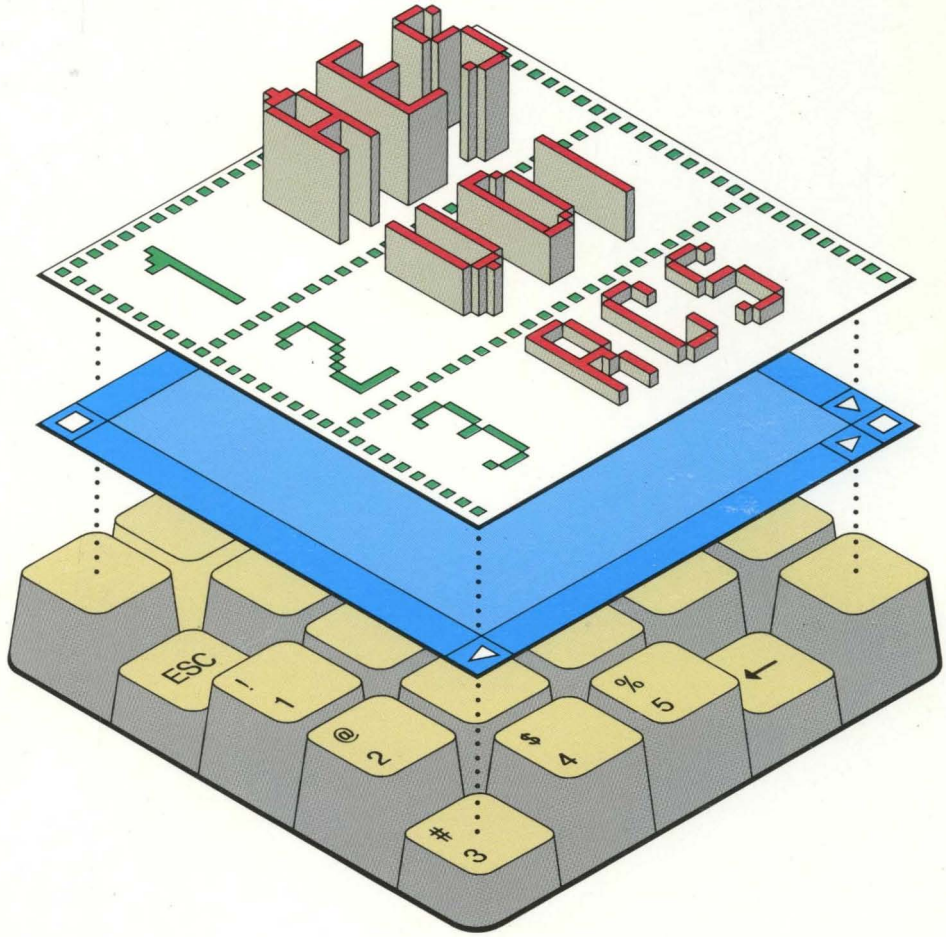
GEM Programmer's Toolkit™



Vol 2
GEM™ VDI

GEM™

Virtual Device Interface

Reference Guide

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Foreword

This guide is intended for microcomputer application programmers with operating system and graphics programming experience. It describes the GEM™ Virtual Device Interface (VDI) features, operation, and applications interface. The GEM VDI provides a device-independent environment in which to write graphics applications that can run under the most widely used operating systems.

GEM VDI provides a device-independent software interface for your application programs. You do not need to rewrite applications for use with different output devices such as screens, printers, and plotters. GEM VDI handles device differences, making it possible for you to send information to the devices through the application program as if the devices were the same. GEM VDI handles graphics requests and supplies the right driver to run the specific device. The GEM VDI specifies the calling sequence to access device driver functions as well as the necessary calling parameters.

The GEM VDI package contains drivers for many of the most popular microcomputer-related graphics devices.

You can write application programs in assembly language or in a high-level language that supports the GEM VDI calling conventions. You can compile or assemble and link programs containing GEM VDI calls in the normal manner.

This guide contains nine sections, seven appendices, and an index.

- Section 1 introduces the GEM VDI.
- Section 2 describes GEM VDI operating procedures, lists the functions that the VDI requires for each device, and details the VDI calling conventions.
- Sections 3 through 9 describe the various GEM VDI functions.
- Appendix A lists and describes the GEM VDI error messages.
- Appendix B describes the format of a metafile.

- Appendix C describes the reserved metafile sub-opcodes.
- Appendix D defines the GEM VDI standard keyboard.
- Appendix E describes entry into the GEM VDI for specific operating systems and microprocessor-specific calling procedures.
- Appendix F describes the system font character sets and the font file format.
- Appendix G describes the format of a bit image file.

The function reference table at the end of this guide lists the GEM VDI functions according to their opcode number and gives their respective C binding procedure names.

Note that throughout the remainder of this guide the term "VDI" is used to refer to the GEM Virtual Device Interface.

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Overview

The GEM VDI provides graphics primitives for implementing graphics applications with reduced programming effort. Application programs interface to the VDI through a standard calling sequence. Drivers for specific graphics devices translate the standard VDI calls into the unique characteristics of each device. In this way, the VDI provides device independence.

The GEM VDI consists of two components: the Graphics Device Operating System (GDOS) and the device drivers and their associated font files.

The GDOS contains the device-independent graphics functions, while the device drivers and font files contain the device-dependent code.

Graphics Device Operating System

The GDOS contains the basic host and device-independent graphics functions that can be called by your application program. Your application program accesses the GDOS in much the same way that it accesses the operating system.

The GDOS performs coordinate scaling so that your application can specify points in a normalized space. It uses device-specific information to transform coordinates into the corresponding values for a particular graphics device.

An application can also specify points in raster coordinate space, in which case no transformation occurs.

Device Drivers

The graphics device drivers are similar to the drivers in any I/O system. They contain the device-specific code required to interface particular graphics devices to the GDOS. The device drivers communicate directly with the graphics devices. The VDI requires a unique device driver for each graphics device in the system.

The GEM VDI package contains drivers for the most popular microcomputer graphics devices, including screens, printers, plotters, and special cameras.

A single program can use several graphics devices; the GDOS loads only the appropriate device driver file into memory. By referring to devices with a device identification number, an application program can send graphics information to any one of several memory-resident device drivers.

A device driver produces graphics primitives according to the inherent capabilities of a particular graphics device. In some cases, a device driver emulates standard capabilities not provided by the graphics device hardware. For example, some devices require that dashed lines be simulated by a series of short vectors generated in the device driver.

See "Required Functions" in Section 2 for a list of the functions that the VDI requires each driver to support.

Opcodes

Each VDI function is associated with an operation code (opcode). A calling routine indicates the graphics function to be performed by a device driver by specifying the function's opcode.

References to VDI functions in this document include the function's opcode in hexadecimal notation; for example, "v_opnwk (1H)" refers to the Open Workstation function, whose opcode is one.

Metafiles

A metafile is the stored generic form of a picture file. Any VDI application can create a GEM VDI metafile that can later be called into another graphics application. The metafile driver stores a description of a picture in a data file. These files can later be sent to any device or used to exchange a picture between two compatible applications.

When the VDI creates a metafile, it provides the ideal device (one with square pixels). Although their origins are different, Normalized Device Coordinates (NDC) and Raster Coordinates (RC) have the same range (0 to 32767). No coordinate transformation is applied. "Coordinate Systems," later in this section, offers more information on the coordinate spaces.

Refer to Appendix B for information about the metafile format.

Device Handles

Because the VDI allows multiple workstations to be open at the same time, each VDI function must be provided with a unique reference to the desired device. This identification is an signed WORD value referred to as the device handle.

The GDOS returns the device handle when an application calls v_opnwk (1H), the Open Workstation function, or v_opnwvk (64H), the Open Virtual Workstation function. Routines that make subsequent calls to select a previously opened device must supply the device handle as an input argument.

The Assignment File, ASSIGN.SYS

The ASSIGN.SYS file lists the device driver filenames, their associated font filenames, device identification numbers, and any device-specific information. ASSIGN.SYS is a text file that can be created or edited using any text editor. Device ID numbers are assigned according to their type; Table 1-1 lists the device ID numbers.

The GDOS parses ASSIGN.SYS to create the assignment table, which it stores in memory to reference whenever an open workstation function is called.

You can include the R command in ASSIGN.SYS to make a driver memory resident. To do so, place "R" after the device identification number of the driver you want resident. See the example that follows Listing 1-1. The opening comments in Listing 2-1 also include an example.

Table 1-1. Device Identification Numbers

Device Type	Device ID Number
Screen	01-10
Plotter	11-20
Printer	21-30
Metafile	31-40
Camera	41-50
Tablet	51-60

Device Driver Filename

A device driver filename contained in ASSIGN.SYS must follow specific naming conventions:

- It must have eight or fewer characters
- Its first character must be alphabetic
- The file's extension must be SYS

Sample ASSIGN.SYS

Listing 1-1 shows the format of ASSIGN.SYS.

Listing 1-1. Sample ASSIGN.SYS

```
21 printer.sys
;comments, if desired
font1.fnt    ;font1 description
font2.fnt    ;font2 description
font3.fnt    ;font3 description
01 screen.sys
;comments, if desired
font4.fnt    ;font4 description
font5.fnt    ;font5 description
11 plotter.sys
;comments, if desired
font6.fnt    ;font6 description
font7.fnt    ;font7 description
```

If included in the ASSIGN.SYS file, the following command would make the screen driver memory resident:

```
01R screen.sys
```

The VDI Entry Point

The VDI specifies the calling sequence and required parameters for access to the device driver functions.

The main entry point into the VDI is a single subroutine with five arguments, in the form of five arrays:

- the control array
- the array of integer input parameters
- the array of input point coordinates
- the array of integer output parameters
- the array of output point coordinates

All array elements are WORD integers (two bytes). All arrays are zero-based. The content of the input and output parameter arrays is function dependent, and is included in the description of each function. "Function Parameters" in Section 2 contains more complete information about the format of the VDI function parameters.

See Appendix E for more detailed information about the microprocessor- and operating system-specific entry points into the VDI.

Coordinate Systems

All computer graphics are displayed using a coordinate system. The VDI verifies that the coordinate system of one device matches the coordinate system of another.

You can address the display surface using one of two coordinate systems:

- Normalized Device Coordinates (NDC)
- Raster Coordinates (RC)

The transformation mode, which the calling routine specifies when it opens a workstation, determines which coordinate system the application is to use.

Normalized Device Coordinates -- Transformation Mode 0

In the NDC system, coordinates range from 0,0 (lower left corner) to 32767,32767 (xmax,ymax in the upper right corner). The NDC system addresses the graphics display in units that are independent of the device coordinate size. These units are then transformed to Raster Coordinates by the GDOS when an application specifies transformation mode 0.

The full scale of NDC space (0-32767) is mapped to the full dimensions of the device on both axes. On a nonsquare display with square pixels, a different scale factor is applied to each axis with this transformation mode.

When transforming from NDC to RC, the GDOS assumes a raster coordinate at the lower left edge of a pixel. You should compensate for a boundary condition created at the top edge of NDC space.

For example, suppose that the NDC point (32767, 32767) maps to the RC point (0, 200). Because pixels are addressed at their lower left corner, the NDC point (32766, 32766) would map to the RC point (1, 199). You should correct for this boundary error by adding half of the NDC height and width into the coordinate transform to ensure that any roundoff error in the application-world-to-NDC transform does not cause the wrong pixel to be addressed.

Raster Coordinates -- Transformation Mode 2

Raster Coordinates (RC) are actual device units (for example, pixels for screens and steps for plotters and printers). Unlike the NDC system, RC system coordinates begin in the upper left corner; the lower right corner (xmax,ymax) addresses the bottom right pixel of the space. Figure 1-1 shows a comparison of the NDC and RC systems.

The GDOS does not transform coordinates when the RC system is in effect. The application needs to adjust its coordinate transformation based on the aspect ratio of the device.

The RC system eliminates the overhead involved when the GDOS transforms every point.

See the Introduction to GEM Programming for more information on coordinate system transformations.

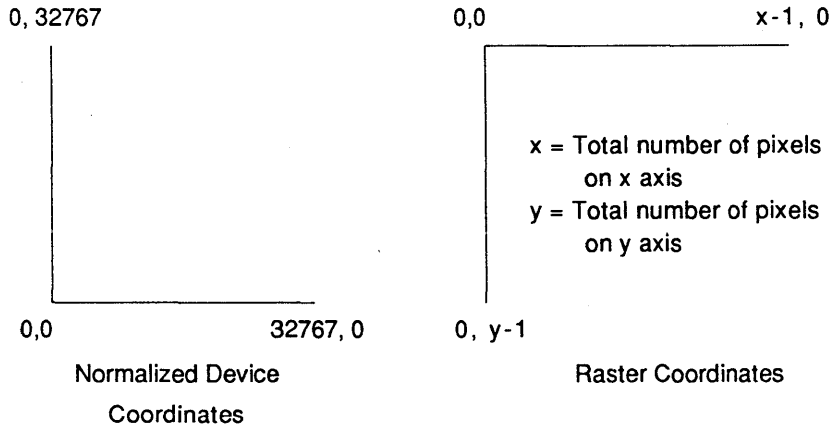

Figure 1-1. Normalized Device Versus Raster Coordinates

End of Section 1

Function Summary and Calling Conventions

This section explains how to use VDI functions in your graphics applications.

The VDI allows you to write graphics applications in assembly language or a high-level language (C language bindings are provided). Assembly language routines address VDI functions by opcode numbers. C language routines address VDI functions by procedure name.

The VDI functions, described in sections 3 through 9, are grouped into the following categories:

Control	These functions open and close the graphics workstation, set default values for device attributes, load and unload fonts, clear and update the display surface, and enable or disable rectangle clipping.
Output	The output functions write text strings and draw output items such as lines between two or more points, a marker at one or more points, and filled areas. The output functions also provide graphics drawing primitives to produce bars, arcs, circles, ellipses and elliptical segments, rounded rectangles, and justified text.
Attribute	The attribute functions control the writing mode (how items are imposed over existing pixel values) and determine the characteristics of the output functions. The output function characteristics determined by the attribute functions include color, line type, marker type, fill pattern and style, and character height.

Raster Operation — These functions operate on bit blocks in memory and on pixel blocks on physical devices. Raster operation functions copy blocks, determine the copy mode (how blocks are imposed over existing pixel values), transform block formats, and set color values for specified pixels.

Input — The input functions set the input mode to either request (wait for an input event) or sample (return input device status or location) and control the input devices. Input functions also set, show, or hide the cursor; sample the mouse button and keyboard states; and exchange the timer interrupt, button change, mouse movement, and cursor change vectors.

Inquire — The inquire functions return the current attribute settings for the output items, information about the text faces, cell definitions, and input mode.

Escape — These are device dependent control functions. For example, they can be used to control the cursor on an alpha screen, set the film type on a camera, and change the name of a metafile.

Required Functions

Each device type requires certain functions. Table 2-1, below, lists all of the VDI functions and indicates which devices are required to support them. Each device driver recognizes all opcodes, whether or not the driver supports the function. If an opcode is out of range, the driver performs no action.

Because metafiles are transportable to any device, they are required to support all those functions common to any device you may use. See Appendix B for descriptions of the metafile format, metafile support of the inquiry functions, and metafile sub-opcodes.

You can determine if a function is available in a specific driver in one of the following ways:

- Check the information about available features returned from Open Workstation, v_opnwk (1H), or Extended Inquire, vq_exntd (66H).
- Check the values that a function returns for the length of the integer output and output point coordinate arrays. If zero is returned where non-zero values are indicated, the driver does not support the function.
- Check the values returned from a function against the values specified in the call. If the two values are not the same, then either the driver does not support the function or the requested value is not available and the VDI selected a best fit value.

Table 2-1. Required VDI Functions

Function (Opcode)	Screen	Printer	Plotter	Metafile	Camera
Open Workstation, v_opnwk (1H)	X	X	X	X	X
Close Workstation, v_clswk (2H)	X	X	X	X	X
Clear Workstation, v_clrwk (3H)	X	X	X	X	X
Update Workstation, v_updwk (4H)	X	X	X	X	X
Inquire Addressable Character Cells, vq_chcells (5-1H)	X	X	X	X	X
Exit Alpha Mode, v_exitcur (5-2H)	X				
Enter Alpha Mode, v_entercur (5-3H)	X				
Cursor Up, v_curup (5-4H)	X				
Cursor Down, v_curdown (5-5H)	X				
Cursor Right, v_curright (5-6H)	X				
Cursor Left, v_curleft (5-7H)	X				
Home Cursor, v_curhome (5-8H)	X				
Erase to End of Screen, v_eeos (5-9H)	X				
Erase to End of Line, v_eeol (5-AH)	X				
Direct Cursor Address, v_curaddress (5-BH)	X				
Output Cursor Addressable Text, v_curtext (5-CH)	X				
Reverse Video On, v_rvon (5-DH)					
Reverse Video Off, v_rvoff (5-EH)					
Inquire Current Alpha Cursor Address, vq_curaddress (5-FH)	X				

Table 2-1. Required VDI Functions (Cont'd)

Function (Opcode)	Screen	Printer	Plotter	Metafile	Camera
Inquire Tablet Status, vq_tabstatus (5-10H)					
Hard Copy, v_hardcopy (5-11H)					
Place Graphic Cursor, v_dspcur (5-12H)	X				
Remove Last Graphic Cursor, v_rmcur (5-13H)	X				
Form Advance, v_form_adv (5-14H)		X		X	
Output Window, v_output_window (5-15H)		X		X	
Clear Display List, v_clear_disp_list (5-16H)		X		X	
Output Bit Image File, v_bit_image (5-17H)		X		X	X
Inquire Printer Scan Heights, vq_scan (5-18H)		X			
Output Printer Alpha Text, v_alpha_text (5-19H)		X		X	
Select Palette, vs_palette (5-3CH)					
Generate Tone, v_sound (5-3DH)	X				
Set/clear Muting Flag, vs_mute (5-3EH)	X				
Select Camera Film Type and Exposure, vsp_film (5-5BH)					X
Inquire Camera Film Name, vqp_filmname (5-5CH)					X
Disable/Enable Film Exposure, vsc_expose (5-5DH)					

Table 2-1. Required VDI Functions (Cont'd)

Function (Opcode)	Screen	Printer	Plotter	Metafile	Camera
Update Metafile Extents, v_meta_extents (5-62H)				X	
Write Metafile Item, v_write_meta (5-63H)				X	
Change GEM VDI Filename, vm_filename (5-64H)				X	
Polyline, v_line (6H)	X	X	X	X	X
Polymarker, v_pmarker (7H)	X	X	X	X	
Text, v_gtext (8H)	X	X	X	X	
Filled Area, v_fillarea (9H)	X	X	X	X	
Cell Array, v_cellarray (AH)					
Bar GDP, v_bar (B-1H)	X	X	X	X	X
Arc GDP, v_arc (B-2H)	X	X	X	X	X
Pie Slice GDP, v_pieslice (B-3H)	X	X	X	X	X
Circle GDP, v_circle (B-4H)	X	X	X	X	X
Ellipse GDP, v_ellipse (B-5H)	X	X	X	X	X
Elliptical Arc GDP, v_ellarc (B-6H)	X	X	X	X	X
Elliptical Pie Slice GDP, v_ellpie (B-7H)	X	X	X	X	X
Rounded Rectangle GDP, v_rbox (B-8H)	X	X	X	X	X
Filled, Rounded Rectangle GDP, v_rfbox (B-9H)	X	X	X	X	X
Justified Graphics Text GDP, v_justified (B-AH)	X	X	X	X	X

Table 2-1. Required VDI Functions (Cont'd)

Function (Opcode)	Screen	Printer	Plotter	Metafile	Camera
Set Character Height Absolute Mode, vst_height (CH)	X	X	X	X	X
Set Character Baseline Vector, vst_rotation (DH)	X	X	X	X	X
Set Color Representation, vs_color (EH)	X			X	X
Set Polyline Line Type, vsl_type (FH)	X	X	X	X	X
Set Polyline Width, vsl_width (10H)	X	X	X	X	X
Set Polyline Color Index, vsl_color (11H)	X	X	X	X	X
Set Polymarker Type, vsm_type (12H)	X	X	X	X	X
Set Polymarker Height, vsm_height (13H)	X	X	X	X	X
Set Polymarker Color Index, vsm_color (14H)	X	X	X	X	X
Set Text Font, vst_font (15H)	X	X	X	X	X
Set Text Color Index, vst_color (16H)	X	X	X	X	X
Set Fill Interior Style, vsf_interior (17H)	X	X	X	X	X
Set Fill Style Index, vsf_style (18H)	X	X	X	X	X
Set Fill Color Index, vsf_color (19H)	X	X	X	X	X
Inquire Color Representation, vq_color (1AH)	X			X	X
Inquire Cell Array, vq_cellarray (1BH)					
Input Locator - Request Mode, vrq_locator (1CH) Input Locator - Sample Mode, vsm_locator (1CH)					

Table 2-1. Required VDI Functions (Cont'd)

Function (Opcode)	Screen	Printer	Plotter	Metafile	Camera
Input Valuator - Request Mode, vrq_valuator (1DH) Input Valuator - Sample Mode, vsm_valator (1DH)					
Input Choice - Request Mode, vrq_choice (1EH) Input Choice - Sample Mode, vsm_choice (1EH)					
Input String - Request Mode, vrq_string (1FH)	X				
Input String - Sample Mode, vsm_string (1FH)	X				
Set Writing Mode, vswr_mode (20H)	X	X		X	X
Set Input Mode, vsin_mode (21H)	X				
Inquire Current Polyline Attributes, vql_attributes (23H)	X	X	X	X	X
Inquire Current Polymarker Attributes, vqm_attributes (24H)	X	X	X	X	X
Inquire Current Fill Area Attributes, vqf_attributes (25H)	X	X	X	X	X
Inquire Current Graphic Text Attributes, vqt_attributes (26H)	X	X	X	X	X
Set Graphic Text Alignment, vst_alignment (27H)	X	X	X	X	X
Open Virtual Workstation, v_opnvwk (64H)	X				
Close Virtual Workstation, v_clsvwk (65H)	X				

Table 2-1. Required VDI Functions (Cont'd)

Function (Opcode)	Screen	Printer	Plotter	Metafile	Camera
Extended Inquire, vq_extnd (66H)	X	X	X	X	X
Contour Fill, v_contourfill (67H)				X	
Set Fill Perimeter Visibility, vsf_perimeter (68H)	X	X	X	X	X
Get Pixel, v_get_pixel (69H)					
Set Graphic Text Special Effects, vst_effects, (6AH)	X	X	X	X	X
Set Character Cell Height, Points Mode, vst_point (6BH)	X	X	X	X	X
Set Polyline End Styles, vsl_ends (6CH)	X	X	X	X	X
Copy Raster, Opaque, vro_cpyfm (6DH)	X				
Transform Form, vr_trn_fm (6EH)	X				
Set Mouse Form, vsc_form (6FH)	X				
Set User-defined Fill Pattern, vsf_udpat (70H)	X	X		X	X
Set User-defined Line Style, vsl_udsty (71H)	X	X		X	X
Fill Rectangle, vr_recfl (72H)	X			X	
Inquire Input Mode, vqin_mode (73H)	X				
Inquire Text Extent, vqt_extent (74H)	X	X	X		X
Inquire Character Cell Width, vqt_width (75H)	X	X	X		X
Exchange Timer Interrupt Vector, vex_timv (76H)	X				
Load Fonts, vst_load_fonts (77H)	X	X	X	X	X

Table 2-1. Required VDI Functions (Cont'd)

Function (Opcode)	Screen	Printer	Plotter	Metafile	Camera
Unload Fonts, vst_unload_fonts (78H)	X	X	X	X	X
Copy Raster, Transparent, vrt_cpyfm (79H)	X				
Show Cursor, v_show_c (7AH)	X				
Hide Cursor, v_hide_c (7BH)	X				
Sample mouse button state (7CH)	X				
Exchange Button Change Vector, vex_butv (7DH)	X				
Exchange Mouse Movement Vector, vex_motv (7EH)	X				
Exchange Cursor Change Vector, vex_curv (7FH)	X				
Sample Keyboard State Information, vq_key_s (80H)	X				
Set Clipping Rectangle, vs_clip (81H)	X	X	X	X	X
Inquire Font Name and Index, vqt_name (82H)	X	X	X		X
Inquire Current Font Information, vqt_font_info (83H)	X	X	X		X
Inquire Justified Graphics Text, vqt_justified (84H)	X				

Function Parameters

Calling routines pass arguments to the VDI functions in the form of input arrays. The VDI returns values from the functions in output arrays. All arrays are zero-based and all array elements are WORD integers. The following names are used to refer to the arrays in the descriptions of the VDI functions:

- control -- the control array
- intin -- the array of integer input parameters
- ptsin -- the array of input point coordinates
- intout -- the array of integer output parameters
- ptsout -- the array of output point coordinates

The format that the VDI functions use for parameters is shown below under "Input Parameters" and "Output Parameters."

VDI function calls can be made from applications written in assembly language or a high-level language. C language bindings are provided with GEM VDI and are shown in the description of each function.

Assembly language routines address VDI functions according to their opcodes and place the LONGWORD address of the five parameter arrays in a ten-word data structure called a Parameter Block (PB). Figure 2-1 shows the format of the PB.

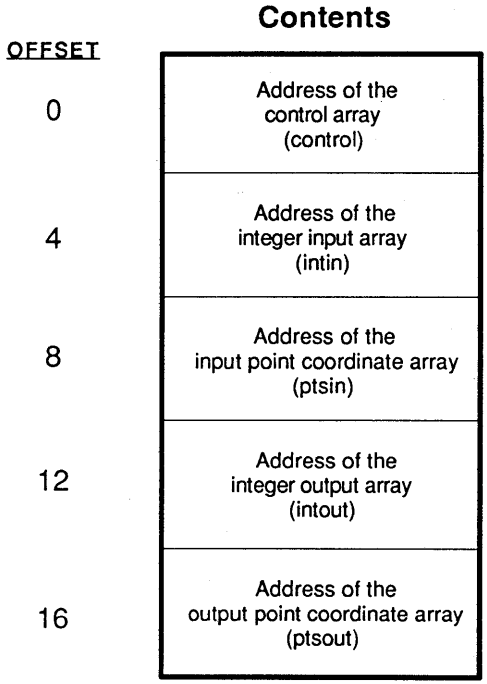

Figure 2-1. Parameter Block Format

Prior to a VDI function call, the assembly language application:

- Loads the address of the PB and the VDI ID number in the appropriate registers
- Invokes the processor-specific interrupt or TRAP

See Appendix E, "Processor-Specific Data," for the registers and interrupts to be used for your system.

In the C language bindings, WORD declares a 16-bit integer type; BYTE declares an 8-bit integer type.

Input Parameters:

control(0)	Opcode number for the VDI function
control(1)	Number of vertices in the ptsin array Each vertex consists of an x,y coordinate pair, so the length of the ptsin array is twice the number of specified vertices.
control(3)	Length of integer array intin
control(5)	Subfunction identification number for a Generalized Drawing Primitive (GDP) or Escape
control(6)	Device handle
control(7-n)	Function dependent information
intin	Array of integer input parameters
ptsin	Array of input point coordinates Refer to the Extended Inquire function, vq_extnd (66H), in Section 8 for information on how to determine the maximum size of the ptsin array.

Because coordinates may be converted by the GDOS, the calling routine must ensure that control(1), the number of vertices, is correctly set. If no x,y coordinates are being passed to the VDI by the calling routine, control(1) must be set to 0. In addition, control(3), the input integer count, must always be set. The calling routine must set control(3) to 0 if it is not passing integers to the VDI.

Output Parameters:

control(2)	Number of vertices in the ptsout array Each vertex consists of an x,y coordinate pair, so the length of the ptsout array is twice the number of specified vertices.
control(4)	Length of integer array intout
control(6)	Device handle
control(7–n)	Function dependent information
intout	Array of integer output point parameters
ptsout	Array of output point coordinate data

The VDI always sets control(2), the output vertex count, and control(4), the output integer count, correctly. If it is not passing back information in ptsout and intout, the VDI sets control(2) and control(4) to 0.

Running Applications Under the VDI

To use the graphics features provided by the VDI, you must ensure that the following conditions are met:

1. Your program must conform to the VDI calling conventions to access graphics primitives. This process involves making a call to the GDOS and using the interrupt for your operating system. Refer to Appendix E for the specific interrupts.

   The parameter list provides information to the VDI and returns information to the calling program.

2. Adequate stack space must be made available for VDI operations. This space includes a buffer area for transforming points passed to the VDI and some fixed overhead space. "Memory Requirements," below, describes how to determine the required stack space.

3. When your program is executed, the required device drivers must be located in the current directory at the time the VDI was invoked (typically /GEMSYS). The ASSIGN.SYS file must contain the names of your device drivers and a device ID number for each device driver; refer to "The Assignment File, ASSIGN.SYS" in Section 1.

4. After successfully compiling or assembling and linking your program, you can run it like any other application, once the VDI is active. You can enable VDI graphics with the GEMVDI command, described below.

Enabling Graphics

Special commands let you enable graphics functions from the command level of the operating system. Each command loads the GDOS and any drivers declared resident in the ASSIGN.SYS file. ASSIGN.SYS and the driver files must be located in the current directory.

Note that any application to be invoked by a GEM command must be located in the search path.

To load the VDI and start a non-GEM application that uses the VDI (like a test program or debugger), enter the following command:

GEMVDI /FILENAME

Enter the following command to load the VDI and start a GEM application:

GEMVDI FILENAME

To load the VDI and start the GEM Desktop.. application, enter:

GEMVDI

Memory Requirements

To determine the amount of stack space required to run a given graphics application, make the following calculation:

Open Workstation call = approximately 128 bytes

All other calls = ptsin size + 128 bytes + the overhead requirements of the operating system

ptsin is the array of input point coordinates passed to the device driver from the application program (two words for each point).

The stack requirement is the larger of the two resulting values. This stack space must be available in the application program stack area.

Sample C Language Graphics Program

Figure 2-2 depicts the output of the sample C language graphics program contained in Listing 2-1, below. To load the VDI and start such a program use the

GEMVDI /FILENAME

command.

