This document provides programming information about the MicroVMS Workstation graphics software. It describes the general concepts and specific routine calls which are used in writing application programs.


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This document was prepared using an in-house documentation production system. All page composition and make-up was performed by TeX, the typesetting system developed by Donald E. Knuth at Stanford University. TeX is a trademark of the American Mathematical Society.
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<td>C-18</td>
<td>Font 18</td>
<td>DVWSVT0I03WK00PG0001QZZZZ02A000</td>
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<td>C-20</td>
<td>Font 20</td>
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<td>C-21</td>
<td>Font 21</td>
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<td>C-22</td>
<td>Font 22</td>
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<tr>
<td>C-23</td>
<td>Font 23</td>
<td>DVWSVT0R03WK00GG0001QZZZZ02A000</td>
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<td>C-24</td>
<td>Font 24</td>
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<td>C-26</td>
<td>Font 26</td>
<td>DVWSVT0R07SK00GG0001QZZZZ02A000</td>
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</table>
Preface

This programming guide describes the MicroVMS workstation graphics software. It contains general information about basic MicroVMS graphics concepts, a tutorial for learning to program with MicroVMS graphics, and complete descriptions and reference information about the system routines for all callable functions.

Intended Audience

This guide is intended for general users and programmers who want to learn the concepts and use appropriate routines in graphics application programs.

Structure of This Document

This guide is divided into four major sections, MicroVMS Workstation Graphics Concepts, How to Program with MicroVMS Workstation Graphics, UIS Routine Descriptions, and UIS Device Coordinate (UISDC) Routines. These sections are briefly described in the following paragraphs.

Part I — MicroVMS Workstation Graphics Concepts

This section contains five chapters which provide a general overview of the basic concepts of MicroVMS workstation graphics.

• Chapter 1 — System Description
  This chapter briefly describes the hardware, software, and options that are parts of the MicroVMS workstation system.

• Chapter 2 — Display Management Concepts
  This chapter discusses the concepts of world coordinates, device coordinates, virtual displays, windows, viewports, window and viewport scaling, and distortion of graphic objects.

• Chapter 3 — Graphic Objects and Attributes
  This chapter describes and shows the relationship between graphics routines, attribute blocks, text attributes, graphics attributes, and segments.
• Chapter 4 — Color Concepts
  This chapter discusses the various color and intensity environments supported by
  the VAXstation color systems.

• Chapter 5 — Input Devices
  This chapter shows how the workstation input devices relate to the workstation
  graphics system.

Part II — How to Program with MicroVMS Workstation Graphics

This section contains step-by-step tutorial information about writing application
programs using MicroVMS graphics. Practical programming examples are provided
throughout this section. It is divided according to routine functions into the following
chapters:

• Chapter 6 — Programming Considerations
  This chapter describes the programming interface and topics relating to program
  execution.

• Chapter 7 — Creating Basic Graphic Objects
  This chapter describes the underlying structures and shows how to create graphic
  objects.

• Chapter 8 — Display Windows and Viewports
  This chapter shows how to create and manipulate display windows and display
  viewports.

• Chapter 9 — General Attributes
  This chapter describes writing modes, display background and foreground, and
  the writing index.

• Chapter 10 — Text Attributes
  This chapter describes how attributes may be used to enhance and modify text.

• Chapter 11 — Graphics Attributes
  This chapter describes how attributes may be used to enhance and modify the
  appearance of graphic objects.

• Chapter 12 — Inquiry Routines
  This chapter discusses how information can be returned to the application
  program.

• Chapter 13 — Display Lists and Segmentation
  This chapter describes how to create and manipulate display lists and segments.
• Chapter 14 — Geometric and Attribute Transformations
  This chapter describes the various ways graphic objects and components of
  graphic objects can be manipulated with the respect to the coordinate space.

• Chapter 15 — Metafiles and Private Data
  This chapter discusses how to extract the contents of a display list and store the
data in a buffer or external file. There is additional information about how to
associate private data with a graphics display.

• Chapter 16 — Programming in Color
  The chapter describes how to create and display graphic objects in color.

• Chapter 17 — Asynchronous System Trap Routines
  This chapter discusses how to make use of program-related events to increase
the interactive nature of your applications.

Part III — UIS Routine Descriptions
This section contains reference material about the device-independent MicroVMS
workstation graphics routines.

• Chapter 18 — UIS Routines Descriptions
• UIS Routine Descriptions

Part IV — UIS Device Coordinate (UISDC) Routines
This section contains reference material about device-dependent MicroVMS
workstation graphics routines.

• Chapter 19 — UIS Device Coordinate Graphics Routines
• UISDC Routines

Appendix A — Summary of UIS Calling Sequences
Appendix B — Summary of UISDC Calling Sequences
Appendix C — UIS Fonts
Appendix D — UIS Fill Patterns
Appendix E — Error Messages
Appendix F — Obsolete Routines
Glossary

NOTE: For documentation on VMS data types, see Appendix A of the MicroVMS
Workstation Version 3.0 Release Notes.
**How To Use This Guide**

This guide is designed so that it can be used in two different ways:

- It can be used as a learning tool by general users and programmers new to graphics software and MicroVMS workstation graphics.
- It can be used as a reference tool by programmers already familiar with graphics software in general and/or MicroVMS workstation graphics.

**Inexperienced User**

If you are unfamiliar with the MicroVMS workstation graphics system, you should begin by reading Part I of this guide. It gives you an overview of the graphics concepts discussed in subsequent sections of the book.

The programming tutorial in Part II provides a step-by-step approach for learning how to write applications that take advantage of the graphics capabilities of the MicroVMS workstation.

Part III provides you with reference information about all of the UIS routines used in MicroVMS workstation graphics. It is easier to use after you have read Part II of this guide.

Part IV contains appendices that provide reference material about UISDC graphics routines and error messages.

**Experienced User**

Once you have become familiar with MicroVMS workstation graphics, you will seldom need to refer to Part I of this guide, except when reviewing basic concepts.

Refer to Part II for examples and suggestions on the proper use of MicroVMS workstation graphics routines.

Part III is an alphabetically arranged reference section that you can use to get detailed descriptions of MicroVMS workstation graphics routines. Before using this section, you should already be familiar with Parts I and II of this guide.

Part IV contains appendices that provide reference material about UISDC graphics routines and error messages.
Associated Documents

The following MicroVMS manuals are related to this guide:

- MicroVMS Workstation User’s Guide
- MicroVMS Workstation Video Device Driver Manual
- MicroVMS User’s Manual
- MicroVMS User’s Primer
- MicroVMS Programmer’s Manual
- MicroVMS FORTRAN Programmer’s Primer
- MicroVMS Programming Pocket Reference
- Installing or Upgrading MicroVMS From Diskettes
- Installing or Upgrading MicroVMS From a Tape Cartridge

Conventions Used in This Document

This manual uses the following conventions:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ SHOW TIME</td>
<td>Command examples show all output lines or prompting characters that the system prints or displays in black letters. All user-entered commands are shown in red letters.</td>
</tr>
<tr>
<td>05-JUN-1986 11:55:22</td>
<td></td>
</tr>
<tr>
<td>$ TYPE MYFILE.DAT</td>
<td>Vertical series of periods, or ellipsis, mean either that not all the data that the system would display in response to the particular command is shown or that not all the data a user would enter is shown.</td>
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<td>.</td>
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<td></td>
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<tr>
<td>.</td>
<td></td>
</tr>
<tr>
<td>file-spec,...</td>
<td>Horizontal ellipsis indicates that additional parameters, values, or information can be entered.</td>
</tr>
<tr>
<td>Convention</td>
<td>Meaning</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>[logical-name]</td>
<td>Square brackets indicate that the enclosed item is optional. (Square brackets are not, however, optional in the syntax of a directory name in a file specification or in the syntax of a substring specification in an assignment statement.)</td>
</tr>
<tr>
<td>quotation marks</td>
<td>The term quotation marks is used to refer to double quotation marks (&quot;'&quot;). The term apostrophe (’) is used to refer to a single quotation mark.</td>
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</tbody>
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New and Changed Features

The following sections describes changes to the programming interface since UIS Version 2.0.

New UIS Routines

The following UIS routines were added.

<table>
<thead>
<tr>
<th>Function</th>
<th>Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>AST-enabling</td>
<td>UIS$SET_ADDOPT_AST</td>
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<tr>
<td></td>
<td>UIS$SET_EXPAND_ICON_AST</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_TB_AST</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_SHRINK_TO_ICON_AST</td>
</tr>
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<td>Color</td>
<td>UIS$CREATE_COLOR_MAP</td>
</tr>
<tr>
<td></td>
<td>UIS$CREATE_COLOR_MAP_SEG</td>
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<tr>
<td></td>
<td>UIS$DELETE_COLOR_MAP</td>
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<td></td>
<td>UIS$DELETE_COLOR_MAP_SEG</td>
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<tr>
<td></td>
<td>UIS$GET_COLORS</td>
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<tr>
<td></td>
<td>UIS$GET_HW_COLOR_INFO</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_INTENSITIES</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_VCM_ID</td>
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<td></td>
<td>UIS$HLS_TO_RGB</td>
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<tr>
<td></td>
<td>UIS$HSV_TO_RGB</td>
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<td></td>
<td>UIS$RESTORE_CMS_COLORS</td>
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<tr>
<td></td>
<td>UIS$RGB_TO_HLS</td>
</tr>
<tr>
<td></td>
<td>UIS$RGB_TO_HSV</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_INTENSITIES</td>
</tr>
<tr>
<td>Function</td>
<td>Routine</td>
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<td>--------------------------------------------------------------</td>
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<tr>
<td>Display list</td>
<td>UIS$COPY_OBJECT</td>
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<td></td>
<td>UIS$DELETE_OBJECT</td>
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<tr>
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<td>UIS$DELETE_PRIVATE</td>
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<td>UIS$EXECUTE</td>
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<td>UIS$EXECUTE_DISPLAY</td>
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<td>UIS$EXTRACT_HEADER</td>
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<td>UIS$EXTRACT_OBJECT</td>
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<td>UIS$EXTRACT_PRIVATE</td>
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<td>UIS$EXTRACT_REGION</td>
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<td>UIS$EXTRACT_TRAILER</td>
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<td>UIS$FIND_PRIMITIVE</td>
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<td></td>
<td>UIS$FIND_SEGMENT</td>
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<td></td>
<td>UIS$GET_CURRENT_OBJECT</td>
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<td>UIS$GET_NEXT_OBJECT</td>
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<td>UIS$GET_OBJECT_ATTRIBUTES</td>
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<td>UIS$GET_PARENT_SEGMENT</td>
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<td>UIS$GET_ROOT_SEGMENT</td>
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<td>UIS$INSERT_OBJECT</td>
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<td>UIS$SET_INSERTION_POSITION</td>
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<td>UIS$TRANSFORM_OBJECT</td>
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<td>Graphics</td>
<td>UIS$LINE</td>
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<tr>
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<td>UIS$LINE_ARRAY</td>
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<tr>
<td>Keyboard and pointer</td>
<td>UIS$CREATE_TB</td>
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<td>UIS$DELETE_TB</td>
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<td>UIS$GET_TB_INFO</td>
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<td>UIS$GET_TB_POSITION</td>
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<tr>
<td>Function</td>
<td>Routine</td>
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<td>----------------------------------------------</td>
</tr>
<tr>
<td>Text</td>
<td>UIS$GET_CHAR_ROTATION</td>
</tr>
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<td>UIS$GET_CHAR_SIZE</td>
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<td></td>
<td>UIS$GET_CHAR_SLANT</td>
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<td></td>
<td>UIS$GET_FONT_ATTRIBUTES</td>
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<tr>
<td></td>
<td>UIS$GET_TEXT_FORMATTING</td>
</tr>
<tr>
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<td>UIS$GET_TEXT_MARGINS</td>
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<tr>
<td></td>
<td>UIS$GET_TEXT_PATH</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_TEXT_SLOPE</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_CHAR_ROTATION</td>
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<tr>
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<td>UIS$SET_CHAR_SIZE</td>
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<td></td>
<td>UIS$SET_FONT_ATTRIBUTES</td>
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<tr>
<td></td>
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<td>UIS$SET_TEXT_MARGINS</td>
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<td>UIS$SET_TEXT_PATH</td>
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<td>UIS$SET_TEXT_SLOPE</td>
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<td>Windowing</td>
<td>UIS$EXPAND_ICON</td>
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<td></td>
<td>UIS$GET_VIEWPORT_ICON</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_WINDOW_SIZE</td>
</tr>
<tr>
<td></td>
<td>UIS$SHRINK_TO_ICON</td>
</tr>
</tbody>
</table>

**New UISDC Routines**

The following UISDC routines are new for Version 3.0.

- UISDC$ALLOCATE_DOP
- UISDC$EXECUTE_DOPASYNCH
- UISDC$EXECUTE_DOP_SYNCH
- UISDC$GET_CHAR_SIZE
- UISDC$GET_TEXT_MARGINS
- UISDC$LINE
- UISDC$LINE_ARRAY
- UISDC$LOAD_BITMAP
- UISDC$QUEUE_DOP
- UISDC$SET_CHAR_SIZE
- UISDC$SET_TEXT_MARGINS
New Chapters

Three new chapters describing color concepts and color programming considerations have been added since Version 2.0.

- Color Concepts
- Geometric and Attribute Transformations
- Programming in Color

New UIS Writing Modes

Five new writing modes have been added since Version 2.0.

- UIS$C_{-}MODE_{-}BIC
- UIS$C_{-}MODE_{-}BICN
- UIS$C_{-}MODE_{-}BIS
- UIS$C_{-}MODE_{-}BISN
- UIS$C_{-}MODE_{-}COPYN

New Technical Character Set Fonts

Twelve new technical character set fonts have been added since Version 2.0.

New Text Attributes

The following new text attributes have been added to the programming interface.

- Character rotation
- Character scaling
- Character slant
- Text formatting
- Text margins
- Text path
- Text slope
Changes to Existing UIS Routines

**UIS$BEGIN_SEGMENT**

*UIS$BEGIN_SEGMENT* now returns segment identifier that can be referenced by other display list routines. For example, this allows traversing segments and segment paths.

**UIS$MEASURE_TEXT and UIS$TEXT**

You can now use control lists with *UIS$TEXT* and *UIS$MEASURE_TEXT*.

**UIS$DISABLE_DISPLAY_LIST and UIS$ENABLE_DISPLAY_LIST**

Additional arguments have been included that control display screen and display list updates.

**UIS$SET_POINTER_PATTERN and UISDC$SET_POINTER_PATTERN**

If you are using a color system, you can now specify a pointer pattern outline.

Display Lists and Segmentation

The chapter on display lists and segmentation has been expanded with more examples.

**UIS Metafiles**

You can create and store metafiles of generically encoded instructions as files and reexecute the file.

Shrinking Viewports and Expanding Icons

Applications can now shrink display viewports and expand icons.
Obsolete Version 2.0 UIS Routines

The following routines are obsolete.

- UIS$GET_LEFT_MARGIN
- UIS$SET_LEFT_MARGIN
- UISDC$GET_LEFT_MARGIN
- UISDC$SET_LEFT_MARGIN
PART I  MicroVMS Workstation
Graphics Concepts
Chapter 1

System Description

1.1 Overview

This chapter introduces the MicroVMS workstation graphics system. It is divided into two parts:

- A summary of typical workstation hardware
- A description of the graphics software

1.2 VAXstation Hardware

The MicroVMS workstation can be used as a standalone system. It has all the components necessary to run programs and perform tasks without being connected to a host computer. It can also be connected to a host computer and used as a part of a network in a larger system.

The MicroVMS workstation typically consists of a configuration of the following hardware:

- Processor
- Display monitor
- Keyboard
- Three-button mouse or a tablet
- Communications board
- Printer

An illustration of the typical MicroVMS workstation hardware is provided in Figure 1–1.
1.2.1 Processor

The processor is the heart of the MicroVMS workstation system. The processor contains the disk drives, all of the memory, any options, and communications hardware for the system. Usually, it houses both fixed and flexible disk drives. The amount of memory it has can vary, depending upon the options installed.

1.2.2 Monitor

The monitor displays text and graphics information. It is a high-resolution bitmap device that can be used to display black-and-white, grey scale, or color graphics.
1.2.3 Keyboard

The keyboard used with the workstation is the DIGITAL LK201, a standard low-profile style keyboard. This keyboard consists of:

- A top row of function keys which are user-definable
- A numeric keypad which is also user definable
- A special keypad which has arrow keys and function keys
- A standard alphanumeric keypad

Some of the top row of function keys are control keys that enable the user to:

- Hold the screen
- Display the operator window
- Switch the windowing system
- Change the active window

In this row, there are also keys that call functions such as cancel, exit, help, and provide aid in editing.

The function keys and numeric keypad keys can be defined by an application program to perform functions suited to a particular application. The arrow keys can be used to move the keyboard cursor within applications. The alphanumeric keypad is similar in function to a typewriter keyboard.

1.2.4 Mouse

The three-button mouse is a medium-resolution, relative pointing device. It is the primary means for a user to point to an object on the screen. When the mouse is rolled on a flat surface, the pointer on the screen moves in a similar fashion. The buttons are used to make selections.

1.2.5 Tablet

The tablet is a high-resolution, absolute positioning device. It consists of a flat tablet, a puck with buttons, and a pen with buttons. When the puck or pen are moved on the tablet, the pointer on the display screen moves in an identical fashion. The buttons are used for selection.
1.2.6 Communications Board
The communications board allows the system to be connected with and communicate with other computers.

1.2.7 Printer
The MicroVMS workstation can have a printer connected to the processor's console port or can access printers located at remote location through the network. You can print any rectangular portion of display screen.

1.3 Software
The MicroVMS workstation graphics software is a versatile graphics and windowing interface. It is designed to be used on any of the MicroVAX family of workstation products (such as VAXstations). This graphics interface allows the user to write application programs in VAX MACRO, VAX BLISS, and many other high-level languages. Application programs written to take advantage of this software will be able to create and manipulate windows, display multiple styles of text and sizes, receive input, and draw graphic objects in the created windows.

1.3.1 Graphics Routine Types
The MicroVMS workstation graphics software is composed of callable routines that can be accessed from a high-level programming language. An application program can perform graphics and windowing functions by making calls to the appropriate routines. This software contains routines for creating display windows, drawing lines and text, and building graphic objects.

Routines fall into the following general categories:

- AST-enabling routines
- Attribute routines
- Color routines
- Display list routines
- Graphics and text routines
- Inquiry routines
- Keyboard routines
- Pointer routines
- Sound routines


- Windowing routines
- Device coordinate routines

### 1.3.2 Human Interface

The MicroVMS workstation provides an interface between the graphics software and the user. This interface is called the *human interface* because it acts to aid the human operator to use the workstation.

One of the things that this interface does is make it easy for the user to create new terminal windows on the screen. The MicroVMS workstation provides the operator with the capability of having the equivalent of many terminals at his or her disposal. A user can easily create emulated DIGITAL VT220 or Tektronix TEK4014 terminals by merely selecting a menu item which creates a window on the screen.

The operator can also control the placement of windows on the screen. Windows can be moved anywhere on the screen (or even partially off of it). They can be hidden from view, pushed behind other windows, popped in front of other windows, and so on. The following list shows some of the operations that are possible.

- Create a new VT220 or TEK4014 terminal window
- Move a window to a different part of the screen
- Push a window behind other windows
- Pop a window in front of other windows
- Shrink a viewport to a icon
- Change the size of a window
- Delete a window
- Switch the keyboard from one window to another
- Suspend all screen activity (hold screen)
- Print any portion (or all) of a window or the screen
- Set workstation attributes
- Get online help
1.3.2.1 Terminal Emulation
You can create emulated terminals on the MicroVMS workstation. The programming interface and the capabilities of emulated terminals are the same as the programming interface and capabilities of the corresponding real terminal. The appearance of an emulated terminal on the MicroVMS workstation screen is similar to that of the corresponding real terminal. (It will not be completely identical due to hardware differences.)

An advantage of having several terminal windows is that a job can be started on one terminal, and while it’s left running, another terminal can be created and another job started. The user can create as many terminals as desired and switch back and forth between them at will.

VT220/TEK4014
The VAXstation can emulate the DIGITAL VT220 or Tektronix TEK4014 terminal. There can be any number of VT220 or TEK4014 windows on the screen simultaneously. However, only one window may use the keyboard at any one time. The keyboard is assigned to a window by the operator.

VT220 ANSI and DIGITAL private escape sequences, and TEK4014 escape sequences, are interpreted and translated into the appropriate graphics routines.

Programs written using the VAX/VMS operating system will operate in a VT100 or VT220 workstation window without modification.

1.3.2.2 Communication Tools
Users can communicate with the software interface through either the mouse, tablet, or keyboard.

Mouse and Tablet
The mouse and tablet control a cursor called a pointer on the screen. When the mouse or tablet is manipulated by the user, the pointer moves on the screen. The pointer is used by an operator to point to things on the screen, such as an item in a menu. The buttons associated with mouse and tablet are used to make selections. The pointer, in combination with buttons on the mouse, can perform several tasks:

- Point to objects on the screen
- Select objects on the screen
- Move objects around on the screen
- Push and pop windows on the screen
• Call menus to the screen
• Switch the keyboard between emulated terminals or windows
• Perform application designated functions

Keyboard
You can use the keyboard to perform the following functions:
• Respond to system prompts
• Provide control keys, such as \texttt{HOLD SCREEN} and \texttt{CYCLE}
• Provide special keys, such as \texttt{HELP}
• Enter data and information into a screen window
• Move a cursor in a window on the screen
• Perform application specific functions

1.3.3 Windowing Feature
The graphics software allows a large number of windows to be created and maintained at the same time. Graphics routines are provided to handle the creation, deletion, and manipulation of overlapping windows. Windows can be popped to the front of the screen, pushed to the background, moved around the screen to a new position, and completely deleted from the screen. The amount and size of information that appears in a window can also be controlled.

1.3.4 Graphics Capabilities
Routines are provided to create new displays and draw graphics within the created displays. A display list, which is an encoded description of the routines used to create the contents of a display, is kept in memory. The display list enables a program to easily pan and zoom portions of a display without having to redraw the entire display. Scaling of the display is done automatically by the graphics software. A display, or a portion of a display, can be mapped into one or more windows on the screen.
Chapter 2
Display Management Concepts

2.1 Overview

This chapter discusses the basic concepts involved in creating a graphic object and displaying it on the workstation screen. Some of the topics covered in this chapter are as follows:

- Virtual displays
- Display windows
- Display viewports
- World and device coordinates
- Display window and viewport scaling

2.1.1 Summary

The MicroVMS workstation graphics software enables application programs to build graphic objects and display them on the workstation screen.

An application program that takes full advantage of the capabilities of the MicroVMS workstation graphics can do the following things:

- Create a virtual display.
- Draw graphics and text into the virtual display.
- Open windows into the virtual display for viewing on an output device.
- Map the windows into display viewports on the workstation screen.
- Manipulate the windows and viewports to display as much or as little of the virtual display as desired.
- Pan, zoom in and out, resize, and duplicate the display windows.
- Manipulate display lists.
To do these things, an application program must first create a virtual display in which to build the object. A virtual display can be thought of as a conceptual display space that has no actual physical size or shape. This conceptual display space, called the world coordinate system, is defined by the application program in terms of world coordinates. World coordinates are arbitrary units of measure selected by the application program that specify locations (or points) in the world coordinate system using values that are convenient to the application.

World coordinates are automatically translated to normalized coordinates (by the graphics software) before being mapped to an output device. Normalized coordinates convert user world coordinates into a single device-independent coordinate system so that the user does not have to deal with several coordinate systems. Normalized coordinates are automatically mapped to the device-dependent coordinates of the physical output device.

A graphic object constructed in a virtual display is not available for display on an output device until a display window and display viewport are created by the application program.

A display window defines what portion of the graphic object in a virtual display is to be viewed. By creating the display window, the program is making the information in the virtual display potentially visible to the user. The information in the display window is not actually visible to a user until the display window is mapped to a display viewport.

A display viewport is the physical region on a display device that is created by the MicroVMS workstation software and controlled by the user. The display viewport is the physical representation of the display window that is mapped to it. It enables a user to view the graphic object that is inside the display window. Figure 2-1 illustrates the relationship between the virtual display, display window, and display viewport.

Physical device coordinates are used in mapping a display window to a display viewport. Physical device coordinates are the physical points on the display screen that are used to locate the graphic object. The process of mapping a graphic object from the world coordinates of the display window to the device coordinates of the display viewport is called a viewing transformation. Viewing transformations are handled automatically by the graphics software.

The world coordinates of the display window can be manipulated in relation to the world coordinates of the virtual display to achieve the effects of panning and zooming the graphic object in the display viewport.
2.2 Coordinate Systems

The MicroVMS workstation graphics environment can be thought of as a two dimensional plane. Because of this, the Cartesian coordinate system applies in describing points within this environment. Cartesian coordinates take the form of $x,y$, where $x$ is the horizontal axis and $y$ is the vertical axis. A point on this plane is specified by a coordinate pair. The area of this plane that is specified by coordinate pairs is called the coordinate space.

The MicroVMS workstation graphics software makes use of four Cartesian coordinate systems: world, normalized, absolute, and viewport-relative device coordinates.

2.2.1 Device-Independent Coordinate Systems

Device-independent coordinate systems mediate between the requirements of the application program and the graphics subsystem versus those of the output device.
2.2.1.1 World Coordinates

An application program uses world coordinates to describe a virtual display and to build a graphic object within it. Initially, the application program creates a virtual display and specifies a convenient world coordinate system to use when referring to the virtual display. Next, the program specifies the size and location of objects to be created within the virtual display, using the same coordinates.

World coordinates are device-independent Cartesian coordinates that are specified by the application program. They provide a means of locating the points in a virtual display. The range of world coordinate values is specified when the virtual display is created. In this way, the virtual display can be created to any proportions that are selected by the application program. World coordinate values are given as floating-point numbers.

The world coordinate system can represent any unit of measure. World coordinates enable application programs to use convenient increments of measurement when constructing a graphic object. If the program is accessing information from a database, it could specify world coordinates that are meaningful for the data used. For instance, if an application is drawing a chart showing the sales of a company's product during a holiday season, it could use convenient measurements representing units sold in thousands versus the time in weeks. Or, if the application program is drawing a graphic object, it could use measurements that make sense for the object. For example, a virtual display containing a map of the United States might logically have world coordinates representing measurements in miles or kilometers. A floor plan of a house might likely use world coordinates representing feet and inches, or meters and centimeters.

Figure 2-2 shows a world coordinate system that describes a virtual display in which an object has been constructed.
2.2.1.2 Normalized Coordinates

Normalized coordinates are device-independent coordinates that are defined by the graphics software. They are used to describe the virtual display in physical terms that any output device can use. An output device cannot use the arbitrary world coordinates that an application program uses to describe a virtual display. Instead, each kind of output device has its own device-specific coordinates that it uses to locate and build the graphic object. Normalized coordinates can be thought of as a way for the graphics software to normalize these different coordinate systems so that a graphic object can be mapped from a virtual display to any output device.
Normalized coordinates are not directly used or manipulated by application programs. They are used internally by the graphics software. The mapping of normalized coordinates into device-specific display coordinates is handled entirely by the software.

Normalized coordinates provide a means of delaying the actual mapping of an application program's world coordinates to device-specific coordinates until the actual output device is established.

### 2.2.2 Device-Dependent Coordinate Systems

Output devices use device-dependent coordinate systems to map graphic objects on the display screen or to print objects on a printer. Device-dependent coordinates are physical device coordinates that denote some physical unit of measure such as pixels, centimeters, or inches. Such physical device coordinates reflect device-dependent mapping and drawing characteristics of the output device.

#### 2.2.2.1 Absolute Device Coordinates

Absolute device coordinates are physical device-dependent Cartesian coordinates that specify positions on the MicroVMS workstation display screen. The position is specified in centimeters relative to the lower-left corner of the display screen. Typically, viewport placement, pointer position, and tablet placement use absolute coordinates. Figure 2-3 illustrates viewport placement on the VAXstation screen relative to the lower-left corner of the screen.
2.2.2.2 Viewport-Relative Device Coordinates

Many MicroVMS workstation graphics software routines utilize a special type of physical device coordinates called *viewport relative* device coordinates. Viewport relative device coordinates are physical device coordinates that specify positions within a display viewport. The position specified is relative to the lower-left corner of the viewport. Viewport-relative device coordinates are always positive.

Viewport-relative device coordinates are specified in units of *pixels*. A pixel is the smallest displayable unit on a display screen. The MicroVMS workstation graphics software takes care of all mapping of display windows to the display screen.
Viewport-relative device coordinates are used in mapping graphic objects from a display window to a display viewport on a physical display device.

In order to display a graphic object in a display viewport on a display device, the world coordinates of the object must be transformed to the viewport-relative device coordinates of the display device.

Figure 2-4 shows an object in a display window being mapped to a display viewport on a physical display device. In this illustration, the world coordinates of the display window undergo a viewing transformation to the physical device coordinates of the display device.

Figure 2-4  Mapping a Display Window to a Display Viewport

2.3 Virtual Displays

A virtual display is a conceptual display space created by an application program. It is used by an application program as the place where graphic objects are constructed. All text and graphics output of the application program are written to a virtual display.
A virtual display has no physical size (dimensions of length and width). Therefore, objects constructed in a virtual display also have no actual physical dimensions. You cannot measure a virtual display or the graphic objects within it.

Instead, a virtual display and the objects within it have relative sizes and proportions. The comparison of the relative proportions of the vertical and horizontal components of an object in a virtual display is called the aspect ratio of the object. The aspect ratio is used in referring to an object’s relative size in a virtual display.

To create a virtual display, an application program specifies a coordinate range in the world coordinate system. The coordinate range establishes the relative size, or aspect ratio, of the virtual display. Objects constructed in the virtual display are also specified in terms of world coordinates and also have an aspect ratio. The aspect ratio will later affect how the virtual display and the objects it contains map to the display window.

Refer back to Figure 2–2 which shows a graphic object drawn in a virtual display. Both the virtual display and the graphics object are specified in terms of world coordinates.

### 2.4 Display Windows

A display window is used to display all or a part of the contents of a virtual display. Display windows are created by an application program. A display window is used by the application program to control how much of a virtual display is potentially available for the user to view. A display window can be the size of an entire virtual display or just a small portion of it. There can be one or several display windows active at one time in a virtual display.

The relative proportions and location of a display window are specified by an application program in terms of world coordinates. Therefore, the amount of the virtual display that is encompassed by a display window is relative to the world coordinates of the virtual display. By specifying the proportions and location of the display window, an application program determines what portion of the graphic object within a virtual display is viewable.

The world coordinate boundaries of a display window define what is called a clipping rectangle. Any graphic object that lies within the clipping rectangle is potentially visible in the display viewport. Objects that fall outside of the clipping rectangle are not viewable and are clipped from the window as illustrated in Figure 2–5.
A display viewport is the area of the physical display screen to which a display window is mapped. The display viewport is the user’s means of viewing the contents of a display window. A display viewport is always associated with a display window and is the mechanism by which the display window is displayed on the screen.

They can vary in size and shape, and can be located anywhere on the physical display screen. There can be as many viewports as desired on the screen at a time. If viewports overlap each other, they will occlude in the areas that overlap. The last viewport created will be on top and visible. However, the operator can modify which viewport is on top at any one time.

The display window is mapped and scaled to the display viewport automatically by the graphics software. Normally, the display window is mapped to the display viewport on a one-to-one basis. That is, the boundaries of the display viewport always implicitly default to the same size and shape as that of the display window. However, it is possible for the application program to explicitly specify that the display window be of a size or shape that is different than that of the display viewport; or, that the display viewport be of a size or shape that is different from that of the display window. The effects that are achieved when the display window and display viewport are of a different size or shape are discussed in the following sections of this chapter.
Refer to Figure 2–6 for an illustration of the relationship between the virtual display, the display window and the display viewport. This illustration shows how a graphics object in a virtual display is clipped to the display window, scaled and mapped into a display viewport, and displayed on a physical display device such as a terminal screen.

**Figure 2–6 Displaying a Graphic Object**

2.6 Display Window and Viewport Scaling

Graphic objects on the display screen can be magnified or reduced in size by manipulating the relative sizes of the display window and the display viewport. The following list describes the various effects that can be achieved and the method used to accomplish each effect.

**Magnifying**

To magnify the graphic object, use one of these two methods:

- Decrease the size of the display window without altering the viewport size.
- Increase the size of the display viewport without altering the window size.
Reducing
To reduce the graphic object, use one of these two methods:
• Increase the size of the display window without altering the viewport size.
• Decrease the size of the display viewport without altering the window size.

Panning
To pan the graphic object, use this method:
• Move the display window within the virtual display without altering the display viewport.

Changing View Size
You can change the area of the virtual display that is being viewed, without performing scaling, in the following ways:
• To increase the area of the virtual display being viewed, expand both the display window and the display viewport proportionately.
• To decrease the area of the virtual display being viewed, contract both the display window and the display viewport proportionately.

2.6.1 Distortion of Graphic Objects
The aspect ratio of the virtual display, the display window, and the display viewport are the factors that determine whether a graphic object will be distorted when it is mapped to the display screen. The display viewport can have any proportions width to height that is specified (within the limits of the display device). If the proportions of the display viewport do not match the proportions of the display window, a stretching or squeezing effect occurs with the graphic object. The exact effect depends upon the proportional differences between the viewport and window. This happens because the graphics software is trying to make the display window fit the display viewport. The transformation of the graphic object affects different types of objects in different ways:
• Straight lines remain straight, but may differ in length and slope, depending upon the window size and the coordinate system.
• Curved lines can change somewhat in shape. The amount and nature of the change depends upon the characteristics of the graphic object and the mapping (transformation) from display window to viewport.
• Arcs change their shape and size. For instance, an ellipse may change its proportions.

• Graphics text (specifically character size and spacing) is not adjusted to fit the required number of characters into the display viewport. The size and spacing of text characters is fixed and will not distort. However, the starting position of the text may change, depending upon the transformation which occurs between window and viewport.

Distortion can be corrected in the following way:

The application program can create a display viewport whose proportions are appropriate for a particular graphics window in world coordinate space. Because the display window can have any proportions in world coordinate space, a display viewport of the proper proportions for a display window that is square, tall and narrow, short and wide, or any other proportions, can be created.

2.7 Display Lists

A display list is a device-independent encoding of the exact contents of a virtual display. The graphics software maintains and uses display lists to achieve the following goals:

• Allow the automatic management of panning, zooming, resizing, and duplication of display windows.

• Allow the structuring of virtual display objects.

• Allow objects in a virtual display to be viewed simultaneously within several display viewports.

• Allow the storage and reexecution of UIS pictures

• Allow editing of UIS pictures

2.8 Generic Encoding and UIS Metafiles

Whenever a graphic object is drawn in the virtual display or an attribute is modified, an encoded entry of the object or attribute modification is added to the display list.
Such entries allow any application to extract arbitrary output from a virtual display, give it to an intelligent application or store the data as a generically encoded file or buffer known as a metafile, and then later reexecute the generically encoded binary stream into a new virtual display.

Generic encoding is both device independent and self describing.

When UIS routines are executed, a binary encoded packet of values is constructed and stored as display list entries. When the binary encoded packet is extracted from the display list used, it becomes a generically encoded UIS metafile. Such metafiles can be reexecuted to invoke the appropriate internal generic encoding routines.

**Figure 2-7 Display List Extraction**

<table>
<thead>
<tr>
<th>UIS Routine Call</th>
<th>Binary Encoded Packet</th>
<th>Generic Encoding Primitive</th>
</tr>
</thead>
</table>

Although many UIS routines have corresponding generic encoding primitives there is not necessarily a one-to-one mapping between UIS routines and generic encoding routines or between the UIS routine arguments and generic encoding routine arguments.
3.1 Overview

This chapter discusses the basic building blocks that are used in constructing graphic objects in a virtual display. These basic components are:

- Text and graphics routines
- Attributes and attribute modification routines
- Attribute blocks
- Segments

These topics are discussed in greater detail in the following sections of this chapter.

3.2 Summary

_Text and graphics routines_ (sometimes called output routines) are the fundamental building blocks that an application program uses to create graphic objects. These routines are used to specify lines, circles, text, or other graphic objects. The particular details (or attributes) of the way a text or graphic object look when it is displayed is determined by the _attribute block_ associated with it.

An attribute block is a group, or set, of _attributes_. Attributes are values which specify various things about the appearance of a text or graphic object. Every text and graphics routine used in an application program is required to specify an attribute block that it will use.

_Attribute routines_ are used in an application program to specify or change the current value of an attribute associated with an attribute block. The changed attribute value affects subsequent text and graphics routines that use the changed attribute block. An attribute routine is required to specify which attribute block in the application program it is affecting.
Application programs are allowed to group associated attribute, graphics and text routines together. A group of attribute, graphics and text routines is called a **segment**. Segments provide the program with a convenient way of viewing several attribute, graphics and text routines as a single unit.

An application program can associate graphics and text routines or even entire segments with *application-specific* data. The application program is allowed to store data which is application-specific in the generic encoding stream. In this way, if a portion of a display screen is copied, stored and then later used (restored) the program will be able to associate internal information with the graphic object.

**3.3 Text and Graphics Routines**

Graphics and text routines map objects directly into the virtual display. They can be used to create new objects or modify an existing one. Application programs use text and graphics routines to draw lines, circles, text, and other graphic objects. They can be combined in various ways to form a desired graphic object.

Each text and graphics routine has two required arguments: one argument that specifies the virtual display in which to draw a graphic object, and another argument that specifies the attribute block to be used when drawing the graphic object.

The way that a text or graphics routine draws a graphic object is influenced by several factors. One of the major factors which determines the appearance of a graphic object is the attributes that are associated with it.

**3.4 Attributes**

Attributes specify the appearance characteristics of graphic objects created by text and graphics routines. They are the factors that influence the way a graphic object appears on a display device. Color intensity, style, mode, width, and so on, are all characteristics that attributes can determine. Once specified, attribute values stay the same until explicitly changed. For example, if the line width is decreased, all lines drawn are drawn to that thickness unless the line width is changed. If the application program increases the line width, all lines are drawn to the same increased thickness until the line width is changed again.

Each type of graphic and text object has a set of unique attributes. For example, attributes that affect graphics do not affect text; the opposite is also true. There are, however, general attributes that affect all routines. For example the background has an attribute that can be set to determine the way the background will appear. The background can be thought of as all parts of a display that are not covered by an object created by a text or graphics routine.
Attributes can be divided into the following general categories:

- General attributes
- Text attributes
- Graphics attributes
- Window attribute

These categories are discussed in the following sections of this chapter.

### 3.4.1 General Attributes

General attributes apply to all types of text and graphics routines. General attributes include the following kinds of attributes:

- Writing color
- Background color
- Writing mode

**Writing Color**

The writing color attribute assigns the writing color. This attribute is used by all text and graphics routines (such as lines, text, etc.). It is expressed by specifying an index into a color map.

**Background Color**

This attribute assigns the background color. It is expressed by specifying an index into a color map.

**Writing Mode**

This attribute assigns the mode of writing text or graphics. In particular, the writing mode determines the exact way that a text or graphics routine will use the writing and background colors to display a graphic object.

### 3.4.2 Text Attributes

**Font set**

The font set attribute specifies the font set that is used to define text characters. Fonts express the size and shape of the characters in physical dimensions. This attribute enables text to be displayed in the right size by display routines during text plotting. You can choose from a variety of multinational character set fonts and technical character set fonts.
Character spacing

The character spacing attribute defines character spacing for width and height of character sizes. It is defined as the additional unit of increment beyond the normal character size for highly spaced characters. This attribute is specified as a floating-point number. It is multiplied by the normal character size to produce the actual spacing distance. If zeros are specified, then no additional spacing is performed. Negative values are also allowed. When used, the spacing is reduced instead of increased. Negative values for this attribute can cause the characters to overlap in some cases.

