indicated on the screen.

10 The system removes the Confirm Window from the screen and displays the Software Window. It is now safe to remove the floppy diskette.

- Open the drive by flipping the drive lever up.
- Remove the diskette.
- Press (Exit) to return to the Administration Window.
- Press (Exit) again to return to the Office Window.

Setting the Environment

There are several environmental variables that should be set before running your application. Since there is a possibility that several drivers may be resident on your UNIX PC for that device type, you must indicate which driver should be used by GSS-DRIVERS functions. When v_opnwk (Open Workstation) is called, you specify a logical device name such as PRINTER, PLOTTER, DISPLAY, etc. The v_opnwk then searches the environment for a variable by the same name as the device. This variable holds the file name of the driver.

You must also specify which physical device a driver is to use. This is accomplished by setting an environmental variable with the same name as the device driver, containing the name of the physical device. The variable VDIPATH holds the appropriate pathname for GSS-DRIVERS.

These assignments can be made through the "GSS-Drivers Setup" menu. They are inserted in the environment by executing the file

/usr/lib/GSS_Drivers/Environment

If the GSS-DRIVERS pathname is not provided, the current working directory is used.

The default output metafile name is **metafile.met.** This can be changed with the following commands:

METAOUTPUT=<filename>
export METAOUTPUT

where ***<filename>*** is the name to be used for subsequently created metafiles.

Linking Applications

The code that implements the interface between GSS-DRIVERS and your programming language is contained in the libcvdi.a binding library included on the distribution diskette. After your program is compiled, it must be linked with this binding library and other modules and libraries required by the application. In general, the binding should be linked after your application code and before any language support libraries.

The C language binding library, libcvdi.a, is located in the system library directory:

```
/usr/lib/libcvdi.a
```

It can be accessed from any directory by the command:

```
cc picture.c -lcvdi -ltam -ltermcap -o picture
```

The option -lcvdi is an abbreviation for /usr/lib/libcvdi.a. It informs the linker that a library called /usr/lib/libcvdi.a is required.

Note

The -l switch can be used to associate an argument with an exact library file within /usr/lib. The linker will look for the file name that begins with "lib" and ends with the string that follows the -l switch. For example, -ltester would be the library /usr/lib/libtester.a, and -lm would be the library /usr/lib/libm.a.

Testing the System

The test programs provided in the distribution files can be used to verify that the configuration shell script is correct and that your application is properly linked. If the test programs do not execute successfully, retrace your installation steps to discover the source of the error. Make sure that you have made the appropriate physical device (port) assignment and baud rate selection by exercising your peripherals with previously operating programs.

The executable program module is executed and debugged in the normal manner using the tools provided by the operating system environment. Since GSS-DRIVERS functions always return to the calling program with status information rather than displaying error messages, we recommend that you include a very simple status checking routine in your program that is called after each graphics function. Its purpose is to display any error codes that arise before you have finished debugging your application error handling routines.

5 Control Functions

Control Functions

This section covers the control functions provided by GSS-DRIVERS that allow:

- initialization and termination
- device control
- workstation control
- cursor control

Initialization and Termination

When you initialize GSS-DRIVERS, default values are set for all attributes and the device capabilities are determined. When you terminate the program, control returns to the keyboard. Open Workstation must be the first routine called and Close Workstation, the last.

Device Control

For ultimate device control, GSS-DRIVERS allows you to set the pen speed on a plotter, set the raster writing mode and generate hard copy.

Workstation Control

Control functions are also provided that allow you to update a workstation by making all output current and to clear the workstation.

Cursor Control

You will remember from the Graphics Model discussed in Part 2 that GSS-DRIVERS supplies three types of text:

- Alpha Text used for creating word processor quality text on CRTs or printers
- Cursor Text used primarily for creating forms
- Graphics Text.

To control both Alpha and Graphics Text, you must be in the **Graphics Mode.**

To control the cursor for cursor text you must be in the **Cursor Addressing Mode.** This gives you access to functions that are used for positioning the standard CRT cursor and placing text on the screen.

Note

Cursor addressing only applies to CRT devices.

Cursor addressing is defined on a character cell grid of rows and columns. Rows are the number of lines of text on the screen, and columns are the number of character cells per line. The upper left corner of the screen is row 1, column 1. Typical screen formats are 24 rows by 80 columns.

Metafile VDI Functions

Two special VDI functions are available in GSS-DRIVERS for use with metafiles. The Message function allows message text that is not part of a picture to be placed in the metafile. This text is simply passed on to the metafile interpreter and displayed to the operator at interpretation time. It is intended to permit the display of special device-dependent information needed to process a VDM. There is no control over the position or appearance of the text.

The Application Data function allows an application program to store and access private data in a metafile. When retrieved, this data is not processed in any way by the metafile interpreter, but is available to the application.

A Note on Binding Conventions

In the C bindings, INT16 refers to signed 16-bit integers and INT8 refers to signed 8-bit integers. FD refers to a signed 16-bit integer. INT32 refers to a long integer (32 bit). Scalar input arguments are passed by value, array input arguments are passed by address. All output arguments are passed by address.

TABLE 5-1 Control Functions

Function	Routine	Description	Page
Initialization	v_opnwk	Open Workstation	5-20
Termination	v_clswk	Close Workstation	5-7
Device Control	v_hardcopy	Hard copy	5-18
	vs_penspeed	Set Pen Speed	5-33
	vswr_mode	Set Writing Mode	5-35
Workstation Control	v_clrwk	Clear Workstation	5-6
	v_updwk	Update Workstation	5-31
Alpha Text Control	vsa_position	Set Alpha Text Position	5-34
Cursor Text Control	v_enter_cur	Enter Cursor Addressing Mode	5-16
	v_curup	Cursor Up	5-12
	v_curdown	Cursor Down	5-8
	v_curright	Cursor Right	5-11
	v_curleft	Cursor Left	5-10
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	v_eeol	Erase to End of Line	5-14
	v_eeos	Erase to End of Screen	5-15
	vs_curaddress	Direct Cursor Address	5-32
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Graphics Cursor Control	v_dspcur	Display Graphics Input Cursor	5-13
	v_rmcur	Remove Graphics Input Cursor	5-30
Metafile	v_appl	Application Data	5-5
	v_msg	Message	5-19

v_appl ()

Purpose — Metafile application data

Syntax — **v_appl (dev_handle, function, data_cnt, app_data)**

Data Types

```
INT16 v_appl ();
INT16 dev_handle;
INT8 function[ ];
INT16 data_cnt;
INT16 app_data[ ];
```

Input

dev_handle
Metafile device handle

function
Text string indicating function name

data_cnt
Number of integers of application data

app_data
Name of array containing application data

Function Returns

Function **v_appl** returns error state.
 0 if no error
 -1 if error
Actual error can be retrieved by invoking error inquiry function.

Description

This routine allows the metafile generator to place application specific data into the metafile. The function name is a user-defined title for whatever the application data element represents.

v_clrwk ()

Purpose	Clear workstation
Syntax	**v_clrwk (dev_handle)**
Data Types	**INT16 v_clrwk ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_clrwk** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine clears CRT screens, prompts for new paper on plotters, or displays all pending graphics and advances to top-of-form on printers. Often, this call is preceded by an input routine when using a CRT so that output will not be cleared from the screen before the user has a chance to view the image. Prompts can be controlled by Open Workstation.

v_clswk ()

Purpose	Close workstation
Syntax	**v_clswk (dev_handle)**
Data Types	**INT16 v_clswk ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_clswk** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine displays any pending graphics, then stops all graphics output to the specified workstation. It must be called to terminate a program and should be the last graphics routine called.

v_curdown ()

Purpose: Cursor down

Syntax: **v_curdown (dev_handle)**

Data Types:
```
INT16 v_curdown ();
INT16 dev_handle;
```

Input: **dev_handle**
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Function Returns: Function **v_curdown** returns error state.
 0 if no error
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description: When you are in Cursor Addressing Mode, this routine moves the cursor down one row without altering its horizontal position. If the cursor is already at the bottom margin, the screen will scroll up one line. When the cursor is on the bottom line of the screen and characters are subsequently sent to the screen, any characters which exceed the right margin will wrap around to the left margin. Any characters already on the last line will be overwritten. This function is only applicable to CRT devices.

v_curhome ()

Purpose	Cursor home
Syntax	**v_curhome (dev_handle)**
Data Types	**INT16 v_curhome ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_curhome** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	When you are in Cursor Addressing Mode, this routine moves the cursor to the home position (upper left corner of the screen). It is only applicable to CRT devices.

v_curleft ()

Purpose	Cursor left
Syntax	**v_curleft (dev_handle)**
Data Types	**INT16 v_curleft ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_curleft** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	When you are in Cursor Addressing Mode, this routine moves the cursor left one column without altering its vertical position. No action occurs if the cursor is already at left margin. This function is only applicable to CRT devices.

v_curright ()

Purpose: Cursor right

Syntax: **v_curright (dev_handle)**

Data Types: **INT16 v_curright ();**
INT16 dev_handle;

Input: **dev_handle**
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Function Returns: Function **v_curright** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description: When you are in Cursor Addressing Mode, this routine moves the cursor right one column without altering its vertical position. No action occurs if the cursor is already at right margin. This function is only applicable to CRT devices.

v_curup ()

Purpose — Cursor up

Syntax — **v_curup (dev_handle)**

Data Types
```
INT16 v_curup ();
INT16 dev_handle;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Function Returns

Function **v_curup** returns error state.
 0 if no error
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

When you are in Cursor Addressing Mode, this routine moves the cursor up one row without altering its horizontal position. No action occurs if the cursor is already at the top margin. This function is only applicable to CRT devices.

v_dspcur ()

Purpose
Display graphics input cursor

Syntax
v_dspcur (dev_handle, x, y)

Data Types
```
INT16 v_dspcur ();
INT16 dev_handle;
INT16 x,y;
```

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

x
x-coordinate of location to place cursor.

y
y-coordinate of location to place cursor.

Function Returns
Function **v_dspcur** returns error state
 0 if no error
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
When you have exited Cursor Addressing Mode, this routine displays a graphics input cursor centered about the specified location. The graphics cursor is the same as the one used for feedback by the Input Locator function (crosshairs, arrow, etc.). The Input Locator function will automatically display a cursor when needed. This function does not need to be referenced when using Input Locator. It is only applicable to CRT devices.

v_eeol ()

Purpose	Erase to end of line
Syntax	**v_eeol (dev_handle)**
Data Types	**INT16 v_eeol ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_eeol** returns error state 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	When you are in Cursor Addressing Mode, this routine erases from the current cursor position to the end of the line. It is only applicable to CRT devices.

v_eeos ()

Purpose	Erase to end of screen
Syntax	**v_eeos (dev_handle)**
Data Types	**INT16 v_eeos ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_eeos** returns error state 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	When you are in Cursor Addressing Mode, this routine erases from the current cursor to the end of the screen. It is only applicable to CRT devices.

v_enter_cur ()

Purpose — Enter cursor addressing mode

Syntax — **v_enter_cur (dev_handle)**

Data Types —
INT16 v_enter_cur ();
INT16 dev_handle;

Input — **dev_handle**
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Function Returns — Function **v_enter_cur** returns error state
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description — This routine exits Graphics Mode if different from Cursor Addressing Mode.

It must precede all other cursor addressing functions, such as Cursor Up, etc. This routine "homes" the cursor.

Cursor addressing is only meaningful on CRT devices. It is defined on a character cell grid of rows and columns (rows equals the number of lines on a screen, and columns equals the number of character cells per line). The upper left-hand corner of the screen is row 1, column 1.

v_exit_cur ()

Purpose	Exit cursor addressing mode
Syntax	**v_exit_cur (dev_handle)**
Data Types	**INT16 v_exit_cur ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_exit_cur** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine exits Cursor Addressing Mode if different from Graphics Mode. For applications to work properly, this function must be used to enter Graphics Mode from Cursor Addressing Mode.

v_hardcopy ()

Purpose	Hardcopy
Syntax	**v_hardcopy (dev_handle)**
Data Types	**INT16 v_hardcopy ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_hardcopy** returns error state 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine generates a hard copy. It is very device-specific and may involve copying the screen to a printer (doing a "screen dump") or other attached hard copy device.

v_msg ()

Purpose	Metafile message
Syntax	**v_msg (dev_handle, message, wait)**
Data Types	**INT16 v_msg ();** **INT16 dev_handle;** **INT8 message[ ];** **INT16 wait;**
Input	**dev_handle** Metafile device handle. **message** Text string. **wait** Pause indicator. 0 = if no response required 1 = if pause after issuing message and wait for a response.
Function Returns	Function **v_msg** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking error inquiry function.
Description	This function places a text string in the metafile which will be displayed by the interpreter as an operator message. It appears on the console in a device-dependent position. The pause indicator controls whether the interpreter will pause for a (device-dependent) response or continue.

v_opnwk ()

Purpose — Open workstation

Syntax — **v_opnwk (work_in, &dev_handle, work_out)**

Data Types

```
INT16 v_opnwk ();
INT16 work_in[19];
INT16 dev_handle;
INT16 work_out[66];
```

Input

work_in[0]
Coordinate transformation mode flag.
Determines how to transform NDC space to device coordinate.

0 = Map NDC space to full extent of each axis. This mode does not preserve aspect ratio. Picture will completely fill screen.

1 = Map NDC space to full extent of longest axis only; map subset of NDC space to shorter axis. This mode preserves unity aspect ratio. Using this technique and the appropriate scaling factor results in a picture with the same aspect ratio.

work_in[1]
Polyline line type.

work_in[2]
Polyline color index.

work_in[3]
Polymarker type.

work_in[4]
Polymarker color index.

work_in[5]
Graphics text font.

work_in[6]
Graphics text color index.

work_in[7]
Fill interior style.

work_in[8]
Fill style index.

work_in[9]
Fill color index.

work_in[10]
Prompting flag for controlling screen prompts. Typical prompts are for paper and pen changes on plotters.

0 = Do not display device-dependent prompts to the logical message device
1 = Display device-dependent prompts to the logical message device

work_in[11-18]
Workstation identifier (device driver logical name). This is an ADE form that is used to determine which driver to dynamically bring into memory, but is not used by the driver itself. The following names should be used for logical device names unless they are superseded by an environment variable: DISPLAY, PLOTTER, PRINTER, METAFIL, CAMERA, JOYSTIK, MOUSE, GRAFOUT, GRAFIN.

Output

dev_handle
Device handle associated with the workstation identifier. (workin_[11-18])

work_out[0]
Maximum addressable width of screen/plotter in rasters/steps assuming a 0 start point (e.g. a resolution of 640 implies an addressable area of 0-639, so work_out[0]=639)

work_out[1]
Maximum addressable height of screen/plotter in rasters/steps assuming a 0 start point (e.g. a resolution of 480 implies an addressable area of 0-479, so work_out[1]=479)

work_out[2]
Device coordinate units flag.

0 = Device capable of producing precisely scaled image (typically plotters and printers)
1 = Device not capable of precisely scaled image (CRTs)

work_out[3]
Width of one pixel (plotter step) in micrometers.

work_out[4]
Height of one pixel (plotter step) in micrometers.

work_out[5]
Number of character heights.
0 = continuous scaling

work_out[6]
Number of line types.
0 = device is not capable of graphics

work_out[7]
Number of line widths.

work_out[8]
Number of marker types.

work_out[9]
Number of marker sizes.
0 = continuous scaling

work_out[10]
Number of graphics text fonts.

work_out[11]
Number of patterns.

work_out[12]
Number of hatch styles.

work_out[13]
Number of predefined colors.
This is the number of colors that can be displayed on the device simultaneously when in Graphics Mode. The number of colors in Cursor Addressing Mode may be different.

Note

There must be at least two colors, even for monochrome devices.

work_out[14]
Number of Generalized Drawing Primitives (GDP).

work_out[15-24]
List of available GDPs. (Up to ten allowed)

1 = bar
2 = arc
3 = pie slice
4 = circle
-1 = GDP does not exist

The list can be specified in any order.

work_out[25-34]
Attribute set associated with each GDP.

-1 = GDP does not exist
0 = Polyline
1 = Polymarker
2 = Text
3 = Fill area
4 = None
5 = Other

work_out[35]
Color capability flag.

0 = no
1 = yes

work_out[36]
Text rotation capability flag.

0 = no
1 = yes

work_out[37]
Fill area capability flag.

0 = no
1 = yes

work_out[38]
Pixel operation capability flag

0 = no
1 = yes

work_out[39]
Number of available colors.
Total number of colors in color palette.

0 = Continuous device
2 = Monochrome (black and white)
>2 = Number of colors available

work_out[40]
Locator capability flag.
0 = no
1 = yes

work_out[41]
Valuator capability flag.
0 = no
1 = yes

work_out[42]
Choice capability flag.
The value returned is the number of CHOICE indicators available. For example, if five function keys are used as CHOICE devices, the value returned would be 5.

work_out[43]
String input capability flag.
0 = no
1 = yes

work_out[44]
Workstation type.
0 = Output only
1 = Input only
2 = Input/Output
3 = Device-independent segment storage
4 = Metafile output
5 = Other

work_out[45]
Device type.
0 = CRT
1 = Plotter
2 = Printer
3 = Camera/film recorder
4 = Metafile output
5 = Other

work_out[46]
Number of writing modes available.

work_out[47]
Highest level of input mode available.
0 = none
1 = request
2 = sample

work_out[48]
Text alignment capability flag.
0 = no
1 = yes

work_out[49]
Inking capability flag as output echo device.
0 = no
1 = yes

work_out[50]
Rubberbanding capability flag as output echo device.
0 = No rubberband capability
1 = Capable of rubberband lines
2 = Capable of rubberband lines and rectangles

work_out[51]
Maximum addressable NDC space coordinate on x-axis. This value is filled in based on the coordinate transformation mode selected.

work_out[52]
Maximum addressable NDC space coordinate on y-axis. This value is filled in based on the coordinate transformation mode selected.

work_out[53-57]
Version of the driver.
This is an ADE character string that represents the version of the driver in the following form:
vv.ll
where vv is the actual version
and ll is the level.

work_out[58-59]
Reserved for future use.

work_out[60]
Minimum graphics character height in NDC units.

work_out[61]
Maximum graphics character height in NDC units.

work_out[62]
Minimum line width in NDC units.

work_out[63]
Maximum line width in NDC units.

work_out[64]
Minimum marker height in NDC units.

work_out[65]
Maximum marker height in NDC units.

Function Returns

Function **v_opnwk** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine initializes a workstation (a graphics device). It sets all defaults and returns device information. Both the alpha and graphics display surfaces are cleared by this function.

Color Indices

The following lists are the color index values for the Open Workstation routine.

Monochrome Devices Index

0 = Black for CRTs & White for printers/plotters
1 = White for CRTs & Black for printers/ plotters

Color Devices Index

0 = Black for CRTs & White for printers/ plotters
1 = White for CRTs & Black for printers/ plotters
2 = Red
3 = Green
4 = Blue
5 = Yellow
6 = Cyan
7 = Magenta
8-n = Device-dependent

Opening an Output Device

Each time **v_opnwk** is invoked to open an output device, the values specified in the input array, work_in, are implemented. In addition, the following default values take effect:

Graphics character height = largest size that allows 80 characters horizontally and 24 characters vertically
Character baseline rotation = 0 degrees rotation
Line width = 1 device unit (raster, plotter step)
Marker height = minimum marker height
Writing mode = 4 (replace)
Input mode = request for all input classes (locator, valuator, choice, string)
Text alignment = bottom for vertical alignment; left for horizontal alignment
Cursor addressing mode = off
Alpha text position = uppermost left corner of display surface to allow for one default alpha text character to appear but not be off the display surface
Alpha text line spacing = single spacing
Alpha text font = standard font that has 80 characters horizontally across the display surface
Alpha text subscripting and superscripting = off
Alpha text underlining = off
Alpha text overstriking = off
Alpha text pass through = off
Alpha text quality = high quality
Alpha text color index = 1
Line delete character = ^U (NAK)
Char delete character = ^H (Backspace)

Opening an Input Device

When Open Workstation (**v_opnwk**) is called to open an input device, the input array (work_in) is implemented as follows: work_in[0], the coordinate transformation mode flag, specifies which aspect ratio to use. If O is chosen for this flag for both the input device and the output echo device, the full extents of the graphics input device will map to the full extents of the output echo device when echoing input. If 1 is chosen for the flag for either the input device or the output echo device, the full extents of the two devices may not be the same. For example, the two devices could possibly overlap.

work_in[1] to work_in[10] are not applicable for an input device
work_in[11] to work_in[18] specify the logical name to be used to refer to the device.

The output array (work_out) for a typical input device would contain the following elements:

work_out[0], the addressable width of input device in rasters = Device-dependent value
work_out[1], the addressable height of input device in rasters = Device-dependent value
work_out[2], device coordinates in raster units flag = 1
work_out[3], width of a pixel in micrometers = Device-dependent value
work_out[4], height of a pixel in micrometers = Device-dependent value
work_out[5], number of character heights = 0
work_out[6], number of line types = 0
work_out[7], number of line widths = 0
work_out[8], number of marker types = 0
work_out[9], number of marker sizes = 0
work_out[10], number of graphics fonts = 0
work_out[11], number of patterns = 0
work_out[12], number of hatch styles = 0
work_out[13], number of predefined colors = 0
work_out[14], number of GDPs = 0
work_out[15] to work_out[34], no GDPs or associated bundle tables available = –1
work_out[35], color capability flag = 0
work_out[36], text rotation capability flag = 0
work_out[37], fill area capability flag = 0
work_out[38], pixel operation capability flag = 0
work_out[39], number of available colors = 0
work_out[40], locator capability flag = 1
work_out[41], valuator capability flag = 0
work_out[42], number of choices devices available = 0
work_out[43], string input capability flag = 0
work_out[44], workstation type = 1
work_out[45], device type is other = 5
work_out[46], number of writing modes available = 0
work_out[47], highest level of input mode available—request = 1
work_out[48], text alignment capability flag = 0

work_out[49], inking capability flag = 0
work_out[50], rubberbanding capability flag = 0
work_out[51], max x in NDC = Device-dependent value
work_out[52], max y in NDC = Device-dependent value
work_out[53] to work_out[57], Version of driver = 2.00
work_out[58], reserved = 0
work_out[59], reserved = 0
work_out[60], minimum character height in NDC space = 0
work_out[61], maximum character height in NDC space = 0
work_out[62], minimum line width in NDC space = 0
work_out[63], maximum line width in NDC units = 0
work_out[64], minimum marker height in NDC units = 0
work_out[65], maximum marker height in NDC units = 0

Code Example—Open Workstation

The following program is a code example for the **v_opnwk** (Open Workstation) function:

```
static  int16 nominate[] = {1, /* coordinate  transformation mode,
   mode 0 is to map chart to entire display surface,
   mode 1 is to map 32767 to longest axis */
     1, /* line type to use, 1 indicates solid */
     1, /* line color index to use */
     3, /* marker type, 3 is a star */
     1, /* marker color index */
     1, /* text font to use */
     1, /* text color */
     0, /* fill interior style, 0 indicates hollow */
     0, /* fill style index */
     1, /* fill color index */
     1, /* device messages to screen */
    'D','I','S','P','L','A','Y',' '/* device name to use*/
}
int16 device_info[66], device_handle, err_report, xscale, yscale, scale;
err_report = v_opnwk (nominate, &device_handle, device_info);
   /* Using the aspect ratio returned from the GSS VDI,
       determine the scaling in the x direction */
xscale = device_info[51] / 300;
   /* Using the aspect ratio returned from the GSS VDI, determine
       the scaling in the y direction */
yscale = device_info[52] / 200;
   /* determine the smaller of the two scaling factors and use it
       for transformation from user units (300 cm by 200 cm) to
       normalized device coordinates */
scale = (xscale > yscale) ? yscale : xscale;
```

v_rmcur ()

Purpose	Remove graphics input cursor
Syntax	**v_rmcur (dev_handle)**
Data Types	**INT16 v_rmcur ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_rmcur** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine removes the graphics input cursor from its current location on the screen. It does not need to be referenced for performing Locator Input.

v_updwk ()

Purpose	Update workstation
Syntax	**v_updwk (dev_handle)**
Data Types	**INT16 v_updwk ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_updwk** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine displays all pending graphics on the workstation. For printers, this causes the current picture to be output and the printer to advance to top-of-form.

vs_curaddress ()

Purpose	Direct cursor address
Syntax	**vs_curaddress (dev_handle, row, column)**
Data Types	**INT16 vs_curaddress ();** **INT16 dev_handle;** **INT16 row;** **INT16 column;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open. **row** Row number. 1 to number of rows **column** Column number. 1 to number of columns
Function Returns	Function **vs_curaddress** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	When you are in Cursor Addressing Mode, this routine moves the cursor to a specified position. The position is specified in cursor space with row 1 column 1 being the top left corner of the screen. If you specify a position off the screen, the cursor will not move. It is only applicable to CRT devices.

vs_penspeed ()

Purpose: Set pen speed

Syntax: **vs_penspeed (dev_handle, speed)**

Data Types:

INT16 vs_penspeed ();
INT16 dev_handle;
INT16 speed;

Input:

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

speed
Pen speed as percentage of maximum speed.
0 to 100

Function Returns:

Function **vs_penspeed** returns
≥ 0 if pen speed
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description:

This routine sets the plotter pen speed to a percentage of the maximum speed between 0 and 100; it only affects plotter devices.

This call can be used to slow down a plotter when using nonstandard inks or media.

vsa_position ()

Purpose — Set alpha text position

Syntax — **vsa_position (dev_handle, x_in, y_in, &x_out, &y_out)**

Data Types

INT16 vsa_position ();
INT16 dev_handle;
INT16 x_in;
INT16 y_in;
INT16 x_out;
INT16 y_out;

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

x_in
x-coordinate of text position in NDC units.

y_in
y-coordinate of text position in NDC units.

Output

x_out
x-coordinate of text position selected in NDC units.

y_out
y-coordinate of text position selected in NDC units.

Function Returns

Function **vsa_position** returns
 0 if no error
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

When you have exited Cursor Addressing Mode, this routine sets the alpha text position to the location specified. This specifies the position of the lower left-hand corner of the alpha text string. It is assumed that (0,0) is at the lower left-hand corner of the display surface. The alpha position is updated only when the position is set or when the Output Alpha Text function is invoked. If the position is set at the maximum x or y extent, display of alpha text is device-dependent since characters positioned at that point would be off the display surface.

vswr_mode ()

Purpose	Set writing mode
Syntax	**vswr_mode (dev_handle, mode_in)**
Data Types	**INT16 vswr_mode ();** **INT16 dev_handle;** **INT16 mode_in;**

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

mode_in
Writing mode requested.
Key: s = color index of source pixel
d = color index of destination pixel
1–d = 0 (all bits of color index off)
2–d = d and s
3–d = (not d) and s
4–d = s
5–d = d and (not s)
6–d = d
7–d = d xor s
8–d = d or s
9–d = not (d or s)
10–d = not (d xor s)
11–d = not d
12–d = (not d) or s
13–d = not s (reverse video)
14–d = d or (not s)
15–d = not (d and s)
16–d = all bits of color index on

Function Returns

Function **vswr_mode** returns
$\geq$ 0 if mode selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine sets the current writing mode. It specifies the Boolean operation that is performed between the color indices of the source and destination pixels when lines, text, filled areas, etc. are placed on the display. Mode 4 "replace" is the default for printers and screen devices. Mode 8, ''overstrike'' is the default for plotters.

This function refers only to Graphics Mode, and does not affect cursor text.

Writing modes will work on the printers in a manner similar to screen device operation. If two objects are displayed on top of each other, the result will be determined by the current writing mode.

Output Functions

This section covers the output functions that allow you to describe objects in Normalized Device Coordinates. They provide the capabilities to:

- place polymarkers
- display alpha, cursor and graphics text
- fill a defined area
- output a cell array
- draw special geometric primitives such as bars, circles, and arcs.

Primitive Functions

The graphical world that the programmer describes to the system consists of one or more objects. Each graphical object is described, in turn, by output primitives which have specific attributes.

Polyline Function

The polyline is the fundamental line drawing primitive and generates a set of connected lines given an array of points as a parameter. Since polyline is the basic primitive, attributes such as line color or line style apply to the complete polyline rather than to a segment.

Polymarker Function

Markers are special symbols that can be placed on the display surface to provide a method for identifying two-dimensional positions on the output display surface. The basic primitive is a polymarker that outputs a sequence of markers, each centered on a specified position.

Text Function

The text primitives display a string of either alpha, cursor or graphics text characters at a specified location.

Fill Area Function

This primitive defines the boundary of a polyline that can be hollow, filled in solidly or filled with either a pixel pattern or a hatching pattern.

Cell Array Function

The cell array function provides a means of specifying an array of colors or intensities. This is particularly useful in image processing applications.

Generalized Drawing Primitives

GSS-DRIVERS also supports special geometric primitives.

Bars
: Bars are a special type of filled area defined by opposite corners, so filled area attributes affect their appearance. Bars can be displayed with control over the interior style (HOLLOW, SOLID, PATTERN, HATCH), fill style (type of pattern or hatch) and color.

Circles	Circles are also a special type of filled area defined by a center point and radius, so filled area attributes affect their appearance. They too can be displayed with control over the interior style and fill style.
Pie Slices	Pie slices are a special type of filled area defined by a center point and the two points of the arc. Like bars and circles, they are affected by filled area attributes, including interior and fill style.
Arcs	Arcs are a special type of polyline defined by a center point and the two end points of the arc. They are affected by the polyline attributes of color, line style and line width.

TABLE 5-2 Output Functions

Function	Routine	Description	Page
Polyline	v_pline	Output Polyline	5-56
Polymarker	v_pmarker	Output Polymarker	5-58
Alpha Text	v_atext	Output Alpha Text	5-42
Cursor Addressable Text	v_curtext	Output Cursor	5-50
Graphics Text	v_gtext	Output Graphics Text	5-53
Fill Area	v_fillarea	Output Filled Area	5-51
Cell Array	v_cellarray	Output Cell Array	5-45
Generalized Drawing Primitives	v_arc v_circle v_bar v_pieslice	Output Arc Output Circle Output Bar Output Pie Slice	5-40 5-49 5-44 5-54

v_arc ()

Purpose
Output arc

Syntax
v_arc (dev_handle, x, y, radius, begang, endang)

Data Types
INT16 v_arc();
INT16 dev_handle;
INT16 x, y;
INT16 radius;
INT16 begang;
INT16 endang;

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

x
x-coordinate of center point of arc.

y
y-coordinate of center point of arc.

radius
Radius.

begang
Start angle in tenths of degrees.
0 to 3600

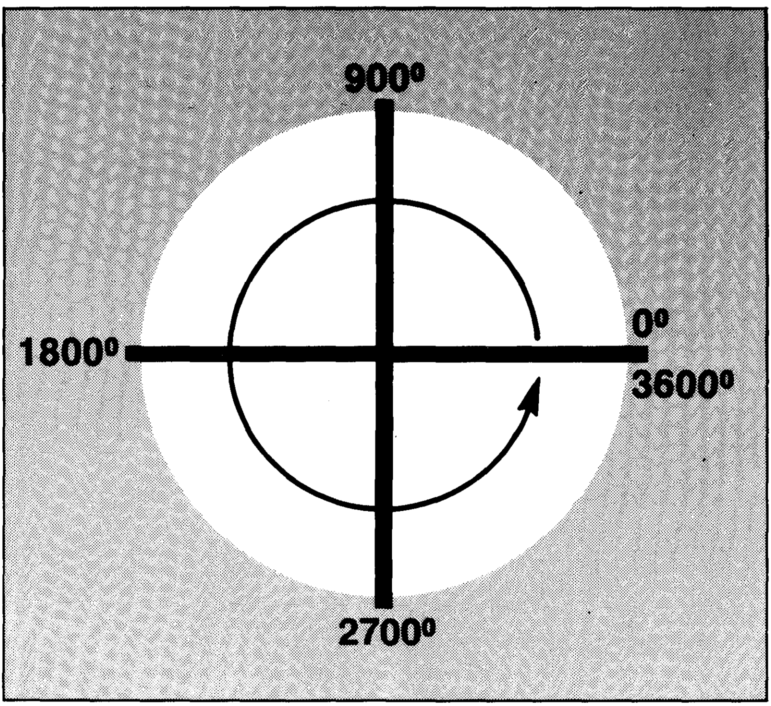
endang
End angle in tenths of degrees.
0 to 3600

Function Returns
Function **v_arc** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine draws arcs using current line attributes. Arcs are defined by the center point and two end points of the arc. The radius is assumed to be measured along the x-(horizontal) axis. All angle specifications assume that 0 degrees is 90 degrees to the right of vertical (or 3:00), with values increasing in the counterclockwise direction.

Arcs and pie slices are always drawn in a counterclockwise direction. The start angle does not need to be larger than the ending angle. If a start angle of 40 degrees and an ending angle of 15 degrees are given, an arc would be drawn counter-clockwise from the 40 degree angle to the 15 degree angle.

FIGURE 5-1 Angle Specification



v_atext ()

Purpose — Output alpha text

Syntax — **v_atext (dev_handle, string, &x_out, &y_out)**

Data Types

```
INT16 v_atext ();
INT16 dev_handle;
INT8 string[ ];
INT16 x_out;
INT16 y_out;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

string
Text string.
Passed as a contiguous stream of bytes.

Output

x_out
x-coordinate of text position (in NDC units) after the text string has been output. This is the same value that is returned if Inquire Alpha Text Position were invoked.

y_out
y-coordinate of text position (in NDC units) after the text string has been output. This is the same value that is returned if Inquire Alpha Text Position were invoked.

Function Returns

Function **v_atext** returns error state.
 0 if no error
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine outputs text at the current alpha text position, honoring all current alpha text attributes (subscripting, under-line, alpha text font, etc.), and the cursor is positioned at the end of the string. The alpha text position is updated appropriately after outputting the text string. Receipt of the ASCII character <CR> (carriage return) causes the alpha text position to be set to the beginning of the line (x = 0). Receipt of a LF (line feed) causes the alpha text position to be advanced by the current line spacing (y = y-line spacing). All other control characters/nonprintable characters (ASCII characters 0-31) are not output. Attempting to display characters past the X or Y maximum of the display surface produces device-dependent results.

Alpha text is useful for outputting word processor quality text display on CRTs, printers, etc., and is displayed to the best resolution and accuracy of the hardware.

Note
In the C language the '\n' character is interpreted as a line feed character. Use '\n\r' to get a line feed, carriage return combination.

v_bar ()

Purpose Output bar

Syntax **v_bar (dev_handle, xy)**

Data Types

```
INT16 v_bar ();
INT16 dev_handle;
INT16 xy[4];
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

xy[0]
x-coordinate of lower left-hand corner of bar

xy[1]
y-coordinate of lower left-hand corner of bar

xy[2]
x-coordinate of upper right-hand corner of bar

xy[3]
y-coordinate of upper right-hand corner of bar

Function Returns

Function **v_bar** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine draws a rectangular area using current filled area attributes of interior style, fill style and color.

v_cellarray ()

Purpose: Output cell array

Syntax:

```
v_cellarray (dev_handle, xy, row_length, el_per_row,
    num_rows, wr_mode, colors)
```

Data Types:

```
INT16 v_cellarray ();
INT16 dev_handle;
INT16 xy[4];
INT16 row_length;
INT16 el_per_row;
INT16 num_rows;
INT16 wr_mode;
INT16 colors[ ];
```

Input:

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

xy[0]
x-coordinate of lower left-hand corner (NDC units)

xy[1]
y-coordinate of lower left-hand corner (NDC units)

xy[2]
x-coordinate of upper right-hand corner (NDC units)

xy[3]
y-coordinate of upper right-hand corner (NDC units)

row_length
Length of each row in color index array

el_per_row
Number of elements used in each row of color index array.

num_rows
Number of rows in color index array.

wr_mode
Pixel operation to be performed.
See Set Writing Mode function for list of operations.

colors
Color index array (stored one row at time).

Function Returns

Function **v_cellarray** returns error state.

0 if no error

-1 if error

Actual error can be retrieved by invoking **vq_error**.

Description

This routine outputs pixels to the device and can be used for imaging.

Each row in the color index array is expanded evenly to fill the entire width of the rectangle specified by pixel replication. Each row in the color index array is also replicated the appropriate number of times to fill the entire height of the rectangular area evenly with the color pattern, starting from the top of the rectangular area and filling downward.

For example, if there are two rows and three elements per row, the vertical dimension of the rectangle is divided into two equal parts, and the horizontal dimension is divided into three equal parts. The rectangle is filled in the upper left-hand corner of the area with the color index specified in the first element of the color index array, etc. If the device can't do cell arrays, the area is outlined in the current line color.

The input array to the cell array function is a list of color indices. Each of these indices indicates the color to use to fill one of the cells of the cell array. The "XY" array defines the corners of the rectangle. "Elements per row" and "number of rows" define how many sections (cells) to divide the rectangle into. For example, to create the cell array shown in Figure 5-2, the following values would be entered:

xy(0) = 24
xy(1) = 300
xy(2) = 50
xy(3) = 500
row_length = 3
el_per_row = 3
num_rows = 2
wr_mode = 4

colors(0) = 2
colors(1) = 4
colors(2) = 5
colors(3) = 3
colors(4) = 1
colors(5) = 4

We could also have used the following set of values:

xy(0) = 24
xy(1) = 300
xy(2) = 50
xy(3) = 500
row_length = 5
el_per_row = 3
num_rows = 2
wr_mode = 4
colors(0) = 2
colors(1) = 4
colors(2) = 5
colors(3) = data value not used
colors(4) = data value not used
colors(5) = 3
colors(6) = 1
colors(7) = 4
colors(8) = data value not used
colors(9) = data value not used

Note in the second example, that the "row length" is set to 5 and the colors array has been increased. Since the "elements per row" value is 3, we only use the first three of the five elements per row. This mechanism is useful when the user only wants to use a portion of a large array of data.

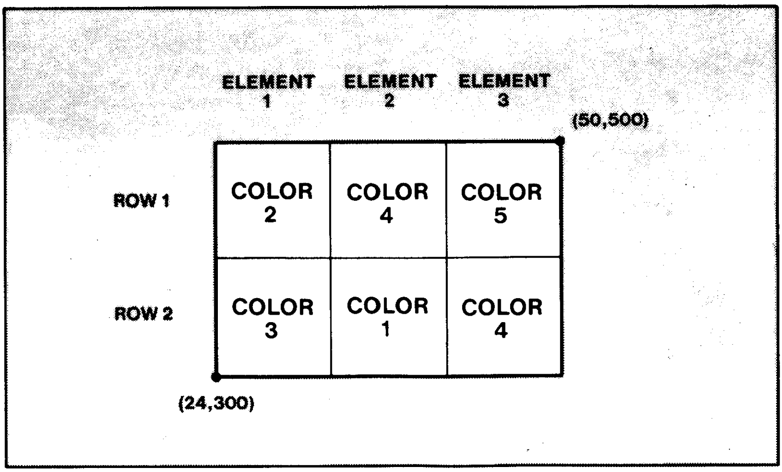
The "colors" values correspond to entries from the currently defined color table.

In this example, we used a writing mode value of 4. However, any of the sixteen writing mode values could have been used.

The term "pixel" is synonymous with the words "raster" and "pel". The current standards documents use the word "pixel". Each "pixel" within a cell is displayed with the indicated color.

By specifying an array that is 320 × 200 pixels long and indicating the colors of the display, the user could set the color of each individual pixel on the screen using the current color graphics card.

FIGURE 5-2 Cell Array



v_circle ()

Purpose — Output circle

Syntax — **v_circle (dev_handle, x, y, radius)**

Data Types

```
INT16 v_circle ();
INT16 dev_handle;
INT16 x;
INT16 y;
INT16 radius;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

x
x-coordinate of center point of circle

y
y-coordinate of center point of circle

radius
Radius

Function Returns

Function **v_circle** returns error state.
 0 if no error
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine draws a circle, specified by a center point and filled radius. The radius is assumed to be measured along the x-axis (horizontal). Since circles are a special type of filled area, they are affected by filled area attributes including interior style, fill style and color.

v_curtext ()

Purpose	Output cursor addressable text
Syntax	**v_curtext (dev_handle, string)**
Data Types	**INT16 v_curtext ();** **INT16 dev_handle;** **INT8 string[ ];**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open. **string** Text string. Passed as a contiguous stream of bytes.
Function Returns	Function **v_curtext** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**. You must be in Cursor Addressing Mode to output cursor addressable text.
Description	For CRTs, this routine outputs text at the current cursor position, honoring all the cursor text attributes (such as color, reverse video, etc.). Note that new text replaces (overwrites) old text at the same location. Only text that will fit onto the line of the cursor will be displayed, and it will not wrap onto the next line at the left edge.

v_fillarea ()

Purpose: Output filled area

Syntax: **v_fillarea (dev_handle, count, xy)**

Data Types:

```
INT16 v_fillarea ();
INT16 dev_handle;
INT16 count;
INT16 xy[2n];
```

Input:

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

count
Number of vertices in polyline.

xy
Array of coordinates of polyline (NDC units)

xy[0]
x-coordinate of first point

xy[1]
y-coordinate of first point

xy[2]
x-coordinate of second point

xy[3]
y-coordinate of second point

.
.
.

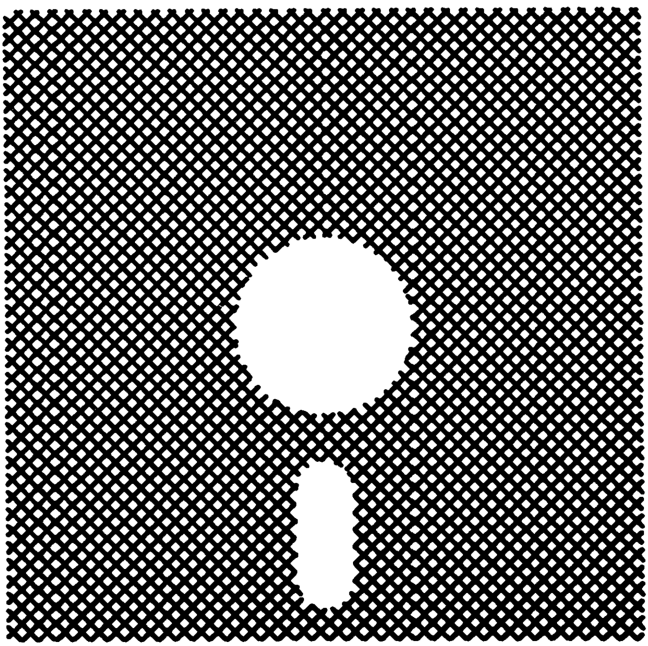
xy[2n-2]
x-coordinate of last point

xy[2n-1]
y-coordinate of last point

Function Returns: Function **v_fillarea** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description This routine outputs a filled area to the device using current fill area attributes of fill color index, fill interior style index, fill style index. HOLLOW filled areas are outlined with a solid border using the current fill color. SOLID, HATCH, and PATTERN filled areas are not outlined.

FIGURE 5-3 Filled Area



v_gtext ()

Purpose Output graphics text

Syntax **v_gtext (dev_handle, x, y, string)**

Data Types

```
INT16 v_gtext ();
INT16 dev_handle;
INT16 x,y;
INT8 string[ ];
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

x
x-coordinate of alignment point of text (NDC units)

y
y-coordinate of alignment point of text (NDC units)

string
Text string.
Passed as a pointer to characters or array.
Characters must be printable characters, ASCII <space> and above.

Function Returns

Function **v_gtext** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine outputs graphics text with current attributes to the device. The X, Y location is the position the text will be aligned to, taking into account the current graphics text alignment values. Any text that is outside of the display surface is not displayed.

v_pieslice ()

Purpose — Output pie slice

Syntax — **v_pieslice (dev_handle, x, y, radius, begang, endang)**

Data Types

```
INT16 v_pieslice ();
INT16 dev_handle;
INT16 x;
INT16 y;
INT16 radius;
INT16 begang;
INT16 endang;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

x
x-coordinate of center point of arc (NDC units)

y
y-coordinate of center point of arc (NDC units)

radius
Radius (NDC units)

begang
Start angle in tenths of degrees
0 to 3600

endang
End angle in tenths of degrees
0 to 3600

Function Returns

Function **v_pieslice** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine draws pie slices by specifying the center point and two points on the arc. The radius is assumed to be measured along the x- (horizontal) axis. Since pie slices are a special type of filled area, they are affected by filled area attributes including interior style, fill style and color.

All angle specifications assume that 0 degrees is 90 degrees to the right of vertical, with values increasing in the counter-clockwise direction. (See Figure 5-1.)

v_pline ()

Purpose
Output polyline

Syntax
v_pline (dev_handle, count, xy)

Data Types
INT16 v_pline ();
INT16 dev_handle;
INT16 count;
INT16 xy[2n];

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

count
Number of vertices (x,y pairs) in polyline

xy
Array of coordinates of polyline (NDC units)

xy[0]
x-coordinate of first point

xy[1]
y-coordinate of first point

xy[2]
x-coordinate of second point

xy[3]
y-coordinate of second point

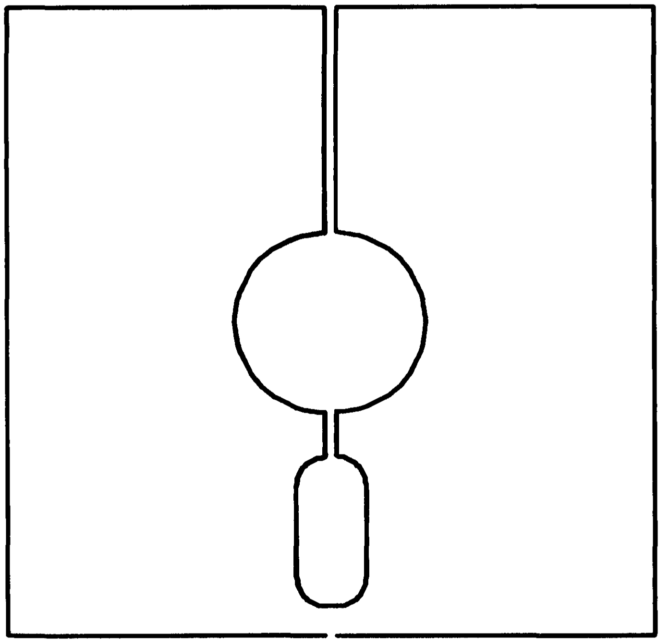
xy[2n-2]
x-coordinate of last point

xy[2n-1]
y-coordinate of last point

Function Returns
Function **v_pline** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine outputs a polyline (with the current polyline attributes of line style, width and color) to the device. It moves to the first point and draws a line between subsequent points.