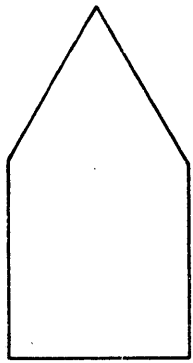

Figure 2-2. Output from the Polyline Sample Program

Listing 2-1. Sample C Language Program, Polyline

```
/*  This program, sample.c, uses the VDI to draw */
/*  a simple picture and then wait for a single  */
/*  key to be pressed before terminating.        */
/*                                               */
/*  To compile sample.c:                         */
/*          lc1 sample                           */
/*          lc2 sample -v                        */
/*                                               */
/*   To link sample.c:                           */
/*   link tcs+sample+vdibind+vdiasm,sample,      */
/*     sample/map,,                              */
/*                                               */
/*   Note: Modify ASSIGN.SYS so that the screen  */
/*         driver is resident (01r XXXXXXXX.SYS) */
/*                                               */
/*   To run sample.c:                            */
/*          gemvdi /sample.exe                   */

/*  VDI Global Arrays  */
int   contrl[11];        /* control inputs       */
int   intin[80];         /* max string length    */
int   ptsin[256];        /* polygon fill points  */
int   intout[45];        /* v_opnwk output       */
int   ptsout[12];        /* Points out array     */

/*  Local Data Area     */
int   work_in[11];       /* Input for v_opnwk    */
int   work_out[57];      /* Return from v_opnwk  */
int   handle;            /* Returned handle      */
int   pxyarray[12];      /* Points for Poly Line */

int   max_length;        /* Maximum string length */
int   echo_mode;         /* Mode for char echo   */
int   echo_xy[2];        /* String x,y           */
char  string[1];         /* String array         */
```

Listing 2-1. (Cont'd)

```
MAIN()                          /* Called by TCS binding */
{

      int   i;                  /* Loop variable         */

/* Clear work_in array for the VDI                       */
      for (i = 0; i < 11; i++)

      work_in[i] = 0;
      work_in[0] = 1;    /* Dev ID (01 = Screen)  */
      work_in[1] = 1;    /* Line type (Solid)     */
      work_in[2] = 1;    /* Line Color (Black)    */
      work_in[10] = 0;   /* Use NDC coordinates   */

      v_opnwk(work_in, &handle, work_out);

      pxyarray[0]  = 12000;  /* v_pline vertices */
      pxyarray[1]  = 12000;
      pxyarray[2]  = 12000;
      pxyarray[3]  = 20000;
      pxyarray[4]  = 14000;
      pxyarray[5]  = 24000;
      pxyarray[6]  = 16000;
      pxyarray[7]  = 20000;
      pxyarray[8]  = 16000;
      pxyarray[9]  = 12000;
      pxyarray[10] = 12000;
      pxyarray[11] = 12000;

/* Draw the polyline                                     */
      v_pline(handle, 6, pxyarray);
```

Listing 2-1. (Cont'd)

```
/* Length of the input string                          */
      max_length = sizeof(string);

      echo_mode  = 0;       /* Do not echo             */
      echo_xy[0] = 12000;   /* x,y coordinates         */
      echo_xy[1] = 12000;   /* for string input        */

      vrq_string(handle, max_length, echo_mode,
                 echo_xy, &string);

      v_clswk(handle);      /* Close workstation       */
}
```

End of Section 2

Control Functions

The VDI control functions initialize and close the graphics workstation, set workstation defaults, load and unload fonts, and enable or disable rectangle clipping.

Table 3-1 lists and briefly describes each of the VDI control functions.

Table 3-1. VDI Control Functions

Function	Page	Purpose
v_opnwk (1H)	3-2	Open a workstation
v_clswk (2H)	3-12	Close a workstation
v_clrwk (3H)	3-13	Clear a workstation screen
v_updwk (4H)	3-14	Execute all pending commands
v_opnvwk (64H)	3-15	Open a virtual workstation
v_clsvwk (65H)	3-17	Close a virtual workstation
vst_load_fonts (77H)	3-18	Load fonts named in ASSIGN.SYS
vst_unload_fonts (78H)	3-19	Remove device's external fonts
vs_clip (81H)	3-20	Enable/disable rectangle clipping

Workstation default attributes are listed in the description of v_opnwk (1H).

V_OPNWK (1H)

The Open Workstation function loads a graphics device driver and returns a device handle and information that describes the device's general characteristics. v_opnwk initializes the device's line, color, marker, text, and fill style attribute values as specified in the input arguments. See Section 5 for detailed information about attribute values. Workstation default values are listed below in Table 3-2. Table 3-3 lists the default color table index values.

If the specified device cannot be opened, v_opnwk returns a device handle value of zero. If the specified device is a screen, v_opnwk clears it and sets it to graphics mode; you do not need to call v_clrwrk (3H).

When v_opnwk is called to open a metafile, it initializes the file's buffer, writes the metafile header to the buffer, and returns the standard workstation information as described under "Output Arguments," below. See Appendix B for a description of the metafile and its header.

Use vq_extnd (66H) to obtain additional device-specific information.

Table 3-2. Workstation Default Attribute Values

Attribute	Default Value	VDI Function
Character height	Nominal character height	vst_height (CH)
Character baseline rotation	0 degrees rotation	vst_rotation (DH)
Text alignment	Left baseline	vst_alignment (27H)
Text effect	Normal intensity	vst_effects (6AH)
Line width	Nominal line width	vsl_width (10H)
Marker height	Nominal marker height	vsm_height (13H)
Polyline end style	Squared	vsl_ends (6CH)
Writing mode	Replace	vswr_mode (20H)
Input mode	Request for all devices	vsin_mode (21H)
Fill perimeter visibility	Visible	vsf_perimeter (68H)
User-defined line style	Solid	vsl_udsty (71H)
User-defined fill pattern	DRI Logo	vsf_udpat (70H)
Cursor	Hidden	v_show_c (7AH) and v_hide_c (7BH)
Clipping	Disabled	vs_clip (81H)

Use the VDI functions referenced in Table 3-2 to change the attribute values.

Table 3-3. Default Color Table Index Values

Index	Color	
0*	White	**Default indices for monochrome**
1	Black	**screens and printer/plotters**
2	Red	
3	Green	
4	Blue	
5	Cyan	
6	Yellow	
7	Magenta	
8	White	
9	Black	
10	Dark Red	
11	Dark Green	
12	Dark Blue	
13	Dark Cyan	
14	Dark Yellow	
15	Dark Magenta	
16 - n	Device Dependent	

*Index 0 is defined as the current background color.

Note that devices with less than 16 colors use the first "n" index entries, where "n" is the number of available colors.

Input Arguments

work_in[0] Device ID number, defined as follows:

01 - 10	Screen
11 - 20	Plotter
21 - 30	Printer
31 - 40	Metafile
41 - 50	Camera
51 - 60	Tablet

work_in[1] Line type value, see vsl_type (FH) in Section 5 for information on line types.

work_in[2] Polyline color index value; See Table 3-3 on page 3-4 for a list of the default color index values. vsl_color (11H) may also be used to set the the polyline color index (see Section 5, "Attribute Functions").

Note: The VDI defaults to color index 1 if the index values you specify in work_in[2], work_in[4], work_in[6], and work_in[9] are out of range.

work_in[3] Polymarker type, see vsm_type (12H) in Section 5 for information on setting the polymarker type.

work_in[4] Polymarker color index -- see Table 3-3 on page 3-4. Use vsm_color (14H), described in Section 5, to set the polymarker color index.

work_in[5] Text font, see vst_font (15H) in Section 5 and vqt_name (82H) in Section 8 for information on face selection.

work_in[6] Text color index -- see Table 3-3. vst_color (16H), described in Section 5, should be used to set the text color index after the workstation has been opened.

work_in[7] Fill interior style, see vsf_interior (17H) and vsf_style (18H) in Section 5 for information on fill interior style selection.

work_in[8] Fill style index -- based on the fill interior style. For the pattern style, an index of 1 maps to the lowest intensity pattern on the device; if the fill interior style is solid, any index value produces an opaque fill style.

work_in[9] Fill color index -- see Table 3-3. vsf_color (19H), described in Section 5, should be used to set the fill color index after the workstation has been opened.

work_in[10] NDC to RC transformation flag:

0 Map full NDC space to full RC space
1 Reserved
2 Use RC system

Output Arguments

Note: See Table 3-2, above, for the default values of the attributes not included in the input arguments.

handle Device handle, used in all subsequent VDI calls to select this device

work_out[0] Maximum addressable x-point on the display surface in raster coordinates

work_out[1] Maximum addressable y-point on the display surface in raster raster coordinates

work_out[2] Device Coordinate units flag:

0 Device produces precisely scaled image
1 Device does not produce a precisely scaled image

work_out[3] Pixel width in microns

work_out[4] Pixel height in microns

work_out[5] Number of character heights; zero indicates continuous scaling

work_out[6] Number of line types

work_out[7] Number of line widths; zero indicates continuous scaling

work_out[8] Number of marker types

work_out[9] Number of marker sizes; zero indicates continuous scaling

work_out[10] Number of fonts; you must load a font before sending output to devices that return zero, see vst_load_fonts (77H) in this section

work_out[11] Number of patterns

work_out[12] Number of hatch styles

work_out[13] Number of predefined colors (2 for monochrome)

work_out[14] Number of Generalized Drawing Primitives (GDPs)

work_out[15]
to
work_out[24] Sequential list of supported GDPs according to primitive id numbers (-1 = end of list):

1 Bar -- v_bar (B-1H)
2 Arc -- v_arc (B-2H)
3 Pie slice -- v_pieslice (B-3H)
4 Circle -- v_circle (B-4H)
5 Ellipse -- v_ellipse (B-5H)
6 Elliptical arc -- v_ellarc (B-6H)
7 Elliptical pie -- v_ellpie (B-7H)
8 Rounded rectangle -- v_rbox (B-8H)
9 Filled rounded rectangle -- v_rfbox (B-9H)
10 Justified graphics text -- v_justified (B-AH)

work_out[25]
to
work_out[34] Sequential list of GDP attributes:

0 Polyline
1 Polymarker
2 Text
3 Fill area
4 None

work_out[35] Set Color Representation, vs_color (EH), flag:

0 Unavailable
1 Available

work_out[36] Text Rotation, vst_rotation (DH), flag:

0 Unavailable
1 Available

work_out[37] Filled Area, v_fillarea (9H) flag:

0 Unavailable
1 Available

work_out[38] Cell Array, v_cellarray (AH), flag:

0 Unavailable
1 Available

work_out[39] Number of available colors; zero indicates continuous color scaling, two indicates monochrome

work_out[40] Number of available locator devices:

0 None
1 Keyboard only
2 Keyboard and another locator

work_out[41] Number of available valuator devices

work_out[42] Number of available choice devices

work_out[43] Number of available string devices:

0 None
1 Keyboard

work_out[44] Workstation device type:

0 Output only
1 Input only
2 Input/output
3 Reserved
4 Metafile-output

work_out[45] Minimum character width in x-axis NDC/RC coordinates

work_out[46] Minimum character height in y-axis NDC/RC coordinates

work_out[47] Maximum character width in x-axis NDC/RC coordinates

work_out[48] Maximum character height in y-axis coordinates

Note that minimum and maximum character height values do not include the interline and intercharacter spacing.

work_out[49] Minimum line width in x-axis NDC/RC coordinates

work_out[50] 0

work_out[51] Maximum line width in x-axis NDC/RC coordinates

work_out[52] 0

work_out[53] Minimum marker width in x-axis NDC/RC coordinates

work_out[54] Minimum marker height in device's y-axis NDC/RC coordinates

work_out[55] Maximum marker width in x-axis NDC/RC coordinates

work_out[56] Maximum marker height in y-axis NDC/RC coordinates

Sample Call to C Language Binding

```
WORD   v_opnwk();
WORD   work_in[11], work_out[57], handle;

v_opnwk(work_in, &handle, work_out);
```

Parameter Block Binding

Control	Input	Output
control(0) = 1	intin(0) = work_in[0]	intout(0) = work_out[0]
control(1) = 0	intin(1) = work_in[1]	intout(1) = work_out[1]
control(2) = 6	intin(2) = work_in[2]	intout(2) = work_out[2]
control(3) = 11	intin(3) = work_in[3]	intout(3) = work_out[3]
control(4) = 45	intin(4) = work_in[4]	intout(4) = work_out[4]
control(5) = 0	intin(5) = work_in[5]	intout(5) = work_out[5]
control(6) = handle	intin(6) = work_in[6]	intout(6) = work_out[6]
	intin(7) = work_in[7]	intout(7) = work_out[7]
	.	.
	.	.
	intin(10) = work_in[10]	intout(10) = work_out[10]
		.
		.
		intout(44) = work_out[44]
		ptsout(0) = work_out[45]
		.
		.
		ptsout(11) = work_out[56]

V_CLSWK (2H)

This function closes the workstation previously opened with v_opnwk (1H). All access to the device whose handle is specified in v_clswk is denied following the call. v_clswk performs the following close events for the indicated device type:

Screen	Selects the alpha device
Plotter	Performs an update
Printer	Performs an update
Metafile	Writes an end-of-file marker to the buffer, flushes it, and closes the file
Camera	Performs an update

Note: Use v_clsvwk (65H) to close all virtual workstations before calling v_clswk.

Input Arguments

handle	Device handle returned from v_opnwk (1H)

Sample Call to C Language Binding

```
WORD  v_clswk();
WORD  handle;

v_clswk(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 2		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		

V_CLRWK (3H)

This function clears the workstation by performing the following events for each device type:

Screen	v_clrwk clears the screen and sets it to the background color. The background color is defined as index zero in the color table (see Section 5).
Plotter	v_clrwk clears the buffer.
Printer	v_clrwk clears the buffer and issues a form feed. Use v_form_adv (5-14H) to issue a form feed without clearing the buffer (see Section 9).
Metafile	v_clrwk writes a metafile item to the metafile buffer.
Camera	v_clrwk clears the device and sets it to the currently selected background color.

Note: You do not need to call v_clrwk after calling v_opnwk (1H). v_opnwk clears the device after opening the workstation.

Input Arguments

handle	Device handle

Sample Call to C Language Binding

```
WORD    v_clrwk();
WORD    handle;

v_clrwk(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 3		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		

V_UPDWK (4H)

The Update Workstation function immediately executes the graphics commands currently stored in the specified device's buffer.

Note: You must use v_updwk to initiate printer output; however, v_updwk does not perform a form feed command. Use v_clrwk (3H) or v_form_adv (5-14H) to perform a form feed. v_from_adv is described in Section 9, "Escape Functions."

If the specified device is a metafile, v_updwk writes a metafile item to the metafile buffer.

Because they execute graphics commands upon request, v_updwk does not affect screens.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD  v_updwk();
WORD  handle;

v_updwk(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 4		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		

V_OPNVWK (64H)

Open Virtual Workstation opens and initializes multiple virtual screens on a single physical workstation. The physical workstation, whose device handle is specified in the v_opnvwk control array, must be a screen device previously opened with v_opnwk (1H). v_opnvwk returns a device handle for the virtual workstation in the control array. If the virtual workstation cannot be opened, v_opnvwk returns a device handle value of zero.

v_opnvwk gives each virtual workstation access to to the entire screen. The VDI maintains each workstation's attributes separately. For example, each virtual workstation may have different transformation modes and clipping rectangles.

v_opvwk input and output arguments are the same as those for v_opnwk (1H); v_opnwk is described on page 3-2.

Note: The VDI has no mechanism to control input device contention between several virtual workstations. It is the application's responsibility to manage its use of the VDI input functions. Applications with multiple virtual workstations should not access input devices in sample mode. See Section 7, "Input Functions," for more information.

Input Arguments

handle — Screen device handle returned from v_opnwk (1H), specified in control array -- this is the root device handle

See page 3-5 for the other input arguments.

Output Arguments

See page 3-6

Sample Call to C Language Binding

```
WORD   v_opnvwk();
WORD   work_in[11], work_out[57], handle;

v_opnvwk(work_in, &handle, work_out);
```

Parameter Block Binding

Control	Input	Output
control(0) = 100	intin(0) = work_in[0]	intout(0) = work_out[0]
control(1) = 0	intin(1) = work_in[1]	intout(1) = work_out[1]
control(2) = 6	intin(2) = work_in[2]	intout(2) = work_out[2]
control(3) = 11	intin(3) = work_in[3]	intout(3) = work_out[3]
control(4) = 45	intin(4) = work_in[4]	intout(4) = work_out[4]
control(5) = 0	intin(5) = work_in[5]	intout(5) = work_out[5]
control(6) = handle	intin(6) = work_in[6]	intout(6) = work_out[6]
	intin(7) = work_in[7]	intout(7) = work_out[7]
	.	.
	.	.
	intin(10) = work_in[10]	intout(10) = workout[10]
		.
		.
		intout(44) = work_out[44]
		ptsout(0) = work_out[45]
		.
		.
		ptsout(11) = work_out[56]

Important: Control(6) is both an input and an output argument. v_opnvwk returns the device handle for the virtual workstation in control(6).

V_CLSVWK (65H)

This function closes a virtual workstation previously opened with v_opnvwk (64H). The virtual workstation handle specified in the v_clsvwk call is recycled.

Input Arguments

handle Device handle returned from v_opnvwk (64H)

Sample Call to C Language Binding

```
WORD  v_clsvwk();
WORD  handle;

v_clsvwk(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 101		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		

VST_LOAD_FONTS (77H)

The ASSIGN.SYS file associates external fonts with a particular device driver. This function loads the driver's external fonts into memory, making them available to the calling program, and returns the number of additional font identifiers.

If the specified device's external fonts were previously loaded, or ASSIGN.SYS does not associate any font files with the driver, vst_load_fonts returns zero.

Note: You do not need to call vst_load_fonts if the driver's default system fonts are sufficient.

Input Arguments

handle	Device handle
select	Reserved, must be zero

Output Arguments

additional	Number of additional font identifiers

Sample Call to C Language Binding

```
WORD   vst_load_fonts();
WORD   additional, handle, select;

additional = vst_load_fonts(handle, select);
```

Parameter Block Binding

Control	Input	Output
control(0) = 119 control(1) = 0 control(2) = 0 control(3) = 1 control(4) = 1 control(5) = 0 control(6) = handle	intin(0) = select	intout(0) = additional

VST_UNLOAD_FONTS (78H)

This function dissociates the external fonts previously loaded by vst_load_fonts from the specified device. If possible, vst_unload_fonts frees up the memory occupied by the driver's external fonts.

When the external fonts are shared by virtual workstations with the same root device handle, they are not unloaded from memory until one of the following conditions is met:

- all workstations that share the fonts are closed, see v_clsvwk (65H)
- this call has been made for all workstations that share the font

The driver's default system fonts remain loaded and available.

Input Arguments

handle	Device handle
select	Reserved for future use

Sample Call to C Language Binding

```
WORD  vst_unload_fonts();
WORD  handle, select;

v_unload_fonts(handle, select);
```

Parameter Block Binding

Control	Input	Output
control(0) = 120	intin(0) = select	
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 0		
control(5) = 0		
control(6) = handle		

VS_CLIP (81H)

vs_clip enables or disables the clipping of all output primitives by the VDI. Clipping refers to confining output to a rectangle defined within the device's display surface. Input arguments pxarray[0] to pxarray[3] specify the clipping rectangle's coordinates according to the current coordinate system (NDC or RC units). vq_extnd (66H), described in Section 8, indicates if clipping is currently enabled on the device (work_out[19]) and returns the coordinates of clipping rectangle in work_out[45] to work_out[48].

By default, clipping is disabled when the workstation is opened.

If the specified device is a metafile, v_clip writes a metafile item to the metafile buffer.

Input Arguments

handle	Device handle
clip_flag	Clipping flag: 0 Disable clipping 1 Enable clipping
pxyarray[0]	x-coordinate of corner of clipping rectangle
pxyarray[1]	y-coordinate of corner of clipping rectangle
pxyarray[2]	x-coordinate of corner diagonal to pxarray[0]
pxyarray[3]	y-coordinate of corner diagonal to pxarray[1]

Sample Call to C Language Binding

```
WORD    vs_clip();
WORD    handle, clip_flag, pxyarray[4];

vs_clip(handle, clip_flag, pxyarray);
```

Parameter Block Binding

Control	Input	Output
control(0) = 129	intin(0) = clip_flag	
control(1) = 2		
control(2) = 0	ptsin(0) = pxarray[0]	
control(3) = 1	ptsin(1) = pxarray[1]	
control(4) = 0	ptsin(2) = pxarray[2]	
control(5) = 0	ptsin(3) = pxarray[3]	
control(6) = handle		

End of Section 3

Output Functions

The VDI output functions produce graphics primitives such as polylines, circles, and rounded rectangles.

Table 4-1 lists and briefly describes the output functions. Output functions use the current line, marker, fill area, or text attributes. These attributes, the output functions that use them, and the attribute functions that control them are listed in Tables 4-2 through 4-5.

Table 4-1. VDI Output Functions

Function	Page	Purpose
v_pline (6H)	4-4	Draw a line between specified points
v_pmarker (7H)	4-6	Draw markers at specified points
v_gtext (8H)	4-8	Write a text string
v_fillarea (9H)	4-10	Fill a polygon specified by points
v_cellarray (AH)*	4-12	Draw a cell array
v_bar (B-1H)	4-16	Draw a filled rectangle
v_arc (B-2H)	4-17	Draw a circular arc
v_pieslice (B-3H)	4-19	Draw a filled circular arc
v_circle (B-4H)	4-21	Draw a filled circle
v_ellipse (B-5H)	4-22	Draw a filled ellipse
v_ellarc (B-6H)	4-23	Draw an elliptical arc
v_ellpie (B-7H)	4-24	Draw a filled elliptical arc
v_rbox (B-8H)	4-25	Draw a rounded rectangle
v_rfbox (B-9H)	4-26	Draw a filled, rounded rectangle
v_justified (B-AH)	4-27	Display justified text
v_contourfill (67H)*	4-29	Seed fill a specified area
vr_recfl (72H)*	4-30	Fill a specified rectangle without perimeter

*These functions are either not required and may not be available on all devices, or contain unrequired options; see "Required Functions" in Section 2.

Table 4-2. Output Functions and Line Attributes

Output Functions That Use Line Attributes			
v_pline (6H)	v_arc (B-2H)	v_ellarc (B-6H)	v_rbox (B-8H)

Line Attributes:	Attribute Functions:
Line type	vsl_type (FH)
Line width	vsl_width (10H)
Line color	vsl_color (11H)
Line end style	vsl_ends (6CH)

Table 4-3. Marker Attributes Used by v_pmarker

Marker Attributes	Attribute Functions
Marker type	vsm_type (12H)
Marker height	vsm_height (13H)
Marker color	vsm_color (14H)

Note: The attribute functions are described in Section 5.

Table 4-4. Output Functions and Fill Area Attributes

Output Functions That Use Fill Area Attributes		
v_fillarea (9H)	v_bar (B-1H)	v_pieslice (B-3H)
v_circle (B-4H)	v_ellipse (B-5H)	v_ellpie (B-7H)
v_rfbox (B-9H)	v_contourfill (67H)	vr_recfl (72H)*

Fill Area Attributes:	Attribute Functions:
Fill interior style	vsf_interior (17H)
Fill style index	vsf_style (18H)
Fill area color	vsf_color (19H)
Fill perimeter	vsf_perimeter (68H)

*vr_recfl always operates with the fill perimeter disabled.

Table 4-5. Output Functions and Text Attributes

Output Functions That Use Text Attributes	
v_gtext (8H)	v_justified (B-AH)

Text Attributes:	Attribute Functions:
Character height	vst_height (CH)
Baseline vector	vst_rotation (DH)
Text face	vst_font (15H)
Text color	vst_color (16H)
Text alignment	vst_alignment (27H)
Text effect	vst_effects (6AH)
Cell height, points	vst_point (6BH)

Note: The output functions operate according to the current writing mode as controlled by vswr_mode (20H). vswr_mode is described in Section 5. vs_clip (81H), described in Section 3, defines the area on the screen where an output function is allowed to draw.

V_PLINE (6H)

This function displays a polyline on the graphics device. The line's starting point is specified in the first coordinate pair (xy[0] and xy[1]). v_pline draws the line between subsequent points as specified in the remaining input arguments according to the current coordinate system (NDC or RC units).

v_pline displays a zero length line (degenerate case) as a point and does not display a single coordinate pair. Use vq_extnd (66H), described in Section 8, "Inquire Functions," to obtain the maximum number of input vertices for the specified device.

v_pline produces lines according to the line attributes listed in Table 4-2, above, and the current writing mode. You can use vql_attributes (23H) to obtain the current settings of the line attributes.

Input Arguments

handle	Device handle
count	Number of input vertices (n)
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[2*count-2]	x-coordinate of last point
xy[2*count-1]	y-coordinate of last point

Sample Call to C Language Binding

```
WORD  v_pline();
WORD  handle, count, xy[2 * count];

v_pline(handle, count, xy);
```

Parameter Block Binding

Control	Input
control(0) = 6	ptsin(0) = xy[0]
control(1) = count	ptsin(1) = xy[1]
control(2) = 0	ptsin(2) = xy[2]
control(3) = 0	ptsin(3) = xy[3]
control(4) = 0	.
control(5) = 0	.
control(6) = handle	ptsin(2*count-2) = xy[2*count-2]
	ptsin(2*count-1) = xy[2*count-1]

V_PMARKER (7H)

This function draws markers at the points specified in the input argument coordinates (in NDC or RC units). v_pmarker produces markers according to the attributes listed in Table 4-3 and the current writing mode. vqm_attributes (24H), described in Section 8, returns the current settings of these attributes.

Use vq_extnd (66H), to obtain the maximum number of polymarker vertices for the specified device.

Input Arguments

handle	Device handle
count	Number of input vertices (n)
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[2*count-2]	x-coordinate of last marker
xy[2*count-1]	y-coordinate of last marker

Sample Call to C Language Binding

```
WORD   v_marker();
WORD   handle, count, xy[2 * count]

v_pmarker(handle, count, xy);
```

Parameter Block Binding

Control	Input
control(0) = 7	ptsin(0) = xy[0]
control(1) = count	ptsin(1) = xy[1]
control(2) = 0	ptsin(2) = xy[2]
control(3) = 0	ptsin(3) = xy[3]
control(4) = 0	.
control(5) = 0	.
control(6) = handle	ptsin(2*count-2) = xy[2*count-2]
	ptsin(2*count-1) = xy[2*count-1]

V_GTEXT (8H)

v_gtext writes a text string to the display surface. The (x,y) position specified by the calling routine is the alignment point of the text string in units of the current coordinate system (NDC or RC). The vst_alignment function establishes the relationship between the string's starting point and the specified x,y position (see in Section 5). See Table 4-5, above, for other text attributes that affect the operation of v_gtext.

Note that vqt_attributes (26H) returns the current text attribute settings (see Section 8, "Inquire Functions").

For the C language binding, the string input argument is byte-oriented and must be null-terminated. For the Parameter Block (assembly language) binding, the string is word-oriented. Any unsupported character is mapped to a question mark (?), the symbol for an undefined character. work_out[15] of vq_extnd (66H) returns the maximum number of characters (size of intin array) allowed in the text string. vq_extnd is described in Section 8.

Be sure that the specified device has a font loaded before outputting text. Printers and some other devices may not have a system font available; if v_opnwk (1H) returned zero in work_out[10] when the device was opened, call vst_load_fonts (77H) before v_gtext. v_opnwk and vst_load_fonts are described in Section 3, "Control Functions."

Input Arguments

handle	Device handle
x	x-coordinate of text string's alignment point
y	y-coordinate of text string's alignment point
string	ASCII character string

Sample Call to C Language Binding

```
WORD   v_gtext();
WORD   handle, x, y;
BYTE   *string;

v_gtext(handle, x, y, string);
```

Parameter Block Binding

Control	Input	Output
control(0) = 8	intin = string (in 16-bit characters)	
control(1) = 1		
control(2) = 0		
control(3) = number of chars in string	ptsin(0) = x\	
control(4) = 0	ptsin(1) = y	
control(5) = 0		
control(6) = handle		

V_FILLAREA (9H)

The v_fillarea function fills the polygon defined by the input argument coordinates (in NDC or RC units) according to the fill area attributes listed in Table 4-4 and the writing mode. Use vqf_attributes (25H) to obtain the current settings of the attributes that affect the operation of this function (see Section 8, "Inquire Functions").

When the fill perimeter attribute is enabled (visibile), v_fillarea outlines the polygon with a solid line of the current fill area color. If the specified device does not have fill area capability, the polygon is outlined with the current fill area color.

A polygon with zero area (degenerate case) is displayed as a dot only when the fill perimeter attribute is enabled. If the fill perimeter attribute is disabled, a dot is not displayed for the degenerate case.

v_fillarea does not display a polygon with only one vertex. The device driver ensures that the fill area is closed by connecting the first point to the last point.

work_out[14] of vq_extnd (66H) returns the maximum number of input vertices you may use to define a polygon.

Input Arguments

handle	Device handle
count	Number of input vertices (n)
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[2*count-2]	x-coordinate of last point

xy[2*count-1] y-coordinate of last point

Sample Call to C Language Binding

```
WORD    v_fillarea();
WORD    handle, count, xy[2 * count];

v_fillarea(handle, count, xy);
```

Parameter Block Binding

Control	Input
control(0) = 9	ptsin(0) = xy[0]
control(1) = count	ptsin(1) = xy[1]
control(2) = 0	ptsin(2) = xy[2]
control(3) = 0	ptsin(3) = xy[3]
control(4) = 0	.
control(5) = 0	.
control(6) = handle	ptsin(2*count-2) = xy[2*count-2]
	ptsin(2*count-1) = xy[2*count-1]

V_CELLARRAY (AH)

This function draws the rectangular array defined by the pxyarray input coordinates (in NDC or RC units) and divides it into color cells of equal size and shape based on the length and number of each row in the color index array. The color index array determines the color for each cell; it is composed of indices selected from the color table (see Section 5).

Each cell of the rectangle is mapped to pixels on the display surface. A pixel takes the color of the cell that covers its center.

If the specified device does not support cell arrays, the rectangle is outlined with a solid line in the current line color and line width.

Use the vq_cellarray (1BH) function to obtain information about a previously defined cell array -- see Section 8, "Inquire Functions."

Note: v_cellarray may not be supported by all devices drivers. work_out[38] of v_opnwk (1H) returns zero if the device does not provide this function.

Input Arguments

handle	Device handle
row_length	Length of each row in color index array (size as declared in a high-level language)
el_used	Number of elements used in each row (number of columns) of color index array
num_rows	Number of rows in color index array
wrt_mode	Pixel operation (write mode) to be performed: 1 Replace 2 Transparent 3 XOR 4 Reverse transparent See vswr_mode (20H) in Section 5 for a description of each mode.

colarray[0] Color index array, stored by row

.

.

colarray[n] Last row of color index
The size of the array equals (num_rows * el_used).

pxyarray[0] x-coordinate of rectangle's lower left corner

pxyarray[1] y-coordinate of rectangle's lower left corner

pxyarray[2] x-coordinate of rectangle's upper right corner

pxyarray[3] y-coordinate of rectangle's upper right corner

Sample Call to C Language Binding

```
WORD  v_cellarray();
WORD  handle, pxyarray[4], row_length, el_used, num_rows, wrt_mode,
      colarray[num_rows*el_used];

v_cellarray(handle, pxyarray, row_length, el_used, num_rows,
      wrt_mode, colarray)
```

Parameter Block Binding

Control	Input	Output
control(0) = 10	intin(0) = colarray[0]	
control(1) = 2	.	
control(2) = 0	.	
control(3) = n	intin(n) = colarray[n]	
control(4) = 0		
control(5) = 0	ptsin(0) = pxyarray[0]	
control(6) = handle	ptsin(1) = pxyarray[1]	
control(7) = row_length	ptsin(2) = pxyarray[2]	
control(8) = el_used	ptsin(3) = pxyarray[3]	
control(9) = num_rows		
control(10) = wrt_mode		

Generalized Drawing Primitives

The Generalized Drawing Primitives (GDPs) produce special graphics elements such as arcs, circles, and ellipses.

All GDPs share the same opcode; however, input and output arguments and the arrays are primitive-dependent. The calling routine specifies the function to be performed according to the primitive's ID number, which is contained in control(5). The primitive ID numbers are listed below:

1 Bar -- v_bar
2 Arc -- v_arc
3 Pie slice -- v_pieslice
4 Circle -- v_circle
5 Ellipse -- v_ellipse
6 Elliptical arc -- v_ellarc
7 Elliptical pie -- v_ellpie
8 Rounded rectangle -- v_rbox
9 Filled rounded rectangle -- v_rfbox
10 Justified graphics text -- v_justified

GDP Angle Specifications

All GDP input angle specifications must be in tenths of degrees. 0 degrees is 90 degrees to the right of vertical. As shown in Figure 4-1, values increase in the counterclockwise direction. Arcs are drawn counterclockwise.

All radius arguments, except for v_ellipse (B-5H) and v_ellarc (B-6H), specify an extent (distance) in x-axis units. The v_ellipse and v_ellarc functions use both x and y axis units.

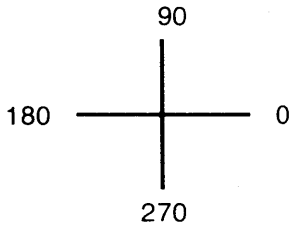

Figure 4-1. GDP Angle Specification

Note that all GDP coordinates are specified in units of the current coordinate system (NDC or RC).

Descriptions of the individual GDP functions follow.

V_BAR (B-1H)

This function draws a rectangle using the current writing mode and fill area attributes. These attributes are listed in Table 4-4, above; use the vqf_attributes function (25H) to obtain their current settings.

Input Arguments

pxyarray[0]	x-coordinate of corner of bar
pxyarray[1]	y-coordinate of corner of bar
pxyarray[2]	x-coordinate of corner diagonal to pxyarray[0]
pxyarray[3]	y-coordinate of corner diagonal to pxyarray[1]

Sample Call to C Language Binding

```
WORD   v_bar();
WORD   handle, pxyarray[4];

v_bar(handle, pxyarray);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	ptsin(0) = pxyarray[0]	
control(1) = 2	ptsin(1) = pxyarray[1]	
control(2) = 0	ptsin(2) = pxyarray[2]	
control(3) = 0	ptsin(3) = pxyarray[3]	
control(4) = 0		
control(5) = 1		
control(6) = handle		

V_ARC (B-2H)

v_arc draws an arc using the current writing mode and polyline attributes. These attributes are listed in Table 4-2, above; use vql_attributes (23H) to obtain their current settings.