Text Path

The text path is the direction of text drawing. The text path specification consists of two parts—the major path and the minor path. The major path refers to the direction in which character are drawn on a line. The minor path refers to the direction used for beginning a new line of text. The following table lists the major path and minor path available.

- Left to right (default major text path)
- Right to left
- Bottom to top
- Top to bottom (default minor text path)

Text Slope

Text slope represents the angle between the actual path of text drawing and the major text path. The actual path of text drawing connects the baseline points of each character cell.

Text Margins

The text margins attribute specifies a starting margin and the x coordinate distance to the ending margin.

Text Formatting

The text formatting attribute along with the text margins attribute positions text flush against either or both margins, centered, or with no formatting at all. UIS supports four types of text formatting modes as follows:

- Left justification
- Right justification
- Center justification
- Full justification
Character Rotation

Individual characters are rotated counterclockwise from 0 to 360 degrees. The angle of rotation is the angle between the baseline vector of the character cell and the actual path of the text drawing.

Character Slant

The character slant attribute specifies the angle between the character cell's up vector and baseline vector. The angle of character slant can be expressed as a negative or positive value.

Character Size

Character scaling allows you to increase the height and width of characters drawn in the virtual display.

3.4.3 Graphics Attributes

Graphics attributes, or line attributes, affect graphic objects such as lines, polylines, polygons, rectangles, arcs, and curves. They determine the line style and width, and control filling of objects, among other things.

Current Line Drawing Width

The current line drawing width sets the line width in terms of world or device coordinate units. Line width is specified as a floating-point number that is either interpreted as a world coordinate width or multiplied with the standard line width for a device to produce the desired line width.

Line Style

The line style attribute sets the current line style of line routines. It is a bit vector that is used to indicate the color of each pixel to be drawn. The color can be designated to be either the same as the foreground or the background. The bit vector is repeated as many times as necessary to draw all the pixels in the line.

Fill Pattern

The fill pattern attribute specifies the fill character to be used for filling closed figures such as polygons, circles, and ellipses. The fill pattern is specified as a font file and the index of a character in that font file. The pattern defined by the character is used to fill the figure. Refer to Appendix D of this manual for further information about fill patterns.
3-6 Graphic Objects and Attributes

**Arc Type**

The arc type attribute specifies the way an open arc of a circle or ellipse should be closed. This attribute can have the following values:

- **Open**—when specified as open, the arc is not closed off.
- **Pie**—when specified as pie, two radii are drawn from the endpoints of the arc to the centerpoint (forming a pie shape).
- **Chord**—when specified as chord, a line is drawn between the two endpoints of the arc connecting them together.

**3.4.4 Window Attribute**

**Clipping Rectangle**

The clipping rectangle is the area of a virtual display that is made available for the user to view. The clipping rectangle is specified as the corners of a world coordinate rectangle that all drawing operations are clipped to. Objects, or parts of objects, outside of the clipping rectangle cannot be viewed.

**3.5 Attribute Blocks**

An attribute block is a set of attribute values that describes the appearance of any graphic object that is created by an application program. Each attribute block contains attributes for graphics, text, and general display characteristics such as writing mode and background and foreground indices.

There can be up to 256 different attribute blocks addressable at any one time. They are addressed by numbers ranging from 0 to 255. Application programs assign and use attribute block numbers.

**3.5.1 Attribute Block 0**

Attribute block 0 is a special attribute block that is specified by the graphics software. This attribute block contains a standard set of text and graphics attributes. The attributes in this block cannot be modified by the application program. Attribute block 0 is read only. There is no convention on the naming and usage of attribute blocks, with the exception of attribute block 0. This attribute block is reserved by the graphics software as a default attribute block.

Attribute block 0 provides default attribute values that can be used by an application program. It also serves as an attribute block template for an application programmer to use when creating alternate attribute blocks.
3.6 Segments

A segment is a designated group of attribute block, graphics and text objects. Segments allow the application program to use a special attribute without the need for knowing which particular attribute blocks are not being used by other parts of the program. Another major use of segmentation is to implement transformations either on a per-segment basis or on the entire segment tree. This provides convenience for the programmer and increased modularity for the program.

Nested Segments

Segments can be nested. Each nested segment uses the current set of attribute blocks of higher level segments. This makes it simpler to create segments without having to redefine attribute blocks. However, modifications of attribute blocks in a segment do not affect the attribute blocks of higher level segments.

Extracting and Reexecuting Segments

An application program can take the contents of a file containing a display list of a virtual display and execute it into another virtual display as a segment. The attributes of the original virtual display should not affect the virtual display segment which is being inserted.

3.7 Viewing Transformations

The viewing transformation is the mapping of the display window to the display viewport. The viewing transformation can affect the appearance of a graphic object when it is viewed on a display screen. The shapes of the display window and the display viewport will affect the way text and graphic objects look when they are displayed.

3.8 Two-Dimensional Geometric Transformations

Geometric transformations can also alter the way graphic objects are displayed through scaling, translation, and rotation. All of these methods involve manipulation of the object’s angular orientation or shape in the virtual display.
Scaling

The term *scaling* applies to the proportional expansion or reduction of graphic objects on the display screen. For example, if the display window and viewport shapes are different in proportion, the graphics software has to squeeze or stretch the window to fit the viewport. The distortion of the graphics window causes distortion of the graphic objects in that window. Different graphic objects are affected in different ways. Refer to Chapter 2 for further information about the distortion of graphic objects.

Translation

The points that define the position of graphic object in a coordinate system are *translated* when its coordinates are altered without changing its angular relationship with other object or the implied angular relationship between the object and the coordinate system. For example, two lines are moved in the coordinate system, and yet remain parallel.

Rotation

When a graphic object turns on a pivotal point or axis, it is rotating. It can rotate with respect to some point on its surface, or it can *revolve* around some external point. In order to give the appearance of rotation on the display screen, you must first translate the axis of the object to the origin or center of the coordinate system.
Chapter 4

Color Concepts

4.1 Overview

Depending on the type of VAXstation available to you, you can display graphic objects in black-and-white, grey scale, or color. The VAXstation offers you a number of color options. However, there are several concepts you should be aware of at the outset. This chapter discusses these concepts and the features of the color subsystem in the following topics:

- Color hardware systems
- VIS virtual color maps
- Miscellaneous color concepts

See Chapter 16 for more information about programming in color.

4.2 Color Hardware Systems

There are three types of VAXstation hardware systems: (1) monochrome displays black and white only, (2) intensity displays shades of gray or achromatic color, and (3) color displays shades, tints, hues or chromatic colors. VIS supports all three color systems.

4.3 Raster Graphics Concepts

The VAXstation display screen consists of a set of picture elements called pixels. Pixels are the smallest displayable unit of a graphic object. The rectangular set of pixels on the VAXstation screen is a raster. Graphic objects are written by illuminating the necessary pixels along the path of points that geometrically describe the object. Each pixel has an address and a binary value associated with it. Pixel values determine the color of graphic objects.
4.3.1 Hardware Interpretation of Pixel Values

The number of possible pixel values depends on the number of bit planes or *planes* of memory that the system hardware supports. You can think of a plane as an allocation of memory where each bit on a plane maps to a pixel on the display screen. Conversely, each pixel has an address in memory. The following table shows the relationship between the number of planes supported in hardware and the number of the possible pixel values.

<table>
<thead>
<tr>
<th>Workstation</th>
<th>Number of Planes</th>
<th>Number of Possible Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monochrome</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Intensity or color</td>
<td>4 or 8</td>
<td>16 or 256</td>
</tr>
</tbody>
</table>

Figure 4–1 show how pixel values are represented in single- and multiplane systems.

**Figure 4–1  Bitplane Configuration in Single- and Multiplane Systems**

In Figure 4–1, a pixel on the VAXstation screen is associated with four corresponding bits in memory on each bit plane of a four-plane system. If the bit settings are arranged as a binary value corresponding to the high- and low-order planes, they would appear in the following order: $1011_2$. 
Therefore, the pixel value would be $11_{10}$. A pixel in a four-plane system can have a maximum of 16 values. The pixel value can be used in two different ways, as a direct color value or as a mapped color value.

**Direct Color Value**

If the pixel value were used as a direct color value, each of the possible pixel values would directly specify a color. In other words, the pixel value would be sent directly to system hardware, such as a digital-to-analog converter, and would be used as the actual color value of the graphic object. For example, the VAXstation monochrome system, which is a one-plane system, interprets pixel values as direct color values where 0 is black and 1 is white.

**Figure 4–2 Direct Color Values**

![Diagram showing direct color values](image)

Each bit maps to a specific pixel on the display screen.

**Mapped Color Value**

When pixel values are interpreted as mapped color values, they indirectly specify an actual color value located in a hardware color look-up table or hardware color map. The pixel value is an index to an entry in the color map.
The size of the hardware color map is identical to the number of possible pixel values and is the maximum number of colors that can be displayed simultaneously. Table 4-1 lists the size of the hardware color map in intensity and color systems.

**Table 4-1 Hardware Color Map Characteristics**

<table>
<thead>
<tr>
<th>System</th>
<th>Number of Planes</th>
<th>Number of Entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intensity</td>
<td>Four</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Eight</td>
<td>256</td>
</tr>
<tr>
<td>Color</td>
<td>Four</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Eight</td>
<td>256</td>
</tr>
</tbody>
</table>

Each hardware color map entry contains a color value to be displayed for each pixel. Conversely, the value of each pixel is the hardware color map index of a color map entry containing the actual color value. The pixel on the VAXstation screen is illuminated using this color value.
Figure 4-4  Mapped Color Values in Four-Plane System

Each bit maps to the same pixel on the display screen.

Hardware Color Map

<table>
<thead>
<tr>
<th></th>
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<tbody>
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<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

Corresponding pixel on the display screen is illuminated using the color value located in the eleventh hardware color map entry.
For example, an eight-plane VAXstation intensity or color system has a hardware color map with 256 entries. Each color map entry contains color values that are RGB color components and that define the desired color.

### 4.3.2 Color Representation Models

Color values are expressed according to the requirements of the particular color representation model used. Three well known color representation models are hue lightness saturation (HLS), hue saturation value (HSV), and red green blue (RGB). The UIS base color model is the RGB model. RGB color values are in the range 0.0 to 1.0, inclusive. Red, green, and blue color component values comprise a single color value on a VAXstation color system.

Intensity values, the color values associated with shades of gray are specified as a single value in the range 0.0 to 1.0, inclusive. Figure 4-5 shows RGB and intensity color values as hardware color map entries.

![Figure 4-5 RGB and Intensity Color Values as Hardware Color Map Entries](ZK-5239-86)

### 4.3.3 Color Palette

Your color palette is the number of possible colors that you can specify. Table 4-2 show the color palette available on each color system.

#### Color Palette Size and Direct Color Systems

On direct color systems, the palette size is identical to the number of simultaneously displayable colors. For example, the size of the color palette of a VAXstation monochrome system is 2. Only two possible colors, black and white, can be displayed simultaneously on the screen.
Color Concepts 4-7

Color Palette Size and Mapped Color Systems

On mapped color systems, the palette size is, typically, much greater than the number of the simultaneously displayable colors. The palette size is determined by the precision of color components' specification. For example, on VAXstation color system, each color component can be specified with eight binary bits of precision for each red, green, and blue color components or $2^{24}$ or 16,177,216 possible colors.

<table>
<thead>
<tr>
<th>System</th>
<th>Possible Colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monochrome</td>
<td>black and white</td>
</tr>
<tr>
<td>Intensity</td>
<td>up to $2^{24}$ shades of gray</td>
</tr>
<tr>
<td>Color</td>
<td>up to $2^{24}$ chromatic colors</td>
</tr>
</tbody>
</table>

4.4 UIS Virtual Color Maps

An application that uses hardware color resources, that is, the hardware color map must be aware of the hardware system limitations. The application must know the color characteristics of the hardware as well. Is the system direct color or mapped color? What is the precision of the color representation values for each RGB color component? What is the range of possible pixel values?

The hardware color map contains a finite number of entries—for example, 16 entries in a four-plane system. Concurrent processes executing in the same display space must somehow share system color resources.

Why Use Virtual Color Maps?

The virtualization of the hardware color map solves problems arising from individual applications requiring large amounts of system resources. It also solves the problem of many processes competing for finite color resources. The use of virtual color maps is analogous to the use of virtual memory in a multiprogramming environment where many processes must access physical memory. When concurrent processes require collectively more color map entries than exist in the hardware color map, the color values associated with each competing process are swapped in and out of the hardware color map as virtual color maps. Swapping virtual color maps in and out of the hardware color map is a means of arbitrating hardware color map use across applications. The process of loading or writing values of the virtual color map into the hardware lookup table is transparent to the user. Figure 4-6 illustrates the swapping of two 16-entry virtual color maps into a 16-entry hardware color map.
Figure 4-6  Swapping Virtual Color Maps
Applications see only a virtual color map, not the underlying hardware resources. Each virtual display has a virtual color map associated with it.

**Characteristics of Virtual Color Maps**

A virtual color map is flexible enough to meet the needs of a wide range of applications. Virtual color map size can range from 2 to 32,768 entries. If you do not specify a virtual color map, a two-entry virtual color map is created by default. The virtual color map size does not have to match that of the hardware color map. Although virtual color maps are potentially shareable among applications, they are private by default. Virtual color maps can be specified as *resident*, that is, nonswappable in the hardware color map. The following table shows how virtual color map entries are initialized.

<table>
<thead>
<tr>
<th>Virtual Color Map Entry</th>
<th>Color Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Default window background color</td>
</tr>
<tr>
<td>1</td>
<td>Default window foreground color</td>
</tr>
</tbody>
</table>

All other entries are undefined.

UIS transparently reconciles differences between the virtual color map model and the hardware color resources. UIS manages the concurrent use of these resources across applications.

For information about creating and using virtual color maps, see Chapter 16.

**4.4.1 Reserved Hardware Color Map Entries**

On mapped color systems, due to hardware limitations, the hardware color system or the UIS window management software preallocates some of the hardware color map entries for special purposes. For example, pointer colors, window background and foreground colors, and display screen color are allocated reserved entries in the hardware color map. Figure 4-7 describes reserved entries in a hardware color map in a four-plane system.
Whenever a virtual color map exceeds the size of the hardware color map less the reserved entries, the results are unpredictable. For more information about obtaining the hardware color map characteristics using the programming interface, see Chapter 16.
4.5 UIS Color Map Segments

The use of color map segments represents a device-specific binding of a virtual color map to the underlying hardware color resources, that is, the hardware color map. In a color mapped color system, color map segments are bound to specific hardware color map entries and swapped in and out of the hardware color map based on system and user events. Usually, applications need not worry about color map segments. UIS handles the device-specific binding automatically. Applications may want to use color map segments for the following reasons:

- Applications can control explicitly the binding of the virtual color map and the hardware color map.
- Applications are not transported to different hardware configurations, for example, four-plane to eight-plane systems or VAXstation color and intensity systems to VAXstation monochrome systems.

4.6 Shareable Virtual Color Maps

By default, virtual color maps are private. Yet, they may be shared among cooperating application programs to define a uniform color regime and to conserve hardware color map entries. Shared virtual color maps have names, an ASCII string from 1 to 15 characters and a name space (UIC group or system). For example, UIS uses a system-wide, shared color map to display terminal emulator windows and the window and screen menus.

4.7 Miscellaneous UIS Color Concepts

The following sections contain additional information about the UIS color subsystem.

4.7.1 Standard and Preferred Colors

VAXstation color and intensity systems support two sets of symbolically defined colors. Workstation standard colors and intensity values are a set of colors used for specific purposes within the workstation environment. For example, the default window background and foreground, cursor background and foreground colors, and the display screen color are the workstation standard colors.

Workstation preferred colors are a set of colors representing the user's preference for the eight combinations of the RGB primary colors. For example, workstation preferred colors are used to define a particular shade of red, rather than a full intensity red. In an intensity system, preferred colors may be used to define a base white level from which preferred shades of gray are derived. Preferred values are
simply a mechanism for conveniently maintaining and communicating a user's color preferences to an application.

Values for standard and preferred colors are set using the workstation setup mechanism. Standard and preferred color and intensity values can be returned using UIS$GET_WS_COLOR and UIS$GET_WS_INTENSITY.

### 4.7.2 Monochrome, Intensity, and Color Compatibility Features

Two types of calls are provided to change or retrieve color map entries. UIS$SET_COLOR and UIS$SET_INTENSITY both load a single color value in a color map entry. Both routines can be used in any of the three hardware color environments—monochrome, intensity, or color.

<table>
<thead>
<tr>
<th>Color System</th>
<th>Compatibility Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monochrome</td>
<td>UIS chooses the color (black or white) closest to the color specified by the application.</td>
</tr>
</tbody>
</table>
| Intensity\(^1\) | UIS$SET_COLOR converts the specified RGB values to an equivalent gray level using an equation.  
 | | UIS$SET_INTENSITY sets the requested gray level directly. |
| Color\(^2\)   | UIS$SET_COLOR sets the requested RGB color values directly.  
 | | UIS$SET_INTENSITY converts the specified intensity value to an equivalent RGB value using an equation. |

\(^1\)The color-to-intensity equation is \( I = 0.30R + 0.59G + 0.11B \). Color television broadcasts transmitted for reception by noncolor television sets are processed in this manner.

\(^2\)The intensity-to-color equation is \( R = I, G = I, B = I \).

### 4.7.3 Color Value Conversion

Routines are provided to convert color values in applications using other color representation models.

- Hue lightness saturation (HLS)
- Hue saturation value (HSV)

In both models, hue values are specified from 0.0 to 360.0, inclusive, where red = 0.0. Values for lightness, saturation, and value are between 0.0 and 1.0, inclusive.
4.7.4 Set Colors and Realized Colors

UIS routines that set or load color map entries in the virtual color map accept F-floating point values between 0.0 and 1.0, inclusive. The precision of the F-floating point data type is approximately seven decimal places.

The precision for the color representation for a particular device may not be enough to represent accurately the requested F-floating point value.

In this case, the set color value (F-floating) differs from the realized color value (device precision). An application can determine realized color values using UIS$GET_COLOR(S) and including the optional parameter. See Chapter 16 for details.

4.7.5 Color Regeneration Characteristics

Color regeneration is a hardware characteristic that specifies whether changing a color map entry affects the color of existing graphic objects (retroactive regeneration) or only graphic objects drawn after the color map is changed (sequential regeneration).

The following table summarizes regeneration characteristics of direct and mapped color systems.

<table>
<thead>
<tr>
<th>System</th>
<th>Regeneration Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct color</td>
<td>Usually sequential</td>
</tr>
<tr>
<td>Mapped color</td>
<td>Usually retroactive</td>
</tr>
</tbody>
</table>

An application can determine the hardware color regeneration characteristics by calling UIS$GET_HW_INFO.
Chapter 5
Input Devices

5.1 Overview
This chapter discusses the devices that enable user and application program interaction. Some of the topics covered in this chapter are:

• Pointing devices
• Virtual keyboards
• Physical keyboards

5.1.1 VAXstation Input Devices
Application programs and users interact through input devices. The types of input devices that a VAXstation typically utilizes are:

• Keyboard
• Mouse
• Tablet

The keyboard allows you to initiate program interaction and respond to application program prompts by pressing a key or entering data. The mouse and tablet let you communicate with an application program by pointing to objects or items with a pointer and by making selections with buttons.
5.2 Pointers

There are two types of pointing devices that can be used with the workstation, a mouse and a tablet. The workstation supports the use of only one pointing device at a time.

Application programs receive input from a pointing device by either polling or soliciting interrupts. To do this, programs use pointer input routines. Because only one pointer input device can be used at a time, applications use the same set of pointer input routines to get input from either the mouse or the tablet. The actual pointer input device being used is transparent to an application.

The programming interface lets you set the pattern or the position of the cursor that is synchronized with the pointing device.

5.2.1 Mouse

The mouse is a small hand-held device with three buttons on the top and a roller-ball on the bottom. Associated with the mouse, on the display screen, is an arrow-shaped cursor (or pointer).

The user is able to manipulate items on the display screen by the combined use of the mouse-controlled pointer and the mouse buttons. By moving the mouse in any direction on a flat surface, the ball on the bottom is turned, causing the pointer on the screen to move. In this way, the pointer can be moved in any direction and placed at any desired position on the display screen. By pressing the buttons on the mouse, the user can select items in a menu and perform a variety of other functions.

The mouse is a relative pointing device. The mouse reports only its relative movement to the workstation. The mouse can be picked up and placed in different position without any change in the position of the pointer on the screen. Consequently, the workstation keeps track of the current mouse position, only when the mouse is moved on a surface.

Some of the ways that application programs can use the pointer are as follows:

- To create menus from which the user selects items
- To read the position of the pointer and the state of the mouse buttons

The workstation human interface implements menus that allow users to create, select, move, and delete objects on the display screen. Application programs can create menus that do the same things. To select a menu item, the user moves the pointer to the region of the desired item and presses one of the mouse buttons. The application program predefines items and specifies the action to be taken when the user selects an item.
Application programs can detect when the pointer is moved across the boundary of a window or a mouse button is pressed within a window. Programs can also read the current pointer location and current button state. When the pointer is moved to the border, or outside, of a screen viewport, the human interface detects interrupts from the mouse. If the pointer is positioned inside of a viewport that is mapped to an application-created window, the application program can receive these interrupts.

5.2.2 Tablet

The tablet is an optional input device that can be used with the workstation. Tablets operate in much the same way as a mouse. An application program uses the same routines to receive information from a tablet as it does for the mouse. This is possible because the actual physical input device being used is transparent to an application program.

The tablet is an absolute pointing device. That is, it reports all movement to the workstation. For example, if the pen or stylus is picked up and moved to another position on the tablet, the pointer will change its position on the display screen to match the movement.

A tablet is composed of the following parts:

- Tablet
- Puck
- Stylus

**Tablet**

The tablet is a flat square device with a surface similar to a table top. It is used in conjunction with a puck and/or stylus to locate points on the display screen. When the puck and/or stylus are moved on the surface of the tablet, the pointer on the display screen moves in an identical fashion. If you pick up the puck and place it in different region of the tablet, the pointer on the display screen would reflect this change. The tablet has a grid that senses a change in the position of the pen or stylus.

**Puck**

The puck is a hand-held device which is moved on the tablet to locate points on the display screen. The puck has cross-hair markings used for precision in positioning it on the tablet. It also has four buttons which can be used for various purposes, depending upon the application.
5-4 Input Devices

Stylus

The stylus is a hand held device which resembles a pen. It is moved on the tablet to locate points on the display screen. The stylus has greater precision than the puck in locating positions. The stylus can also have buttons, usually one is located on the outside of the barrel and one on the tip. The functions of these buttons are application specific.

5.3 Keyboards

It is important to be able to distinguish between a physical keyboard (the workstation keyboard) and a virtual keyboard (a simulated keyboard).

The physical keyboard is the actual workstation keyboard. You can press its keys to respond to prompts from the application program, or you can type and enter data into the currently active display window. The workstation can have only one physical keyboard attached to it at any one time.

A virtual keyboard is a conceptual keyboard that does not have an actual physical existence. Rather, a virtual keyboard is a simulated keyboard that exists in software and is associated with a display window. Each application may have one or more virtual keyboards attached to it. Virtual keyboards provide the means for applications to share the single physical keyboard.

5.3.1 Virtual Keyboards

A virtual keyboard is not an actual physical keyboard; but instead can be considered a simulated keyboard. Virtual keyboards are conceptual in nature and exist only in software. Virtual keyboards have much the same relationship to the physical keyboard as virtual displays have to the physical display screen.

Application programs can read from the physical (workstation) keyboard, assign the physical keyboard to a display window, and modify the characteristics of a physical keyboard associated with a window. Programs are able to do this by means of virtual keyboard routines. These routines can establish one or more virtual keyboards. They enable applications to manipulate the workstation keyboard by referring to the established virtual keyboards.

You can think of virtual keyboards in the following way. The VAXstation supports multiple windows with multiple processes running simultaneously. Normally, these windows and processes require keyboard input at various times. Therefore, each window may need to have a keyboard associated with it. Consequently, there is a need for several keyboards (one for each window). Because there is only one physical keyboard available, it must be shared among several windows. The way that this is done is through the concept of virtual keyboards.
Virtual keyboards provide a way for each window to have its own keyboard. There can be one, or several, display windows and virtual keyboards active on the display screen at one time. However, the physical keyboard can be connected to only one virtual keyboard at a time. A virtual keyboard can be attached to more than one display window at a time; however, each display window may have only one virtual keyboard attached to it.

The user has control over the association between the physical keyboard and the various virtual keyboards that exist at any point in time. A user can connect the workstation keyboard to different windows by manipulating the display viewports to which the virtual keyboards are connected. The user determines which window the workstation keyboard is attached to, and in that way, which process is receiving keyboard input. In this way, the user determines which window on the screen is currently active.

When the user switches the keyboard between windows, the workstation gives notification of which window has the keyboard. It places a small KB icon in the upper right corner of all windows that are able to use the keyboard. The KB icon is highlighted in the window that is currently active. An application can restrict windows from receiving keyboard input. Display windows that do not interact with the keyboard will not have the KB icon.
PART II  How to Program with MicroVMS Workstation Graphics
Chapter 6

Programming Considerations

6.1 Overview

The User Interface Services (UIS) graphics software package allows you to create application programs that call system routines. Using UIS system routines, you can create virtual displays, display windows, viewports, graphic images, and text. These callable routines can be accessed through high-level programming languages as well as VAX MACRO and VAX BLISS. The programming examples used in succeeding chapters to illustrate the capabilities of the UIS graphics software are written in VAX FORTRAN. This chapter discusses the following topics:

- Calling UIS routines
- Argument characteristics
- Constants
- Condition values
- Additional program components
- Program execution

Refer to the MicroVMS Programming Support Manual for additional information about other callable routines.

6.2 Calling UIS Routines

Your application programs must contain references or calls to specific UIS system routines to draw and manipulate graphic images and text. These CALL statements and language-specific function declarations invoke the UIS system routines through the VAX Procedure Calling Standard.
6.2.1 Calling Sequences

The format of a call to UIS, or the calling sequence, consists of the elements that make up the statement and their positional order. Refer to Tables A-1 and B-1 in the appendices for summaries of UIS and UISDC calling sequences, respectively.

6.2.1.1 Call Type

Calls to UIS system routines from application programs, typically specify the function name and an argument list as follows:

```
vd_id=UIS$CREATE_DISPLAY(-1.0,-1.0,+1.0,+1.0,width,height)
```

However, some UIS routines are functions and return values to the calling program. The preceding example shows such a call from a VAX FORTRAN program. It also returns a value, the virtual display identifier, to the `vd_id` argument. Such return values are stored in variables that are often arguments (where applicable) in subsequent routine calls.

UIS routines that are not functions must be called using an explicit VAX FORTRAN CALL statement.

```
CALL UIS$PLOT(vd_id,1,-1.0,-1.0)
```

There is no standard call type used by all programming languages to invoke the UIS system routines. This manual does not attempt to describe the ways in which each high-level programming language calls a UIS system routine but uses VAX FORTRAN as an example of a typical call syntax. For specific information about calling syntax, please refer to the appropriate language user’s guide.

6.2.1.2 Routine Name

You must identify the system routine you are calling by specifying its routine name, for example, UIS$MOVE_AREA. The routine name consists of a symbol prefix identifying the system facility (UIS$) and the symbol name indicating what operation it performs (MOVE_AREA). The routine name is also known as the entry point name.

6.2.1.3 Argument List

The argument list is the list of parameters to be passed to the UIS routine. This list, typically, follows the function name as a parenthetical expression containing arguments separated by commas. You can substitute your own argument names in place of the formal parameter names. However, whenever you invoke a UIS routine, you must maintain the positional order of the parameters in the argument list. The following example illustrates positional order of the parameters:

```
CALL UIS$CIRCLE(vd_id,ATB,CENTER_X,CENTER_Y,XRADIUS,START_DEG,END_DEG)
```
6.3 Argument Characteristics

Because the arguments in your routine call are the means of passing data to the called routine, you should keep in mind the characteristics of arguments—VMS Usage, type, access, mechanism.

6.3.1 VMS Usage

The VMS Usage entry contains the name of a VMS data type that has special meaning in the VMS operating system environment.

The VMS Usage entry is NOT a traditional data type such as the VAX standard data types byte, word, longword and so on. It is significant only within the context of the VMS operating system environment and is intended solely to expedite data declarations within application programs.

Refer to Appendix A in the MicroVMS Workstation Version 3.0 Release Notes for a complete listing of VMS usage entries and implementation charts for each VAX language supported by UIS. The implementation charts describe how to code the VMS usage entry in the programming language of your application.

6.3.2 Type

The type characteristic refers to the standard data type of the argument, that is, whether the argument is a word, longword, floating point number, and so forth. Depending on the programming language you are using, you may be required to declare certain data types locally within your program. These locally declared data structures provide data type definitions for the arguments in subsequent calls to UIS routines.

6.3.2.1 VAX Standard Data Types

When a calling program passes an argument to a system routine, the routine expects the argument to be of a particular data type. The routine descriptions in Part III indicate the expected data types for each argument.

Properly speaking, an argument does not have a data type; rather, the data specified by an argument has a data type. The argument is merely the vehicle for the passing of data to the called routine.

Nevertheless, the phrase "argument data type" is frequently used to describe the data type of the data that is specified by the argument. This terminology is used because it is simpler and more straightforward than the strictly accurate phrase "data type of the data specified by the argument."
The following table contains the data types allowed by the VAX Procedure Calling Standard.

### Table 6-1  VAX Standard Data Types

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Symbolic Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute date and time</td>
<td>DSC$K_DTYPE_ADT</td>
</tr>
<tr>
<td>Byte integer (signed)</td>
<td>DSC$K_DTYPE_B</td>
</tr>
<tr>
<td>Bound label value</td>
<td>DSC$K_DTYPE_BLV</td>
</tr>
<tr>
<td>Bound procedure value</td>
<td>DSC$K_DTYPE_BPV</td>
</tr>
<tr>
<td>Byte (unsigned)</td>
<td>DSC$K_DTYPE_BU</td>
</tr>
<tr>
<td>COBOL intermediate temporary</td>
<td>DSC$K_DTYPE_CIT</td>
</tr>
<tr>
<td>D_floating</td>
<td>DSC$K_DTYPE_D</td>
</tr>
<tr>
<td>D_floating complex</td>
<td>DSC$K_DTYPE_DC</td>
</tr>
<tr>
<td>Descriptor</td>
<td>DSC$K_DTYPE_DSC</td>
</tr>
<tr>
<td>F_floating</td>
<td>DSC$K_DTYPE_F</td>
</tr>
<tr>
<td>F_floating complex</td>
<td>DSC$K_DTYPE_FC</td>
</tr>
<tr>
<td>G_floating</td>
<td>DSC$K_DTYPE_G</td>
</tr>
<tr>
<td>G_floating complex</td>
<td>DSC$K_DTYPE_GC</td>
</tr>
<tr>
<td>H_floating</td>
<td>DSC$K_DTYPE_H</td>
</tr>
<tr>
<td>H_floating complex</td>
<td>DSC$K_DTYPE_HC</td>
</tr>
<tr>
<td>Longword integer (signed)</td>
<td>DSC$K_DTYPE_L</td>
</tr>
<tr>
<td>Longword (unsigned)</td>
<td>DSC$K_DTYPE_LU</td>
</tr>
<tr>
<td>Numeric string, left separate sign</td>
<td>DSC$K_DTYPE_NL</td>
</tr>
<tr>
<td>Numeric string, left overpunched sign</td>
<td>DSC$K_DTYPE_NLO</td>
</tr>
<tr>
<td>Numeric string, right separate sign</td>
<td>DSC$K_DTYPE_NR</td>
</tr>
<tr>
<td>Numeric string, right overpunched sign</td>
<td>DSC$K_DTYPE_NRO</td>
</tr>
<tr>
<td>Numeric string, unsigned</td>
<td>DSC$K_DTYPE_NU</td>
</tr>
<tr>
<td>Numeric string, zoned sign</td>
<td>DSC$K_DTYPE_NZ</td>
</tr>
<tr>
<td>Octaword integer (signed)</td>
<td>DSC$K_DTYPE_O</td>
</tr>
<tr>
<td>Octaword (unsigned)</td>
<td>DSC$K_DTYPE_OU</td>
</tr>
<tr>
<td>Packed decimal string</td>
<td>DSC$K_DTYPE_P</td>
</tr>
<tr>
<td>Quadword integer (signed)</td>
<td>DSC$K_DTYPE_Q</td>
</tr>
<tr>
<td>Quadword (unsigned)</td>
<td>DSC$K_DTYPE_QU</td>
</tr>
<tr>
<td>Character string</td>
<td>DSC$K_DTYPE_T</td>
</tr>
<tr>
<td>Aligned bit string</td>
<td>DSC$K_DTYPE_V</td>
</tr>
<tr>
<td>Varying character string</td>
<td>DSC$K_DTYPE_VT</td>
</tr>
</tbody>
</table>
### Table 6-1 (Cont.) VAX Standard Data Types

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Symbolic Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaligned bit string</td>
<td>DSC$K_DTYPE_VU</td>
</tr>
<tr>
<td>Word integer (signed)</td>
<td>DSC$K_DTYPE_W</td>
</tr>
<tr>
<td>Word (unsigned)</td>
<td>DSC$K_DTYPE_WU</td>
</tr>
<tr>
<td>Unspecified</td>
<td>DSC$K_DTYPE_Z</td>
</tr>
<tr>
<td>Procedure entry mask</td>
<td>DSC$K_DTYPE_ZEM</td>
</tr>
<tr>
<td>Sequence of instruction</td>
<td>DSC$K_DTYPE_ZI</td>
</tr>
</tbody>
</table>

Refer to the *MicroVMS Programming Support Manual* for more information about VAX standard data types.

**6.3.3 Access**

The *access* characteristic describes how a calling routine will use the data specified by the argument. Following is a list of the most common types of argument access:

- **Read only access**—the UIS routine uses the data specified by the argument as input only.
- **Write only access**—the UIS routine uses the argument as a location to return data only.
- **Modify access**—the UIS routine uses the data specified by the argument as input for its operation and then writes data to that argument.

**6.3.4 Mechanism**

VAX language extensions provide the means of reconciling the different argument passing mechanisms within a programming language. The VAX Procedure Calling Standard provides three ways by which all application programs may pass arguments to a system routine:

- **By value**—the argument contains the actual data to be used by the routine, the actual data is said to be passed to the routine by value.
- **By reference**—the argument contains the address of the location in memory of the actual data to be used by the routine, the actual data is said to be passed to the routine by reference.
6-6 Programming Considerations

- By descriptor—the argument contains the address of a descriptor, the actual data is said to be passed by descriptor.

A descriptor consists of two or more longwords (depending on the type of descriptor used) that describe the location, length, and data type of the data to be used by the called routine.

All language processors, except VAX MACRO and VAX BLISS, pass arguments by reference or descriptor by default. Some high-level languages including VAX FORTRAN set up the descriptors and arrays for you.

The following list contains the passing mechanisms allowed by the VAX Procedure Calling Standard.

<table>
<thead>
<tr>
<th>Passing Mechanism</th>
<th>Descriptor Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>By value</td>
<td></td>
</tr>
<tr>
<td>By reference</td>
<td></td>
</tr>
<tr>
<td>By reference, array reference</td>
<td></td>
</tr>
<tr>
<td>By descriptor</td>
<td></td>
</tr>
<tr>
<td>By descriptor, fixed-length</td>
<td>DSC$K_CLASS_S</td>
</tr>
<tr>
<td>By descriptor, dynamic string</td>
<td>DSC$K_CLASS_D</td>
</tr>
<tr>
<td>By descriptor, array</td>
<td>DSC$K_CLASS_A</td>
</tr>
<tr>
<td>By descriptor, procedure</td>
<td>DSC$K_CLASS_P</td>
</tr>
<tr>
<td>By descriptor, decimal string</td>
<td>DSC$K_CLASS_SD</td>
</tr>
<tr>
<td>By descriptor, noncontiguous array</td>
<td>DSC$K_CLASS_NCA</td>
</tr>
<tr>
<td>By descriptor, varying string</td>
<td>DSC$K_CLASS_VS</td>
</tr>
<tr>
<td>By descriptor, varying string array</td>
<td>DSC$K_CLASS_VSA</td>
</tr>
<tr>
<td>By descriptor, unaligned bit string</td>
<td>DSC$K_CLASS_UBS</td>
</tr>
<tr>
<td>By descriptor, unaligned bit array</td>
<td>DSC$K_CLASS_UBA</td>
</tr>
<tr>
<td>By descriptor, string with bounds</td>
<td>DSC$K_CLASS_S</td>
</tr>
<tr>
<td>By descriptor, unaligned bit string 1 with bounds</td>
<td>DSC$K_CLASS_UBSB</td>
</tr>
</tbody>
</table>

Refer to the *MicroVMS Programming Support Manual* for more information about passing mechanisms.
6.3.4.1 VAX FORTRAN Built-In Functions

VAX FORTRAN also supports explicit argument passing mechanisms, or built-in functions that do not require formal data declarations. Built-in functions are specified only in the argument list of the call (with one exception) and are used when data must be passed to a subroutine written in a programming language other than VAX FORTRAN. The four VAX FORTRAN built-in functions are as follows:

- %VAL—specifies that the argument must be passed as a value.
- %REF—specifies that the argument must be passed as the address of the actual data.
- %DESCR—specifies that the argument must be passed as the address of a descriptor that points to the actual data.
- %LOC—returns the virtual address of the actual data.

The built-in function %LOC can be used outside an argument list to obtain the address of a variable. For example, %LOC can be used in an assignment statement where a longword in a character string descriptor is assigned the address of the actual character string.

By default, VAX FORTRAN passes numeric data by reference and character string data by descriptor. The built-in functions override default argument passing mechanisms. Occasionally, an external procedure is encountered that passes data differently from the VAX FORTRAN default and, in such cases, the built-in functions can be used in VAX FORTRAN code.

For specific information regarding similar procedure argument passing mechanisms for other high-level programming languages, refer to the appropriate language user’s guide.

Figure 6–1 illustrates how arguments are placed on the stack and shows how arguments are passed to the called routine.
### Figure 6-1 Passing Arguments

#### Procedure Argument Passing Mechanisms

<table>
<thead>
<tr>
<th>ARGUMENT LIST</th>
<th>PROCEDURE ARGUMENT PASSING MECHANISMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>N (AP)</td>
<td>(a) ARGUMENT PASSED BY VALUE</td>
</tr>
<tr>
<td>ARG 1</td>
<td></td>
</tr>
<tr>
<td>ARG 2</td>
<td></td>
</tr>
<tr>
<td>ACTUAL VALUE</td>
<td></td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>ARG N</td>
<td></td>
</tr>
</tbody>
</table>

- **(a) ARGUMENT PASSED BY VALUE**
  - Actual values are passed by value.

<table>
<thead>
<tr>
<th>N (AP)</th>
<th>(b) ARGUMENT PASSED BY REFERENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARG 1</td>
<td></td>
</tr>
<tr>
<td>ARG 2</td>
<td></td>
</tr>
<tr>
<td>POINTER TO ACTUAL VALUE</td>
<td>DATA</td>
</tr>
<tr>
<td>...</td>
<td>ACTUAL VALUE</td>
</tr>
<tr>
<td>ARG N</td>
<td></td>
</tr>
</tbody>
</table>

- **(b) ARGUMENT PASSED BY REFERENCE**
  - A pointer to the actual value is passed by reference.