FIGURE 5-4 Polyline



v_pmarker ()

Purpose Output polymarker

Syntax **v_pmarker (dev_handle, count, xy)**

Data Types
```
INT16 v_pmarker ();
INT16 dev_handle;
INT16 count;
INT16 xy[2n];
```

Input **dev_handle**
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

count
Number of markers.

xy
Array of coordinates (NDC units)

xy[0]
x-coordinate of first marker.

xy[1]
y-coordinate of first marker.

xy[2]
x-coordinate of second marker.

xy[3]
y-coordinate of second marker.

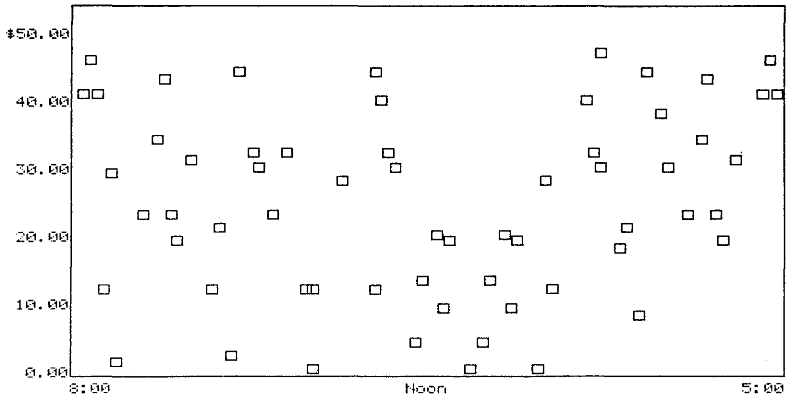
xy[2n-2]
x-coordinate of last marker.

xy[2n-1]
y-coordinate of last marker.

Function Returns Function **v_pmarker** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description This routine outputs markers (with the current polymarker attributes of scale, type and color) to the device. At least six marker types are provided as specified in the Set Polymarker Type routine.

FIGURE 5-5 Polymarkers



Attribute Functions

This section discusses primitive attributes, the general characteristics of a display primitive assigned at the time it is defined by the application program. You can interrogate current attribute values and change them at any time after GSS-DRIVERS is initiated.

Attribute Functions

The purpose of the attribute functions is to specify general characteristics for output primitives. Some attributes control the geometric aspects of the primitives. These are aspects that affect the shape or size of a primitive (for example, character height). Geometric attributes are expressed in NDC units. A second type of attribute controls the non-geometric aspects of primitives; these modify the appearance of primitives without changing their shape (for example, line style).

TABLE 5-3 Attribute Functions

Function	Routine	Description	Page
Polyline Attributes	vsl_color	Set Polyline Color Index	5-86
	vsl_type	Set Polyline Line Type	5-87
	vsl_width	Set Polyline Line Width	5-88
Polymarker Attributes	vsm_color	Set Polymarker Color Index	5-89
	vsm_height	Set Polymarker Height	5-90
	vsm_type	Set Polymarker Type	5-91
Alpha Text Attributes	vsa_color	Set Alpha Text Color Index	5-72
	vsa_font	Set Alpha Text Font and Size	5-73
	vsa_spacing	Set Alpha Text Line Spacing	5-79
	vsa_overstrike	Set Alpha Text Overstrike Mode	5-76
	vsa_passthru	Set Alpha Text Pass Through Mode	5-77
	vsa_quality	Set Alpha Text Quality	5-78
	vsa_supersub	Set Alpha Text Subscript/ Superscript Mode	5-80
	vsa_underline	Set Alpha Text Underline Mode	5-81
Cursor Text Attributes	vcur_color	Set Cursor Text Color Index	5-68
	vcur_att	Set Cursor Text Attributes	5-66
	v_rvoff	Reverse Video Off	5-64
	v_rvon	Reverse Video On	5-65

(continued)

TABLE 5-3 (continued)

Function	Routine	Description	Page
Graphics Text Attributes	vst_height	Set Character Height	5-96
	vst_alignment	Set Graphics Text Alignment	5-92
	vst_rotation	Set Graphics Text String Baseline Rotation	5-98
	vst_color	Set Graphics Text Color Index	5-94
	vst_font	Set Graphics Text Font	5-95
Color Attributes	vsb_color	Set Background Color Index	5-82
	vs_color	Set Color Representation	5-69
Fill Attributes	vsf_color	Set Fill Color Index	5-83
	vsf_interior	Set Fill Interior Style	5-84
	vsf_style	Set Fill Style Index	5-85
Input Attributes	vs_editchars	Set Line Edit Characters	5-71

v_rvoff ()

Purpose	Reverse video off
Syntax	**v_rvoff (dev_handle)**
Data Types	**INT16 v_rvoff ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_rvoff** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	When you are in Cursor Addressing Mode, this routine displays subsequent cursor addressable text in standard video. It is only applicable to CRT devices.

v_rvon ()

Purpose	Reverse video on
Syntax	**v_rvon (dev_handle)**
Data Types	**INT16 v_rvon ();** **INT16 dev_handle;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Function Returns	Function **v_rvon** returns error state. 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	When you are in Cursor Addressing Mode, this routine displays subsequent cursor addressable text in reverse video. It is only applicable to CRT devices.

vcur_att ()

Purpose
Set cursor text attributes

Syntax
vcur_att (dev_handle, req_att, sel_att)

Data Types
INT16 vcur_att ();
INT16 dev_handle;
INT16 req_att[4];
INT16 sel_att[4];

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

req_att[0]
Requested Reverse Video Mode.
0 = Disable Reverse Video
1 = Enable Reverse Video
2 = Do not change current state
3 = Toggle Reverse Video Status

req_att[1]
Requested Underline Cursor Text Mode.
0 = Disable Underline Cursor Text
1 = Enable Underline Cursor Text
2 = Do not change current state
3 = Toggle Underline Cursor Text Status

req_att[2]
Requested Blink Text Mode.
0 = Disable Blink Cursor Text
1 = Enable Blink Cursor Text
2 = Do not change current state
3 = Toggle Blink Cursor Text Status

req_att[3]
Requested Bold Cursor Text Mode.
0 = Disable Bold Cursor Text
1 = Enable Bold Cursor Text
2 = Do not change current state
3 = Toggle Bold Cursor Text Status

Output	**sel_att[0]** Selected Reverse Video Mode. 0 = disabled 1 = enabled **sel_att[1]** Selected Underline Cursor Text Mode. 0 = disabled 1 = enabled **sel_att[2]** Selected Blink Text Mode. 0 = disabled 1 = enabled **sel_att[3]** Selected Bold Cursor Text Mode. 0 = disabled 1 = enabled
Function Returns	Function **vcur_att** returns error state 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine allows the attributes of Reverse Video, Underline, Blink, and Bold to be set for subsequent cursor addressable text. The Reverse Video Mode can be set in this routine or in the Reverse Video On and Reverse Video Off functions. Whichever was called last will be used as the reverse video attribute for subsequent cursor addressable text. This function can be used to do an inquiry of the current status by setting all modes to DO NOT CHANGE STATUS. The current state would then be returned in sel_att.

vcur_color ()

Purpose
Set cursor text color index

Syntax
vcur_color (dev_handle, fore_requested, back_requested, &fore_selected, &back_selected)

Data Types
INT16 vcur_color ();
INT16 dev_handle;
INT16 fore_requested;
INT16 back_requested;
INT16 fore_selected;
INT16 back_selected;

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

fore_requested
Color index of the foreground of subsequent output cursor text.
default = 1

back_requested.
Color index of the background of subsequent output cursor text.
default = 0

Output

fore_selected
Color index selected for cursor text foreground.

back_selected
Color index selected for cursor text background.

Function Returns
Function **vcur_color** returns error state
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine sets the foreground and background colors for cursor addressable text. If an invalid color index is specified, it is mapped to the index closest to the current device's capabilities.

vs_color ()

Purpose — Set color representation

Syntax — **vs_color (dev_handle, ind_in, rgb_in, rgb_out)**

Data Types

```
INT16 vs_color ();
INT16 dev_handle;
INT16 ind_in;
INT16 rgb_in[3];
INT16 rgb_out[3];
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

ind_in
Color index requested.

rgb[0]
Red color intensity.
0 to 1000 (tenths of percent)

rgb[1]
Green color intensity.
0 to 1000 (tenths of percent)

rgb[2]
Blue color intensity.
0 to 1000 (tenths of percent)

Output

rgb_out[0]
Red color intensity selected.
0 to 1000 (tenths of percent)

rgb_out[1]
Green color intensity selected.
0 to 1000 (tenths of percent)

rgb_out[2]
Blue color intensity selected.
0 to 1000 (tenths of percent)

Function Returns

Function **vs_color** returns
≥ 0 if index selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine is used to map indices to new colors. At least two color indices are provided. If the desired index is outside of the device's capabilities, then the closest device index is set. If a color intensity of less than 0 is requested, it is mapped to 0. If a color intensity greater than 1000 is requested, it is mapped to 1000.

To change the appearance of a color, you must select the desired levels of the three color components (red, green and blue) that make up the index. This can be used to create nondefault colors such as brown or orange. The new color will only be visible on devices that support color definition.

If the value of the function vs_color is negative then an error occurred. If the function returns a value greater than or equal to zero, then it is equal to the color index selected, and no error occurred.

vs_editchars ()

Purpose
Set line edit characters

Syntax
vs_editchars (dev_handle, line_del, char_del)

Data Types
INT16 vs_editchars ();
INT16 dev_handle;
INT8 line_del;
INT8 char_del;

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

line_del
Character to use to delete previous line.
Default = ^U (NAK)

char_del
Character to use to delete previous character.
Default = ^H (Backspace)

Function Returns
Function **vs_editchars** returns error state
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine sets the current line editing characters. They are applied to the Input String function only.

vsa_color ()

Purpose	Set alpha text color index
Syntax	**vsa_color (dev_handle, ind_in)**
Data Types	**INT16 vsa_color ();** **INT16 dev_handle;** **INT16 ind_in;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open. **ind_in** Requested text color index. 1 to device maximum
Function Returns	Function **vsa_color** value returned is: ≥0 if color index selected -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine selects the alpha text color index for subsequent output. At least two color indices are provided. Color indices range from 0 to a device-dependent maximum. If the color index requested is not valid, the closest value within the range of the current device's capabilities is selected.

vsa_font ()

Purpose
Set alpha text font and size

Syntax
vsa_font (dev_handle, font_in, size_in, font_cap)

Data Types
INT16 vsa_font ();
INT16 dev_handle;
INT16 font_in;
INT16 size_in;
INT16 font_cap[8];

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

font_in
Requested font.
If requested font is not available, font 1 (standard font) is used. Fonts 1 to 3 are fixed-space fonts.
1 = Normal/standard font (default)
2 = Bold (always provided for printers)
3 = Italics
4 = Proportionally spaced normal font
5 = Proportionally spaced bold
6 = Proportionally spaced italics
>6 = Device-dependent

size_in
Requested text size.
1 to device maximum
where size n+1 is larger (occupies more area) than size n.

Output

font_cap[0]
Text size index selected.

font_cap[1]
Number of horizontal character cell positions across the display surface in this font. This is -1 if the font selected is a proportional font, since the character cell size is not constant.

font_cap[2]
Number of vertical character cell positions down the display surface in this font.

font_cap[3]
Number of horizontal character cell positions represented by the distance specified in font_cap[6]. The ratio (font_cap[6]/ font_cap[3]) can be used to determine the width of a character cell, including any roundoff error.

font_cap[4]
Number of vertical character cell positions represented by the distance specified in font_cap[7]. The ratio (font_cap[7]/ font_cap[4]) can be used to determine the height of a character cell, including any roundoff error.

font_cap[5]
Proportional spacing flag.
0 = No
1 = Yes
If this value is 1, then the size represented by font_cap[6] and font_cap[7] may not represent the selected font. This is the case if the desired font is proportionally spaced.

font_cap[6]
Width in NDC units of the number of character cells in the selected font specified in font_cap[3]. The ratio (font_cap[6]/ font_cap[3]) can be used to determine the width of a character cell, including any roundoff error. This value is not accurate if the proportional spacing flag is set, since the character cell size is not constant.

font_cap[7]
Height in NDC units of the number of character cells in the selected font specified in font_cap[5]. The ratio (font_cap[7]/ font_cap[4]) can be used to determine the height of a character cell including any roundoff error.

Function Returns

Function **vsa_font** returns
≥0 if font selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine sets the hardware alpha text font and size for subsequent output alpha text functions.

On printers, the resident font capability is used. Unlike graphics text, alpha text capabilities do not include font emulation.

vsa_overstrike ()

Purpose
Set alpha text overstrike mode

Syntax
vsa_overstrike (dev_handle, mode_in)

Data Types
INT16 vsa_overstrike ();
INT16 dev_handle;
INT16 mode_in;

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

mode_in
Overstrike mode requested.
  0 = off (default)
  1 = on
If an invalid mode is requested, the default is selected.

Function Returns
Function **vsa_overstrike** returns
 ≥0 if mode selected
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine turns overstriking on or off. The default is overstriking off. When this mode is on, the alpha text position is not automatically advanced after each character is output; however, carriage return and line feed can still modify the current alpha text position.

vsa_passthru ()

Purpose	Set alpha text pass through mode
Syntax	**vsa_passthru (dev_handle, mode_in)**
Data Types	**INT16 vsa_passthru ();** **INT16 dev_handle;** **INT16 mode_in;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open. **mode_in** Pass through mode requested. 0 = off (default) 1 = on If an in valid mode is requested, the default is selected.
Function Returns	Function **vsa_passthru** returns $\geq$0 if mode selected -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine turns pass through mode on or off. Pass through mode enables all text to be output. Attributes such as font, color, superscripting, etc. may not be honored. When this mode is in effect, any text displayed does not modify the alpha text position. All characters, including control characters are sent directly to the device. This routine may be used to send device-dependent set-up strings to a particular device. The default is pass through OFF.

vsa_quality ()

Purpose: Set alpha text quality

Syntax: **vsa_quality (dev_handle, mode_in)**

Data Types:
INT16 vsa_quality ();
INT16 dev_handle;
INT16 mode_in;

Input:

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

mode_in
Text quality requested.
0 to 100
where 0 = Lowest (draft) quality
100 = Highest quality (default)
If an invalid mode is requested, the default (high quality) is selected. The number of quality levels is device-dependent.

Function Returns:
Function **vsa_quality** returns
≥0 if mode selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description:
This routine sets the alpha text quality level to some level between draft quality and high quality. The default is high quality. In draft quality range, small imperfections due to bidirectional printing or print head speed are acceptable. In high quality range the output is the best possible.

Alpha text quality is a device-dependent attribute normally associated with printers. CRTs often may have multiple alpha fonts, but do not differentiate by quality levels. On dot matrix printers, quality usually affects the number of dots used to display a character.

vsa_spacing ()

Purpose — Set alpha text line spacing

Syntax — **vsa_spacing (dev_handle, spac_in)**

Data Types —
INT16 vsa_spacing ();
INT16 dev_handle;
INT16 space_in;

Input —
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

spac_in
Line spacing requested.
positive value in NDC units

Function Returns —
Function **vsa_spacing** returns
≥0 if spacing selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description —
This routine sets the vertical spacing between lines of alpha text. It determines the amount of movement down the page when it receives a line feed control character in an output alpha text string. The default is single spacing; that is, the amount of spacing between lines of alpha text is the same as the default character cell height.

Line spacing must always be a positive value. It specifies a decrement in the absolute vertical position when a line feed is encountered. You will need to update the line spacing to the character cell height of the new font (or whatever is desired) whenever fonts are changed.

vsa_supersub ()

Purpose
: Set alpha text subscript/superscript mode

Syntax
: **vsa_supersub (dev_handle, mode_in)**

Data Types
: **INT16 vsa_supersub ();**
INT16 dev_handle;
INT16 mode_in;

Input
: **dev_handle**
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

mode_in
Mode requested.
0 = Subscripting and superscripting off (default)
1 = Subscripting on
2 = Superscripting on
If an invalid mode is requested, mode = 0 is selected.

Function Returns
: Function **vsa_supersub** returns
≥0 if mode selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
: This routine sets subscripting or superscripting for subsequent alpha text. It causes output to be offset above or below the line and is useful for footnotes, etc. The default is subscripting and superscripting OFF.

vsa_underline ()

Purpose	Set alpha text underline mode
Syntax	**vsa_underline (dev_handle, mode_in)**
Data Types	**INT16 vsa_underline ();** **INT16 dev_handle;** **INT16 mode_in;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open. **mode_in** Underline mode requested. 0 = off (default) 1 = on If an invalid mode is requested, the default is selected.
Function Returns	Function **vsa_underline** returns ≥0 if color index selected -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine turns alpha text underlining ON or OFF. The default is underlining OFF.

vsb_color ()

Purpose Set background color index

Syntax **vsb_color (dev_handle, ind_in)**

Data Types **INT16 vsb_color ();**
INT16 dev_handle;
INT16 ind_in;

Input **dev_handle**
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

ind_in
Background color index.
0 to device maximum

Function Returns Function **vsb_color** returns
≥0 if color index selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description This routine sets the device's background color to the desired index. On some devices, this change may not appear until the next Clear Workstation function is called. If the index is not valid, no change will be made in the background index. However, the color index selected is always returned. This function is not applicable on plotters or printers.

vsf_color ()

Purpose

Set fill color index

Syntax

vsf_color (dev_handle, ind_in)

Data Types

INT16 vsf_color ();
INT16 dev_handle;
INT16 ind_in;

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

ind_in
Requested fill color index.
0 to device maximum

Function Returns

Function **vsf_color** returns
$\geq$0 if color index selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine determines the color to be used for filling polygons, bars, pie slices and circles.

At least two color indices are provided. Color indices range from 0 to a device-dependent maximum. If the color specified is invalid, the closest value in range is chosen. However, the color index selected is returned.

vsf_interior ()

Purpose — Set fill interior style

Syntax — **vsf_interior (dev_handle, styl_in)**

Data Types —
INT16 vsf_interior ();
INT16 dev_handle;
INT16 styl_in;

Input —
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

styl_in
Requested fill interior style.
0 = HOLLOW
1 = SOLID
2 = PATTERN
3 = HATCH

Function Returns —
Function **vsf_interior** returns
≥0 if style selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description —
This routine sets the style of fill to be used for filled areas, bars, pie slices and circles.

When you select HOLLOW style, the area is outlined in the current fill color. A SOLID area is filled in the current color. PATTERN and HATCH are determined by SET FILL STYLE INDEX. If the requested style is invalid, then HOLLOW is used. SOLID, HATCH, and PATTERN filled areas are not outlined.

vsf_style ()

Purpose Set fill style index

Syntax **vsf_style (dev_handle, ind_in)**

Data Types **INT16 vsf_style ();**
INT16 dev_handle;
INT16 ind_in;

Input **dev_handle**
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

ind_in
Requested fill style index for PATTERN or HATCH fill.

Function Returns Function **vsf_style** returns
≥0 if index selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description This routine selects a fill style based on the fill interior style. This index has no effect if the interior style is either HOLLOW or SOLID. If the requested index is not available, index 1 is used.

The index references a HATCH style if the fill interior style is HATCH, or a PATTERN if the fill interior style is PATTERN. At least six HATCH styles are provided:

1 = Narrow spaced +45 degree lines
2 = Medium spaced +45 degree lines
3 = Widely spaced +45 degree lines
4 = Narrow spaced +45 & -45 degree lines
5 = Medium spaced +45 & -45 degree lines
6 = Widely spaced +45 & -45 degree lines
>6 = Device-dependent

There is no difference between HATCH and PATTERN styles on many devices. For example on some devices, asking for a HATCH style of 3 will result in the same output as asking for a PATTERN style of 3.

vsl_color ()

Purpose
Set polyline color index

Syntax
vsl_color (dev_handle, ind_in)

Data Types
INT16 vsl_color ();
INT16 dev_handle;
INT16 ind_in;

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

ind_in
Requested color index.
0 to device maximum

Function Returns
Function **vsl_color** returns
$\geq$0 if color index selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine sets the color index for subsequent polylines and arcs.

At least two color indices are provided. Color indices range from 0 to a device-dependent maximum. If the color specified is invalid, the closest value in range is chosen. However, the color index selected is always returned.

To change the appearance of a color, you must select the desired levels of the three color components (red, green and blue) that make up the index by calling the Set Color Representation routine. This can be used to create non-default colors such as brown or orange. Then Set Polyline Color Index may be called with this index. The new color will only be visible on devices that support color definition.

vsl_type ()

Purpose — Set polyline line type

Syntax — **vsl_type (dev_handle, type_in)**

Data Types

```
INT16 vsl_type ();
INT16 dev_handle;
INT16 type_in;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

type_in
Requested line style.
1 = Solid
2 = Long dashed
3 = Dotted
4 = Dashed-dotted
5 = Medium dashed
6 = Dashed with two dots
>6 = device-dependent

Function Returns

Function **vsl_type** returns
≥0 if line type selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine sets the line style (dash pattern) for subsequent polylines and arcs. The total number of line styles available is device-dependent, however, the above six line styles are provided. If the requested line style is out of range, then line style 1 is used.

vsl_width ()

Purpose	Set polyline line width
Syntax	**vsl_width (dev_handle, wid_in)**
Data Types	**INT16 vsl_width ();** **INT16 dev_handle;** **INT16 wid_in;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open. **wid_in** Requested line width in NDC units.
Function Returns	Function **vsl_width** returns ≥ 0 if line width selected -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine sets the width for subsequent polylines and arcs. If the requested line width is outside of the device's capabilities, the line width is set to one device unit and returned in NDC units.

vsm_color ()

Purpose — Set polymarker color index

Syntax — **vsm_color (dev_handle, ind_in)**

Data Types —
INT16 vsm_color ();
INT16 dev_handle;
INT16 ind_in;

Input —
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

ind_in
Requested polymarker color index.
0 to device maximum

Function Returns —
Function **vsm_color** returns
≥0 if color index selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description — This routine sets the color index in which subsequent markers will be displayed.

At least two color indices are provided. Color indices range from 0 to a device-dependent maximum. If the color specified is invalid, the closest value in range is chosen. However, the color index selected is always returned.

To change the appearance of a color, you must select the desired levels of the three color components (red, green and blue) that make up the index. This can be used to create non-default colors such as brown or orange. The new color will only be visible on devices that support color definition.

vsm_height ()

Purpose
Set polymarker height

Syntax
vsm_height (dev_handle, hgt_in)

Data Types
INT16 vsm_height ();
INT16 dev_handle;
INT16 hgt_in;

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

hgt_in
Requested polymarker height in NDC units.

Function Returns
Function **vsm_height** returns
 ≥0 if height selected in NDC units
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine sets the size of subsequent polymarkers.

If the requested marker height is outside of the capabilities of the device, the marker height is set to the closest device size. If the requested marker height does not exactly map to a device-supported size, then the largest device size that is not greater than the requested marker height is used. Marker sizes, just like graphics text sizes are specified by NDC values.

vsm_type ()

Purpose — Set polymarker type

Syntax — **vsm_type (dev_handle, type_in)**

Data Types

```
INT16 vsm_type ();
INT16 dev_handle;
INT16 type_in;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

type_in
Requested polymarker type.

1 = .
2 = +
3 = *
4 = O
5 = X
6 = Diamond
>6 = device-dependent

Function Returns

Function **vsm_type** returns
≥0 if marker type selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine sets the polymarker (symbol) type for subsequent polymarker operations.

The total number of markers available is device-dependent, however, the above six marker types are provided. If the requested marker type is out of range, type 3 is used.

vst_alignment ()

Purpose Set graphics text alignment

Syntax **vst_alignment (dev_handle, hor_in, vert_in, &hor_out, &vert_out)**

Data Types
```
INT16 vst_alignment ();
INT16 dev_handle;
INT16 hor_in;
INT16 vert_in;
INT16 hor_out;
INT16 vert_out;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

hor_in
Horizontal alignment requested.
Horizontal alignment applies to the width of the character body not the character cell.
0 = Left justified (default)
1 = Center justified
2 = Right justified
If an invalid horizontal alignment is requested, the default of left justified is selected.

vert_in
Vertical alignment requested.
Vertical alignment applies to the height of the character body not the character cell.
0 = Bottom justified (default)
1 = Center justified
2 = Top justified
If an invalid vertical alignment is requested, the default of bottom is selected.