Arcs are defined for v_arc by the beginning and ending angles, center point (x- and y-coordinates), and the length of the radius as measured on the x axis.

Input Arguments

handle	Device handle
begang	Beginning angle in tenths of degrees, (0-3600)
endang	Ending angle in tenths of degrees, (0-3600)
x	x-coordinate of arc's center point
y	y-coordinate of arc's center point
radius	Length of arc's radius in x-axis units

Sample Call to C Language Binding

```
WORD  v_arc();
WORD  handle, x, y, radius, begang, endang;

v_arc(handle, x, y, radius, begang, endang);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	intin(0) = begang	
control(1) = 4	intin(1) = endang	
control(2) = 0		
control(3) = 2	ptsin(0) = x	
control(4) = 0	ptsin(1) = y	
control(5) = 2	ptsin(2) = 0	
control(6) = handle	ptsin(3) = 0	
	ptsin(4) = 0	
	ptsin(5) = 0	
	ptsin(6) = radius	
	ptsin(7) = 0	

V_PIESLICE (B-3H)

This function draws a pie slice using the current writing mode and fill area attributes. Table 4-4, above, lists the fill area attributes. Use the vqf_attributes function (25H) to obtain the current attribute settings.

Specify the pie slice by its beginning and ending angles, center point (x- and y-coordinates), and the length of its radius, measured on the x axis. v_pieslice draws the pieslice counter-clockwise from the beginning angle to the end angle.

Input Arguments

handle	Device handle
begang	Beginning angle in tenths of degrees, (0-3600)
endang	Ending angle in tenths of degrees, (0-3600)
x	x-coordinate of center point of pie slice
y	y-coordinate of center point of pie slice
radius	Length of radius of pie slice in x-axis units

Sample Call to C Language Binding

```
WORD  v_pieslice();
WORD  handle, x, y, radius, begang, endang;

v_pieslice(handle, x, y, radius, begang, endang);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	intin(0) = begang	
control(1) = 4	intin(1) = endang	
control(2) = 0		
control(3) = 2	ptsin(0) = x	
control(4) = 0	ptsin(1) = y	
control(5) = 3	ptsin(2) = 0	
control(6) = handle	ptsin(3) = 0	
	ptsin(4) = 0	
	ptsin(5) = 0	
	ptsin(6) = radius	
	ptsin(7) = 0	

V_CIRCLE (B-4H)

This function draws a circle using the current writing mode and fill area attributes. These attributes are listed in Table 4-4, above; use vqf_attributes (25H) to obtain their current settings.

Specify the circle by the x- and y-coordinates of its center point and the length of its radius as measured on the x-axis.

Input Arguments

handle	Device handle
x	x-coordinate of circle's center point
y	y-coordinate of circle's center point
radius	Length circle's of radius in x-axis units

Sample Call to C Language Binding

```
WORD  v_circle();
WORD  handle, x, y, radius;

v_circle(handle, x, y, radius);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	ptsin(0) = x	
control(1) = 3	ptsin(1) = y	
control(2) = 0	ptsin(2) = 0	
control(3) = 0	ptsin(3) = 0	
control(4) = 0	ptsin(4) = radius	
control(5) = 4	ptsin(5) = 0	
control(6) = handle		

V_ELLIPSE (B-5H)

This function draws an ellipse using the writing mode and fill area attributes. These attributes are listed in Table 4-4. vqf_attributes (25H) returns the current settings of the attributes that affect the operation of v_ellipse.

An ellipse is defined for v_ellipse by the x- and y-coordinates of the ellipse's center point, the x-axis radius, and the y-axis radius.

Input Arguments

handle	Device handle
x	x-coordinate of ellipse's center point
y	y-coordinate of ellipse's center point
xradius	Radius in x-axis units
yradius	Radius in y-axis units

Sample Call to C Language Binding

```
WORD   v_ellipse();
WORD   handle, x, y, xradius, yradius;

v_ellipse(handle, x, y, xradius, yradius);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	ptsin(0) = x	
control(1) = 2	ptsin(1) = y	
control(2) = 0	ptsin(2) = xradius	
control(3) = 0	ptsin(3) = yradius	
control(4) = 0		
control(5) = 5		
control(6) = handle		

V_ELLARC (B-6H)

This function draws an elliptical arc. It uses the writing mode and line attributes. The line attributes are listed in Table 4-2; use vql_attributes (23H) to obtain their current settings.

Define an elliptical arc for v_ellarc by specifying its beginning and ending angles, the x- and y-coordinates of its center point, its x-axis radius, and its y-axis radius.

Input Arguments

handle	Device handle
begang	Beginning angle in tenths of degrees, (0-3600)
endang	Ending angle in tenths of degrees, (0-3600)
x	x-coordinate of arc's center point
y	y-coordinate of arc's center point
xradius	Radius in x-axis units
yradius	Radius in y-axis units

Sample Call to C Language Binding

```
WORD  v_ellarc();
WORD  handle, x, y, xradius, yradius, begang, endang;

v_ellarc(handle, x, y, xradius, yradius, begang, endang);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	intin(0) = begang	
control(1) = 2	intin(1) = endang	
control(2) = 0		
control(3) = 2	ptsin(0) = x	
control(4) = 0	ptsin(1) = y	
control(5) = 6	ptsin(2) = xradius	
control(6) = handle	ptsin(3) = yradius	

V_ELLPIE (B-7H)

This function draws an elliptical pie segment using the writing mode and fill area attributes. Table 4-4 lists the fill attributes; use vqf_attributes (25H) to obtain their current settings.

Define the elliptical pie segment for v_ellpie by specifying its beginning and ending angles, the x- and y-coordinates of its center point, its x-axis radius, and its y-axis radius.

Input Arguments

handle	Device handle
begang	Beginning angle in tenths of degrees, (0-3600)
endang	Ending angle in tenths of degrees, (0-3600)
x	x-coordinate of arc's center point
y	y-coordinate of arc's center point
xradius	Radius in x-axis units
yradius	Radius in y-axis units

Sample Call to C Language Binding

```
WORD   v_ellpie();
WORD   handle, x, y, xradius, yradius, begang, endang;

v_ellpie(handle, x, y, xradius, yradius, begang, endang);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	intin(0) = begang	
control(1) = 2	intin(1) = endang	
control(2) = 0		
control(3) = 2	ptsin(0) = x	
control(4) = 0	ptsin(1) = y	
control(5) = 7	ptsin(2) = xradius	
control(6) = handle	ptsin(3) = yradius	

V_RBOX (B-8H)

v_rbox draws a rectangle with rounded corners. This functions uses the current writing mode and line attributes. See Table 4-2, above. vql_attributes (23H) returns the current settings of the attributes that affect v_rbox.

Define the rectangle by specifying coordinates (NDC or RC units) for two of its corners.

Input Arguments

Handle	device handle
xyarray[0]	x-coordinate of rectangle corner
xyarray[1]	y-coordinate of rectangle corner
xyarray[2]	x-coordinate of corner diagonal to xyarray[0]
xyarray[3]	y-coordinate of corner diagonal to xyarray[1]

Sample Call to C Language Binding

```
WORD   v_rbox();
WORD   handle, xyarray[4];

v_rbox(handle, xyarray);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	ptsin(0) = xyarray[0]	
control(1) = 2	ptsin(1) = xyarray[1]	
control(2) = 0	ptsin(2) = xyarray[2]	
control(3) = 0	ptsin(3) = xyarray[3]	
control(4) = 0		
control(5) = 8		
control(6) = handle		

V_RFBOX (B-9H)

This function draws a filled rectangle with rounded corners. v_rfbox uses the current writing mode and fill area attributes. Table 4-2, above, lists the fill area attributes; use vqf_attributes (25H) to obtain their current settings.

Define the rounded rectangle to be filled by specifying the coordinates (NDC or RC units) for two of its corners.

Input Arguments

Handle	device handle
xyarray[0]	x-coordinate of rectangle corner
xyarray[1]	y-coordinate of rectangle corner
xyarray[2]	x-coordinate of corner diagonal to xyarray[0]
xyarray[3]	y-coordinate of corner diagonal to xyarray[1]

Sample Call to C Language Binding

```
WORD   v_rfbox();
WORD   handle, xyarray[4];

v_rfbox(handle, xyarray);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	ptsin(0) = xyarray[0]	
control(1) = 2	ptsin(1) = xyarray[1]	
control(2) = 0	ptsin(2) = xyarray[2]	
control(3) = 0	ptsin(3) = xyarray[3]	
control(4) = 0		
control(5) = 9		
control(6) = handle		

V_JUSTIFIED (B-AH)

This function writes and attempts to justify both the left and right margins of a text string. The text string is justified according to the alignment points, passed as input arguments x and y, and the requested string length. x, y, and length are specified in units of the current coordinate system (NDC or RC).

v_justified uses the current writing mode and text alignment attributes; see Table 4-5. Use vqt_attributes (26H) to obtain the current settings of the attributes that affect the operation of v_justified.

You can specify whether or not v_justified is to modify the inter-word and/or inter-character spacing to match the requested length of the text string with the word_space and char_space arguments.

For the C language binding, the string input argument is byte-oriented and must be null-terminated. For the Parameter Block (assembly language) binding, the string is word-oriented. Any unsupported character is mapped to a question mark (?), the symbol for an undefined character. vq_extnd (66H), described in Section 8, returns the maximum number of characters (size of intin array) allowed in the text string.

The vqt_justified function (84H), also described in Section 8, returns the x- and y-axis offsets for each character in a text string given the same input arguments as v_justified.

Be sure that the specified device has a font loaded before outputting text. Printers and some other devices may not have a system font available; if v_opnwk (1H) returned zero in work_out[10] when the device was opened, call vst_load_fonts (77H) before v_justified. v_opnwk and vst_load_fonts are described in Section 3, "Control Functions."

Input Arguments

word_space	Word spacing flag: zero Do not modify inter-word spacing nonzero Modify inter-word spacing
char_space	Character spacing flag: zero Do not modify inter-character spacing nonzero Modify inter-character spacing
string	ASCII character string
x	x-coordinate of the text alignment point
y	y-coordinate of the text alignment point
length	Requested length of the string, in x-axis units

Sample Call to C Language Binding

```
WORD   v_justified();
WORD   handle, x, y, length, word_space, WORD char_space;
BYTE   string(n);

v_justified(handle, x, y, string, length, word_space, char_space);
```

Parameter Block Binding

Control	Input	Output
control(0) = 11	intin(0) = word_space	
control(1) = 2	intin(1) = char_space	
control(2) = 0	intin(n+2) = string(n)	
control(3) = 2+n		
control(4) = 0	ptsin(0) = x	
control(5) = 10	ptsin(1) = y	
control(6) = handle	ptsin(2) = length	
	ptsin(3) = 0	

Note: "n" is used here to represent the number of characters in the string.

V_CONTOURFILL (67H)

This function is often referred to as "seed" or "flood" fill. It fills an area using the current fill area attributes until it reaches either the edge of the screen or a specified color. Table 4-4 lists the fill area attributes; use vqf_attributes (25H) to obtain their current settings.

The center point of the area to be filled is specified in the x and y arguments using units of the current coordinate system. The color that defines the contour to be filled by v_contourfill is specified as a fill area color index value. If this value is negative, v_contourfill searches for any color other than the color of the seed point.

Note: This function may not be supported by all device drivers. Check work_out[7] of vq_extnd (66H) to determine if the device has seed fill capability.

Input Arguments

index	Color index that defines the contour
x	x-coordinate of starting point
y	y-coordinate of starting point

Sample Call to C Language Binding

```
WORD  v_contourfill();
WORD  handle, x, y, index;

v_contourfill(handle, x, y, index)
```

Parameter Block Binding

Control	Input	Output
control(0) = 103	intin(0) = index	
control(1) = 1		
control(2) = 0	ptsin(0) = x	
control(3) = 1	ptsin(1) = y	
control(4) = 0		
control(5) = 0		
control(6) = handle		

VR_RECFL (72H)

vr_recfl fills a rectangle whose area is defined by the pxyarray arguments in units of the current coordinate system (NDC or RC) according to the fill area attributes. This function is similar to v_bar (B-1H) except that the fill perimeter attribute is not used. Regardless of its current setting, vr_recfl operates with the fill perimeter attribute disabled (invisibile).

The fill area attributes are listed in Table 4-4, above; vqf_attributes (25H) returns their current settings.

Input Arguments

pxyarray[0] x-coordinate of corner of rectangle

pxyarray[1] y-coordinate of corner of rectangle

pxyarray[2] x-coordinate of corner diagonal to pxyarray[0]

pxyarray[3] y-coordinate of corner diagonal to pxyarray[1]

Sample Call to C Language Binding

```
WORD   vr_recfl();
WORD   handle, pxyarray[4];

v_recfl(handle, pxyarray);
```

Parameter Block Binding

Control	Input	Output
control(0) = 114	ptsin(0) = pxyarray[0]	
control(1) = 2	ptsin(1) = pxyarray[1]	
control(2) = 0	ptsin(2) = pxyarray[2]	
control(3) = 0	ptsin(3) = pxyarray[3]	
control(4) = 0		
control(5) = 0		
control(6) = handle		

End of Section 4

Attribute Functions

The VDI attribute functions control how output items are imposed over existing pixel values (the writing mode) and determine the characteristics of the output functions. The output function characteristics determined by the attribute functions include color, line type, marker type, fill pattern and style, and character height.

Note that the function descriptions in this section are organized according to the attributes they control, rather than opcode.

Table 5-1 lists each of the VDI attribute functions.

Table 5-1. VDI Attribute Functions

Function	Page	Purpose
vst_height (CH)	5-19	Set character height, abolute mode
vst_rotation (DH)	5-23	Set the character baseline vector
vs_color (EH)	5-6	Determine color representation
vsl_type (FH)	5-8	Set the line type
vsl_width (10H)	5-11	Set the line width
vsl_color (11H)	5-12	Set the line color index
vsm_type (12H)	5-15	Set the polymarker type
vsm_height (13H)	5-17	Set polymaker height
vsm_color (14H)	5-18	Set the polymarker color index
vst_font (15H)	5-25	Select a character font
vst_color (16H)	5-27	Set the text color index
vsf_interior (17H)	5-33	Set the fill interior style
vsf_style (18H)	5-35	Set the fill style index
vsf_color (19H)	5-38	Set the fill color index
vswr_mode (20H)	5-3	Select the writing mode
vst_alignment (27H)	5-31	Set text alignment
vsf_perimeter (68H)	5-39	Determine fill area perimeter visibility
vst_effects (6AH)	5-28	Set special effects for text
vst_point (6BH)	5-21	Set character height, points mode
vsl_ends (6CH)	5-13	Set line end styles
vsf_udpat (70H)	5-40	Set a user-defined fill pattern
vsl_udsty (71H)	5-10	Set a user-defined line style

VSWR_MODE (20H)

This function selects the writing mode. The writing mode affects the way new pixels for subsequent drawing operations are placed on the display. The calling routine specifies the operation to be performed between the color indices of the current pixel (source) and the existing pixel (destination) by selecting one of four writing modes.

The writing modes are: replace, transparent, XOR, and reverse transparent. work_out[9] of vq_extnd (66H) returns the number of writing modes available on a particular device -- see Section 8. Table 5-2 defines the operands used in the Boolean expressions that describe the four writing modes.

Table 5-2. Writing Mode Operands

Operand	Definition
mask	Line style or fill pattern
fore	Selected color after mapping from the VDI
back	Color 0 after mapping from the VDI (white is default)
old	Current color value
new	Replacement color value

Mode 1, Replace

Replace mode is insensitive to the currently displayed image. Any information already displayed is replaced. This is the default writing mode when the workstation is opened. The Boolean expression for replace mode is:

new = (fore **AND** mask) **OR** (back **AND NOT** mask)

Mode 2, Transparent

Transparent mode affects only the pixels where the mask is 1. These are changed to the fore value. The Boolean expression for transparent mode is:

new = (fore **AND** mask) **OR** (old **AND NOT** mask)

Mode 3, XOR

XOR mode reverses the bits representing the color. The Boolean expression for XOR mode is as follows:

new = mask **XOR** old

Mode 4, Reverse Transparent

Reverse transparent mode affects only the pixels where the mask is 0, changing them to the fore value. The Boolean expression for this mode is:

new = (old **AND** mask) **OR** (fore **AND NOT** mask)

Input Arguments

handle — Device handle

mode — Writing mode:

1 Replace mode
2 Transparent mode
3 XOR mode
4 Reverse transparent mode

If the writing mode specified by the calling routine is not in the range of 1 - 4, vswr_mode selects replace mode, 1.

Output Arguments

set_mode Selected writing mode

Sample Call to C Language Binding

```
WORD  vswr_mode();
WORD  set_mode, handle, mode;

set_mode = vswr_mode(handle, mode);
```

Parameter Block Binding

Control	Input	Output
control(0) = 32	intin(0) = mode	intout(0) = set_mode
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VS_COLOR (EH)

Set Color Representation assigns a specified color index to units of RGB (Red, Green, Blue) intensity. The calling routine specifies the unit of intensity for each of the three colors in tenths of a percent (0 - 1000).

If the specified value of a color intensity is less than 0, vs_color maps the value to 0; an intensity value of greater that 1000 is mapped to 1000.

On a monochrome device, the VDI maps any percentage of color to white. The background color is referenced as color index zero. The default color table index values are listed in Table 3-3 on page 3-4.

The number of color indices is device dependent; work_out[13] of v_opnwk (1H) and v_opnvwk (64H) returns the number of colors that can be defined. v_opnwk and v_opnvwk are described in Section 3, "Control Functions."

Note: This function performs no operation if a color lookup table is not supported for the specified device. work_out[5] of vq_extnd (66H), described in Section 8, indicates the availability of a color lookup table.

Input Arguments

handle	Device handle
index	The color index
rgb_in[0]	Red color intensity (in tenths of percent, 0-1000)
rgb_in[1]	Green color intensity (in tenths of percent, 0-1000)
rgb_in[2]	Blue color intensity (in tenths of percent, 0-1000)

Sample Call to C Language Binding

```
WORD   vs_color();
WORD   handle, index, rgb_in[3];

vs_color(handle, index, rgb_in);
```

Parameter Block Binding

Control	Input	Output
control(0) = 14	intin(0) = index	
control(1) = 0	intin(1) = rgb_in[0]	
control(2) = 0	intin(2) = rgb_in[1]	
control(3) = 4	intin(3) = rgb_in[2]	
control(4) = 0		
control(5) = 0		
control(6) = handle		

VSL_TYPE (FH)

This function sets the line type for subsequent polyline operations. All devices support at least six polyline types; the total number of available line types is device-dependent. v_opnwk (1H) and v_opnvwk (64H) return the number of line types for a particular device in work_out[6].

The line type index values and their corresponding pattern word bit settings are listed in Table 5-3. The pixel value in the pattern word is 1 = pixel on (active); 0 = pixel off, the most significant bit is the first pixel displayed.

Table 5-3. Line Type Index Values and Pattern Words

Value	Style	Line Pattern Word	
		MSB LSB	
1	Solid	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	FFFFH
2	Long dash	1 1 1 1 1 1 1 1 1 1 1 1 0 0 0 0	FFF0H
3	Dot	1 1 1 0 0 0 0 0 1 1 1 0 0 0 0 0	E0E0H
4	Dash,dot	1 1 1 1 1 1 1 0 0 0 1 1 1 0 0 0	FE38H
5	Dash	1 1 1 1 1 1 1 1 0 0 0 0 0 0 0 0	FF00H
6	Dash,dot,dot	1 1 1 1 0 0 0 1 1 0 0 1 1 0 0 0	F198H
7	User-defined	See vsl_udsty (71H) on page 5-10	
8-n	Device-dependent		

By default at open workstation, the user-defined line style is set to the pattern word for a solid line. This default assignment can be changed with vsl_udsty (71H).

vsl_type returns the line type selected and uses a solid line (1) if the value specified by the calling routine is out of range.

Note: If a nondefault line width is used, the device may draw the thickened line using a solid line style and may change the writing mode. Check the information returned by vq_extnd (66H) in work_out[17] and work_out[18]; vq_extnd is described in Section 8, "Inquire Functions."

Input Arguments

handle Device handle

style Requested line type, see Table 5-3

Output Arguments

set_type Line type selected

Sample Call to C Language Binding

```
WORD   vsl_type();
WORD   set_type, handle, style;

set_type = vsl_type(handle, style);
```

Parameter Block Binding

Control	Input	Output
control(0) = 15	intin(0) = style	intout(0) = set_type
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VSL_UDSTY (71H)

v_udsty sets the user-defined line style pattern word in the device driver to the specified pattern word (16-bits). This line is used for subsequent polyline operations when an application selects the user-defined line style, index 7.

The Most Significant Bit (MSB) of the pattern word is the first pixel displayed in the line; see Table 5-3 on page 5-8.

When the workstation is opened, the default for the user-defined line style is a solid pattern word.

Input Arguments

handle	Device handle
pattern	Line style pattern word, 16 bits

Sample Call to C Language Binding

```
WORD  vsl_udsty();
WORD  handle, pattern;

vsl_udsty(handle, pattern);
```

Parameter Block Binding

Control	Input	Output
control(0) = 113	intin(0) = pattern	
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 0		
control(5) = 0		
control(6) = handle		

VSL_WIDTH (10H)

This function sets the line width for subsequent polyline operations. The available line width closest to, but not greater than, the requested line width is used. Line widths are odd numbers that begin at one. If you select two in Raster Coordinates, vsl_width returns one, which sets the line width at one pixel.

vql_attributes (23H), described in Section 8, "Inquire Functions," returns the current line width in work_out[5].

Note: Thickened lines might be rendered on the device by selecting a solid line type (1).

Input Arguments

handle	Device handle
width	Requested line width in x-axis NDC/RC units

Output Arguments

set_width	Selected line width in x-axis NDC/RC units

Sample Call to C Language Binding

```
WORD  vsl_width();
WORD  set_width, handle, width;

set_width = vsl_width(handle, width);
```

Parameter Block Binding

Control	Input	Output
control(0) = 16	ptsin(0) = width	ptsout(0) = set_width
control(1) = 1	ptsin(1) = 0	ptsout(1) = 0
control(2) = 1		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		

VSL_COLOR (11H)

vsl_color sets the color index for subsequent polyline operations. The vs_color (EH) function determines the color the index represents.

At least two color indices, 0 and 1, are always supported (monochrome). Color indices range from 0 to a device-dependent maximum. vsl_color returns the color index selected and uses color index 1 if the calling process specifies an index that is out of range.

The default color table index values are listed in Table 3-3 on page 3-4.

Input Arguments

handle	Device handle
color_index	Requested color index

Output Arguments

set_color	Color index selected

Sample Call to C Language Binding

```
WORD   vsl_color();
WORD   set_color, handle, color_index;

set_color = vsl_color(handle, color_index);
```

Parameter Block Binding

Control	Input	Output
control(0) = 17 control(1) = 0 control(2) = 0 control(3) = 1 control(4) = 1 control(5) = 5 control(6) = handle	intin(0) = color_index	intout(0) = set_color

VSL_ENDS (6CH)

This function sets the style for the beginning and ending points of a polyline. The two points of a polyline can have different styles. The calling routine can specify the end styles listed in Table 5-4.

Table 5-4. Polyline End Styles

Value	End Style
0	Squared (Default)
1	Arrow
2	Rounded

If the calling routine requests an invalid end style, vsl_ends uses squared (0).

Both the squared and arrow styles end at the end of the polyline. The rounded style is drawn so that the center of the rounding is at the end of the polyline; see Figure 5-1.

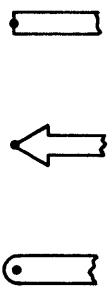

Figure 5-1. Points for Polyline End Styles

Input Arguments

handle	Device handle
beg_style	End style for beginning point, see Table 5-4
end_style	End style for ending point

Sample Call to C Language Binding

```
WORD  vsl_ends();
WORD  handle, beg_style, end_style;

vsl_ends(handle, beg_style, end_style);
```

Parameter Block Binding

Control	Input	Output
control(0) = 108	intin(0) = beg_style	
control(1) = 0	intin(1) = end_style	
control(2) = 0		
control(3) = 2		
control(4) = 0		
control(5) = 0		
control(6) = handle		

VSM_TYPE (12H)

vsm_type sets the marker type for subsequent polymarker functions. Although the total number of available marker types is device-dependent, the VDI always defines at least six. The marker types are listed in Table 5-5.

Table 5-5. Polymarker Types

Value	Type
1	Dot
2	Plus
3	Asterisk (Default)
4	Square
5	Diagonal Cross
6	Diamond
7-n	User-defined

v_opnwk (1H) and v_opnvwk (64H) return the number of marker types for a particular device in work_out[8]; see Section 3. vqm_attributes (24H), described in Section 8, "Inquire Functions," returns the current marker type.

If the marker type requested by the calling routine is out of range, vsm_type uses an asterisk, type 3. Marker type 1 is the smallest dot the VDI displays on the device; it cannot be scaled.

Input Arguments

handle Device handle

symbol Requested polymarker type, see Table 5-5

Output Arguments

set_type Polymarker type selected

Sample Call to C Language Binding

```
WORD  vsm_type();
WORD  set_type, handle, symbol;

set_type = vsm_type(handle, symbol);
```

Parameter Block Binding

Control	Input	Output
control(0) = 18 control(1) = 0 control(2) = 0 control(3) = 1 control(4) = 1 control(5) = 0 control(6) = handle	intin(0) = symbol	intout(0) = set_type

VSM_HEIGHT (13H)

The polymarker height determined by vsm_height is used for subsequent polymarker functions. The number of polymarker sizes available for a particular device is returned by v_opnwk (1H) and v_opnvwk (64K) in work_out[9] -- see Section 3.

If the marker height requested by the calling routine does not exist, vsm_height selects the next smaller height. vsm_height returns the actual marker height selected in set_height.

Input Arguments

handle	Device handle
height	Requested polymarker height in y-axis NDC/RC units

Output Arguments

set_height	Polymarker height selected in y-axis NDC/RC units

Sample Call to C Language Binding

```
WORD  vsm_height();
WORD  set_height, handle, height;

set_height = vsm_height(handle, height);
```

Parameter Block Binding

Control	Input	Output
control(0) = 19	ptsin(0) = 0	ptsout(0) = 0
control(1) = 1	ptsin(1) = height	ptsout(1) = set_height
control(2) = 1		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		

VSM_COLOR (14H)

vsm_color sets the color index for subsequent polymarker operations. The vs_color (EH) function determines the color the index represents.

At least two color indices, 0 and 1, are always supported (monochrome). Color indices range from 0 to a device-dependent maximum. vsm_color returns the color index selected for the polymarker and selects color index 1 if the index specified by the calling process is out of range.

The default color table index values are listed in Table 3-3 on page 3-4.

Input Arguments

handle Device handle

color_index Requested polymarker color index

Output Arguments

set_color Selected polymarker color index

Sample Call to C Language Binding

```
WORD   vsm_color();
WORD   set_color, handle, color_index;

set_color = vsm_color(handle, color_index);
```

Parameter Block Binding

Control	Input	Output
control(0) = 20 control(1) = 0 control(2) = 0 control(3) = 1 control(4) = 1 control(5) = 0 control(6) = handle	intin(0) = color_index	intout(0) = set_color

VST_HEIGHT (CH)

vst_height sets the current graphic text character height in NDC/RC units (absolute mode). The character height is specified the according to the distance from the character baseline to the top of the character cell, rather than the character cell height.

If the specified character height does not map exactly to a size available on device, vst_height selects the closest character size that does not exceed the requested size.

vst_height returns the selected character height (baseline to top line) and the size of a character cell; see Figure 5-2. For fixed (monospaced) fonts, vst_height returns the width of a character and the width of a character cell. For proportional fonts, vst_height returns the width of the widest character and the width of the widest character cell.

All input and output arguments are specified in units of the current coordinate system (NDC or RC).