<table>
<thead>
<tr>
<th>N (AP)</th>
<th>(c) ARGUMENT PASSED BY DESCRIPTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARG 1</td>
<td></td>
</tr>
<tr>
<td>ARG 2</td>
<td></td>
</tr>
<tr>
<td>POINTER TO DESCRIPTOR</td>
<td>DESCRIPTOR</td>
</tr>
<tr>
<td>...</td>
<td>CLASS TYPE LENGTH</td>
</tr>
<tr>
<td>ARG N</td>
<td>POINTER</td>
</tr>
</tbody>
</table>

- **(c) ARGUMENT PASSED BY DESCRIPTOR**
  - A pointer to a descriptor containing the actual value's data and length is passed.

---

**Note.** ARG 1, ARG 2, ARG N can be passed by value, by reference, or by descriptor in any of the above examples.

:*(AP) = argument pointer

N = number of arguments
6.4 UIS Constants

UIS constants are symbolic names for values that can be passed to, or returned from, UIS routines. UIS constants are syntactically equivalent to literal integer constants and are used in the following ways:

- As arguments to UIS functions
- As indexes into array arguments that are passed to, or received from, the UIS subsystem
- As literals with which you can compare a returned value from an inquiry routine

Refer to Section 6.6 for information about UIS symbol definition files.

6.5 Condition Values Signaled

Occasionally hardware- or software-related events occur indicating errors that could jeopardize successful program execution. Instead of returning condition values to R0 (as in VAX MACRO) or to a status variable (as in high-level languages), the UIS routines signal a condition. In such cases, unless you have explicitly arranged to handle the signaled condition, program execution terminates.

6.6 Additional Program Components

In addition to the usual program entities, you should be aware of UIS-specific and language-specific program components that affect program execution.

Subroutines and Functions

VAX FORTRAN application programs must declare subroutines as external procedures with the EXTERNAL statement if the subroutine name is used as an actual argument to other subprograms. The subprogram can then use the corresponding dummy argument in a function reference or a CALL statement.

Entry Point and Symbol Definition Files

All UIS and UISDC routines are declared in an entry point file supplied with the graphics software. In addition, you may need to include a file of UIS symbol definitions depending on the language you are using. These files are also known as data description files. See your appropriate language user’s manual to determine whether you must include these files in your program data declarations.
The following table contains a list of entry point files and symbol definition files for each VAX programming language. All files are located in SYS$LIBRARY.

<table>
<thead>
<tr>
<th>VAX Language</th>
<th>Entry Point File</th>
<th>Symbol Definition File</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLISS</td>
<td>UISENTRY.R32</td>
<td>UISUSRDEF.R32</td>
</tr>
<tr>
<td>C</td>
<td>UISENTRY.H</td>
<td>UISUSRDEF.H</td>
</tr>
<tr>
<td>FORTRAN</td>
<td>UISENTRY.FOR</td>
<td>UISUSRDEF.FOR</td>
</tr>
<tr>
<td>MACRO</td>
<td></td>
<td>UISUSRDEF.MAR</td>
</tr>
<tr>
<td>PASCAL</td>
<td>UISENTRY.PAS</td>
<td>UISUSRDEF.PAS</td>
</tr>
<tr>
<td>PL/I</td>
<td>UISENTRY.PLI</td>
<td>UISUSRDEF.PLI</td>
</tr>
</tbody>
</table>

Message Definition File

A language-specific message definition file called UISMSG is included in the directory SYS$LIBRARY. All possible UIS error codes are defined in this file. It is similar to the entry point file UISENTRY. For instance, to define message symbols in a VAX FORTRAN condition handler, you would add the following line to your program.

```
INCLUDE 'SYS$LIBRARY:UISMSG'
```

The appropriate language version of UISMSG is copied to your disk during the installation procedure depending on the programming language options you select.

All messages symbols use the prefix UIS$_.

### 6.7 Notes to Programmers

As a programmer, you should know about language-specific issues that might affect program execution. It is recommended that all application programmers read this section.

#### 6.7.1 VAX C Programmers

**Entry Point and Symbol Definition Files**

The file UISENTRY.H defines all routine entry points in lowercase characters, while UISUSRDEF.H defines all constants in uppercase characters.
6.7.2 VAX PASCAL Programmers

Entry Point Files

Because VAX PASCAL references arguments as formal parameters, your calls to UIS must specify the same parameter names as those contained in the entry point file UISENTRY.PAS. Therefore, specify \texttt{obj\_id} as the argument whenever the routine descriptions in Parts III and IV allow a choice between the \texttt{obj\_id} and \texttt{seg\_id} arguments. Refer to Tables A-1 and B-1 for summaries of UIS and UISDC calling sequences.

Creating Environment Files

Before running application programs written in VAX PASCAL, you must perform the following procedure.

1. Set your default directory to SYS$LIBRARY.
   
   \$ SET DEFAULT SYS$LIBRARY

2. Produce an environment file of symbolic definitions and type declarations by invoking the VAX PASCAL compiler with the /ENVIRONMENT and /NOOBJECT qualifiers.

   \$ PASCAL/ENVIRONMENT/NOOBJECT UISENTRY

   The result of the compilation is UISENTRY.PEN, an environment file.

3. Include the INHERIT attribute in the first line of the application program or program module specifying UISENTRY.PEN.

   \[\text{INHERIT('UISENTRY.PEN')}\]

4. Repeat this procedure for the symbol definition file UISUSRDEF.PAS.

Refer to Programming in VAX PASCAL for more information about the /ENVIRONMENT and /NOOBJECT qualifiers and the INHERIT attribute.

Drawing Lines and Polygons

VAX PASCAL application programs should use UIS$PLOT\_ARRAY rather than UIS$PLOT and UIS$LINE\_ARRAY instead of UIS$LINE, when drawing lines and polygons.
6.7.3 VAX PL/I Programmers

Entry Point Files

Because VAX PL/I references arguments as formal parameters, your calls to UIS must specify the same parameter names as those contained in the entry point file UISENTRY.PLI. Therefore, specify \texttt{obj\_id} as the argument whenever the routine descriptions in Parts III and IV allow a choice between the \texttt{obj\_id} and \texttt{seg\_id} arguments. Refer to Tables A-1 and B-1 for summaries ofUIS and UISDC calling sequences.

6.8 Programming Examples

The programming examples in Parts II and III of this manual use VAX FORTRAN Version 4.4. In addition, some examples particularly in Part III include ellipses, the standard convention for indicating portions of code that have been left out. The ellipses are also included to point out places in the program where code could be added at the programmer’s discretion.

Many of the examples include the VAX FORTRAN PAUSE statement. The PAUSE suspends program execution and returns the user to the DCL prompt ($). A default message “FORTRAN PAUSE” is returned to the display screen. The graphic images that were created on the display screen will remain. You can respond to the DCL prompt ($) by typing one of the following commands:

- **CONTINUE**—Program execution resumes at the next executable statement.
- **EXIT**—Program execution is terminated.
- **DEBUG**—Program execution resumes under the control of the VAX/VMS Symbolic Debugger.

**NOTE:** If your program is running in batch mode, program execution is not suspended. All messages are written to the system output file.

6.8.1 Structure of Programming Tutorial

Part II attempts to describe UIS graphics features and programming using a tutorial approach in each chapter. Within each chapter, after a discussion of the main topics, you are offered two types of information under the following headings:

- **Programming options** — Lists the features that you can use at a given point in time. The addition of each new group of programming options lets you progress in an orderly fashion from simple programming tasks to relatively complex ones.
• Program development — Lists the current programming objective and the tasks needed to successfully implement the objective.

  Program — Contains the source module with embedded callouts. Each callout refers to a programming feature that should be noted.

  Program output — Displays and explains the output from the program.

Each programming example uses some or all of the programming options listed. Not all routines are illustrated in the accompanying example.

6.9 Program Execution

Your program can run in batch mode with predefined data or it can run interactively accepting input from you when needed. However, in order to execute your application program successfully, you must first store it as a file using a text editor. Invoke the text editor on your workstation using the following command sequence. Please refer to appropriate sections of the user's manual for detailed information about MicroVMS text editors.

$ EDIT MYPROG.FOR

Please note in the previous example that you must supply a file name, for example, MYPROG. In addition, a VAX FORTRAN file type (FOR) is added to the file name to identify the file as a VAX FORTRAN source file. Enter your program according to the rules of the programming language you are using. Refer to the appropriate language reference manual for detailed information about the language.

6.9.1 Compiling Your Program

The newly created source file MYPROG.FOR must be compiled prior to execution. The language compiler, in our case the VAX FORTRAN compiler, checks for proper syntax and initiates code optimization where appropriate. Invoke the language compiler in the following manner.

$ FORTRAN/LIST MYPROG

Note that the file type need not be included. By default, the system searches for the latest version of the file, MYPROG, with a file type of FOR. If the application source file contains syntax errors, you will receive compile-time error messages called diagnostics. These diagnostic messages indicate the portion of code in error as well as an explanation. The /LIST qualifier specifies the creation of a listing file of accounting information and diagnostics (if present).

Some language compilers return a predetermined maximum number of diagnostics before terminating compilation. In any case, you must correct these errors and resubmit the source program for a successful compilation. Successful compilation produces an object module with file type of OBJ.
6.9.2 Linking the Object Module

The Linker resolves references to subroutines and allocates memory to variables within your program. Invoke the Linker in the following manner:

$ LINK MYPROG

You need not specify the file type of the program, MYPROG. By default, the system searches for the latest version of the file MYPROG with the file type OBJ.

In addition, you can link object modules of programs written in different source code.

6.9.3 Running the Executable Image

The Linker produces an executable image with a file type of EXE. At this point, you can run your program. However, you may receive run-time errors in which case you must correct errors in your source code and recompile the source module and relink the object modules. Run the executable image after receiving the $ prompt in the following manner:

$ RUN MYPROG
Chapter 7

Creating Basic Graphic Objects

7.1 Overview

This chapter describes how to create basic graphic objects: lines, circles, ellipses, and text. To accomplish this task you will need to know about the following topics:

- Creating a virtual display
- Creating graphics and text
- Creating a display window

You will construct an interactive program that contains the necessary components for creating graphic objects. Later, you will manipulate these displays using other windowing routines.

Refer to Section 6.8 for more information about the programming examples that appear in this manual.

7.2 Step 1—Creating a Virtual Display

When an artist paints a picture, he is concerned with presenting a subject from a particular perspective. He then wonders how he will frame his subject and how much space he will need to accomplish this task successfully. These needs are fulfilled by the size of the canvas he chooses. All of the objects that we will create will use such a frame of reference or virtual display to establish the universe in which our graphic objects will exist.

While the artist simply chooses a spot on the canvas to paint, our calls to UIS routines must reference points within our virtual display. The UIS subsystem uses the coordinates you specify to generate a coordinate system with which we can create the virtual display and subsequent windows. This coordinate system, or grid, allows us to reference points as world coordinates along two perpendicular axes labelled $x$ and $y$. 
Creating Basic Graphic Objects

Unlike the artist's canvas which has finite dimensions, your virtual display is infinite and graphic objects may be drawn anywhere in it.

7.2.1 Specifying Coordinate Values

Many routines documented in this manual require specifying coordinates to define virtual displays, display windows, and extent rectangles. Table 7-1 lists information about coordinate values.

Table 7-1  Types of Coordinates

<table>
<thead>
<tr>
<th>Coordinate</th>
<th>Units</th>
<th>Data Type</th>
<th>Origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute</td>
<td>cm</td>
<td>F_floating</td>
<td>Lower-left corner of display screen or tablet</td>
</tr>
<tr>
<td>Normalized</td>
<td>Gutenbergs</td>
<td>F_floating</td>
<td>Lower-left corner of virtual display</td>
</tr>
<tr>
<td>Viewport-relative</td>
<td>Pixels</td>
<td>Longword (unsigned)</td>
<td>Lower-left corner of display viewport</td>
</tr>
<tr>
<td>World</td>
<td>User-specified</td>
<td>F_floating</td>
<td>Lower-left corner of virtual display</td>
</tr>
</tbody>
</table>

1. F_floating point numbers may be expressed with up to approximately seven decimal digits of precision.

7.2.2 Programming Options

The following options allow you to create the basic structures used to create graphic objects.

Creating a Virtual Display

You must use UIS$CREATE_DISPLAY to specify the world coordinate space in which you will draw graphic objects. The world coordinate values specified in UIS$CREATE_DISPLAY establish mapping and scaling factors that the system may later use in viewport creation. The coordinate values should not be thought of as the absolute boundaries of the virtual display.

You can create an unlimited number of virtual displays subject to system and process resources.

Deleting a Virtual Display

You may delete a virtual display at any time in your program using UIS$DELETE_DISPLAY. However, you should remember that when you delete a virtual display you are throwing out the canvas on which you have drawn graphic objects.
7.2.3 Program Development

Programming Objectives

To create an executable program using the VAX FORTRAN programming language.

Programming Tasks

1. Create a virtual display.
2. Delete the virtual display.

```
PROGRAM IMAGES_1
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'


VD_ID=UIS$CREATE_DISPLAY(+1.0,+1.0,+20.0,+20.0,10.0,10.0)

PAUSE
CALL UIS$DELETE_DISPLAY(VD_ID)

END
```

At this point the program contains UIS entry points and definitions. It also includes a call to UIS$CREATE_DISPLAY. The plus sign (+) is optional for positive coordinates. The minus sign (−) is required for negative coordinates.

Because world coordinates are floating numbers, the decimal point is required when specifying world coordinate pairs.

See Section 6.8 for information about the VAX FORTRAN PAUSE statement.

UIS$DELETE_DISPLAY is called to remove the virtual display before the program ends. Terminating an application program with UIS$DELETE_DISPLAY is not required.

Besides specifying the world coordinate range of the virtual display, UIS$CREATE_DISPLAY returns the value of the virtual display identifier in \texttt{vd\_id}. The virtual display ID uniquely identifies this newly created virtual display and is used in subsequent windowing routines. Typically, UIS$CREATE_DISPLAY is the first UIS routine to be called in an application program.

If your application program were to invoke the UIS$CREATE_DISPLAY only, you would not notice a change in your workstation display screen.
Creating Basic Graphic Objects

7.3 Step 2—Creating Graphics and Text

You are now at a point comparable to the artist preparing to draw on the canvas. The virtual display is an infinitely large canvas. You must choose the types of graphic objects to be drawn there. You can draw graphic objects anywhere in the virtual display. Three types of graphic objects can be drawn in the virtual display as shown in the following table.

<table>
<thead>
<tr>
<th>Graphic Object</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Geometric shapes</td>
<td>Point, line, polygon, circle, and ellipse</td>
</tr>
<tr>
<td>Text</td>
<td>Characters</td>
</tr>
<tr>
<td>Raster images</td>
<td>Any object constructed with a bitmap of varying size</td>
</tr>
</tbody>
</table>

7.3.1 Graphics Drawing Operations

The following considerations apply to graphics operations:

- All line drawing operations are symmetrical and include both end points.
- All region specifications include the borders of the region specified. This applies in all cases to fill patterns, images, ellipses, moving windows, and so forth.

7.3.2 Programming Options

You can draw any of the graphic objects listed in this section. Read the routine description of each routine carefully.

Creating Points, Lines, and Polygons

Depending on the number of times you repeat coordinate pairs in UIS$PLOT or UIS$PLOT-ARRAY, you can draw a point, connected lines, or a polygon.

You can draw more than one unconnected line in single call to UIS$LINE or UIS$LINE-ARRAY. Each pair of world coordinate pairs specified represents the end points of a line.

**NOTE:** VAX PASCAL application programs should use UIS$PLOT-ARRAY or UIS$LINE-ARRAY to draw all lines, disconnected lines, and polygons.

Creating Circles

You can create circles or circular arcs with UIS$CIRCLE.

Creating Ellipses

You can create ellipses or elliptical arcs with UIS$ELLIPSE.
Creating Basic Graphic Objects

Drawing Images

You can create a bitmap image of a graphic object and then draw the raster to the display screen with UIS$IMAGE using the following procedure:

1. Create a data structure in your program, such as an array or record, that defines the bitmap.
2. Set the bits in the structure to create the bitmap image by assigning values to the elements of the structure.
3. Specify width and height of the raster image in pixels in UIS$IMAGE.
4. Specify the name of the data structure in UIS$IMAGE.

Figure 7-1 illustrates how bitmap settings are mapped to raster images.

Figure 7-1 Mapping a Bitmap to a Raster

Mapping the raster image occurs from left to right and from top to bottom. See the UIS$IMAGE routine description for more information.

Text

You can set the current position and create text anywhere within a virtual display using UIS$TEXT. The text within a virtual display could be used for labelling an accompanying graphic object within the window. Only UIS$TEXT can write characters in a virtual display.
7-6 Creating Basic Graphic Objects

7.3.3 Program Development

Programming Objectives

To create an executable program using the VAX FORTRAN programming language.

Programming Tasks

1. Create a virtual display.
2. Draw four graphic objects in the virtual display.
3. Delete the virtual display.

```fortran
PROGRAM IMAGES_2
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL WIDTH,HEIGHT

VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,20.0,20.0,10.0,10.0)
CALL UIS$CIRCLE(VD_ID,0,10.0,10.0,1.0) 1
CALL UIS$PLOT(VD_ID,0,4.0,3.0,5.0,7.0) 2
CALL UIS$ELLIPSE(VD_ID,0,15.0,15.0,1.0,2.0) 3
CALL UIS$TEXT(VD_ID,O,'This is a test.',1.0,12.0) 4

PAUSE
CALL UIS$DELETE_DISPLAY(VD_ID)
END
```

In the preceding example, world coordinate pairs are specified explicitly to the UIS graphics routines 1 2 3 4 describing the exact locations of the graphic objects (circle, line, ellipse, and text) in the virtual display.

If you executed the program in its present form, the workstation display screen would show no objects. Your calls to the UIS graphics and text routines have been processed. However, you must create a window to view what has been drawn.

7.4 Step 3—Creating a Display Window

The next step is to create a display window. The display window defines the world coordinate range of the viewable portion of the virtual display. When you create a display window, you are also creating a display viewport, an area on the physical screen on which the display window is mapped.
7.4.1 Programming Options

All the programming options available to us at this point, are provided through UIS$CREATE_WINDOW. At this point, you do not need to know about its full capabilities, which are discussed in more detail in the next chapter.

Creating a Display Window and Viewport

You can create a display viewport and its associated viewport with UIS$CREATE_WINDOW.

7.4.2 Program Development

Programming Objectives

To create an executable program that draws and displays graphic objects on the VAXstation display screen.

Programming Tasks

1. Create a virtual display.
2. Draw four graphic objects in the virtual display.
3. Create a display window and viewport.
4. Delete the virtual display.

PROGRAM IMAGES_2A
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL*4 WIDTH, HEIGHT
TYPE *, 'ENTER DESIRED VIEWPORT WIDTH AND HEIGHT'
ACCEPT *, WIDTH, HEIGHT
VD_ID=UIS$CREATE_DISPLAY(1.0, 1.0, 20.0, 20.0, WIDTH, HEIGHT)
CALL UIS$CIRCLE(VD_ID, 0, 10.0, 10.0, 1.0)
CALL UIS$PLOT(VD_ID, 0, 4.0, 3.0, 5.0, 7.0)
CALL UIS$ELLIPSE(VD_ID, 0, 15.0, 15.0, 1.0, 2.0)
CALL UIS$TEXT(VD_ID, 0, 'This is a test.', 1.0, 12.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION')
PAUSE
CALL UIS$DELETE_DISPLAY(VD_ID)
END
Creating Basic Graphic Objects

The world coordinate range of the virtual display and the default dimensions of the display viewport are specified in a call to UIS$CREATE_DISPLAY 1.

NOTE: The display viewport will not be mapped until a display window is created.

Next, the graphics and text routines are called 2 3 4 5 to draw the graphic objects.

A display window and viewport are created in a call to UIS$CREATE_WINDOW 6. The world coordinate range of the window and the viewport width and height are not specified. Therefore, the world coordinate space of the display window, that is, the viewable portion of the virtual display defaults to the entire virtual display. You will see all objects drawn in the virtual display.

7.4.3 Calling UIS$CIRCLE, UIS$ELLIPSE, UIS$PLOT, UIS$TEXT, and UIS$CREATE_WINDOW

When you run the program IMAGES_2A, you should get a single display viewport without a title, containing text, a circle, a line, and an ellipse as shown in Figure 7–2.

Figure 7–2 Display Viewport and Graphic Objects
Chapter 8

Display Windows and Viewports

8.1 Overview

Before you begin to manipulate graphic objects, you need to know more about display windows and viewports. After all, display windows and viewports allow you to see graphic objects drawn in the virtual display. This chapter discusses the following topics:

• Creating display windows and viewports
• Moving display windows
• Manipulating display viewports
• Deleting display windows
• Erasing the virtual display
• Creating transformations

These tasks are accomplished by the UIS windowing routines.

8.2 Windowing Routines

Windowing routines are responsible for the creation and deletion of virtual displays, display windows, and display viewports. Table 8-1 provides a list of window routines and their functions.
Table 8-1  UIS Windowing Routines

<table>
<thead>
<tr>
<th>Routine</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$CREATE_DISPLAY</td>
<td>Creates a virtual display and defines default viewport dimensions</td>
</tr>
<tr>
<td>UIS$CREATE_WINDOW</td>
<td>Creates display window and viewport</td>
</tr>
<tr>
<td>UIS$EXPAND_ICON</td>
<td>Substitutes an associated viewport for an icon</td>
</tr>
<tr>
<td>UIS$MOVE_AREA</td>
<td>Moves a specified rectangle and its contents in the virtual display to another part of the virtual display</td>
</tr>
<tr>
<td>UIS$MOVE_WINDOW</td>
<td>Pans the display window across the virtual display</td>
</tr>
<tr>
<td>UIS$POP_VIEWPORT</td>
<td>Allows an occluded viewport to be fully displayed</td>
</tr>
<tr>
<td>UIS$PUSH_VIEWPORT</td>
<td>Places a viewport behind another viewport</td>
</tr>
<tr>
<td>UIS$SHRINK_TO_ICON</td>
<td>Substitutes an icon for a display viewport</td>
</tr>
<tr>
<td>UIS$CREATE_TRANSFORMATION</td>
<td>Alters the world coordinate space of the virtual display</td>
</tr>
<tr>
<td>UIS$ERASE</td>
<td>Erases objects that lie completely within a specified rectangle in the virtual display</td>
</tr>
<tr>
<td>UIS$DELETEgetDisplay</td>
<td>Deletes a virtual display</td>
</tr>
<tr>
<td>UIS$DELETE_WINDOW</td>
<td>Deletes a display window and viewport</td>
</tr>
</tbody>
</table>

These routines allow you to create and manage the display screen environment and to perform certain housekeeping functions such as erasing and deleting virtual displays and windows.

8.3  Step 1—Creating Many Display Windows

For every display window that you create, you are also creating a display viewport. A one-to-one relationship exists between each display window and its associated viewport. An application program can create an unlimited number of display windows and viewports subject to system and process resources.

8.3.1  Programming Options

Each display window can be unique with regard to world coordinate range. Therefore, you can create display viewports that are also unique with respect to dimensions and position in the display screen.
Display Windows and Viewports

Display Window Size

By default, a newly created display window displays the full world coordinate space specified when creating the virtual display. You can specify world coordinates pairs in UIS$CREATE_WINDOW as you see fit to produce display windows of different proportions within the virtual display.

Display Viewport Size

Similarly, the default display viewport dimensions are equal to the values specified in the width and height arguments in the UIS$CREATE_DISPLAY call. However, you may specify different dimensions to scale the contents of the window. Maximum display viewport size depends on the dimensions of the display screen. If you specify viewport dimensions that exceed the size of the display screen, UIS scales the viewport to the size of the display screen.

Graphic Object Magnification

The world coordinate range of the display window or the dimensions of the display viewport can be manipulated to increase or decrease magnification of the object displayed in the viewport. This occurs when the display window area is decreased or increased while the viewport size remains the same, or when the viewport is decreased or increased while dimensions of the window remain the same.

Distortion

Distortion occurs whenever the aspect ratios of the display viewport and display window are not equal. The aspect ratio of the display window is the absolute value of the difference between y world coordinates of the upper-right and the lower-right corners of the window divided by the absolute value of the difference between the x world coordinates of the lower-right and lower-left corners. Figure 8-1 illustrates how to calculate the aspect ratios of the display window and viewport.

![Aspect Ratios of the Display Window and Display Viewport](ZK-4579-85)

Number of Windows and Viewports

You can create an unlimited number of display windows and, as a result, an unlimited number of display viewports subject to system and process resources. In addition, you can specify the dimensions of each display viewport.
Display Windows and Viewports

Display Banner

The display banner appears along the top border of the display viewport and contains the menu and keyboard icons as well as the viewport title. The maximum length of the viewport title is 63 characters.

You can suppress the generation of the display banner with the attributes argument in UIS$CREATE_WINDOW. When the display banner is suppressed, only the viewport border is displayed.

Display Viewport Placement

You can either explicitly place a display viewport on the workstation display screen or you can allow UIS to choose a location for you. By default, display viewport placement is random.

8.3.2 Program Development

Programming Objectives

To create four display windows and display viewports.

Programming Tasks

1. Create a virtual display.
2. Draw four graphic objects in the virtual display.
3. Create four display windows and viewports omitting the display window coordinates in the calls to UIS$CREATE_WINDOW.
4. Delete the virtual display.

```
PROGRAM IMAGES_3
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,20.0,20.0,10.0,10.0)
CALL UIS$CIRCLE(VD_ID,0,10.0,10.0,1.0)
CALL UIS$PLOT(VD_ID,0,4.0,3.0,5.0,7.0)
CALL UIS$ELLIPSE(VD_ID,0,15.0,15.0,1.0,2.0)
CALL UIS$TEXT(VD_ID,0,'This is a test.',1.0,12.0)

WD_ID1=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION') ①
PAUSE
WD_ID2=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION') ②
WD_ID3=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION') ③
WD_ID4=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION') ④
```
PAUSE
CALL UIS$DELETE_DISPLAY(VD_ID)
END

Four calls to UIS$CREATE_WINDOW ① ② ③ ④ have been inserted to create four windows. The world coordinate range of each window defaults to the world coordinate range of the entire virtual display.

8.3.3 Calling UIS$CREATE_WINDOW

If you were to run this program now, your workstation screen would display the graphic objects as shown in Figure 8–2.
As you can see, four display windows have been created and mapped to the display screen as four viewports. Each of the viewports contains four objects. Because display window world coordinate pairs were not explicitly specified in UIS$CREATE_WINDOW, the viewports allow you to see the entire area of the
virtual display by default. In addition, because the display viewport width and height in centimeters were not explicitly specified in the UIS$CREATE_WINDOW call, each display viewport is, by default, 10 cm square as specified in the width and height arguments of the UIS$CREATE_DISPLAY call.

8.4 Step 2—Deleting and Erasing Display Windows

Some windowing routines perform housekeeping functions, that is, they delete unused display windows or erase graphic objects from the virtual displays. Such routines are important in managing display environment, when you run complicated applications.

8.4.1 Programming Options

You may want your application program to delete unwanted windows, viewports, and virtual displays. This can be done by calling UIS routines for deleting and erasing display windows and virtual displays.

Display Window Deletion

Any display window can be deleted without interfering with other windows or viewports. Deletion of the display window does not affect the graphic objects in the virtual display. If you delete a display window, you are also deleting the associated display viewport. Delete any display window and its associated viewport by specifying the appropriate display window identifier in UIS$DELETE_WINDOW.

Erasing the Virtual Display

Graphic objects that lie completely within a specified rectangle in the virtual display can be deleted at any time using UIS$ERASE. If no rectangle is specified, the entire virtual display is used.

8.4.2 Program Development

Programming Objectives

To enclose each graphic object in its own display window and then to delete a window and its viewport.
Programming Tasks

1. Create a virtual display.
2. Draw four graphic objects in the virtual display.
3. Create four display windows and viewports specifying display window regions that enclose each of the graphic objects.
   - Specify display window regions that enclose each of the graphic objects.
   - Specify a viewport title identifying the graphic object.
4. Delete one of the display windows and its viewport.

```fortran
PROGRAM IMAGES_4
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL WIDTH,HEIGHT
TYPE *, 'ENTER DISPLAY SIZE' 
ACCEPT *,WIDTH,HEIGHT
VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,20.0,20.0,WIDTH,HEIGHT)
CALL UIS$CIRCLE(VD_ID,0,12.0,12.0,1.0)
CALL UIS$PLOT(VD_ID,0,4.0,3.0,5.0,7.0)
CALL UIS$ELLIPSE(VD_ID,0,15.0,15.0,1.0,2.0)
CALL UIS$TEXT(VD_ID,0,'This is a test.',1.0,12.0)
WD_ID1=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','CIRCLE', 2
   10.0,10.0,14.0,14.0,WIDTH,HEIGHT) 
WD_ID2=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','LINE', 2
   3.0,2.0,6.0,8.0,WIDTH,HEIGHT) 
WD_ID3=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','TEXT', 2
   1.0,12.0,10.0,10.0,WIDTH,HEIGHT) 
WD_ID4=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','ELLIPSE', 2
   13.0,13.0,17.0,18.0,WIDTH,HEIGHT) 
PAUSE
CALL UIS$DELETE_WINDOW(WD_ID2)
PAUSE
END
```

The program now accepts input for the display viewport dimensions interactively.

The world coordinate space that defines each display window is specified explicitly in the UIS$CREATE_WINDOW calls.
UIS$CREATE_WINDOW returns the variable \( wd\_id2 \), the display window identifier to uniquely identify the LINE window. Note that the call to delete the LINE window references this variable.

### 8.4.3 Calling UIS$DELETE_WINDOW

If we ran this program until the first PAUSE statement, the workstation screen would display the graphic objects shown in Figure 8–3.
By specifying explicitly a particular world coordinate range within the virtual display for each display window, each graphic object lies within a separate window that maps to the physical display screen as a separate display viewport.
To continue program execution, type CONTINUE at DCL prompt ($). The program continues to execute and the screen changes as shown in Figure 8–4.

**Figure 8–4  Display Window Deletion**

The viewport LINE and its window are deleted. However, the actual graphic object still exists. You have simply deleted the display window that allowed you
to view the portion of the virtual display that contained the line. If you called UIS$CREATE__WINDOW again, specifying the appropriate world coordinate space in the virtual display, the object would reappear.

8.5 Step 3—Manipulating Display Windows and Viewports

Display viewports and windows do not have to remain as static objects on your screen. You can manipulate the newly created display windows and viewports in many ways.

8.5.1 Programming Options

Viewport placement features and window attributes are implemented using the optional attributes argument of UIS$CREATE__WINDOW.

NOTE: When you include the attributes argument in UIS$CREATE__WINDOW, you are not modifying attribute block 0.

Attributes and attribute block 0 are discussed in detail in the next chapter.

General and Exact Placement of Viewports

Unless you specify otherwise, your display viewports are placed randomly throughout the screen. You can move any display viewport to any position on the screen. When you create the window, you can specify general viewport placement, that is, within a certain vicinity on the screen—top, left, right, or bottom.

Exact placement positions your display viewport where you want on the screen and allows you to occlude other viewports to save space.

Panning and Zooming the Virtual Display

You can pan across the virtual display to include either the entire virtual display or any discrete area within it.

Pushing and Popping Display Viewports

Pushing and popping display viewports is useful when you have created display windows with the exact placement attribute. In such a case, your application may have created two windows and purposely occluded one of the viewports. In this instance, you know which viewport will be occluded and the use of UIS$POP_VIEWPORT is clearly indicated.

Otherwise, the UIS subsystem places newly created windows randomly on the display screen by default. As a result, you will not know where the viewports will be placed. Therefore, use of UIS$POP_VIEWPORT or UIS$PUSH_VIEWPORT in this instance, would be unnecessary and confusing.
Moving a Display Viewport

You can move an existing display viewport anywhere on the display screen using UIS$MOVE_VIEWPORT.

Moving a Portion of the Virtual Display

You can draw a graphic object in a portion of the virtual display, then move that coordinate space to another part of the same virtual display with UIS$MOVE_AREA. The vacated source area is filled with the current background color.

8.5.2 Program Development I

Programming Objectives

To delete three display windows and viewports and then to pan the virtual display using the remaining display window.

Programming Tasks

1. Create a virtual display.
2. Draw four graphic objects in the virtual display.
3. Create four display windows and viewports each containing a graphic object.
4. Specify a title for each viewport.
5. Delete three of the four display windows.
6. Pan the virtual display with the remaining display window using UIS$MOVE_WINDOW.

```plaintext
PROGRAM IMAGES_5
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL WIDTH,HEIGHT

TYPE *, 'ENTER VIEWPORT WIDTH AND HEIGHT'
ACCEPT *,WIDTH,HEIGHT

VD_ID=UIS$CREATE_DISPLAY(10.0,10.0,20.0,20.0,10.0,10.0)
CALL UIS$CIRCLE(VD_ID,0,12.0,12.0,1.0) ①
CALL UIS$PLOT(VD_ID,0,4.0,3.0,5.0,7.0) ②
CALL UIS$ELLIPSE(VD_ID,0,15.0,15.0,1.0,2.0) ③
CALL UIS$TEXT(VD_ID,0,'This is a test.',1.0,12.0) ④
```
WD_ID1=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','CIRCLE',
  2   10.0,10.0,14.0,14.0,WIDTH,HEIGHT) ⑤
WD_ID2=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','LINE',
  2   3.0,2.0,6.0,8.0,WIDTH,HEIGHT) ⑥
WD_ID3=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','TEXT',
  2   1.0,12.0,10.0,10.0,WIDTH,HEIGHT) ⑦
WD_ID4=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','ELLIPSE',
  2   13.0,13.0,17.0,18.0,WIDTH,HEIGHT) ⑧
PAUSE ⑨
CALL UIS$DELETE_WINDOW(WD_ID1) ⑩
CALL UIS$DELETE_WINDOW(WD_ID3) ⑪
CALL UIS$DELETE_WINDOW(WD_ID4) ⑫
PAUSE ⑬
CALL UIS$MOVE_WINDOW(VD_ID,WD_ID2,6.0,8.0,18.0,18.0) ⑭
PAUSE ⑮
CALL UIS$DELETE_DISPLAY(VD_ID)
END

The program IMAGE_5 creates four graphic objects ① ② ③ ④ in the virtual display.
The program prompts for the viewport width and height which overrides the values
specified in UIS$CREATE_DISPLAY.

Each graphic object is contained within a newly created display window ⑤ ⑥ ⑦ ⑧. Each display window is mapped to the physical screen as a display viewport with an
appropriate title describing the graphic object within the window.

Program execution is suspended ⑨. The display screen contains four viewports as
previously described.

Three calls to UIS$DELETE_WINDOW ⑩ ⑪ ⑫ remove the windows and their
viewports CIRCLE, ELLIPSE, and TEXT from the display screen.

Program is suspended ⑬. The display screen contains one display viewport LINE.
A call to UIS$MOVE_WINDOW ⑭ has been inserted. Thus, the display window
LINE pans the virtual display.
8.5.3 Calling **UIS$MOVE_WINDOW**

The display screen initially contains all four windows as shown in Figure 8–5.

**Figure 8–5 Before Panning the Virtual Display**

This is a test.
Three of the display windows and viewports are deleted.

The display viewport LINE remains. Originally, the viewport contained a line; now it contains the circle and the ellipse. The display window will go to the location in the virtual display you have specified. You may include as many calls to UIS$MOVE_WINDOW as you see fit. Your workstation screen will display the objects shown in Figure 8-6.
Figure 8-6  Panning the Virtual Display
The circle and the ellipse still exist in the virtual display.

### 8.5.4 Program Development II

#### Programming Objectives

To demonstrate exact placement of the display viewport on the display screen in order to pop and push viewports.

#### Programming Tasks

1. Create a viewport attributes data structure specifying viewport placement data.
2. Create a virtual display.
3. Draw two graphic objects in the virtual display in separate viewports.
4. One viewport will occlude the other initially.

```plaintext
PROGRAM IMAGES_6
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL WIDTH, HEIGHT

STRUCTURE/PLACE/ ①
   INTEGER*4 CODE_1
   REAL*4 ABS_POS_X
   INTEGER*4 CODE_2
   REAL*4 ABS_POS_Y
   INTEGER*4 END_OF_LIST
END STRUCTURE

RECORD /PLACE/PLACE_LIST, ON_TOP ②

PLACE_LIST.CODE_1=WDPL$C_ABS_POS_X
PLACE_LIST.ABS_POS_X=8 ③
PLACE_LIST.CODE_2=WDPL$C_ABS_POS_Y
PLACE_LIST.ABS_POS_Y=8 ④
PLACE_LIST.END_OF_LIST=WDPL$C_END_OF_LIST

ON_TOP.CODE_1=WDPL$C_ABS_POS_X
ON_TOP.ABS_POS_X=8.5 ⑤
ON_TOP.CODE_2=WDPL$C_ABS_POS_Y
ON_TOP.ABS_POS_Y=8.5 ⑥
ON_TOP.END_OF_LIST=WDPL$C_END_OF_LIST

TYPE *, 'ENTER DISPLAY SIZE'
ACCEPT *, WIDTH, HEIGHT

VD_ID=UIS$CREATE_DISPLAY(1.0, 1.0, 20.0, 20.0, 10.0, 10.0)
```
CALL UIS$CIRCLE(VD_ID,0,10.0,10.0,1.0)
CALL UIS$PLOT(VD_ID,0,4.0,3.0,5.0,7.0)

WD_ID1=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','CIRCLE',
2     8.0,8.0,12.0,12.0,WIDTH,HEIGHT,PLACE_LIST)  
WD_ID2=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','LINE',
2     3.0,2.0,6.0,8.0,,ON_TOP)  

PAUSE  

CALL UIS$POP_VIEWPORT(WD_ID1)  

PAUSE  

CALL UIS$PUSH_VIEWPORT(WD_ID1)  

PAUSE  

CALL UIS$DELETE_DISPLAY(VD_ID)
END

A data structure argument is created and given the symbolic name PLACE using the STRUCTURE statement. The symbolic names for the fields were chosen arbitrarily.

Two variables, PLACE_LIST and ON_TOP, of type PLACE are created and contain five longwords.

Actual values are assigned to the different fields of the record PLACE_LIST. In this case, the absolute coordinates of the lower-left corner of the display viewport LINE are assigned to the fields ON_TOP.ABS_POS_X and ON_TOP.ABS_POS_Y. The absolute coordinates of the display viewport CIRCLE, are assigned to the fields PLACEMENT.ABS_POS_X and PLACEMENT.ABS_POS_Y as well.

Also, the position of your calls to UIS$CREATE_WINDOW within your program is important. The call to create the display viewport CIRCLE must be executed prior to LINE.

At the first PAUSE statement, viewport LINE occludes viewport CIRCLE.

UIS$POP_VIEWPORT is called. The display viewport CIRCLE is placed over the viewport LINE.

A call to UIS$PUSH_VIEWPORT returns the viewports to their original position.
8.5.5 Calling UIS$POP_VIEWPORT and UIS$PUSH_VIEWPORT

Initially, the viewport LINE is placed over CIRCLE. Note that display viewports are placed on the physical display screen with absolute coordinates. The lower-left corner of any viewport is the origin of the viewport rectangle. When you request exact placement of a viewport, you are specifying where on display screen the origin of the viewport rectangle is to be placed relative to the lower-left corner of the display screen.