Output

hor_out
Horizontal alignment selected.

vert_out
Vertical alignment selected.

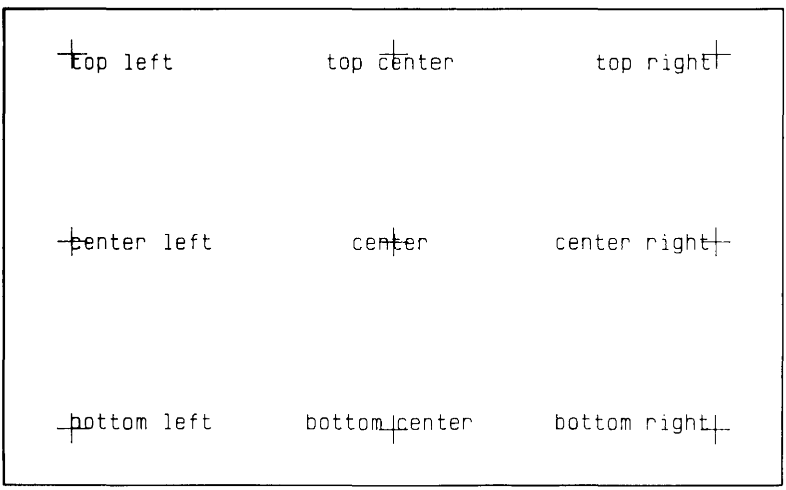
Function Returns

Function **vst_alignment** returns error state.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine sets graphics text horizontal and vertical alignment. This controls the positioning of the text extent rectangle in relation to the graphics text position. The default alignment places the bottom left-hand corner of the character (not the character cell) at the graphics text position.

FIGURE 5-6 Text Alignment



vst_color ()

Purpose
Set graphics text color index

Syntax
vst_color (dev_handle, ind_in)

Data Types
INT16 vst_color ();
INT16 dev_handle;
INT16 ind_in;

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

ind_in
Requested text color index.
0 to device maximum

Function Returns
Function **vst_color** returns
≥0 if color index selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine sets the graphics text color index.

At least two color indices are provided. Color indices range from 0 to a device-dependent maximum. However, the color index selected is always returned. If the color index requested is not valid, the closest value within the range of the current device's capabilities is selected.

vst_font ()

Purpose
Set graphics text font

Syntax
vst_font (dev_handle, font_in)

Data Types
INT16 vst_font ();
INT16 dev_handle;
INT16 font_in;

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

font_in
Requested hardware graphics text font number.
1 to device-dependent maximum

Function Returns
Function **vst_font** returns
≥0 if font selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine sets the hardware text font for graphics text.

Fonts are device-dependent and are specified from 1 to a device-dependent maximum. If a font is selected outside of device capability, font 1 is used.

vst_height ()

Purpose
Set character height

Syntax
vst_height (dev_handle, rq_height, &char_width, &cell_width, &cell_height)

Data Types
```
INT16 vst_height ();
INT16 dev_handle;
INT16 rq_height;
INT16 char_width;
INT16 cell_width;
INT16 cell_height;
```

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

rq_height
Requested character height in NDC units.

Output
char_width
Actual character width selected in NDC units.

cell_width
Character cell width in NDC units.

cell_height
Character cell height in NDC units.

Function Returns
Function **vst_height** returns error state.
≥0 if height selected in NDC units
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine sets the size of subsequent graphics text.

The height specified is the height of the actual character (baseline to top of tallest character), not the character cell. If the requested size is outside of device capabilities, the closest available size on the device is used. If the desired character height does not map exactly to a device size, then the largest character height that does not exceed the desired size is used.

The default size permits at least eighty characters to be displayed horizontally across the display surface and twenty-four characters to be displayed vertically down the display surface.

Code Example—Set Character Height

```
titl_size = 160;
xheight = vst_height(dev_handle, title_size, &xwidth, &cwidht, &cheight);
      /* set a new character height */
line_length = 800;
   /* we want to make sure that the text we write will not
      be longer than this line */
while ((cwidth * 12) >= line_length && titl_size >= 20)  {
   /* loop making sure that a string 12 characters long
      won't be longer than line_length */
   title_size -= 10;
   xheight = vst_height(dev_handle, title_size, &xwidth, &cwidth, &cheight)
   }
```

vst_rotation ()

Purpose Set graphics text string baseline rotation

Syntax **vst_rotation (dev_handle, ang_in)**

Data Types

INT16 vst_rotation ();
INT16 dev_handle;
INT16 ang_in;

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

angin
Requested angle of rotation of character base line.
0 to 3600 (tenths of degrees)

Function Returns

Function **vst_rotation** returns
≥0 if angle selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine sets the base line rotation of graphic text. The entire string of text is rotated (rather than each character separately) specified by the angle of rotation.

The angle specification assumes that 0 degrees is 90 degrees to the right of vertical (east on a compass), with angles increasing in the counter-clockwise direction. If the desired angle is outside of the range (0-3600), then a character baseline of 0 degrees is used.

Input Functions

This section describes the input functions. An application program obtains graphical input from an operator by controlling the activity of one or more logical input devices that deliver input values to the program.

The input class determines the type of logical input value the device delivers. The four classes and the values they provide are:

Locator	Locator input reports coordinate information from a device representing a location on the display surface. An example device is a mouse.
Valuator	Valuator input returns scalar values in the range that is proportional (0 to 32767) to the valuator position. An example device is a control dial.
Choice	Choice input returns an integer value indicating one of a set of alternatives. An example device is a set of function keys, and the value returned is the function key pressed.
String	String input returns text strings from the console keyboard.

The input functions operate in two modes: sample and request. In sample mode, the input value (locator, valuator, choice or string) is returned immediately. In request mode, the input device is activated and waits for the user to terminate the input process with a device-specific action. Then the input value is returned. For example, a sample locator input returns the current location of the graphics cursor immediately. In request mode, the location of the graphics cursor is returned when the user types an alphanumeric key.

TABLE 5-4 Input Functions

Function	Routine	Description	Page
Locator	vrq_locator	Input Locator (request mode)	5-104
	vsm_locator	Input Locator (sample mode)	5-110
Valuator	vrq_valuator	Input Valuator (request mode)	5-108
	vsm_valuator	Input Valuator (sample mode)	5-113
Choice	vrd_curkeys	Read Cursor Movement Keys	5-101
	vrq_choice	Input Choice (request mode)	5-103
	vsm_choice	Input Choice (sample mode)	5-109
String	vrq_string	Input String (request mode)	5-106
	vsm_string	Input String (sample mode)	5-111

vrd_curkeys ()

Purpose
Read cursor movement keys

Syntax
vrd_curkeys (dev_handle, input_mode, &direction,&key)

Data Types
INT16 vrd_curkeys ();
INT16 dev_handle;
INT16 input_mode;
INT16 direction;
INT8 key;

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

input_mode
Input mode.
1 = Request
2 = Sample

Output

direction
Direction indicated.
-1 = No keystroke occurred (sample mode only)
0 = Key was pressed, but not a cursor movement key
1 = Down and left
2 = Down
3 = Down and right
4 = Left
6 = Right
7 = Up and left
8 = Up
9 = Up and right

key
Key identification value.
ASCII Decimal Equivalent value of pressed key.
-1 if cursor movement key was pressed, or no key was pressed.

Function Returns
Function **vrd_curkeys** returns
>0 if request successful
0 if request unsuccessful
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description This routine determines if a cursor movement (arrow) key was pressed and returns the resultant direction. It can be used in either the Graphics Mode or Cursor Addressing Mode to input user cursor movement.

vrq_choice ()

Purpose	Input choice (request mode)
Syntax	**vrq_choice (dev_handle, ch_in, &ch_out)**
Data Types	**INT16 vrq_choice ();** **INT16 dev_handle;** **INT16 ch_in;** **INT16 ch_out;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open. **ch_in** Initial choice number.
Output	**ch_out** Choice number.
Function Returns	Function **vrq_choice** returns >0 if request successful 0 if request unsuccessful -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine activates the choice device associated with a specified workstation. You must make a selection for the function to terminate. See Appendix C for information on the choice device for the desired workstation. The initial choice number, ch_in, is the value returned as the selected choice value if a non-choice device button/key is pressed. The initial choice number must be a valid value for it to be returned when the user does not press a valid choice input.

vrq_locator ()

Purpose
Input locator (request mode)

Syntax
vrq_locator (dev_handle, xy_in, ink, rubberband, echo_handle, xy_out, &terminator)

Data Types
```
INT16 vrq_locator ();
INT16 dev_handle;
INT16 xy_in[2];
INT16 ink;
INT16 rubberband;
INT16 echo_handle;
INT16 xy_out[2];
INT8 terminator;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

xy_in[0]
Initial x-coordinate of locator in NDC units.

xy_in[1]
Initial y-coordinate of locator in NDC units.

ink
Inking status.
0 = off
1 = on
If on, a line is drawn between the initial locator position and the final locator position, honoring the current line attributes, such as color and line type. If an invalid status is specified, then inking is turned off.

rubberband
Rubberbanding status.
0 = off
1 = rubber band line
2 = rubberband rectangle

If rubberband line is specified, a line is drawn between the initial locator position and the current position of the locator device as it is moved. The line changes dynamically as the input device changes position. When the locator event is complete the last rubberband line is removed from the display surface.

If rubberband rectangle is specified, a rectangle is drawn using the initial locator position as one corner and the current position of the locator device as the opposite corner. The rectangle changes dynamically as the input device changes position. When the locator event is complete the last rubberband rectangle is removed from the display surface. If an invalid status is specified, then rubberbanding is turned off. Rubberbanding honors current line attributes, such as color and line style.

echo_handle
The device handle of the device where the echoed output from the input operation will be displayed.

Output

xy_out[0]
Final x-coordinate of locator in NDC units.

xy_out[1]
Final y-coordinate of locator in NDC units.

terminator
Locator terminator.
For keyboard terminated locator input, this is the byte value of the key pressed to terminate input. For non-keyboard terminated input (tablet, mouse, etc.) valid locator terminators begin with <space> and increase from there. For instance, if the puck on a tablet has four buttons, the first button may generate a <space> as a terminator, the second a <!>, the third a <">, and the fourth a <#>.

Function Returns

Function **vrq_locator** returns
>0 if request successful
0 if request unsuccessful
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine causes the graphics cursor to be displayed on the output echo device until the function is terminated. See Appendix C for information on the locator device for the desired workstation.

vrq_string ()

Purpose — Input string (request mode)

Syntax

```
vrq_string (dev_handle, max_length, echo_mode, echo_xy,
    string)
```

Data Types

```
INT16 vrq_string ();
INT16 dev_handle;
INT16 max_length;
INT16 echo_mode;
INT16 echo_xy[2];
INT8 string[ ];
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

max_length
Maximum string length.

echo_mode
Echo mode.
  0 = Don't echo input characters
  1 = Echo input characters

echo_xy[0]
x-coordinate of echo position in NDC units.

echo_xy[1]
y-coordinate of echo position in NDC units.

Output

string
Output string.
Passed as a contiguous stream of bytes.

Function Returns

Function **vrq_string** returns
  >0 if request successful (length of string)
  0 if request unsuccessful
  -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine activates the keyboard. Any characters up to (but not including) the Return terminator are returned. Line editing characters have their normal effect and can be used if errors are made. The maximum string length must be ≥1. This routine terminates when the "maximum length" number of characters or a line terminator has been entered. Since strings in C are null-terminated, the length of array string must be one larger than max_length.

vrq_valuator ()

Purpose — Input valuator (request mode)

Syntax — **vrq_valuator (dev_handle, val_in, &val_out)**

Data Types

```
INT16 vrq_valuator ();
INT16 dev_handle;
INT16 val_in;
INT16 val_out;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

val_in
Initial value.

Output

val_out
Output value.

Function Returns

Function **vrq_valuator** returns status
>0 if request successful
0 if request unsuccessful
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine activates the valuator device and the user sets it to the desired value. When ready, the user terminates the process with a device-specific action (for example, pushing a function key). See Appendix C for information on the valuator device for the desired workstation.

vsm_choice ()

Purpose	Input choice (sample mode)
Syntax	**vsm_choice (dev_handle, &ch_out)**
Data Types	**INT16 vsm_choice ();** **INT16 dev_handle;** **INT16 ch_out;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Output	**ch_out** Choice. Choice number if sample successful 0 if sample unsuccessful
Function Returns	Function **vsm_choice** returns >0 if sample successful 0 if sample unsuccessful -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine polls the choice device and if a choice was pending, it is returned. See Appendix C for information on the choice function for the desired workstation.

vsm_locator ()

Purpose
Input locator (sample mode)

Syntax
vsm_locator (dev_handle, xy_out)

Data Types
INT16 vsm_locator ();
INT16 dev_handle;
INT16 xy_out[2];

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Output
xy_out[0]
Current x-coordinate of locator in NDC units.

xy_out[1]
Current y-coordinate of locator in NDC units.

Function Returns
Function **vsm_locator** returns
 1 if sample successful
 0 if sample unsuccessful
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine returns the current position of the graphics input cursor without waiting for operator interaction. See Appendix C for information on the locator device for the desired workstation.

vsm_string ()

Purpose
Input string (sample mode)

Syntax
vsm_string (dev_handle, max_length, echo_mode, echo_xy, string)

Data Types
```
INT16 vsm_string ();
INT16 dev_handle;
INT16 max_length;
INT16 echo_mode;
INT16 echo_xy[2];
INT8 string[ ];
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

max_length
Maximum string length.

echo_mode
Echo mode.
0 = Don't echo input characters
1 = Echo input characters

echo_xy[0]
x-coordinate of echo position in NDC units.

echo_xy[1]
y-coordinate of echo position in NDC units.

Output

string
Output string.
Passed as a contiguous stream of bytes.

Function Returns

Function **vsm_string** returns
>0 if sample successful
(value = length of string)
0 if sample unsuccessful
(value = characters not available)
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine polls the keyboard of the desired device. If there is any pending input, it is returned until the queue is empty, a carriage return or line feed is encountered or the input maximum string length is exceeded. The line terminators themselves are not returned. See Appendix C for information on the string device for the desired workstation. Since strings in the C language are null-terminated, the length of array string must be one larger than max_length.

vsm_valuator ()

Purpose	Input valuator (sample mode)
Syntax	**vsm_valuator (dev_handle, &val_out)**
Data Types	**INT16 vsm_valuator ();** **INT16 dev_handle;** **INT16 val_out;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Output	**val_out** Current valuator value, if sample successful.
Function Returns	Function **vsm_valuator** returns >0 if sample successful 0 if sample unsuccessful -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine returns the current value of the valuator device without waiting for operator interaction. See Appendix C for information on the valuator device for the desired workstation.

Inquiry Functions

This section describes the inquiry functions provided. These routines allow you to inquire on primitive attributes and device capabilities.

TABLE 5-5 Inquiry Functions

Function	Routine	Description	Page
Device Capabilities	vq_chcells	Inquire Addressable Character Cells	5-119
Primitive Attributes	vq_cellarray	Inquire Cell Array	5-117
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vq_cellarray ()

Purpose
Inquire cell array

Syntax
vq_cellarray (dev_handle, xy, row_length, num_rows, &el_per_row, &rows_used, &status, colors)

Data Types
```
INT16 vq_cellarray ();
INT16 dev_handle;
INT16 xy[4];
INT16 row_length;
INT16 num_rows;
INT16 el_per_row;
INT16 rows_used;
INT16 status;
INT16 colors[row_length * num_rows];
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

xy[0]
x-coordinate of lower left-hand corner in NDC units.

xy[1]
y-coordinate of lower left-hand corner in NDC units.

xy[2]
x-coordinate of upper right-hand corner in NDC units.

xy[3]
y-coordinate of upper right-hand corner in NDC units.

row_length
Length of each row in color index array.

num_rows
Number of rows in color index array.

Output

el_per_row
Number of elements used in each row of color index array.

rows_used
Number of rows used in color index array.

status
Invalid value flag.
0 if no errors
1 if a color value could not be determined for some pixel

colors
Color index array (stored one row at a time).
-1 indicates that a color index could not be determined for that particular pixel

Function Returns

Function **vq_cellarray** returns error state
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine returns color indices one row at a time, starting from the top of the rectangular area, proceeding downward. See the Cell Array routine for information regarding how the rectangular area is divided.

vq_chcells ()

Purpose Inquire addressable character cells

Syntax **vq_chcells (dev_handle, &rows, &columns)**

Data Types
INT16 vq_chcells ();
INT16 dev_handle;
INT16 rows;
INT16 columns;

Input **dev_handle**
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Output **rows**
Number of addressable rows on the screen.
-1 indicates cursor addressing is not possible.

columns
Number of addressable columns on the screen.
-1 indicates cursor addressing is not possible.

Function Returns
Function **vq_chcells** returns error state
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description This routine returns the number of cursor addressable columns in a row and the number of cursor addressable rows on the screen. It is only applicable to CRT devices and is useful for determining addressable page size.

vq_color ()

Purpose
Inquire color representation

Syntax
vq_color (dev_handle, in_in, set_flag, rgb)

Data Types
```
INT16 vq_color ();
INT16 dev_handle;
INT16 ind_in;
INT16 set_flag;
INT16 rgb[3];
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

ind_in
Requested color index.

set_flag
Set or realized flag.
0 = Set (return color values requested)
1 = Realized (return color values realized on device)

Output

rgb[0]
Red intensity.
0 to 1000 (tenths of percent)

rgb[1]
Green intensity.
0 to 1000 (tenths of percent)

rgb[2]
Blue intensity.
0 to 1000 (tenths of percent)

Function Returns
Function **vq_color** returns
≥0 if color index selected
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine allows inquiry of the color associated with a given index. If an index outside of the device's capability is requested, the index closest to it is used for the inquiry.

vq_curaddress ()

Purpose
Inquire current cursor text address

Syntax
vq_curaddress (dev_handle, &row, &column)

Data Types
```
INT16 vq_curaddress ();
INT16 dev_handle;
INT16 row;
INT16 column;
```

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Output
row
Row number.
1 to number of rows

column
Column number.
1 to number of columns

Function Returns
Function **vq_curaddress** returns error state
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
When you are in Cursor Addressing Mode, this routine returns the current cursor position. It is only applicable to CRT devices.

vq_error

Purpose	Inquire VDI error
Data Types	**INT16 vq_error();**
Function Returns	Function **vq_error** returns last error encountered. 0 if no error <0 actual error last encountered
Description	This routine returns the number of the actual error last encountered. It is called when the function value returned by any other function is -1. See Appendix B for the current list of error numbers.

vqa_cap ()

Purpose — Inquire alpha text capabilities

Syntax — **vqa_cap (dev_handle, alph_cap)**

Data Types
INT16 vqa_cap ();
INT16 dev_handle;
INT16 alph_cap[15];

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Output

alph_cap[0]
Superscript capability flag.
  0 = no
  1 = yes

alph_cap[1]
Subscript capability flag.
  0 = no
  1 = yes

alph_cap[2]
Underline capability flag.
  0 = no
  1 = yes

alph_cap[3]
Overstrike capability flag.
  0 = no
  1 = yes

alph_cap[4]
Number of discrete alpha text sizes.
  where size 2 is larger (occupies more area) than size 1, etc.
At least one size must be present.

alph_cap[5]
Discrete size index of the default font.
This size is dependent on the number of font sizes supported.

alph_cap[6]
Character positioning capability flag.

0 = Characters positionable on cell boundaries only
1 = Characters positionable on a finer grid than a character cell, but not necessarily the same grid as graphics.

alph_cap[7]
Number of horizontal character cell positions across the display surface in the default font. For a typical CRT or printer that can only place text on cell boundaries, this value is 80.

alph_cap[8]
Number of vertical character cell positions down the display surface in the default font. This value is 24 for a typical CRT and 66 for a typical printer that can only place text on cell boundaries.

alph_cap[9]
Number of horizontal character cell positions represented by distance specified in alph_cap[13]. The ratio alph_cap[13]/alph_cap[9] can be used to determine the width of a character cell, including any roundoff error.

alph_cap[10]
Number of vertical character cell positions represented by distance specified in alph_cap[14]. The ratio alph_cap[14]/alph_cap[10] can be used to determine the height of a character cell, including any roundoff error.

alph_cap[11]
Number of horizontal alpha text grids represented by distance specified in alph_cap[13]. The ratio alph_cap[13]/alph_cap[11] can be used to determine the width of an alpha text grid, including roundoff error.

alph_cap[12]
Number of vertical alpha text grids represented by distance specified in alph_cap[14]. The ratio alph_cap[14]/alph_cap[12] can be used to determine the height of an alpha text grid, including roundoff error.

alph_cap[13]
Width in NDC units of the number of character cells (in the default font) specified in alph_cap[9]. This ratio (alph_cap[13]/ alph_cap[9]) can be used to determine the width of a character cell, including any roundoff error.

alph_cap[14]
Height in NDC units of the number of character cells (in the default font) specified in alph_cap[10]. This ratio (alph_cap[14]/alph_cap[10]) can be used to determine the height of a character cell, including any roundoff error.

Function Returns

Function **vqa_cap** returns error state
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine returns information regarding the alpha text features of the device, such as subscripting, superscripting and default character width and height.

vqa_cell ()

Purpose Inquire alpha text cell location

Syntax **vqa_cell (dev_handle, row, column, &propflag, &x_out, &y_out)**

Data Types

```
INT16 vqa_cell ();
INT16 dev_handle;
INT16 row;
INT16 column;
INT16 propflag;
INT16 x_out;
INT16 y_out;
```

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

row
Row number of character cell.
1 to number of rows

column
Column number of character cell.
1 to number of columns

Output

propflag
Proportional spacing flag.
0 = no
1 = yes
If this value is 1, then the size represented by x_out and y_out may not represent the selected font. This is the case if the desired font is proportionally spaced.

x_out
x-coordinate of lower left-hand corner of character cell in NDC units. Value may not be accurate if the proportional spacing flag is set to 1, since the character cell size is not constant.

y_out
y-coordinate of lower left-hand corner of character cell in NDC units. Value may not be accurate if the proportional spacing flag is set to 1, since the character cell size is not constant.

Function Returns	Function **vqa_cell** returns 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine returns the Normalized Device Coordinates of the lower left-hand corner of the character cell position specified, based on the current font. This allows text to be positioned in a specific column on the output device. Column 1 implies a 0 x position on the display surface, and row 1 implies the maximum y position on the display surface. This is not applicable if the current font is a proportional font since the size of a character cell is not constant.

vqa_font ()

Purpose Inquire alpha text font capability

Syntax **vqa_font (dev_handle, font_in, size_in, font_status)**

Data Types
INT16 vqa_font ();
INT16 dev_handle;
INT16 font_in;
INT16 size_in;
INT16 font_status[7];

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

font_in
Requested font.
Fonts 1 to 3 are fixed-space fonts.
1 = Normal/standard font (default)
2 = Bold (always provided for printers)
3 = Italics
4 = Proportionally spaced normal font
5 = Proportionally spaced bold
6 = Proportionally spaced italics
>6 = Device-dependent

size_in
Requested text size.
1-device maximum
where size n+1 is larger (occupies more area) than size n, etc.