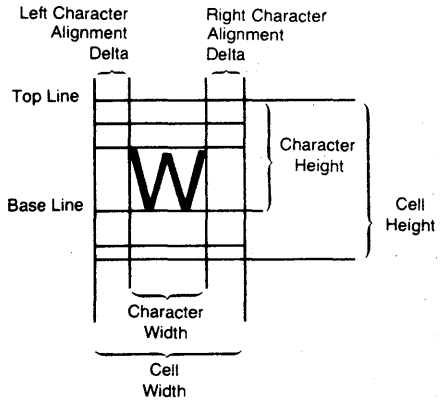

Figure 5-2. Character Size Definition

v_opnwk (1H), v_opnvwk (64H), and vqt_attributes (26H) return information about character sizes for the specified device. v_opnwk and v_opnvwk are described in Section 3; vqt_attributes is described in Section 8.

Input Arguments

handle	Device handle
height	Requested character height in y-axis NDC/RC units

Output Arguments

char_width	Character width selected in x-axis NDC/RC units
char_height	Character height selected in y-axis NDC/RC units
cell_width	Character cell width in x-axis NDC/RC units
cell_height	Character cell height in y-axis NDC/RC units

Sample Call to C Language Binding

```
WORD    vst_height();
WORD    handle, height, char_width, char_height, cell_width,
        cell_height;

vst_height(handle, height, &char_width, &char_height, &cell_width,
        &cell_height);
```

Parameter Block Binding

Control	Input	Output
control(0) = 12	ptsin(0) = 0	ptsout(0) = char_width
control(1) = 1	ptsin(1) = height	ptsin(1) = char_height
control(2) = 2		ptsout(2) = cell_width
control(3) = 0		ptsout(3) = cell_height
control(4) = 0		
control(5) = 0		
control(6) = handle		

VST_POINT (6BH)

This function sets the current graphic text character height in printer points (points mode). A point is 1/72 of an inch. The character height is specified according to the distance between the baseline of one line of text and the baseline of the next line of text. This specification is is the character cell height.

If the character height specified by the calling routine does not map exactly to a device size, vst_point selects the closest character size that does not exceed the requested size.

vst_point returns the selected point size in set_point. Note that vst_point returns the character height, character width, cell height, and the cell width in NDC/RC units; see Figure 5-2 on page 5-19.

For proportional faces, vst_point returns the width of the widest character and the width of the widest character cell in the font.

v_opnwk (1H), v_opnvwk (64H), and vqt_attributes (26H) return information about character sizes for the specified device. v_opnwk and v_opnvwk are described in Section 3; vqt_attributes is described in Section 8.

Input Arguments

handle	Device handle
point	Character cell height in points

Output Arguments

set_point	Selected cell height in points
char_width	Selected character width in x-axis NDC/RC units
char_height	Selected character height in y-axis NDC/RC units
cell_width	Character cell width in x-axis NDC/RC units
cell_height	Character cell height in y-axis NDC/RC units

Sample Call to C Language Binding

```
WORD    vst_point();
WORD    set_point, handle, point, char_width, char_height,
        cell_width, cell_height;

set_point = vst_point(handle, point, &char_width, &char_height,
        &cell_width, &cell_height);
```

Parameter Block Binding

Control	Input	Output
control(0) = 107	intin(0) = point	intout(0) = set_point
control(1) = 0		ptsout(0) = char_width
control(2) = 2		ptsout(1) = char_height
control(3) = 1		ptsout(2) = cell_width
control(4) = 1		ptsout(3) = cell_height
control(5) = 0		
control(6) = handle		

VST_ROTATION (DH)

vst_rotation specifies the baseline for subsequent graphic text output by requesting an angle of rotation for the character baseline vector. The calling routine specifies the angle for the baseline vector in tenths if degrees. Figure 5-3 depicts how angles are specified to vst_rotation.

vst_rotation returns the selected baseline vector, which is a best-fit match to the requested value.

The default angle of rotation for the baseline vector is zero degrees when the workstation is opened.

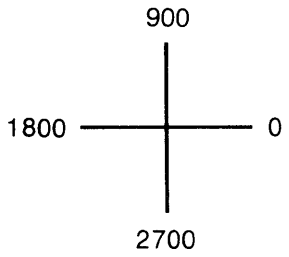

Figure 5-3. Angle Specification

Input Arguments

handle	Device handle
angle	Angle character baseline rotation (in tenths of degrees, 0 - 3600)

Output Arguments

set_baseline	Selected angle of character baseline rotation (in tenths of degrees 0-3600)

Sample Call to C Language Binding

```
WORD   vst_rotation();
WORD   set_baseline, handle, angle;

set_baseline = vst_rotation(handle, angle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 13	intin(0) = angle	intout(0) = set_baseline
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VST_FONT (15H)

This function selects a graphic character face for subsequent graphic text operations. The calling routine selects a face according to its number as listed in Table 5-6. You can load external faces with v_load_fonts (77H), described Section 3.

Note that some faces might not be supported on all devices. Use the Inquire Font Name and Index function, vqt_name (82H), to determine face names and indices. vqt_attributes (26H) returns the currently selected face in work_out[0]; vqt_name and vqt_attributes are described in Section 8, "Inquire Functions." v_opnwk (1H) and v_opnvwk (64H) both return the number of faces for the device in work_out[10] -- see Section 3.

Table 5-6. Face Values and Names

Value	Font
1	System Face
2	Swiss 721
3	Swiss 721 Thin
4	Swiss 721 Thin Italic
5	Swiss 721 Light
6	Swiss 721 Light Italic
7	Swiss 721 Italic
8	Swiss 721 Bold
9	Swiss 721 Bold Italic
10	Swiss 721 Heavy
11	Swiss 721 Heavy Italic
12	Swiss 721 Black
13	Swiss 721 Black Italic
14	Dutch 801 Roman
15	Dutch 801 Italic
16	Dutch 801 Bold
17	Dutch 801 Bold Italic

Input Arguments

handle	Device handle
font	Number of requested software text face

Output Arguments

set_font	Number of face selected

Sample Call to C Language Binding

```
WORD   vst_font();
WORD   set_font, handle, font;

set_font = vst_font(handle, font);
```

Parameter Block Binding

Control	Input	Output
control(0) = 21	intin(0) = font	intout[0] = set_font
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VST_COLOR (16H)

This function sets the color index for subsequent graphic text operations. The vs_color (EH) function determines the color the index represents.

At least two color indices, 0 and 1, are always supported (monochrome). Color indices range from 0 to a device-dependent maximum. vst_color returns the color index selected and uses color index 1 if the calling process specifies an index that is out of range.

The default color table index values are listed in Table 3-3 on page 3-4.

Input Arguments

handle Device handle

color_index Requested text color index

Output Arguments

set_color Selected text color index

Sample Call to C Language Binding

```
WORD   vst_color();
WORD   set_color, handle, color_index;

set_color = vst_color(handle,color_index);
```

Parameter Block Binding

Control	Input	Output
control(0) = 22	intin(0) = color_index	intout(0) = set_color
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VST_EFFECTS (6AH)

This function sets text special effects for subsequently displayed graphic text. The following effects are available:

- thickened
- light intensity
- skewed
- underlined
- outlined
- shadowed
- any combination of the above

The **effect** input argument is a bit pattern. The attributes set by vst_effects correspond to the setting in the six least significant bits. Table 5-7 lists the bit assignments.

Table 5-7. Text Attribute Bit Mapping

Bit	Description
0	Thickened 0 thickened not selected 1 set style to thickened
1	Intensity 0 normal intensity 1 light intensity
2	Skewed 0 skewed not selected 1 set style to skewed
3	Underlined 0 do not underline 1 underline text
4	Outline 0 do not outline 1 outline
5	Shadow 0 no shadow 1 shadow

If effect = 9 (1001 binary), for example, the text style is set to thickened and underlined.

For effects not supported on a device, vst_effects returns those bits set to 0 in set_effect. work_out[2] of vq_extnd (66H) returns the supported text effects.

The default text effect when the workstation is opened is normal intensity.

Figure 5-4 depicts the five of the special text effects.

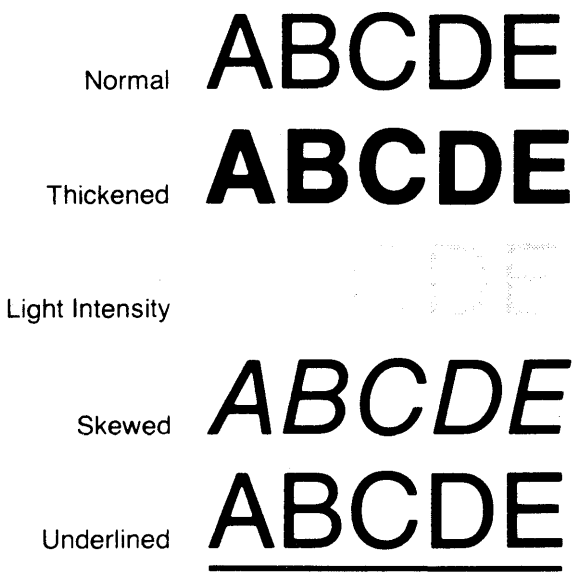

Figure 5-4. Graphic Text Special Effects

Input Arguments

handle	Device handle
effect	Text effect bit pattern

Output Arguments

set_effect Text effects actually selected (text effect word with the appropriate bits set)

Sample Call to C Language Binding

```
WORD   vst_effects();
WORD   set_effect, handle, effect;

set_effect = vst_effects(handle, effect);
```

Parameter Block Binding

Control	Input	Output
control(0) = 106	intin(0) = effect	intout(0) = set_effect
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VST_ALIGNMENT (27H)

vst_alignment sets horizontal and vertical alignment for graphic text. The horizontal alignment is the direction of the baseline; the vertical alignment is perpendicular to the baseline. This function controls the positioning of the text string in relation to the graphic text position.

The default alignment, when the workstation is opened, places the left baseline corner of the string at the graphic text position.

If the calling routine specifies an invalid horizontal alignment, vst_alignment selects the default, left justified. vst_alignment selects the default vertical alignment, baseline, if the calling routine specifies an invalid vertical alignment.

vqt_attributes (26H) returns the current horizontal and vertical alignment settings in work_out[3] and work_out[4], respectively; see Section 8, "Inquire Functions."

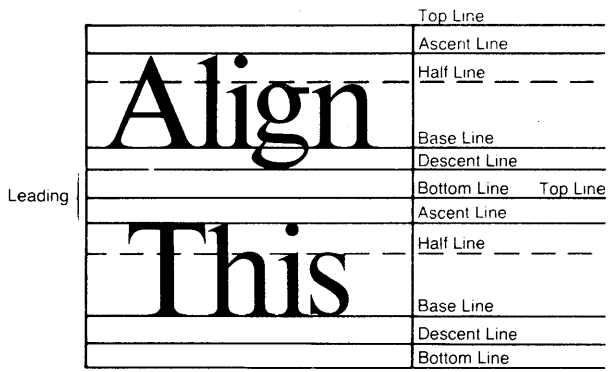

Figure 5-5. Graphic Text Alignment

Input Arguments

handle — Device handle

hor_in — Horizontal alignment:

0 Left justified (default)
1 Center justified
2 Right justified

vert_in — Vertical alignment (see Figure 5-5):

0 Baseline (default)
1 Half line
2 Ascent line
3 Bottom line
4 Descent line
5 Top line

Output Arguments

hor_out — Selected horizontal alignment

vert_out — Selected vertical alignment

Sample Call to C Language Binding

```
WORD   vst_alignment();
WORD   handle, hor_in, vert_in, hor_out, vert_out;

vst_alignment(handle, hor_in, vert_in, &hor_out, &vert_out);
```

Parameter Block Binding

Control	Input	Output
control(0) = 39	intin(0) = hor_in	intout(0) = hor_out
control(1) = 0	intin(1) = vert_in	intout(1) = vert_out
control(2) = 0		
control(3) = 2		
control(4) = 2		
control(5) = 0		
control(6) = handle		

VSF_INTERIOR (17H)

The fill interior style to be used in subsequent polygon fill operations is determined by vsf_interior.

vsf_interior returns the selected fill interior style. If the calling routine specifies an unavailable style, vsf_interior selects hollow. Hollow style fills the interior with the current background color (color index 0). Solid style fills the area with the currently selected fill color.

vqf_attributes (25H), described in Section 8, returns both the current fill interior style and fill style index values.

Input Arguments

handle — Device handle

style — Fill interior style:

0 Hollow
1 Solid
2 Pattern
3 Hatch
4 User-defined style

Output Arguments

set_interior — Selected fill interior style

Sample Call to C Language Binding

```
WORD   vsf_interior();
WORD   set_interior, handle, style;

set_interior = vsf_interior(handle, style);
```

Parameter Block Binding

Control	Input	Output
control(0) = 23	intin(0) = style	intout(0) = set_interior
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VSF_STYLE (18H)

vsf_style selects a fill style based on the fill interior style determined by vsf_interior (17H). If the current fill interior style is hollow (0), solid (1), or user-defined (4), this function has no effect on the fill style. A fill style index can be selected only for the pattern (2) and hatch (3) fill interior styles.

Fill style indices range from 1 to a device-dependent maximum. work_out[11] and work_out[12] of v_opnwk (1H) return this maximum; see Section 3. If the calling routine specifies an unavailable fill style index, vsf_style uses index 1.

Figure 5-6 shows the available fill styles. Under each fill style shown Figure 5-6 are two numbers separated by a comma. The number to the left of the comma corresponds to the interior style: Hollow, Pattern, or Hatch. The number to the right of the comma corresponds to the index for the particular pattern or hatch.

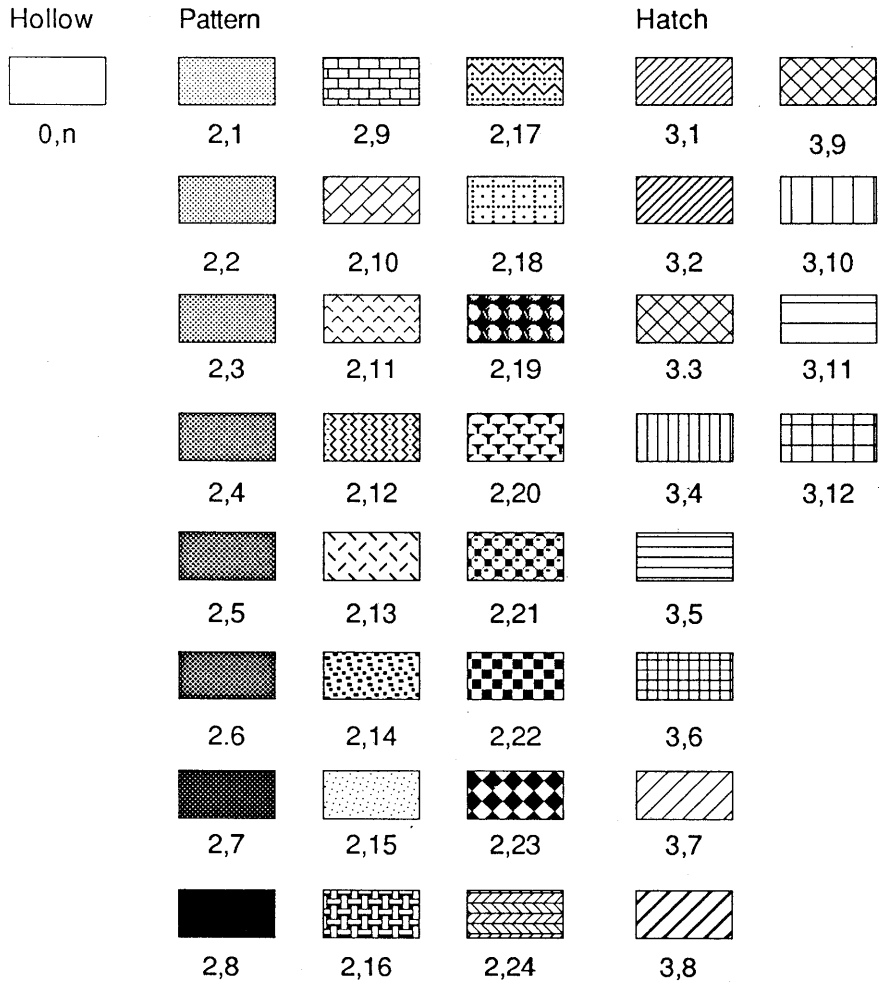

Figure 5-6. Fill Styles and Indices

Note: 1,n (interior style 1, solid, followed by any index) produces the same result as 2,8.

For patterns, index 1 maps to the lowest intensity pattern on the device. The pattern is always monochrome and uses the current fill area color for foreground pixels.

The number of available pattern and hatch styles is returned in work_out[11] and work_out[12], respectively, of v_opnwk (1H) and v_opnvwk (64H). These functions are described in Section 3.

Input Arguments

handle Device handle

style_index Fill style index for pattern or hatch interior

Output Arguments

set_style Selected fill style index for pattern or hatch interior

Sample Call to C Language Binding

```
WORD   vsf_style();
WORD   set_style, handle, style_index;

set_style = vsf_style(handle, style_index);
```

Parameter Block Binding

Control	Input	Output
control(0) = 24	intin(0) = style_index	intout(0) = set_style
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VSF_COLOR (19H)

vsf_color sets the color index for subsequent fill operations. Set Color Representation, vs_color (EH), determines the color the index represents.

At least two color indices, 0 and 1, are always supported (monochrome). Color indices range from 0 to a device-dependent maximum. vsf_color returns the color index selected and uses color index 1 if the calling process specifies an invalid index.

The default color table index values are listed in Table 3-3 on page 3-4.

Input Arguments

handle	Device handle
color_index	Requested fill color index

Output Arguments

set_color	Selected fill color index

Sample Call to C Language Binding

```
WORD   vsf_color();
WORD   set_color, handle, color_index;

set_color = vsf_color(handle, color_index);
```

Parameter Block Binding

Control	Input	Output
control(0) = 25 control(1) = 0 control(2) = 0 control(3) = 1 control(4) = 1 control(5) = 0 control(6) = handle	intin(0) = color_index	intout(0) = set_color

VSF_PERIMETER (68H)

vsf_perimeter turns the outline of a fill area on or off. When perimeter visibility is on (the default when the workstation is opened), the border of a fill area is drawn in the current fill area color with a solid line. When perimeter visibility is off, no outline is drawn.

Any nonzero value specified for the perimeter visibility flag, per_vis, causes the perimeter to be visible.

Input Arguments

handle	Device handle
per_vis	Perimeter visibility flag: zero Invisible nonzero Visibile

Output Arguments

set_perimeter Selected perimeter visibility

Sample Call to C Language Binding

```
WORD   vsf_perimeter();
WORD   set_perimeter, handle, per_vis;

set_perimeter = vsf_perimeter(handle, per_vis);
```

Parameter Block Binding

Control	Input	Output
control(0) = 104	intin(0) = per_vis	intout(0) = set_perimeter
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VSF_UDPAT (70H)

This function redefines the user-definable fill pattern. This fill pattern is referenced by vsf_interior (17H) as fill interior style 4.

16 two-byte words are required for a single plane fill pattern. Bit 15 of the first word is the upper left bit of the pattern. Bit 0 of word 16 is the lower right bit of the pattern. Bit 0 is the Least Significant Bit of the word. Words are stored in the same format as 16-bit integers.

For a single plane pattern, a bit value of 1 indicates foreground color. A bit value of 0 indicates the background color. The color used for the foreground is determined by the current fill area color index as set by vsf_color (19H).

For a multiple plane pattern (multiple colors), the number of full 16-by-16 (words-by-bits) planes defined is used in the fill operation. Any unspecified planes are zeroed. Note that the writing mode must be set to replace (mode 1) when using a multiplane fill pattern; see vswr_mode (20H) on page 5-3.

The user-defined fill pattern is the DRI logo by default when the workstation is opened.

Input Arguments

handle	Device handle
pfill_pat	Fill pattern data (16 words per plane)

Sample Call to C Language Binding

```
WORD   vsf_udpat();
WORD   handle, planes, pfil_pat[planes x 16];

vsf_udpat(handle, pfill_pat, planes);
```

Parameter Block Binding

Control	Input
control(0) = 112	intin(0)
control(1) = 0	.
control(2) = 0	.
control(3) = 16-n	intin(15) =1st plane of fill pattern
control(4) = 0	intin(16)
control(5) = 0	.
control(6) = handle	.
	intin(29) = 2nd plane of fill pattern
	intin(n-15)
	.
	.
	intin(n) = last plane of fill pattern

End of Section 5

Raster Operations

Raster operations perform logic operations on rectangular blocks of bits in memory and on rectangular blocks of pixels on physical devices.

Table 6-1. Raster Operation Functions

Function	Page	Purpose
v_get_pixel (69H)	6-9	Get Pixel
vro_cpyfm (6DH)	6-10	Copy raster, opaque
vr_trnfm (6EH)	6-12	Transform form
vrt_cpyfm (79H)	6-13	Copy raster, transparent

Memory Form Definition Block

A raster area is defined by a Memory Form Definition Block (MFDB). As shown in Figure 6-1, an MFDB consists of ten words; its components are as follows:

- A 32-bit pointer to the memory address of the upper left corner of the first plane of the raster area. This pointer is a native-machine pointer. If all 32 bits of this pointer are 0, the MFDB is for a physical device, and any MFDB parameters you enter are ignored -- these values are defined in the device driver.
- The width and height of the raster area in pixels.
- The width of the raster area in words. This value is equal to the width of the raster area in pixels, divided by the word size.
- A flag indicating whether the format of the raster area is standard or device-dependent.
- The number of memory planes in the raster area.
- Some locations reserved for future use.

A raster area must start on a word boundary and have a width that is an integral multiple of the word size.

	One word (16 bits)
Word 1	Memory pointer word 1
Word 2	Memory pointer word 2
Word 3	Form Width in Pixels
Word 4	Form Height in Pixels
Word 5	Form Width in Words
Word 6	Form format flag
Word 7	Number of Memory Planes
Word 8	Reserved for future use
Word 9	Reserved for future use
Word 10	Reserved for future use

Figure 6-1. Memory Form Definition Block

Raster Area Formats

Two memory formats are associated with raster areas:

- device-specific format
- well-defined standard format

The VDI provides the vr_trnfm (6EH) function to transform a raster area from one format to another. You must transform a standard format raster area to a device-specific format before using a copy raster function, vro_cpyfm (6DH) or vrt_cpyfm (79H).

The form format flag of the MFDB can have two values:

0 The form is in device-specific format
1 The form is in standard format

The layout of a standard form format is as follows (see Figure 6-2):

- Plane based - The planes are contiguous blocks of memory, each having the same x,y resolution. A monochrome implementation has a single plane. A color index is mapped to a pixel value with each plane representing one bit in the value. Tables 6-2 and 6-3 define the pixel-value-to-color-index mapping for eight-color and sixteen-color screens, respectively.
- The Most Significant Bit in a word (16-bit integer) is the leftmost bit in the image. Note that the data is stored in the same format as 16-bit integers.
- Words are arranged sequentially along a row. The first word is on the left edge of the row.

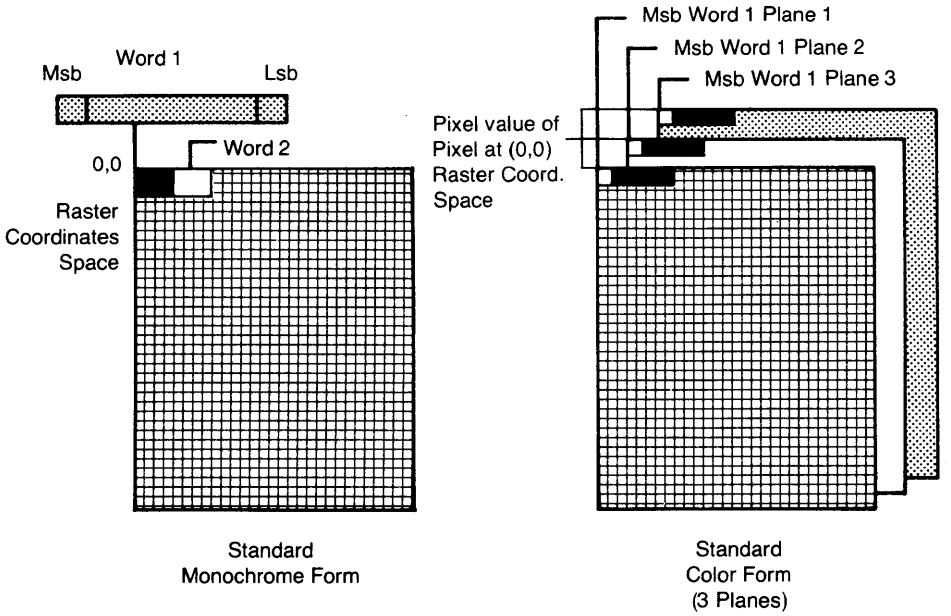

Figure 6-2. Standard Forms

Table 6-2. Pixel Value to Color Index Mapping for 8-color Screens

Pixel Value	Color Index	Color
000	0	White
001	2	Red
010	3	Green
011	6	Yellow
100	4	Blue
101	7	Magenta
110	5	Cyan
111	1	Black

Table 6-3. Pixel Value to Color Index Mapping for 16-color Screens

Pixel Value	Color Index	Color
0000	0	White
0001	2	Red
0010	3	Green
0011	6	Yellow
0100	4	Blue
0101	7	Magenta
0110	5	Cyan
0111	8	Light Grey
1000	9	Dark Grey
1001	10	Dark Red
1010	11	Dark Green
1011	14	Dark Yellow
1100	12	Dark Blue
1101	15	Dark Magenta
1110	13	Dark Cyan
1111	1	Black

Note: A pixel value of 0 maps to the background color.

In addition to the MFDB, the copy raster functions vro_cpyfm (6DH) and vrt_cpyfm (79H) also take a rectangle as an argument. This allows operations on a specified portion of the raster area. A rectangle is specified by the x,y coordinates of two diagonal corners.

Coordinate Systems

A sample single-plane memory form with a form width of 16 pixels, a form height of 8 pixels, and a highlighted rectangle with corners of (3,1) and (5,4) is shown in Figure 6-3.

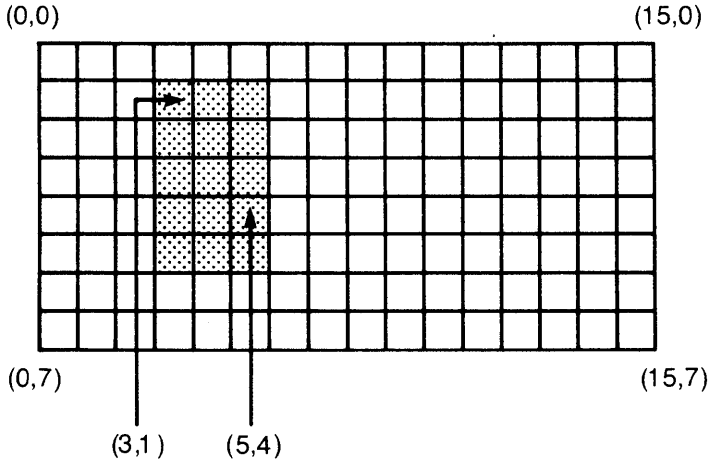

Figure 6-3. Sample Single Plane Memory Form

Logic Operations

To provide greatest flexibility, raster operations subject to a logic operation take the operation as an argument rather than using the logic operation associated with vector primitives. In addition, the operations available are greatly expanded to allow more flexibility. Table 6-4 lists the available operations with the following conventions:

- **S** = source pixel value (0 or 1)
- **D** = destination pixel value (0 or 1)
- **D'** = destination pixel value after the logical operation

Table 6-4. Raster Operation Logic Operations

Mode	Definition	
0	D'= 0	
1	D'= S AND D	
2	D'= S AND [NOT D]	
3	D'= S	(Replace mode)
4	D'= [NOT S] AND D	
5	D'= D	
6	D'= S XOR D	(XOR mode)
7	D'= S OR D	
8	D'= NOT [S OR D]	
9	D'= NOT [S XOR D]	
10	D'= NOT D	
11	D'= S OR [NOT D]	
12	D'= NOT S	
13	D'= [NOT S] OR D	
14	D'= NOT [S AND D]	
15	D'= 1	

V_GET_PIXEL (69H)

This function returns a pixel value and a color index for the pixel specified in x and y by the calling routine.

Color index 0 is the background color. It might not map to pixel value 0 in device-specific form. Refer to Tables 6-2 and 6-3 for the colors and values. Standard form always maps color index 0 to pixel value 0.

Note: v_get_pixel may not be supported by all device drivers.

Input Arguments

handle	Device handle
x	x-coordinate of pixel in RC/NDC units
y	y-coordinate of pixel in RC/NDC units

Output Arguments

pel	Pixel value in device-specific form
index	Color index

Sample Call to C Language Binding

```
WORD   v_get_pixel();
WORD   handle, x, y, pel, index;

v_get_pixel(handle, x, y, &pel, &index);
```

Parameter Block Binding

Control	Input	Output
control(0) = 105	ptsin(0) = x	intout(0) = pel
control(1) = 1	ptsin(1) = y	intout(1) = index
control(2) = 0		
control(3) = 0		
control(4) = 2		
control(5) = 0		
control(6) = handle		

VRO_CPYFM (6DH)

Copy Raster Opaque copies a rectangular raster area from source form to destination form using the logic operation specified by the calling routine. If the source and destination forms are the same, and the rectangles overlap, vro_cpyfm copies so that the source rectangle is not changed until the corresponding area in the destination has been processed. No rotation or transformation occurs as a result of this function; the copy is pixel for pixel.

If the source and destination rectangles are not the same size, vro_cpyfm uses the destination as a pointer and the source for the size. vq_extnd (66H), described in Section 8, returns scaling ability.

The source and destination forms must be in device-specific form; see vr_trnfm (6EH) in this section.

All input coordinates (xy[0] to xy[7]) must be specified according to the current coordinate system (NDC or RC).

Input Arguments

handle	Device handle
srcMFDB	Double-word address of the source MFDB
desMFDB	Double-word address of the destination MFDB
wr_mode	Logic operation (refer to Table 6-4)
xy[0]	x-coordinate of source rectangle corner in NDC/RC
xy[1]	y-coordinate of source rectangle corner in NDC/RC
xy[2]	x-coordinate, in NDC/RC, of corner diagonal to xy[0]
xy[3]	y-coordinate, in NDC/RC, of corner diagonal to xy[1]
xy[4]	x-coordinate of destination rectangle corner in NDC/RC
xy[5]	y-coordinate of destination rectangle corner in NDC/RC

xy[6] x-coordinate of destination rectangle corner diagonal to xy[4]

xy[7] y-coordinate of destination rectangle corner diagonal to xy[5]

Sample Call to C Language Binding