The program execution is suspended at the first PAUSE statement. The display screen contains the graphic objects shown in Figure 8–7.
Figure 8-7  Occluding a Display Viewport
The display viewports LINE and CIRCLE exchange positions when the call to UIS$POP_VIEWPORT is executed. The viewport CIRCLE now occludes LINE as shown in Figure 8–8.

Figure 8–8  Popping a Display Viewport
In order to return the viewports to their original positions, a call to UIS$PUSH_VIEWPORT pushes viewport CIRCLE behind viewport LINE as shown in Figure 8–9.

Figure 8–9 Pushing a Display Viewport
8.5.6 Program Development III

Programming Objectives

To place a viewport in a general vicinity on the display screen and to create a display viewport with no border.

Programming Tasks

1. Create a viewport attributes list to hold the appropriate viewport placement and attributes data.
2. Create a virtual display.
3. Draw two graphic objects in the virtual display.
4. Create two display windows and associated viewports each containing a graphic object.
5. Delete the virtual display.

```
PROGRAM IMAGES_7
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL WIDTH,HEIGHT

STRUCTURE/PLACE/
  INTEGER*4 CODE_5
  INTEGER*4 REL_POS
  INTEGER*4 CODE_6
  INTEGER*4 ATTR
  INTEGER*4 END_OF_LIST
END STRUCTURE

RECORD /PLACE/LOCATION(2)
  LOCATION(1).CODE_5=WDPL$C_PLACEMENT
  LOCATION(1).REL_POS=WDPL$M_TOP .OR. WDPL$M_LEFT
  LOCATION(1).CODE_6=WDPL$C_ATTRIBUTES
  LOCATION(1).ATTR=WDPL$M_NOMENU_ICON
  LOCATION(1).END_OF_LIST=WDPL$C_END_OF_LIST

  LOCATION(2).CODE_5=WDPL$C_PLACEMENT
  LOCATION(2).REL_POS=WDPL$M_RIGHT .OR. WDPL$M_BOTTOM
  LOCATION(2).CODE_6=WDPL$C_ATTRIBUTES
  LOCATION(2).ATTR=WDPL$M_NOBORDER
  LOCATION(2).END_OF_LIST=WDPL$C_END_OF_LIST

TYPE *, 'ENTER VIEWPORT WIDTH AND HEIGHT'
ACCEPT *,WIDTH,HEIGHT
VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,20.0,20.0,10.0,10.0)
```
CALL UIS$CIRCLE(VD_ID,0,12.0,12.0,1.0)
CALL UIS$ELLIPSE(VD_ID,0,15.0,15.0,1.0,2.0)

WD_ID1=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','CIRCLE', 2 10.0,10.0,14.0,14.0,WIDTH,HEIGHT,LOCATION(1))
WD_ID4=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','ELLIPSE', 2 13.0,13.0,17.0,18.0,WIDTH,HEIGHT,LOCATION(2))

PAUSE
CALL UIS$DELETE_DISPLAY(VD_ID)
PAUSE
END

The name of the data structure argument PLACE is defined using the STRUCTURE statement ①. An array LOCATION is defined to have two elements that are records with a structure defined by the structure PLACE ②. Each record LOCATION(1) and LOCATION(2) consists of two pairs of longwords terminated by a longword equaling the constant WDPL$C_END_OF_LIST.

We prefer to have the display viewport CIRCLE placed in the upper-left corner of the display screen and the borderless viewport ELLIPSE in the lower-right corner. Therefore, we must specify in each assignment two preference masks for each viewport ③ ④.

NOTE: Note that you must use the logical operator .OR. when specifying more than one preference mask.

The array name LOCATION is added to the argument lists of the viewport CIRCLE and ELLIPSE to invoke the optional attribute list.

8.5.7 Requesting General Placement and No Border

General display viewport placement works best on an uncluttered display screen. Your workstation screen will display the objects shown in Figure 8–10.
Figure 8-10  General Placement and No Border
8.5.8 Program Development IV

Programming Objectives

To move graphic objects within the virtual display.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport.
3. Draw two graphic objects in the virtual display.
4. Move the coordinate space containing each graphic object to another portion of the virtual display using UIS$MOVE_AREA.

```plaintext
PROGRAM AREA
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIJ'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,50.0,50.0,15.0,15.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION', 'MOVE AREA')

CALL UIS$PLOT(VD_ID,0.1,0.25,0.16,0.25,0.9,0.42,0.1,0.25) 1
CALL UIS$CIRCLE(VD_ID,0,35.0,35.0,10.0) 2
PAUSE
CALL UIS$MOVE_AREA(VD_ID,0.0,0.22,0.20,0.42,0.30,0.1.0) 3
CALL UIS$MOVE_AREA(VD_ID,25.0,25.0,50.0,50.0,1.0,1.0) 4
PAUSE
END
```

A triangle and a circle are drawn in the upper half of the virtual display using UIS$PLOT and UIS$CIRCLE 1 2.

A rectangular area containing the triangle is moved to the lower-right area of the virtual display 3. A rectangular area containing the circle is moved to the lower-left region in the virtual display 4.
Figure 8-11  Moving Graphic Objects Within the Virtual Display
8.5.9 Calling UIS$MOVE_AREA

Figure 8–11 shows how areas within the virtual display containing graphic objects can be moved to other parts of the same virtual display.

8.6 World Coordinate Transformations

Certain applications may require that you create more than one virtual display, or world coordinate space. Depending on the requirements of the program, you might have to map graphic objects in one virtual display to another virtual display.

8.6.1 Programming Options

To illustrate the advantages of world coordinate transformations, we will construct a program that creates a virtual display. We will then create a circle in a virtual display. The circle will be written to new world coordinate space or transformation space.

Two-Dimensional Transformation and Scaling

Depending on the values supplied to UIS$CREATE_TRANSFORMATION, graphic objects mapped to other coordinate spaces may be scaled. If the coordinates of the new transformation space are the same as those of the original virtual display, no scaling occurs.

8.6.2 Program Development

Programming Objectives

To transform a world coordinate space by altering its mapping and scaling factors.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport.
3. Draw a graphic object in the virtual display.
4. Create a new coordinate space using UIS$CREATE_TRANSFORMATION.
5. Redraw the graphic object substituting the transformation identifier of the new coordinate space returned by UIS$CREATE_TRANSFORMATION for the virtual display identifier of the old coordinate space.
The virtual display and the new transformation space specify different coordinate ranges. The circles are created in calls to `UIS$CIRCLE` where the `tr_id` argument is substituted for `vd_id` in the second call. The same circle is redrawn with the same world coordinates in the new transformation space.

### 8.6.3 Calling UIS$CREATE_TRANSFORMATION

The graphic objects appear to be superimposed one over the other. If the `vdx1` and `vdy1` arguments are manipulated, the size of the arc can increase or decrease relative to the size of the first circle. In any case, the arc is mapped to the transformation space eliminating the need for additional computation and coding on the part of the programmer.
Figure 8-12  World Coordinate Transformations
Chapter 9

General Attributes

9.1 Overview

Until the information presented in this manual has been concerned with UIS output routines that create the basic structures needed to produce graphic objects. However, there are other types of routines. This chapter discusses the following topics:

- Understanding general attributes
- Using general attributes

The attribute routines place a great deal of control over the quality of graphic objects and text in the hands of the programmer.

9.2 Attributes—How to Use Them

As the canvas gradually fills with various shapes and figures, the artist is concerned not only with the shapes of the subjects—a line, a circle, an ellipse, and text but also with whether their appearance conveys the intended meaning. What our artist would regard as an aesthetic consideration, we will call an attribute. Attributes control the appearance of graphic objects and text. You will use attributes whenever you need to enhance some element on the display screen. Attributes can be modified at any time within your program.
9-2 General Attributes

9.2.1 Attribute Blocks

All UIS attributes are grouped in a data structure called an attribute block. One or more attributes may be modified within a given attribute block. Default attribute settings reside in attribute block 0. Table 9-1 lists the categories of attributes within attribute block 0.

Table 9-1 Attribute Block 0

<table>
<thead>
<tr>
<th>Type</th>
<th>Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Writing mode</td>
</tr>
<tr>
<td></td>
<td>Writing color index</td>
</tr>
<tr>
<td></td>
<td>Background color</td>
</tr>
<tr>
<td>Text</td>
<td>Character rotation</td>
</tr>
<tr>
<td></td>
<td>Character spacing</td>
</tr>
<tr>
<td></td>
<td>Character slant</td>
</tr>
<tr>
<td></td>
<td>Character size</td>
</tr>
<tr>
<td></td>
<td>Text path</td>
</tr>
<tr>
<td></td>
<td>Text slope</td>
</tr>
<tr>
<td></td>
<td>Text formatting</td>
</tr>
<tr>
<td></td>
<td>Left margin</td>
</tr>
<tr>
<td></td>
<td>Right margin</td>
</tr>
<tr>
<td></td>
<td>Font</td>
</tr>
<tr>
<td>Graphics</td>
<td>Line width</td>
</tr>
<tr>
<td></td>
<td>Line style</td>
</tr>
<tr>
<td></td>
<td>Fill pattern</td>
</tr>
<tr>
<td></td>
<td>Arc type</td>
</tr>
<tr>
<td>Windowing</td>
<td>Clipping rectangle</td>
</tr>
</tbody>
</table>

The default attribute settings in attribute block 0 can never be modified.
9.2.2 Modifying General Attributes

When you modify general attributes, you do not change the default attribute settings within attribute block 0 itself. You should think of attribute block 0 as a template of default settings and you are modifying a copy of this attribute block for use within your program. Attribute modification routines contain two arguments—the input attribute block number (iatb) and the output attribute block number (oatb). Table 9-2 lists the default settings of general attributes.

Table 9-2 Default Settings of General Attributes

<table>
<thead>
<tr>
<th>General Attribute</th>
<th>Default Setting</th>
<th>Modification Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background index¹</td>
<td>Index 0</td>
<td>UIS$SET_BACKGROUND_INDEX</td>
</tr>
<tr>
<td>Writing index²</td>
<td>Index 1</td>
<td>UIS$SET_WRITING_INDEX</td>
</tr>
<tr>
<td>Writing mode</td>
<td>Overlay</td>
<td>UIS$SET_WRITING_MODE</td>
</tr>
</tbody>
</table>

¹Index of the background color in the virtual color map.  
²Index of the foreground color in the virtual color map.

Perform attribute modification using the following procedure:

1. Choose an appropriate attribute modification routine to modify the attribute.
2. Specify 0 as the iatb argument to obtain a copy of attribute block 0.
3. Specify a number from 1 to 255 as the oatb argument. The attribute block can then be referenced in subsequent UIS graphics and text routines or in any other attribute modification routine.

Graphics and text routines as well as UIS$MEASURE_TEXT, UIS$NEWTEXT_LINE, and UIS$SET_ALIGNEDPOSITION reference attribute blocks in the atb argument.

9.3 Structure of Graphic Objects

There are three types of graphic objects: (1) geometric shapes such as circles, ellipses, points, lines, and polygons, (2) text, and (3) raster images. Graphic objects consist of a pattern. In memory, the pattern represents one or more bit settings to 0 or 1 that comprise the actual graphic object.

When these entities are written in the virtual display, the UIS writing modes interpret the bit settings that comprise these objects in different ways.
9-4 General Attributes

Text

In the case of text, a standard character within the default font displayed on the workstation screen represents the bitmap image of a cell in memory. The size of the cell varies and depends on the type of font. UIS draws monospaced and proportionally spaced text. Monospaced fonts use a standard cell size for all letters within the font. However, the standard cell size varies depending on the monospaced font you are using.

Proportionally spaced fonts use character cells that vary in width according to the letter used. The height of the character cell remains constant for all characters within the font.

The character cell contains the pattern. The remaining bits in the cell are set to 0. All bits within the character cell are significant to UIS writing modes.

Geometric Shapes

In the case of geometric shapes, only the bit settings that actually comprise the pattern are significant. Bit settings in the pattern may be 0 or 1. For example, a dotted line represents bit settings of 0 and 1 in a pattern. All bit settings both 0 and 1 within this pattern are significant to UIS writing modes.

Raster Images

When you draw a raster image, you set bits in a bitmap to create text characters or geometric shapes. For example, UIS$IMAGE and UIS$SET_POINTER_PATTERN use bitmaps to map rasters to the display screen. All bits in the bitmap are significant to the UIS writing modes. The following table shows the underlying structures from which graphic objects are created.

<table>
<thead>
<tr>
<th>Graphic Object</th>
<th>Structure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Text</td>
<td>Character cell</td>
</tr>
<tr>
<td>Geometric shapes</td>
<td>Pattern</td>
</tr>
<tr>
<td>Raster Image</td>
<td>Bitmap image of varying size</td>
</tr>
</tbody>
</table>

For a given graphic object, the current writing mode determines how the bit settings in the appropriate structure are displayed. All bit settings of a particular structure are significant to UIS writing modes. Figure 9-1 shows graphic objects as structures that UIS writing modes recognize: (1) the letter E within a character cell, (2) a square as a pattern, and (3) a bitmap containing the letter E, a square, and a vertical dashed line of double thickness.
General Attributes

Figure 9-1 Structure of Graphic Objects
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9.4 UIS Writing Modes

There are 14 UIS writing modes: transparent, complement, copy, copy negate, overlay, overlay negate, erase, erase negate, replace, replace negate, bit set, bit set negate, bit clear, and bit clear negate. The writing mode controls how graphics and text routines use foreground and background colors to display graphic objects. The default writing mode is overlay.

Table 9–3 lists how each writing mode functions.

Table 9–3 UIS Writing Modes

<table>
<thead>
<tr>
<th>Device-Independent</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_MODE_ERAS</td>
<td>Displays the current background color for each bit position no matter what the bit settings are in the character cell, pattern, or bitmap image.</td>
</tr>
<tr>
<td>UIS$C_MODE_ERASN</td>
<td>Displays the current writing color for each bit position no matter what the bit settings are in the character cell, pattern, or bitmap image.</td>
</tr>
<tr>
<td>UIS$C_MODE_OVER</td>
<td>Displays the current writing color for bits set to 1 in the character cell, pattern, or bitmap image. All bits set to 0 have no effect on the existing graphic object. This is the default writing mode attribute setting.</td>
</tr>
<tr>
<td>UIS$C_MODE_OVERN</td>
<td>Bitwise complements the character cell, pattern, or bitmap image that is, bits originally set to 0 are now set to 1 and vice versa. The bits now set to 1 in the character cell, pattern, or bitmap image display the current writing color. The bits that are now set to 0 in the character cell have no effect on any existing graphic object.</td>
</tr>
<tr>
<td>UIS$C_MODE_REPL</td>
<td>Displays the current writing color for bits set to 1 in the character cell, pattern, or bitmap image. Bits set to 0 in the character cell, pattern, or bitmap image display the current background color.</td>
</tr>
</tbody>
</table>
Table 9-3 (Cont.) UIS Writing Modes

<table>
<thead>
<tr>
<th>UIS Writing Modes</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device-Independent</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$C_MODE_REPLN</td>
<td>Bitwise complements the character cell, pattern, or bitmap image. The bits now set to 1 in the character cell, pattern, or bitmap image now display the current writing color. Bits now set to 0 in the character cell, pattern, or bitmap image now display the current background color.</td>
</tr>
<tr>
<td>UIS$C_MODE_COMP</td>
<td>Where the two graphic objects intersect, the bits in the character cell, pattern, or bitmap image are exclusive .OR.ed with the existing graphic object.</td>
</tr>
<tr>
<td>UIS$C_MODE_TRAN</td>
<td>Does not alter the display screen.</td>
</tr>
<tr>
<td><strong>Device-Dependent(^1)</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$C_MODE_BIC</td>
<td>The bitwise complement of the character cell, pattern, or bitmap image is logically .AND.ed with the existing graphic object and background. On mapped color systems, where the two graphic objects intersect, the bitwise complement of the writing index of the character cell, pattern, or bitmap image is logically .AND.ed with the pixel values of the existing graphic object and background.</td>
</tr>
<tr>
<td>UIS$C_MODE_BICN</td>
<td>On monochrome systems, the bits in the character cell, pattern, or bitmap image are logically .AND.ed with the existing graphic object and background. On mapped color systems, the writing index of the character cell, pattern, or bitmap image is logically .AND.ed with the pixel values of the existing graphic object and background.</td>
</tr>
<tr>
<td>UIS$C_MODE_BIS</td>
<td>The bits in the character cell, pattern, or bitmap image are logically .OR.ed with the existing graphic object and background. On mapped color systems, the writing index of the character cell, pattern, or bitmap image is logically .OR.ed with the pixel values of the existing graphic object and background.</td>
</tr>
</tbody>
</table>

\(^1\)These UIS writing modes produce device-dependent results. Depending on the specific operation, graphic objects drawn using these writing modes may appear differently on VAXstation monochrome and color systems.
### 9.4.1 Using General Attributes

General attributes affect all graphics images displayed on the screen. These attributes are background color, writing color (foreground), and writing mode.

#### 9.4.1.1 Programming Options

A program can set different background and writing colors for different display viewports for application-specific reasons or, simply, for variety.

**Setting the Background Color**

Modifying the background color attribute sets the value of an index into the color map. Modifying the background color affects how the current writing mode interprets the bits that comprise background color of the graphic object. You can set the background color attribute with `UIS$SET_BACKGROUND_INDEX`.

---

<table>
<thead>
<tr>
<th>UIS Writing Modes</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Device-Dependent^1</strong></td>
<td></td>
</tr>
<tr>
<td><strong>UIS$C_MODE_BISN</strong></td>
<td>On monochrome systems, the bitwise complement of the character cell, pattern, or bitmap image is logically .OR.ed with the existing graphic object and background. On color systems, the bitwise complement of the writing index of the character cell, pattern, or bitmap image is logically .OR.ed with the pixel values of the existing graphic object and background.</td>
</tr>
<tr>
<td><strong>UIS$C_MODE_COPY</strong></td>
<td>Displays the character cell, pattern, or bitmap image without regard to current background and writing color. On a VAXstation monochrome system, bits set to 0 are black, and bits set to 1 are white. On mapped color systems, the writing index of the character cell, pattern, or bitmap is used directly as an index.</td>
</tr>
<tr>
<td><strong>UIS$C_MODE_COPYN</strong></td>
<td>Displays the character cell, pattern, or bitmap image without regard to current background and writing color. On monochrome systems, bits set to 0 are white and bits set to 1 are black. On mapped color systems, the bitwise complement of the writing index of the character cell, pattern, or bitmap image is used directly as an index.</td>
</tr>
</tbody>
</table>

---

^1These UIS writing modes produce device-dependent results. Depending on the specific operation, graphic objects drawn using these writing modes may appear differently on VAXstation monochrome and color systems.
Setting the Writing Color

Modifying the writing color attribute sets the value of an index into the color map. Writing color affects the color of the graphic object. You can set the writing color with UIS$SET_WRITING_INDEX.

Setting the Writing Mode

The writing mode controls how background and foreground colors are used to draw graphic objects in the virtual display. You can specify the writing mode using UIS$SET_WRITING_MODE.

9.4.1.2 Program Development I

Programming Objective

To draw a graphic object in each of the UIS device-independent writing modes using the default background and writing color attribute settings.

Programming Tasks

1. Create a virtual display.
2. Create a display window and associated viewport.
3. Draw a line using the default overlay writing mode in the virtual display.
4. Draw a character at same location in each of the UIS writing modes.
5. Erase graphic objects in the virtual display using UIS$ERASE and delete the window using UIS$DELETE_WINDOW.
6. Repeat steps 3 through 5.

The font name MY_FONT_5 is a logical name.

```
PROGRAM MODE
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,3.0,0,3.0,6.0,5.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')
CALL UIS$PLOT(VD_ID,0.0,5.1,0.2,0,2.5)
PAUSE

CALL UIS$ERASE(VD_ID,0.0,0.0,0,3.0,3.0)
CALL UIS$DELETE_WINDOW(WD_ID)
PAUSE
```
9-10 General Attributes

```
WD_ID=UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION', 'OVERLAY')
CALL UIS$SET_FONT(VD_ID, 0, 1, 'MY_FONT_5')
CALL UIS$PLOT(VD_ID, 0, 0.5, 1.0, 2.0, 2.5)
CALL UIS$TEXT(VD_ID, 1, 'D', 1.0, 2.0)
PAUSE
CALL UIS$ERASE(VD_ID, 0, 0, 0.3, 0.3)
CALL UIS$DELETE_WINDOW(WD_ID)
PAUSE
WD_ID=UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION', 'OVERLAY NEGATE')
CALL UIS$SET_WRITING_MODE(VD_ID, 1, 1, 2, UIS$C_MODE_OVERN)
CALL UIS$PLOT(VD_ID, 0, 0.5, 1.0, 2.0, 2.5)
CALL UIS$TEXT(VD_ID, 2, 'D', 1.0, 2.0)
PAUSE
CALL UIS$ERASE(VD_ID, 0, 0, 0.3, 0.3)
CALL UIS$DELETE_WINDOW(WD_ID)
PAUSE
WD_ID=UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION', 'REPLACE')
CALL UIS$SET_WRITING_MODE(VD_ID, 2, 3, UIS$C_MODE_REPL)
CALL UIS$PLOT(VD_ID, 0, 0.5, 1.0, 2.0, 2.5)
CALL UIS$TEXT(VD_ID, 3, 'D', 1.0, 2.0)
PAUSE
CALL UIS$ERASE(VD_ID, 0, 0, 0.3, 0.3)
CALL UIS$DELETE_WINDOW(WD_ID)
PAUSE
WD_ID=UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION', 'REPLACE NEGATE')
CALL UIS$SET_WRITING_MODE(VD_ID, 3, 4, UIS$C_MODE_REPLN)
CALL UIS$PLOT(VD_ID, 0, 0.5, 1.0, 2.0, 2.5)
CALL UIS$TEXT(VD_ID, 4, 'D', 1.0, 2.0)
PAUSE
CALL UIS$ERASE(VD_ID, 0, 0, 0.3, 0.3)
CALL UIS$DELETE_WINDOW(WD_ID)
PAUSE
WD_ID=UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION', 'ERASE')
CALL UIS$SET_WRITING_MODE(VD_ID, 4, 5, UIS$C_MODE_ERAS)
CALL UIS$PLOT(VD_ID, 0, 0.5, 1.0, 2.0, 2.5)
CALL UIS$TEXT(VD_ID, 5, 'D', 1.0, 2.0)
PAUSE
```
The program MODE sets the writing mode attribute ten times. The letter D is placed over the line. Table 9–3 describes the behavior of the UIS writing modes when text or geometric shapes such as circles are placed on top of an existing graphic object. Remember character cells refer to text, while patterns refer to geometric shapes.

9.4.1.3 Calling UIS$SET_BACKGROUND_INDEX, UIS$SET_WRITING_INDEX, and UIS$SET_WRITING_MODE

To illustrate the effects of the writing modes, imagine that the character cell is slowly lowered onto the virtual display containing an existing graphic object drawn in OVERLAY mode—a line. As it approaches the plane of the virtual display, the writing mode of the character cell determines the final appearance of the graphic object. See Table 9–3 for a description of each writing mode.

The default background and writing color are in effect as shown in Figure 9–2.
Figure 9-2  UIS Device-Independent Writing Modes
Figure 9-2 (Cont.)  UIS Device-Independent Writing Modes

(Continued on next page)
9.4.1.4 Program Development II

Programming Objective

To illustrate the behavior of the device-dependent writing modes.

Programming Tasks

1. Create an eight-entry virtual color map containing intensity values.
2. Draw three overlapping circles—one in overlay mode and two in bit set mode.
3. Redraw the same circles—one in overlay mode, one in bit clear mode, and one in bit set mode.
4. Redraw two of the circles in the remaining device-dependent writing modes. One circle is always drawn in OVERLAY mode. Both are drawn using the same writing index.

```plaintext
PROGRAM PLANE_MODES
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
INCLUDE 'SYS$LIBRARY:UISENTRY'
REAL*4 I_VECTOR(8)
DATA I_VECTOR/O.0,0.125,0.25,0.375,0.50,0.625,0.75,1.0/  
DATA VCM_SIZE/8/  
DATA INDEX2/2/  
DATA INDEX4/4/  
```
VCM_ID = UIS$CREATE_COLOR_MAP(VCM_SIZE)
VD_ID = UIS$CREATE_DISPLAY(0.0, 0.0, 40.0, 40.0, 15.0, 15.0, VCM_ID)
WD_ID = UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION')
CALL UIS$SET_INTENSITIES(VD_ID, 0, 8, I_VECTOR)

CALL 'UIS$SET_FONT(VD_ID, 0, 1, 'UIS$FILL_PATTERNS')
CALL UIS$SET_FILL_PATTERN(VD_ID, 1, 1, PATT$C_FOREGROUND)

CALL UIS$SET_FONT(VD_ID, 0, 2, 'UIS$FILL_PATTERNS')
CALL UIS$SET_FILL_PATTERN(VD_ID, 2, 2, PATT$C_FOREGROUND)
CALL UIS$SET_WRITING_INDEX(VD_ID, 4, INDEX4)

CALL UIS$SET_WRITING_MODE(VD_ID, 2, 2, UIS$C_MODE_BIS)
CALL UIS$CIRCLE(VD_ID, 1, 15.0, 20.0, 10.0)
CALL UIS$CIRCLE(VD_ID, 2, 25.0, 20.0, 10.0)
CALL UIS$CIRCLE(VD_ID, 4, 20.0, 30.0, 10.0)

PAUSE

CALL UIS$SET_WRITING_MODE(VD_ID, 4, 4, UIS$C_MODE_BIC)
CALL UIS$CIRCLE(VD_ID, 1, 15.0, 25.0, 10.0)
CALL UIS$CIRCLE(VD_ID, 2, 25.0, 25.0, 10.0)

PAUSE

CALL UIS$ERASE(VD_ID)
CALL UIS$DELETE_WINDOW(WD_ID)

PAUSE

WD_ID = UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION')
CALL UIS$SET_WRITING_MODE(VD_ID, 2, 2, UIS$C_MODE_BICN)
CALL UIS$CIRCLE(VD_ID, 1, 15.0, 25.0, 10.0)
CALL UIS$CIRCLE(VD_ID, 2, 25.0, 25.0, 10.0)

PAUSE

CALL UIS$ERASE(VD_ID)
CALL UIS$DELETE_WINDOW(WD_ID)

PAUSE

WD_ID = UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION')
CALL UIS$SET_WRITING_MODE(VD_ID, 2, 2, UIS$C_MODE_BISN)
CALL UIS$CIRCLE(VD_ID, 1, 15.0, 25.0, 10.0)
CALL UIS$CIRCLE(VD_ID, 2, 25.0, 25.0, 10.0)

PAUSE

CALL UIS$ERASE(VD_ID)
CALL UIS$DELETE_WINDOW(WD_ID)

PAUSE
An array I_VECTOR is declared to hold the intensity values. Each location in the array element is initialized with an intensity value. The color map size variable is initialized to the number of color map entries. Color index variables index2 and index4 are initialized.

Three circles are drawn using three different indices in the virtual color map—index 1 (the default), index 2, and index 4. The circles are filled with the current foreground color. The following table lists the circles, their writing modes and indices and corresponding intensity values.

<table>
<thead>
<tr>
<th>Circle</th>
<th>Writing Mode</th>
<th>Writing Index</th>
<th>Intensity Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Overlay</td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>Bit Set</td>
<td>2</td>
<td>0.125</td>
</tr>
<tr>
<td>3</td>
<td>Bit Set</td>
<td>4</td>
<td>0.375</td>
</tr>
</tbody>
</table>

The three circles are redrawn with circle 3 drawn in Bit Clear mode.

In subsequent drawings, only overlapping circles 1 and 2 are redrawn. Circle one is always drawn in overlay mode while circle 2 is drawn in the remaining writing modes.
9.4.1.5 Using Device-Dependent Writing Modes

The preceding program PLANE-MODES produced Figures 9-3 through 9-8. In each of the figures, the circle on the left (circle 1) was drawn in overlay mode and writing index 1. The circle on the right (circle 2) was drawn in a different writing mode with a writing index 2. The circle on top (circle 3) was drawn with writing index 4 and is drawn in Figures 9-3 and 9-4 only. The following table lists the writing indices, their binary value and binary bitwise complements.

<table>
<thead>
<tr>
<th>Object</th>
<th>Writing Index</th>
<th>Binary Value</th>
<th>Bitwise Complement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td>0</td>
<td>000₂</td>
<td>000₂</td>
</tr>
<tr>
<td>Circle 1</td>
<td>1</td>
<td>001₂</td>
<td>110₂</td>
</tr>
<tr>
<td>Circle 2</td>
<td>2</td>
<td>010₂</td>
<td>101₂</td>
</tr>
<tr>
<td>Circle 3</td>
<td>4</td>
<td>100₂</td>
<td>011₂</td>
</tr>
</tbody>
</table>

In Figure 9-3, whenever the circles 1, 2, and 3 intersect, their writing indices 001₂, 010₂, and 100₂, are logically ORed with the pixel values of the existing graphic objects and the background. The bit set writing mode has the effect of combining the value of the bit plane settings of each object. Therefore, the intersections of the circles are lighter than the rest of the circles.
Figure 9-3  Bit Set Mode
In Figure 9-4, circle 3 is drawn in bit clear mode with a writing index of 4 or $100_2$. Circle 2 is drawn in bit set mode in writing index 2 or $010_2$. The binary bitwise complement of the writing index of circle 3 is $101_2$. It is logically AND.ed with the pixel values of the existing graphic objects—circle 1, circle 2, and the background. In bit clear mode the appropriate bit plane settings are now changed such that, circle 3 appears to blend into the background and circles 1 and 2.

**Figure 9-4  Bit Clear Mode**
In Figure 9–5 the binary bitwise complement of the writing index of the circle 2 is 101₂. It is logically .OR.ed with the pixel values of the existing graphic object and background which are 001₂ and 000₂. In bit set negate mode the appropriate bit plane settings are now changed such that all of circle 2 is drawn in writing index 5.

Figure 9–5  Bit Set Negate Mode
In Figure 9–6, the writing index of the circle 2 010₂ is logically .AND.ed with the pixel values of the existing circle 001₂ and the background 000₂ to produce the pixel value 000₂. The appropriate bit plane settings are now changed such that all of circle 2 including the area of intersection with circle 1 match the background.

**Figure 9–6  Bit Clear Negate Mode**
In figure 9-7 the writing index of circle 2 is used as the index in the virtual color map to draw the circle regardless of existing graphic objects or background.

Figure 9-7  Copy Mode
In Figure 9–8, the binary bitwise complement of the writing index of circle $2 \, 101_2$ was used as the index into the virtual color map to draw the circle regardless of existing graphic objects or background.

**Figure 9–8  Copy Negate Mode**
Chapter 10

Text Attributes

10.1 Overview

UIS draws characters in the virtual display according to the specifications of the particular font. The appearance or shape of characters remains unaltered unless an appropriate text attribute is changed. Likewise, UIS draws characters and character strings at user-specified locations within the coordinate space. This orientation within the coordinate space does not change unless an appropriate attribute modification routine is executed.

The orientation and shape of characters and character strings defines spatially how UIS draws these objects on the display screen. Text attribute modification routines allow you to alter the appearance of characters and character strings and redefine the spatial relationship of a character to other characters in significant ways. This chapter discusses the following topics:

- Structure of text
- Using text attributes

Refer to Section 10.3.1 for information about how to modify the default text attribute settings of attribute block 0.

10.2 Structure of Text

The underlying structure of a single character is a character cell. Every character drawn on the display screen is contained within a character cell. Figure 10–1 describes a character cell and its reference points.
10.2.1 Monospaced and Proportionally Spaced Fonts

For text drawing purposes fonts are either monospaced or proportionally spaced. Monospaced fonts use a standard character cell size for each character within the font. The character cells of proportionally spaced fonts vary in width for each character within the font, although the height of each cell is the same for each character in the font. Figure 10–2 shows the two types of fonts.

The character cell is a bitmap whose settings are mapped to the display screen as a character.

10.2.2 Lines of Text

Lines of text share a spatial relationship with other lines of text—for example, a line of text within a paragraph. Ordinarily, lines of English text are read from left to right. Your eyes trace an imaginary path across the page from the left margin to the right margin. By default UIS draws lines of text in this left-to-right direction known as the default major path. Normally, when you reach the end of the line, you would start reading the next line below this one. When UIS finishes drawing a line of text, the secondary downward movement to begin a new line of text drawing is known as the default minor path of text drawing. This is the normal relationship between lines of English text and the direction in which they are drawn. Figure 10–3 illustrates the two default paths that UIS uses to draw text.
Figure 10-2  Monospaced and Proportionally Spaced Characters

Figure 10-3  Text Path

Default Major Path

Default Minor Path

a night at the opera

a day at the zoo

ZK 5280-86

ZK 5467-86
10.2.3 Character Strings

Characters within character strings also share a spatial relationship with other members of the string.

Text Slope

UIS draws all characters of a character string at the same angle with respect to the major path. The actual path of text drawing is a line containing the baseline points of all the character cells in a character string. The angle between the actual path and the major path, measured counterclockwise, is called the angle of text slope. UIS can draw text at any angle from 0 to 360 degrees. Figure 10-4 describes how text slope can be manipulated.
Figure 10-4  Text Slope

\[ \angle \alpha = \text{Positive Text Slope} \]
\[ \angle \alpha = \text{Negative Text Slope} \]
Text Attributes

Text Margins

Character strings are drawn along the actual path of text drawing within certain explicit or implicit boundaries called *margins*. The implied text margin for all text output is the minor text path when the angle of text slope is 0 degrees. The programming interface lets you set explicit text margins that are always parallel to the implied margins.

Character Spacing

Spacing between characters and lines can be increased uniformly throughout the character string through the use of *x* and *y* spacing factors. The size of the characters remains constant; space between them diminishes or increases.

Figure 10–5 shows how text path affects character spacing.
Figure 10-5  Character Spacing

(Continued on next page)
Figure 10-5 (Cont.) Character Spacing
Text Formatting

Character strings can be arranged on a line in many ways through justification. Formatted character strings are drawn as follows: (1) flush against the left margin, (2) flush against the right margin, (3) centered between the margins, and (4) both right and left justified or fully justified.

10.2.4 Character Cell

The components of a character cell share a spatial relationship with each other. The orientation and shape of a single character cell in the virtual display can be altered through character rotation, slanting, and scaling. These attributes when modified alter the character cell with respect to its baseline vector. For example a scaled character may have its height modified changing the height-relationship. The resulting letter may appear “squat” or vertically elongated.

Rotating Characters

An individual character is rotated about its baseline point. The angle of character rotation is the angle between the baseline vector and the actual path of text drawing measured counterclockwise. Figure 10–6 describes simple character cell rotation about the baseline point.
Figure 10-6  Simple Character Rotation
Figure 10–7 describes character rotation and text slope manipulation performed simultaneously.

**Figure 10–7  Character Rotation with Slope Manipulation**
When the character rotation attribute is set to 0 and text slope is 0 degrees, the angle of character rotation behaves in the following manner:

<table>
<thead>
<tr>
<th>Slope (degrees)</th>
<th>Major Path</th>
<th>Rotation (degrees)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Left to right (default)</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>Bottom to top</td>
<td>-90</td>
</tr>
<tr>
<td>0</td>
<td>Right to left</td>
<td>-180</td>
</tr>
<tr>
<td>0</td>
<td>Top to bottom</td>
<td>-270</td>
</tr>
</tbody>
</table>

Figure 10-8 describes the appearance of the angle of rotation after text path modification when default character rotation is in effect.
Figure 10-8  Text Path Manipulation Without Character Rotation

Baseline Point

Baseline Vector = Actual Path
\angle \beta = 0^\circ

Angle of Slope = \angle \alpha = 0^\circ

Actual Path = Default Major Path

(Continued on next page)
Figure 10-8 (Cont.)  Text Path Manipulation Without Character Rotation

Angle of Slope - $\alpha - 0^\circ$

Baseline Vector $\perp$ Actual Path

$\beta - 90^\circ$

(Continued on next page)
Figure 10-8  (Cont.)  Text Path Manipulation Without Character Rotation

Angle of Slope = $\angle \alpha = 0^\circ$

Actual Path = Major Path

$\angle \beta = -180^\circ$

(Continued on next page)
Figure 10-8 (Cont.)  Text Path Manipulation Without Character Rotation

- Actual Path = Major Path
- Baseline Vector
- Baseline Vector ⊥ Actual Path
- Angle of Slope = ∠ α = 0°
Slanting Characters

Character slant is a measure of the angle between the up vector of the character cell and baseline vector. Character slant is 0.0 when this angle is 90 degrees. As slant increases, the up vector rotates clockwise toward the baseline vector, until at a slant of 90 degrees, the two vectors coincide. Figure 10–9 show a slanted character cell where the actual path and the default major path form an angle of 0 degrees.
Figure 10-9 Character Slanting

$\theta$ = Negative Character Slant

$\theta$ = Positive Character Slant
Figure 10–10 shows character slanting, character rotation, and text slope operations performed simultaneously on two character cells.

Figure 10–10  Character Slanting and Rotation with Slope Manipulation

(Continued on next page)
Scaling Characters

Character scaling involves increasing or diminishing the size of the character cell. Scaling factors specify the world coordinate space in which the scaled character is drawn. The character cell is expanded or contracted to fill the specified space.
10.3 Using Text Attributes

As you can see, there are several attributes associated with text output. You are not limited to simply choosing from a library of fonts. For example, you can modify the appearance of any font through scaling and slanting and also alter the way in which the system draws the text in the virtual display using formatting modes and paths.

The following routines are not attribute modification routines but included here to illustrates other types of text manipulation.

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$NEW_TEXT_LINE</td>
<td>Moves the current text position along the minor text path</td>
</tr>
<tr>
<td>UIS$SET_ALIGNED_POSITION</td>
<td>Sets the current text position at the upper-left corner of the character cell</td>
</tr>
<tr>
<td>UIS$SET_POSITION</td>
<td>Sets the current text position at the baseline point of the character cell</td>
</tr>
</tbody>
</table>

These routines contain an atb argument which indicates that appropriate text attribute settings can modify their behavior.
10.3.1 Modifying Text Attributes

When you modify text attributes, you do not change the default attribute settings within attribute block 0 itself. You should think of attribute block 0 as a template of default settings and you are modifying a copy of this attribute block for use within your program. Attribute modification routines contain two arguments—the input attribute block number (\texttt{iatb}) and the output attribute block number (\texttt{oatb}). Table 10-1 lists all text attributes and their default settings.