Output

font_status[0]
Number of horizontal character cell positions across the display surface in this font. This is -1 if the font selected is a proportional font, since the character cell size is not constant. It is 0 if the requested font is not available.

font_status[1]
Number of vertical character cell positions down the display surface in this font. This is 0 if the requested font is not available.

font_status[2]
Number of horizontal character cell positions represented by the distance specified in font_status[5]. This ratio (font_status[5]/font_status[2]) can be used to determine the width of a character cell, including any roundoff error. This is 0 if the requested font is not available.

font_status[3]
Number of vertical character cell positions represented by the distance specified in font_status[6]. This ratio (font_status[6]/font_status[3]) can be used to determine the height of a character cell,including any roundoff error. This is 0 if the requested font is not available.

font_status[4]
Proportional spacing flag.

0 = no
1 = yes

If this value is 1, then the size represented by font_status[5] and font_status[6] may not represent the selected font. This is the case if the desired font is proportionally spaced.

font_status[5]
Width in NDC units of the number of character cells (in the selected font) specified in font_status[2]. This ratio (font_status[5]/font_status[2]) can be used to determine the width of a character cell, including any roundoff error. This value is not accurate if the proportional spacing flag is set to 1, since the character cell size is not constant. It is 0 if the font is not available.

font_status[6]
Height in NDC units of the number of character cells (in the selected font) specified in font_status[3]. This ratio (font_status[6]/font_status[3]) can be used to determine the height of a character cell, including any roundoff error. It is 0 if the font is not available.

Function Returns	Function **vqa_font** returns >0 if font and size available 0 if font and size not available -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine inquires the attributes of a particular alpha text font and size, such as availability on this device and height and width. It can be used to determine the font which best fits specific size requirements without having to alter the currently set text font.

vqa_length ()

Purpose

Inquire alpha text string length

Syntax

vqa_length (dev_handle, string)

Data Types

INT16 vqa_length ();
INT16 dev_handle;
INT8 string[ ];

Input

dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

string
Text string.
Passed as a contiguous stream of bytes. All control characters (ASCII 0 to 31) are ignored and not taken into account in computing the length.

Function Returns

Function **vqa_length** returns
≥0 if string length in NDC units
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine returns the length of the text string specified in NDC units, based on the current font in use. If a control character (ASCII 0-31) appears in the string, it terminates the string length, and the string length up to that point is returned.

This routine is useful when using proportional fonts since each character is not the same width. It is also useful for doing microjustification between words since multiplication of the width of a character cell in NDC space may produce inaccurate results due to the inherent roundoff error in the character cell size reported back to the user.

vqa_position ()

Purpose	Inquire alpha text position
Syntax	**vqa_position (dev_handle, &x_out, &y_out)**
Data Types	**INT16 vqa_position ();** **INT16 dev_handle;** **INT16 x_out;** **INT16 y_out;**
Input	**dev_handle** Device handle returned from **v_opnwk**. Refers to a specific graphics device when multiple workstations are open.
Output	**x_out** x-coordinate of text position in NDC units. **y_out** y-coordinate of text position in NDC units.
Function Returns	Function **vqa_position** returns 0 if no error -1 if error Actual error can be retrieved by invoking **vq_error**.
Description	This routine reports the current alpha text position (returned in 0-32767 NDC units). It is assumed that (0,0) is at the lower left-hand corner of the display surface.

vqf_attributes ()

Purpose
Inquire current fill area attributes

Syntax
vqf_attributes (dev_handle, attrib)

Data Types
INT16 vqf_attributes ();
INT16 dev_handle;
INT16 attrib[4];

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Output
attrib[0]
Current fill area interior style.
0 = HOLLOW
1 = SOLID
2 = PATTERN
3 = HATCH

attrib[1]
Current fill area color index.

attrib[2]
Current fill area style index.
1 = Narrow spaced +45 degree lines
2 = Medium spaced +45 degree lines
3 = Widely spaced +45 degree lines
4 = Narrow spaced +45 & -45 degree lines
5 = Medium spaced +45 & -45 degree lines
6 = Widely spaced +45 & -45 degree lines
>6 = Device-dependent

attrib[3]
Current writing mode.
(See Set Writing Mode function for description)

Function Returns
Function **vqf_attributes** returns
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
Reports current setting of all attributes that affect filled areas, bars, pie slices and circles, including interior style, fill color and fill style index.

vql_attributes ()

Purpose
Inquire current polyline attributes

Syntax
vql_attributes (dev_handle, attrib)

Data Types
INT16 vql_attributes ();
INT16 dev_handle;
INT16 attrib[4];

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Output
attrib[0]
Current polyline line type.
1 = Solid
2 = Long dashed
3 = Dotted
4 = Dashed-dotted
5 = Medium dashed
6 = Dashed with two dots
>6 = Device-dependent

attrib[1]
Current polyline line color index.

attrib[2]
Current writing mode.
(See Set Writing Mode function for description.)

attrib[3]
Current line width in NDC units.

Function Returns
Function **vql_attributes** returns
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine reports the current setting of all attributes that affect polylines and arcs, such as line type, line color, line width and writing mode.

vqm_attributes ()

Purpose
Inquire current polymarker attributes

Syntax
vqm_attributes (dev_handle, attrib)

Data Types
INT16 vqm_attributes ();
INT16 dev_handle;
INT16 attrib[4];

Input
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Output
attrib[0]
Current polymarker marker type.
1 = .
2 = +
3 = *
4 = O
5 = X
6 = Diamond
>6 = Device-dependent

attrib[1]
Current polymarker marker color index.

attrib[2]
Current writing mode.
(See Set Writing Mode function for description.)

attrib[3]
Current polymarker height in NDC units.
0 if no error
-1 if error
Actual error can be retrieved by invoking **vq_error**.

Description
This routine reports the current setting of all attributes that affect polymarkers, such as marker type, marker color and marker height.

vqt_attributes ()

Purpose — Inquire current graphics text attributes

Syntax — **vqt_attributes (dev _handle, attrib)**

Data Types —
INT16 vqt_attributes ();
INT16 dev_handle;
INT16 attrib[10];

Input —
dev_handle
Device handle returned from **v_opnwk**.
Refers to a specific graphics device when multiple workstations are open.

Output —
attrib[0]
Current graphics text font.

attrib[1]
Current graphics text color.

attrib[2]
Current angle of rotation of text base line.
0 to 3600 (tenths of degrees)

attrib[3]
Current horizontal alignment.
0 = Left justified (default)
1 = Center justified
2 = Right justified

attrib[4]
Current vertical alignment.
2 = Top justified
1 = Center justified
0 = Bottom justified (default)

attrib[5]
Current writing mode.
(See Set Writing Mode function for description.)

attrib[6]
Current character width in NDC units.

attrib[7]
Current character height in NDC units.

attrib[8]
Current character cell width in NDC units.

attrib[9]
Current character cell height in NDC units.

Function Returns

Function **vqt_attributes** returns
 0 if no error
 -1 if error
Actual error can be retrieved by invoking **vq_error**.

Description

This routine reports the current setting of all attributes that affect graphics text, such as text size, text color, text font and text rotation.

Input/Output Functions

This section covers character and file I/O functions. Though these routines are not required in a graphics program, we have included them to insure computer independence for your programs.

All graphics calls are functions that return an integer value which may be the error status or other requested information.

The Open Workstation call initializes a device and returns a "device handle," an integer number used to refer to that device. All other calls require the device handle as an input argument to identify the object device.

Communications (Port) I/O

Character I/O (cm) functions always return status. The status is in a 16-bit word where bit 0 is the least significant bit and bit 15 is the most significant bit. Not all cm functions return all the status fields. The fields that a function returns are noted in the descriptions of the individual functions.

Bit(s)	Meaning	Yes	No
15	Error	1	0
14	Always reset to 0		
13	Always reset to 0		
12	Receive ready	1	0
11	Transmit ready	1	0
10	EOF	1	0
9	Comm initialized	1	0
8	(Unused)		
7	Framing error	1	0
6	Overrun error	1	0
5	Parity error	1	0
0-4	Lower five bits of VDI error codes		

The high bit ON (bit 15 set to 1) indicates that an error has occurred. The lower five bits of such a negative return function value correspond to one of the VDI error codes listed in Appendix B, "Error Codes."

Disk I/O

The disk I/O (fd) functions treat a file as a linear sequence of bytes. The length of the file is the number of bytes in the file. There is a current file position associated with each open file which is the next byte to be read or written in the file.

Each read/write operation implicitly advances the current file position forward by the number of bytes read/written. A seek operation is provided to set the current file position without reading or writing any bytes. A directory is an area in which a file resides. It is specified as a null-terminated string of bytes. The syntax is dependent on the operating environment.

A file name is specified as a null-terminated string of bytes. The syntax is dependent on the operating environment. A fully qualified file name consists of a directory and simple file name. All file operations take a file descriptor (fd) as an argument. This descriptor is used to identify a connection to a directory or file. A maximum of sixteen file descriptors (fd's), open files, may exist at one time. There may be a maximum of eighty characters in a fully qualified file name.

Unless otherwise stated (as in fd_parse), directories may be specified relative to the current directory or be fully qualified (with a leading slash).

VDI error codes contain both generic and system-dependent information based on the following rules:

- A negative return from a function always implies an error.
- An error return greater than or equal to zero indicates that no error occurred.
- The generic part of the code is of the form–**XX00**
- The system-dependent part of the code is of the form–**00YY**

Error codes are listed in Appendix B, "Error Codes."

TABLE 5-6 Input/Output Functions

Function	Routine	Description	Page
Character I/O	cm_start	Initialize I/O System	5-146
	cm_stop	Close I/O System	5-147
	cm_open	Initialize Logical Channel	5-145
	cm_close	Close Logical Channel	5-143
	cm_inq	Inquire Status of Channel	5-144
	cmrx_wait	Read Character From Channel With Wait	5-149
	cmrx_now	Read Character From Channel Without Wait	5-148
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File I/O	fd_connect	Connect Directory	5-153
	fd_disconnect	Disconnect Directory	5-157
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	fd_open	Open File	5-159
	fd_close	Close File	5-152
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	fdp_read	Read File Proceed	5-166
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	fd_directory	Read Directory	5-156
	fd_parse	Parse File Name	5-160

cm_close ()

Purpose	Close logical channel
Syntax	**cm_close (channel)**
Data Types	**INT16 cm_close ();** **INT16 channel;**
Input	**channel** Logical channel number.
Function Returns	Function **cm_close** returns status of operation.
Description	This routine flushes the output buffer associated with the I/O channel and marks the logical channel as uninitialized. Default parameters will be reset to their original values (prior to being set by cm_open). Bits 15, 9 and 0-4 are valid in the returned status.

cm_inq ()

Purpose	Inquire status of channel
Syntax	**cm_inq (channel)**
Data Types	**INT16 cm_inq ();** **INT16 channel;**
Input	**channel** Logical channel number.
Function Returns	Function **cm_inq** returns status of operation.
Description	This routine returns the status of the specified channel. All fields are valid except bits 5-7. If bit 11 is 1 and you attempt to send a character, the write will be successful. If bit 12 is 1 and you attempt to read a character, the read will be successful.

cm_open ()

Purpose: Initialize logical channel

Syntax: **cm_open (channel)**

Data Types:
INT16 cm_open ();
INT16 channel;

Input:
channel
Logical channel number.
- 0 = Alpha console/CRT
- 1 = Graphics CRT
- 2 = Printer
- 3 = Plotter
- 4 = Messages
- 5 = Host communications
- 6 = Auxiliary graphics input

Function Returns: Function **cm_open** returns status of operation.

Description: This routine performs the environment-dependent actions necessary to prepare the logical channel for input/output. Baud rate, stop bits, and parity must be set by the user through standard operating system commands prior to using the channel. All other terminal port parameters will be set as required by GSS-DRIVERS. Sixteen logical channels are provided to allow for expansion. In practice, many logical channels may map the same physical channel. All fields are valid in the returned status.

These routines may be nested but the opened channels must be closed in the reverse order to the order in which they were opened. Failure to close channels in this reverse order may result in parameters being reset to incorrect values.

cm_start

Purpose	Initialize I/O system
Data Types	**INT16 cm_start ();**
Function Returns	Function **cm_start** returns status of operation.
Description	This routine performs the actions necessary to start the I/O system, such as setting all logical channels to the uninitialized state. Bits 15, 9 and 0-4 are valid in the returned status.

cm_stop

Purpose	Close I/O system
Data Types	**INT16 cm_stop ();**
Function Returns	Function **cm_stop** returns status of operation.
Description	This routine flushes all output buffers associated with all I/O channels. Default parameters will be reset to their original values (prior to being set by cm_open). Bits 15, 9 and 0-4 are valid in the returned status.

cmrx_now ()

Purpose	Read character from channel without wait
Syntax	**cmrx_now (channel, &cp)**
Data Types	**INT16 cmrx_now ();** **INT16 channel;** **INT8 cp;**
Input	**channel** Logical channel number.
Output	**cp** Character read.
Function Returns	Function **cmrx_now** returns status of operation.
Description	If a character is available on the specified channel, this routine places it in the byte pointed to by the second parameter. Bits 15, 12, 10, 9 and 0-7 are valid in the returned status.

cmrx_wait ()

Purpose	Read character from channel with wait
Syntax	**cmrx_wait (channel, &cp)**
Data Types	**INT16 cmrx_wait ();** **INT16 channel;** **INT8 cp;**
Input	**channel** Logical channel number.
Output	**cp** Character read.
Function Returns	Function **cmrx_wait** returns status of operation.
Description	This routine waits until a character has been received on the specified channel and then places it in the byte pointed to by the second parameter. Bits 15, 12, 10, 9 and 0-7 are valid in the returned status.

cmtx_now ()

Purpose Send character without wait

Syntax **cmtx_now (channel, c)**

Data Types
```
INT16 cmtx_now ();
INT16 channel;
INT8 c;
```

Input **channel**
Logical channel number.

c
Character sent.

Function Returns Function **cmtx_now** returns status of operation.

Description If the specified channel is ready, then this routine sends the character specified as the second parameter. If a no-wait function is not available on the channel, then this routine is identical to Send Character With Wait. Bits 15, 12, 9 and 0-4 are valid in the returned status.

cmtx_wait ()

Purpose	Send character with wait
Syntax	**cmtx_wait (channel, c)**
Data Types	**INT16 cmtx_wait ();** **INT16 channel;** **INT8 c;**
Input	**channel** Logical channel number. **c** Character sent.
Function Returns	Function **cmtx_wait** returns status of operation.
Description	This routine waits until the specified channel is ready, then sends a character specified as the second parameter. Bits 15, 12, 9 and 0-4 are valid in the returned status.

fd_close ()

Purpose	Close file
Syntax	**fd_close (fd)**
Data Types	**INT16 fd_close ();** **FD fd;**
Input	**fd** File descriptor.
Function Returns	Function **fd_close** returns status of operation. <0 if error **-6YY** if unable to close the file associated with the fd.
Description	This routine closes the file specified by the input file descriptor. This includes writing any pending data buffers to disk. The directory associated with that fd is the one associated with the fd_connect call. The file descriptor remains active until fd_disconnect is called.

fd_connect ()

Purpose	Connect directory
Syntax	**fd_connect (directory)**
Data Types	**FD fd_connect ();** **INT8 directory[ ];**
Input	**directory** Directory name. string
Function Returns	Function **fd_connect** returns status of operation. $\geq$0 if fd associated with the directory <0 if error **–2YY** if unable to connect to directory
Description	This routine returns a file descriptor that is associated with the specified directory. This must be done before a file can be opened and any I/O operations performed. Note that the current working directory can be specified with a null string ("") or a dot (.). The string cannot exceed eighty characters. Additional characters beyond eighty will be truncated.

fd_copy ()

Purpose	Copy directory
Syntax	**fd_copy (fd)**
Data Types	**FD fd_copy ();** **FD fd;**
Input	**fd** File descriptor.
Function Returns	Function **fd_copy** returns status of operation. <0 if error **–4YY** if unable to create a new fd
Description	This routine returns a unique file descriptor that is associated with the same directory of the file descriptor specified. If the fd is connected to a file, the function returns an error.

fd_delete ()

Purpose	Delete file
Syntax	**fd_delete (fd, name)**
Data Types	**INT16 fd_delete ();** **FD fd;** **INT8 name[ ];**
Input	**fd** File descriptor. **name** File name.
Function Returns	Function **fd_delete** returns status of operation. <0 if error **–14YY** if unable to delete file
Description	This routine deletes the file specified. The full path name (directory name plus file name) cannot exceed eighty characters.

fd_directory ()

Purpose	Read directory
Syntax	**fd_directory (fd, name, buffer, space_available)**
Data Types	**INT16 fd_directory ();** **FD fd;** **INT8 name[ ];** **INT8 buffer[ ];** **INT16 space_available;**
Input	**fd** File descriptor. **name** File name qualifier. **space_available** Number of bytes available in buffer.
Output	**buffer** Directory buffer location.
Function Returns	Function **fd_directory** returns amount of space used to hold both directory name and file name. Space needed is returned if space needed is greater than space available. (Only space available bytes of buffer were filled.) **–16YY** returned if unable to get directory list on fd
Description	This function returns the names of all files matching the specified name in the directory associated with the specified fd. File names are specified as null-terminated byte strings which are placed in the buffer. Input name descriptions are specified as null-terminated byte strings. Wildcards are allowed in input name descriptions: * matches any string of characters in name ? matches any individual character in name A null name specifies that the names of all files in the directory are to be returned. The end of the buffer is marked be an additional null following the final name/null entry.

fd_disconnect ()

Purpose	Disconnect directory
Syntax	**fd_disconnect (fd)**
Data Types	**INT16 fd_disconnect ();** **FD fd;**
Input	**fd** File descriptor.
Function Returns	Function **fd_disconnect** returns status of operation. <0 if error **–300** if unable to disconnect the fd
Description	This routine disassociates the specified fd from a directory.

fd_inq ()

Purpose: Inquire file status

Syntax: **fd_inq (fd)**

Data Types:
INT16 fd_inq ();
FD fd;

Input: **fd**
File descriptor.

Function Returns: Function **fd_inq** returns status of operation.
≥ 0 if number of bytes read/written by the last **fdp_read** or **fdp_write**.
–11YY if unable to get read/write status for the fd.

Description: This routine returns the number of bytes read or written by the last **fdp_read** or **fdp_write** routine, unless an illegal fd is specified in which case it returns an error.

fd_open ()

Purpose	Open file
Syntax	**fd_open (fd, name, mode)**
Data Types	**INT16 fd_open ();** **FD fd;** **INT8 name[ ];** **INT16 mode;**
Input	**fd** File descriptor. **name** File name. **mode** Access mode.
Function Returns	Function **fd_open** returns status of operation. **–5YY** if unable to open the requested file.

Description

This routine opens the specified file in the directory associated with the specified fd. The file descriptor (fd) will be ignored if the file name (name) is fully qualified. Mode is a 16-bit word where bit 0 is the least significant and bit 15 is the most significant bit.

Bit	Meaning
0	Read access 0 = no 1 = yes
1	Write access 0 = no 1 = yes
2	ASCII/binary flag 0 = ASCII text 1 = Binary (8-bit) data

The current file position is initialized to 0, that is, before the first byte of the file.

fd_parse ()

Purpose	Parse file name
Syntax	**fd_parse (qualified_name, buffer, space_available)**
Data Types	**INT16 fd_parse ();** **INT8 qualified_name[ ];** **INT8 buffer[ ];** **INT16 space_available;**
Input	**qualified_name** Fully qualified file name to be parsed.
Output	**buffer** Parsing buffer location. **space_available** Buffer space available (size).
Function Returns	Function **fd_parse** returns amount of space used to hold both the directory name and file name. If space needed is greater than the space available, then space needed is returned. (Only space available bytes of the buffer are filled.)
Description	This routine returns the directory and name portions of a fully qualified file name. The buffer contains two null-terminated byte strings (directory and file name). This routine is useful for separating the directory from the file name.

fd_read ()

Purpose — Read file wait

Syntax — **fd_read (fd, buffer, count)**

Data Types —
INT16 fd_read ();
FD fd;
INT8 buffer[ ];
INT16 count;

Input —
fd
File descriptor.

count
Desired number of bytes.

Output —
buffer
Read buffer location.

Function Returns — Function **fd_read** returns number of bytes read.
<0 if error
–7YY if error reading file

Description — This routine reads the specified number of bytes from the file associated with the specified file descriptor, starting at the current file position. It returns the number of bytes actually read and increments the current file position by the number of bytes read. If the number of bytes requested is greater than the number of bytes currently in the buffer, all bytes in the buffer will be returned. If the file position is at end of file, then the routine reports that zero bytes were read.

fd_rename ()

Purpose Rename file

Syntax **fd_rename (fd, old_name, new_name)**

Data Types
```
INT16 fd_rename ();
FD fd;
INT8 old_name[ ];
INT8 new_name[ ];
```

Input **fd**
File descriptor.

old_name
Old file name.

new_name
New file name.

Function Returns Function **fd_rename** returns status of operation.
<0 if error
–15YY if unable to rename file

Description This routine changes the name of file old_name to be new_name.

fd_seek ()

Purpose
: Seek file

Syntax
: **fd_seek (fd, position, offset)**

Data Types
: **INT32 fd_seek ();**
FD fd;
INT32 position;
INT16 offset;

Input
: **fd**
File descriptor.

position
Specifies new file position.

offset
Offset mode.
0 = Absolute
1 = Relative

Function Returns
: Function **fd_seek** returns status of operation.
≥ 0 if updated position
<0 if error
–12YY if unable to seek on requested fd

Description
: This routine sets the current file position of the file associated with fd to the position specified in the position argument. The position may be specified either as an absolute offset from the beginning of the file (offset = 0) or an offset relative to the current position (offset = 1). Both the position requested and the updated position are long integers (32 bits).

fd_size (fd)

Purpose	File size
Syntax	**fd_size (fd)**
Data Types	**INT32 fd_size ();** **FD fd;**
Input	**fd** File descriptor.
Function Returns	Function **fd_size** returns status of operation. The size returned is a long integer (32 bits): ≥0 if file size in bytes <0 if error **–13YY** if unable to determine file size on requested fd.
Description	This routine returns the current length of the file associated with the specified file descriptor in bytes. This value can be used to set the file position to the end of the file and append to the file. To obtain the size of an open file, first call fd_close to close the file.

fd_write ()

Purpose — Write file wait

Syntax — **fd_write (fd, buffer, count)**

Data Types —
INT16 fd_write ();
FD fd;
INT8 buffer[ ];
INT16 count;

Input —
fd
File descriptor.

buffer
Write buffer location.

count
Desired number of bytes.

Function Returns — Function **fd_write** returns actual number of bytes written.
<0 if error
–10YY if error writing file

Description — This routine writes the specified number of bytes to the file associated with the specified file descriptor, starting at the current file position. It returns the number of bytes actually written and increments the current file position by the number of bytes written.

fdp_read ()

Purpose Read file proceed

Syntax **fdp_read (fd, buffer, count)**

Data Types
```
INT16 fdp_read ();
FD fd;
INT8 buffer[ ];
INT16 count;
```

Input **fd**
File descriptor.

count
Desired number of bytes.

Output **buffer**
Read buffer location.