```
WORD  vro_cpyfm();
WORD  handle, wr_mode, xy[], *srcMFDB, *desMFDB;

vro_cpyfm(handle, wr_mode, xy, srcMFDB, desMFDB);
```

Parameter Block Binding

Control	Input	Output
control(0) = 109	intin(0) = wr_mode	
control(1) = 4	ptsin(0) = xy[0]	
control(2) = 0	ptsin(1) = xy[1]	
control(3) = 1	.	
control(4) = 0	.	
control(5) = 0	ptsin(7) = xy[7]	
control(6) = handle		
control(7-8) = srcMFDB		
control(9-10) = desMFDB		

VR_TRNFM (6EH)

This function transforms a raster area from standard format to device-specific format or from device-specific to standard format. The operation is a toggle that changes the current format state.

The number of planes specified in the source MFDB determines the number transformed. The source format flag is toggled and placed in the destination. The user is required to ensure that the other parameters in the destination MFDB are correct.

Note that the source and destination MFDBs must be either completely coincident or separate; they cannot partially overlap.

Input Arguments

handle	Device handle
srcMFDB	Double-word address of the source MFDB
desMFDB	Double-word address of the destination MFDB

Sample Call to C Language Binding

```
WORD   vr_trnfm();
WORD   handle, *srcMFDB, *desMFDB;

vr_trnfm(handle, srcMFDB, desMFDB);
```

Parameter Block Binding

Control	Input	Output
control(0) = 110		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		
control(7-8) = srcMFDB		
control(9-10) = desMFDB		

VRT_CPYFM (79H)

Copy Raster Transparent copies a monochrome rectangular raster area from the source form to a color area. The calling routine specifies a writing mode and color indices for both 0's and 1's. The source form cannot be the screen.

If the source and destination rectangles are not the same size, vrt_cpyfm uses the source rectangle for the size and the upper left corner of the destination rectangle for the initial destination location.

All rectangle coordinates (xy[0] to xy[1]) must be specified according to the current coordinate system (NDC or RC).

Transfer of information from the source to the destination is controlled by specifying the writing mode as described below.

Mode 1, Replace

Replace mode results in a replacement of all pixels in the destination rectangle. The foreground color index, specified in index[0], is output to all pixels associated with source locations which are set to one. The background color index, specified in index[1], is output to all pixels associated with source locations set to zero.

Mode 2, Transparent

Transparent mode affects only the pixels associated with a source value of one. Those pixels are set to the foreground color whose index is specified in index[0]. The color index specified in index[1] is not used.

Mode 3, XOR

In XOR mode, the monochrome raster source area is logically XORed with each plane of the destination. The specified color indices are not used.

Mode 4, Reverse Transparent

Reverse Transparent mode affects only the pixels associated with a source value of zero. These pixels are set to the background color specified in index[1]. The color index specified in index[0] is not used.

Input Arguments

handle	Device handle
srcMFDB	Double-word address of the source MFDB
desMFDB	Double-word address of the destination MFDB
wr_mode	Writing Mode: 1 Replace mode 2 Transparent mode 3 XOR mode 4 Reverse transparent mode
index[0]	Color index for ones in data (foreground)
index[1]	Color index for zeros in data (background)
xy[0]	x-coordinate of source rectangle corner in NDC/RC
xy[1]	y-coordinate of source rectangle corner in NDC/RC
xy[2]	x-coordinate, in NDC/RC, of corner diagonal to xy[0]
xy[3]	y-coordinate, in NDC/RC, of corner diagonal to xy[1]
xy[4]	x-coordinate of destination rectangle corner in NDC/RC
xy[5]	y-coordinate of destination rectangle corner in NDC/RC
xy[6]	x-coordinate, in NDC/RC, of corner diagonal to xy[4]
xy[7]	y-coordinate, in NDC/RC, of corner diagonal to xy[5]

Sample Call to C Language Binding

```
WORD   vrt_cpyfm();
WORD   handle, wr_mode, xy[], *srcMFDB *desMFDB, index;

vrt_cpyfm(handle, wr_mode, xy, srcMFDB, desMFDB, &index);
```

Parameter Block Binding

Control	Input	Output
control(0) = 121	intin(0) = wr_mode	
control(1) = 4	intin(1) = index[0]	
control(2) = 0	intin(2) = index[1]	
control(3) = 3	ptsin(0) = xy[0]	
control(4) = 0	ptsin(1) = xy[1]	
control(5) = 0	.	
control(6) = handle	.	
control(7-8) = srcMFDB	ptsin(7) = xy[7]	
control(9-10) = desMFDB		

End of Section 6

Input Functions

The VDI input functions allow user interactions with the application program. Many of the input functions support two modes: request and sample. In request mode, the driver waits until an input event occurs before returning. In sample mode, the driver returns the current status or location of the input device without waiting.

In VDI-only programs with multiple workstations, use the request mode rather than the sample mode to input characters. Workstations using the sample mode might not get all of the characters input.

Note: Programs that use both the Application Environment Services (AES) and VDI functions must use the AES input functions rather than the VDI functions. Use the VDI input functions only in programs that do not use the AES. The AES is described in the GEM Application Environment Services Reference Guide.

Table 7-1 lists the VDI input functions.

Table 7-1. VDI Input Functions

Function	Page	Purpose
vrq_locator (1CH)	7-5	Input locator, request mode
vsm_locator (1CH)	7-7	Input locator, sample mode
vrq_valuator (1DH)	7-9	Input valuator, request mode
vsm_valuator (1DH)	7-11	Input valuator, sample mode
vrq_choice (1EH)	7-13	Input choice, request mode
vsm_choice (1EH)	7-14	Input choice, sample mode
vrq_string (1FH)	7-16	Input string, request mode
vsm_string (1FH)	7-18	Input string, sample mode
vsin_mode (21H)	7-3	Set input mode
vsc_form (6FH)	7-20	Set mouse form
vex_timv (76H)	7-22	Exchange timer interrupt vector
v_show_c (7AH)	7-24	Show cursor
v_hide_c (7BH)	7-26	Hide cursor
vq_mouse (7CH)	7-27	Sample mouse button state
vex_butv (7DH)	7-28	Exchange button change vector
vex_motv (7EH)	7-30	Exchange mouse movement vector
vex_curv (7FH)	7-32	Exchange cursor change vector
vq_key_s (80H)	7-34	Sample keyboard state information

VSIN_MODE (21H)

vsin_mode sets the input mode to request or sample for the specified logical input device. The logical input devices are:

- locator (mouse, trackball, or joystick)
- valuator (potentiometer)
- choice (function keys)
- string (keyboard)

Input Arguments

handle — Device handle

dev_type — Logical input device:

1 Locator
2 Valuator
3 Choice
4 String

mode — Input mode:

1 Request
Driver does not return until an input event occurs

2 Sample
Driver returns current status or location of the input device without waiting

Sample Call to C Language Binding

```
WORD   vsin_mode();
WORD   handle, dev_type, mode;

vsin_mode(handle, dev_type, mode);
```

Parameter Block Binding

Control	Input	Output
control(0) = 33	intin(0) = dev_type	intout(0) = Selected mode
control(1) = 0	intin(1) = mode	
control(2) = 0		
control(3) = 2		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VRQ_LOCATOR (1CH)

This function returns the position of the specified locator device in request mode. Upon entry to the locator routine, the current cursor form is displayed at the initial coordinate. Because vrq_locator operates in request mode, it tracks the graphic cursor with the input device until a terminating event occurs, which can result from the user pressing a key or a button on a mouse. vrq_locator removes the cursor when the terminating event occurs.

Typically, the arrow keys move the cursor in large jumps when used without the Shift key and in pixel increments when used with the Shift key. If both a keyboard and another locator device are available, the cursor is tracked by input from either. This gives the user maximum flexibility.

vrq_locator always displays a cursor on the screen, even if the cursor is currently obscured or hidden.

Note: This function is not required and might not be supported by all device drivers.

Input Arguments

handle	Device handle
initx	Initial x-coordinate of locator in NDC/RC units
inity	Initial y-coordinate of locator in NDC/RC units

Output Arguments

xout — Final x-coordinate of locator in NDC/RC units

yout — Final y-coordinate of locator in NDC/RC units

term — Locator terminator
The low byte contains a character terminator. For keyboard-terminated locator input, this is the ASCII character code of the key that was struck to terminate input. For nonkeyboard-terminated input (tablet or mouse for example), valid locator terminators begin with 20H (space) and increase from there. For instance, if the puck on a tablet has 4 buttons, the first button must generate 20H as a terminator, the second 21H, the third 22H, and the fourth 23H.

Sample Call to C Language Binding

```
WORD  vrq_locator();
WORD  handle, initx, inity, xout, yout, term;

vrq_locator(handle, initx, inity, &xout, &yout, &term);
```

Parameter Block Binding

Control	Input	Output
control(0) = 28	ptsin(0) = initx	intout(0) = term
control(1) = 1	ptsin(1) = inity	ptsout(0) = xout
control(2) = 1		ptsout(1) = yout
control(3) = 0		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VSM_LOCATOR (1CH)

vsm_locator returns the position of the specified locator device. Input is sampled. Upon entry to the locator routine, no cursor is displayed. Use v_show_c (7AH), described on page 7-24, to display the cursor. If the cursor position has changed, vsm_locator returns the cursor position; if a terminating event occurred, vsm_locator returns a character. See Table 7-2 for the appropriate settings of control(2) and control(4).

Note: This function is not required and might not be supported by all device drivers. If both a keyboard and another locator device are available, the input comes from either, giving the user maximum flexibility.

Input Arguments

handle	Device handle
initx	Initial x-coordinate of locator in NDC/RC units
inity	Initial y-coordinate of locator in NDC/RC units

Output Arguments

xout	New x-coordinate of locator in NDC/RC units
yout	New y-coordinate of locator in NDC/RC units
term	Locator keypress if keypress occurs This information is the same as for vrq_locator (1CH), see page 7-5.

Table 7-2. Sample Mode Status Returned

Event	Control(2)	Control(4)
Coordinates changed	1	0
Key pressed; coordinates unchanged	0	1
No input	0	0
Key pressed; coordinates changed	1	1

Sample Call to C Language Binding

```
WORD  vsm_locator();
WORD  handle, initx, inity, xout, yout, term;

vsm_locator(handle, initx, inity, &xout, &yout, &term);
```

Parameter Block Binding

Control	Input	Output
control(0) =28	ptsin(0) = x	intout(0) = term
control(1) = 1	ptsin(1) = y	ptsout(0) = xout
control(2) = 1 coordinate changed		ptsout(1) = yout
0 no coordinate changed		
control(3) = 0		
control(4) = 0 no keypress character		
1 keypress character returned		
control(5) = 0		
control(6) = handle		

VRQ_VALUATOR (1DH)

This function returns the value of the valuator device. Because it operates in request mode, vrq_valuator increments or decrements the initial value of the valuator until a terminating character is struck.

Valuator keys are typically the up-arrow and down-arrow keys. Valuator numbers range from 1 to 100. Typical implementation of the up-arrow and down-arrow keys is as follows:

- Pressing the up-arrow key adds ten to the valuator.
- Pressing the down-arrow key subtracts ten from the valuator.
- Pressing the up-arrow key with the Shift key adds one to the valuator.
- Pressing the down-arrow key with the Shift key subtracts one from the valuator.

Note: vrq_valuator is not required and might not be supported by all device drivers.

Input Arguments

handle	Device handle
val_in	Initial value

Output Arguments

val_out	Output value
term	Terminator

Sample Call to C Language Binding

```
WORD   vrq_valuator();
WORD   handle, val_in, val_out, term;

vrq_valuator(handle, val_in, &val_out, &term);
```

Parameter Block Binding

Control	Input	Output
control(0) = 29	intin(0) = val_in	intout(0) = val_out
control(1) = 0		intout(1) = term
control(2) = 0		
control(3) = 1		
control(4) = 2		
control(5) = 0		
control(6) = handle		

VSM_VALUATOR (1DH)

vsm_valuator returns the current value of the valuator device in sample mode. If the valuator has changed, vsm_valuator increments or decrements the valuator value as required. If a terminating event occurs, vsm_valuator returns the value. If nothing happens, the function does not return a value.

Valuator numbers range from 1 to 100. The suggested keys are the same as for vrq_valuator (1DH); see page 7-9.

Note: This function is not required and may not be available on all devices.

Input Arguments

handle	Device handle
val_in	Initial value

Output Arguments

val_out	New valuator value
term	Keypress, if keypress event occurred
status	Terminating status: 0 Nothing happened 1 Valuator changed 2 Keypress character

Sample Call to C Language Binding

```
WORD   vsm_valuator();
WORD   handle, val_in, val_out, term, status;

vsm_valuator(handle, val_in, &val_out, &term, &status);
```

Parameter Block Binding

Control	Input	Output
control(0) = 29	intin(0) = val_in	intout(0) = val_out
control(1) = 0		intout(1) = term
control(2) = 0		
control(3) = 1		
control(4) = status		
control(5) = 0		
control(6) = handle		

VRQ_CHOICE (1EH)

Operating in request mode, this function returns the status of the selected choice device (function key). vrq_choice samples input until a key is pressed; if a valid choice key is pressed, vrq_choice returns its value. Otherwise, vrq_choice returns the initial choice number.

Choice numbers range from one to a device-dependent maximum value. v_opnwk (1H) and v_opnvwk return the number of choice devices in work_out[42]; see Section 3.

Note: This function is not required and might not be supported by all device drivers.

Input Arguments

handle	Device handle
in_choice	Initial choice number

Output Arguments

out_chioce	Choice key number

Sample Call to C Language Binding

```
WORD   vrq_choice();
WORD   handle, in_choice, out_choice;

vrq_choice(handle, in_choice, &out_choice);
```

Parameter Block Binding

Control	Input	Output
control(0) = 30	intin(0) = in_choice	intout(0) = out_choice
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VSM_CHOICE (1E)

vsm_choice returns the choice status of the selected choice device. Upon entry to the routine, vsm_choice samples input. If input is available and is a valid choice key, vsm_choice returns it. Choice numbers range from one to a device-dependent maximum value. v_opnwk (1H) and v_opnvwk return the number of choice devices in work_out[42]; see Section 3.

Note: This function is not required and may not be available on all devices.

Input Arguments

handle — Device handle

Output Arguments

choice — Choice number if sample successful, 0 if unsuccessful

status — Choice status:

0 Nothing happened
1 Sample successful

Sample Call to C Language Binding

```
WORD  vsm_choice();
WORD  handle, choice;

vsm_choice(handle, &choice);
```

Parameter Block Binding

Control	Input	Output
control(0) = 30		intout(0) = choice
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = status		
control(5) = 0		
control(6) = handle		

VRQ_STRING (1FH)

Operating in request mode, vrq_string returns a string from the specified device. Input is accumulated until vrq_string encounters a carriage return or the intout array is full (maximum string length has been reached).

If the calling routine enables echo mode, text will be echoed to the screen with the current text attributes using the vertex passed in echo_yx as the justification point. Note that echo mode might not be available on all devices. vqt_attributes, described in Section 8, returns the current text attributes.

If the number passed as the maxiumum string length is negative, the output string values returned by vrq_string conform to the standard keyboard defined in Appendix D. In this case, the absolute value of length is used as the maximum string size.

Note: Echo mode might not be available on all devices.

Input Arguments

handle	Device handle
length	Maximum string length
echo_mode	Echo mode: 0 No echo 1 Echo input characters at specified position
echo_xy	x- and y-coordinates of echo area in NDC/RC units

Output Arguments

string	Output string returned in ADE

The string is word-oriented for the Parameter Block Binding. For the C Binding, the string is byte-oriented and null-terminated; its length includes an additional byte for the terminating null.

Sample Call to C Language Binding

```
WORD   vrq_string();
WORD   handle, length, echo_mode, echo_xy[];
BYTE   *string;

vrq_string(handle, length, echo_mode, echo_xy, string);
```

Parameter Block Binding

Control	Input	Output
control(0) = 31	intin(0) = length	intout = string
control(1) = 1	intin(1) = echo_mode	
control(2) = 0	ptsin(0) = echo_xy(0)	
control(3) = 2	ptsin(1) = echo_xy(1)	
control(4) = string length		
control(5) = 0		
control(6) = handle		

VSM_STRING (1FH)

vsm_string returns a string from the specified device. Upon entry, vsm_string samples input; if data is available, it is accumulated, and the function samples the input again. vsm_string accumulates input until one of the following events occurs:

- data is no longer available
- a carriage return is encountered
- the maximum string length is reached

If the string will always be terminated with RETURN, use vrq_string (1FH); see page 7-16.

If the calling routine enables echo mode, text will be echoed to the screen with the current text attributes using the vertex passed in echo_yx as the justification point. vqt_attributes, described in Section 8, returns the current text attributes.

Note: Echo mode might not be available on all devices.

If the number passed as the maxiumum string length is negative, the output string values returned by vrq_string conform to the standard keyboard defined in Appendix D. In this case, the absolute value of the length argument is used as the maximum string size.

Input Arguments

handle	device handle
length	Maximum string length
echo_mode	Echo mode: 0 No echo 1 Echo input characters at the specified position
echo_xy	x- and y-coordinates of echo area in NDC/RC units

Output Arguments

string — Output string, if sample successful
The string is word-oriented for the Parameter Block Binding. For the C Binding, the string is byte-oriented and null-terminated; its length includes an additional byte for the terminating null.

status — Length of output string:

0 Sample unsuccessful (characters not available)

>0 Sample successful (characters available)

Sample Call to C Language Binding

```
WORD   vsm_string();
WORD   status, handle, length, echo_mode, echo_xy[];
BYTE   *string;

vsm_string(handle, length, echo_mode, echo_xy, string, &status);
```

Parameter Block Binding

Control	Input	Output
control(0) = 31	intin(0) = length	intout = string
control(1) = 1	intin(1) = echo_mode	
control(2) = 0	ptsin(0) = echo_xy(0)	
control(3) = 2	ptsin(1) = echo_xy(1)	
control(4) = status		
control(5) = 0		
control(6) = handle		

VSC_FORM (6FH)

vsc_form redefines the cursor pattern displayed during locator input or at any time the cursor is shown (see the description of v_show_c (7AH) on page 7-24).

The size of the cursor is 16 by 16 pixels; it is defined by two arrays, cursor mask and cursor data. For the cursor mask and data, bit 15 of word 1 is the upper left bit of the pattern. Bit 0 of word 16 is the lower right bit of the pattern. Bit zero is the Least Significant Bit of the word.

The hot spot is the location of the pixel (relative to the upper left pixel of the mouse form) that lies over the pixel whose address is returned by the input locator function. The hot spot determines the location of the cursor; its coordinates are specified in cur_form[0] and cur_form[1].

The mouse form is drawn as follows:

1. The data under the mouse form is saved so that it can be restored when the cursor moves.
2. 1's in the mask cause the corresponding pixel to be set to the color index designated in cur_form[3].
3. 1's in the mouse form data cause the corresponding pixel to be set to the color index designated in cur_form[4].

Input Arguments

handle	Device handle
cur_form[0]	x-coordinate of hot spot
cur_form[1]	y-coordinate of hot spot
cur_form[2]	Reserved for future use, must be 1
cur_form[3]	Mask color index, normally 0
cur_form[4]	Data color index, normally 1
cur_form[5] to cur_form[20]	16 words of 16-bit cursor mask
cur_form[21] to cur_form[36]	16 words of 16-bit cursor data

Sample Call to C Language Binding

```
WORD   vsc_form();
WORD   handle, cur_form[37];

vsc_form(handle, cur_form);
```

Parameter Block Binding

Control	Input	Output
control(0) = 111	intin(0) = cur_form[0]	
control(1) = 0	.	
control(2) = 0	.	
control(3) = 37	intin(36) = cur_form[36]	
control(4) = 0		
control(5) = 0		
control(6) = handle		

VEX_TIMV (76H)

vex_timv allows the application to perform some action each time a timer tick occurs.

Input to this function is a two-word pointer, tim_addr, that indicates the starting address of the application-dependent code that is to receive control when a timer tick occurs. vex_timv returns the address of the old timer routine in old_addr and the number of milliseconds per timer tick in scale.

The application-dependent code is invoked with a processor-dependent instruction. When this is complete, the application should perform a processor-dependent return instruction. See Appendix E for processor specific instructions and register names.

Note: It is the responsibility of the application-dependent code to save and restore any registers used. When the application code is invoked, interrupts are disabled. The application should not enable interrupts.

This function is available only to the application that opened the physical workstation. The device handle must be the "root" or physical device handle.

Input Arguments

handle	Physical device handle
tim_addr	Address of application timer routine

Output Arguments

old_addr	Address of the old timer routine
scale	Milliseconds per tick

Sample Call to C Language Binding

```
WORD   vex_timv();
WORD   handle, scale;
LONG   tim_addr, old_addr;

vex_timv(handle, tim_addr, &old_addr, &scale);
```

Parameter Block Binding

Control	Input	Output
control(0) = 118		intout(0) = scale
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 1		
control(5) = 0		
control(6) = handle		
control(7-8) = tim_addr		
control(9-10) = old_addr		

V_SHOW_C (7AH)

v_show_c displays the current cursor. The cursor moves on the display surface based on information input from a mouse.

v_show_c and v_hide_c (7BH) are closely related. Once the cursor is visible, a single v_hide_c call removes the cursor from the display surface. The VDI keeps track of the number of times v_hide_c is called. v_show_c must be called the same number of times for the cursor to reappear. For example, if v_hide_c is called four times, v_show_c must be called four times for the cursor to appear.

v_show_c does, however, provide a reset flag. If the calling routine sets the flag is zero, the cursor appears on the screen regardless of the number of v_hide_c calls. A nonzero value for the reset flag affects v_show_c as described above.

Input Arguments

handle	Device handle	
reset	Reset flag:	
	zero	Ignore number of v_hide_c calls
	nonzero	Normal v_show_c functionality

Sample Call to C Language Binding

```
WORD  v_show_c();
WORD  handle, reset;

v_show_c(handle, reset);
```

Parameter Block Binding

Control	Input	Output
control(0) = 122	intin(0) = reset	
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 0		
control(5) = 0		
control(6) = handle		

V_HIDE_C (7BH)

v_hide_c removes the cursor from the display surface. This state is the default condition set when the device is opened with v_opnwk (1H) or v_opnwvk (64H). The cursor can appear in a new position when the application calls v_show_c (7AH) because the VDI updates the cursor position based on information input from a mouse.

See the description of v_show_c on page 7-24 for a discussion of how the number of v_hide_c calls affects the v_show_c function.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD  v_hide_c();
WORD  handle;

v_hide_c(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 123		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		

VQ_MOUSE (7CH)

vq_mouse returns the current state of the mouse buttons. The state of the leftmost mouse button is returned in the Least Significant Bit of status. A bit value of 0 indicates the button is up; a bit value of 1 indicates the button is currently being pressed.

This function also returns the current (x,y) position of the cursor.

Input Arguments

handle	Device handle

Output Arguments

status	Mouse button state: 0 Button up 1 Button pressed
px	x position of cursor in NDC/RC units
py	y position of cursor in NDC/RC units

Sample Call to C Language Binding

```
WORD  vq_mouse();
WORD  handle, status, px, py;

vq_mouse(handle, &status, &px, &py);
```

Parameter Block Binding

Control	Input	Output
control(0) = 124		intout(0) = status
control(1) = 0		ptsout(0) = px
control(2) = 1		ptsout(1) = py
control(3) = 0		
control(4) = 1		
control(5) = 0		
control(6) = handle		

VEX_BUTV (7DH)

With vex_butv, the calling routine can designate the address of application-dependent code that is to receive control each time the state of the mouse buttons changes. This function passes control to the application-dependent code after the button state is decoded, but before the driver button state changes.

Input to vex_butv is a two-word pointer, usercode. This argument indicates the starting address of the code to receive control when the mouse button state changes. vex_butv returns a two-word pointer, savecode, to the old mouse routine.

Control is passed to the specified address whenever the mouse button state changes. The application code is invoked via a processor-dependent instruction; a processor-dependent register contains the mouse button keys. Keys are encoded by the same rules that apply to the vq_mouse (7CH) function. When complete, the application-dependent code should perform a processor-dependent return instruction with the mouse button state the driver is to store in the same register. This gives the application the opportunity of altering the buttons before they are used by the driver.

See Appendix E for processor-specific instructions and register names.

Note: It is the responsibility of the application-dependent code to save and restore any registers used. When the application-dependent code is invoked, interrupts are disabled. The application should not enable interrupts.

This function is available only to the application that opened the physical workstation. The device handle must be the root or physical device handle.

Input Arguments

handle	Physical device handle
usercode	Address of application mouse button state change routine

Output Arguments

savecode Address of old mouse button state change routine

Sample Call to C Language Binding

```
WORD    vex_butv();
WORD    handle;
LONG    usercode, savecode;

vex_butv(handle, usercode, &savecode);
```

Parameter Block Binding

Control	Input	Output
control(0) = 125		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		
control(7-8) = usercode		
control(9-10) = savecode		

VEX_MOTV (7EH)

vex_motv allows the calling routine to designate the address of application-dependent code that is to receive control each time the mouse moves to a new location. The application-dependent code receives control after the x,y address is computed, but before the current mouse position in the driver is updated or the mouse form is actually redrawn on the screen.

Input to this function is a two-word pointer, usercode. This argument indicates the starting address of the code to receive control when the mouse moves. vex_motv returns a two-word pointer, savecode, to the address of the old mouse movement routine.

When the mouse moves, the application-dependent code is invoked via a processor-dependent instruction. The new x and y locations are contained in processor-dependent registers. Upon completion, the application-dependent code performs a processor-dependent return instruction with the x,y mouse position the driver is to store in the appropriate hardware registers. This procedure allows the x,y position to be altered before it is used by the driver. See Appendix E for processor-specific instructions and register names.

Note: It is the responsibility of the application-dependent code to save and restore any registers used. When the application code is invoked, interrupts are disabled. The application should not enable interrupts.

This function is available only to the application that opened the physical workstation. The device handle must be the "root" or physical device handle.

Input Arguments

handle	Physical device handle
usercode	Address of application mouse movement routine

Output Arguments

savecode Address of the old mouse movement routine

Sample Call to C Language Binding

```
WORD   vex_motv();
WORD   handle;
LONG   usercode, savecode;

vex_motv(handle, usercode, &savecode);
```

Parameter Block Binding

Control	Input	Output
control(0) = 126		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		
control(7-8) = usercode		
control(9-10) = savecode		

VEX_CURV (7FH)

vex_curv allows the calling routine to designate the address of application-dependent code that is to receive control each time the cursor is drawn. The application can completely take over drawing the cursor or perform some action and then have the VDI draw the cursor. Control is passed to the application whenever the cursor position should be updated.

Input to this function is a two-word pointer, usercode. This argument indicates the starting address of the code to receive control when a cursor is drawn. vex_curv returns a pointer, savecode, to the address of the old cursor draw routine.

The application-dependent code is invoked with a processor-dependent instruction. The x,y position at which the cursor should be drawn is contained in a pair of processor-dependent registers. If the application-dependent code does not draw its own cursor, a processor-dependent call should be performed to the address returned in psavcode. This will cause the VDI to draw a cursor. When it is done, the application should perform a processor-dependent return instruction. See Appendix E for processor-specific instructions and register names.

Note: It is the responsibility of the application-dependent code to save and restore any registers used. The VDI cursor draw routine preserves the contents of all registers. When the application code is invoked, interrupts are disabled. The application should not enable interrupts.

This function is available only to the application that opened the physical workstation. The device handle must be the "root" or physical device handle.

Input Arguments

handle	Physical device handle
usercode	Address of application cursor draw routine

Output Arguments

savecode Address of the old cursor draw routine

Sample Call to C Language Binding

```
WORD   vex_curv();
WORD   handle;
LONG   usercode, savecode;

vex_curv(handle, usercode, &savecode);
```

Parameter Block Binding

Control	Input	Output
control(0) = 127		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 0		
control(6) = handle		
control(7-8) = usercode		
control(9-10) = savecode		

VQ_KEY_S (80H)

vq_key_s returns the current state of the keyboard's Control, Shift, and Alt keys as a bit-encoded value in status. The bit assignments are:

Bit 0 - Right shift key
Bit 1 - Left shift key
Bit 2 - Control key
Bit 3 - Alt key

Bit 0 is the Least Significant Bit of the word. A bit value of zero indicates the key is up, a bit value of 1 indicates that the key is being pressed.

Input Arguments

handle Device handle

Output Arguments

status Keyboard state

Sample Call to C Language Binding

```
WORD   vq_key_s();
WORD   handle, status;

vq_key_s(handle, &status);
```

Parameter Block Binding

Control	Input	Output
control(0) = 128		intout(0) = status
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 1		
control(5) = 0		
control(6) = handle		

End of Section 7

Inquire Functions

The inquire functions return the current settings for device-specific attributes such as color index values, polyline types, and fill area styles.

Table 8-1. VDI Inquire Functions

Function	Page	Purpose
vq_color (1AH)	8-2	Inquire color representation
vq_cellarray (1BH)	8-4	Inquire cell array
vql_attributes (23H)	8-6	Inquire current polyline attributes
vqm_attributes (24H)	8-8	Inquire current polymarker attributes
vqf_attributes (25H)	8-10	Inquire current fill area attributes
vqt_attributes (26H)	8-12	Inquire current graphic text attributes
vq_extnd (66H)	8-14	Return extended device-specific information
vqin_mode (73H)	8-18	Inquire input mode
vqt_extent (74H)	8-19	Inquire text extent
vqt_width (75H)	8-22	Inquire character cell width
vqt_name (82H)	8-24	Inquire font name and index
vqt_font_info (83H)	8-26	Inquire current font information
vqt_justified (84H)	8-29	Inquire justified graphics text

VQ_COLOR (1AH)

Inquire Color Representation returns the units of RGB intensity associated with a color index. You can specify that vq_color is to return either the units of RGB intensity as set by a call to vs_color (EH) or the actual RGB values used by the device driver (these are the realized values selected by the driver if a color is not available). vs_color is described in Section 5, "Attribute Functions."

The Parameter Block (assembly language) binding for vq_color returns -1 in intout(0) if the specified index is out of range. The C binding returns only the units of RGB intensity.

Input Arguments

handle — Device handle

index — Requested color index

set_flag — Set or realized flag:

0 set (return RGB intensities for requested index)
1 realized (return color values realized on device)

Output Arguments

rgb[0] — Red intensity (in tenths of percent 0-1000)

rgb[1] — Green intensity

rgb[2] — Blue intensity

Sample Call to C Language Binding

```
WORD  vq_color();
WORD  handle, index, set_flag, rgb[3];

vq_color(handle, index, set_flag, rgb);
```

Parameter Block Binding

Control	Input	Output
contrl(0) = 26	intin(0) = index	intout(0) = -1 if index invalid
contrl(1) = 0	intin(1) = set_flag	intout(1) = rgb[0]
contrl(2) = 0		intout(2) = rgb[1]
contrl(3) = 2		intout(3) = rgb[2]
contrl(4) = 4		
contrl(6) = Device handle		

VQ_CELLARRAY (1BH)

vq_cellarray returns the cell array definition of the specified pixels. Color indices are returned one row at a time, starting from the top of the rectangular area defined by the pxyarray arguments. vq_cellarray returns -1 to indicate that it could not determine a color index for a particular pixel.

All input coordinates are specified according to the current coordinate system (NDC/RC).

Note: This function is not required and may not be supported by all devices drivers.

Input Arguments

handle	Device handle
pxyarray[0]	x-coordinate of rectangle's lower left corner
pxyarray[1]	y-coordinate of rectangle's lower left corner
pxyarray[2]	x-coordinate of rectangle's upper right corner
pxyarray[3]	y-coordinate of rectangle's upper right corner
row_length	Length of each row in color index array
num_rows	Number of rows in color index array

Output Arguments

el_used	Number of elements used in each row (number of columns) of color index array
rows_used	Number of rows used in color index array
status	Invalid value flag: 0 No errors 1 If a color value could not be determined for some pixel

colarray[0] Color index array, stored by row

.

.

colarray[n] Last row of color index

Sample Call to C Language Binding