<table>
<thead>
<tr>
<th>Text Attribute</th>
<th>Default Setting</th>
<th>Modification Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Character rotation</td>
<td>0.0</td>
<td>\texttt{UIS$SET_CHAR_ROTATION}</td>
</tr>
<tr>
<td>Character size</td>
<td>Specified by the font</td>
<td>\texttt{UIS$SET_CHAR_SIZE}</td>
</tr>
<tr>
<td>Character slant</td>
<td>0.0</td>
<td>\texttt{UIS$SET_CHAR_SLANT}</td>
</tr>
<tr>
<td>Character spacing</td>
<td>0.0,0.0</td>
<td>\texttt{UIS$SET_CHAR_SPACING}</td>
</tr>
<tr>
<td>Text formatting</td>
<td>Normal</td>
<td>\texttt{UIS$SET_TEXT_FORMATTING}</td>
</tr>
<tr>
<td>Text margins</td>
<td>0.0,0.0</td>
<td>\texttt{UIS$SET_TEXT_MARGINS}</td>
</tr>
<tr>
<td>Text path</td>
<td>Left to right (default major path) top to bottom (default minor path)</td>
<td>\texttt{UIS$SET_TEXT_PATH}</td>
</tr>
<tr>
<td>Text slope</td>
<td>0.0</td>
<td>\texttt{UIS$SET_TEXT_SLOPE}</td>
</tr>
<tr>
<td>Font</td>
<td>Multinational ASCII, 14-point, fixed pitch</td>
<td>\texttt{UIS$SET_FONT}</td>
</tr>
</tbody>
</table>

Perform attribute modification using the following procedure:

1. Choose an appropriate attribute routine to modify the attribute.
2. Specify 0 as the \texttt{iatb} argument to obtain a copy of attribute block 0.
3. Specify a number from 1 to 255 as the \texttt{oatb} argument. The attribute block can then be referenced in subsequent UIS graphics and text routines or in any other attribute modification routine.

Graphics and text routines as well as \texttt{UIS\$MEASURE\_TEXT}, \texttt{UIS\$NEW\_TEXT\_LINE}, and \texttt{UIS\$SET\_ALIGNED\_POSITION} reference modified attribute blocks in the \texttt{atb} argument. These routines are discussed later in this chapter.
10.4 Programming Options

You can modify text attributes within your application to change the font type, margin settings, and character spacing.

Fonts

You can change the font type of a line of text using UIS$SET_FONT. You must specify the desired font file name in the font_id argument. Font files reside in the directory SYS$FONT. The directory contains one file of fill patterns (UIS$FILL_PATTERNS) and 26 font files. You can choose between two types of fonts.

- Multinational character fonts — Contain international alphanumeric characters, including characters with diacritical marks.
- Technical fonts — Include scientific and mathematical symbols.

Font File Names

A standard 31-character file name identifies each font file as follows:

DTERMINM060K00PG0001UZZZZ02A000

The first 16 bytes of this sample file name (representing unique font specifications) are explained in the following table.

<table>
<thead>
<tr>
<th>Field</th>
<th>Field Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registration code</td>
<td>D</td>
<td>Registered by DIGITAL</td>
</tr>
<tr>
<td>2-7</td>
<td>Type family ID</td>
<td>TERMIN</td>
<td>Terminal</td>
</tr>
<tr>
<td>8</td>
<td>Spacing</td>
<td>M36</td>
<td>13 pitch (monospaced)</td>
</tr>
<tr>
<td>9-11</td>
<td>Type size</td>
<td>06O36</td>
<td>24 points (240 decipoints)</td>
</tr>
<tr>
<td>12</td>
<td>Scale factor</td>
<td>K</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>13-14</td>
<td>Style</td>
<td>0036</td>
<td>Roman</td>
</tr>
<tr>
<td>15</td>
<td>Weight</td>
<td>P</td>
<td>Bold</td>
</tr>
<tr>
<td>16</td>
<td>Proportion</td>
<td>G</td>
<td>Regular</td>
</tr>
</tbody>
</table>

Refer to Appendix C for more information about UIS fonts.

NOTE: You can define logical names to represent font file names.
Font File Types

The following table lists sample font file names and their device-dependent font file types.

<table>
<thead>
<tr>
<th>System</th>
<th>Font File Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutinational Character Set Fonts</td>
<td></td>
</tr>
<tr>
<td>Monochrome</td>
<td>DTERMINM06OK00PG0001UZZZZ02A000.VWS$FONT</td>
</tr>
<tr>
<td>Intensity or color</td>
<td>DTERMINM06OK00PG0001UZZZZ02A000.VWS$VAFONT</td>
</tr>
<tr>
<td>Technical Character Set Fonts</td>
<td></td>
</tr>
<tr>
<td>Monochrome</td>
<td>DVWSVT0G03CK00GG0001QZZZZ02A000.VWS$FONT</td>
</tr>
<tr>
<td>Intensity or color</td>
<td>DVWSVT0G03CK00GG0001QZZZZ02A000.VWS$VAFONT</td>
</tr>
</tbody>
</table>

NOTE: Whenever you reference a font file name as in UIS$SET_FONT, you should not specify the directory SYS$FONT or the file type.

Setting the Text Margins

You can set the left and right margins with UIS$SET_TEXT_MARGINS.

Setting the Text Formatting Mode

There are four text formatting modes—left justification, right justification, center justification, and full justification. The text formatting modes are set using UIS$SET_TEXT_FORMATTING.

NOTE: UIS$SET_TEXT_FORMATTING does not automatically wrap long lines of text.

Setting the Character Spacing

You can alter the spacing between character, or kerning, or the spacing between lines, also known as leading, with UIS$SET_CHAR_SPACING.

New Text Lines

When you are writing text and you need to move to a new line, use UIS$NEW_TEXT_LINE. When you create a new line of text, the current position becomes the beginning of the new line. When used in conjunction with UIS$SET_CHAR_SPACING, you can manipulate the spacing between lines, or leading.

Character Rotation

You can rotate characters about a pivotal point called the baseline point from 0 to 360 degrees using UIS$SET_CHAR_ROTATION.
Aligning Text Along the Baseline and Top of Character Cell

You can align text along the baseline vector using UIS$SET_POSITION or along the upper-left corner of the character cell using UIS$SET_ALIGNED_POSITION.

Specifying Character Slant

You can specify the angle relative to the text baseline vector by which text is to be slanted using UIS$SET_CHAR_SLANT.

Specifying Character Scaling

You can specify the width and height for characters in a font using UIS$SET_CHAR_SIZE.

Specifying Slope of the Text Baseline

You can specify the angle of the actual path of text drawing relative to the major path using UIS$SET_TEXT_SLOPE.

Specifying the Text Path

You can specify the direction of text drawing with UIS$SET_TEXT_PATH. There are four directions in which text can be drawn: (1) left to right, (2) right to left, (3) bottom to top, and (4) top to bottom. You must use these direction in the context of a major text drawing path and a minor text drawing path. The major path of text drawing is the relationship between letters; the minor path is the relationship between lines.

10.4.1 Program Development I

Programming Objective

To draw the multinational character set fonts available in the directory SYS$FONT and to show how to move to a new text line.

Programming Task

1. Create a virtual display.
2. Create a display window and viewport.
3. Modify the font attribute in attribute block 0.
4. Move to the beginning of a new line using UIS$NEW_TEXT_LINE and the appropriate attribute setting.
5. Draw a line of text.
6. Repeat steps 3 through 5.
Note that font file names used in the program TEXT_1 are logical names. Some examples of a font occupy two lines.

```plaintext
PROGRAM TEXT_1
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,30.0,30.0,20.0,10.0)
WD_ID1=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','FONTS')

CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_1') ①
CALL UIS$TEXT(VD_ID,1,'The quality of mercy is not strained',
2 1.0,30.0) ②

CALL UIS$SET_FONT(VD_ID,0,2,'MY_FONT_2')
CALL UIS$NEW_TEXT_LINE(VD_ID,2) ③
CALL UIS$TEXT(VD_ID,2,'Long visits bring short compliments')

CALL UIS$SET_FONT(VD_ID,0,3,'MY_FONT_3')
CALL UIS$NEW_TEXT_LINE(VD_ID,3)
CALL UIS$TEXT(VD_ID,3,'Wise men make proverbs and fools')
CALL UIS$NEW_TEXT_LINE(VD_ID,3)
CALL UIS$TEXT(VD_ID,3,'repeat them')

CALL UIS$SET_FONT(VD_ID,0,4,'MY_FONT_4')
CALL UIS$NEW_TEXT_LINE(VD_ID,4)
CALL UIS$TEXT(VD_ID,4,'Je pense donc je suis')

CALL UIS$SET_FONT(VD_ID,0,5,'MY_FONT_5')
CALL UIS$NEW_TEXT_LINE(VD_ID,5)
CALL UIS$TEXT(VD_ID,5,'Do well and have well')

CALL UIS$SET_FONT(VD_ID,0,6,'MY_FONT_6')
CALL UIS$NEW_TEXT_LINE(VD_ID,6)
CALL UIS$TEXT(VD_ID,6,'You cannot make a crab walk straight')

CALL UIS$SET_FONT(VD_ID,0,7,'MY_FONT_7')
CALL UIS$NEW_TEXT_LINE(VD_ID,7)
CALL UIS$TEXT(VD_ID,7,'Great minds think alike')

CALL UIS$SET_FONT(VD_ID,0,8,'MY_FONT_8')
CALL UIS$NEW_TEXT_LINE(VD_ID,8)
CALL UIS$TEXT(VD_ID,8,'One today is worth two tomorrows')

CALL UIS$SET_FONT(VD_ID,0,9,'MY_FONT_9')
CALL UIS$NEW_TEXT_LINE(VD_ID,9)
CALL UIS$TEXT(VD_ID,9,'With Latin, a horse, and money, you may')
CALL UIS$NEW_TEXT_LINE(VD_ID,9)
CALL UIS$TEXT(VD_ID,9,'travel the world')
```
The font attribute in attribute block 0 is modified in fourteen calls to UIS$SET_FONT. There now exists an attribute block containing a modified font attribute for each font in SYS$FONT. These attribute blocks are identified by their output attribute block number when they were created.

The atb argument of UIS$TEXT uses the appropriate attribute block number to generate text in the desired font.

A call to UIS$NEW_TEXT_LINE causes each new line of text to begin on a new line at the left margin.

10.4.2 Calling UIS$SET_FONT and UIS$NEW_TEXT_LINE

Once again, note the positional order of the attribute routines. Attribute routines modify the attribute block used by the routine creating the graphic object and, therefore, must precede that routine. The attribute routine and the output routine must reference the same attribute block. Figure 10–12 contains examples of each of the UIS fonts.
The quality of mercy is not strained
Long visits bring short compliments
Wise men make proverbs and fools repeat them
Je pense donc je suis
Do well and have well
You cannot make a crab walk straight
Great minds think alike
One today is worth two tomorrows
With Latin, a horse, and money you may travel the world
Whispered words are heard afar
Et tu, Brute?
Per ardua astra
Velut arbor aevum
One mule scrubs another
Life is just a bowl of cherries
10.4.3 Program Development II

Programming Objective

To increase character and line spacing in two lines of text.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport with a title.
3. Draw a line of text using the default character spacing factor.
4. Modify the character and line spacing factors using UIS$SET_CHAR_SPACING.
5. Draw a line of text using the modified spacing attribute.
6. Move to the beginning of a new line using UIS$NEW_TEXT_LINE with the modified spacing attribute.
7. Repeat steps 3 through 5.

```
PROGRAM SPACE_1
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,40.0,40.0,18.0,6.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION', 'KERNING AND LEADING')

CALL UIS$SET_FONT(VD_ID,0,15,'MY_FONT_1') 1
CALL UIS$TEXT(VD_ID,15,'The best mirror is an old friend',0.0,40.0) 2
CALL UIS$NEW_TEXT_LINE(VD_ID,15) 3
CALL UIS$SET_CHAR_SPACING(VD_ID,15,16,3.0,3.0) 4
CALL UIS$TEXT(VD_ID,16,'The best mirror is an old friend') 5
CALL UIS$NEW_TEXT_LINE(VD_ID,16) 6
CALL UIS$TEXT(VD_ID,15,'In the coldest flint there is hot fire')

CALL UIS$NEW_TEXT_LINE(VD_ID,15)
CALL UIS$TEXT(VD_ID,16,'In the coldest flint there is hot fire')

PAUSE

END
```

A call to UIS$SET_FONT 1 sets the font attribute. The attribute block containing the newly modified font attribute is assigned the number 15. The logical name MY_FONT_1 denotes a font that is used throughout the program.

The first line of text is drawn in the appropriate font 2. The text is drawn at the location in the virtual display specified in UIS$TEXT.
When the next line of text is written, **UIS$NEW_TEXT_LINE** references attribute block number 15. **UIS$NEW_TEXT_LINE** uses the characteristics of the new font to determine proper line spacing. If you had used attribute block number 0, **UIS$NEW_TEXT_LINE** would use the characteristics of the default font. In that case, the descenders of letters in the previous line and the ascenders of the letters of the new line might crash into each other or obscure portions of letters in either line. Therefore, you should call **UIS$NEW_TEXT_LINE** using the appropriate attribute block number.

Attribute block 15 is further modified in a call to **UIS$SET_CHAR_SPACING**. Attribute block 15 containing the previously modified font attribute and now the newly modified character spacing attribute is assigned the number 16.

**NOTE:** Attribute block 15 still exists and can be referenced.

The character and line spacing attributes are set to a factor of 3. Characters are placed apart by a factor of 3 times their width. Lines of text are placed apart by a factor of 3 times the height of the character.

Text is drawn and spaced, character by character, according to the values specified in font attribute and the character spacing attribute in attribute block 16. The character spacing component of the character spacing attribute, or *x factor* determines spacing between characters for left-to-right and right-to-left text paths.

A call to **UIS$NEW_TEXT_LINE** creates a new text line using attribute block number 16. **UIS$NEW_TEXT_LINE** uses the line spacing component of the character spacing attribute, or *y factor* to determine spacing between lines. The *y* factor is used for top-to-bottom and bottom-to-top text paths.

### 10.4.4 Calling **UIS$SET_CHAR_SPACING**

You can call character spacing in one line of the previous example by calling **UIS$SET_CHAR_SPACING** as shown here.

**UIS$SET_CHAR_SPACING** specified a spacing factor of 3. If you ran this program with the changes described above, your workstation screen would display the graphic objects shown in Figure 10-13.
Figure 10-13  Character and Line Spacing

The best mirror is an old friend

In the coldest flint there is hot fire

The line now extends beyond the right margin of the display viewport.

10.4.5  Program Development III

Programming Objective

To alignment along the top of the character cell and along the baseline vector.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport with title.
3. Draw a horizontal line the width of the viewport.
4. Set the current position for text output at the leftmost point on the line using UIS$SET_ALIGNED_POSITION.
5. Choose a font and modify the font attribute block in attribute block 0.
6. Draw a line of text using the new font.
7. Repeat step 4 using UIS$SET_POSITION.

8. Repeat steps 5 and 6.

```
PROGRAM SET_POS
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,40.0,40.0,18.0,5.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','TEXT ALIGNMENT')

CALL UIS$PLOT(VD_ID,0.0,0.0,35.0,40.0,35.0) 1
CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_7')
CALL UIS$SET_ALIGNED_POSITION(VD_ID,1,0.0,35.0) 2
CALL UIS$TEXT(VD_ID,1,'Never refuse a good offer') 3
CALL UIS$PLOT(VD_ID,0.0,0.0,20.0,40.0,20.0) 4
CALL UIS$SET_POSITION(VD_ID,0.0,20.0) 5
CALL UIS$SET_FONT(VD_ID,0,2,'MY_FONT_5')
CALL UIS$TEXT(VD_ID,2,'Weigh justly and sell dearly') 6
PAUSE
END
```

Two horizontal and parallel lines are drawn with UIS$PLOT 1 4.

Both calls to UIS$SET_ALIGNED_POSITION and UIS$SET_POSITION 2 5 use the starting points of the respective lines to establish the current position for new text output unless the current position is specified in UIS$TEXT.

Text creation 3 6 begins by default at the current position established in UIS$SET_ALIGNED_POSITION and UIS$SET_POSITION.

10.4.6 Calling UIS$SET_POSITION and UIS$SET_ALIGNED_POSITION

The first sentence shown in Figure 10–14 illustrates the alignment of text along the top of the character cell. The second sentence is aligned on the baseline vector.
10.4.7 Program Development IV

Programming Objective

To draw characters at three different angles relative to the baseline vector.

Programming Tasks

1. Create a virtual display.
2. Create a display window and a viewport with a title.
3. Choose a font and modify the font attribute in attribute block 0.
4. Draw a character string at the default angle 0 degrees.
5. Modify the character slant attribute using UIS$SET_CHAR_SLANT.
6. Draw the character string again using the modified attribute block.
7. Repeat step 5 specify negative degrees.

The file name MY_FONT_12 is a logical name for a font in SYS$FONT.

```
PROGRAM SLANT
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE DISPLAY(0.0,0.0,20.0,5.0,18.0,4.5)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','CHARACTER SLANTING')
CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_12')  
CALL UIS$TEXT(VD_ID,1,'Unslanted characters do not lean',0.1,5.0)  
```
A font is selected using UIS$SET_FONT ①. A text string is drawn using the default attribute setting in attribute block 0 ②.

Next, the character slant attribute is modified ③ to specify a 25 degree shift to the right of a line perpendicular to the text baseline.

The character slant attribute is further modified ④ to specify a 25 degree shift to the left of a line perpendicular to the text baseline.

### 10.4.8 Calling UIS$SET_CHAR_SLANT

First, the character string is drawn at the default slant—0 degrees. Next, the character string is drawn twice slanting each character 25 degrees to the right of a line perpendicular to the text baseline and then 25 degrees to the left of that line.

**Figure 10-15 Character Slanting**

<table>
<thead>
<tr>
<th>Character Slanting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unslanted characters do not lean</td>
</tr>
<tr>
<td>Slanted characters lean forward</td>
</tr>
<tr>
<td>Slanted characters lean backward</td>
</tr>
</tbody>
</table>
10.4.9 Program Development V

Programming Objective

To draw a character string whose actual path increases at 20-degree increments from 0 to 340 degrees.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport.
3. Create DO loop that increases from 0 to 360 degrees by 20-degree increments.
   • Place the slope attribute modification routine UIS$SET_TEXT_SLOPE within the DO loop.
   • Place the text drawing routine UIS$TEXT within the DO loop.

The font file name MY_FONT_13 is a logical name for a font in SYS$FONT.

```
PROGRAM SLOPE
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,50.0,50.0,10.0,10.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','text slope')
CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_13') 1
DO I=0,340,20 2
   CALL UIS$SET_TEXT_SLOPE(VD_ID,1,2,FLOAT(I)) 3
   CALL UIS$TEXT(VD_ID,2,' Slope!',25.0,25.0) 4
ENDDO 5
PAUSE
END
```

A font is selected and the default font attribute setting is modified using UIS$SET_FONT 1.

A DO loop is established 2 5. The counter I is initialized to 0 and will increase by increments of 20. The angle argument in UIS$SET_TEXT_SLOPE uses the value of I as the new text baseline attribute setting 3. The VAX FORTRAN function FLOAT changes the integer counter I to a real number 3.

Using UIS$TEXT, text strings are drawn from a central point (25.0,25.0) at 20-degree intervals 4.
10.4.10 Calling UIS$SET_TEXT_SLOPE

Text strings are drawn at 20-degree intervals from 0 degrees to 360 degrees. The angle of each new text baseline increases by a multiple of 20. Text is drawn in a counterclockwise direction from the default horizontal baseline.

Figure 10-16  Manipulating the Text Baseline

10.4.11 Program Development VI

Programming Objective

To rotate each character in order to offset text slope.
Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport.
3. Create a DO loop.
4. Modify the attributes within the DO loop.

```plaintext
PROGRAM SLOPE_ROTATE
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,50.0,51.0,10.0,10.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION',2
   'TEXT SLOPE AND CHARACTER ROTATION')
CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_13')
DO I=0,340,20
   CALL UIS$SET_TEXT_SLOPE(VD_ID,1,2,FLOAT(I)) 1
   CALL UIS$SET_CHAR_ROTATION(VD_ID,2,2,FLOAT(-I)) 2
   CALL UIS$TEXT(VD_ID,2,' Rotate!',24.0,28.5)
ENDDO
PAUSE
END
```

This program is identical to the previous program SLOPE except that in addition to the text slope attribute we have modified the character rotation attribute. Within the DO loop, both attribute modification calls use the value of the counter I to increase the angles of text slope and character rotation for different purposes 1 2.

For every 20-degree increase in the angle of text slope, the angle of character rotation of each character must be decremented by -20 degrees. Consequently, each character's baseline vector remains parallel with the default major path.

10.4.12 Calling UIS$SET_CHAR_ROTATION

The program SLOPE_ROTATE draws a series of character strings from a center point from 0 to 360 degrees at 20-degree intervals. Because the angle of character rotation offsets exactly the angle of text slope, character maintain a readable orientation.
If you add a single call to modify the character slanting attribute, your viewport will display character rotation and slanting as the text slope from 0 to 360 degrees at 20-degree intervals as shown in Figure 10-18.
10.4.13 Program Development VII

Programming Objective

To manipulate the width and height of character through scaling.
Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport with title.
3. Draw a character string.
4. Increase the character size for width and height by 1.
5. Repeat steps 3 and 4.

Font names used in this program are logical names.

```fortran
PROGRAM CHARSIZE
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL*4 WIDTH,HEIGHT

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,70.0,90.0,12.0,16.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','CHARACTER SCALING')
CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_1')  
CALL UIS$TEXT(VD_ID,1,'Great scott!',0.0,90.0)  
CALL UIS$TEXT(VD_ID,1,2,'Great scott!',0.0,2.0)  
CALL UIS$TEXT(VD_ID,1,2,2,'Great scott!',0.0,80.0)  
CALL UIS$TEXT(VD_ID,1,2,3,'Great scott!',0.0,70.0)  
CALL UIS$TEXT(VD_ID,1,2,4,'Great scott!',0.0,4.0)  
CALL UIS$TEXT(VD_ID,1,2,5,'Great scott!',0.0,6.0)  
CALL UIS$TEXT(VD_ID,1,2,6,'Great scott!',0.0,40.0)  
CALL UIS$TEXT(VD_ID,1,2,7,'Great scott!',0.0,40.0)  
CALL UIS$TEXT(VD_ID,1,2,8,'Great scott!',0.0,30.0)  
CALL UIS$TEXT(VD_ID,1,2,9,'Great scott!',0.0,20.0)  
CALL UIS$TEXT(VD_ID,1,2,10,'Great scott!',0.0,10.0)
PAUSE
END
```

A font is selected 1.

The unscaled character string Great scott! is drawn in the virtual display 2.

The character string is redrawn as scaled text. The scale factors for the width and height are incremented 3 each time the character string is drawn 4.
10.4.14 Calling UIS$SET_CHAR_SIZE

Figure 10-19 shows the character string increasing in height and width as the scale factors are incremented.

Figure 10-19 Manipulating Character Size
Chapter 11

Graphics and Windowing Attributes

11.1 Overview

This chapter discusses the following topics:

- Creating dashed lines
- Creating lines of varying widths
- Using fill patterns
- Using clipping rectangles

11.2 Using Graphics Attributes

Graphics attributes affect arc type, line width, line style, and the use of fill patterns.

11.2.1 Modifying Graphics and Windowing Attributes

When you modify graphics and windowing attributes, you do not change the default attribute settings within attribute block 0 itself. You should think of attribute block 0 as a template of default settings and you are modifying a copy of this attribute block for use within your program. Attribute modification routines contain two arguments—the input attribute block number (iatb) and the output attribute block number (oatb). Table 11-1 lists the default settings of graphics and windowing attributes.
### Table 11-1 Default Settings of Graphics and Windowing Attributes

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Default Setting</th>
<th>Modification Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc type</td>
<td>Open</td>
<td>UIS$SET_ARC_TYPE</td>
</tr>
<tr>
<td>Fill pattern</td>
<td>Off</td>
<td>UIS$SET_FILL_PATTERN</td>
</tr>
<tr>
<td>Line style</td>
<td>Solid</td>
<td>UIS$SET_LINE_STYLE</td>
</tr>
<tr>
<td>Line width</td>
<td>1.0 (unscaled)</td>
<td>UIS$SET_LINE_WIDTH</td>
</tr>
<tr>
<td>Clipping rectangle</td>
<td>Off</td>
<td>UIS$SET_CLIP</td>
</tr>
</tbody>
</table>

Perform attribute modification using the following procedure:

1. Choose an appropriate attribute routine to modify the attribute.
2. Specify 0 as the \textit{iatb} argument to obtain a copy of attribute block 0.
3. Specify a number from 1 to 255 as the \textit{atb} argument. The attribute block can then be referenced in subsequent UIS graphics and text routines or in any other attribute modification routine.

Graphics and text routines reference modified attribute blocks in the \textit{atb} argument as well as UIS$MEASURE\_TEXT, UIS$NEW\_TEXT\_LINE, and UIS$SET\_ALIGNED\_POSITION.

### 11.2.2 Programming Options

Depending on the graphic object to be created—a line, a polygon, an ellipse, or circle—there are several attributes to choose from.

**Fill Patterns**

Fill patterns are used to add shading to geometric figures displayed on the workstation screen. Fill patterns are most often used to accentuate portions of a pie graph. Fill patterns range in coloration from light to heavy. Typically, light fill patterns connote light activity or minimal density in graphs. Heavy fill patterns connote the opposite meaning—heavy activity or maximum density.

You can also create your own fill pattern by selecting a character from any UIS font to serve as a fill pattern glyph.

All fill patterns are stored together in a font file in the directory SYS$FONT. For your convenience, this file name has been converted to a logical name UIS$FILL\_PATTERNS.
Select a fill pattern in the following manner:

1. Using UIS$SET_FONT, specify 0 to select a copy of attribute block 0 to modify or specify the number of a previously modified attribute block as the input attribute block.

2. Assign an output attribute block number to this newly modified attribute block in UIS$SET_FONT. This attribute block number allows you to keep track of attributes. You can also modify some other element in this attribute block later on.

3. Specify the name of the fill pattern file in UIS$SET_FONT. Use the predefined logical name for the fill pattern file is UIS$FILL_PATTERNS.

   If you wish to use a character from a font other than the default fill pattern file as fill pattern glyph, specify the appropriate font name.

4. Using UIS$SET_FILL_PATTERN, specify the actual fill pattern using a UIS symbol in the argument index. A UIS symbol in the form PATTC__xxx exists for each fill pattern and serves an index of each fill pattern in the file. The symbolic constant represents a hexadecimal offset indicating the fill pattern's position in the font file.

   If you are creating a fill pattern from a UIS font other than the default fill pattern file, specify the ASCII code of the desired character in the index of UIS$SET_FILL_PATTERNS.

   NOTE: To disable fill patterns without modifying the fill pattern attribute, do not specify the index argument in UIS$SET_FILL_PATTERNS.

Refer to Section 6.4 for more information about UIS constants.

Setting the Arc Type

Perhaps you want to draw a pie chart. You can draw chords or request that no chord be drawn using UIS$SET_ARC_TYPE and by specifying one of the constants shown in the following table.

<table>
<thead>
<tr>
<th>Arc Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_ARC_OPEN</td>
<td>Does not draw any chords</td>
</tr>
<tr>
<td>UIS$C_ARC_PIE</td>
<td>Draws a line from both end points of the arc to the center position</td>
</tr>
<tr>
<td>UIS$C_ARC_CHORD</td>
<td>Draws a line connecting the end points of the arc</td>
</tr>
</tbody>
</table>

Remember that fill patterns are not drawn in the arc when the arc type attribute is specified as OPEN.
11-4  Graphics and Windowing Attributes

Line Width
You can increase the apparent thickness of lines displayed on the workstation screen with UIS$SET_LINE_WIDTH. Note that this routine affects the thickness of lines created with UIS$LINE, UIS$LINE_ARRAY, UIS$PLOT, UIS$PLOT_ARRAY, and UIS$ELLIPSE only.

Line Style
Occasionally, a solid line is not exactly what you need. You can create dots, hyphens, and dashes with UIS$SET_LINE_STYLE.

11.2.2.1 Program Development I

Programming Objective
To draw the different arc types and to demonstrate their use with fill patterns.

Programming Tasks
1. Create a virtual display.
2. Create a display window and viewport with title.
3. Modify the arc type attribute using the chord arc type in the attribute block 0.
4. Draw an arc using UIS$CIRCLE with the modified attribute block.
5. Repeat steps 3 and 4.
6. Erase the virtual display and delete the display window.
7. Create a display window and viewport with an identifying title.
8. Modify the arc type attribute. Select the pie arc type.
9. Select a fill pattern.
   • Modify the font attribute in attribute block 0.
   • Modify the fill pattern attribute block 0.
10. Draw an arc using the modified arc type, font, and fill pattern attribute blocks.

```fortran
PROGRAM ARC
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,40.0,40.0,15.0,15.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,JSYS$WORKSTATIONJ,JCHORDANDPIEJ)

CALL UIS$SET_ARC_TYPE(VD_ID,0,6,UIS$C_ARC_CHORD)
CALL UIS$CIRCLE(VD_ID,6.5,0.0,20.0,15.0,0.0,150.0)
```
CALL UIS$SET_ARC_TYPE(VD_ID,0,1,UIS$C_ARC_PIE) ②
CALL UIS$CIRCLE(VD_ID,1,23.0,20.0,15.0,0.0,0.0,150.0)

PAUSE

CALL UIS$DELETE_WINDOW(WD_ID) ③
CALL UIS$ERASE(VD_ID) ④

PAUSE

WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','FILLED PIE') ⑤
CALL UIS$SET_ARC_TYPE(VD_ID,0,1,UIS$C_ARC_PIE)
CALL UIS$SET_FONT(VD_ID,1,2,'UIS$FILL_PATTERNS')
CALL UIS$SET_FILL_PATTERN(VD_ID,2,3,PATT$C_HORIZ2_6) ⑥
CALL UIS$CIRCLE(VD_ID,3,18.0,20.0,15.0,0.0,0.150.0)

PAUSE

END

The program ARC creates two arcs and specifies two ways of closing those arcs ①②.

In order to change the window caption, we delete the display window and its associated viewport ③. Because the second part of the program draws a new graphic object, we need to erase existing graphic objects ④.

A new display window is created and its viewport bears a new title. ⑤.

The new graphic object is another arc with a pie arc type and containing a fill pattern ⑥.

11.2.2.2 Calling UIS$SET_ARC_TYPE and Using Fill Patterns

Figure 11–1 describes two ways of closing an arc.
Figure 11-1  Closing an Arc
Finally, the second part of the program ARC executes and the fill pattern is drawn in the pie as shown in Figure 11–2.

Figure 11–2  Filling a Closed Arc
11.2.2.3 Program Development II

Programming Objective

To draw thickened lines.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport with a title.
3. Draw two horizontal lines the width of the viewport—one near the bottom of the viewport and one near the top of the viewport.
4. Draw a vertical line connecting the horizontal lines.
5. Modify the line width attribute in attribute block 0 by a factor of 2.
6. Repeat steps 4 and 5.

```
PROGRAM LINE_WIDTH
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,60.0,30.0,15.0,15.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','LINE WIDTH')

CALL UIS$PLOT(VD_ID,0,1.0,25.0,60.0,25.0) ..
CALL UIS$PLOT(VD_ID,0,1.0,5.0,60.0,5.0) ..
CALL UIS$PLOT(VD_ID,0,5.0,5.0,5.0,25.0) ..
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,2.0) ..
CALL UIS$PLOT(VD_ID,1,10.0,5.0,10.0,25.0) ..
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,4.0) ..
CALL UIS$PLOT(VD_ID,1,15.0,5.0,15.0,25.0) ..
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,6.0) ..
CALL UIS$PLOT(VD_ID,1,20.0,5.0,20.0,25.0) ..
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,8.0) ..
CALL UIS$PLOT(VD_ID,1,25.0,5.0,25.0,25.0)
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,10.0)
CALL UIS$PLOT(VD_ID,1,30.0,5.0,30.0,25.0)
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,12.0)
CALL UIS$PLOT(VD_ID,1,35.0,5.0,35.0,25.0)
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,14.0)
CALL UIS$PLOT(VD_ID,1,40.0,5.0,40.0,25.0)
```
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,16.0)
CALL UIS$PLOT(VD_ID,1,45.0,5.0,45.0,25.0)

CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,18.0)
CALL UIS$PLOT(VD_ID,1,50.0,5.0,50.0,25.0)

CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,20.0)
CALL UIS$PLOT(VD_ID,1,55.0,5.0,55.0,25.0)

PAUSE
END

Two parallel lines are drawn with normal thickness the width of the display window using UIS$PLOT • ③.

A vertical line of normal thickness is drawn ④.

Subsequent calls modify the line width attribute ⑤ and draw the resulting line ⑥ from the line in the lower half of the display window to the line in the upper half of the display screen.

11.2.2.4 Calling UIS$SET_LINE_WIDTH

Figure 11-3 shows lines are drawn from point to point with increasing thickness.

Figure 11-3  Line Width

NOTE: Extremely thick lines should be drawn using UIS$PLOT or UIS$PLOT_ARRAY to and UIS$SET_FILL_PATTERN construct filled rectangles.
11.2.2.5 Program Development III

Programming Objective

To draw various patterns of thickened dots and dashes.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport with title.
3. Modify the line width attribute to a thickness of 5 pixels.
4. Draw a solid thick line.
5. Modify the line style attribute.
6. Draw the dashed line.
7. Repeat steps 5 and 6.

```
PROGRAM LINE_STYLE
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,20.0,20.0,15.0,6.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','LINE STYLE AND WIDTH')

CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,5.0)
CALL UIS$PLOT(VD_ID,1,1,0,18.0,18.0,10.0)

CALL UIS$SET_LINE_STYLE(VD_ID,1,1,'FFFFFFFO'X)
CALL UIS$PLOT(VD_ID,1,1,0,14.0,18.0,10.0)

CALL UIS$SET_LINE_STYLE(VD_ID,2,1,'FOFOFOFO'X)
CALL UIS$PLOT(VD_ID,2,1,0,10.0,18.0,10.0)

CALL UIS$SET_LINE_STYLE(VD_ID,3,2,'90909090'X)
CALL UIS$PLOT(VD_ID,3,1,0,6.0,18.0,10.0)

CALL UIS$SET_LINE_STYLE(VD_ID,3,4,'10010010'X)
CALL UIS$PLOT(VD_ID,4,1,0,2.0,18.0,10.0)

PAUSE
END
```

Different line styles are created by selecting different hexadecimal values in the calls to UIS$SET_LINE_STYLE 1 2 3 4. The hexadecimal values set bits in the line style bit vector, which, in turn, generate a pattern.
11.2.2.6 Calling UIS$SET_LINE_WIDTH and UIS$SET_LINE_STYLE
When the program LINE_STYLE executes, five lines are drawn. Each line is drawn with the same width but different style. The pattern of dots and dashes is determined by the value supplied to the line style longword bit vector as shown in Figure 11-4.

Figure 11-4 Modifying Line Width and Style

11.2.2.7 Program Development IV
Programming Objective
To construct a vertical bar graph.

Programming Tasks
1. Load arrays from DATA statements.
2. Create a virtual display.
3. Create a display window and viewport with a title.
4. Draw the x and y axes.
5. Draw the legend.
6. Draw the information along the x axis.
7. Draw the information along the y axis.
8. Modify the font and fill pattern attributes.
9. Draw the vertical bars using the appropriate fill patterns to their proper heights using the arrays.

```plaintext
PROGRAM GRAPH
IMPLICIT INTEGER(A-Z)
CHARACTER*4 STRING
REAL ARRAY1(B), ARRAY2(B), X, X2, HEIGHT, Y
DATA ARRAY1 /5.0, 10.0, 12.0, 13.0, 15.0, 20.0, 25.0, 30.0/
DATA ARRAY2 /0.0, 1.0, 2.0, 1.0, 4.0, 9.0, 15.0, 21.0/
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
VD_ID=UIS$CREATE_DISPLAY(-5.0,-5.0,50.0,50.0,20.0,20.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','GRAPH')
CALL UIS$SET_LINE_WIDTH(VD_ID,0,16,5.0)
.. CALL UIS$PLOT(VD_ID,16,0,0,0,35.0) ..
CALL UIS$PLOT(VD_ID,16,0,0,45.0,0)
CALL UIS$TEXT(VD_ID,0,'U.S. ADULT POPULATION VS. CAR OWNERSHIP',
2 10.0,-3.0)
CD Information along the y axis
DO 20 I = 1,7
  Y = 5.0 * FLOAT(I)
  N = 25 * I
  ENCODE (3,10,STRING) N
10 FORMAT (I3)
20 CALL UIS$TEXT(VD_ID,0,STRING,-3.0,Y) CD Information along the x axis
DO 40 I = 1,8
  Y = 5.0 * FLOAT(I)
  N = 1900 + (10 * I)
  ENCODE (4,30,STRING) N
30 FORMAT (I4)
40 CALL UIS$TEXT(VD_ID,0,string,Y,-1.0)
CALL UIS$SET_FONT(VD_ID,0,1,'UIS$FILL_PATTERNS')
CALL UIS$SET_FILL_PATTERN(VD_ID,1,1,PATT$C_HORIZ4_4)
CALL UIS$SET_FILL_PATTERN(VD_ID,1,2,PATT$C_GREY12_16)
C PLOT POPULATION RECTANGLE
DO 100 I = 1,8
```
Two arrays, $ARRAY1$ and $ARRAY2$ are declared to store the height of each vertical bar in the graph.

The $x$ and $y$ axes are drawn. However, a previous call to $UIS\$SET\_LINE\_WIDTH$ has modified the attribute block controlling the appearance of lines. We have indicated that we want the width of the lines ($x$ and $y$ axes) to be five times wider than normal.

The legend of the graph is created in a call to $UIS\$TEXT$. The $y$ world coordinate values are computed as multiples of 5 where $I$ represents the number of passes through the DO loop. The adult population numbers will be written at these intervals.

The numbers along the $y$ axis are computed and stored in the variable $N$ and then returned to the variable $string$ as character string constants.

Before you create the rectangles to represent the eight vertical bars in the graph, you must specify the fill pattern—either an existing one or a new pattern. Because the font attribute has not been modified in our program, $UIS\$SET\_FONT$ uses a copy of attribute block 0 to set the font attribute. In this case, specify a font ID $UIS\$FILL\_PATTERNS$ to indicate that you want the file of fill patterns.

Now we must set the fill pattern attribute using $UIS\$SET\_FILL\_PATTERN$. The program must use two different fill patterns to contrast adult population vertical bars from automobile vertical bars.

The values previously assigned to each element of $ARRAY1$ and $ARRAY2$ control the height of the vertical bars.
11.2.2.8 Calling UIS$SET_FONT and UIS$SET_FILL_PATTERN

If you ran the program GRAPH now it would produce the vertical bar graph as shown in Figure 11-5.

Whenever you create a fill pattern, you must include UIS$SET_FONT and UIS$SET_FILL_PATTERN. The positional order of the calls is important. Calls to UIS routines that modify an attribute block must precede the call that creates the graphic object.

In order to produce the desired change in the resulting graphic object, the accompanying call to UIS$PLOT must reference the same output attribute block number.

11.2.3 Using the Windowing Attribute

The clipping rectangle attribute modifies the size of the viewable portion of the virtual display. It does not resize the display window or display viewport.

11.2.3.1 Programming Options

There is only one attribute, namely the clipping attribute, that controls what is visible through the display window and viewport.

Clipping Rectangle

Maybe you need to restrict drawing in the virtual display to a specified rectangle. You can create clipping rectangles that view a portion of your original display window using UIS$SET_CLIP. These rectangles are not display windows, but they can be used to partition your virtual display into discrete areas. They create an environment within your virtual display that can be visited whenever you reference the appropriate attribute block that contains a modified clipping rectangle attribute. Note that the clipping rectangle merely restricts drawing to an area. It does not change mapping between the virtual display and the display window.

11.2.3.2 Program Development

Programming Objective

To construct three clipping rectangles.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport with a title.
3. Choose a font and modify the font attribute.
4. Specify a clipping rectangle and modify the clipping attribute.
5. Draw a line of text using the modified font attribute with clipping disabled.
6. Draw a line of text using the modified font attribute with clipping enabled.
Figure 11-5  Vertical Bar Graph

U.S. ADULT POPULATION VS. CAR OWNERSHIP

(in millions)
7. Repeat steps 3 through 6 two more times.