Function Returns
Function **fdp_read** returns status.
>0 if number of bytes read
0 if read operation in progress
–7YY if error reading file

Description This routine reads the specified number of bytes from the file associated with the specified file descriptor, starting at the current file position. It increments the current file position by the number of bytes read. This routine does not wait for the read to be complete to return. The Inquire File Status routine can be used to determine if file operation has been completed. This operation is the same as a Read File.

fdp_write ()

Purpose
: Write file proceed

Syntax
: **fdp_write (fd, buffer, count)**

Data Types
: **INT16 fdp_write ();**
FD fd;
INT8 buffer[ ];
INT16 count;

Input
: **fd**
File descriptor.

buffer
Write buffer location.

count
Desired number of bytes.

Function Returns
: Function **fdp_write** returns status.
>0 if number of bytes written
0 if write operation in progress
–8YY if unable to write to requested file

Description
: This routine writes the specified number of bytes to the file associated with the specified file descriptor, starting at the current file position. It increments the current file position by the number of bytes written. This routine does not wait for the write to be complete to return. The Inquire File Status routine can be used to determine if file operation has been completed. This operation is the same as a Write File.

Glossary

ADE	ASCII Decimal Equivalents are decimal numbers used in code to represent ASCII characters. Examples are 65=A, 66=B. ADE character parameters are passed and returned as integers.
Argument	One of the independent variables that the action or output of a routine depends on. Arguments are enclosed in parentheses in the routine call.
Array	Series of related items (data) arranged in a meaningful pattern.
Aspects of Primitives	Ways in which the appearance of a primitive can vary. Aspects are controlled directly by primitive attributes.
Attribute Functions	Primitive attributes affect the appearance of objects created with primitive functions. (Examples: character height, line style)
Binding	Language binding refers to the exact calling syntax and data type specification for arguments to be used when calling GSS-DRIVERS routines from a specific programming language.
Cartesian Coordinate System	Coordinate system composed of an X-axis (horizontal) increasing positively towards the right, and a Y-axis (vertical) increasing positively upwards. The axes are positioned at right angles, and the point of intersection is the origin (0., 0.). The position of any point is defined by the displacement from the origin along first the X- and then the Y-axis.

Cell Array — GSS-DRIVERS output primitive consisting of a rectangular grid of equal size rectangular cells, each having a single color.

Note
These cells may not map one-to-one with frame buffer pixels.

Choice Input Device — A logical input device that offers the user a set of alternatives and returns an integer value indication of the option selected. An example device is a set of function keys.

Clipping — When you set a window in the world coordinate space, part of an object may lie outside the window. In this case, the part lying outside the window will be clipped; that is, it will not be projected onto the viewport.

Color Map — Table designed to provide a range of colors by defining different mixtures of the color components. A desired color is referenced by its assigned number. The identifying numbers with their assigned colors are called the color map. Changing colors assigned to the identifying number changes the map.

Color Table — Workstation-dependent table in which the entries specify the values of the red, green and blue intensities defining a particular color. Control Functions These facilities allow you to exercise control over certain aspects of the system and the display device. GSS-DRIVERS provides a means to access the non-standard capabilities of your display device through an escape mechanism invoked with the escape function.

Coordinate Graphics — Computer graphics in which display images are generated from display commands and coordinate data.

Coordinate Scaling	Coordinate scaling transforms points from one "space" to another. In GSS-DRIVERS all point coordinates must be specified in Normalized Device Coordinates with values between 0 and 32767. These coordinates are then scaled into values which are appropriate for your graphics device.
Default	A value assigned to a parameter by GSS-DRIVERS and used when you do not specify a value.
Device Coordinate	A coordinate expressed in a coordinate system that is device-dependent.
Device Driver	Device-dependent software that generates instructions specifying items to be drawn on the display surface from the invocations of GSS-DRIVERS.
Device Handle	Number returned that represents a unique device.
Device-Independent	The ability to be used on more than one type of graphics display device.
Device Space	The space defined by the addressable points of a display device.
Display Device	A device (for example, refresh display, storage tube display, plotter) on which display images can be represented.
Display Surface	In a display device, that medium on which display images may appear.
Echo	The immediate notification of the current value provided by an input device to the operator at the display console.
Environmentals	Environmentals are attributes, selected by the programmer, that affect the appearance of some aspect of the displayed graph. For example, there is a call to set the line type for polyline output. Environmentals have default values which are in effect after initialization of GSS-DRIVERS. If the

	programmer alters an environmental, it retains its new value until it is changed by another attribute call or GSS-DRIVERS is reinitialized.
Escape	A function within GSS-DRIVERS which is the only access to implementation-dependent or device-dependent support for nonstandard functionality other than graphics output.
Fill Area	A GSS-DRIVERS output primitive consisting of a polygon (closed boundary) which may be hollow or may be filled with a uniform color, a pattern, or a hatch style.
Generalized Drawing Primitive (GDP)	A display element (output primitive) used to address special geometrical workstation capabilities such as curve drawing.
GKS	Graphical Kernel System.
Graphical Kernel System	The Graphical Kernel System (GKS) is an international standard for the programmer's interface to graphics.
Graphics Primitives	Graphics primitives are the basic graphics operations performed by GSS-DRIVERS; for example, drawing lines, markers and text strings.
GSS-DRIVERS	GSS-DRIVERS is a host- and device-independent graphics subsystem that serves as an environment for graphics applications as well as application development.
Host-Independent	Capable of running on a number of operating systems.
Input Functions	GSS-DRIVERS allows you to obtain the value of an NDC point from an interactive graphics device. The method for specifying the point is device-dependent.

Inquiry Functions — GSS-DRIVERS provides inquiry facilities that allow your program to determine the present state of the system. You may determine the current value of the following:

- primitive attributes
- device capabilities
- device state

Integer — A whole number; that is, a number with no fractional part.

I/O System — Host-dependent part of GSS-DRIVERS which allows GSS-DRIVERS to communicate with your graphics devices using the standard host hardware.

Locator Input Device — A GSS-DRIVERS logical input device providing a position in world coordinates and a normalization transformation number. Examples include cursors, mice and joysticks.

NDC — Normalized Device Coordinates.

Normalized Device Coordinate Space — Normalized Device Coordinate Space is a uniform virtual space by which a graphics application program passes graphics information to a device. GSS-DRIVERS translates between NDC space and the display coordinates of a particular device.

Normalized Device Coordinates — GSS-DRIVERS introduces the concept of a Normalized Device Coordinate (NDC) Space in which the full extent of the device axes are assigned values between 0 and 32767. This convention provides improved device independence for a graphics system by allowing the viewing operations to be carried out without regard for device coordinate specifics. The NDC coordinates are then converted to specific device coordinates by GSS-DRIVERS.

Null-Terminated String	A one-dimensional array or list of characters. The end of a string is indicated by the NULL character (ADE 0).
Output Primitives	The graphical world which the programmer describes consists of one or more objects. Objects are created and modified by invocations of graphics primitive functions provided by GSS-DRIVERS. These functions describe polylines, polymarkers, text strings, pixel arrays, fill areas and generalized drawing primitives. The invocation of an output primitive function results in an output primitive, such as a sequence of markers or polylines. The appearance of output primitives is affected by the values of primitive attributes.
Pixel	The smallest element of a display surface that can be independently assigned a color or intensity.
Polyline	A GSS-DRIVERS output primitive consisting of a set of connected lines.
Polymarker	A GSS-DRIVERS output primitive consisting of a set of locations to be indicated by a marker.
Raster	A field of closely spaced lines on the face of a video terminal that defines an image. The spacing between raster lines defines the resolution of a display.
Real	A number which contains a fractional part expressed as a decimal. For example, 23.56.
RGB	An additive method for defining color, in which colors are produced by adding percentages of the primaries:

		red	+	**green**	+	**blue**
white	=	100%	+	100%	+	100%
yellow	=	100%	+	100%	+	0%
magenta	=	100%	+	0%	+	100%
cyan	=	0%	+	100%	+	100%

Transformation	The mapping of objects from one coordinate space to another.
Valuator Input Device	A logical input device that returns scalar values in the range that is proportional (0 to 32767) to the valuator position. An example device is a control dial.
VDI	Virtual Device Interface.
Virtual Device Interface	The Virtual Device Interface is a standard interface between device-dependent and device-independent code in a graphics environment. VDI makes all device drivers appear identical to the calling program. GSS-DRIVERS is based on VDI and all device drivers written for GSS-DRIVERS must conform to the VDI specification.
Workstation	GSS-DRIVERS is based on the concept of abstract graphical workstations which provide the logical interface through which the applications program controls physical devices.

Appendices

C Conventions and Example

GSS-DRIVERS C language binding provides an interface between VDI-compatible device drivers and your C compiler. This allows the programmer to specify graphics operations as subroutine calls with the native syntax of the language environment. By hiding many of the details of the device-driver interface, the language binding eases programming tasks and allows the programmer to concentrate on his application.

Using the Bindings

The C binding is implemented as a linkable library containing all the functions described in Part 5. This library must be included in the list of relocatable modules during the linking process. The normal operating procedures for your linker should be followed when linking GSS-DRIVERS bindings to an application.

A Note on Binding Conventions

In the C bindings, INT16 refers to signed 16-bit integers and INT8 refers to signed 8-bit integers. FD refers to signed 16-bit integers. INT32 refers to long integer (32 bit). Scalar input arguments are passed by value; array input arguments are passed by address. All output arguments are passed by address.

All graphics calls are functions that return an integer value which may be the error status or other requested information.

The Open Workstation call initializes a device and returns a "device handle," an integer number used to refer to that device. All other calls require the device handle as an input argument to identify the object device.

Programming Example

The following C programming example accompanies the pseudocode in Part 2, producing the Gantt Chart in Figure 2-2.

```
/* This is a program to use the VDI C binding to draw a Gantt chart */

main()
{
   static char *tasks[ ] = {"Full Production", "Evaluation", "One Third",
     "Plant", "Purchasing", "Tool Design", "Review", "Design"};
   static char *title = {"Aurora Processing Plant"};
   static char *y_label = {"As of June 15"};
   static char *y_ticks[ ] = {"July", "August", "September", "October"};

   extern box();
   extern short  pto32k();

   short  dev_handle,
          xheight,
          istring[2],
          gdms_err,
          xy[10],
          savary[64],
          xwidth,
          cwidth,
          i, j,
          cheight;

   static short  echo_xy[2] = {0,0};

   static short  nominate[ ] = {0, 1, 1, 3, 1, 1, 1, 0, 0, 1, 1,
            'D', 'I', 'S', 'P', 'L', 'A', 'Y', ' '};

   static short  start_dates[ ] = {83, 72, 70, 48, 48, 45, 40};
   static short  end_dates[ ] = {95, 83, 79, 75, 67, 60, 49};

   gdms_err = v_opnwk(nominate,&dev_handle,savary);
          /* nominate the device */
   xy[1] = pto32k(10); xy[3] = pto32k(80);
          /* set the constants for the grid */
   for (i=50;i<=80;i+=15){
     xy[0] = pto32k(i); xy[2] = xy[0];
          /* set variable elements in array for grid */
     gdms_err = v_pline(dev_handle,2,xy);
          /* draw the line */
              }

   xheight = vst_height(dev_handle,pto32k(4),&xwidth,&cwidth,&cheight);
          /* set character height */
   gdms_err = vst_alignment(dev_handle,1,2,&i,&j);
          /* set text alignment */
   j = 0;
          /* index into tick labels */
   for (i=43;i<=88;i+=15){
     gdms_err = v_gtext(dev_handle,pto32k(i),pto32k(10),y_ticks[ j++]);
     /* write text */
              }

   gdms_err = vst_alignment(dev_handle,2,1,&i,&j);
          /* set text alignment */
```

```
   j = 0;
            /* index into y axis labels */
   for (i=15;i<=75;i+=10){
      gdms_err = v_gtext(dev_handle,pto32k(33),(short) (pto32k(i)-xheight/2.0),
               tasks[ j++]);
            /* write out text */
            }
   gdms_err = vst_alignment(dev_handle,0,0,&i,&j);
            /* set text alignment */
   gdms_err = v_gtext(dev_handle,pto32k(35),pto32k(82),y_label);
            /* write out the y axis label */
   gdms_err = vst_height(dev_handle,pto32k(9),&xwidth,&cwidth,&cheight);
            /* set new character height */
   gdms_err = v_gtext(dev_handle,pto32k(35),pto32k(88),title);
            /* write out title text */

   gdms_err = vsf_style(dev_handle,2);
   gdms_err = vsf_interior(dev_handle,3);
            /* set fill pattern */
   j = 0;
            /* set index into data arrays */
   for (i=12;i<=72;i+=10) {
      xy[1] = pto32k(i); xy[3] = pto32k(i+6);
      xy[0] = pto32k(start_dates[ j]);
      xy[2] = pto32k(end_dates[ j++]);
            /* set dimensions for bars */
      gdms_err = v_bar(dev_handle,xy);
            /* draw the bars */
            }

   box(35,95,10,80,xy);
            /* create box points */
   gdms_err = v_pline(dev_handle,5,xy);
            /* draw frame around chart */
   box(0,100,0,100,xy);
            /* create page border */
   gdms_err = v_pline(dev_handle,5,xy);
            /* draw page border */
   gdms_err = vrq_string(dev_handle,2,0,echo_xy,istring);
            /* wait for <CR> */
   gdms_err = v_clswk(dev_handle);
}

box(xmin,xmax,ymin,ymax,xyout)

short xmin, xmax, ymin, ymax, xyout[ ];

{
   extern short pto32k();
   xyout[0] = pto32k(xmin); xyout[1] = pto32k(ymin);
   xyout[2] = pto32k(xmax); xyout[3] = xyout[1];
   xyout[4] = xyout[2]; xyout[5] = pto32k(ymax);
   xyout[6] = xyout[0]; xyout[7] = xyout[5];
   xyout[8] = xyout[0]; xyout[9] = xyout[1];
}

short pto32k(percent)

short percent;

{
   return((float) percent / 100.0 * 32767);
}
```

Error Codes

This appendix lists the error codes returned by GSS-DRIVERS functions.

GSS-DRIVERS functions always return to the caller whether or not the requested operation was successful. Each function returns an error status that indicates the results of the request. In this way the application program is made aware of the condition of the graphics subsystem and can take appropriate action without losing control of the system. This also places a responsibility for checking error status and attempting error recovery, or at least informing the user, on the applications program.

No error messages are displayed on the system console by GSS-DRIVERS.

Error codes contain both generic and system-dependent information based on the following conventions:

- A negative return from a function always implies an error An error return greater than or equal to zero indicates that no error occurred.
- The error code has two parts: generic and system-dependent.
- The generic part of the code is in the form -XX00.
- The system-dependent part of the code is in the form 00YY.

For example error code **–1405** indicates:

–1400 => **error in fd delete error**
–0005 => **access denied**

TABLE B-1 Generic Codes

Code	Cause
–100	**VDI SWAP DRIVER ERROR** An error has been encountered while swapping device drivers. The proper driver may not be resident in the specified directory area or the driver name may not be included in the system environment.
–200	**FD CONNECT ERROR** Error during the file connect operation.
–300	**FD DISCONNECT ERROR** Error during the file disconnect operation.
–400	**FD COPY ERROR** Error during the copy file descriptor operation.
–500	**FD OPEN ERROR** Error while opening a file.
–600	**FD CLOSE ERROR** Error while closing a file.
–700	**FD READ ERROR** Error while reading a file in wait mode.
–800	**FD WRITE ERROR** Error while writing to a file in wait mode.
–900	**FDP READ ERROR** Error while reading file in proceed mode.
–1000	**FDP WRITE ERROR** Error while writing to a file in proceed mode.
–1100	**FD INQUIRE ERROR** Error while inquiring about file status.
–1200	**FD SEEK ERROR** Error during seek operation.
–1300	**FD SIZE ERROR** Error while inquiring current file size.
–1400	**FD DELETE ERROR** Error during file delete operation.

(continued)

TABLE B-1 (continued)

Code	Cause
–1500	**FD RENAME ERROR** Error while renaming a file.
–1600	**FD DIRECTORY ERROR** Error during directory list operation.
–1700	**FD PARSE ERROR** Error while parsing filename.
–1800	**EM DASH ERROR** Error during dash output.
–1900	**EM MARKER ERROR** Error during marker output.
–2000	**EM ALIGNMENT ERROR** Error during text alignment output.
–2100	**EM POLYGON ERROR** Error during polygon output.
–2200	**EM BAR ERROR** Error during bar output.
–2300	**EM ARC ERROR** Error during arc output.
–2400	**EM PIE ERROR** Error during pie output.
–2500	**EM CIRCLE ERROR** Error during circle output.
–2600	**GIN INIT ERROR** Error initializing input device.
–2700	**GIN POINT ERROR** Error moving cursor during GIN.
–2800	**GIN TERMINATOR** Error terminating GIN function.
–3000	**DEVICE DRIVER ERROR** Error while calling device driver.
–5000	**NOT CAPABLE ERROR** Specified device is not capable of requested function.

TABLE B-2 Specific Codes

Code	Cause
–1	INVALID FUNCTION Operating system error—invalid function code.
–2	FILE NOT FOUND Operating system error—named file not found.
–3	PATH NOT FOUND Operating system error—named path not found.
–4	TOO MANY OPEN FILES Operating system error—too many files open.
–5	ACCESS DENIED Operating system error. Named file not accessible (protected).
–6	INVALID HANDLE Operating system error—invalid device handle.
–8	INSUFFICIENT MEMORY Operating system error. Insufficient memory for requested operation.
–16	RM CURRENT DIRECTORY Operating system error. Attempt to remove the current directory.
–18	NO MORE FILES Operating system error. No more space on device.
–78	CANT DELETE DIRECTORY Attempted to delete a directory.
–79	DEVICE BUSY Device currently in use.
–80	HARDWARE NOT PRESENT Device or hardware not present.
–81	ALL SLOTS USED Cannot open another UNIX driver.
–82	VDI CANT START Cannot get VDI going.

(continued)

TABLE B-2 (continued)

Code	Cause
–84	**CANT START DRIVER** Fork of driver failed.
–85	**EOF ERROR** End of file found.
–86	**ALREADY OPEN** Open Workstation attempted when workstation already open.
–88	**CANNOT START READ FORK** Reader not executed.
–89	**NO DRIVER FILE** Filename not found.
–90	**UNKNOWN DRIVER** Driver file does not exist.
–92	**ILLEGAL HANDLE** Illegal device handle.
–94	**FD ILLEGAL OFFSET** Illegal byte offset within file.
–96	**FD NOT CONNECTED** The file description is not connected.
–97	**FD FILE IS OPEN** File currently open.
–98	**FD NOT AVAILABLE** File not available.
–99	**FD NOT DIRECTORY FILE** File not within current directory.

Device-Dependent Information

This appendix contains information about specific graphics peripheral devices that are supported by GSS-DRIVERS. It describes the capabilities and limitations of devices, the index assignments for selectable functions such as polymarker types and color, and other special information.

Specific information is provided for the following devices:

Device Information Categories

The following information is given for each graphics devices:

File Name	The name of the device driver file.
Device Type	The logical name of the device. This name must be included as the workstation identifier in the Open Workstation call that initializes the device. It is also used when setting your graphics environment to redefine the logical to physical assignments.
Communications	Specific information about the data interface to the device such as flagging protocols and strapping options.
Features Supported	Describes the features contained within the VDI Specification that are supported on this device. Subcategories include:

Polylines	Describes the available line styles and their index numbers.
Graphics Text	Describes the graphics text capabilities of the device such as character size and rotation and their index numbers.
Graphics Markers	Describe the marker symbols available, their size variations and their index numbers.
Filled Areas	Describes the fill styles available for area fills and their corresponding indices.

Color	Describes the color capabilities of the device, default colors, color selection, color indices and color index to pen correspondence in the case of plotters.
Graphics Input	Specific information about the operation of graphics input such as the operator action required to initiate and terminate input.
Alpha Text	Describes the text capabilities of the device such as fonts, sizes, color and other

	attributes. On some devices alpha text is distinct from graphics text.
Request Locator	Describes how the Request Locator function is implemented on the device.
Request String	Describes how the Request String function is implemented on the device.
Raster Writing	Describes pixel (pel) operations.
Cursor Addressable Text	Lists the attributes available to cursor addressable text on the device. Cursor text attributes include reverse video, underline, blink, bold, and color.
Special Information	Contains information unique to the device which is not described under another heading.
VDI Opcode Summary	Lists the VDI operations that are supported by the device.

AT&T Model 470 Graphics Printer

File Name	att470
Device Type	PRINTER
Communications	Parallel The standard Centronics parallel cable will operate the Model 470 printer properly.

Features Supported

Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text — This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers — The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color

The Model 470 printer supports two colors: Index 1 is displayed in black ink and index 0 is not displayed. These colors can not be redefined.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the Model 470 printer:

Fonts: 1 = Normal (default)
2 = Bold
4 = Proportional spaced
5 = Bold proportional spaced

Sizes: 1 = 17 characters per inch
2 = 12 characters per inch
3 = 10 characters per inch
4 = 8.5 characters per inch
5 = 6 characters per inch
6 = 5 characters per inch

Note
Text size is ignored when selecting a proportional font.

Superscript and Subscript

Underline

Line Spacing

Overstrike Mode

Pass Through Mode

VDI Opcode Summary

The GSS VDI functions available for the Model 470 driver include:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation; resets printer to default state
Open Workstation —Initializes printer for output
Set Alpha Text Position
Set Writing Mode—All sixteen Boolean writing modes are supported
Update Workstation—Causes picture generation; advances paper; subsequent output is overlayed

Primitives
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode

Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

AT&T Model 455 Letter Quality Printer

File Name	att455
Device Type	PRINTER
Communications	Parallel A Centronics standard parallel cable will operate the AT&T 455 printer properly.

Features Supported

Polylines Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style: 1 = Narrow diagonal 2 = Medium diagonal 3 = Wide diagonal 4 = Narrow crosshatch 5 = Medium crosshatch 6 = Wide crosshatch

Color

The AT&T Model 455 printer supports two colors. Index 1 is displayed with the black ribbon and index 0 is not displayed. These colors cannot be redefined.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the AT&T 455 printer:

Fonts: 1 = Normal (default)
2 = Bold
4 = Proportionally spaced
5 = Bold proportionally spaced

Sizes: One size supported.
10 cpi print wheel for constant spacing, or a WPS print wheel for proportional spacing.

Superscript and Subscript

Underline

Overstrike Mode

Pass Through Mode

Alpha Text Quality:
<50 : Turn on bi-direction printing
≥50 : Turn off bi-direction printing

Special Information

Prior to running an application, the constant spacing print wheel must be installed. When a proportionally spaced alpha text font is desired, the user will be prompted to place the proportional spacing print wheel into the AT&T 455. If the alpha text font is later changed back to a constant spacing font, the user will be prompted to insert it back into the printer. Note that changing the print wheel will cause the READY light to blink. Press the PAUSE button to reactivate the printer.

VDI Opcode Summary

The functions available in the GSS VDI for the AT&T 455 printer are:

Clear Workstation—Causes picture generation and advances paper
Close Workstation—Causes picture generation
Open Workstation—Advances the paper
Set Alpha Text Position
Set Writing Mode—Mode 4 (replace) and mode 8 (overstrike) are supported
Update Workstation—Causes picture generation; subsequent output is overlaid

Output
Arc—uses polyline attributes
Bar—uses filled area attributes
Cell Array—Outlines the area, no other action
Circle—uses filled area attributes
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice—uses filled area attributes
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Quality
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

AT&T UNIX PC Model 7300 Display

File Name	pc7300
Device Type	DISPLAY

Features Supported

Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text — This printer supports five character sizes with a Preserve Aspect Ratio and five sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers — The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas — Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color

In graphics mode, there are two available colors that can be used to display graphic primitives. Color index 0 is displayed as Black, and color index 1 is displayed as white. These colors can not be redefined.