```
WORD  vq_cellarray();
WORD  handle, pxyarray[4], row_length, num_rows, el_used,
      rows_used, status, colarray[n];

vq_cellarray(handle, pxyarray, row_length, num_rows, &el_used,
      &rows_used, &status, colarray);
```

Parameter Block Binding

Control	Input	Output
control(0) = 27	ptsin(0) = pxyarray[0]	intout(0) = colarray[0]
control(1) = 2	ptsin(1) = pxyarray[1]	.
control(2) = 0	ptsin(2) = pxyarray[2]	.
control(3) = 0	ptsin(3) = pxyarray[3]	intout(0) = colarray[n]
control(4) = n		
control(5) = 0		
control(6) = handle		
control(7) = row_length		
control(8) = num_rows		
control(9) = el_used		
control(10) = rows_used		
control(11) = status		

VQL_ATTRIBUTES (23H)

vql_attributes returns the current setting of the attributes that affect polylines.

Input Arguments

handle Device handle

Output Arguments

attrib[0] Current polyline line type:

1 Solid
2 Long dash
3 Dot
4 Dash,dot
5 Dash
6 Dash,dot,dot
7 User-defined; see vsl_udsty (71H) on page 5-10
8-n Device-dependent

See vsl_type (FH) in Section 5 for more information.

attrib[1] Current polyline line color index

attrib[2] Current writing mode:

1 Replace mode
2 Transparent mode
3 XOR mode
4 Reverse transparent mode

See vswr_mode (20H) in Section 5 for more information.

attrib[3] End style for beginning point of polyline (not returned by C binding):

0 Squared
1 Arrow
2 Rounded

attrib[4] End style for ending point of polyline (not returned by C binding)

attrib[5] Current line width, in x-axis NDC/RC units

Note that only the Parameter Block (assembly language) binding for vql_attributes returns the polyline end styles. The C binding returns the line type in attrib[0], the line color in attrib[1], the current writing mode in attrib[2], and the current line width in attrib[3].

Sample Call to C Language Binding

```
WORD  vql_attributes();
WORD  handle, attrib[4];

vql_attributes(handle, attrib);
```

Parameter Block Binding

Control	Input	Output
control(0) = 35		intout(0) = attrib[0]
control(1) = 0		intout(1) = attrib[1]
control(2) = 1		intout(2) = attrib[2]
control(3) = 0		intout(3) = attrib[3]
control(4) = 5		intout(4) = attrib[4]
control(5) = 0		
control(6) = handle		pstout(0) = attrib[5]
		ptsout(1) = 0

VQM_ATTRIBUTES (24H)

vqm_attributes returns the current setting of the attributes that affect polymarkers.

Input Arguments

handle Device handle

Output Arguments

attrib[0] Current marker type:

1 Dot
2 Plus
3 Asterisk
4 Square
5 Diagonal Cross
6 Diamond
7-n User-defined

attrib[1] Current polymarker color index

attrib[2] Current writing mode

1 Replace mode
2 Transparent mode
3 XOR mode
4 Reverse transparent mode

See vswr_mode (20H) in Section 5 for more information.

attrib[3] Current polymarker width, in x-axis NDC/RC units

attrib[4] Current polymarker height, in y-axis NDC/RC units

Note that only the Parameter Block (assembly) binding for vqm_attributes returns the current polymarker width. The C binding returns the marker type in attrib[0], the marker color index in attrib[1], the current writing mode in attrib[2], and the marker height in attrib[3].

Sample Call to C Language Binding

```
WORD   vqm_attributes();
WORD   handle, attrib[4];

vqm_attributes(handle, attrib);
```

Parameter Block Binding

Control	Input	Output
control(0) = 36		intout(0) = attrib[0]
control(1) = 0		intout(1) = attrib[1]
control(2) = 1		intout(2) = attrib[2]
control(3) = 0		
control(4) = 3		ptsout(0) = attrib[3]
control(5) = 0		ptsout(1) = attrib[4]
control(6) = handle		

VQF_ATTRIBUTES (25H)

vqf_attributes returns the current setting of the attributes that affect fill areas.

Input Arguments

handle Device handle

Output Arguments

attrib[0] Current fill area interior style:

0 Hollow
1 Solid
2 Pattern
3 Hatch
4 User-defined

See vsf_interior (17H) in Section 5 for more information.

attrib[1] Current fill area color index

attrib[2] Current fill area style index, refer to vsf_style (18H) on 5-35

attrib[3] Current writing mode:

1 Replace mode
2 Transparent mode
3 XOR mode
4 Reverse transparent mode

See vswr_mode (20H) in Section 5 for more information.

attrib[4] Current fill perimeter status:

zero Invisible
nonzero Visibile

Note that only the Parameter Block (assembly) binding for aqf_attributes returns the current fill perimeter status. The C binding does not return attrib[4].

Sample Call to C Language Binding

```
WORD   vqf_attributes();
WORD   handle, attrib[4];

vqf_attributes(handle, attrib);
```

Parameter Block Binding

Control	Input	Output
control(0) = 37		intout(0) = attrib[0]
control(1) = 0		intout(1) = attrib[1]
control(2) = 0		intout(2) = attrib[2]
control(3) = 0		intout(3) = attrib[3]
control(4) = 5		intout(4) = attrib[4]
control(5) = 0		
control(6) = handle		

VQT_ATTRIBUTES (26H)

vqt_attributes returns the current setting of all attributes that affect graphic text. These attributes include text size, text color, and cell dimensions.

Input Arguments

handle Device handle

Output Arguments

attrib[0] Current graphic text font, see Table 5-6 on 5-25

attrib[1] Current graphic text color index

attrib[2] Current angle of rotation of text baseline (in tenths of degrees 0-3600)

attrib[3] Current horizontal alignment:

0 Left justified
1 Center justified
2 Right justified

See vst_alignment (27H) in Section 5 for more information.

attrib[4] Current vertical alignment:

0 Baseline (default)
1 Half line
2 Ascent line
3 Bottom line
4 Descent line
5 Top line

attrib[5] Current writing mode:

1 Replace mode
2 Transparent mode
3 XOR mode
4 Reverse transparent mode

See vswr_mode (20H) in Section 5 for more information.

attrib[6] Current character width in x-axis NDC/RC units

attrib[7] Current character height in y-axis NDC/RC units

attrib[8] Current character cell width in x-axis NDC/RC units

attrib[9] Current character cell height in y-axis NDC/RC units

Sample Call to C Language Binding

```
WORD   vqt_attributes();
WORD   handle, attrib[10];

vqt_attributes(handle, attrib);
```

Parameter Block Binding

Control	Input	Output
control(0) = 38		intout(0) = attrib[0]
control(1) = 0		.
control(2) = 2		.
control(3) = 0		intout(5) = attrib[5]
control(4) = 6		
control(5) = 0		ptsout(0) = attrib[6]
control(6) = handle		.
		.
		ptsout(3) = attrib[9]

VQ_EXTND (66H)

vq_extnd returns an extended set of device-specific information not included in the Open Workstation, v_opnwk (1H), function. The information type flag allows the calling routine to specify if vq_extnd is to return the v_opnwk output arguments or its extended set of device-specific information. Refer to 3-2 in Section 3, "Control Functions," for a description of the values returned by v_opnwk.

Note that although some values are undefined for the extended set of device-specific information, vq_extnd always returns six output vertices and 45 output integers (57 work_out arguments).

Input Arguments

handle — Device handle

owflag — Information type flag:

- 0 Return Open Workstation, v_opnwk (1H) information
- 1 Return extended inquire information

Output Arguments

work_out[0] — Type of screen:

- 0 not screen
- 1 separate alpha and graphic controllers and separate screens
- 2 separate alpha and graphic controllers with a common screen
- 3 common alpha and graphic controller with separate image memory
- 4 common alpha and graphic controller with common image memory

work_out[1] Number of background colors in color palette

On some devices, this may be different from the number of colors returned by v_opnwk (1H) in work_out[39].

work_out[2] Supported text effects, bit pattern, see vst_effects (6AH) in Section 5

work_out[3] Scale rasters:

0 Scaling not possible
1 Scaling possible

work_out[4] Number of planes for raster operations

work_out[5] Color lookup table support:

0 Table not supported
1 Table supported

work_out[6] Performance factor, number of 16 x 16 pixel raster operations per second

work_out[7] Contour Fill, v_contourfill (67H), flag:

0 Unavailable
1 Available

work_out[8] Character rotation support:

0 Not supported
1 90-degree increments only
2 Arbitrary angles

work_out[9] Number of writing modes available

work_out[10] Highest level of input mode available:

0 None
1 Request
2 Sample

work_out[11] Text alignment, vst_alignment (27H), flag:

0 Unavailable
1 Available

work_out[12] Inking capability flag:

0 Device cannot ink
1 Device can ink

work_out[13] Rubberbanding capability flag:

0 Device incapable
1 Capable of rubberband lines
2 Capable of both rubberband lines and rectangles

work_out[14] Maximum number of vertices for v_pline (6H), v_pmarker (7H), or v_fillarea (9H):

-1 No maximum

work_out[15] Maximum length of intin array:

-1 No maximum

work_out[16] Number of buttons available on the mouse

work_out[17] Styles supported for wide lines:

0 No
1 Yes

work_out[18] Writing modes for wide lines:

0 No
1 Yes

work_out[19] Clipping, vs_clip (81H), flag:

0 Clipping disabled
1 Clipping enabled

work_out[20]
to
work_out[44] Reserved, contain zeros

work_out[45] Upper left x-coordinate of the clipping rectangle in x-axis NDC/RC units

work_out[46] Upper left y-coordinate of the clipping rectangle in y-axis NDC/RC units

work_out[47] Lower right x-coordinate of the clipping rectangle in x-axis NDC/RC units

work_out[48] Lower right y-coordinate of the clipping rectangle in y-axis NDC/RC units

work_out[49]
to
work_out[56] Reserved, contain zeros

Sample Call to C Language Binding

```
WORD   vq_extnd();
WORD   handle, owflag, work_out[57];

vq_extnd(handle, owflag, work_out);
```

Parameter Block Binding

Control	Input	Output
control(0) = 102	intin(0) = owflag	intout(0) = work_out[0]
control(1) = 0		.
control(2) = 6		.
control(3) = 1		intout(44) = work_out[44]
control(4) = 45		
control(5) = 0		pstout(0) = work_out[45]
control(6) = handle		.
		.
		pstout(11) = work_out[56]

VQIN_MODE (73H)

vqin_mode returns the current input mode for the specified logical device: locator, valuator, choice, or string.

Input Arguments

handle — Device handle

dev_type — Logical input device:

1 Locator
2 Valuator
3 Choice
4 String

Output Arguments

input_mode — Input mode:

1 Request
2 Sample

Sample Call to C Language Binding

```
WORD   vqin_mode();
WORD   handle, dev_type, input_mode;

vqin_mode(handle, dev_type, &input_mode);
```

Parameter Block Binding

```
control(0) = 115          intin(0) = dev_type          intout(0) = input_mode
control(1) =   0
control(2) =   0
control(3) =   1
control(4) =   1
control(5) =   0
control(6) = handle
```

VQT_EXTENT (74H)

vqt_extent uses the current text attributes to calculate the dimensions of a specified string and returns the coordinates of a rectangle that encloses string. The returned vertex coordinates define an extent rectangle that touches both the x and y axes. The string is in the first quadrant. All text attributes, including style and baseline rotation, affect the calculation.

Output arguments extent[0] to extent[7] specify string points according to the current coordinate system (NDC or RC).

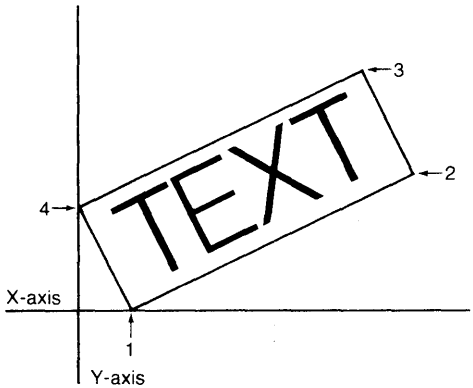

Figure 8-1. Inquire Text Extent Function

Input Arguments

handle — Device handle

string — Character string as ASCII codes

The C binding string is byte-oriented and must be null-terminated. For the Parameter block binding, the string is word-oriented (16-bits). The maximum number of characters equals the size of the intin array; see work_out[15] of vq_extnd (66H).

Output Arguments

extent[0]	delta-x for point 1 of string in x-axis NDC/RC units
extent[1]	delta-y for point 1 of string in y-axis NDC/RC units
extent[2]	delta-x for point 2 of string in x-axis NDC/RC units
extent[3]	delta-y for point 2 of string in y-axis NDC/RC units
extent[4]	delta-x for point 3 of string in x-axis NDC/RC units
extent[5]	delta-y for point 3 of string in y-axis NDC/RC units
extent[6]	delta-x for point 4 of string in x-axis NDC/RC units
extent[7]	delta-y for point 4 of string in y-axis NDC/RC units

Sample Call to C Language Binding

```
WORD   vqt_extent();
WORD   handle, extent[8];
BYTE   *string;

vqt_extent(handle, string, extent);
```

Parameter Block Binding

Control	Input	Output
control(0) = 116	intin = string	ptsout(0) = extent[0]
control(1) = 0		.
control(2) = 4		.
control(3) = number of chars in string		ptsout(7) = extent[7]
control(4) = 0		
control(5) = 0		
control(6) = handle		

Parameter Block Binding

Control	Input	Output
control(0) = 116	intin = string	ptsout(0) = extent[0]
control(1) = 0		.
control(2) = 4		.
control(3) = number of chars in string		ptsout(7) = extent[7]
control(4) = 0		
control(5) = 0		
control(6) = handle		

VQT_WIDTH (75H)

This function returns the character cell width for a specified character in the current font. The character cell width is the distance from the left edge of the character to the left edge of the character that follows it in a text string; see Figure 8-2. Special effects and rotation do not apply.

vqt_width returns all values in the current coordinate system.

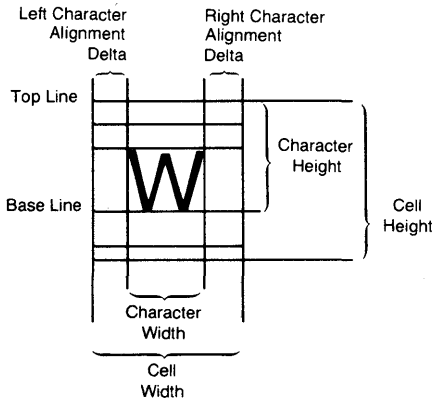

Figure 8-2. Character Cell Definition

Input Arguments

handle	Device handle
character	ASCII Decimal Equivalent (ADE) value of the character in current font

Output Arguments

status	ADE value of the specified character; -1 if invalid character
cell_width	Cell width of the character in x-axis NDC/RC units
left_delta	Left character alignment delta in x-axis NDC/RC units
right_delta	Right character alignment delta in y-axis NDC/RC units

Sample Call to C Language Binding

```
WORD   vqt_width();
WORD   status, handle, cell_width, left_delta, right_delta;
BYTE character;

status = vqt_width(handle, character, &cell_width,
         &left_delta, &right_delta);
```

Parameter Block Binding

Control	Input	Output
control(0) = 117	intin(0) = character	intout(0) = status
control(1) = 0		
control(2) = 3		ptsout(0) = cell_width
control(3) = 1		ptsout(1) = 0
control(4) = 1		ptsout(2) = left_delta
control(5) = 0		ptsout(3) = 0
control(6) = handle		ptsout(4) = right_delta
		ptsout(5) = 0

VQT_NAME (82H)

vqt_name returns a 32-character ASCII Decimal Equivalent (ADE) string that describes a specified font. The calling routine specifies a font by its element number (1 to the number of fonts available).

The first 16 characters of the ADE string name the font. The next 16 characters describe the font's style and weight. The string is null terminated. See Table 8-2 for a sample of the possible configurations.

vqt_name also returns the font index number. This number is used to access the font with vst_font (15H).

Table 8-2. Face Names and Styles

Face Name	Styles
Swiss 721	Light
Swiss 721	Thin Italic
Dutch 801	Roman
Dutch 801	Bold Italic

Input Arguments

handle Device handle

element_num Element number

Output Arguments

index	Font ID number
name[0] to name[31]	32-character ADE string

For the Parameter Block (assembly language) binding, the string is word-oriented. For the C binding, the string is byte-oriented.

Sample Call to C Language Binding

```
WORD   vqt_name();
WORD   index, handle, element_num;
BYTE name[32];

index = vqt_name(handle, element_num, name);
```

Parameter Block Binding

Control	Input	Output
control(0) = 130	intin(0) = element_num	intout(0) = index
control(1) = 0		intout(1) = name[0]
control(2) = 0		.
control(3) = 1		.
control(4) = 33		intout(32) = name[31]
control(5) = 0		
control(6) = handle		

VQT_FONT_INFO (83H)

This function returns size information for the current font with the current size and text effects.

Because the text effects can change the cell width and extent, vqt_font_info returns a value (maxwidth) for the maximum cell width that excludes any text special effects. This allows the use of the width information returned by vqt_width (75H).

When the character is skewed, the cell contains left and right offsets as shown in Figure 8-3.

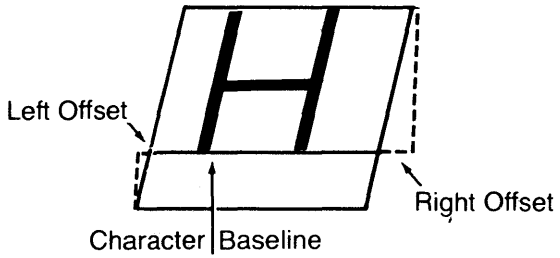

Figure 8-3. Skewed Character Offsets

Input Arguments

handle Device handle

Output Arguments

minADE Minimum ADE (ASCII Decimal Equivalent); this is the first character in the font

maxADE Maximum ADE, the last character in the font

maxwidth	Maximum cell width not including special effects
distances[0]	Bottom line distance relative to baseline
distances[1]	Descent line distance relative to baseline in y-axis NDC/RC units
distances[2]	Half line distance relative to baseline in y-axis NDC/RC units
distances[3]	Ascent line distance relative to baseline in y-axis NDC/RC units
distances[4]	Top line distance relative to baseline in y-axis NDC/RC units
effects[0]	Special effects delta x, the current special effects increase character width by this amount in x-axis NDC/RC units
effects[1]	Left offset, positive value relative to position in x-axis NDC/RC units (see Figure 8-3)
effects[2]	Right offset in x-axis NDC/RC units (see Figure 8-3)

Sample Call to C Language Binding

```
WORD  vqt_font_info();
WORD  handle, minADE, maxADE, distances[5], maxwidth, effects[3];

vqt_font_info(handle, &minADE, &maxADE, distances, &maxwidth,
        effects);
```

Parameter Block Binding

Control	Input	Output
control(0) = 131		intout(0) = minADE
control(1) = 0		intout(1) = maxADE
control(2) = 5		
control(3) = 0		ptsout(0) = maxwidth
control(4) = 2		ptsout(1) = distances[0]
control(5) = 0		ptsout(2) = effects[0]
control(6) = handle		ptsout(3) = distances[1]
		ptsout(4) = effects[1]
		ptsout(5) = distances[2]
		ptsout(6) = effects[2]
		ptsout(7) = distances[3]
		ptsout(8) = 0
		ptsout(9) = distances[4]

VQT_JUSTIFIED (84H)

Inquire Justified Graphics Text returns the x- and y-axis offsets for each character in a string given a text alignment point and physical string length.

See v_justified (B-AH) on page 4-27 in Section 4 for related information.

Input Arguments

handle	Device handle
word_space	Word spacing flag: zero Do not modify inter-word spacing nonzero Modify inter-word spacing
char_space	Character spacing flag: zero Do not modify inter-character spacing nonzero Modify inter-character spacing
string	ASCII character string
x	x-coordinate of the text alignment point
y	y-coordinate of the text alignment point
length	Requested length of the string, in x-axis units

Output Arguments

offsets[0]	x-axis offset to base-left of the first character in string
offsets[1]	y-axis offset to base-left of the first character in string
	.
	.
	.
offsets[2*n-2]	x-axis offset to base-left of the last character in the string ("n" is used here for the number of characters in the string)
offsets[2*n-1]	y-axis offset to base-left of the last character in the string ("n" is used here for the number of characters in the string)

Sample Call to C Language Binding

```
WORD    vqt_justified();
WORD    handle, x, y, length, word_space, char_space, string[],
        offsets[];

vqt_justified(handle, x, y, string, length, word_space, char_space,
        offsets);
```

Parameter Block Binding

Control	Input	Output
control(0) = 132	intin(0) = word_space	ptsout(0) = offsets[0]
control(1) = 2	intin(1) = char_space	ptsout(1) = offsets[1]
control(2) = n	intin(2) = string[0]	.
control(3) = 2 + n	.	.
control(4) = 0	.	ptsout(j) = offsets[j]
control(5) = 0	intin(2+n) = string[2+n]	
control(6) = handle		
	ptsin(0) = x	
	ptsin(1) = y	
	ptsin(2) = length	
	ptsin(3) = 0	

Note: "n" is used here as the number of characters in the string.

End of Section 8

Escape Functions

The escape functions access the special capabilities of a graphics device. The VDI predefines some escape functions, such as those for controlling the cursor on an alpha screen. Others, whose opcodes must be greater than 5-64H, can be defined for specific devices.

Table 9-1 lists and briefly describes the VDI escape functions.

Table 9-1. Escape Function Identifiers

Function	Page	Purpose
vq_chcells (5-1H)	9-3	Return the number of alpha cursor addressable rows and columns
v_exit_cur (5-2H)	9-4	Exit alpha mode for graphics mode
v_enter_cur (5-3H)	9-5	Exit graphics mode for alpha mode
v_curup (5-4H)	9-6	Move alpha cursor up one row, maintain column position
v_curdown (5-5H)	9-7	Move alpha cursor down one row, maintain column position
v_curright (5-6H)	9-8	Move alpha cursor right one column, maintain row position
v_curleft (5-7H)	9-9	Move alpha cursor left one column, maintain row position
v_curhome (5-8H)	9-10	Move alpha cursor to home position
v_eeos (5-9H)	9-11	Erase from alpha cursor positon to end of screen
v_eeol (5-AH)	9-12	Erase from alpha cursor to end of line
vs_curaddress (5-BH)	9-13	Move alpha cursor to specified location
v_curtext (5-CH)	9-14	Display text string at alpha cursor location

Table 9-1. (Cont'd)

Function	Page	Description
v_rvon (5-DH)	9-15	Turn on reverse video
v_rvoff (5-EH)	9-16	Turn off reverse video
vq_curaddress (5-FH)	9-17	Return current alpha cursor address
vq_tabstatus (5-10H)	9-18	Inquire tablet status
v_hardcopy (5-11H)	9-19	Copy physical screen to printer
v_dspcur (5-12H)	9-20	Place graphic cursor at specified coordinates
v_rmcur (5-13H)	9-21	Remove last graphic cursor
v_form_adv (5-14H)	9-22	Form advance
v_output_window (5-15H)	9-23	Output window to printer
v_clear_disp_list (5-16H)	9-25	Clear the printer display list
v_bit_image (5-17H)	9-26	Print the specified bit image file
vq_scan (5-18H)	9-29	Return printer scan heights and number of head passes per page
v_alpha_text (5-19H)	9-31	Print specified alpha text string
vs_palette (5-3CH)	9-33	Select color palette
v_sound (5-3DH)	9-34	Generate specified tone
vs_mute (5-3EH)	9-35	Set\Clear tone muting flag
vt_resolution (5-51H)	9-36	Set tablet axis resolution in lines/inch
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vm_filename (5-64H)	9-47	Use specified filename to rename metafile

VQ_CHCELLS (5-1H)

vq_chcells returns the number of vertical (row) and horizontal (column) positions at which the alpha cursor can be positioned on the screen. Typically, only screens support alpha text.

Input Arguments

handle	Device handle

Output Arguments

rows	Number of addressable rows on the screen, (-1 indicates cursor addressing not possible)
columns	Number of addressable columns on the screen, (-1 indicates cursor addressing not possible)

Sample Call to C Language Binding

```
WORD  vq_chcells();
WORD  handle, rows, columns;

vq_chcells(handle, &rows, &columns);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		intout(0) = rows
control(1) = 0		intout(1) = columns
control(2) = 0		
control(3) = 0		
control(4) = 2		
control(5) = 1		
control(6) = handle		

V_EXIT_CUR (5-2H)

This function causes the graphics device to enter graphics mode if graphics mode is different from alpha mode. v_exit_cur exits alpha cursor addressing mode explicitly, properly transferring from alpha to graphics mode. v_exit_cur also clears the graphics screen.

If the specified device is a metafile, v_exit_cur writes a metafile item to the metafile buffer.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD  v_exit_cur();
WORD  handle;

v_exit_cur(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(5) = 2		
control(6) = handle		

V_ENTER_CUR (5-3H)

v_enter_cur causes the graphics device to exit graphics mode if graphics mode is different from alpha mode. This function enters alpha cursor addressing mode explicitly, properly transferring from graphics to alpha mode. It also clears the alpha screen.

v_enter_cur also returns the cursor to the home position on the display device.

If this function is called by a metafile, v_enter_cur writes a metafile item to the metafile buffer.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD   v_enter_cur();
WORD   handle;

v_enter_cur(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 3		
control(6) = handle		

V_CURUP (5-4H)

This function moves the alpha cursor up one row without altering its horizontal position. If the cursor is already at the top margin, v_curup takes no action.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD   v_curup();
WORD   handle;

v_curup(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 4		
control(6) = handle		

V_CURDOWN (5-5H)

v_curdown moves the alpha cursor down one row without altering its horizontal position. No action occurs if the cursor is already at the bottom margin.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD  v_curdown();
WORD  handle;

v_curdown(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 5		
control(6) = handle		

V_CURRIGHT (5-6H)

This function moves the alpha cursor right one column without altering its vertical position. If the cursor is already at the right margin, v_curright performs no action.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD   v_curright();
WORD   handle;

v_curright(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 6		
control(6) = handle		

V_CURLEFT (5-7H)

v_curleft moves the alpha cursor left one column without altering its vertical position. This function performs no action if the cursor is already at the left margin.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD  v_curleft();
WORD  handle;

v_curleft(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 7		
control(6) = handle		

V_CURHOME (5-8H)

This function moves the alpha cursor to the home position, usually the upper left character cell of the display device.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD   v_curhome();
WORD   handle;

v_curhome(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 8		
control(6) = handle		

V_EEOS (5-9H)

v_eeos erases the display surface from the current alpha cursor position to the end of the alpha screen. The current alpha cursor location does not change.

Input Arguments

handle Device handle

Sample Calling to C Language Binding

```
WORD  v_eeos();
WORD  handle;

v_eeos(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 9		
control(6) = handle		

V_EEOL (5-AH)

This function erases the display surface from the current alpha cursor position to the end of the current alpha text line. The current alpha cursor location does not change.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD  v_eeol();
WORD  handle;

v_eeol(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 10		
control(6) = handle		

VS_CURADDRESS (5-BH)

vs_curaddress moves the alpha cursor directly to the row and column specified. The calling routine can specify any location on the display surface. vs_curaddress sets addresses beyond the displayable range of the screen to the nearest value that is within the displayable range of the screen.

Use vq_chcells (5-1H), described on page 9-3, to determine the number of addressable rows and columns.

Input Arguments

handle	Device handle
row	Row number (1 to maximum number of rows)
column	Column number (1 to maximum number of columns)

Sample Call to C Language Binding

```
WORD  vs_curaddress();
WORD  handle, row, column;

vs_curaddress(handle, row, column);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = row	
control(1) = 0	intin(1) = column	
control(2) = 0		
control(3) = 2		
control(4) = 0		
control(5) = 11		
control(6) = handle		

V_CURTEXT (5-CH)

v_curtext displays a specified string of alpha text starting at the current position of the alpha cursor. It moves the cursor right one column for each character in the string. The alpha text attribute currently in effect determines how the text is displayed (see v_rvon (5-DH) and v_revoff on pages 9-15 and 9-16, respectively).

The device must be in alpha cursor addressing mode before using v_curtext, see v_enter_cur (5-3H) on page 9-5.

Input Arguments

handle	Device handle
string	ASCII Decimal Equivalent (ADE) text string
	The string is word-oriented for the Parameter Block binding. For the C binding, the string is byte-oriented.

Sample Call to C Lanugage Binding

```
WORD   v_curtext();
WORD   handle;
BYTE   *string;

v_curtext(handle, string);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin = string	
control(1) = 0		
control(2) = 0		
control(3) = n		
control(4) = 0		
control(5) = 12		
control(6) = handle		

V_RVON (5-DH)

This function causes all subsequent alpha text to be displayed in reverse video.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD  r_von();
WORD  handle;

v_rvon(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 13		
control(6) = handle		

V_RVOFF (5-EH)

v_revoff displays all subsequent alpha text in normal video format.

Input Arguments

handle Device handle

Sample Call to C Langugage Binding

```
WORD   v_rvoff();
WORD   handle;

v_rvoff(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 14		
control(6) = handle		

VQ_CURADDRESS (5-FH)

vq_curaddress returns the current position of the alpha cursor in row, column coordinates.

Input Arguments

handle	Device handle

Output Arguments

row	Row number (1 to the maximum number of rows)
column	Column number (1 to the maximum number of columns)

Sample Call to C Language Binding

```
WORD  vq_curaddress();
WORD  handle, row, handle;

vq_curaddress(handle, &row, &column);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		intout(0) = row
control(1) = 0		intout(1) = column
control(2) = 0		
control(3) = 0		
control(4) = 2		
control(5) = 15		
control(6) = handle		

VQ_TABSTATUS (5-10H)

vq_tabstatus returns the availability status of a graphics tablet, mouse, joystick, or other similar device.

Input Arguments

handle Device handle

Output Arguments

status Tablet status:

0 Tablet not available
1 Tablet available

Sample Call to C Language Binding

```
WORD   vq_tabstatus();
WORD   status, handle;

status = vq_tabstatus(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		intout(0) = status
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 1		
control(5) = 16		
control(6) = handle		

V_HARDCOPY (5-11H)

v_hardcopy causes the specified device to generate a hard copy. This function is device-specific; it copies the physical screen to a printer or other attached hard copy device.

v_hardcopy is not required and might not be supported by all device drivers (see "Required Functions" in Section 2).