Logical names have been defined for font file names.

```
PROGRAM CLIP
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,45.0,45.0,15.0,5.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','CLIPPING')

CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_5') ①
CALL UIS$SET_CLIP(VD_ID,1,5,1.0,1.0,10.0,40.0) ②
CALL UIS$TEXT(VD_ID,1,'Still waters run deep',0.0,40.0)
CALL UIS$NEW_TEXT_LINE(VD_ID,1)
CALL UIS$TEXT(VD_ID,5,'Still waters run deep')

CALL UIS$SET_FONT(VD_ID,0,2,'MY_FONT_6') ③
CALL UIS$NEW_TEXT_LINE(VD_ID,2)
CALL UIS$SET_CLIP(VD_ID,2,6,15.0,15.0,35.0,40.0) ④
CALL UIS$TEXT(VD_ID,2,'The sleepy fox has seldom feathered breakfasts')
CALL UIS$NEW_TEXT_LINE(VD_ID,2)
CALL UIS$TEXT(VD_ID,6,'The sleepy fox has seldom feathered breakfasts')

CALL UIS$SET_FONT(VD_ID,0,3,'MY_FONT_10') ⑤
CALL UIS$NEW_TEXT_LINE(VD_ID,3)
CALL UIS$SET_CLIP(VD_ID,3,7,7.0,5.0,30.0,40.0) ⑥
CALL UIS$TEXT(VD_ID,3,'When the wind is west, the fish bite best')
CALL UIS$NEW_TEXT_LINE(VD_ID,3)
CALL UIS$TEXT(VD_ID,7,'When the wind is west, the fish bite best')

PAUSE

END
```

Three fonts ① ② ③ are used to illustrate clipping rectangles. The call to UIS$SET_CLIP modifies the attribute block that controls clipping rectangle size. Each call to UIS$SET_CLIP ② ④ ⑥ specifies a different clipping rectangle size. Although, only one display viewport has been specified in this program, UIS$SET_CLIP creates many compartments within the display window.
11.2.3.3 Calling UIS$SET__CLIP
Your workstation screen would display the graphic objects shown in Figure 11–6.

Figure 11–6  Clipping rectangles

As you can see, UIS$SET__CLIP has altered the display window of the last three lines. Only portions of each lines are now visible.
Chapter 12

Inquiry Routines

12.1 Overview

Inquiry routines return program-specific information to the application; in this way, they behave like functions. However, unlike functions which return a single value through a return variable, certain UIS inquiry routines return data in two or more parameters in the argument list. This data can range from current attribute settings to current state of the pointer buttons. Your application program can use this data to establish context during program execution, to check for true or false conditions, or to verify that requested operation has been performed.

12.2 Inquiry Routines—How to Use Them

Many common graphics application programs rely on program-specific data such as the position of pointer devices or the font size and so forth. Inquiry routines return such data to the program. The data can be used as input to the application as you see fit. Such routines are more properly termed *functions* when used with high-level programming languages.

12.2.1 Using Inquiry Routines

Generally, UIS routines in the form UIS$GET_xxx return information to the application program. Some of these routines behave like functions and return a single value to the program, while others return more than one value in the argument list. In any case, these routines obtain data about text and font size, windows, keyboard attributes, pointer position, and attribute settings. Such data can be used as input to subsequent routines.
12-2 Inquiry Routines

12.2.1.1 Programming Options
Your application program can request the following types of application-specific information:

- Color information
- Display list information
- Graphics and text attributes
- Keyboard and pointer characteristics
- Windowing information

The inquiry routines are grouped functionally in Table 12-1.

Table 12-1 Inquiry Routines

<table>
<thead>
<tr>
<th>Inquiry</th>
<th>Information Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color1</td>
<td></td>
</tr>
<tr>
<td>UIS$GET_BACKGROUND_INDEX</td>
<td>Background color index</td>
</tr>
<tr>
<td>UIS$GET_COLOR</td>
<td>Single RGB color value in a color map entry</td>
</tr>
<tr>
<td>UIS$GET_COLORS</td>
<td>RGB color values</td>
</tr>
<tr>
<td>UIS$GET_HW_COLOR_INFO</td>
<td>Hardware color map characteristics</td>
</tr>
<tr>
<td>UIS$GET_INTENSITIES</td>
<td>Intensity values in virtual color map</td>
</tr>
<tr>
<td>UIS$GET_INTENSITY</td>
<td>Single intensity value in a virtual color map entry</td>
</tr>
<tr>
<td>UIS$GET_VCM_ID</td>
<td>Virtual color map identifier</td>
</tr>
<tr>
<td>UIS$GET_WRITING_INDEX</td>
<td>Writing color index</td>
</tr>
<tr>
<td>UIS$GET_WRITING_MODE</td>
<td>Writing mode</td>
</tr>
<tr>
<td>UIS$GET_WS_COLOR</td>
<td>Workstation standard color</td>
</tr>
<tr>
<td>UIS$GET_WS_INTENSITY</td>
<td>Workstation standard color intensity</td>
</tr>
</tbody>
</table>

Color Conversion2

<table>
<thead>
<tr>
<th>Routines</th>
<th>Information Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$HLS_TO_RGB</td>
<td>Converts HLS values to RGB color values</td>
</tr>
<tr>
<td>UIS$HSV_TO_RGB</td>
<td>Converts HSV values to RGB color values</td>
</tr>
<tr>
<td>UIS$RGB_TO_HLS</td>
<td>Converts RGB values to HLS color values</td>
</tr>
<tr>
<td>UIS$RGB_TO_HSV</td>
<td>Converts RGB values to HSV color values</td>
</tr>
</tbody>
</table>

1See Chapter 16 for more information about color and intensity inquiry routines.

2See Chapter 16 for more information about color conversion routines.
### Table 12-1 (Cont.) Inquiry Routines

<table>
<thead>
<tr>
<th>Inquiry</th>
<th>Information Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Display List</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$FIND_PRIMITIVE</td>
<td>Identifier of the next primitive in the specified rectangle</td>
</tr>
<tr>
<td>UIS$FIND_SEGMENT</td>
<td>Segment identifier of the next segment that contains objects in a specified rectangle</td>
</tr>
<tr>
<td>UIS$GET_CURRENT_OBJECT</td>
<td>Identifier of last object drawn in virtual display</td>
</tr>
<tr>
<td>UIS$GET_NEXT_OBJECT</td>
<td>Identifier of next object</td>
</tr>
<tr>
<td>UIS$GET_OBJECT_ATTRIBUTES</td>
<td>Object type</td>
</tr>
<tr>
<td>UIS$GET_PARENT_SEGMENT</td>
<td>Parent segment identifier</td>
</tr>
<tr>
<td>UIS$GET_PREVIOUS_OBJECT</td>
<td>Identifier of the previous object</td>
</tr>
<tr>
<td>UIS$GET_ROOT_SEGMENT</td>
<td>Root segment identifier</td>
</tr>
</tbody>
</table>

| **Graphics** | |
| UIS$GET_ARC_TYPE | Arc type used to close arc |
| UIS$GET_FILL_PATTERN | Fill pattern index and status |
| UIS$GET_LINE_STYLE | Line style vector |
| UIS$GET_LINE_WIDTH | Line width in pixels or as a world coordinate x-coordinate width |

| **Keyboard and Pointer** | |
| UIS$GET_ABS_POINTER_POS | Absolute position of the pointer |
| UIS$GET_BUTTONS | State of the pointer device buttons |
| UIS$GET_KB_ATTRIBUTES | Keyboard characteristics |
| UIS$GET_POINTER_POSITION | Position of pointer in world coordinates |
| UIS$GET_TB_INFO | Returns the characteristics of the tablet |
| UIS$GET_TB_POSITION | Position on tablet in centimeters |
| UIS$TEST_KB | Successful or unsuccessful connection between virtual and physical keyboard |

| **Text** | |
| UIS$GET_ALIGNED_POSITION | World coordinates along the x-height of the current position of the next character |
| UIS$GET_CHAR_ROT | Angle of character rotation in degrees |
| UIS$GET_CHAR_SIZE | If character scaling is enabled and the scaling factors used |
Table 12-1 (Cont.)  Inquiry Routines

<table>
<thead>
<tr>
<th>Inquiry</th>
<th>Information Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Text</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$GET_CHAR_SLANT</td>
<td>Angle of character slant in degrees</td>
</tr>
<tr>
<td>UIS$GET_CHAR_SPACING</td>
<td>Character and line spacing factor</td>
</tr>
<tr>
<td>UIS$GET_FONT</td>
<td>Font name</td>
</tr>
<tr>
<td>UIS$GET_FONT_ATTRIBUTES</td>
<td>All font character characteristics</td>
</tr>
<tr>
<td>UIS$GET_FONT_SIZE</td>
<td>Font size in centimeters</td>
</tr>
<tr>
<td>UIS$GET_LEFT_MARGIN</td>
<td>World coordinate of left margin</td>
</tr>
<tr>
<td>UIS$GET_POSITION</td>
<td>World coordinates of text baseline</td>
</tr>
<tr>
<td>UIS$GET_TEXT_FORMATTING</td>
<td>Formatting mode</td>
</tr>
<tr>
<td>UIS$GET_TEXT_MARGINS</td>
<td>Text margin settings for a line of text</td>
</tr>
<tr>
<td>UIS$GET_TEXT_PATH</td>
<td>Direction of text drawing</td>
</tr>
<tr>
<td>UIS$GET_TEXT_SLOPE</td>
<td>Angle of the text baseline in degrees</td>
</tr>
<tr>
<td>UIS$MEASURE_TEXT</td>
<td>Proportions of text in world coordinates</td>
</tr>
</tbody>
</table>

| **Windowing**                             |                                                      |
| UIS$GET_CLIP                              | Clipping rectangle                                   |
| UIS$GET_DISPLAY_SIZE                      | Display screen dimensions in centimeters             |
| UIS$GET_VIEWPORT_ICON                     | Whether or not the icon is occluded                  |
| UIS$GET_VIEWPORT_POSITION                 | Absolute position of display viewport on display screen |
| UIS$GET_VIEWPORT_SIZE                     | Dimensions of the display viewport in centimeters    |
| UIS$GET_VISIBILITY                        | Whether or not viewport is occluded                   |
| UIS$GET_WINDOW_ATTRIBUTES                 | Window and viewport attributes                        |
| UIS$GET_WINDOW_SIZE                       | Dimensions of the display window in world coordinates |
12.2.1.2 Program Development I

Programming Objective

To return font and viewport information in order to center text.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport with a title.
3. Obtain the font size for a particular character string, viewport size, and display screen size.
4. Choose a font and modify the font attribute block.
5. Draw a line of centered text in the viewport using the modified font attribute and the information from the inquiry routines.
6. Print the inquiry information in the terminal emulation window.
7. Repeat steps 3 through 6.

The font file names used in this program are logical names.

```plaintext
PROGRAM CENTER
IMPLICIT INTEGER(a-z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL F_WIDTH,F_HEIGHT,D_WIDTH,D_HEIGHT
REAL V_WIDTH,V_HEIGHT
VD_ID1=UIS$CREATE_DISPLAY(1.0, 1.0,15.0,2.0,15.0,2.0)
WD_ID1=UIS$CREATE_WINDOW(VD_ID1,'SYS$WORKSTATION','CENTERED TEXT')
CALL UIS$GET_FONT_SIZE('MY_FONT_7','Time has wings',2 F_WIDTH,F_HEIGHT)
CALL UIS$GET_DISPLAY_SIZE('SYS$WORKSTATION',D_WIDTH,D_HEIGHT)
CALL UIS$GET_VIEWPORT_SIZE(WD_ID1,V_WIDTH,V_HEIGHT)
CALL UIS$SET_FONT(VD_ID1,0,7,'MY_FONT_7')
CALL UIS$TEXT(VD_ID1,7,'Time has wings',2 (V_WIDTH-F_WIDTH)/2,
2V_HEIGHT)
PAUSE
PRINT 50
50 FORMAT(T10,'FIRST LINE',T39,'WIDTH',T51,'HEIGHT')
PRINT 75
75 FORMAT(T2,'-----------------------------------------------------',
2'------')
```
The three inquiry functions UIS$GET_FONT_SIZE, UIS$GET_DISPLAY_SIZE, and UIS$GET_VIEWPORT_SIZE are called 1 2 3. Each function returns data to uniquely specified variables within its argument list.

A logical name is defined 4 5 to represent the 31-character font file name. The first call to UIS$TEXT 6 places a text string in the window. The starting position for creating text is calculated from the expression in the argument list. VAX FORTRAN allow arithmetic expressions as arguments. 7 If your application is written in a programming language other than VAX FORTRAN, please refer to the appropriate language reference manual.
In order to center the text in this window, we subtracted the length of the text from the total width of the viewport and divided the result by 2. The distance of the text from the lower border of the window (the \( y \) coordinate) is equal to the value of the variable \( v\_height \), the height of the display viewport.

**12.2.1.3 Invoking UIS$GET_FONT_SIZE, UIS$GET_DISPLAY_SIZE, and UIS$GET_VIEWPORT_SIZE**

If you ran this program now, your workstation screen would display graphic objects as shown in Figure 12-1.

**Figure 12-1  Centering Text**

```
CENTERED TEXT

Time has wings
Forgive and forget
```

```
$ for/lie center
$ link center
$ run center
FORTRAN `PAUSE
$ continue

<table>
<thead>
<tr>
<th>FIRST LINE</th>
<th>WIDTH</th>
<th>HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>The dimensions of the font are:</td>
<td>6.46 cm.</td>
<td>0.85 cm.</td>
</tr>
<tr>
<td>The dimensions of the display are:</td>
<td>36.90 cm.</td>
<td>28.34 cm.</td>
</tr>
<tr>
<td>The dimensions of the viewport are:</td>
<td>14.99 cm.</td>
<td>1.97 cm.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SECOND LINE</th>
<th>WIDTH</th>
<th>HEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>The dimensions of the font are:</td>
<td>10.33 cm.</td>
<td>0.49 cm.</td>
</tr>
<tr>
<td>The dimensions of the display are:</td>
<td>36.90 cm.</td>
<td>28.34 cm.</td>
</tr>
<tr>
<td>The dimensions of the viewport are:</td>
<td>14.99 cm.</td>
<td>1.97 cm.</td>
</tr>
</tbody>
</table>
| FORTRAN PAUSE
$```

ZK-4555-85
Note that output from the FORTRAN PRINT or TYPE statement is not displayed in the window we have created. The TYPE and PRINT statements are equivalent to the logical names FOR$TYPE and FOR$PRINT which translate to the logical name SYS$OUTPUT. Only UIS$TEXT can write text to a virtual display.

12.2.1.4 Program Development II

Programming Objective

To construct a pie graph illustrating the operating budget of a small New England town.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport with a title.
3. Choose a font and modify the font attribute.
4. Print the title of the graph using the modified font attribute.
5. Obtain font information.
6. Modify the arc type attribute.
7. Choose a fill pattern and modify the font attribute and the fill pattern attribute.
8. Draw an arc using the modified fill pattern attribute.
9. Draw part of the legend to appear below the pie graph.
10. Obtain and print arc type and fill pattern information.
11. Repeat steps 6 through 9.

```
PROGRAM PIE_GRAPH
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
CHARACTER*32 BUFFERDESC
LOGICAL*4 FILL_ENABLED
VD_ID=UIS$CREATE_DISPLAY(-3.0,-3.0,25.0,25.0,15.0,15.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION' ,'PIE GRAPH')
CALL UIS$SET_FONT(VD_ID,0,9, 'MY_FONT_10')
CALL UIS$TEXT(VD_ID,9,'OPERATING BUDGET',6.0,24.0)
CALL UIS$TEXT(VD_ID,9,'TOWN OF GREENWICH, MASS.',4.0,22.0)
CALL UIS$GET_FONT(VD_ID,9,BUFFERDESC,LENGTH)  
PRINT 10,BUFFERDESC
10 FORMAT(T2,'THE FONT NAME IS' ,T20,A31)
```
The program PIE_GRAPH returns information about the heading of the graph. A call to `UIS$GET_FONT` identifies the font and its length. The font `MY_FONT.IO` is a logical name for a 31-character font file name.

Attribute block 1 contains the modified arc type attribute. When a new section of the arc is drawn, it will have a pie arc type which enables fill pattern.
Arc type information is returned in the variable `arc_type`.

A call to `UIS$GET_FILL_PATTERN` tests whether fill patterns are enabled. Fill pattern information is returned in the variable `fill_enabled` as a Boolean value.

12.2.1.5 Invoking `UIS$GET_ARC_TYPE`, `UIS$GET_FILL_PATTERN`, and `UIS$GET_FONT`

The program `PIE_GRAPH` draws a pie graph containing four fill patterns and requests and displays certain program-specific information as shown in Figure 12-2.
Figure 12-2 Pie Graph

**Operating Budget**

**Town of Greenwich, Mass.**

- **Fire**
- **Sanitation**
- **Police**
- **Schools**

**VT100 Terminal**

```
$ for/lis pie_graph
$ link pie_graph
$ run pie_graph
THE FONT NAME IS MY_FONT_10
THE LENGTH OF THE FONT NAME IS 10 CHARACTERS
THE ARC TYPE IS 1
IS THE FILL PATTERN ENABLED? T
FORTRAN PAUSE
```

ZK-4556-85
Chapter 13
Display Lists and Segmentation

13.1 Overview

As you have seen so far, you can use your applications to construct different types of graphic objects. Programs containing code for complex graphic objects can pose a problem because of their sheer size. In any case, the increasing complexity of your displays will require that you understand display list concepts. This chapter discusses the following topics:

• Creating and searching segments
• Editing and walking the display list
• Disabling display lists
• Creating UIS metafiles
• Attaching private data to graphic objects

You can view creating complex objects as an opportunity to reduce the complexity of your graphic object and to modularize your coding through the use of segmentation.

13.2 Display Lists

UIS constructs a display list of encoded commands for graphics. These display lists remain resident in memory for use by UIS routines. Figure 13-1 shows the format of an entry in the display list.
UIS signals an error if it encounters an invalid opcode. Whenever you call UIS routines to create graphic objects or modify attribute blocks, you have added an entry to a display list. Only one display list exists for each virtual display.

A display list is a device-independent encoding of the exact contents of the virtual display. UIS maintains display lists for the following purposes:

- Automatic management of panning, zooming, resizing, and duplication of display windows
- High resolution printing of physical and virtual displays
- Structuring and manipulation of graphic objects in the virtual display
- Storing the contents of the virtual display in a buffer for later reexecution

### 13.3 Segments

A segment consists of calls to UIS graphics and text routines and any nested segments. Segments are created explicitly with a call to UIS$BEGIN_SEGMENT, and are terminated with a call to UIS$END_SEGMENT. A complex display list is a hierarchy of nested segments.

Any segment or output (graphic and text) routine not contained in an explicitly created segment is part of a top-level root segment.

The primary purpose of segmentation of graphics routines is to facilitate transformations—scaling, rotation, and translation. Segmentation also modularizes attributes. Complex graphic objects can be constructed in parts where each logical grouping of display list entries is contained within a segment. Such segments could be transformed or displayed individually and independently of the rest of the object. Changing attributes within a segment will not affect the attribute settings of a higher-level segment.
For example, a house, a barn, and landscape are constructed as three logical groupings, or subpictures of a complex display. Each subpicture is a segment of appropriate UIS routines. You could manipulate all three subpictures independently of each other.

Figure 13–2 shows a tree diagram of a display list containing nested segments. The diagram should be read from left to right and downward whenever a segment is encountered until there are no more segments. Read each level to the right and move upward to the next level where you left off.

**Figure 13–2 Nested Segments**

13.3.1 **Identifiers and Object Types**

There are many types of UIS identifiers—for example, virtual display identifier, virtual keyboard identifier, transformation identifier, and so on. Identifiers allow your application to reference and manipulate internal objects. Managing the display list involves (1) traversing the display list downward object by object, (2) searching a segment, and (3) traversing upward through the segment path.
Segments

Each segment has a unique identifier returned by UIS$BEGIN_SEGMENT. If no segments were explicitly declared using UIS$BEGIN_SEGMENT, then the root segment has a unique identifier that can be used to manipulate the display list.

Objects

Every object in the virtual display has an object identifier. However, not all routines return identifier explicitly. Object and segment identifiers are useful in walking and editing the display list. They are used as reference points within complex display lists.

The identifier may not always be part of the calling sequence and sometimes must be returned using another UIS routine. For example, none of the graphics and text routines return identifiers explicitly. You can obtain the identifier using one of the routines listed in the table. The following table lists identifiers and the UIS routines that return them.

<table>
<thead>
<tr>
<th>Graphic Object</th>
<th>Identifier</th>
<th>Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Segment</td>
<td>seg_id</td>
<td>UIS$BEGIN_SEGMENT</td>
</tr>
<tr>
<td>Root segment</td>
<td>root_id</td>
<td>UIS$GET_ROOT_SEGMENT</td>
</tr>
<tr>
<td>Parent segment</td>
<td>parent_id</td>
<td>UIS$GET_PARENT_SEGMENT</td>
</tr>
<tr>
<td>Graphic objects</td>
<td>prev_id</td>
<td>UIS$GET_PREVIOUS_OBJECT</td>
</tr>
<tr>
<td></td>
<td>current_id</td>
<td>UIS$GET_CURRENT_OBJECT</td>
</tr>
<tr>
<td></td>
<td>next_id</td>
<td>UIS$GET_NEXT_OBJECT</td>
</tr>
</tbody>
</table>

\(^1\text{UIS$BEGIN\_SEGMENT$ returns the segment identifier in a return variable, }\text{seg\_id.}\)

Object Types

Even though you can manipulate the display list using segment and object identifiers, you still need to further identify those objects within a segment. You need to know exactly what type of object the display list entry is. The object type refers to the way UIS categorizes graphic objects and segments. There are six object types represented by the symbols listed here.
Display Lists and Segmentation

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Graphic Object</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_OBJECT_SEGMENT</td>
<td>New segment</td>
</tr>
<tr>
<td>UIS$C_OBJECT_PLOT</td>
<td>Point, line, or polygon</td>
</tr>
<tr>
<td>UIS$C_OBJECT_TEXT</td>
<td>Text</td>
</tr>
<tr>
<td>UIS$C_OBJECT_ELLIPSE</td>
<td>Ellipse or circle</td>
</tr>
<tr>
<td>UIS$C_OBJECT_IMAGE</td>
<td>Raster image</td>
</tr>
<tr>
<td>UIS$C_OBJECT_LINE</td>
<td>Unconnected lines</td>
</tr>
</tbody>
</table>

UIS$GET_OBJECT_ATTRIBUTES returns object type information.

13.3.2 Programming Options

The behavior of display lists and segmentation can best be described separately. From the options available below, we will construct two programs. The first program illustrates disabling display lists, while the second demonstrates walking the display list.

Creating Segments

You can create an unlimited number of segments explicitly with UIS$BEGIN_SEGMENT and UIS$END_SEGMENT. UIS returns a unique identifier for each newly created segment that can be used by appropriate UIS routines to locate and edit segments. In addition, you can nest segments within segments.

**NOTE:** If UIS$BEGIN_SEGMENT is called and no graphics and text routines are called before UIS$END_SEGMENT is called, the segment is deleted and the identifier returned is no longer valid. If you wish to create an empty segment, call UIS$BEGIN_SEGMENT followed by UIS$PRIVATE. This sequence places private data in the segment and UIS$END_SEGMENT will not consider the segment empty.

Enabling and Disabling Display Lists

Disabling a display list prevents new additions from being added to the list. Display lists are enabled and disabled explicitly with UIS$ENABLE_DISPLAY_LIST and UIS$DISABLE_DISPLAY_LIST. You can enable and disable a display list any number of times within a program. However, to see the results of disabling a display list, you **must** execute the display list. UIS$EXECUTE can be used to execute the display list. The following routines may also cause the display list to be executed.
Display Lists and Segmentation

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$CREATE_WINDOW</td>
<td>Creates a display window and viewport</td>
</tr>
<tr>
<td>UIS$DELETE_OBJECT&lt;sup&gt;1&lt;/sup&gt;,&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Deletes an object in the virtual display</td>
</tr>
<tr>
<td>UIS$EXECUTE&lt;sup&gt;2&lt;/sup&gt;,&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Executes the display list</td>
</tr>
<tr>
<td>UIS$MOVE_AREA&lt;sup&gt;3&lt;/sup&gt;,&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Moves a portion of the virtual display another part of the virtual display</td>
</tr>
<tr>
<td>UIS$MOVE_WINDOW&lt;sup&gt;4&lt;/sup&gt;,&lt;sup&gt;5&lt;/sup&gt;</td>
<td>Redefines the display window coordinate space.</td>
</tr>
</tbody>
</table>

1 UIS$DELETE_OBJECT executes the display list only when the object to be deleted occluded another object.

2 UIS$EXECUTE executes the entire display list, if buflen and bufaddr are not specified.

3 UIS$MOVE_AREA executes the display list only if the specified source and destination rectangles lie within a display window.

4 UIS$MOVE_WINDOW executes the display list only if the window size is changed.

5 This routine checks display list flags.

The position of UIS$DISABLE_DISPLAY_LIST and UIS$ENABLE_DISPLAY_LIST in your program is important. If the display list is disabled after the display list is executed, the viewport displays all the graphic objects drawn in the virtual display. If the display list is disabled before one of the routines listed above is called, the viewport displays none of the graphic objects created between calls to UIS$DISABLE_DISPLAY_LIST and UIS$ENABLE_DISPLAY_LIST. No binary instructions were added to the display list.

Walking the Display List

You can traverse, or walk the entire display list from top to bottom and from object to object using UIS$GET_ROOT_SEGMENT and UIS$GET_NEXT_OBJECT.

Searching a Segment

If the display list contains segments, you can search the contents of any segment in the display list with UIS$GET_NEXT_OBJECT.

Traversing the Segment Path

Because the root segment is the ultimate parent segment, every nested segment has a parent segment. The root segment acts as the parent for all level-one segments. See Figure 13–2. A segment identifier identifies the beginning of each segment in a display list. The segment identifiers within a display list comprise its segment path. You can traverse the segment path from the innermost segment outward with UIS$GET_PARENT_SEGMENT.
13.3.3 Program Development I

Programming Objective

To disable a display list.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport.
3. Disable the display list.
4. Draw some graphic objects in the virtual display.
5. Reenable the display list.
6. Draw some graphic objects in the virtual display.
7. Create a second display window and viewport.

PROGRAM LIST

```
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(-1.0,-1.0,50.0,50.0,10.0,10.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','MORE')

CALL UIS$DISABLE_DISPLAY_LIST(VD_ID)

c Disable the display list

CALL UIS$CIRCLE(VD_ID,O, 15.0, 15.0, 5.0)
CALL UIS$CIRCLE(VD_ID,O, 5.0, 5.0, 5.0)
CALL UIS$PLOT(VD_ID,O,27.0,17.0,35.0,17.0,35.0,24.0,27.0,24.0,
            27.0,17.0)
CALL UIS$CIRCLE(VD_ID,O,35.0,35.0,8.0)
CALL UIS$PLOT(VD_ID,O,5.0,30.0,15.0,30.0,10.0,40.0,5.0,30.0)

PAUSE

c Reenable the display list

CALL UIS$ENABLE_DISPLAY_LIST(VD_ID)

c Draw circle and triangle

CALL UIS$CIRCLE(VD_ID,O,33.0,35.0,8.0)
CALL UIS$PLOT(VD_ID,O,7.0,31.0,17.0,31.0,12.0,41.0,7.0,31.0)

PAUSE

WD_ID1=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','LESS')

PAUSE

END
```
Initially, a display window and viewport labelled MORE are created ①. The world coordinate range of the window defaults to that of the virtual display.

The display list is disabled ②.

Five graphic objects are drawn in the virtual display—three circles, a triangle, and a square. Even though all five objects appear in the viewport MORE, no entries are added to the display list.

After the PAUSE statement, the display list is reenabled ③ and a triangle and another circle are drawn ④ ⑤.

Remember the first call to UIS$CREATE_WINDOW was executed before the display list was disabled. Therefore, objects drawn in the virtual display and within the display window are displayed in the viewport, but are not added to the display list.

Finally, the second display window and viewport labelled LESS are created ⑥. The display list is executed and all objects except those included within the disable-enable request appear in the viewport LESS.

13.3.3.1 Calling UIS$DISABLE_DISPLAY_LIST and UIS$ENABLE_DISPLAY_LIST

When the program executes, the viewport MORE is displayed first as shown in Figure 13–3.

Figure 13–3 Disabling a Display List
Type CONTINUE at the dollar sign prompt ($). Figure 13-4 shows both viewports MORE and LESS. Note that the second call to UIS$CREATE_WINDOW executes the display list.

**Figure 13-4  After Display List Execution**

---

13.3.3.2 Program Development II

**Programming Objective**

To traverse the entire display list and examine each object type.

**Programming Tasks**

1. Create a virtual display.
2. Draw graphic objects in the virtual display.
3. Print headings for the output in the emulation window.
4. Obtain the identifier of the root segment.
5. Walk downward through the display list.
6. Examine each object type and place its identifier in one of five arrays.
The program WALK draws objects in a virtual display and then identifies each object by walking the entire display list and examining the various object type values. The program also shows how you can collect and store object identifiers according to object type. If you intend to run program WALK, the subroutine DETERMINE should be compiled as a separate module and linked with WALK.

PROGRAM WALK
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
COMMON NEXT_ID1, TYPE1 ..

VD_ID1 = UIS$CREATE_DISPLAY(0.0, 0.0, 40.0, 40.0, 20.0, 20.0) ②

CALL UIS$CIRCLE(VD_ID1, O, 15.0, 15.0, 6.0)
CALL UIS$PLOT(VD_ID1, O, 1.0, 1.0, 20.0, 1.0, 20.0, 8.0, 1.0, 1.0)
CALL UIS$PLOT(VD_ID1, O, 20.0, 20.0, 40.0, 20.0, 30.0, 35.0, 20.0, 20.0, 20.0)
CALL UIS$PLOT(VD_ID1, O, 3.0, 25.0, 13.0, 25.0, 13.0, 35.0, 25.0)
CALL UIS$TEXT(VD_ID1, O, 'The footsteps of fortune are slippery', 2)
CALL UIS$NEW_TEXT_LINE(VD_ID1, O)
CALL UIS$TEXT(VD_ID1, O, 'Mirth without measure is madness')

PRINT 10
10 FORMAT(T2, 'DISPLAY LIST ELEMENTS')
PRINT 20
20 FORMAT(T1, '--------------------------------------------')
PRINT 30
30 FORMAT(T2, 'IDENTIFIER', T17, 'OBJECT TYPE')

ROOT_ID1 = UIS$GET_ROOT_SEGMENT(VD_ID1) ③
NEXT_ID1 = ROOT_ID1

C Walk the display list
DO WHILE (NEXT_ID1 .NE. 0)
  TYPE1=UIS$GET_OBJECT_ATTRIBUTES(NEXT_ID1)
  CALL DETERMINE
  NEXT_ID1=UIS$GET_NEXT_OBJECT(NEXT_ID1)
ENDDO

WD_ID1=UIS$CREATE_WINDOW(VD_ID1,'SYS$WORKSTATION')
PAUSE
END

SUBROUTINE DETERMINE
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
INTEGER*4 SEG_ARRAY(6),PLOT_ARRAY(6),TEXT_ARRAY(6),ELLIP_ARRAY(6)
INTEGER*4 LINE(6),IMAGE(6)
DATA H,I,J,K,L,M/1,1,1,1,1,1/ COMMON NEXT_ID1,TYPE1
IF (TYPE1 .EQ. UIS$C_OBJECT_SEGMENT) THEN
  SEG_ARRAY(H)= NEXT_ID1
  PRINT 40,SEG_ARRAY(H),TYPE1
  H = H + 1
ENDIF
IF (TYPE1 .EQ. UIS$C_OBJECT_PLOT) THEN
  PLOT_ARRAY(I) = NEXT_ID1
  PRINT 50,PLOT_ARRAY(I),TYPE1
  I = I + 1
ENDIF
IF (TYPE1 .EQ. UIS$C_OBJECT_TEXT) THEN
  TEXT_ARRAY(J) = NEXT_ID1
  PRINT 55,TEXT_ARRAY(J),TYPE1
  J = J + 1
ENDIF
IF (TYPE1 .EQ. UIS$C_OBJECT_ELLIPSE) THEN
  ELLIP_ARRAY(K) = NEXT_ID1
  PRINT 60,ELLIP_ARRAY(K),TYPE1
  K = K + 1
ENDIF
The variables next_id1 and type1 are used in both the main program and the subroutine DETERMINE. The COMMON statement ensures access to data stored in both locations by both the main program and the subroutine 18.

A virtual display is created 2. As objects are drawn in the virtual display, display list entries in the form of encoded binary data identifying the particular objects are added to the display list. Only one display list is created for each virtual display.

Because the entire display list is to be traversed, the root segment will be the starting point and its identifier must be returned 6.

A DOWHILE loop 4 implements traversing the display list through successive calls to UIS$GET_NEXT_OBJECT 7.

An object type for each display list entry is returned 5.

Within the DOWHILE loop the subroutine DETERMINE is called 6 which sorts each object identifier according to its object type 18. For more information about object type symbols such as UIS$C_OBJECT_PLOT, see UIS$GET_OBJECT_ATTRIBUTES.

Five arrays for each object type represented in the display list are declared 19. Each object identifier is stored in one of these arrays. All counter variables have been initialized to the value 1 19.

A call to UIS$CREATE_WINDOW creates a display window and viewport and executes the contents of the display list in the virtual display 9.
13.3.3 Calling UIS$GET_NEXT_OBJECT, UIS$GET_OBJECT_ATTRIBUTES, and UIS$GET_ROOT_SEGMENT

The program WALK walks the display list and identifies each object in the display list. Information about each object is returned in the terminal emulation window as shown in Figure 13–6.

Figure 13-6  Display List Elements

```
$ run walk
DISPLAY LIST ELEMENTS
-----------------------------
IDENTIFIER OBJECT TYPE
113992   UIS$C_OBJECT_SEGMENT
115328   UIS$C_OBJECT_ELLIPSE
115575   UIS$C_OBJECT_PLOT
115822   UIS$C_OBJECT_PLOT
116069   UIS$C_OBJECT_PLOT
116316   UIS$C_OBJECT_PLOT
116810   UIS$C_OBJECT_TEXT
117057   UIS$C_OBJECT_TEXT
FORTRAN PAUSE
$ 
```

The program WALK also creates a display window and viewport containing the objects in the virtual display.
Figure 13-7 Contents of the Display List

The footsteps of fortune are slippery
Mirth without measure is madness
13.3.3.4 Program Development III

Programming Objective

To create a display list with nested segment, traverse upward through the segment path, and then search downward through a specified segment.

Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport.
3. Create five levels of nested segments.
4. Print the headings of the output to appear in the emulation window.
5. Beginning at the innermost nested segment, obtain and print the parent segment identifier using UIS$GET_PARENT_SEGMENT.
6. Print the headings of the output to appear in the emulation window.
7. Choose a segment to search.
8. Walk downward through the segment using UIS$GET_NEXT_OBJECT.
9. Call the subroutine DETERMINE to examine and store the objects in arrays by object type.

The following figure shows the structure of the display list in the program HOP.
If you intend to run program HOP, the subroutine DETERMINE from the preceding program WALK should be compiled as a separate module and linked with HOP.