Request Locator

When locator is invoked on the UNIX PC, a tracking cross appears on the display at the initial locator position. The cross can be moved by moving the attached mouse. When the cross is at the desired location, the point can be selected by pressing the left mouse button. This causes the coordinates of the point to be transmitted back to the application program.

If desired, the device will perform an inking function. When the locator is terminated, a line from the initial position to the desired position is drawn honoring the current line attributes such as color and line style.

Also the device performs rubberbanding if desired. There are two types of rubberbanding supported: lines and rectangles. If rubberbanding lines are desired, a line will be drawn from the initial locator position to the current position of the graphic cursor. The line changes dynamically as the cursor is moved. When the locator is terminated, the line is removed.

If rubberband rectangle is specified, a rectangle is displayed with one corner at the initial locator position and the opposite at the current position of the graphic cursor. The rectangle changes dynamically as the cursor is moved. When the locator is terminated, the rectangle is removed from the display.

Request Choice	The function keys (F1) to (F8) on the keyboard are used to enter choice input.
Request String	The keyboard is used to enter strings. The string is terminated by the Return key.
Cursor Addressable Text	Cursor addressable text is supported. The device Addressable Text must be in Cursor Addressing Mode before it can perform any cursor control functions. To display graphic primitives, the device must be removed from Cursor Addressing Mode.
Alpha Text	Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the UNIX PC Display: One Font One Size Superscript and Subscript Underline Line spacing
VDI Opcode Summary	The functions available in the GSS VDI for the AT&T UNIX PC Model 7300 driver are: Clear Workstation Close Workstation Cursor Down Cursor Left Cursor Right Cursor Up Direct Cursor Address Enter Cursor Addressing Mode Erase to End of Line Erase to End of Screen

Exit Cursor Addressing Mode
Home Cursor
Open Workstation
Graphic Input Cursor
Set Alpha Text Position
Set Input Mode
Set Line Edit Characters
Set Writing Mode—All sixteen Boolean writing modes are supported
Update Workstation—No action is performed

Primitives
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Reverse Video Off
Reverse Video On
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value
Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Background Color Index
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Cursor Text Attributes
Set Cursor Text Color Indices—Only the foreground color can be selected

Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input
Input Locator—Request Mode
Input Choice—Request Mode
Input String—Request Mode
Read Cursor Movement Keys

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells
Inquire Color Representation
Inquire Cell Array
Inquire Current Cursor Address
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

CIT-101e Terminal with CIG-101e Graphics Card

File Name	cit101	
Device Type	DISPLAY	
Communications	Serial (RS-232)	
Features Supported	Polylines	Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text	This device driver supports four character sizes with a Preserve Aspect Ratio and four sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters cannot be rotated.
Graphic Markers	The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style

index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color	The CIG-101e graphics card supports two simultane- ously displayable colors. These colors cannot be remapped.
Request Locator	When locator is invoked, a tracking cross appears on the display at the initial locator position. The cross can be moved by pressing one of the four arrow keys on the keyboard. Initially, the cross moves in small increments. Holding an arrow key down, will cause the cross to move faster after a slight delay. When the cross is at the desired location, that point can be selected by pressing any alpha key on the keyboard. This causes the coordinates of point to be transmitted back to the user program. If desired, the device will perform an inking function. When the locator is terminated, a line from the initial position to the desired position is drawn honoring the current line attributes such as color and line style.
Request Choice	The numeric keys 0 to 9 on the keypad are used to enter choice input.
Request String	The keyboard is used to enter strings. All strings are terminated by the Return key.

Cursor Addressable Text	Cursor addressable text is supported. The terminal must be in Cursor Addressing Mode before it can perform any cursor control functions. The following attributes are supported:
	Reverse Video
	Blink
	Underline
	To display graphics primitives, the device must be removed from Cursor Addressing Mode.
Alpha Text	Alpha text can be positioned anywhere on the output page. The following text capabilities are available:
	One Font
	One Size
	Superscript and Subscript
	Underline
	Line spacing
VDI Opcode Summary	The functions available in the GSS VDI for the Cit101 driver are:

Clear Workstation
Close Workstation
Cursor Down
Cursor Left
Cursor Right
Cursor Up
Direct Cursor Address
Enter Cursor Addressing Mode
Erase to End of Line
Erase to End of Screen
Exit Cursor Addressing Mode
Home Cursor
Open Workstation
Remove Graphics Input Cursor
Set Alpha Text Position
Set Input Mode
Set Line Edit Characters

Set Writing Mode—Modes supported include:
- 1—Clear (dots off)
- 7—XOR
- 8—Overstrike (OR) Update

Workstation—No action is performed

Primitives

Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes

Reverse Video Off
Reverse Video On
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value
Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Background Color Index
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation
Set Cursor Text Attributes
Set Cursor Text Color Indices
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index

Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input

Input Locator—Request Mode
Input Choice—Request Mode
Input String—Request Mode
Read Cursor Movement Keys

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells
Inquire Color Representation
Inquire Current Cursor Address
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

CIT-161 Terminal with CIG-267 Graphics Card

File Name	cit161
Device Type	DISPLAY
Communications	Serial (RS-232)
Features Supported	Polylines: Lines and arcs can be drawn with the seven line styles listed below:

1 ____________________ Solid
2 ______ ______ Long Dash
3 . . . . Dotted
4 _____ . _____ . Dash Dotted
5 ___ ___ ___ ___ Medium Dashed
6 ____ . . ____ . . Dash Two Dots
7 _ _ _ _ _ _ _ _ Short Dash

Graphics Text: This device driver supports four character sizes with a Preserve Aspect Ratio and four sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters cannot be rotated.

Graphic Markers: The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas: Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style

index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color	The CIG-267 graphics card supports eight simultaneously displayable colors. These colors cannot be remapped.
Request Locator	When locator is invoked, a tracking cross appears on the display at the initial locator position. The cross can be moved by pressing one of the four arrow keys on the keyboard. Initially, the cross moves in small increments. Holding an arrow key down, will cause the cross to move faster after a slight delay. When the cross is at the desired location, that point can be selected by pressing any alpha key on the keyboard. This causes the coordinates of the point to be transmitted back to the user program. If desired, the device will perform an inking function. When the locator is terminated, a line from the initial position to the desired position is drawn honoring the current line attributes such as color and line style.
Request Choice	The numeric keys 0 to 9 on the keypad are used to enter choice input.
Request String	The keyboard is used to enter strings. All strings are terminated by the Return key.

Cursor Addressable Text	Cursor addressable text is supported. The terminal must be in Cursor Addressing Mode before it can perform any cursor control functions. The following attributes are supported:

Reverse Video

Blink

Underline

Bold Intensity

Colors:
- 0 = Black
- 1 = White
- 2 = Red
- 3 = Green
- 4 = Blue
- 5 = Yellow
- 6 = Cyan
- 7 = Magenta

To display graphics primitives, the device must be removed from Cursor Addressing Mode.

Alpha Text	Alpha text can be positioned anywhere on the output page. The following text capabilities are available:

One Font

One Size

Superscript and Subscript

Bold

Underline

Line Spacing

Eight Colors

VDI Opcode Summary	The functions available in the GSS VDI for the cit161 driver are:

Clear Workstation
Close Workstation
Cursor Down

Cursor Left
Cursor Right
Cursor Up
Direct Cursor Address
Enter Cursor Addressing Mode
Erase to End of Line
Erase to End of Screen
Exit Cursor Addressing Mode
Home Cursor
Open Workstation
Remove Graphics Input Cursor
Set Alpha Text Position
Set Input Mode
Set Line Edit Characters
Set Writing Mode—Only REPLACE mode is supported
Update Workstation—No action is performed

Primitives
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Reverse Video Off
Reverse Video On
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value
Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Background Color Index

Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation
Set Cursor Text Attributes
Set Cursor Text Color Indices
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input
Input Locator—Request Mode
Input Choice—Request Mode
Input String—Request Mode
Read Cursor Movement Keys

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells
Inquire Color Representation
Inquire Current Cursor Address
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Diablo C150 Ink Jet Color Printer

File Name	diab150
Device Type	PRINTER
Communications	Parallel A Centronics standard parallel cable will operate the Diablo printer properly.

Features Supported

Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text — This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers — The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style: 1 = Narrow diagonal 2 = Medium diagonal 3 = Wide diagonal 4 = Narrow crosshatch 5 = Medium crosshatch 6 = Wide crosshatch

Color

The printer supports eight colors. They are defined as follows:

0 = Background (not displayed)
1 = Black
2 = Red
3 = Green
4 = Blue
5 = Yellow
6 = Violet
7 = Orange

These colors cannot be redefined.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the Diablo printer:

Fonts: 1—Normal

Sizes: 1—12 characters per inch

Underline

Overstrike Mode

Pass Through Mode

VDI Opcode Summary

The functions available in the GSS VDI for the Diablo Printer are:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation
Open Workstation—Advances the paper
Set Alpha Text Position
Set Writing Mode—Replace mode only
Update Workstation—Causes picture generation; subsequent output is overlaid.

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Quality
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index

Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1,-1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Epson MX-100

File Name	epmx100
Device Type	PRINTER
Communications	Parallel A Centronics standard parallel cable will operate the Epson MX-100 printer properly.

Features Supported

Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1	________________________	Solid
2	_______ _______	Long Dash
3	. . . .	Dotted
4	______ . ______ .	Dash Dotted
5	___ ___ ___ ___	Medium Dashed
6	_____ . . _____ . .	Dash Two Dots
7	_ _ _ _ _ _ _ _	Short Dash

Graphics Text — This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers — The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

	Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style: 1 = Narrow diagonal 2 = Medium diagonal 3 = Wide diagonal 4 = Narrow crosshatch 5 = Medium crosshatch 6 = Wide crosshatch

Color

The Epson MX-100 printer supports two colors. Index 1 is displayed with the black ribbon and index 0 is not displayed. These colors cannot be redefined.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the Epson MX-100 printer:

Fonts: 1 = Normal (default)
2 = Bold

Sizes: 1 = 16.5 characters per inch
2 = 10 characters per inch (default)
3 = 5 characters per inch

Superscript and Subscript

Underline

Overstrike Mode

Pass through Mode

Alpha Text Quality:
<50 : Turn on bi-direction printing
≥ 50 : Turn off bi-direction printing

VDI Opcode Summary

The functions available in the GSS VDI for the Epson MX-100 printer are:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation
Open Workstation—Advances the paper
Set Alpha Text Position
Set Writing mode—Mode 4 (replace) and mode 8 (overstrike) are supported
Update Workstation—Causes picture generation subsequent output is overlaid.

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Quality
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index

Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1,-1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Epson MX-80 with Graphtrax Plus

File Name	epmx80
Device Type	PRINTER
Communications	Parallel A Centronics standard parallel cable will operate the Epson MX-80 printer properly. Serial (RS-232) To communicate with the Epson serially requires an optional serial interface card to be installed in the Epson.

Features Supported

Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 ______________________ Solid
2 ______   ______   Long Dash
3 . . . . Dotted
4 _____ . _____ . Dash Dotted
5 ___ ___ ___ ___ Medium Dashed
6 _____ . . _____ . . Dash Two Dots
7 _ _ _ _ _ _ _ _ Short Dash

Graphics Text — This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers — The driver supports six kinds of graphic markers, as shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio.

Filled Areas

Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color

The MX-80 printer supports two colors. Index 1 is displayed with the black ribbon and index 0 is not displayed. These colors cannot be redefined.

Alpha Text

Alpha Text can be positioned anywhere on the output page. The following text capabilities are available on the Epson MX-80:

Fonts: 1 = Normal (default)
2 = Bold
3 = Italics

Sizes: 1 = 17.16 characters per inch
2 = 10 characters per inch (default)

Superscript and Subscript

Underline

Overstrike Mode

Pass Through Mode

Alpha Text Quality:
<50 : Turn on bi-direction printing
≥50 : Turn off bi-direction printing

VDI Opcode Summary

The functions available in the GSS VDI for the Epson MX-80 printer are:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation
Open Workstation
Set Alpha Text Position
Set Writing Mode—Mode 4 (replace) and mode 8 (overstrike) are supported
Update Workstation—Causes picture generation subsequent output is overlaid.

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Quality
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings

Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1,-1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Hewlett-Packard 7470A Plotter

File Name	hp7470
Device Type	PLOTTER
Communications	Serial (RS-232) To communicate with the Hewlett Packard 7470A requires that the plotter have the serial interface installed.

Features Supported

Polylines — Lines and arcs can be drawn with the six line styles listed below:

1 ______________________ Solid
2 ______   ______ Long Dash
3 . . . . Dotted
4 _____ . _____ . Dash Dotted
5 ___ ___ ___ ___ Medium Dashed
6 ____ . . ____ . . Dash Two Dots

Graphics Text — The plotter supports continuous character scaling. This text can be rotated in increments of one-tenth of a degree.

Graphics Markers — The driver supports six kinds of graphic markers, as shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio.

Filled Areas — Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of

HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color	Color 1 always is located in pen station 1. It is assumed to be a black pen. By default, color index 2 is located in pen station two. If the user program request is a color index other than what currently is in pen stations one or two, the user is prompted to insert the requested pen into pen station two. Color 0 is not displayed.
Request Locator	The pen holder is used to indicate what point is to input. The pen holder is moved by pressing the position keys on the front panel. When the pen holder is at the desired location, the point can be selected by pressing the Enter button. This causes the coordinates of the point to be transmitted back to the user program.
Alpha Text	Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the plotter:

Fonts: 1 = Normal (default)
2 = Bold
3 = Italics

Sizes: 1 (default = 66 characters down page)

Color

Superscript and Subscript

Overstrike Mode

Underlining

VDI Opcode Summary

The functions available in the GSS VDI for the Hewlett-Packard 7470A plotter are:

Clear Workstation—Ask for paper change
Close Workstation
Open Workstation
Set Alpha Text Position
Set Input Mode—Request mode is only supported mode
Set Pen Speed
Set Writing Mode—Overstrike mode is the only supported mode
Update Workstation—No action is performed

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to plotter with no error checking
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value
Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height

Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Five fonts supported
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input
Input Locator—Request Mode

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Returns (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Hewlett-Packard 7475A Plotter

File Name	hp7475
Device Type	PLOTTER
Communications	Serial (RS-232) To communicate with the Hewlett Packard 7475A requires that the plotter have the serial interface installed.
Features Supported	Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 ____________________ Solid
2 ______   ______   Long Dash
3 . . . .   Dotted
4 _____ . _____ .   Dash Dotted
5 ___ ___ ___ ___   Medium Dashed
6 ____ . . ____ . .   Dash Two Dots
7 _ _ _ _ _ _ _ _   Short Dash

Graphics Text — The plotter supports continuous character scaling. This text can be rotated in increments of one-tenth of a degree.

Graphics Markers — The driver supports six kinds of graphic markers, as shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio for A-size and B-size paper.

Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style: 1 = Narrow diagonal 2 = Medium diagonal 3 = Wide diagonal 4 = Narrow crosshatch 5 = Medium crosshatch 6 = Wide crosshatch

Color

Color indices 1 through 6 are mapped to pen stations 1 through 6 of the plotter. Color 0 is not displayed.

Request Locator

The pen holder is used to indicate what point is to be input. The pen holder is moved by pressing the position keys on the front panel. When the pen holder is at the desired location, the point can be selected by pressing the Enter button. This causes the coordinates of the point to be transmitted back to the user program.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the plotter:

Fonts: 1 = Normal (default)
2 = Bold
3 = Italics

Sizes: 1 (default = 66 characters down page)

Color

Superscript and Subscript

Overstrike Mode

Underlining

Special Information

This driver will drive the plotter in both A and B size modes. The paper size can be selected by setting the rear dip switch or by pressing the Size pushbutton simultaneously with the Enter pushbutton. This should be done prior to running your application.

VDI Opcode Summary

The functions available in the GSS VDI for the Hewlett-Packard 7475A plotter are:

Clear Workstation—Ask for paper change
Close Workstation
Open Workstation
Set Alpha Text Position
Set Input Mode—Request mode is only supported mode
Set Pen Speed
Set Writing Mode—Overstrike mode is the only supported mode
Update Workstation—No action is performed

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to plotter with no error checking
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value

Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Five fonts supported
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input

Input Locator—Request Mode

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Returns (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Houston Instrument DMP-29 Plotter

File Name	hipt29	
Device Type	PLOTTER	
Communications	Serial (RS-232) This interface has a maximum baud rate of 9600. The Input Locator function of the driver will function at a maximum of 1200 baud.	
Features Supported	Polylines	Lines and arcs can be drawn with the six line styles listed below:

1 ________________________ Solid
2 _______   _______ Long Dash
3 . . . . Dotted
4 ______ . ______ . Dash Dotted
5 ___ ___ ___ ___ Medium Dashed
6 _____ . . _____ . . Dash Two Dots

Graphics Text — The plotter supports continuous character scaling. This text can be rotated in increments of one-tenth of a degree.

Graphics Markers — The driver supports six kinds of graphic markers, as shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio.

Filled Areas — Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style

index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color	Color indices 1 through 8 correspond to pen stations 1 through 8 of the plotter. Color 0 is not displayed.
Request Locator	The pen holder is used to indicate what point is to be input. To input a point, first the Local button must be pressed so that the plotter can be operated manually. Then the pen holder is moved by pressing the position keys on the front panel. When the pen is at the desired location, the point can be selected by pressing the Report Status button. This causes the coordinates of the point to be transmitted back to the user program. Then the Remote button must be pressed to return control back to the user program.
Alpha Text	Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the plotter: Fonts: 1 = Normal (default) 2 = Bold 3 = Italics Sizes: 1 (default = 66 characters down page) Color Superscript and Subscript

Overstrike Mode

Underlining

Special Information

This driver drives the plotter in large paper mode only.

VDI Opcode Summary

The functions available in the GSS VDI for the Houston Instrument DMP-29 plotter are:

Clear Workstation—Ask for paper change
Close Workstation
Open Workstation
Set Alpha Text Position
Set Input Mode—Request mode is the only supported mode
Set Pen Speed
Set Writing Mode—Overstrike mode is the only supported mode
Update Workstation—No action is performed

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to plotter with no error checking
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value
Set Alpha Text Quality- Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation

Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Five fonts supported
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input
Input Locator—Request Mode

Inquiries
Inquire Alpha Text capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Returns (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes

NEC Model 7730 Letter Quality Printer

File Name	nec7730
Device Type	PRINTER
Communications	Parallel A Centronics standard parallel cable will operate the NEC printer properly.
Features Supported	Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 ______________________ Solid
2 ______   ______ Long Dash
3 . . . . Dotted
4 _____ . _____ . Dash Dotted
5 ___ ___ ___ ___ Medium Dashed
6 _____ . . _____ . . Dash Two Dots
7 _ _ _ _ _ _ _ _ Short Dash

Graphics Text — This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers — The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas	Filled areas, bars, pie slices, and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style: 1 = Narrow diagonal 2 = Medium diagonal 3 = Wide diagonal 4 = Narrow crosshatch 5 = Medium crosshatch 6 = Wide crosshatch

Color

The NEC printer supports two colors. Index 1 is displayed with the black ribbon and index 0 is not displayed. These colors cannot be redefined.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the NEC printer:

Fonts: 1 = Normal (default)
2 = Bold

Sizes: 1 = Courier 10 Thimble (10 cpi)

Superscript and Subscript

Underline

Overstrike Mode

Pass Through Mode

Alpha Text Quality:
<50 : Turn on bi-direction printing
≥ 50 : Turn off bi-direction printing

VDI Opcode Summary

The functions available in the GSS VDI for the NEC 7730 Printer are:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation
Open Workstation—Advances the paper
Set Alpha Text Position
Set Writing Mode—Mode 4 (replace) and mode 8 (overstrike) are supported
Update Workstation—Causes picture generation; subsequent output is overlaid.

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Quality
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style

Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

NEC Model 3550 Letter Quality Printer

File Name	nec3550	
Device Type	PRINTER	
Communications	Parallel A Centronics standard parallel cable will operate the NEC printer properly.	
Features Supported	Polylines	Lines and arcs can be drawn with the seven line styles listed below:

1 ____________________ Solid
2 ______   ______ Long Dash
3 . . . . Dotted
4 _____   . _____   . Dash Dotted
5 ___   ___   ___   ___ Medium Dashed
6 ____ . . ____ . . Dash Two Dots
7 _ _ _ _ _ _ _ _ _ Short Dash

Graphics Text	This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.
Graphic Markers	The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas

Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color

The NEC printer supports two colors. Index 1 is displayed with the black ribbon and index 0 is not displayed. These colors cannot be redefined.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the NEC printer:

Fonts: 1 = Normal (default)
2 = Bold
4 = Proportionally spaced
5 = Bold proportionally spaced

Sizes: One size supported—Courier 10 Thimble (10 cpi, constant spacing) or Bold PS Thimble (proportional spacing)

Superscript and Subscript

Underline

Overstrike Mode

Pass Through Mode

Alpha Text Quality:
<50 : Turn on bi-direction printing
≥50 : Turn off bi-direction printing

Special Information	When a proportionally spaced alpha text font is desired, the user will be prompted to place the proportional space thimble into the NEC 3550, set the front switches correctly, and turn the power to the printer off and on.
VDI Opcode Summary	The functions available in the GSS VDI for the NEC 3550 Printer are:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation
Open Workstation—Advances the paper
Set Alpha Text Position
Set Writing Mode—Mode 4 (replace) and mode 8 (overstrike) are supported
Update Workstation—Causes picture generation; subsequent output is overlaid.

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Quality
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation

Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Nicolet Zeta 8 Plotter

File Name	zeta8
Device Type	PLOTTER
Communications	Serial (RS-232) Communication with the Nicolet Zeta 8 plotter is accomplished through the modem port J102.

Features Supported

Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 ______________________ Solid
2 ______   ______ Long Dash
3 . . . . Dotted
4 _____ . _____ . Dash Dotted
5 ___ ___ ___ ___ Medium Dashed
6 _____ . . _____ . . Dash Two Dots
7 _ _ _ _ _ _ _ _ Short Dash

Graphics Text — The plotter supports continuous character scaling. This text can be rotated in increments of one degree.

Graphics Markers — The driver supports six kinds of graphic markers, as shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio.

Filled Areas — Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style

index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color	Color indices 1 through 8 are mapped to pen stations 1 through 8 of the plotter. Color 0 is not displayed.
Alpha Text	Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the plotter:

Fonts: 1 = Normal (default)
2 = Bold

Sizes: 1 (default = 66 characters down page)

Color

Superscript and Subscript

Overstrike Mode

Underlining

Special Information	This driver expects the plotter to be set to use mode 0 (GML/RS-232). The switch settings are shown below.