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD  v_hardcopy();
WORD  handle;

v_hardcopy(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 17		
control(6) = handle		

V_DSPCUR (5-12H)

This function places a graphic cursor at the location specified by the calling routine in the current coordinate system.

vsc_form (6FH) defines the type of cursor to be displayed. If sample mode input is supported, the calling routine can use this function to generate the cursor for vsm_locator (1CH), Input Locator-Sample Mode. vsc_form and vsm_locator are described in Section 7, "Input Functions."

v_dspcur applies only to devices capable of locator input (a mouse, joystick, or trackball, for example).

Input Arguments

handle	Device handle
x	x-coordinate of location to place cursor
y	y-coordinate of location to place cursor

Sample Call to C Language Binding

```
WORD   v_dspcur();
WORD   handle, x, y;

v_dspcur(handle, x, y);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	ptsin(0) = x	
control(1) = 1	ptsin(1) = y	
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 18		
control(6) = handle		

V_RMCUR (5-13H)

v_rmcur removes the last graphic cursor placed on the screen.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD   v_rmcur();
WORD   handle;

v_rmcur(handle);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		
control(1) = 0		
control(2) = 0		
control(3) = 0		
control(4) = 0		
control(5) = 19		
control(6) = handle		

V_FORM_ADV (5-14H)

v_form_adv advances the printer page. The VDI requires printer driver support of this function.

Use v_form_adv instead of v_clrwk (3H) when you want issue a form feed and retain the current printer display list.

If the specified device is a metafile, v_form_adv writes a metafile item to the metafile buffer.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD   v_form_adv();
WORD   handle;

v_form_adv(handle);
```

Parameter Block Binding

Control	Input
control(0) = 5	
control(1) = 0	
control(2) = 0	
control(3) = 0	
control(4) = 0	
control(5) = 20	
control(6) = handle	

V_OUTPUT_WINDOW (5-15H)

This function outputs a rectangular window of a picture to the printer. v_output_window is similar to v_updwk (4H), except that the calling routine specifies the coordinates (NDC or RC) of a rectangular window area.

Note that use of this function does not always guarantee that adjacent pictures will abut. Pictures will abut with a resolution of one printer head height.

The VDI requires that printer drivers support v_output_window. If the specified device is a metafile, v_output_window writes a metafile item to the metafile buffer.

Input Arguments

handle	Device handle
xyarray[0]	x-coordinate of window corner
xyarray[1]	y-coordinate of window corner
xyarray[2]	x-coordinate of corner diagonal to xyarray[0]
xyarray[3]	y-coordinate of corner diagonal to xyarray[1]

Sample Calling to C Language Binding

```
WORD   v_output_window();
WORD   handle, xyarray[4];

v_output_window(handle, xyarray);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	ptsin(0) = xyarray[0]	
control(1) = 2	ptsin(1) = xyarray[1]	
control(2) = 0	ptsin(2) = xyarray[2]	
control(3) = 0	ptsin(3) = xyarray[3]	
control(4) = 0		
control(5) = 21		
control(6) = handle		

V_CLEAR_DISP_LIST (5-16H)

v_clear_disp_list is required only for printers. It is called to clear the printer display list. This function is similar to v_clrwk (3H) but it does not cause the printer to perform a form advance.

If the device specified by the calling routine is a metafile, v_clear_disp_list writes a metafile item to the metafile buffer.

Input Arguments

handle Device handle

Sample Call to C Language Binding

```
WORD   v_clear_disp_list();
WORD   handle;

v_clear_disp_list(handle);
```

Parameter Block Binding

Control	Input
control(0) = 5	
control(1) = 0	
control(2) = 0	
control(3) = 0	
control(4) = 0	
control(5) = 22	
control(6) = handle	

V_BIT_IMAGE (5-17H)

v_bit_image processes a bit image file (see Appendix G, "Bit Image File Format"). Input arguments include a filename and information on image transformation and page placement.

The calling routine provides three parameters to control image transformation:

- pixel aspect ratio
- x-axis scaling
- y-axis scaling

Pixel Aspect Ratio

The aspect flag allows the calling routine to specify whether the pixel aspect ratio defined in the bit image file is to be preserved or ignored. Preserving pixel aspect ratio means the printed object will have the same aspect ratio it had on the device on which it was originally drawn; for example, squares remain squares, and circles remain circles. If the pixel aspect ration is ignored, the printed object will not necessarily have the same aspect ratio it had on the original device.

Axis Scaling

The two axis scaling flags can be set independently of each other. The scaling flags determine if the bit image's x or y axes are to be scaled fractionally or in integer multiples. The upward boundary of this scaling is a rectangle that the calling routine defines in the xyarray arguments.

If an axis of the bit image is scaled fractionally, it will exactly fit the corresponding axis of the scaling rectangle, with the exception noted below.

If an axis of the bit image is scaled in integer multiples, it might not exactly fit the corresponding axis of the scaling rectangle.

If the scaled bit image does not exactly fit the scaling rectangle, the caller can use the h_align and v_align alignment parameters to locate the bit image within the rectangle. These parameters allow any combination of three vertical and three horizontal positions.

Note: The scaled bit image always resides within the scaling rectangle. If a combination of preserved pixel aspect ratio, axis scaling, or alignment causes the scaled bit image to extend beyond an edge of the scaling rectangle, v_bit_image clips the bit image to that edge.

If the device specified by the calling routine is a metafile, v_bit_image writes a metafile item to the metafile buffer.

Input Arguments

handle — Device handle

filename — Filename for bit image file. For the C language binding, this argument is byte-oriented and must be null-terminated. For the Parameter Block (assembly language) binding, the filename is word-oriented.

aspect — Aspect ratio flag:

0 Ignore aspect ratio
1 Honor pixel aspect ratio

x_scale — Scaling for x-axis:

0 Fractional scaling
1 Integer scaling

y_scale — Scaling for y-axis:

0 Fractional scaling
1 Integer scaling

h_align — Horizontal alignment:

0 Left
1 Center
2 Right

v_align Vertical alignment:

0 Top
1 Middle
2 Bottom

xyarray[0] Upper left x (if specified)

xyarray[1] Upper left y (if specified)

xyarray[2] Lower right x (if specified)

xyarray[3] Lower right y (if specified)

Sample Call to C Language Binding

```
WORD   v_bit_image();
BYTE   *filename;
WORD   handle, aspect, x_scale, y_scale, h_align, v_align, xyarray[];

v_bit_image(handle, filename, aspect, x_scale, y_scale, h_align,
        v_align, xyarray);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = aspect	
control(1) = 2	intin(1) = x_scale	
control(2) = 0	intin(2) = y_scale	
control(3) = filename + 5	intin(3) = h_align	
control(4) = 0	intin(4) = v_align	
control(5) = 23	intin(5)	
control(6) = handle	.	
	.	
	intin(n+4) = filename	
	ptsin(0) = xyarray[0]	
	ptsin(1) = xyarray[1]	
	ptsin(2) = xyarray[2]	
	ptsin(3) = xyarray[3]	

VQ_SCAN (5-18H)

vq_scan returns the height, in pixels, of a printer head pass and the number of head passes in a full page for both graphics and alpha modes.

For devices in which the height of a single head pass is not a discrete number of pixels, this function returns a division factor. For example, if the device outputs 12.5 pixels in a single alpha pass and 4 pixels in a single graphics pass, vq_scan returns an alpha scan height of 25, a graphics scan height of 8, and a division factor of 2.

Input Arguments

handle	Device handle

Output Arguments

g_height	Graphics scan height in scaled pixels
g_slices	Number of graphics head passes per page
a_height	Alpha scan height in scaled pixels
a_slices	Number of alpha head passes per page
factor	Scan height division factor

Sample Call to C Language Binding

```
WORD  vq_scan();
WORD  handle, g_height, g_slices, a_height, a_slices, factor;

vq_scan(handle, &g_height, &g_slices, &a_height, &a_slices, &factor;
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		intout(0) = g_height
control(1) = 0		intout(1) = g_slices
control(2) = 0		intout(2) = a_height
control(3) = 0		intout(3) = a_slices
control(4) = 5		intout(4) = factor
control(5) = 24		
control(6) = handle		

V_ALPHA_TEXT (5-19H)

v_alpha_text outputs a specified string of alpha text to the printer. You must load a font before calling this function; see vst_load_fonts (77H) in Section 3. v_alpha_text is required only for printers.

The alpha text string is output at the current printer head position. All characters are output exactly as specified, with the following exceptions:

- The form-feed character (ADE value 12) has the same effect as a v_form_advance (5-14H) call.
- The two-character control sequences listed below invoke the described printer functions, if supported. DC2 refers to ADE value 18.

  (DC2)0 -- Begin boldface
  (DC2)1 -- End boldface
  (DC2)2 -- Begin italics
  (DC2)3 -- End italics
  (DC2)4 -- Begin underscore
  (DC2)5 -- End underscore

Input Arguments

handle — Device handle

string — ASCII character string

For the C language bindings, the string is byte-oriented and must be null terminated. For the Parameter Block (assembly) bindings, the string is word-oriented. work_out[15] of vq_extnd (66H) returns the maximum number of characters (size of intin array) allowed in the string. vq_extnd is described in Section 8.

Sample Call to C Language Binding

```
WORD   v_alpha_text();
WORD   handle;
BYTE   *string;

v_alpha_text(handle, string);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin = string	
control(1) = 0		
control(2) = 0		
control(3) = number of chars in string		
control(4) = 0		
control(5) = 25		
control(6) = handle		

VS_PALETTE (5-3CH)

This function allows the calling routine to select a color palette on the IBM® medium-resolution color screen. vs_palette returns the selected palette.

Input Arguments

handle Device handle

palette Color selection:

0 Use red, green, brown palette (default)
1 Use cyan, magenta, white palette

Output Arguments

selected Selected palette

Sample all C Language Binding

```
WORD  vs_palette();
WORD  handle, palette;

selected = vs_palette(handle, palette);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = palette	intout(0) = selected
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 1		
control(5) = 60		
control(6) = handle		

V_SOUND (5-3DH)

v_sound generates a tone of the specified frequency for the specified time interval.

Tone generation can be suppressed with vs_mute (5-3EH); see page 9-35.

Input Arguments

handle	Device handle
frequency	Tone frequency in hertz
duration	Tone duration in timer ticks

Sample Call to C Language Binding

```
WORD   v_sound();
WORD   handle, frequency, duration;

v_sound(handle, frequency, duration);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = frequency	
control(1) = 0	intin(1) = duration	
control(2) = 0		
control(3) = 2		
control(4) = 0		
control(5) = 61		
control(6) = handle		

VS_MUTE (5-3EH)

vs_mute sets, clears, or returns the current state of the muting flag. The muting flag controls tone generation.

Input Arguments

handle — Device handle

action — Action to perform:

-1 Return state of muting flag
0 Enable tone generation
1 Disable tone generation

Output Arguments

status — Current state of muting flag (undefined for enable and disable calls):

zero — Tone generation enabled
nonzero — Tone generation disabled

Sample Call to C Language Binding

```
WORD  vs_mute();
WORD  handle,action;

status = vs_mute(handle,action);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = action	intout(0) = status
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 0 for set 1 for inquire		
control(5) = 62		
control(6) = handle		

VT_RESOLUTION (5-51H)

This function sets the x and y resolution of the tablet. Resolution is specified independently for each axis in units of lines per inch. vt_resolution performs upper limit range checking on the xres and yres input arguments and returns the actual resolutions set.

Input Arguments

handle	Device handle
xres	Tablet x resolution in lines/inch
yres	Tablet y resolution in lines/inch

Output Arguments

xset	Actual x resolution set
yset	Actual y resolution set

Sample Call to C Language Binding

```
WORD   vt_resolution();
WORD   handle, xres, yres, xset, yset;

vt_resolution(handle, xres, yres, &xset, &yset);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = xres	intout(0) = xset
control(1) = 0	intin(1) = yset	intout(1) = yset
control(2) = 0		
control(3) = 2		
control(4) = 2		
control(5) = 81		
control(6) = handle		

VT_AXIS (5-52H)

vt_axis sets the x and y axis resolution of the tablet. Resolution is specified independently for each axis in units of lines per axis. Since the resolution of the tablet must ultimately be expressed as an integral number of lines per inch, this vt_axis returns the actual axis resolution realized.

Input Arguments

handle	Device handle
xres	Tablet x resolution in lines
yres	Tablet y resolution in lines

Output Arguments

xset	Actual x resolution set
yset	Actual y resolution set

Sample Call to C Language Binding

```
WORD   vt_axis();
WORD   handle, xres, yres, xset, yset;

vt_axis( handle, xres, yres, &xset, &yset);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = xres	intout(0) = xset
control(1) = 0	intin(1) = yres	intout(1) = yset
control(2) = 0		
control(3) = 2		
control(4) = 2		
control(5) = 82		
control(6) = handle		

VT_ORGIN (5-53H)

This function sets the x and y origin of the tablet.

Input Arguments

handle	Device handle
xorigin	x-coordinate of upper left corner of tablet origin in lines (tablet units)
yorigin	y-coordinate of upper left corner of tablet origin in lines (tablet units)

Sample Call to C Language Binding

```
WORD   vt_origin();
WORD   handle, xorigin, yorigin;

vt_origin(handle, xorigin, yorigin);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = xorigin	
control(1) = 0	intin(1) = yorigin	
control(2) = 0		
control(3) = 2		
control(4) = 0		
control(5) = 83		
control(6) = handle		

VQ_TDIMENSIONS (5-54H)

This function returns the x and y dimensions of the tablet in tenths of inches.

Input Arguments

handle Device handle

Output Arguments

xdimension Tablet x dimension in tenths of inches

ydimension Tablet y dimension in tenths of inches

Sample Call to C Language Binding

```
WORD  vq_tdimensions();
WORD  handle, xdimension, ydimension;

vq_tdimensions(handle, &xdimension, &ydimension);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5		intout(0) = xdimension
control(1) = 0		intout(1) = ydimension
control(2) = 0		
control(3) = 0		
control(4) = 2		
control(5) = 84		
control(6) = handle		

VT_ALIGNMENT (5-55H)

This function establishes an alignment between the physical coordinate axes of the tablet and the coordinate axes of, for example, a drawing affixed to the tablet surface.

vt_alignment is intended to account for inaccurate registration of a drawing with the physical coordinate axes, and might be used prior to tracing a drawing.

The input arguments are delta_x (dx) and delta_y (dy), which are the signed lengths of the sides of a triangle whose hypotenuse lies along the desired x or y axis of the drawing. If the hypotenuse of the triangle is defined by two points [x1, y1] and [x2, y2], delta_x is defined as (x2 - x1), while delta_y is defined as (y2 - y1).

Input Arguments

handle	Device handle
dx	Signed length of the x component of a triangle whose hypotenuse lies along the intended x or y axis
dy	Signed length of the y component of a triangle whose hypotenuse lies along the intended x or y axis

Sample Call to C Language Binding

```
WORD  vt_alignment();
WORD  handle, dx, dy;

vt_alignment(handle, dx, dy);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = dx	
control(1) = 0	intin(1) = dy	
control(2) = 0		
control(3) = 2		
control(4) = 0		
control(5) = 85		
control(6) = handle		

VSP_FILM (5-5BH)

vsp_film selects the film type and exposure time.

Input Arguments

handle	Device handle
index	Desired film type index number from 1 - n where n is the maximum available Use vqp_filmname (5-5CH) to obtain the name of the film associated with an index.
lightness	Lightness integer from -3 and 3. Each integer increase represents opening the aperture 1/3 of an f-stop. That is, -3 results in an exposure one half normal; 3 results in an exposure double normal.

Sample Call to C Language Binding

```
WORD  vs_film();
WORD  handle, index, lightness;

vsp_film(handle, index, lightness);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = index	
control(1) = 0	intin(1) = lightness	
control(2) = 0		
control(3) = 2		
control(4) = 0		
control(5) = 91		
control(6) = handle		

VQP_FILMNAME (5-5CH)

This function returns the film name for the element specified by the calling routine. vqp_filmname returns the film name as a string up to 24 characters long, null terminated. If the specified element number (the index argument) is invalid, a null string is returned (control(4) is zero).

Input Arguments

handle	Device handle
index	Requested element number

Output Arguments

status	.TRUE. if contrl[4] != 0 .FALSE. if contrl[4] == 0
name	Film name (ADE values), word-oriented for Parameter Block (assembly language) bindings, byte-oriented for C language binding

Sample Call to C Language Binding

```
BOOLEAN  vqp_filmname();
BOOLEAN  status;
WORD     handle, index;
BYTE     name[25]

status = vqp_filmname(handle, index, name);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = index	intout = name
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = number of chars in intout		
control(5) = 92		
control(6) = handle		

VSC_EXPOSE (5-5DH)

vsc_expose disables or enables the film exposure on some camera-type devices so that you can preview the frame prior to exposure. This function is limited to devices that support the preview capability.

Input Arguments

handle — Device handle

state — Exposure state set as follows:

zero	Disable exposure
nonzero	Enable exposure

Sample Call to C Language Binding

```
WORD  vsc_expose();
WORD  handle, state;

vsc_expose(handle, state);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = state	
control(1) = 0		
control(2) = 0		
control(3) = 1		
control(4) = 0		
control(5) = 93		
control(6) = handle		

V_META_EXTENTS (5-62H)

v_meta_extents uses the values specified by the calling routine to update the extents information in the metafile header. The extents information can be used as a quick indication of the minimum rectangle that will bound all primitives output to the metafile. See Appendix B for a description of the metafile header and "Special Metafile Escapes."

If extent values are not defined when outputting to the metafile,all four bounding values default to zero.

Input Arguments

handle	Device handle
min_x	Minimum x value of the minimum bounding rectangle
min_y	Minimum y value of the minimum bounding rectangle
max_x	Maximum x value of the minimum bounding rectangle
max_y	Maximum y value of the minimum bounding rectangle

Sample Call to C Language Binding

```
WORD  v_meta_extents();
WORD  handle, min_x, min_y, max_x, max_y;

v_meta_extents(handle, min_x, min_y, max_x, max_y);
```

Parameter Block Binding

Control	Input
control(0) = 5	ptsin(0) = min_x
control(1) = 2	ptsin(1) = min_y
control(2) = 0	ptsin(2) = max_x
control(3) = 0	ptsin(3) = max_y
control(4) = 0	
control(5) = 98	
control(6) = handle	

V_WRITE_META (5-63H)

v_write_meta writes the intin and ptsin parameters to the metafile. The first word of the intin array should contain a sub-opcode that defines this information as a user-defined metafile item.

The VDI reserves sub-opcodes 0 through 100. The sub-opcode you use to define your metafile item must be numbered 101 or higher.

Input Arguments

handle	Device handle
num_intin	Length of intin array
num_ptsin	Number of input vertices
intin	User-defined information
ptsin	User-defined information

Sample Call of C Language Binding

```
WORD  v_write_meta();
WORD  handle, num_intin, num_ptsin, intin[num_intin],
      ptsin[num_ptsin];

v_write_meta(handle, num_intin, intin, num_ptsin, ptsin);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0) = sub-opcode	
control(1) = num_ptsin	intin = intin	
control(2) = 0		
control(3) = num_intin	ptsin = ptsin	
control(4) = 0		
control(5) = 99		
control(6) = handle		

VM_FILENAME (5-64H)

When a metafile is first opened, its default name is GEMFILE.GEM and its default location is the current drive and directory. vm_filename renames a metafile from GEMFILE.GEM to the name specified by the calling routine. The metafile extension of GEM is maintained. The specified name can include a path and drive to locate the file somewhere other than on the current drive and directory.

Note: Call this function immediately after opening the metafile (see v_opnwk (1H) in Section 3) or it has no effect. vm_filename closes and deletes any open metafiles. Before this function is invoked, all metafile output is directed to GEMFILE.GEM.

Input Arguments

handle Device handle

filename Path/filename (null-terminated for C binding)

Sample Call to C Language Binding

```
WORD   vm_filename;
WORD   handle;
BYTE   *filename;

vm_filename(handle, filename);
```

Parameter Block Binding

Control	Input	Output
control(0) = 5	intin(0 to n) = filename.	
control(1) = 0		
control(2) = 0		
control(3) = number of chars in filename		
control(4) = 0		
control(5) = 100		
control(6) = handle		

End of Section 9

GEM VDI Error Messages

Command line syntax error

Description: The VDI displays this message when the command line includes an illegal character, path, or drive specification.

Solution: Be sure that the command line conforms the operating system's command line conventions. Reenter the command line after correcting illegal entries.

Unable to find ASSIGN.SYS

Description: This message indicates that the VDI is unable to find the ASSIGN.SYS file in the specified location.

Solution: Place the ASSIGN.SYS file in the current directory.

Error reading ASSIGN.SYS

Description: The VDI cannot use the ASSIGN.SYS file because its format is incorrect.

Solution: Refer to Section 1 for the file's correct format.

Memory table corrupted

Description: This message indicates that the system's memory is corrupted.

Solution: Reboot your system.

Insufficient memory

Description: This message indicates that the VDI cannot satisfy your memory allocation request.

Solution: If your system has enough memory to run the VDI, reboot your system.

Invalid memory block address

Description: This message indicates that the system's memory is corrupted.

Solution: Reboot the system.

Drive specification not allowed in ASSIGN.SYS

Description: This message indicates that your ASSIGN.SYS file contains an illegal drive specification.

Solution: Edit the file to remove the drive specification. The correct format of an ASSIGN.SYS file is described in Section 1.

Illegal device id in ASSIGN.SYS

Description: The VDI displays this message when your ASSIGN.SYS file contains a device ID number that exceeds the range of values listed in Table 1–1.

Solution: Refer to Table 1–1 in Section 1 for the valid device ID numbers. Correct the ASSIGN.SYS file with your text editor.

Partial record found in ASSIGN.SYS

Description: This message indicates that your ASSIGN.SYS file contains a partial entry.

Solution: Check your ASSIGN.SYS file for incomplete device ID numbers or filenames. Refer to Section 1 for the correct ASSIGN.SYS file format.

Invalid filename encountered in ASSIGN.SYS

Description: Your ASSIGN.SYS file contains a filename which is either too long or contains illegal characters.

Solution: Locate the invalid filename within ASSIGN.SYS and correct it using the following guidelines:

- The filename must have eight or fewer characters.
- The first character in the filename must be alphabetic.
- The file's extension must be SYS.

ASSIGN.SYS file is empty

Description: The VDI displays this message to indicate that it has found an empty ASSIGN.SYS file.

Solution: Use your text editor to enter the necessary ASSIGN.SYS information. Section 1 describes the ASSIGN.SYS contents.

Corrupted driver file

Description: When the VDI has found, but is unable to use, a device driver specified in ASSIGN.SYS, it displays this message.

Solution: Use your distribution disk to make another copy of the device driver. Try to use the new copy. Contact your dealer if you are unable to use the device driver.

End of Appendix A

GEM VDI Metafile Format

This appendix describes the information output by the metafile driver and the operations it performs for various VDI functions.

Standard Metafile Item Format

Most of the function requests passed to the metafile driver result in the driver writing a standard metafile item to the metafile buffer. In a standard format metafile item, the control, integer, and vertex parameters are written to the metafile in the format shown in Table B-1.

Table B-1. Control, Integer and Vertex Parameters

Word	Value	Description
0	control[0]	opcode
1	control[1]	vertex count
2	control[3]	integer parameter count
3	control[5]	sub-opcode (or zero)
4...	ptsin[0-n]	input vertices (if provided)
n+4...	intin[0-m]	input integer (if provided)

Note if the vertex or integer parameter count is zero, nothing is output for the ptsin or intin information.

Standard Metafile Function Requests

Requests for the functions listed below cause the metafile driver to output a standard metafile item.

Opcode (Decimal)	Function
3	Clear Workstation, v_clrwk (3H)
4	Update Workstation, v_updwk (4H)
5-2	Exit Alpha Mode, v_exitcur (5-2H)
5-3	Enter Alpha Mode, v_entercur (5-3H)
5-20	Form Advance, v_form_adv (5-14H)
5-21	Output Window, v_output_window (5-15H)
5-22	Clear Display List, v_clear_disp_list (5-16H)
5-23	Output Bit Image File, v_bit_image (5-17H)
5-25	Output Printer Alpha Text, v_alpha_text (5-19H)
6	Polyline, v_line (6H)
7	Polymarker, v_pmarker (7H)
8	Text, v_qtext (8H)
9	Fill Area, v_fillarea (9H)
11-1	Bar GDP, v_bar (B-1H)
11-2	Arc GDP, v_arc (B-2H)
11-3	Pie GDP, v_pieslice (B-3H)
11-4	Circle GDP, v_circle (B-4H)
11-5	Ellipse GDP, v_ellipse (B-5H)
11-6	Elliptical Arc GDP, v_ellarc (B-6H)
11-7	Elliptical Pie Slice GDP, v_ellpie (B-7H)
11-8	Rounded Rectangle GDP, v_rbox (B-8H)
11-9	Filled, Rounded Rectangle GDP, v_rfbox (B-9H)
11-10	Justified Graphics Text GDP, v_justified (B-AH)
12	Set Character Height, Absolute Mode, vst_height (CH)
13	Set Character Baseline Vector, vst_rotation (DH)
14	Set Color Representation, vs_color (EH)
15	Set Polyline Line Type, vsl_type (FH)
16	Set Polyline Line Width, vsl_width (10H)
17	Set Polyline Color Index, vsl_color (11H)
18	Set Polymarker Type, vsm_type (12H)
19	Set Polymarker Height, vsm_height (13H)
20	Set Polymarker Color Index, vsm_color (14H)
21	Set Text Font, vst_font (15H)
22	Set Text Color Index, vst_color (16H)

23	Set Fill Interior Style, vsf_interior (17H)
24	Set Fill Style Index, vsf_style (18H)
25	Set Fill Color Index, vsf_color (19H)
32	Set Writing Mode, vswr_mode (20H)
39	Set Graphic Text Alignment, vst_alignment (27H)
104	Set Fill Perimeter Visibility, vsf_perimeter (68H)
106	Set Graphic Text Special Effects, vst_effects (6AH)
107	Set Character Height, Points Mode, vst_point (6BH)
108	Set Polyline End Styles, vsl_ends (6CH)
112	Set User-defined Fill Pattern, vsf_udpat (70H)
113	Set User-defined Line Style Pattern, vsl_udsty (71H)
114	Fill Rectangle, vr_recfl (72H)
129	Set Clipping Rectangle, vs_clip (81H)

Nonstandard Metafile Items

Open Workstation - v_opnwk (1H)

v_opnwk initializes the metafile buffer and writes the metafile header to it. The device values normally returned by v_opnwk are returned. The format of the metafile header is described below.

Metafile Header Format

Word	Description
0	0ffffh
1	Length of header in words
2	100*major version number + minor version number
3	NDC/RC transformation mode flag: 0 positive y values ascend from origin (origin in lower left corner) 2 positive y values descend from origin (origin in upper left corner)
4 - 7	Minimum and maximum x and y extent values for the information contained in the metafile. If undefined by the application (see v_meta_extents (5-62H) in Section 9), all four values are zero. The values are stored in the following order: minimum x, minimum y, maximum x, maximum y.
8 - 9	Physical page size: page width in tenths of millimeters, followed by page height in tenths of millimeters. If undefined by the application, both values are zero. (See Appendix C, "Reserved Metafile Sub-opcodes.")

Word	Description
10 - 13	The coordinate window which defines the coordinate system used in the metafile. If undefined by the application, all four values are zero. The values are stored in the following order: lower left x, lower left y, upper right x, upper right y. (See Appendix C.)
14	Bit image opcode flag: 0 No bit image opcode in file 1 Bit image opcode included in metafile Bits 1 - 15 must be zero.

Close Workstation - v_clswk (2H)

v_clswk appends an end-of-metafile marker, 0FFFFH (one word) to the metafile buffer. It then flushes the buffer and closes the metafile.

Special Metafile Escapes

There are three escape functions that provide special functions for metafiles. These functions are briefly described here; Section 9 provides more detailed information.

Update Metafile Extents - v_meta_extents (5-62H)

v_meta_extents updates words 4 - 7 in the metafile header to indicate the extents passed in the ptsin array.

Write Metafile Item - v_write_meta (5-63H)

v_write_meta writes the intin and ptsin parameters to the metafile. The first word of the intin array should contain a sub-opcode that defines what type of user-defined metafile item is being written. This special sub-opcode can be used by an application to identify the metafile item when it is read in. The VDI reserves sub-opcodes 0 through 100.

Change GEM VDI Filename - vm_filename (5-64H)

If any information currently exists in the metafile or metafile buffer, vm_filename flushes the buffer and closes the file. vm_filename reinitializes the metafile buffer and performs rudimentary file name validation. If the drive, path, and filename are valid, they are used to update the File Control Block (FCB) of the metafile. The metafile will not actually be opened until the first buffer needs to be flushed.

Inquire Functions

Inquire Addressable Character Cells - vq_chcells (5-1H)

vq_chcells returns -1 in both intout(0), rows, and intout(1), columns, to indicate that cursor addressing is not possible.

Inquire Color Representation - vq_color (1AH)

vq_color returns -1 for the color index to indicate that no value is available.

Inquire Current Polyline Attributes - vql_attributes (23H)

vql_attributes returns the set values.

Extended Inquire - vq_extnd (66H)

vq_extnd returns the appropriate inquiry values.

End of Appendix B

Reserved Metafile Sub-opcodes

This appendix describes the metafile sub-opcodes reserved for two Digital Research GEM applications, GEM Output™ and GEM Draw™.

Metafile Sub-opcodes for GEM Output

The VDI reserves two sub-opcodes for sub-functions used by the GEM Output application:

Sub-opcode	Sub-function
0	Physical Page Size -- Defines how large a picture is to be rendered on the output page.
1	Coordinate Window -- Defines a newpage transformation which maps from the metafile coordinate system to the output device.

The two GEM Output metafile sub-opcodes result in an update of the metafile header. The opcodes are not actually written to the body of the metafile.

Physical Page Size

This sub-function defines the size of the output area. All of the data in the coordinate window is mapped to this area. If no physical page size is defined, the Output application will attempt a best fit on the target device, assuming that "pixels" in the metafile are square.

Input Arguments

control(0)	5
control(1)	0
control(3)	3
control(5)	99
control(6)	Device handle
intin(0)	Sub-opcode number, 0
intin(1)	Page width, in tenths of millimeter
intin(2)	Page height, in tenths of millimeter

Output Arguments

control(2)	0
control(4)	0

Coordinate Window

This sub-function defines the coordinate system used in the metafile. All of the data in the defined coordinate window is mapped to the area defined by the Physical Page Size sub-function.

The coordinate window defaults to NDC space (0 to 32K). The location of the origin (0, 0), depends on the coordinate space set when the metafile was opened; see v_opnwk (1H) in Section 3. For example, if raster coordinate space was specified when v_opnwk was invoked, the origin would be located in the upper left corner of the display surface.

Note that the window corner information must be specified as the lower left and upper right corners. Arbitrary opposing corners will not convey enough information.