```plaintext
PROGRAM HOP
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
COMMON NEXT_ID1,TYPE1

VD_ID2=UIS$CREATE_DISPLAY(-1.0,-1.0,40.0,40.0,15.0,15.0)
```
SEG_ID1=UIS$BEGIN_SEGMENT(VD_ID2)
    CALL UIS$PLOT(VD_ID2,0,0.0,12.0,5.0,12.0,7.5,17.0,10.0,
    2 12.0,15.0,12.0,
    2 12.5,7.5,15.0,0.0,7.5,5.0,0.0,0.0,2.5,7.5,0.0,12.0)
SEG_ID2=UIS$BEGIN_SEGMENT(VD_ID2)
    CALL UIS$CIRCLE(VD_ID2,0,7.5,8.0,8.0)  ①
SEG_ID3=UIS$BEGIN_SEGMENT(VD_ID2)
    CALL UIS$ELLIPSE(VD_ID2,0,25.0,8.0,5.0,8.0)
SEG_ID4=UIS$BEGIN_SEGMENT(VD_ID2)
    CALL UIS$TEXT(VD_ID2,0,'MISERY LOVES COMPANY',
    2 17.0,24.0)
SEG_ID5=UIS$BEGIN_SEGMENT(VD_ID2)
    CALL UIS$TEXT(VD_ID2,0,'ONE SLUMBER INVITES ANOTHER',
    2 1.0,39.0)
    CALL UIS$NEW_TEXT_LINE(VD_ID2,0)
    CALL UIS$TEXT(VD_ID2,0,'LIVING WELL IS THE BEST REVENGE')
    CALL UIS$END_SEGMENT(VD_ID2)
    CALL UIS$TEXT(VD_ID2,0,'SUCCESS MAKES A FOOL SEEM WISE',
    2 1.0,19.0)
    CALL UIS$END_SEGMENT(VD_ID2)
CALL UIS$PLOT(VD_ID2,0,20.0,25.0,35.0,25.0,35.0,35.0,20.0,35.0,
    2 20.0,25.0)
CALL UIS$CIRCLE(VD_ID2,0,10.0,28.0,8.0)  ②
CALL UIS$END_SEGMENT(VD_ID2)
CALL UIS$END_SEGMENT(VD_ID2)

C HOPPING UPWARD ALONG THE SEGMENT PATH
PRINT 45
45 FORMAT(T2,'SEGMENT PATH')
PRINT 55
55 FORMAT(T1,'------------------------------')
PRINT 56
56 FORMAT(T2,'IDENTIFIER',T17,'LEVEL')
SEG_ID=SEG_ID5
I=5
PRINT 60,SEG_ID5,I

DO I=4,1,-1
    PARENT_ID=UIS$GET_PARENT_SEGMENT(SEG_ID)  ⑥
    SEG_ID=PARENT_ID
    PRINT 60,PARENT_ID,I
ENDDO

① ②
C SEARCHING DOWNWARD THROUGH A NESTED SEGMENT

```
C SEARCHING DOWNWARD THROUGH A NESTED SEGMENT

PRINT 65
65 FORMAT(T2,'SEGMENT')
PRINT 70
70 FORMAT(T1,'-------------------------------')
PRINT 75
75 FORMAT(T2,'IDENTIFIER',T17,'OBJECT TYPE')

NEXT_ID1=UIS$GET_NEXT_OBJECT(SEG_ID2) 8
DO WHILE(NEXT_ID1 .NE. 0) 9
  TYPE1=UIS$GET_OBJECT_ATTRIBUTES(NEXT_ID1)
  CALL DETERMINE 10
  NEXT_ID1=UIS$GET_NEXT_OBJECT(NEXT_ID1,UIS$M_DL_SAME_SEGMENT) 11
ENDDO 12
WD_ID2=UIS$CREATE_WINDOW(VD_ID2,'SYS$WORKSTATION')
PAUSE
END
```

The program HOP contains five levels of nesting excluding the root segment. In order to walk the segment path, you must start at the innermost segment 2. The counter I is initialized to 5 4 indicating the level of nesting from which you are starting.

A DO loop is declared 5 7 containing the call to UIS$GET_PARENT_SEGMENT 9. The seg_id argument in UIS$GET_PARENT_SEGMENT is initialized with the segment identifier of segment 5 3. The counter is decremented as each new parent segment identifier is returned and, in turn, is used as the seg_id argument in the next iteration of the loop.

The second purpose of the program is to search a specified segment. Segments are searched using both parameters in UIS$GET_NEXT_OBJECT. To start at the beginning of a segment, initialize the seg_id to the value of the segment identifier you wish to search 3. By specifying the segment identifier of the segment you wish to search, UIS$GET_NEXT_OBJECT returns the identifier of the next object in the segment. In this example, the second segment is chosen 1.

Another DO loop is established 9 11 containing a call to the subroutine DETERMINE. 10 Note that UIS$GET_NEXT_OBJECT 11 now specifies both arguments. The search will be performed on the specified segment only. If the flag UIS$M_DL_SAME_SEGMENT were not specified, the search would proceed down to the innermost nested segment.
13.3.3.5 Calling UIS$GET_PARENT_SEGMENT
Segment identifiers are returned beginning with the innermost nested segment as shown in Figure 13-8.

Figure 13-8 Traversing Upward Along the Segment Path

```
$ RUN HOP
SEGMENT PATH

<table>
<thead>
<tr>
<th>IDENTIFIER</th>
<th>LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>122664</td>
<td>5</td>
</tr>
<tr>
<td>121576</td>
<td>4</td>
</tr>
<tr>
<td>120488</td>
<td>3</td>
</tr>
<tr>
<td>119400</td>
<td>2</td>
</tr>
<tr>
<td>115592</td>
<td>1</td>
</tr>
</tbody>
</table>
```

Object identifiers within the second-level segment are displayed as shown in Figure 13-9.

Figure 13-9 Searching Downward Through a Segment

```
SEGMENT

<table>
<thead>
<tr>
<th>IDENTIFIER</th>
<th>OBJECT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>117175</td>
<td>UIS$C_OBJECT_ELLIPSE</td>
</tr>
<tr>
<td>120488</td>
<td>UIS$C_OBJECT_SEGMENT</td>
</tr>
<tr>
<td>118904</td>
<td>UIS$C_OBJECT_PLOT</td>
</tr>
<tr>
<td>119151</td>
<td>UIS$C_OBJECT_ELLIPSE</td>
</tr>
</tbody>
</table>

FORTRAN PAUSE
```

All the objects drawn in the virtual display are shown in Figure 13-10.
Figure 13-10 Contents of the Display List Drawn in the Virtual Display

ONE SLUMBER INVITES ANOTHER
LIVING WELL IS THE BEST REVENGE

MISERY LOVES COMPANY

SUCCESS MAKES A FOOL SEEM WISE
13.4 More About Segments

When you use segments in your application programs, you are creating complex object that can be edited or searched on a segment-by-segment basis. Segments also exhibit special behavior when attribute blocks are encountered.

13.4.1 Programming Options

Other than simply creating segments, you can manipulate them as well.

**Editing Display Lists**

You can edit a display list that contains no explicitly defined segments as well as display lists that contain explicitly specified segments.

**NOTE:** You must use UIS$SET_INSERTION_POSITION to insert an object between existing objects in a display list.

The following routines also allow you to edit the display list.

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$COPY_OBJECT</td>
<td>Copies an object to another part of the display list</td>
</tr>
<tr>
<td>UIS$DELETE_OBJECT</td>
<td>Deletes an object from the display list</td>
</tr>
<tr>
<td>UIS$INSERT_OBJECT</td>
<td>Moves an object to another part of the display list</td>
</tr>
<tr>
<td>UIS$TRANSFORM_OBJECT</td>
<td>Scales, rotates, and translates an object</td>
</tr>
</tbody>
</table>

**Modifying Attribute Blocks Within Segments**

As mentioned earlier, a segment consists of calls to graphics and text output routines, attribute routines, and nested segments.

When the same attribute block is modified at two different levels of nesting, modifications to the innermost attribute block take precedence over any previous modifications in outer levels. Such attribute block modifications will influence graphics and text output (where applicable) at deeper levels of nesting.

When you leave a lower-level nested segment, the original attributes of the parent segment are restored. Therefore, you can change attributes within a segment and not worry about affecting a higher-level segment.
13.4.2 Program Development I

Programming Objective
To edit a display list.

Programming Tasks
1. Create a virtual display.
2. Create a series of nested segments containing calls to draw graphic objects.
3. Create a display window and viewport.
4. Delete an object in segment 1.
5. Set the editing pointer to the end of segment 1.
6. Print the headings of the output to appear in the emulation window.
7. Add a line drawing call to the end of segment 1.
8. Verify the contents of segment 1.
9. Position the pointer to the end of segment 2.
10. Add text to segment 2.
11. Verify the contents of segment 2.

Inserting an object in a specific location in the display list may not affect how the object is drawn but rather the order in which objects are drawn in the virtual display. The following diagram shows the structure of the display list before display editing in the program EDIT_LIST.
If you intend to run program EDIT_LIST, the subroutine DETERMINE from the preceding program WALK should be compiled as a separate module and linked with EDIT_LIST.

```
PROGRAM EDIT_LIST
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
COMMON NEXT_ID1, TYPE1

C Create a virtual display
VD_ID=UIS$CREATE_DISPLAY(1.0, 1.0, 50.0, 50.0, 15.0, 15.0)
```
c Create a segment
SEG_ID1=UIS$BEGIN_SEGMENT(VD_ID)
CALL UIS$CIRCLE(VD_ID,0.8,0.35,0.7)
CURR_ID1=UIS$GET_CURRENT_OBJECT(VD_ID)
CALL UIS$PLOT(VD_ID,0.17,0.27,0.32,0.27,0.24,5,0.42,0.17,0.27,0.7,0)
CURR_ID2=UIS$GET_CURRENT_OBJECT(VD_ID)

c Create another segment
SEG_ID2=UIS$BEGIN_SEGMENT(VD_ID)
CALL UIS$ELLIPSE(VD_ID,0.8,0.15,0.5,0.9)
CURR_ID4=UIS$GET_CURRENT_OBJECT(VD_ID)
CALL UIS$PLOT(VD_ID,0.15,0.8,0.30,0.8,0.35,0.22,0.20,0.15,0.8,0)
CURR_ID5=UIS$GET_CURRENT_OBJECT(VD_ID)
CALL UIS$END_SEGMENT(VD_ID)
CALL UIS$TEXT(VD_ID,0,'The ox when weariest treads surest',
               2 5.0,47.0)
CURR_ID6=UIS$GET_CURRENT_OBJECT(VD_ID)
CALL UIS$END_SEGMENT(VD_ID)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')

PAUSE
c Delete an object from segment 1
CALL UIS$DELETE_OBJECT(CURR_ID1)

c Set the editing pointer at the end of segment 1
CALL UIS$SET_INSERTION_POSITION(SEG_ID1)
CALL UIS$PLOT(VD_ID,0.29,0.42,0.44,0.42,0.36,5,0.27,0.29,0.42,0)

PRINT 20
20 FORMAT(T2,'CONTENTS OF SEGMENT 1')
PRINT 25
25 FORMAT(T2,'IDENTIFIER',T14,'OBJECT',T22,'TYPE')
PRINT 30
30 FORMAT('----------------------------')

c Verify the contents of segment 1
NEXT_ID1=UIS$GET_NEXT_OBJECT(SEG_ID1)
DO WHILE(NEXT_ID1 .NE. 0)
  TYPE1=UIS$GET_OBJECT_ATTRIBUTES(NEXT_ID1)
  CALL DETERMINE
  NEXT_ID1=UIS$GET_NEXT_OBJECT(NEXT_ID1,UIS$M_DL_SAME_SEGMENT)
ENDDO
PAUSE
c Set the editing pointer at the end of segment 2
CALL UIS$SET_INSERTION_POSITION(SEG_ID2)
CALL UIS$TEXT(VD_ID,0,'Old foxes want no tutors',
               2 5.0,45.0)
c Verify the contents of segment 2

    NEXT_ID1 = UIS$GET_NEXT_OBJECT(SEG_ID2)

    DO WHILE(NEXT_ID1 .NE. 0)
        TYPE1 = UIS$GET_OBJECT_ATTRIBUTES(NEXT_ID1)
        CALL DETERMINE
        NEXT_ID1 = UIS$GET_NEXT_OBJECT(NEXT_ID1, UIS$M_DL_SAME_SEGMENT)
    ENDDO

    PAUSE

END

Two segments are created 1 2. The second segment is nested within the first.

Successive calls to UIS$GET_CURRENT_OBJECT 3 retrieve an object identifier for each object in both segments. This is useful if you need to insert an object in the display list later.

A call to UIS$DELETE_OBJECT 4 deletes a circle 5 from segment 1 in the display list.

The editing pointer in the display list is set at the end of segment 1 using UIS$SET_INSERTION_POSITION 6. A call to UIS$PLOT is added to segment 1 7.

A call to the subroutine DETERMINE 8 verifies the addition in the display list.

The editing pointer in the display list is set at the end of segment 2 using UIS$SET_INSERTION_POSITION 9. The binary instruction resulting from a call to UIS$TEXT is added to segment 2 10.

A call to the subroutine DETERMINE 11 verifies the changes in the display list.

The following figure shows the structure of the display list after display editing.
13.4.2.1 Calling UIS$SET_INSERTION_POSITION
The original objects, text, a circle, an ellipse, a triangle, and a parallelogram are shown in Figure 13-11.
Figure 13-11 Before Display List Modification

The ox when weariest treads surest
A triangle and a line of text are added to the virtual display. The circle is deleted from the virtual display as shown in Figure 13-12.

**Figure 13-12  Executing the Modified Display List**

The ox when weariest treads surest
Old foxes want no tutors
The contents of the segment are written to the emulation window as shown in Figure 13–13.

**Figure 13–13 Verifying the Contents of the Display List**

```
$ run edit_list
FORTRAN PAUSE
$ cont
CONTENTS OF SEGMENT 1
IDENTIFIER OBJECT TYPE
-----------------------------
116663  UIS$C_OBJECT_PLOT
118888  UIS$C_OBJECT_SEGMENT
117404  UIS$C_OBJECT_TEXT
117651  UIS$C_OBJECT_PLOT
FORTRAN PAUSE
$ cont
CONTENTS OF SEGMENT 2
IDENTIFIER OBJECT TYPE
-----------------------------
116910  UIS$C_OBJECT_ELLIPSE
117157  UIS$C_OBJECT_PLOT
116416  UIS$C_OBJECT_TEXT
FORTRAN PAUSE
$
```

**13.4.2.2 Program Development II**

**Programming Objective**

To draw text at different levels of segmentation.

**Programming Tasks**

1. Create a virtual display.
2. Create a display window and viewport.
3. Create three levels of nested segments.
4. Modify the font character spacing attributes for each level of nesting.
5. Draw text at each level of nesting.
Font names specified in the program are logical names.

```plaintext
PROGRAM SEGMENT
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,30.0,30.0,21.0,5.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')

CALL UIS$BEGIN_SEGMENT(VD_ID) ①
   CALL UIS$SET_FONT(VD_ID,0.1,'MY_FONT_6') ②
   CALL UIS$SET_CHAR_SPACING(VD_ID,1,1,0.0,1.0) ③
   CALL UIS$TEXT(VD_ID,1,'The resolved mind has no cares',0.0,30.0) ④

CALL UIS$BEGIN_SEGMENT(VD_ID) ⑤
   CALL UIS$SET_FONT(VD_ID,1,1,'MY_FONT_13') ⑥
   CALL UIS$NEW_TEXT_LINE(VD_ID,1)
   CALL UIS$TEXT(VD_ID,1,'The camel never sees its own hump') ⑦

CALL UIS$BEGIN_SEGMENT(VD_ID) ⑧
   CALL UIS$SET_FONT(VD_ID,1,1,'MY_FONT_7') ⑨
   CALL UIS$NEW_TEXT_LINE(VD_ID,1)
   CALL UIS$TEXT(VD_ID,1,'First things first')
   CALL UIS$END_SEGMENT(VD_ID) ⑩

PAUSE
   CALL UIS$SET_CHAR_SPACING(VD_ID,1,1,0.0,0.0) ⑪
   CALL UIS$NEW_TEXT_LINE(VD_ID,1)
   CALL UIS$TEXT(VD_ID,1,'A new broom sweeps clean') ⑫
   CALL UIS$END_SEGMENT(VD_ID) ⑬

CALL UIS$NEW_TEXT_LINE(VD_ID,1)
CALL UIS$TEXT(VD_ID,1,'No sun without a shadow') ⑭
CALL UIS$END_SEGMENT(VD_ID) ⑮

PAUSE

END
```

The first call to UIS$BEGIN_SEGMENT ① and the final call to UIS$END_SEGMENT ⑮ establish the limits of the first-level segment. Within this segment there are two calls to UIS$TEXT ④ ⑦. The first call to UIS$TEXT establishes the current position for all text output created at the first level.

An attribute routine UIS$SET_FONT is called ② which modifies the font attribute. The font MY_FONT_6 is now the current font for all text output in the first-level segment. Text created at the first level will be drawn using MY_FONT_6.
The calls to UIS$BEGIN_SEGMENT and UIS$END_SEGMENT establish the limits of the second-level segment nested within the first-level segment. The first call to UIS$SET_FONT in the second-level segment references the same output attribute block number specified in the attribute routine call in the first-level segment. The modifications to attribute block 1 at the second level take precedence over any previous modifications of attribute block 1 at outer levels.

The second-level segment further modifies the font attribute. The font MY_FONT_13 is now the current font for all text output in this second-level segment. The first call to UIS$TEXT within the second-level segment establishes the current position for text output drawn at the second level. Calls to UIS$TEXT within this segment reference the same attribute block 1.

Once again, calls to UIS$BEGIN_SEGMENT and UIS$END_SEGMENT establish the limits of the third level of segmentation nested within the second level. The font MY_FONT_7 is now the current font for all text output in this segment.

The line spacing component of the character spacing attribute was modified twice. The first call to UIS$SET_CHAR_SPACING was made to increase the line spacing by a factor of 1. As the program executes, the second text drawing routine call in levels 1 and 2 require room to avoid overstriking existing lines.

13.4.2.3 Calling UIS$BEGIN_SEGMENT and UIS$END_SEGMENT

As the program SEGMENT executes each instruction sequentially, a text string is drawn in the virtual display at the first, second, and third levels of segmentation as shown in Figure 13-14. Please note the font used in text creation.

Figure 13-14 Text Output During Execution

The camel never sees its own hump
First things first

Text strings are then created in the reverse order of segmentation—second level and then first level. Please note the font used and the order of text string creation as shown in Figure 13-15 as compared to the statements in the source program.
The resolved mind has no cares
No sun without a shadow
The camel never sees its own hump
A new broom sweeps clean
First things first
Chapter 14
Geometric and Attribute Transformations

14.1 Overview
Transformations alter the appearance of graphic objects and text. In Part I, viewing transformations and their possibly distorting effects on graphic objects were discussed. Already in Part II you have seen the effects of world coordinate transformations when you modify the world coordinate space and then redraw graphic objects in the new space. This chapter describes the following two types of transformations:

- Two-dimensional geometric transformations
- Attribute transformations

14.2 Geometric Transformations
A two-dimensional geometric transformation of a graphic object involves changing the graphic object’s angular orientation or its shape within the virtual display. The coordinate system is not modified. Graphic objects are geometrically transformed using the following methods: scaling, translation, and rotation.

14.2.1 Translating Graphic Objects
Translating a graphic object involves moving the object to another part of the coordinate space without altering its physical orientation with respect to the x and y axes. For example, a side of a triangle that was originally parallel to the y axis remains parallel to that axis even if the object is moved to another quadrant in the coordinate space.
Figure 14-1  Translating a Graphic Object
14.2.2 Scaling Graphic Objects

Typically, scaling involves stretching or shrinking a graphic object. Scaling a graphic object can occur in two ways: (1) simple scaling of the graphic object in the virtual display or (2) complex scaling.

Simple Scaling of Graphic Objects

Simple scaling of a graphic object involves executing a single transformation. The position of the newly scaled graphic object in the virtual display is always different from its original position with one exception. If the object’s center point is at the origin, the object will not move when scaled.
Figure 14-2  Simple Scaling
Complex Scaling of Graphic Objects

Complex scaling of graphic objects ensures that the newly scaled object maintains its previous position in the virtual display. The center of the object is first translated to the origin of the coordinate system, scaled, and finally translated to its original position.

Figure 14-3 Complex Scaling
14.2.2.1 Uniformly Scaled Graphic Objects
For example, a photographic enlargement of a snapshot to poster size renders an object whose physical dimensions are proportional to the snapshot. In such a case, the scaling factor of the width of the object, $S_x$, equals the scaling factor of the height of the object, $S_y$.

Figure 14–4 Uniformly Scaling a Graphic Object
14.2.2.2 Differentially Scaled Graphic Objects
Scaling need not be performed uniformly. For example, the height of an object may be increased while its width remains constant where $s_x$ does not equal $s_y$. The object is differentially scaled as shown in Figure 14–5.

Figure 14–5  Differentially Scaling a Graphic Object
14.2.3 Rotating Graphic Objects

Generally speaking, rotation changes an object's angular orientation in the virtual display. All rotations occur about the origin of the coordinate system. Positive rotation is a counterclockwise movement.

Simple Rotation of Graphic Objects

Simple rotation of graphic objects involves executing a single transformation—no translation. With simple rotation, the object appears to revolve about the origin. Figure 14–6 shows rectangle rotating about the origin.
Complex Rotation of Graphic Objects

Complex rotation can occur when the reference or pivotal point is the center of the object. Complex rotation of the graphic object is accomplished by first...
translating the object to the origin so that the origin and reference point share the same coordinate values—(0,0,0). The object is rotated and translated to its original position in the virtual display. Figure 14–7 illustrates complex rotation of a rectangle.

### 14.2.4 Programming Options

You can perform geometric transformations of two types.

**Two-Dimensional Geometric Transformation—COPY**

You may execute a geometric transformation where the graphic object is copied using UIS$COPY_OBJECT. The original object remains unchanged.

**Two-Dimensional Geometric Transformations—MOVE**

You may execute a geometric transformation where the graphic object is transformed in the virtual display using UIS$TRANSFORM_OBJECT. The original object is modified.

### 14.2.5 Program Development I

**Programming Objective**

To rotate a graphic object in a positive counterclockwise 45 degrees about its center.

**Programming Tasks**

1. Create a virtual display.
2. Create a display window and viewport.
3. Create a graphic object and obtain its identifier.
4. Declare and load a two-dimensional array with translation values.
5. Execute translation.
6. Load array with rotation values.
7. Execute rotation.
8. Load array with translation values.
9. Execute the translation where the original object is erased and redraw the object in its original position in the coordinate system.
PROGRAM GEO_TRANSFORM_ROT
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL*4 MATRIX(2,3)

VD_ID=UIS$CREATE_DISPLAY(-20.0,-20.0,20.0,20.0,10.0,10.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')

CALL UIS$PLOT(VD_ID,0.0,0.0,20.0,0.0,-20.0) ②
CALL UIS$PLOT(VD_ID,0.0,-20.0,0.0,20.0,0.0) ③
CALL UIS$PLOT(VD_ID,0.0,5.0,5.0,15.0,5.0,15.0,10.0,5.0,10.0,2
5.0,5.0) ④

CURRENT_ID=UIS$GET_CURRENTBJECT(VD_ID) ⑤
OBJ_ID=CURRENT_ID
PAUSE
MATRIX(1,1)=1.0 ⑥
MATRIX(2,1)=0.0
MATRIX(1,2)=0.0
MATRIX(2,2)=1.0
MATRIX(1,3)=-10.0
MATRIX(2,3)=-7.5
CALL UIS$TRANSFORM_OBJECT(OBJ_ID,MATRIX) ⑦
PAUSE
MATRIX(1,1)=COSD(45.0) ⑧
MATRIX(2,1)=-SIND(45.0)
MATRIX(1,2)=SIND(45.0)
MATRIX(2,2)=COSD(45.0)
MATRIX(1,3)=0.0
MATRIX(2,3)=0.0
CALL UIS$TRANSFORM_OBJECT(OBJ_ID,MATRIX) ⑨
PAUSE
MATRIX(1,1)=1.0 ⑩
MATRIX(2,1)=0.0
MATRIX(1,2)=0.0
MATRIX(2,2)=1.0
MATRIX(1,3)=10.0
MATRIX(2,3)=7.5
CALL UIS$TRANSFORM_OBJECT(OBJ_ID,MATRIX) ⑪
PAUSE
END

A two-dimensional array is declared ①.
The $x$ and $y$ axes are drawn. A rectangle is drawn using \texttt{UIS$\text{PLOT}}$. Call \texttt{UIS$\text{GET}$\_\text{CURRENT}$\text{OBJECT}$} to save its object identifier. The object identifier is used as an argument to the transformation routine.

The rectangle will be rotated about its center.

The VAX FORTRAN intrinsic functions \texttt{SIND} and \texttt{COSD} accept degrees as arguments.

The matrix is loaded with values three times to translate, rotate the rectangle about its center, and then translate it to its original position in the virtual display.

Each transformation is performed as the original object is erased and redrawn in its new orientation. The rectangle is redrawn with each call to \texttt{UIS$\text{TRANSFORM}$\_\text{OBJECT}}.

### 14.2.6 Calling \texttt{UIS$\text{TRANSFORMATION}$\_\text{OBJECT}}

The program \texttt{GEO\_TRANSFORM\_ROT} translates, rotates, and translates a rectangle using \texttt{UIS$\text{TRANSFORM}$\_\text{OBJECT}}. With each transformation, the rectangle's previous position in the virtual display is erased as shown in Figure 14–7.

### 14.2.7 Program Development II

#### Programming Objective

To rotate a copy of the graphic object 45 degrees about its center and place the rotated copy in another quadrant.

#### Programming Tasks

1. Create a virtual display.
2. Create a display window and viewport.
3. Declare and load a two-dimensional array with translation values.
4. Execute the \texttt{COPY} operation and the translation.
5. Load the array with rotation values.
6. Execute rotation.
7. Load array with translation values.
Figure 14-7  Complex Rotation of a Rectangle
14-14  Geometric and Attribute Transformations

PROGRAM COPY_OBJECT
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL*4 MATRIX(2,3)

VD_ID=UIS$CREATE_DISPLAY(-20.0,-20.0,20.0,20.0,10.0,10.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')
CALL UIS$PLOT(VD_ID,0.0,20.0,0.0,-20.0)
CALL UIS$PLOT(VD_ID,0.-20.0,0.0,20.0,0.0)
CALL UIS$PLOT(VD_ID,0.5,0.5,0.5,0.5,15.0,5.0,10.0,10.0,5.0,5.0)
CURRENT_ID=UIS$GET_CURRENT_OBJECT(VD_ID)
OBJ_ID=CURRENT_ID
PAUSE
MATRIX(1,1)=1.0
MATRIX(2,1)=0.0
MATRIX(1,2)=0.0
MATRIX(2,2)=1.0
MATRIX(1,3)=-10.0
MATRIX(2,3)=-7.5
COPY_ID=UIS$COPY_OBJECT(OBJ_ID,MATRIX)
PAUSE
OBJ_ID=COPY_ID
MATRIX(1,1)=COSD(45.0)
MATRIX(2,1)=-SIND(45.0)
MATRIX(1,2)=SIND(45.0)
MATRIX(2,2)=COSD(45.0)
MATRIX(1,3)=0.0
MATRIX(2,3)=0.0
CALL UIS$TRANSFORM_OBJECT(OBJ_ID,MATRIX)
PAUSE
MATRIX(1,1)=1.0
MATRIX(2,1)=0.0
MATRIX(1,2)=0.0
MATRIX(2,2)=1.0
MATRIX(1,3)=-10.0
MATRIX(2,3)=7.5
CALL UIS$TRANSFORM_OBJECT(OBJ_ID,MATRIX)
PAUSE
END
This program is almost identical to the previous program GEO_TRANSFORM_ROT with a few important differences.

The first transformation is executed 1. The triangle is copied and translated to the origin of the coordinate space. The coordinates of the center of the triangle match those of the origin. The original triangle in the first quadrant remains unchanged.

The identifier of the transformed object copy_id is assigned to the obj_id 2. It will be used as an argument in the next transformation.

The VAX FORTRAN intrinsic functions SIND and COSD accepts degrees as arguments 3.

A call to UIS$TRANSFORM_OBJECT rotates the translated triangle 45 degrees 4. The original object is erased and redrawn in its new orientation.

The final translation of the triangle places it in the second quadrant at a 45-degree angle to the original triangle 5.

**14.2.8 Calling UIS$COPY_OBJECT**

The triangle is transformed similarly to the rectangle in the previous example. However, the first transformation copies the triangle. Figure 14–8 shows that the triangle still remains in the virtual display. However, the rotated copy of the triangle is translated to the second quadrant.
Figure 14-8  Complex Rotation of a Triangle
14.3 Attribute Transformations

Attribute transformations involve modifying graphic objects and text without having to know the attribute block of the original graphics or text objects.

14.3.1 Programming Options

Ordinarily, when you modify the appearance of an existing graphic object, you must perform the follow procedure:

1. Obtain the object identifier.
2. Call UIS$DELETE_OBJECT with the object identifier.
3. Redraw the graphic object or text using the modified attribute block.

At the very least, you must use two steps—erase the virtual display using UIS$ERASE and redraw the object with a modified attribute block.

A call to UIS$COPY_OBJECT or UIS$TRANSFORM_OBJECT specifying the atb argument and omitting the matrix argument lets you modify the attributes of graphic objects and text in a single call.

To disable attribute transformations, omit the atb argument in UIS$COPY_OBJECT or UIS$TRANSFORM_OBJECT.

14.3.2 Program Development

Programming Objective

To modify the fill pattern of a circle as a transformation.

Programming Tasks

1. Create a virtual display.
2. Create a display window and a display viewport.
3. Draw a circle using default attributes.
4. Obtain its object identifier.
5. Modify the fill pattern attribute.

6. Transform the circle’s attributes and draw the modified circle.

    PROGRAM ATTR_TRANS
    IMPLICIT INTEGER(A-Z)
    INCLUDE 'SYS$LIBRARY:UISENTRY'
    INCLUDE 'SYS$LIBRARY:UISUSRDEF'

    VD_ID=UIS$CREATE_DISPLAY(-10.5,-10.5,10.5,10.5,10.0,10.0)
    WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')

    CALL UIS$CIRCLE(VD_ID,0,0,0,0,10.0)
    CURRENT_ID=UIS$GET_CURRENT_OBJECT(VD_ID)
    OBJ_ID=CURRENT_ID

    CALL UIS$SET_FONT(VD_ID,0.1,'UIS$FILL_PATTERNS') ①
    CALL UIS$SET_FILL_PATTERN(VD_ID,1,1,PATT$C_DOWNDIAG1_7) ②

    PAUSE

    CALL UIS$TRANSFORM_OBJECT(OBJ_ID,1) ③

    PAUSE
    END

A matrix is not declared in this program. Therefore, the position of any objects drawn will be the same.

The fill pattern attribute is modified ①②.

The object identifier of the original circle and attribute block number of the newly modified attribute block are arguments in the transformation ③.

### 14.3.3 Requesting Attribute Transformations

Because no matrix was specified in the transformation, the resulting transformation will not cause objects to change their positions within the virtual display. The original circle is erased and the modified circle is placed in its position as shown in Figure 14–9.
Figure 14-9  Modifying Attributes with a Transformation
If the call to UIS$TRANSFORM_OBJECT were instead a call to UIS$COPY_OBJECT, the original circle would remain visible in the virtual display. The modified circle would still be placed in the same position.

Figure 14-10  Modifying Attributes with a Copy
Chapter 15
Metafiles and Private Data

15.1 Overview

Many of your applications produce displays that you might wish to use again. In order to reexecute these displays you must first store them in a UIS metafile. We will describe the structure of a metafile and the contents of the binary encoded instructions in more detail.

An additional feature allows you to associate data with your graphics objects. You can specify a particular graphic object or group of objects within the display to be associated with the user-defined data. This chapter discusses metafiles and private data in the following topics:

- Extracting data from a display list
- Interpreting the user buffer
- Creating a UIS metafile
- Creating private data

Hardcopy UIS (HCUIS) translates UIS pictures to other formats. See the MicroVMS Workstation Guide to Printing Graphics for more information about HCUIS.

15.2 Display Lists and UIS Metafiles

Generating graphic objects on the display screen is the purpose of your application programs. As a programmer, you are also concerned with program modularity and efficiency. With each new object drawn in the virtual display, a new entry is added to the display list. Preserving the contents of a display list as generically encoded binary instructions for use across many applications is highly desirable. Graphics output and attribute modifications can then be extracted from display lists and stored in user-defined buffers as metafile components and in files as metafiles.
15.2.1 Generic Encoding of Graphics and Attribute Routines

As mentioned earlier, whenever an object is drawn in the virtual display or an attribute is modified, a binary encoded instruction is added to the display list of the specified virtual display. Entries in the display list are variable length instructions and are encoded as shown in Figure 15–1.

Figure 15–1 Binary Encoded Instruction

<table>
<thead>
<tr>
<th>Op code 16 bits</th>
<th>Length 16 bits</th>
<th>Arguments</th>
</tr>
</thead>
</table>

If the length of the binary encoded instruction is greater than 32,767 bytes, the length field should be set equal to UIS$C_LENGTH_DIFF and the extra length should be set equal to the total number of bytes in the instruction. Figure 15–2 describes the format of a display list entry, if the length field is greater than 32,767 bytes.

Figure 15–2 Extended Binary Encoded Instruction

<table>
<thead>
<tr>
<th>Op code 16 bits</th>
<th>Length 16 bits</th>
<th>Extra Length 32 bits</th>
<th>Arguments</th>
</tr>
</thead>
</table>

15.2.1.1 Normalized Coordinates

The coordinate system used within display lists and when creating generically encoded streams is normalized coordinates. Normalized coordinates are floating point numbers in the range (0.0,0.0) to (max_nc_x,max_nc_y) where (0.0,0.0) refers to lower-left corner of the virtual display and (max_nc_x,max_nc_y) refers to the upper-right corner.

Normalized coordinates are used within UIS as a means of deferring the actual mapping of an application’s world coordinates to device-specific coordinates until the actual output device is known. For example, the device coordinates of a printer may be very different from the device coordinates of a raster display.
15.2.1.2 Interpreting the User Buffer

When UIS routine calls are executed, binary encoded instructions are added to the display list. When you extract the contents of a display list and store them in a buffer, you have created metafile components—header data, an encoded stream of binary instructions, and trailer data. Each metafile component consists of binary encoded instructions. If you write the contents of the buffer to a file, you have created a UIS metafile. A UIS metafile is a *generically encoded* binary stream, that is, all three components exist within a single file and the file is executable on any VAXstation system. The contents of the buffer and metafile contains values that describe the extracted objects. If reexecuted, these encoded instructions cause UIS to recreate the objects drawn in the virtual display. Note that monochrome systems cannot duplicate the color of extracted objects created on color systems.

It is possible to write your own binary encoded instructions and metafiles. First, you must understand how to interpret the contents of the user-defined buffer containing the extracted data.

Opcodes

The portion of the binary encoded instruction that specifies the action that the instruction performs is the opcode. Table 15-1 lists the generic encoding symbols and the corresponding opcodes of binary encoded instructions.

Table 15-1 Generic Encoding Symbols and Opcodes

<table>
<thead>
<tr>
<th>Generic Encoding Symbol</th>
<th>Opcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>GER$C_SET_WRITING_MODE</td>
<td>1</td>
</tr>
<tr>
<td>GER$C_SET_WRITING_INDEX</td>
<td>2</td>
</tr>
<tr>
<td>GER$C_SET_BACKGROUND_INDEX</td>
<td>3</td>
</tr>
<tr>
<td>GER$C_SET_CHAR_SPACING</td>
<td>4</td>
</tr>
<tr>
<td>GER$C_SET_CHAR_SLANT</td>
<td>5</td>
</tr>
<tr>
<td>GER$C_SET_TEXT_SLOPE</td>
<td>6</td>
</tr>
<tr>
<td>GER$C_SET_TEXT_PATH</td>
<td>7</td>
</tr>
<tr>
<td>GER$C_SET_TEXT_FORMATTING</td>
<td>11</td>
</tr>
<tr>
<td>GER$C_SET_CHAR_ROTATION</td>
<td>12</td>
</tr>
<tr>
<td>GER$C_SET_TEXT_MARGINS</td>
<td>13</td>
</tr>
<tr>
<td>GER$C_SET_LINE_WIDTH</td>
<td>14</td>
</tr>
<tr>
<td>GER$C_SET_LINESTYLE</td>
<td>15</td>
</tr>
<tr>
<td>GER$C_SET_FONT</td>
<td>17</td>
</tr>
<tr>
<td>GER$C_SET_ARC_TYPE</td>
<td>26</td>
</tr>
<tr>
<td>Generic Encoding Symbol</td>
<td>Opcode</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>GER$C_SET_FILL_PATTERN</td>
<td>37</td>
</tr>
<tr>
<td>GER$C_SET_CLIP</td>
<td>38</td>
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<tr>
<td>GER$C_SET_CHAR_ENCODING</td>
<td>39</td>
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<tr>
<td>GER$C_SET_CHAR_SIZE</td>
<td>42</td>
</tr>
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<td>Graphics and Text</td>
<td></td>
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<tr>
<td>GER$C_TEXT</td>
<td>19</td>
</tr>
<tr>
<td>GER$C_SET_POSITION</td>
<td>21</td>
</tr>
<tr>
<td>GER$C_PLOT</td>
<td>23</td>
</tr>
<tr>
<td>GER$C_ELLIPSE</td>
<td>25</td>
</tr>
<tr>
<td>GER$C_IMAGE</td>
<td>29</td>
</tr>
<tr>
<td>GER$C_ALIGN_POSITION</td>
<td>33</td>
</tr>
<tr>
<td>GER$C_LINE</td>
<td>52</td>
</tr>
<tr>
<td>Application-specific Private Data</td>
<td></td>
</tr>
<tr>
<td>GER$CPRIVATE</td>
<td>30</td>
</tr>
<tr>
<td>Display List</td>
<td></td>
</tr>
<tr>
<td>GER$C_BEGIN1</td>
<td>31</td>
</tr>
<tr>
<td>GER$C_END1</td>
<td>32</td>
</tr>
<tr>
<td>GER$C_BEGIN_DISPLAY</td>
<td>34</td>
</tr>
<tr>
<td>GER$C_END_DISPLAY1</td>
<td>35</td>
</tr>
<tr>
<td>GER$C_VERSION</td>
<td>36</td>
</tr>
<tr>
<td>GER$C_IDENTIFICATION</td>
<td>43</td>
</tr>
<tr>
<td>GER$C_DATE</td>
<td>44</td>
</tr>
<tr>
<td>GER$C_NOP1</td>
<td>45</td>
</tr>
<tr>
<td>GER$CPRIVATE_ECO</td>
<td>49</td>
</tr>
<tr>
<td>GER$C_DISPLAY_EXTENTS</td>
<td>51</td>
</tr>
<tr>
<td>Color</td>
<td></td>
</tr>
<tr>
<td>GER$C_SET_COLORS</td>
<td>47</td>
</tr>
</tbody>
</table>
Table 15-1 (Cont.) Generics Encoding Symbols and Opcodes

<table>
<thead>
<tr>
<th>Generic Encoding Symbol</th>
<th>Opcode</th>
</tr>
</thead>
<tbody>
<tr>
<td>GER$C_SET_INTENSITIES</td>
<td>48</td>
</tr>
<tr>
<td>GER$C_CREATE_COLOR_MAP</td>
<td>50</td>
</tr>
</tbody>
</table>

Arguments

Figure 15–3 illustrates the format of an argument within a binary instruction that changes attribute settings.

Figure 15–3 Format of Attribute-Related Argument

```
<table>
<thead>
<tr>
<th>Op code</th>
<th>Length</th>
<th>IATB</th>
<th>OATB</th>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>16 bits</td>
<td>16 bits</td>
<td>16 bits</td>
<td></td>
</tr>
</tbody>
</table>
```

Figure 15–4 illustrates the format of an argument within a binary encoded instruction that produces graphics or text.

Figure 15–4 Format of Graphics- and Text-Related Argument