Switch 1
1—ON (plot speed fast)
2—OFF (non-correct)
3—ON (plot on)
4—OFF (non-print)

Switch 2
1—ON (Inch resolution)
2—ON (High resolution)

3—OFF (Monitor echo off)
4—OFF (No Line Turnaround Delay)
5—OFF (No parity)
6—Don't care
7—OFF (CTS/RTS with sw1-2 set to OFF)
8—Reserved

Switch 3
1—OFF (GML mode)
2—OFF (GML mode)
3—OFF (GML mode)
4—OFF (select limit)
5—ON (virtual limit)
6—OFF (multiple pen)
7—OFF (ASA page size)
8—OFF (auto-sense pen pressure)

Switch 4
A—8 (9600 baud)
B—3 (pen pressure)

VDI Opcode Summary

The functions available in the GSS VDI for the Nicolet Zeta 8 plotter are:

Clear Workstation—Advance paper
Close Workstation—Advance paper
Open Workstation
Set Alpha Text Position
Set Input Mode—Request mode is only supported mode
Set Pen Speed
Set Writing Mode—Overstrike mode is the only supported mode
Update Workstation—No action is performed

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to plotter with no error checking

Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value
Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—One font supported
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Returns (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Okidata Microline 93
Okidata Microline 84 with Step 2 Support

File Name	okid84
Device Type	PRINTER
Communications	Parallel A Centronics standard parallel cable will operate the Okidata printer properly.

Features Supported

Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text — This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers — The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

	Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style: 1 = Narrow diagonal 2 = Medium diagonal 3 = Wide diagonal 4 = Narrow crosshatch 5 = Medium crosshatch 6 = Wide crosshatch

Color

The Okidata printers support two colors. Index 1 is displayed with the black ribbon and index 0 is not displayed. These colors cannot be redefined.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the Okidata printers:

Fonts: 1 = Normal (default)
2 = Bold

Sizes: 1 = 17 characters per inch
2 = 12 characters per inch
3 = 10 characters per inch (default)

Superscript and Subscript

Underline

Overstrike Mode

Pass through Mode

Alpha Text Quality:
<50 : Enable Data Processing Mode
≥50 : Enable Correspondence Quality Mode

VDI Opcode Summary

The functions available in the GSS VDI for the Okidata 93 and 84 printers are:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation
Open Workstation—Advances paper
Set Alpha Text Position
Set Writing Mode—Mode 4 (replace) and mode 8 (overstrike) are supported
Update Workstation—Causes picture generation; subsequent output is overlaid.

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Quality
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style

Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1,-1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Okidata Microline 92

File Name	okid92
Device Type	PRINTER
Communications	Parallel A Centronics standard parallel cable will operate the Okidata printer properly.
Features Supported	**Polylines** Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style: 1 = Narrow diagonal 2 = Medium diagonal 3 = Wide diagonal 4 = Narrow crosshatch 5 = Medium crosshatch 6 = Wide crosshatch

Color

The Okidata printer supports two colors. Index 1 is displayed with the black ribbon and index 0 is not displayed. These colors cannot be redefined.

Alpha Text

Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the Okidata printer:

Fonts: 1 = Normal (default)
2 = Bold

Sizes: 1 = 17 characters per inch
2 = 12 characters per inch
3 = 10 characters per inch (default)

Superscript and Subscript

Underline

Overstrike Mode

Pass Through Mode

Alpha Text Quality:
<50 : Enable Data Processing Mode
≥50 : Enable Correspondence Quality Mode

VDI Opcode Summary

The functions available in the GSS VDI for the Okidata 92 Printer are:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation
Open Workstation—Advances the paper
Set Alpha Text Position
Set Writing Mode—Mode 4 (replace) and mode 8 (overstrike) are supported
Update Workstation—Causes picture generation; subsequent output is overlaid.

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to printer immediately
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Output
Set Alpha Text Color—Returns default setting (1)
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Quality
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index

Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1,-1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Printronix MVP Printer
Printronix P300 Printer
Printronix P600 Printer

File Name	prntrx
Device Type	PRINTER
Communications	Serial (RS-232) To communicate to the Printronix Printers requires that the printers have an RS-232 serial interface installed.
Features Supported	Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text — This printer supports twelve character sizes with a Preserve Aspect Ratio and twelve sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphic Markers — The driver supports six kinds of graphic markers, as shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio.

Filled Areas — Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color — The Printronix supports two colors. Index 1 is displayed with the black ink and index 0 is not displayed.

These colors cannot be redefined.

Alpha Text — Alpha text is generated in the Printronix Printer PLOT Mode using a 5 x 7 dot matrix pattern character font. Alpha Text can be positioned anywhere on the output page. The following text capabilities are available on the Printronix printers:

Fonts: 1—Normal (default)

Sizes: 1-10 characters per inch

Superscript and Subscript

Underline

Overstrike Mode

Pass Through Mode

Special Information

This driver allows the user to change the paper width independently. The valid options for paper are WIDE (13 inch output) and NARROW (8 inch output). The default is Narrow paper.

The paper width option can be changed via the ENVIRONMENT capability of UNIX. To change the paper size enter one of the following commands at the UNIX command level:

```
PAPER=WIDE
export PAPER
PAPER=NARROW
export PAPER
```

VDI Opcode Summary

The functions available in the GSS VDI for the Printronix Printers are:

Clear Workstation—Causes picture generation; advances paper
Close Workstation—Causes picture generation
Open Workstation—Advances the paper
Set Alpha Text Position
Writing Mode—All sixteen writing modes are supported
Update Workstation—Causes picture generation; subsequent output is overlaid.

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes

Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation—Returns default settings
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Will return (-1,-1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Strobe Model 100—Single pen Plotter
Strobe Model 200—Single pen Plotter
Strobe Model 260—Eight pen Plotter

File Name	strobe
Device Type	PLOTTER
Communications	Serial (RS-232) Communication with the Strobe plotters requires that the serial interface be installed.
Features Supported	Polylines — Lines and arcs can be drawn with the seven line styles listed below:

1 ______________________ Solid
2 ______ ______ Long Dash
3 . . . . Dotted
4 _____ . _____ . Dash Dotted
5 ___ ___ ___ ___ Medium Dashed
6 ____ . . ____ . . Dash Two Dots
7 _ _ _ _ _ _ _ _ Short Dash

Graphics Text — The plotter supports continuous character scaling. This text can be rotated in increments of ninety degrees.

Graphics Markers — The driver supports six kinds of graphic markers, as shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio.

Filled Areas — Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color — Nine color indices are allowed. Color indices 1 to 8 refer to pen stations 1 to 8 on the model 260. Models 100 and 200 issue a pen change prompt for color changes and will continue on a carriage return. Color 0 is not displayed.

Request Locator — The pen holder is used to indicate what point is to be input. The pen holder is moved by pressing the position keys on the front panel. When the pen holder is at the desired location, the point can be selected by pressing the START/ENTER button. This causes the coordinates of the point to be transmitted back to the user program.

Alpha Text — Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the plotter:

Fonts: 1 = Normal (default)
2 = Bold

Sizes: 1 (default = 52 characters down page)

Color

Superscript and Subscript

Overstrike Mode

Underlining

Special Information

The pen position must be set at the lower left corner of the plotting surface prior to performing Open Workstation. Performing an Open Workstation on the model 100 and 200 sets the pen origin to the current pen position.

VDI Opcode Summary

The functions available in the GSS VDI for the Strobe plotter are:

Clear Workstation—Ask for paper change
Close Workstation
Open Workstation
Set Alpha Text Position
Set Input Mode—Request mode is only supported mode
Set Pen Speed—One speed only
Set Writing Mode—Overstrike mode is the only supported mode
Update Workstation—No action is performed

Output
Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array—Outlines the area, no other action
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text—Transmits string to plotter with no error checking
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode

Set Alpha Text Pass Through Mode
Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Four fonts supported
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input
Input Locator—Request Mode

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells—Returns (-1, -1) to indicate no cursor addressing functions
Inquire Color Representation
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Summagraphics Summatablet

File Name	summatb
Device Type	TABLET
Communications	Serial (RS-232)
Request Locator	When locator is invoked via the tablet, a tracking cross appears at the center of the screen of the output echo device. As the tablet's puck is moved across the tablet surface its position is shown by the tracking cross on the display. When the cross is at the desired location, that point can be selected by pressing one of the buttons on the puck. This causes the coordinates of the point to be transmitted back to the user program along with an ASCII character code for the button(s) pressed. The character codes associated with the buttons are as follows:

Character	Left	Middle	Right
<space>	×		
!		×	
"			×
#	×	×	
$	×		×
%		×	×
'	×	×	×

If desired, the output echo device will perform an inking function. When the locator is terminated, a line from the initial position to the desired position is drawn. The current line attributes of the output echo device, such as color and line style, are honored.

Also the output echo device performs rubberbanding if desired. There are two types of rubberbanding supported, line and rectangle. If rubberbanding lines are desired, then a line will be drawn from the initial locator position to the current position of the graphics cursor. The line changes dynamically as the cursor is moved. When the locator is terminated, the line is removed.

If rubberband rectangle is specified, a rectangle is displayed with one corner at the initial locator position and the opposite at the current position of the graphics cursor. The rectangle changes dynamically as the cursor is moved. When the locator is terminated, the rectangle is removed from the display.

Special Information

This driver is an input only device and must be used in conjunction with an output echo display device.

VDI Opcode Summary

The functions available in the GSS VDI for the Summatablet are:

Close Workstation
Open Workstation
Set Input Mode—Request mode is the only
    supported mode

Input
Input Locator—Request Mode

Tektronix 4105 Color Graphics Terminal

File Name	tek4105
Device Type	DISPLAY
Maximum Baud Rate	38400
Communications	Serial (RS-232)

Features Supported

Polylines — Lines and arcs can be drawn with the seven line styles listed below:

```
1 ______________________ Solid
2 ______      ______     Long Dash
3 .  .  .  .  .  .  .  . Dotted
4 _____    .  _____    . Dash Dotted
5 ___   ___   ___   ___  Medium Dashed
6 ____   . .  ____   . . Dash Two Dots
7 _ _ _ _ _ _ _ _ _ _ _  Short Dash
```

Graphics Text — This terminal supports 58 character sizes. There is one base cell size for the smallest character. All other character sizes are multiples of the base size. The text characters can be rotated on 0, 90, 180, and 270 degree base lines.

Graphics Markers — The driver supports a total of eleven markers, however, only the first six markers map to the VDI. All eleven markers are of a single size, and are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond
7 = Period
8 = Square

9 = Square w/ black dot in center
10 = Solid Diamond
11 = Square w/ white dot in center

Filled Areas — Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, PATTERN, and HATCH are all supported by this device. The interior style of HOLLOW is simulated by drawing vectors. The interior style of SOLID causes the solid fills of the device to be mapped to the VDI for color and index number. Sixteen device-dependent fill styles are available for the fill interior style of PATTERN (See Appendix J of the operators manual). Six different fill styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color — The Tektronix 4105 terminal supports eight simultane- ously displayable colors. Each color index can be remapped to a new color via the Set Color Representation command. There are a total of 64 colors available for mapping.

Request Locator — When locator is invoked, a tracking cross appears on the display at the initial locator position. The cross can be moved by using the joydisk on the 4105 keyboard.

Initially, the cross moves in large increments. Holding down the shift key will cause the cross to move slower. When the cross is at the desired location, that point can be selected by pressing any alpha key on the keyboard. This causes the coordinates of the point to be transmitted back to the user program.

If desired, the device will perform an inking function. When the locator is terminated, a line from the initial position to the desired position is drawn honoring the current line attributes such as color and line style.

Request Choice	The function keys F1 to F8 on the keyboard are used to enter choice input.
Request String	The keyboard is used to enter strings. All strings are terminated with the Return key.
Cursor Addressable Text	Cursor addressable text is supported. The terminal must be in Cursor Addressing Mode before it can perform any cursor control functions. The following attributes are supported:

Reverse Video

Blink

Underline

Bold Intensity uses index 2

Color—Foreground and Background

Color Index
- 0 = Black
- 1 = White
- 2 = Red
- 3 = Green
- 4 = Blue
- 5 = Yellow
- 6 = Cyan
- 7 = Magenta

To display graphics primitives, the device must be removed from Cursor Addressing Mode.

Alpha Text	Alpha text can be positioned anywhere on the output page. The following text capabilities are available: One Font One Size Superscript and Subscript Bold Underline Line spacing Eight colors
VDI Opcode Summary	The functions available in the GSS VDI for the Tektronix 4105 terminal driver are: Clear Workstation Close Workstation Cursor Down Cursor Left Cursor Right Cursor Up Direct Cursor Address Enter Cursor Addressing Mode Erase to End of Line Erase to End of Screen Exit Cursor Addressing Mode Hardcopy—issues a screen hard copy command to the terminal Home Cursor Open Workstation Set Alpha Text Position Set Input Mode Set Line Edit Characters Set Writing Mode—Overstrike and REPLACE (index 4 and 8) mode are supported Update Workstation **Primitives** Arc (uses polyline attributes) Bar (uses filled area attributes) Cell Array Circle (uses filled area attributes) Filled Area

Graphics Text
Output Alpha Text
Output Cursor Addressable Text
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes
Reverse Video Off
Reverse Video On
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value
Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Background Color Index
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation
Set Cursor Text Attributes
Set Cursor Text Color Indices
Set Fill Color Index
Set Fill Interior Style
Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input
Input Locator—Request Mode
Input Choice—Request Mode
Input String—Request Mode
Read Cursor Movement Keys

Inquiries

Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells
Inquire Color Representation
Inquire Current Cursor Address
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

Virtual Device Metafile (VDM)

File Name
ddmeta (device driver)

Device Type
METAFIL The default output metafile name is METAFILE.DAT. This name can be changed with the following commands:

```
METAOUTPUT=filename
export METAOUTPUT
```

Communications
Not applicable

Maximum Baud Rate
Not applicable

Features Supported

Polylines: The six line styles listed below are guaranteed by the interpreter. Other index values are device-dependent.

1	Solid
2	Long Dash
3	Dotted
4	Dash Dotted
5	Medium Dashed
6	Dash Two Dots
7	Short Dash

Metafile supports sixteen polyline colors (assigned in a color table) and many (32767) line widths.

Graphics Text: Metafile supports many fonts, sizes and rotations (32767). Metafile supports 256 text colors, assigned in the color table. When the metafile device is opened via the Open Workstation opcode, the coordinate transform mode should be set to preserve aspect ratio (1) to ensure that the metafile can be transported and displayed correctly on other devices.

Graphics Markers	Metafile supports six styles, 256 colors and many (32767) marker sizes. 1 = Dot 2 = Cross 3 = Star 4 = Circle 5 = X 6 = Diamond
Filled Areas	Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style: 1 = Narrow diagonal 2 = Medium diagonal 3 = Wide diagonal 4 = Narrow crosshatch 5 = Medium crosshatch 6 = Wide crosshatch

Color

A color is selected by an index. The user can change the appearance of a color by selecting desired levels of the three color components: red, green and blue, that will make up the index. This can be used to create non-default colors such brown or orange. This new color will only be visible on color devices that allow color definition.

The metafile supports 256 color indices with many levels of red, green and blue.

The default colors are:

0 = Black
1 = White
2 = Red
3 = Green
4 = Blue
5 = Yellow
6 = Cyan
7 = Magenta
8-15 = White

Raster Writing

Raster writing modes define how pixels are MODES set in the bit map. All sixteen raster writing modes (Boolean operations between source and destination pixels) are supported by the metafile.

Cursor Addressable Text

The following attributes are supported:

Reverse Video
Blink
Bold Intensity
Color—Expanded palette
0 = Black
1 = White
2 = Red
3 = Green
4 = Blue
5 = Yellow
6 = Cyan
7 = Magenta
8-15 = White

To display graphics primitives, the device must be removed from Cursor Addressing Mode.

Alpha Text

The following capabilities are supported:

Underline

Line spacing

Superscript and Subscript

Overstrike

VDI Opcode Summary

The functions available in the VDI for the VDM are:

Open Workstation
Close Workstation
Clear Workstation
Update Workstation—No action is performed
Exit Cursor Addressing Mode
Enter Cursor Addressing Mode
Cursor Up
Cursor Down
Cursor Left
Cursor Right
Home Cursor
Erase to End of Screen
Erase to End of Line
Direct Cursor Address
Set Writing Mode
Output Alpha Text
Output Cursor Addressable Text
Set Pen Speed

Primitives
Polyline
Polymarker
Graphics Text
Filled Area
Cell Array
Generalized Drawing Primitives
Bar
Arc
Pie Slice
Circle

Attributes
Set Background Index
Reverse Video On
Reverse Video Off
Set Cursor Text Attributes
Set Cursor Text Color Indices
Set Alpha Text Line Spacing
Set Alpha Text Font and Size
Set Alpha Text Color Index
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode

Set Alpha Text Position
Set Alpha Text Quality
Set Alpha Text Subscript/Superscript Mode
Set Alpha Text Underline Mode
Set Character Height
Set Graphics Text String Baseline Rotation
Set Color Representation
Set Polyline Line Type
Set Polyline Line Width
Set Polyline Color Index
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index
Set Graphics Text Alignment
Set Graphics Text Font
Set Text Color Index
Set Fill Interior Style
Set Fill Style Index
Set Fill Color Index

Inquiries
Inquire Addressable Character Cells
Inquire Alpha Text Font Availability
Inquire Alpha Text Capabilities
Inquire Alpha Text String Length
Inquire Alpha Text Cell Location
Inquire Alpha Text Position
Inquire Color Representation
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes

VT100 Terminal with Retro-Graphics Card

File Name	vt100ret
Device Type	DISPLAY
Communications	Serial (RS-232)

Features Supported

Polylines Lines and arcs can be drawn with the seven line styles listed below:

1 Solid
2 Long Dash
3 Dotted
4 Dash Dotted
5 Medium Dashed
6 Dash Two Dots
7 Short Dash

Graphics Text This printer supports four character sizes with a Preserve Aspect Ratio and four sizes in a Non-preserve Aspect Ratio. Note that these graphics text characters cannot be rotated.

Graphic Markers The driver supports six kinds of Graphic Markers. Each marker has five possible sizes in Preserve Aspect Ratio and five sizes in Non-preserve Aspect Ratio. The six kinds of markers are shown in the following list:

1 = Dot
2 = Cross
3 = Star
4 = Circle
5 = X
6 = Diamond

Filled Areas Filled areas, bars, pie slices and circles are all displayed using the current fill area attributes of color, interior style, and style index. The interior styles of

HOLLOW, SOLID, and HATCH are all supported by this device. The interior style of PATTERN is mapped to the HATCH interior style. Six different styles are supported for the HATCH interior style:

1 = Narrow diagonal
2 = Medium diagonal
3 = Wide diagonal
4 = Narrow crosshatch
5 = Medium crosshatch
6 = Wide crosshatch

Color	The VT100 with Retro-Graphics supports two colors. Index 1 is displayed as the foreground color (white) and index 0 is displayed as the background color (black). These colors cannot be remapped.
Request Locator	When locator is invoked on the Retro-Graphics card a tracking cross appears on the display at the initial locator position. The cross can be moved by pressing one of the arrow keys on the keyboard. Initially, the cross moves in small increments. Holding the arrow key down will cause the cross movement to speed up after a short pause. When the cross is at the desired location, that point can be selected by pressing any alpha key on the keyboard. This causes the coordinates of the point to be transmitted back to the user program. If desired, the device will perform an inking function. When the locator is terminated, a line from the initial position to the desired position is drawn honoring the current line attributes such as color and line style.
Request Choice	The numeric keys 0 to 9 on the keyboard are used to enter choice input.
Request String	The keyboard is used to enter strings. All strings are terminated by the Enter key.

Cursor Addressable Text	Cursor addressable text is supported. The Text device must be in Cursor Addressing Mode before it can perform any cursor control functions. The following attributes are supported:

Reverse Video

Underline

Blink

Note

Underline or Reverse video may not be active at the same time. The block cursor will allow reverse and the bar cursor will allow underline.

Alpha Text	Alpha text can be positioned anywhere on the output page. The following text capabilities are available on the Retro-Graphics card:

One Font

One Size

Superscript and Subscript

Underline

Line spacing

VDI Opcode Summary	The functions available in the GSS VDI for the VT100 driver are:

Clear Workstation
Close Workstation
Cursor Down
Cursor Left
Cursor Right
Cursor Up
Direct Cursor Address
Enter Cursor Addressing Mode
Erase to End of Line
Erase to End of Screen
Exit Cursor Addressing Mode
Home Cursor
Open Workstation

Remove Graphics Input Cursor
Set Alpha Text Position
Set Input Mode
Set Line Edit Characters
Set Writing Mode—The following modes are supported:
1—Clear (Color 0)
7—XOR
16—All bits on (Color 255)
Update Workstation—No action is performed

Primitives

Arc (uses polyline attributes)
Bar (uses filled area attributes)
Cell Array
Circle (uses filled area attributes)
Filled Area
Graphics Text
Output Alpha Text
Output Cursor Addressable Text
Pie Slice (uses filled area attributes)
Polyline
Polymarker

Attributes

Reverse Video Off
Reverse Video On
Set Alpha Text Color
Set Alpha Text Font and Size
Set Alpha Text Line Spacing
Set Alpha Text Overstrike Mode
Set Alpha Text Pass Through Mode—Returns default value
Set Alpha Text Quality—Returns default value
Set Alpha Text Script Mode
Set Alpha Text Underline Mode
Set Background Color Index
Set Graphics Text String Baseline Rotation
Set Character Height
Set Color Representation
Set Cursor Text Attributes
Set Cursor Text Color Indices
Set Fill Color Index
Set Fill Interior Style

Set Fill Style Index
Set Graphics Text Alignment
Set Graphics Text Color Index
Set Graphics Text Font—Returns default setting
Set Polyline Color Index
Set Polyline Type
Set Polyline Width—Returns default setting
Set Polymarker Type
Set Polymarker Scale
Set Polymarker Color Index

Input
Input Locator—Request Mode
Input Choice—Request Mode
Input String—Request Mode
Input String—Sample Mode
Read Cursor Movement Keys

Inquiries
Inquire Alpha Text Capabilities
Inquire Alpha Cell Location
Inquire Alpha Font Availability
Inquire Alpha Text Position
Inquire Alpha String Extent
Inquire Addressable Character Cells
Inquire Color Representation
Inquire Current Cursor Address
Inquire Current Fill Area Attributes
Inquire Current Graphics Text Attributes
Inquire Current Polyline Attributes
Inquire Current Polymarker Attributes

ASCII Code Chart

The following table is intended as a convenience, to provide you with the ASCII Character Codes that are used throughout the computer industry.

CONTROL		NUMBERS SYMBOLS		UPPER CASE		LOWER CASE	
NUL 0	DLE 16	SP 32	0 48	@ 64	P 80	‘ 96	p 112
SOH 1	DC1 17	! 33	1 49	A 65	Q 81	a 97	q 113
STX 2	DC2 18	” 34	2 50	B 66	R 82	b 98	r 114
ETX 3	DC3 19	# 35	3 51	C 67	S 83	c 99	s 115
EOT 4	DC4 20	$ 36	4 52	D 68	T 84	d 100	t 116
ENQ 5	NAK 21	% 37	5 53	E 69	U 85	e 101	u 117
ACK 6	SYN 22	& 38	6 54	F 70	V 86	f 102	v 118
BEL BELL 7	ETB 23	’ 39	7 55	G 71	W 87	g 103	w 119
BS BACKSPACE 8	CAN 24	(40	8 56	H 72	X 88	h 104	x 120
HT 9	EM 25	) 41	9 57	I 73	Y 89	i 105	y 121
LF 10	SUB 26	* 42	: 58	J 74	Z 90	j 106	z 122
VT 11	ESC 27	+ 43	; 59	K 75	[91	k 107	{ 123
FF 12	FS 28	, 44	< 60	L 76	\ 92	l 108	¦ 124
CR RETURN 13	GS 29	- 45	= 61	M 77	] 93	m 109	} 125
SO 14	RS 30	. 46	> 62	N 78	∧ 94	n 110	~ 126
SI 15	US 31	/ 47	? 63	O 79	_ 95	o 111	RUBOUT (DEL) 127

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