Input Arguments

control(0)	5
control(1)	0
control(3)	5
control(5)	99
control(6)	Device handle
intin(0)	Sub-opcode, 1
intin(1)	x-coordinate of lower left corner of window
intin(2)	y-coordinate of lower left corner of window
intin(3)	x-coordinate of upper right corner of window
intin(4)	y-coordinate of upper right corner of window

Output Arguments

control(2)	0
control(4)	0

Metafile Sub-opcodes for GEM Draw

The following sub-opcodes are reserved for use by the GEM Draw application. GEM VDI defines the sub-opcodes for the following sub-functions:

Sub-opcode	Sub-function
10	Group
49	Set No Line Style
50	Set Attribute Shadow On
51	Set Attribute Shadow Off
80	Start Draw Area Type Primitive
81	End Draw Area Type Primitive

Group

This sub-function indicates how many previous primitives are grouped. The number of preceding primitives in the group is passed to the sub-function in intin(1).

Input Arguments

control(0)	5
control(1)	0
control(3)	2
control(5)	99
control(6)	Device handle
intin(0)	Sub-opcode number, 10
intin(1)	Number of preceding GEM Draw primitives in the group

Output Arguments

control(2)	0
control(4)	0

Set No Line Style

This sub-function is used by GEM Draw to indicate that subsequent area type primitives are not to be outlined. The effects of this sub-opcode are cancelled by any subsequent calls to vsl_type (FH); see Section 5.

Input Arguments

control(0)	5
control(1)	0
control(3)	1
control(5)	99
control(6)	Device handle
intin(0)	Sub-opcode number, 49

Output Arguments

control(2)	0
control(4)	0

Set Attribute Shadow On

This sub-function is used by GEM Draw to indicate that all subsequent primitives that occur before the next Set Attribute Shadow Off sub-function should be ignored. This is because such primitives are used to draw a drop shadow for the first primitive immediately following the Set Attribute Shadow Off call.

Internally, GEM Draw assigns a shadowed attribute to the first primitive that follows the Set Attribute Shadow Off call and performs its own shadow drawing. All attribute information which occurs between Set Attribute Shadow On and Set Attribute Shadow Off will continue to be processed.

Note that GEM Draw will not drop shadows from text or from polylines consisting of only two vertices.

Input Arguments

control(0)	5
control(1)	0
control(3)	1
control(5)	99
control(6)	Device handle
intin(0)	Sub-opcode number, 50

Output Arguments

control(2)	0
control(4)	0

Set Attribute Shadow Off

This sub-function indicates to GEM Draw the end of primitives used to draw a drop shadow of the first primitive immediately following this sub-opcode.

Input Arguments

control(0)	5
control(1)	0
control(3)	1
control(5)	99
control(6)	Device handle
intin(0)	Sub-opcode number, 51

Output Arguments

control(2)	0
control(4)	0

Start Draw Area Type Primitive

This sub-function indicates to GEM Draw that an area type primitive block follows. GEM Draw will use the vertices of the first primitive (anything except text) that follows this sub-opcode to define a GEM Draw area type primitive.

All other primitives encountered before the next End Draw Area Type Primitive sub-opcode will be ignored.

Input Arguments

control(0)	5
control(1)	0
control(3)	1
control(5)	99
control(6)	Device handle
intin(0)	Sub-opcode number, 80

Output Arguments

control(2)	0
control(4)	0

End Draw Area Type Primitive

This sub-function indicates the end of an area type primitive block to GEM Draw.

Input Arguments

control(0)	5
control(1)	0
control(3)	1
control(5)	99
control(6)	Device handle
intin(0)	Sub-opcode number, 81

Output Arguments

control(2)	0
control(4)	0

End of Appendix C

Standard Keyboard

The VDI defines a standard keyboard so applications can take advantage of special keys not defined in the standard, 7-bit ASCII character set. A 16-bit value is used to return these characters. The high byte contains a binary value assigned to each key. The low byte contains the 7-bit ASCII value, if such a value is defined, or a zero if the code is an extended code.

Table D-1. GEM VDI Standard Keyboard Assignments

High Byte	Low Byte	Character
03	00	CNTL 2 (Nul)
1E	01	CNTL A
30	02	CNTL B
2E	03	CNTL C
20	04	CNTL D
12	05	CNTL E
21	06	CNTL F
22	07	CNTL G
23	08	CNTL H
17	09	CNTL I
24	0A	CNTL J
25	0B	CNTL K
26	0C	CNTL L
32	0D	CNTL M
31	0E	CNTL N
18	0F	CNTL O
19	10	CNTL P
10	11	CNTL Q
13	12	CNTL R
1F	13	CNTL S
14	14	CNTL T
16	15	CNTL U

Table D-1. (Cont'd)

High Byte	Low Byte	Character
2F	16	CNTL V
11	17	CNTL W
2D	18	CNTL X
15	19	CNTL Y
2C	1A	CNTL Z
1A	1B	CNTL [
2B	1C	CNTL \\
1B	1D	CNTL]
07	1E	CNTL 6
0C	1F	CNTL -
39	20	Space
02	21	!
28	22	"
04	23	#
05	24	$
06	25	%
08	26	&
28	27	'
0A	28	(
0B	29	)
09	2A	*
0D	2B	+
33	2C	,
0C	2D	-
34	2E	.
35	2F	/
0B	30	0
02	31	1
03	32	2
04	33	3
05	34	4
06	35	5
07	36	6
08	37	7
09	38	8

Table D-1. (Cont'd)

High Byte	Low Byte	Character
0A	39	9
27	3A	:
27	3B	;
33	3C	<
0D	3D	=
34	3E	>
35	3F	?
03	40	@
1E	41	A
30	42	B
2E	43	C
20	44	D
12	45	E
21	46	F
22	47	G
23	48	H
17	49	I
24	4A	J
25	4B	K
26	4C	L
32	4D	M
31	4E	N
18	4F	O
19	50	P
10	51	Q
13	52	R
1F	53	S
14	54	T
16	55	U
2F	56	V
11	57	W
2D	58	X
15	59	Y

Table D-1. (Cont'd)

High Byte	Low Byte	Character
2C	5A	Z
1A	5B	[
2B	5C	\\
1B	5D	]
07	5E	^
0C	5F	_ (Underscore)
29	60	'
1E	61	a
30	62	b
2E	63	c
20	64	d
12	65	e
21	66	f
22	67	g
23	68	h
17	69	i
24	6A	j
25	6B	k
26	6C	l
32	6D	m
31	6E	n
18	6F	o
19	70	p
10	71	q
13	72	r
1F	73	s
14	74	t
16	75	u
2F	76	v
11	77	w
2D	78	x
15	79	y
2C	7A	z

Table D-1. (Cont'd)

High Byte	Low Byte	Character
1A	7B	{
2B	7C	|
1B	7D	}
29	7E	~
0E	7F	Rubout (DEL)
81	00	Alt 0
78	00	Alt 1
79	00	Alt 2
7A	00	Alt 3
7B	00	Alt 4
7B	00	Alt 5
7D	00	Alt 6
7E	00	Alt 7
7F	00	Alt 8
80	00	Alt 9
1E	00	Alt A
30	00	Alt B
2E	00	Alt C
20	00	Alt D
12	00	Alt E
21	00	Alt F
22	00	Alt G
23	00	Alt H
17	00	Alt I
24	00	Alt J
25	00	Alt K
26	00	Alt L
32	00	Alt M
31	00	Alt N
18	00	Alt O
19	00	Alt P
10	00	Alt Q
13	00	Alt R
1F	00	Alt S

Table D-1. (Cont'd)

High Byte	Low Byte	Character
14	00	Alt T
16	00	Alt U
2F	00	Alt V
11	00	Alt W
2D	00	Alt X
15	00	Alt Y
2C	00	Alt Z
3B	00	F1
3C	00	F2
3D	00	F3
3E	00	F4
3F	00	F5
40	00	F6
41	00	F7
42	00	F8
43	00	F9
44	00	F10
54	00	F11
55	00	F12
56	00	F13
57	00	F14
58	00	F15
59	00	F16
5A	00	F17
5B	00	F18
5C	00	F19
5D	00	F20
5E	00	F21
5F	00	F22
60	00	F23
61	00	F24
62	00	F25
63	00	F26
64	00	F27

Table D-1. (Cont'd)

High Byte	Low Byte	Character
65	00	F28
66	00	F29
67	00	F30
68	00	F31
69	00	F32
6A	00	F33
6B	00	F34
6C	00	F35
6D	00	F36
6E	00	F37
6F	00	F38
70	00	F39
71	00	F40
73	00	Ctrl left-arrow
4D	00	right-arrow
4D	36	Shift right-arrow
74	00	Ctrl right-arrow
50	00	down-arrow
50	32	Shift down-arrow
48	00	up-arrow
48	38	Shift up-arrow
51	00	Page down
51	33	Shift Page down
76	00	Ctrl Page down
49	00	Page up
49	39	Shift Page up
84	00	Ctrl Page up
77	00	Ctrl Home
47	00	Home
47	37	Shift Home
52	00	Insert
52	30	Shift Insert
53	00	Delete
53	2E	Shift Delete

Table D-1. (Cont'd)

High Byte	Low Byte	Character
72	00	Ctrl Print Screen
37	2A	Print Screen
01	1B	Escape
0E	08	Backspace
82	00	Alt -
83	00	Alt =
1C	0D	CR
1C	0A	Ctrl CR
4C	35	Shift Num Pad 5
4A	2D	Num Pad -
4E	2B	Num Pad +
0F	09	Tab
0F	00	Backtab
4B	00	left-arrow
4B	34	Shift left-arrow
4F	00	End
4F	31	Shift End
75	00	Ctrl End

End of Appendix D

Processor-Specific Data

8086-Specific Data

Registers and Interrupts

The application program passes the address of the Parameter Block to GEM VDI in registers DS:DX. Pass the VDI ID number, 1139 (0473H), in the register CX. The interrupt is EF.

Note: GEM VDI runs on Concurrent™ operating systems that support DOS calls of versions 2.0 and above.

Exchange Mouse Movement Vector

For 8086-based systems, the application-dependent code is invoked via a CALL FAR (CALLF) instruction. On entry, the BX register contains the new x position of the mouse; the CX register contains the new y position of the mouse. When complete, the application-dependent code should perform a RETURN FAR (RETF) instruction with the x,y position of the mouse the driver is to store in BX, CX. See vex_motv (7EH) in Section 7, "Input Functions," for information related to this function.

Exchange Button Change Vector

For 8086-based systems, the application code is invoked via a CALL FAR (CALLF) instruction with register AX containing the mouse button keys. Keys are encoded by the same rules that apply to the vq_mouse (7CH) function. When complete, the application-dependent code should perform a RETURN FAR (RETF) instruction with the mouse button state the driver is to store in AX. See vex_butv (7DH) for related information. Both vq_mouse and vex_butv are described in Section 7.

Exchange Cursor Change Vector

For 8086-based machines, the application-dependent code is invoked with a CALL FAR (CALLF) instruction. Upon entry, register BX contains the x position and the CX register the y position at which the cursor is to be drawn. If the application-dependent code does not draw its own cursor, a CALL FAR should be performed to the address returned in control(9) and control(10) with the x,y position at which to draw the cursor in BX, CX. This causes GEM VDI to draw a cursor. When complete, the application should perform a RETURN FAR (RETF) instruction. See the description of vex_curv (7FH) in Section 7 for related information.

Exchange Timer Interrupt Vector

For 8086-based systems, the application-dependent code is invoked with a CALL FAR (CALLF) instruction. When complete, the application should perform a RETURN FAR (RETF) instruction.

See the description of vex_timv (76H) in Section 7 for related information.

68000-Specific Data

Registers and TRAPS

Pass the address of the Parameter Block to GEM VDI in one 32-bit register, D0.l. Register D1.w contains the GEM VDI ID number 115 (73H).

For CP/M-68K,™ GEM VDI is invoked via TRAP 2. For other 68K operating systems that support GEM VDI, the TRAP is identified in the operating system's manual.

Exchange Mouse Movement Vector

For 68000-based systems, the application-dependent code is invoked via a JUMP TO SUBROUTINE (JSR) instruction. On entry, the D0.w register contains the new x position of the mouse. The D1.w register contains the new y position of the mouse. When complete, the application-dependent code should perform a RETURN FROM SUBROUTINE (RTS) instruction with the x,y position of the mouse the driver is to store in D0.w, D1.w.

See vex_motv (7EH) in Section 7, "Input Functions," for related information.

Exchange Button Change Vector

For 68000 processors, the application code is invoked via a JUMP TO SUBROUTINE (JSR) instruction and D0.w contains the mouse button keys. Keys are encoded by the same rules that apply to vq_mouse (7CH). When complete, the application-dependent code should perform a RETURN FROM SUBROUTINE (RTS) instruction with the mouse button state the driver is to store in D0.w.

See vex_butv (7DH) for related information. Both vq_mouse and vex_butv are described in Section 7.

Exchange Cursor Change Vector

For 68000-based machines, the application-dependent code is invoked with a JUMP TO SUBROUTINE (JSR) instruction. Upon entry, the D0.w register contains the x position and the D1.w register the y position. If the application-dependent code does not draw its own cursor, a JUMP TO SUBROUTINE (JSR) instruction should be performed to the address returned in control(9) and control(10) with the x,y position at which to draw the cursor in D0.w and D1.w. This causes GEM VDI to draw a cursor. When complete, the application should perform a RETURN FROM SUBROUTINE (RTS) instruction.

Refer to the description of vex_curv (7FH) in Section 7 for related information.

Exchange Timer Interrupt Vector

The application-dependent code on 68000-based systems is invoked with a JUMP TO SUBROUTINE (JSR) instruction. When complete, the application should perform a RETURN FROM SUBROUTINE (RTS) instruction.

Refer to the description of vex_timv (76H) in Section 7 for related information.

End of Appendix E

Character Sets and Font Files

Character Sets

The system fonts provided with the VDI are illustrated in figures F-1 and F-2. Figure F-1 shows the USASCII character set. Figure F-2 shows the additional characters included to form the international character set.

Note that external fonts (those which are dynamically loaded) do not include characters for decimal equivalents 0 through 31; see "Font Format," in this appendix.

DECIMAL VALUE	▶	0	16	32	48	64	80	96	112
▼	HEXA DECIMAL VALUE	0	1	2	3	4	5	6	7
0	0		▶	BLANK (SPACE)	0	@	P	‘	p
1	1	▲	◀	!	1	A	Q	a	q
2	2	▼	⋈	"	2	B	R	b	r
3	3	▶	▬	#	3	C	S	c	s
4	4	◀		$	4	D	T	d	t
5	5	■		%	5	E	U	e	u
6	6	■↘		&	6	F	V	f	v
7	7	◆		’	7	G	W	g	w
8	8	✓		(	8	H	X	h	x
9	9	◔		)	9	I	Y	i	y
10	A	🔔		*	:	J	Z	j	z
11	B	♪		+	;	K	[	k	{
12	C	▲		,	<	L	\	l	¦
13	D	▼		—	=	M	]	m	}
14	E	▶		.	>	N	^	n	~
15	F	◀		/	?	O	_	o	△

Figure F–1. GEM VDI USASCII Character Set

DECIMAL VALUE ▶	128	144	160	176	192	208	224	240
▼ HEXA DECIMAL VALUE	8	9	A	B	C	D	E	F
0	0	Ç	É	á	ã	ij		α	≡
1	1	ü	æ	í	õ	IJ		β	±
2	2	é	Æ	ó	¥	Φ		Γ	≥
3	3	â	ô	ú	₡			π	≤
4	4	ä	ö	ñ	œ			Σ	⌠
5	5	à	ò	Ñ	Œ			σ	⌡
6	6	å	û	a	À			μ	÷
7	7	ç	ù	o	Ã			τ	≈
8	8	ê	ÿ	¿	Õ			Φ	°
9	9	ë	Ö	⌐	¨			Θ	∘
10	A	è	Ü	¬	´			Ω	·
11	B	ï	ø	½	+			δ	√
12	C	î	£	¼	₱			∞	n
13	D	ì	Ø	¡	©			φ	2
14	E	Ä	₧	«	®			∈	■
15	F	Å	ƒ	»	TM			∩	BLANK (SPACE)

Figure F-2. GEM VDI International Character Set Extension

DECIMAL VALUE ➧		128	144	160	176	192	208	224	240
⬇	HEXA DECIMAL VALUE	8	9	A	B	C	D	E	F
0	0	Ç	É	á	ã	ij			
1	1	ü	æ	í	õ	IJ		β	
2	2	é	Æ	ó	¥	Φ			
3	3	â	ô	ú	₡				
4	4	ä	ö	ñ	œ				
5	5	à	ò	Ñ	Œ				
6	6	å	û	a	À				
7	7	ç	ù	o	Ã				
8	8	ê	ÿ	¿	Õ				
9	9	ë	Ö	⌐	¨				
10	A	è	Ü	¬	´				
11	B	ï	ø	½	+				
12	C	î	£	¼	₹				
13	D	ì	Ø	¡	©				
14	E	Ä	₧	«	®				
15	F	Å	ƒ	»	TM				

Figure F-3 GEM VDI International Character Set Extension for FNT Files

Font Format

The system fonts and external fonts used in GEM VDI are composed of four parts: the font data, a font header, a character offset table, and a horizontal offset table.

Font Data

The font data is organized as a single raster area. The area's height equals the font height and its width equals the sum of the character widths.

The top scan line of the first character in the font is aligned to a byte boundary. The top scan line of the second character is abutted to the first character and is not necessarily byte-aligned. That is, the end of any character and the beginning of the following character often occur within the same byte; no byte alignment occurs within the font form.

Bit padding occurs only at the end of a scan line. Each scan line in the font form begins on a word boundary. The number of bytes from the beginning of one scan line to the beginning of the next is called the form width. The number of scan lines required to draw any character is called the form height.

The format of the file is such that the low byte of a word occurs in memory before the high byte.

Font Header

The font header contains information that describes global aspects of the font. Font global aspects include information that applies to every character of the font, for example, the name of the face, the font size, and the minimum and maximum characters in the font. The format of the font header is shown in Table F-1.

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Table F-1. Font Header Format

Byte Number	Description
0 - 1	Font identifier; see vst_font (15H) in Section 5
2 - 3	Font size in points
4 - 35	Font name; see vqt_name (82H) in Section 8
36 - 37	Lowest ADE value in the font, first character
38 - 39	Highest ADE value in the font, last character
40 - 41	*Top line distance
42 - 43	*Ascent line distance
44 - 45	*Half line distance
46 - 47	*Descent line distance
48 - 49	*Bottom line distance
50 - 51	Width of the widest character in the font
52 - 53	Width of the widest character cell in the face
54 - 55	Left offset; see vqt_font_info (83H) in Section 8
56 - 57	Right offset see vqt_font_info (83H) in Section 8
58 - 59	Thickening; this is the number of pixels by which to widen thickened characters
60 - 61	Underline size; this is the pixel-width of the underline

*Distances are measured relative to the character baseline and are always a positive value (magnitude rather than offset).

Table F-1. (Cont'd)

Byte Number	Description
62 - 63	Lightening mask; this mask is used to drop pixels out when lightening (usually 5555H)
64 - 65	Skewing mask; this mask determines when additional character rotation is required to perform skewing (usually 5555H)
66 - 67	Flags: Bit 0 Set if default system font Bit 1 Set if horizontal offset tables should be used Bit 2 Reservered -- must be zero Bit 3 Set if mono-spaced font
68 - 71	Pointer to the horizontal offset table
72 - 75	Pointer to the character offset table
76 - 79	Pointer to the font data
80 - 81	Form width (see "Font Data")
82 - 83	Form height (see "Font Data")
84 - 87	Pointer to the next font (set by the driver)

Character Offset

The character offset table is used to index into the font data and to determine the width of specific characters in the font. It is indexed by relative character value (the ADE value of the desired character, minus the lowest ADE value in the font) and yields the offset from the base of the font data to the beginning of the character definition. The difference between the offset to a character and the offset to the following character gives the width of the character. Note that the character offset table includes one more entry than the number of characters in the font so that a width may be obtained for the final character in the font.

Note: The character offset table is required even for mono-spaced fonts.

Horizontal Offset Table

The horizontal offset table is indexed by relative character value and yields any additional positive or negative spacing necessary before outputting the character. The horizontal offset table often does not exist; this is indicated by the horizontal offset table bit in the Flags word (66) of the font header.

End of Appendix F

Bit Image File Format

A GEM VDI bit image file contains information that can be used to re-create a picture from its bit (pixel) image. The file consists of a header and raw pixel information. The pixel information can be encoded in a variety of formats.

A bit image file has an extension of IMG.

Bit Image File Header

The bit image file header consists eight 16-bit words in which the high order byte precedes the low order byte. The header words are defined as listed in Table G-1.

Table G-1. Bit Image File Header Format

Word	Contents
0	Image file version number
1	Header length in words
2	Number of planes (source device bits per pixel)
3	Pattern definition length (number of bytes)
4	Source device pixel width (microns)
5	Source device pixel height (microns)
6	Scan line width (pixels)
7	Number of scan line items

Word 1 indicates how long the header is. Always check this value; future releases of GEM might have a longer header.

Word 3 defines the number of bytes used to describe pattern_run (pattern_run is described below). The value can range from 1 to 8. Note that this value is 2 for most bit image files taken from screen devices.

Bit Image File Data Format

The bit image data is composed of a series of scan line items. Word 7 in the file header indicates how many scan line items are present.

Each scan line item has two components:

- a vertical replication count
- encoded data for each plane

The vertical replication count is a word value formatted as follows:

Byte	Contents
0	NUL
1	NUL
2	FF Hex
3	Count

The count indicates how many identical scan lines are defined in this scan_line item.

The encoded data for each color plane follows the vertical replication count. The data is presented in the following order:

first plane -- red
second plane -- green
third plane -- blue
fourth plane -- grey

Data is always provided for all defined bit planes.

Note: The number of pixels described for each bit plane of a scan line is not necessarily the scan line width specified in the file header. Because the data is encoded in byte-wide packets (groups of eight pixels), the number of pixels actually described is always a multiple of eight and is never more than seven pixels wider than the scan line width.

Plane data is encoded in one of three modes: solid run, pattern run, or bit string.

A **solid_run** item contains a single byte that describes a state and the number of bytes for which that state is true. The high-order bit defines the state where:

1 = pixels on
0 = pixels off

The low-order seven bits define the run length. For example, to set a stream of 24 pixels (3 bytes) on, the encoded data is 83H. Similarly, to set a stream of 256 pixels (32 bytes) off, the encoded data is 20H.

A **pattern_run** item describes a set of pattern bytes and the number of times the pattern bytes should be repeated. The number of bytes in a pattern is defined in the bit image file header; typically, it is two for a screen device image. A pattern_run item is defined as follows:

Byte	Contents
0	NUL
1	Length of run
2	First byte of pattern
.	
.	
n	Last byte of pattern (n is defined by header word 3)

For example, a stream of 48 pixels (6 bytes) alternating red and blue with a pattern width of two is encoded as follows:

- Red plane item (hex values): 00 03 AA AA
- Blue plane item (hex values): 00 03 55 55
- Green plane item: The green bit plane in this example is a solid run so the encoded data is 06H (all pixels are off).

If a stream of pixels for a given plane cannot be encoded efficiently as a solid run or pattern run, it must be encoded as a **bit_string**. A bit_string item is defined as follows:

Byte	Contents
0	80 Hex
1	Byte count
2	First byte of bit string
.	
.	
n	Last byte of bit string

End of Appendix G

D

E

F

G

H

I

M

N

O

S

T

U

V

W

X

GEM™ VDI Function Reference Table

Opcode Dec	Opcode Hex	Function and Binding
1	1	v_opnwk(work_in, &handle, work_out)
2	2	v_clswk(handle)
3	3	v_clrwk(handle)
4	4	v_updwk(handle)
5-1	5-1	vq_chcells(handle, &rows, &columns)
5-2	5-2	v_exit_cur(handle)
5-3	5-3	v_enter_cur(handle)
5-4	5-4	v_curup(handle)
5-5	5-5	v_curdown(handle)
5-6	5-6	v_curright(handle)
5-7	5-7	v_curleft(handle)
5-8	5-8	v_curhome(handle)
5-9	5-9	v_eeos(handle)
5-10	5-A	v_eeol(handle)
5-11	5-B	vs_curaddress(handle, row, column)
5-12	5-C	v_curtext(handle, string)
5-13	5-D	v_rvon(handle)
5-14	5-E	v_rvoff(handle)
5-15	5-F	vq_curaddress(handle, &row, &column)
5-16	5-10	vq_tabstatus(handle)
5-17	5-11	v_hardcopy(handle)
5-18	5-12	v_dspcur(handle, x, y)
5-19	5-13	v_rmcur(handle)
5-20	5-14	v_form_adv(handle)
5-21	5-15	v_output_window(handle, xy)
5-22	5-16	v_clear_disp_list(handle)
5-23	5-17	v_bit_image(handle, filename, aspect, x_scale, y_scale, h_align, v_align, xy)
5-24	5-18	vq_scan(handle, &g_height, &g_slices, &a_height, &a_slices, &factor)
5-25	5-19	v_alpha_text(handle, string)
5-60	5-3C	vs_palette(handle, palette)
5-61	5-3D	v_sound(handle, frequency, duration)
5-62	5-3E	vs_mute(handle, action)
5-81	5-51	vt_resolution(handle, xres, yres, &xset, &yset)
5-82	5-52	vt_axis(handle, xres, yres, &xset, &yset)

Opcode Dec	Hex	Function and Binding
5-83	5-53	vt_origin(handle, xorigin, yorigin)
5-84	5-54	vq_tdimensions(handle, &xdimension, &ydimension)
5-85	5-55	vt_alignment(handle, dx, dy)
5-91	5-5B	vsp_film(handle, index, lightness)
5-92	5-5C	vqp_filmname(handle, index, name)
5-93	5-5D	vsc_expose(handle, state)
5-98	5-62	v_meta_extents(handle, min_x, min_y, max_x, max_y)
5-99	5-63	v_write_meta(handle, num_ints, ints, num_pts, pts)
5-100	5-64	vm_filename(handle, filename)
6	6	v_pline(handle, count, xy)
7	7	v_pmarker(handle, count, xy)
8	8	v_gtext(handle, x, y, string)
9	9	v_fillarea(handle, count, xy)
10	A	v_cellarray(handle, xy, row_length, el_per_row, num_rows, wr_mode, colors)
11-1	B-1	v_bar(handle, xy)
11-2	B-2	v_arc(handle, xc, yc, rad, sang, eang)
11-3	B-3	v_pieslice(handle, xc, yc, rad, sang, eang)
11-4	B-4	v_circle(handle, xc, yc, rad)
11-5	B-5	v_ellipse(handle, xc, yc, xrad, yrad)
11-6	B-6	v_ellarc(handle, xc, yc, xrad, yrad, sang, eang)
11-7	B-7	v_ellpie(handle, xc, yc, xrad, yrad, sang, eang)
11-8	B-8	v_rbox(handle, xy)
11-9	B-9	v_rfbox(handle, xy)
11-10	B-A	v_justified(handle, x, y, string, length, word_space, char_space)
12	C	vst_height(handle, height, &char_width, &char_height, &cell_width, &cell_height)
13	D	vst_rotation(handle, angle)
14	E	vs_color(handle, index, rgb)
15	F	vsl_type(handle, style)
16	10	vsl_width(handle, width)
17	11	vsl_color(handle, index)
18	12	vsm_type(handle, symbol)
19	13	vsm_height(handle, height)
20	14	vsm_color(handle, index)
21	15	vst_font(handle, font)

Opcode Dec	Hex	Function and Binding
22	16	vst_color(handle, index)
23	17	vsf_interior(handle, style)
24	18	vsf_style(handle, index)
25	19	vsf_color(handle, index)
26	1A	vq_color(handle, index, set_flag, rgb)
27	1B	vq_cellarray(handle, xy, row_len, num_rows, &el_used, &rows_used, &status, colarray)
28	1C	vrq_locator(handle, initx, inity, &xout, &yout, &term)
28	1C	vsm_locator(handle, initx, inity, &xout, &yout, &term)
29	1D	vrq_valuator(handle, val_in, &val_out, &term)
29	1D	vsm_valuator(handle, val_in, &val_out, &term, &status)
30	1E	vrq_choice(handle, in_choice, &out_choice)
30	1E	vsm_choice(handle, &choice)
31	1F	vrq_string(handle, length, echo_mode, echo_xy, string)
31	1F	vsm_string(handle, length, echo_mode, echo_xy, string, &status)
32	20	vswr_mode(handle, mode)
33	21	vsin_mode(handle, dev_type, mode)
35	23	vql_attributes(handle, attributes)
36	24	vqm_attributes(handle, attributes)
37	25	vqf_attributes(handle, attributes)
38	26	vqt_attributes(handle, attributes)
39	27	vst_alignment(handle, hor_in, vert_in, &hor_out, &vert_out)
100	64	v_opnvwk(work_in, &handle, work_out)
101	65	v_clsvwk(handle)
102	66	vq_extnd(handle, owflag, work_out)
103	67	v_contourfill(handle, x, y, index)
104	68	vsf_perimeter(handle, per_vis)
105	69	v_get_pixel(handle, x, y, &pel, &index)
106	6A	vst_effects(handle, effect)
107	6B	vst_point(handle, point, &char_width, &char_height, &cell_width, &cell_height)
108	6C	vsl_ends(handle, beg_style, end_style)
109	6D	vro_cpyfm(handle, wr_mode, xy, srcMFDB, desMFDB)
110	6E	vr_trnfm(handle, srcMFDB, desMFDB)
111	6F	vsc_form(handle, cur_form)

Opcode Dec	Hex	Function and Binding
112	70	vsf_udpat(handle, fill_pat, planes)
113	71	vsl_udsty(handle, pattern)
114	72	vr_recfl(handle, xy)
115	73	vqin_mode(handle, dev_type, &input_mode)
116	74	vqt_extent(handle, string, extent)
117	75	vqt_width(handle, character, &cell_width, &left_delta, &right_delta)
118	76	vex_timv(handle, tim_addr, &old_addr, &scale)
119	77	vst_load_fonts(handle, select)
120	78	vst_unload_fonts(handle, select)
121	79	vrt_cpyfm(handle, wr_mode, xy, srcMFDB, desMFDB, &index)
122	7A	v_show_c(handle, reset)
123	7B	v_hide_c(handle)
124	7C	vq_mouse(handle, &status, &px, &py)
125	7D	vex_butv(handle, usercode, &savecode)
126	7E	vex_motv(handle, usercode, &savecode)
127	7F	vex_curv(handle, usercode, &savecode)
128	80	vq_key_s(handle, &status)
129	81	vs_clip(handle, clip_flag, xy)
130	82	vqt_name(handle, element_num, name)
131	83	vqt_font_info(handle, &minADE, &maxADE, distances, &maxwidth, effects)
132	84	vqt_justified(handle, x, y, string, length, word_space, char_space, offsets)