```
<table>
<thead>
<tr>
<th>Op code</th>
<th>Length</th>
<th>ATB</th>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>16 bits</td>
<td>16 bits</td>
<td></td>
</tr>
</tbody>
</table>
```

Table 15–2 lists the possible arguments that can appear in a binary encoded instruction.
Table 15-2 Arguments of Binary Encoded Instructions

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attributes&lt;sup&gt;1&lt;/sup&gt;</td>
<td>iatb</td>
<td>word</td>
<td>Input attribute block for set operations</td>
</tr>
<tr>
<td></td>
<td>oatb</td>
<td>word</td>
<td>Output attribute block for set operations</td>
</tr>
<tr>
<td>GER$C$SET$ARC$TYPE</td>
<td>arc$\text{_}$type</td>
<td>word</td>
<td>arc type</td>
</tr>
<tr>
<td>GER$C$SET$BACKGROUND_INDEX</td>
<td>background$\text{_}$index</td>
<td>word</td>
<td>Background index</td>
</tr>
<tr>
<td>GER$C$SET$CHAR$ENCODING</td>
<td>char$\text{_}$encoding$\text{_}$type</td>
<td>word</td>
<td>Character encoding type</td>
</tr>
<tr>
<td>GER$C$SET$CHAR$SIZE</td>
<td>char$\text{_}$size$\text{_}$flags</td>
<td>word</td>
<td>Scaling flags</td>
</tr>
<tr>
<td></td>
<td>char$\text{_}$size$\text{_}$enable</td>
<td>bitfield mask</td>
<td>Font ideal size for x</td>
</tr>
<tr>
<td></td>
<td>char$\text{_}$size$\text{_}$def$\text{_}$x</td>
<td>bitfield mask</td>
<td>Font ideal size for y</td>
</tr>
<tr>
<td></td>
<td>char$\text{_}$size$\text{_}$def$\text{_}$y</td>
<td>bitfield mask</td>
<td>Widest character</td>
</tr>
<tr>
<td></td>
<td>char$\text{_}$size$\text{_}$char</td>
<td>word</td>
<td>Example character</td>
</tr>
<tr>
<td></td>
<td>char$\text{_}$size$\text{_}$width</td>
<td>F_floating</td>
<td>Character width</td>
</tr>
<tr>
<td></td>
<td>char$\text{_}$size$\text{_}$height</td>
<td>F_floating</td>
<td>Character height</td>
</tr>
<tr>
<td></td>
<td>char$\text{_}$slant$\text{_}$angle</td>
<td>F_floating</td>
<td>Character slant angle</td>
</tr>
<tr>
<td>GER$C$SET$CHAR$SLANT</td>
<td>char$\text{_}$space$\text{_}$dx</td>
<td>F_floating</td>
<td>Delta x spacing</td>
</tr>
<tr>
<td></td>
<td>char$\text{_}$space$\text{_}$dy</td>
<td>F_floating</td>
<td>Delta y spacing</td>
</tr>
<tr>
<td>GER$C$SET$CHAR$ROTATION</td>
<td>char$\text{_}$rotation$\text{_}$angle</td>
<td>F_floating</td>
<td>Character rotation angle</td>
</tr>
<tr>
<td>GER$C$SET$CLIP</td>
<td>clip$\text{_}$flags</td>
<td>word</td>
<td>Clipping rectangle</td>
</tr>
<tr>
<td></td>
<td>clip$\text{_}$x1</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>clip$\text{_}$y1</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>clip$\text{_}$x2</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>clip$\text{_}$y2</td>
<td>F_floating</td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup>All attribute-related encoding items start with input attribute block (IATB) and output attribute block (OATB) numbers and then contain attribute specific information.

<sup>3</sup>Arguments whose data type is word, longword, or character use the prefix GER$\text{\_}W$-, GER$\text{\_}F$-, or GER$\text{\_}G$, respectively, EXCEPT GER$\text{\_}L$\_LINE\_STYLE and GER$\text{\_}L$\_IMAGE\_SIZE. For example, GER$\text{\_}W$\_IATB, GER$\text{\_}F$\_CHAR\_SIZE\_WIDTH, or GER$\text{\_}G$\_FONT\_ID\_STRING.
Table 15-2 (Cont.) Arguments of Binary Encoded Instructions

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATTRIBUTES</td>
<td>color_count</td>
<td>word</td>
<td>Number of indices</td>
</tr>
<tr>
<td></td>
<td>color_index</td>
<td>word</td>
<td>First index</td>
</tr>
<tr>
<td></td>
<td>color_values</td>
<td>longword array</td>
<td>R, G, and B vectors</td>
</tr>
<tr>
<td>GER$C$SET_FILL_</td>
<td>fill_flags</td>
<td>word</td>
<td>Flags</td>
</tr>
<tr>
<td>PATTERN</td>
<td>fill_index</td>
<td>word</td>
<td>Index</td>
</tr>
<tr>
<td>GER$C$SET_FONT</td>
<td>font_id_length</td>
<td>word</td>
<td>Font name length</td>
</tr>
<tr>
<td></td>
<td>font_id_string</td>
<td>character</td>
<td>Font name string</td>
</tr>
<tr>
<td>GER$C$SET_INTENSITIES</td>
<td>intensity_count</td>
<td>word</td>
<td>Number of indices</td>
</tr>
<tr>
<td></td>
<td>intensity_index</td>
<td>word</td>
<td>First index</td>
</tr>
<tr>
<td></td>
<td>intensity_values</td>
<td>longword array</td>
<td>I vector</td>
</tr>
<tr>
<td>GER$C$SET_LINE_</td>
<td>line_style</td>
<td>longword</td>
<td>32-bit bitvector</td>
</tr>
<tr>
<td>STYLE</td>
<td>line_width_nc</td>
<td>F_floating</td>
<td>Normalized coordinates</td>
</tr>
<tr>
<td>GER$C$SET_LINE_</td>
<td>line_width_dc</td>
<td>F_floating</td>
<td>Pixel coordinates</td>
</tr>
<tr>
<td>WIDTH</td>
<td>line_width_mode</td>
<td>word</td>
<td>Width mode</td>
</tr>
<tr>
<td></td>
<td>text_format_mode</td>
<td>word</td>
<td>Text formatting mode</td>
</tr>
<tr>
<td>GER$C$SET_TEXT_</td>
<td>text_margin_x</td>
<td>F_floating</td>
<td>Starting position</td>
</tr>
<tr>
<td>FORMATTING</td>
<td>text_margin_y</td>
<td>F_floating</td>
<td>Ending position</td>
</tr>
<tr>
<td></td>
<td>text_margin_distance</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td>GER$C$SET_TEXT_</td>
<td>text_path_major</td>
<td>word</td>
<td>Major path code</td>
</tr>
<tr>
<td>PATH</td>
<td>text_path_minor</td>
<td>word</td>
<td>Minor path code</td>
</tr>
<tr>
<td></td>
<td>text_slope_angle</td>
<td>F_floating</td>
<td>Angle of text slope</td>
</tr>
</tbody>
</table>

1. All attribute-related encoding items start with input attribute block (IATB) and output attribute block (OATB) numbers and then contain attribute specific information.

2. Arguments whose data type is word, longword, or character use the prefix GER$W_-$, GER$F_-$, or GER$G$, respectively, EXCEPT GER$L_LINE_STYLE$ and GER$L_IMAGE_SIZE$. For example, GER$W_IATB$, GER$F_CHAR_SIZE_WIDTH$, or GER$G_FONT_ID_STRING$. 

3. Arguments whose data type is word, longword, or character use the prefix GER$W_-$, GER$F_-$, or GER$G$, respectively, EXCEPT GER$L_LINE_STYLE$ and GER$L_IMAGE_SIZE$. For example, GER$W_IATB$, GER$F_CHAR_SIZE_WIDTH$, or GER$G_FONT_ID_STRING$. 
### Table 15-2 (Cont.) Arguments of Binary Encoded Instructions

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument 3</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attributes¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GER$C_SET_ WRITING_MODE</td>
<td>writing_mode</td>
<td>word</td>
<td>Writing mode</td>
</tr>
<tr>
<td>GER$C_SET_ WRITING_INDEX</td>
<td>writing_index</td>
<td>word</td>
<td>Writing index</td>
</tr>
<tr>
<td>Graphics and Text²</td>
<td>output_atb</td>
<td>word</td>
<td>ATB for graphics and text operations</td>
</tr>
<tr>
<td>GER$C_ELLIPSE</td>
<td>ellipse_x</td>
<td>F_floating</td>
<td>Center point</td>
</tr>
<tr>
<td></td>
<td>ellipse_y</td>
<td>F_floating</td>
<td>Radius width and height</td>
</tr>
<tr>
<td></td>
<td>ellipse_width</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ellipse_height</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ellipse_start_deg</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ellipse_end_deg</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td>GER$C_IMAGE</td>
<td>image_x1</td>
<td>F_floating</td>
<td>Lower-left corner of raster image</td>
</tr>
<tr>
<td></td>
<td>image_y1</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>image_x2</td>
<td>F_floating</td>
<td>Upper-right corner of raster image</td>
</tr>
<tr>
<td></td>
<td>image_y2</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>image_width</td>
<td>word</td>
<td>Image width in pixels</td>
</tr>
<tr>
<td></td>
<td>image_height</td>
<td>word</td>
<td>Image height in pixels</td>
</tr>
<tr>
<td></td>
<td>image_bpp</td>
<td>word</td>
<td>Bits per pixel</td>
</tr>
<tr>
<td></td>
<td>image_size</td>
<td>longword</td>
<td>Number of bytes in image</td>
</tr>
</tbody>
</table>

1 All attribute-related encoding items start with input attribute block (IATB) and output attribute block (OATB) numbers and then contain attribute specific information.

2 All output-related encoding items start with an attribute block (ATB) number and then followed by graphics and text output information.

3 Arguments whose data type is word, longword, or character use the prefix GER$W_, GER$F_, or GER$G, respectively. EXCEPT GER$L_LINE_STYLE and GER$L_IMAGE_SIZE. For example, GER$W_IATB, GER$F_CHAR_SIZE_WIDTH, or GER$G_FONT_ID_STRING.
<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument^3</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graphics and Text^2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>image_data</td>
<td>byte array</td>
<td>Place to store actual data</td>
<td></td>
</tr>
<tr>
<td>plot_count</td>
<td>word</td>
<td>Number of points</td>
<td></td>
</tr>
<tr>
<td>plot_data</td>
<td>longword array</td>
<td>Points</td>
<td></td>
</tr>
<tr>
<td>text_encoding</td>
<td>word</td>
<td>8- or 16-bit encoding</td>
<td></td>
</tr>
<tr>
<td>text_length</td>
<td>word</td>
<td>Text length in bytes</td>
<td></td>
</tr>
<tr>
<td>text_data</td>
<td>character</td>
<td>Text string</td>
<td></td>
</tr>
<tr>
<td>line_count</td>
<td>word</td>
<td>Number of points</td>
<td></td>
</tr>
<tr>
<td>line_data</td>
<td>longword array</td>
<td>Points</td>
<td></td>
</tr>
</tbody>
</table>

**Color Map**

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GER$C$-CREATE_</td>
<td>color_map_attributes</td>
<td>longword</td>
<td>Color map attributes</td>
</tr>
<tr>
<td>COLOR$_MAP$</td>
<td>color_map_resident</td>
<td>bitfield mask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>color_map_no_bind</td>
<td>bitfield mask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>color_map_share</td>
<td>bitfield mask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>color_map_system</td>
<td>bitfield mask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>color_map_name_size</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td></td>
<td>color_map_size</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td></td>
<td>color_map_name</td>
<td>character</td>
<td>Virtual color map name</td>
</tr>
</tbody>
</table>

**Private Data**

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GER$C$-PRIVATE</td>
<td>private_facnum</td>
<td>word</td>
<td>Facility number</td>
</tr>
<tr>
<td></td>
<td>private_length</td>
<td>word</td>
<td>Length of data</td>
</tr>
<tr>
<td></td>
<td>private_data</td>
<td>byte array</td>
<td>Data</td>
</tr>
</tbody>
</table>

**Metafile**

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GER$C$-VERSION</td>
<td>version_major</td>
<td>word</td>
<td>Encoding version number</td>
</tr>
</tbody>
</table>

---

2 All output-related encoding items start with an attribute block (ATB) number and then followed by graphics and text output information.

3 Arguments whose data type is word, longword, or character use the prefix GER$W$-, GER$F$-, or GER$G$, respectively, EXCEPT GER$L$_LINE_STYLE and GER$L$_IMAGE_SIZE. For example, GER$W$_IATB, GER$F$_CHAR_SIZE_WIDTH, or GER$G$_FONT_ID_STRING.
### Table 15-2 (Cont.) Arguments of Binary Encoded Instructions

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metafile</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>version_minor</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td></td>
<td>version_eco</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td>GER$C_ IDENTIFICATION</td>
<td>identification_length</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td></td>
<td>identification_string</td>
<td>character</td>
<td></td>
</tr>
<tr>
<td>GER$C_DATE</td>
<td>date_length</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td></td>
<td>date_string</td>
<td>character</td>
<td></td>
</tr>
<tr>
<td>GER$C_PRIVATE_ ECO</td>
<td>private_eco_facnum</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td></td>
<td>private_eco_major</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td></td>
<td>private_eco_minor</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td></td>
<td>private_eco_eco</td>
<td>word</td>
<td></td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GER$C_DISPLAY_ EXTENTS</td>
<td>extent_minx</td>
<td>F_floating</td>
<td>Extent rectangle</td>
</tr>
<tr>
<td></td>
<td>extent_miny</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>extent_maxx</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>extent_maxy</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td>GER$C_SET_ POSITION</td>
<td>text_pos_x</td>
<td>F_floating</td>
<td>Text position</td>
</tr>
<tr>
<td></td>
<td>text_pos_y</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td>GER$C_ALIGN_ POSITION</td>
<td>align_pos_atb</td>
<td>word</td>
<td>Attribute block</td>
</tr>
<tr>
<td></td>
<td>align_pos_x</td>
<td>F_floating</td>
<td>Position</td>
</tr>
<tr>
<td></td>
<td>align_pos_y</td>
<td>F_floating</td>
<td></td>
</tr>
<tr>
<td>GER$C_BEGIN_ DISPLAY</td>
<td>display_wc_minx</td>
<td>f_floating</td>
<td>Dimensions of virtual display</td>
</tr>
<tr>
<td></td>
<td>display_wc_miny</td>
<td>f_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>display_wc_maxx</td>
<td>f_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>display_wc_maxy</td>
<td>f_floating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>display_width</td>
<td>f_floating</td>
<td></td>
</tr>
</tbody>
</table>

3 Arguments whose data type is word, longword, or character use the prefix GER$W_-, GER$F_-, or GER$G_, respectively, EXCEPT GER$L_LINE_STYLE and GER$L_IMAGE_SIZE. For example, GER$W_IATB, GER$F_CHAR_SIZE_WIDTH, or GER$G_FONT_ID_STRING.
Table 15-2 (Cont.) Arguments of Binary Encoded Instructions

<table>
<thead>
<tr>
<th>Opcode</th>
<th>Argument</th>
<th>Data Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miscellaneous</td>
<td>display_height</td>
<td>f_floating</td>
<td></td>
</tr>
<tr>
<td>GER$C_END_DISPLAY</td>
<td>No arguments</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3 Arguments whose data type is word, longword, or character use the prefix GER$W_, GER$F_, or GER$G, respectively, EXCEPT GER$L_LINE_STYLE and GER$L_IMAGE_SIZE. For example, GER$W_IATB, GER$F_CHAR_SIZE_WIDTH, or GER$G_FONT_ID_STRING.

15.2.2 Creating UIS Metafiles

UIS metafiles are encoded binary instructions which when extracted from a display list with UIS$EXTRACT_OBJECT or UIS$EXTRACT_REGION are generically encoded. UIS metafiles consist of the following parts: (1) header information, (2) generically encoded binary instructions, and (3) a trailer. The header and trailer are special binary instructions that indicate the beginning and end of a UIS metafile. The generic encoding of UIS metafiles allows you to store the extracted contents of the display list in a buffer or file. Table 15-3 lists the parts of a UIS metafile.

Table 15-3 Structure of UIS Metafiles

<table>
<thead>
<tr>
<th>Generic Encoding Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Header Information</td>
<td></td>
</tr>
<tr>
<td>GER$C_VERSION</td>
<td>Level of generic encoding syntax. The version always appears first.</td>
</tr>
<tr>
<td>GER$C_IDENTIFICATION</td>
<td>User-specified optional identification string.</td>
</tr>
<tr>
<td>GER$C_DATE</td>
<td>Optional and user-specified.</td>
</tr>
<tr>
<td>GER$C_PRIVATE_ECO1,2</td>
<td>Optional and user-specified.</td>
</tr>
<tr>
<td>GER$C_CREATE_COLOR_MAP</td>
<td>Used by UIS$EXECUTE_DISPLAY.</td>
</tr>
<tr>
<td>GER$C_SET_COLORS</td>
<td>Used by UIS$EXECUTE_DISPLAY.</td>
</tr>
<tr>
<td>GER$C_BEGIN_DISPLAY</td>
<td>Dimensions of the virtual display to be created by UIS$EXECUTE_DISPLAY.</td>
</tr>
</tbody>
</table>

1 Engineering Change Order

2 See Table 15-1 for the generic symbols in each of these categories of binary encoded instructions.
15-12  Metafiles and Private Data

Table 15-3 (Cont.)  Structure of UIS Metafiles

<table>
<thead>
<tr>
<th>Generic Encoding Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Encoded Binary Instructions</strong>²</td>
<td></td>
</tr>
<tr>
<td>GER$C_DISPLAY_EXTENTS³</td>
<td>Bounds of an extent rectangle used in UIS$EXTRACT_REGION.</td>
</tr>
<tr>
<td>Segment</td>
<td>Express the hierarchical structure within a display list and identify the attributes associated with a segment.</td>
</tr>
<tr>
<td>Attribute</td>
<td>Allow the modification of any attribute in any attribute block. A generic encoding opcode exists for each attribute.</td>
</tr>
<tr>
<td>Graphics and text</td>
<td>Contain the data necessary to draw graphic objects.</td>
</tr>
<tr>
<td>Application-specific</td>
<td>Associate data with a user-specified facility.</td>
</tr>
<tr>
<td><strong>Trailer</strong></td>
<td></td>
</tr>
<tr>
<td>GER$C_END_DISPLAY</td>
<td>Ends the UIS metafile.</td>
</tr>
</tbody>
</table>

²See Table 15-1 for the generic symbols in each of these categories of binary encoded instructions.

³Generated by UIS$EXTRACT\_REGION only

15.2.3  Structure of a UIS Metafile

A UIS metafile consists of three parts—header information, binary instructions, and trailer information. Figure 15-5 illustrates the structure of a UIS metafile containing a single extracted graphic object. Note that attribute modification instructions precede the object and private data instructions follow it. Also, if the extracted object lay previously within a segment, segmentation instructions must surround it in the metafile.
Private data is discussed later in this chapter.
15.2.4 Programming Options

The ability to create UIS metafiles allows you to save display screen output in files for reexecution at a later time.

Creating UIS Metafiles

You can extract an object or the contents of a region within a virtual display using UIS$EXTRACT_HEADER, UIS$EXTRACT_OBJECT or UIS$EXTRACT_REGION, UIS$EXTRACT_TRAILER and store the data in a buffer or file as a metafile using the following procedure:

1. Determine the size of the buffer needed to store the header information, binary encoded stream, and trailer using UIS$EXTRACT_HEADER, UIS$EXTRACT_OBJECT or UIS$EXTRACT_REGION, and UIS$EXTRACT_TRAILER omitting the buffer length and buffer address parameters.

2. Call UIS$EXTRACT_HEADER, UIS$EXTRACT_OBJECT or UIS$EXTRACT_REGION, and UIS$EXTRACT_TRAILER again, specifying the previously omitted parameters to extract the header information, binary encoded instructions, and trailer and to store the data in three buffers.

3. Use the VAX FORTRAN OPEN and WRITE statements to write the contents of the buffers to an external file.

Executing the Metafile

UIS metafiles extracted and stored in a buffer can be written to the same virtual display using UIS$EXECUTE.

UIS$EXECUTE_DISPLAY creates a new virtual display and executes the metafile in the new display space. However, you must call UIS$CREATE_WINDOW to view the graphic object in the virtual display.

15.2.5 Program Development I

Programming Objective

To extract the contents of a region in the virtual display and create a UIS metafile.

Programming Tasks

1. Initialize variables.
2. Create a virtual display.
3. Draw graphic objects in the virtual display.
4. Create a display window and viewport.
5. Determine the size of each part of the metafile.
6. Allocate the space in buffers for each part of the metafile.
7. Extract the contents of the specified region in a buffer.
8. Write the contents of the buffer to an external file.

```
PROGRAM EXTRACT
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
DATA RETLEN1,RETLEN2,RETLEN3/3*0/
VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,30.0,30.0,20.0,20.0)

 c Draw some objects
 CALL UIS$PLOT(VD_ID,0.7,0.10.0,16.0,10.0,7.0,15.0, 1
 2 7.0,10.0)
 CALL UIS$ELLIPSE(VD_ID,0,20.0,20.0,9.0,5.0) 2
 CALL UIS$TEXT(VD_ID,0,'Haste and wisdom are things far odd', 3
 2 11.0,15.0)

 c Create a display window
 WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')

 PAUSE

 c Find out how much space to allocate for each part of the metafile
 CALL UIS$EXTRACT_HEADER(VD_ID,.,RETLEN1) 4
 CALL UIS$EXTRACT_REGION(VD_ID,.,.,.,.,.,RETLEN2) 5
 CALL UIS$EXTRACT_TRAILER(VD_ID,.,.,.,.,.,RETLEN3) 6

 c Virtual memory is allocated for the buffers
 STATUS=LIB$GET_VM(RETLEN1,ENCODED1) 7
 IF (.NOT.STATUS) CALL LIB$STOP(%VAL(STATUS)) 3
 STATUS=LIB$GET_VM(RETLEN2,ENCODED2) 9
 IF (.NOT.STATUS) CALL LIB$STOP(%VAL(STATUS)) 10
 STATUS=LIB$GET_VM(RETLEN3,ENCODED3) 11
 IF (.NOT.STATUS) CALL LIB$STOP(%VAL(STATUS)) 12
 RETLEN=RETLEN1+RETLEN2+RETLEN3
 TYPE *, 'HEADER DATA',RETLEN1,' BYTES' 13
 TYPE *, 'BINARY INSTRUCTION',RETLEN2,' BYTES' 14
 TYPE *, 'TRAILING DATA',RETLEN3,' BYTES' 15
 TYPE *, 'NO. OF BYTES ALLOCATED = ',RETLEN 16

 PAUSE

 C Extract the data and store it in a buffer
 CALL UIS$EXTRACT_HEADER(VD_ID,RETLEN1,%VAL(ENCODED1)) 17
 CALL UIS$EXTRACT_REGION(VD_ID,.,.,.,.,.,RETLEN2,%VAL(ENCODED2)) 18
 CALL UIS$EXTRACT_TRAILER(VD_ID,RETLEN3,%VAL(ENCODED3)) 19
```
c Write the contents of the buffer to an external file
   OPEN(UNIT=10,FILE='$/DISK:[MY_DIR]METAFILE.DAT',STATUS='NEW')
c Call subroutine to write the contents of the buffer
   CALL BUFFERWRITE(%VAL(ENCODED1),RETLEN1,10)
   CALL BUFFERWRITE(%VAL(ENCODED2),RETLEN2,10)
   CALL BUFFERWRITE(%VAL(ENCODED3),RETLEN3,10)
c Close the external file
   CLOSE(UNIT=10,STATUS='SAVE')
END

SUBROUTINE BUFFERWRITE(BUFFER,LENGTH,LUN)
   IMPLICIT INTEGER(A-Z)
   BYTE BUFFER(LENGTH)
   WRITE(LUN,500)BUFFER
   RETURN
END

Calls to UIS$PLOT, UIS$ELLIPSE, and UIS$TEXT draw objects in the virtual display.

Next, you must find out how much space must be allocated for the buffers that will hold the header data, binary encoded stream, and trailing data. The variables retlen1, retlen2, and retlen3 receive the length of the header data, binary encoded stream, and trailing data.

Virtual memory is allocated for the buffers and the address of each buffer is stored in the pointers encoded1, encoded2, and encoded3 using LIB$GET_VM. A test for completion status of each Run-Time Library call is performed.

The length of the header data, encoded stream, and trailing data are typed in the emulation window as well as the total number of bytes allocated.

The contents of the display list are extracted using UIS$EXTRACT_HEADER, UIS$EXTRACT_REGION, and UIS$EXTRACT_TRAILER stored at the location indicated by pointers encoded1, encoded2, and encoded3. Using the VAX FORTRAN built-in function %VAL, the pointers encoded1, encoded2, and encoded3 are evaluated in terms of the actual data they store—the addresses of the starting point of each buffer.

An external file is opened with the VAX FORTRAN OPEN statement for program output.

The pointer encoded was implicitly declared as a longword integer. Therefore, you cannot simply write the data to the file PRIVATE.DAT.
The subroutine BUFFERWRITE is called three times to perform this task. Three arguments are passed in the call—buffer address, buffer size, and the VAX FORTRAN logical unit number of the output device. An array BUFFER is constructed from this data.

The subroutine BUFFERWRITE writes the contents of BUFFER to the UIS metafile PRIVATE.DAT. First the header data is stored in the metafile, then the binary encoded stream, and, finally, the trailing data is written to PRIVATE.DAT.

Prior to program termination, the VAX FORTRAN CLOSE statement closes the file.

15.2.5.1 Calling UIS$EXTRACT_HEADER, UIS$EXTRACT_REGION, and UIS$EXTRACT_TRAILER

A triangle, an ellipse, and text are drawn in a virtual display as shown in Figure 15–6.
Figure 15-6  Original Objects Drawn in the Virtual Display

Haste and wisdom are things far odd
The terminal emulation window shown in Figure 15-7 shows buffer size information for metafile components.

**Figure 15-7 After Buffer Execution**

```
$ run extract
FORTTRAN PAUSE
$ cont
HEADER DATA       101  BYTES
BINARY INSTRUCTION 151  BYTES
TRAILING DATA      4   BYTES
TOTAL NO. OF BYTES ALLOCATED = 256
FORTTRAN PAUSE
```

### 15.3 Display Lists and Private Data

As mentioned earlier, display lists are created when graphics routines are executed. Application-specific or *private data* can be bound to graphic objects. The binary encoded instructions contained in the display list points to internal buffers that contain the private data.

#### 15.3.1 Using Private Data

Private data is used to include some application-specific information with the graphic objects displayed on the workstation screen. The nature of this information is entirely at the discretion of the user. For example, an application that draws a vertical bar graph and plots relative humidity over a 24-hour period could create data on an hourly basis. The private data, in this case, indicating temperature or wind speed could be associated with each vertical bar. Private data is not displayed on the workstation screen and is not available to users unless extracted into a buffer or metafile and executed. Private data can be attached to any graphic object drawn in the virtual display.
15-20 Metafiles and Private Data

15.3.2 Programming Options
We will construct a program that reads data from an external file and uses it as private data.

Creating Private Data
You can create private data with UIS$PRIVATE.

Extracting Private Data
You can extract private data and store it in a buffer using UIS$EXTRACT_PRIVATE using the following procedure:
1. Determine the size of the buffer needed to store the header information, binary encoded stream, and the trailer using UIS$EXTRACT_HEADER, UIS$EXTRACT_PRIVATE, and UIS$EXTRACT_TRAILER omitting the buffer length and buffer address parameters.
2. Call UIS$EXTRACT_HEADER, UIS$EXTRACT_PRIVATE and UIS$EXTRACT_TRAILER again specifying the previously omitted parameters to extract the private data and store the data in a buffer.
3. Use the VAX FORTRAN OPEN statement to write the contents of the buffer to an external file.

Deleting Private Data
You can delete private data associated with a graphic object using UIS$DELETE_PRIVATE.

15.3.3 Program Development II
Programming Objectives
1. To append private data to an object in the display list.
2. To extract the private data.
3. To create a UIS metafile containing the private data instruction.

Programming Tasks
1. Declare an array to receive the private data from an external file.
2. Type out the contents of the array to verify it.
3. Create private data and append it to the last object in the display list.
4. Determine how large the buffers must be.
5. Allocate memory for the buffers.
6. Extract the private data.

7. Write the contents of the buffers to an external file.

Please note that in order to run this program, you should modify the file specifications in the OPEN statements and construct a data file similar to DATA.DAT.

```
PROGRAM PRIVATE
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
BYTE PRIV(1:23)

! Construct a descriptor
INTEGER*4 PRIV_DESC(2)
PRIV_DESC(1)=23
PRIV_DESC(2)=%LOC(PRIV)

! Open external file containing private data
OPEN(UNIT=8,FILE='$DISK:[MY_DIR]DATA.DAT',STATUS='OLD')

! Read data into array
READ(8,50)PRIV

50 FORMAT(A7)
CLOSE(UNIT=8,STATUS='SAVE')

VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,30.0,30.0,15.0,15.0)

! Draw the hot air balloon
CALL UIS$SET_FONT(VD_ID,0,2,'MY_FONT_5')
INDEX=87
CALL UIS$SET_FILL_PATTERN(VD_ID,2,2,INDEX)
CALL UIS$CIRCLE(VD_ID,2,12.0,20.0,8.0)
CALL UIS$LINE(VD_ID,2,10.0,12.0,10.0,8.0,14.0,12.0,14.0,8.0,10.0,10.0,14.0,10.0,10.0,8.0,14.0,8.0)

! Draw house
CALL UIS$PLOT(VD_ID,0,15.0,8.0,29.0,8.0,22.0,13.0,2,15.0,8.0)
CALL UIS$LINE(VD_ID,0,15.0,8.0,15.0,0.0,29.0,8.0,29.0,0.0)

! Draw door
CALL UIS$PLOT(VD_ID,0,21.0,0.0,21.0,4.0,23.0,4.0,23.0,0.0)

! Create windows
CALL UIS$PLOT(VD_ID,0,17.0,2.0,17.0,6.0,19.0,6.0,19.0,2.0,2,17.0,2.0)
CALL UIS$LINE(VD_ID,0,17.0,4.0,19.0,4.0,18.0,2.0,18.0,6.0)
CALL UIS$PLOT(VD_ID,0,25.0,2.0,25.0,6.0,27.0,6.0,27.0,2.0,2,25.0,2.0)
CALL UIS$LINE(VD_ID,0,25.0,4.0,27.0,4.0,26.0,2.0,26.0,6.0)
```
c create chimney
    CALL UIS$LINE(VD_ID,0,26.0,11.0,28.0,11.0,26.0,11.0,26.0,10.0,2
    28.0,11.0,28.0,9.0)

c create smoke
    CALL UIS$ELLIPSE(VD_ID,0,27.0,13.0,2.5,1.0)
    CALL UIS$ELLIPSE(VD_ID,0,27.25,16.0,2.25,1.0)
    CALL UIS$ELLIPSE(VD_ID,0,27.5,19.0,2.0,1.0)
    CALL UIS$ELLIPSE(VD_ID,0,27.75,22.0,1.75,1.0)
    CALL UIS$ELLIPSE(VD_ID,0,28.0,25.0,1.5,1.0)
    CALL UIS$ELLIPSE(VD_ID,0,28.25,28.0,1.25,1.0)
    CURR_ID=UIS$GET_CURRENT_OBJECT(VD_ID) 7

c type out buffer containing private data
    TYPE *,PRIV

C Create private data
    FACNUM = 1
    CALL UIS$PRIVATE(vd_id,FACNUM,PRIV_DESC) 9
    CALL UIS$SET_LINE_WIDTH(VD_ID,0,3,15.0) 10
    CALL UIS$PLOT(VD_ID,3,1.0,29.0,4.0,11.0) 11
    CALL UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION') 12
    PAUSE

C Determine size of buffer
    CALL UIS$EXTRACT_HEADER(VD_ID,,RETLEN1) 13
    CALL UIS$EXTRACT_PRIVATE(CURR_ID,,RETLEN2) 14
    CALL UIS$EXTRACT_TRAILER(VD_ID,,RETLEN3) 15
    RETLEN=RETLEN1+RETLEN2+RETLEN3
    TYPE *,’BUFFER SIZE FOR HEADER INFO’,RETLEN1,’BYTES’ 16
    TYPE *,’BUFFER SIZE REQUIRED’,RETLEN2,’BYTES’ 17
    TYPE *,’BUFFER SIZE FOR TRAILING INFO’,RETLEN3,’BYTES’ 18

C Allocate the virtual memory for the buffer
    STATUS=LIB$GET_VM(RETLEN1,EXT_PRIV1) 19
    IF (.NOT. STATUS) CALL LIB$STOP(%VAL(STATUS)) 20
    STATUS=LIB$GET_VM(RETLEN2,EXT_PRIV2) 21
    IF (.NOT. STATUS) CALL LIB$STOP(%VAL(STATUS)) 22
    STATUS=LIB$GET_VM(RETLEN3,EXT_PRIV3) 23
    IF (.NOT. STATUS) CALL LIB$STOP(%VAL(STATUS)) 24

C Extract and store private data in buffer
    CALL UIS$EXTRACT_HEADER(VD_ID,RETLEN1,%VAL(EXT_PRIV1)) 25
    CALL UIS$EXTRACT_PRIVATE(CURR_ID,RETLEN2,%VAL(EXT_PRIV2)) 26
    CALL UIS$EXTRACT_TRAILER(VD_ID,RETLEN3,%VAL(EXT_PRIV3)) 27
CALL BUFFERTYPE(%VAL(EXT_PRIV2), RETLEN2)

C Open an external file
OPEN(UNIT=11, FILE='$DISK: [MY_DIR]PRIVATE.DAT', STATUS='NEW', 
  FORM='UNFORMATTED')

c Write the contents of the buffer
CALL BUFFERWRITE(%VAL(EXT_PRIV1), RETLEN1, 11)
CALL BUFFERWRITE(%VAL(EXT_PRIV2), RETLEN2, 11)
CALL BUFFERWRITE(%VAL(EXT_PRIV3), RETLEN3, 11)

C Close the file
CLOSE(UNIT=11, STATUS='SAVE')

PAUSE
END
SUBROUTINE BUFFERWRITE(BUFFER.LENGTH.LUN)
IMPLICIT INTEGER(A-Z)
BYTE BUFFER(LNGTH)
WRITE(LUN,500)BUFFER
500 FORMAT(T3,I7)
RETURN
END

SUBROUTINE BUFFERTYPE(BUFFER.length)
IMPLICIT INTEGER(A-Z)
BYTE BUFFER(length)
TYPE *,buffer
RETURN
END

A data file DATA.DAT of private data is constructed. It consists of a sentence. Because each character requires a byte of storage, the total number of characters in the data file is specified as the upper bound of array PRIV as well as the buffer length in the descriptor you must construct for UIS$PRIVATE.

An external file DATA.DAT is opened and read into the array PRIV.

A circle, a triangle, and text are drawn in the virtual display. UIS$GET_CURRENT_OBJECT retrieves the identifier of the last object drawn in the virtual display.

The array PRIV is typed out to verify its contents.

UIS$PRIVATE associates the sentence contained in the array PRIV with the objects drawn in the virtual display. Note that the location of the array PRIV is passed by descriptor.
Suppose you want to extract the data and store it in a buffer as a UIS metafile. You must first determine how much space the header data, binary encoded private data, and trailing data will occupy by calling UIS$EXTRACT_HEADER, UIS$EXTRACT_PRIVATE, and UIS$EXTRACT_TRAILER without specifying the buflen and bufaddr arguments.

The variables retlen1, retlen2, and retlen3 are typed out to reveal the size of each part of the display list.

A call to LIB$GET_VM allocates virtual memory for three buffers using the value of retlen1, retlen2, and retlen3 and stores the location of each buffer in the pointers ext_priv1, ext_priv2, and ext_priv3, respectively. A test for completion status is performed for each Run-Time Library call.

If you did not use LIB$GET_VM, you would have to explicitly declare an array with an actual length in the beginning of the program. However, at that point in the program, you would have no idea how large such an array would need to be.

A call to UIS$EXTRACT_HEADER, UIS$EXTRACT_PRIVATE, and UIS$EXTRACT_TRAILER, specifying the omitted parameters, extracts the header data, binary encoded private data, and the trailing data and stores them in separate buffers. Because ext_priv1, ext_priv2, and ext_priv3 are pointers, you must obtain the actual data that they store using the VAX FORTRAN built-in function %VAL.

Suppose you want to look at the contents of the user buffer before you write the contents to an external file.

Because the pointer ext_priv was implicitly declared a longword integer and functions as a pointer, we cannot simply type the data in the user.

A subroutine BUFFERTYPE is called referencing the pointer ext_priv2 and the size of the buffer. Two arguments are passed in the call—the pointer name and the size of the buffer. The subroutine BUFFERTYPE reads the data from the location to which ext_priv2 points and writes the data in terminal emulation window.

The file PRIVATE.DAT is opened.

The subroutine BUFFERWRITE is called three times to write the header, private, and trailer data to the external file. Three arguments are passed in the call—buffer address, buffer size, and the VAX FORTRAN logical unit number of the output device. An array BUFFER is declared from this data and an association with an external file is established.

The subroutine BUFFERWRITE writes the contents of BUFFER to the file PRIVATE.DAT. The file is closed and saved.
15.3.3.1 Calling UIS$PRIVATE and UIS$EXTRACT_PRIVATE

Figure 15–8 shows the sample containing character string private data in the external file DATA.DAT.

Figure 15–8  Private Data
Figure 15-9 shows the contents of the array PRIV read from the external file DATA.DAT. Note that each number is an ASCII code. The required buffer size is also shown. In addition, the extracted generically encoded binary private data instruction is shown as metafile opcodes and ASCII codes.

Figure 15-9 Verifying the Contents of the Temporary Array and User Buffer
The private data was appended to the last ellipse drawn—the smallest cloud of a smoke rising from the chimney shown in Figure 15-10.

**Figure 15-10  Hot Air Balloon**
Chapter 16
Programming in Color

16.1 Overview
Until now we have assumed that the one way to change the appearance of graphic objects and text is through modification of attribute settings in attribute block 0. However, depending on the VAXstation color system you have, you can draw graphic objects in over 16 million colors. This chapter discusses the following topics:

- Using color and intensity routines
- Setting entries in virtual color maps
- Creating shareable color maps
- Using color map segments
- Using color and intensity inquiry routines

This chapter is meaningful for VAXstation users programming in either an intensity or color environment.

16.2 Color and Intensity Routines—How to Use Them
Color and intensity routines allow your application to draw graphic objects in either color or shades of gray. These routines create and load the structures known as virtual color maps and color map segments that hold the color values that your application use. Such routines perform the following tasks:

- Create and delete virtual color maps
- Load virtual color map entries with color values
- Create and delete color map segments
- Load entries in color map segments

We will discuss color map segments later in this chapter.
16.2.1 Step 1—Creating a Virtual Color Map

Whether you are programming in a color or an intensity environment, you must create a virtual color map using UIS$CREATE_COLOR_MAP. The virtual color map is a storage location similar to an artist’s palette. Within the color map, you can store color values in locations known as entries. The virtual color map can vary according to the needs of your application. You can specify the attributes of the virtual color map as you see fit.

16.2.2 Step 2—Setting Virtual Color Map Attributes

The attributes specified for a virtual color map are either required or optional. You must specify the size of the virtual color map, that is, how many color map values it will hold. You can also specify optionally a name for the virtual color map. Other optional attributes are access and residency.

Virtual Color Map Size

As with any storage location, size is a consideration. For every color your application uses, you will need an entry in the virtual color map. You can specify a maximum size of 32,768 entries.

Access to Virtual Color Maps

Another important consideration involves who should have access to your virtual color map. What processes should you allow to have access to your virtual color map? Virtual color maps can be either private or shareable. If you specify that the virtual color map is private, no other processes have access to it. You can designate a virtual color map shareable for a certain group of users or shareable among all users.

Virtual Color Map Residency

Another attribute that you can specify explicitly, is residency. For application-specific reasons, you may wish to dedicate the color resources to the execution of your application. Since this precludes sharing the hardware color resources among applications, you should use this feature carefully.
16.2.3 Step 3—Setting Entries in the Virtual Color Map

At this point, depending on your color environment, your application must load color values into the color map entries using UIS$SET_COLOR, UIS$SET_COLORS, UIS$SET_INTENSITIES, or UIS$SET_INTENSITY.

Color and intensity values are expressed as floating-point number between 0.0 and 1.0, inclusive. The color subsystem uses the red green blue (RGB) color model. The colors that result from the use of color values which denote percentages of red, green, and blue are sometimes not readily apparent from the value chosen. Therefore, it is recommended that you use color setup menus of the human interface to determine the appropriate RGB color component values. You can use these menus as you write your application.

Setting Single Entries

If your application uses only a few colors or intensities, you may require a small virtual color map. In such a case, you could load each color map entry using UIS$SET_COLOR or UIS$SET_INTENSITY each time.

Setting Multiple Entries

If, on the other hand, your virtual color map is large, you can arrange your color map values in an array using a single call to UIS$SET_COLORS or UIS$SET_INTENSITIES.

16.2.4 Programming Options

Whenever your application requires a range of color or intensities, you will need to use several of the UIS routines listed in Table 16–1.

Table 16–1 Color and Intensity Routines

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virtual Color Maps</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$CREATE_COLOR_MAP</td>
<td>Creates a virtual color map</td>
</tr>
<tr>
<td>UIS$DELETE_COLOR_MAP</td>
<td>Deletes a virtual color map</td>
</tr>
<tr>
<td><strong>Loading Virtual Color Map Entries</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$SET_COLOR</td>
<td>Sets a single RGB color value in a virtual color map</td>
</tr>
<tr>
<td>UIS$SET_COLORS</td>
<td>Sets multiple RGB color values in a virtual color map</td>
</tr>
<tr>
<td>UIS$SET_INTENSITIES</td>
<td>Sets a single intensity value in a virtual color map</td>
</tr>
<tr>
<td>UIS$SET_INTENSITY</td>
<td>Sets multiple RGB color values in a virtual color map</td>
</tr>
</tbody>
</table>
Table 16-1 (Cont.)  Color and Intensity Routines

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$CREATE_COLOR_MAP_SEGMENT</td>
<td>Creates a color map segment</td>
</tr>
<tr>
<td>UIS$DELETE_COLOR_MAP_SEGMENT</td>
<td>Deletes a color map segment</td>
</tr>
</tbody>
</table>

16.2.5 Program Development

Programming Objective

To create and load a color map with single entries.

Programming Tasks

1. Establish a size for the virtual color map.
2. Create the virtual color map.
3. Create a virtual display.
4. Create a display window and viewport.
5. Load a single color map entry with one color value using UIS$SET_COLOR.

```plaintext
PROGRAM SINGLE_ENTRY
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL J,K
DATA J/17.0/           ①
DATA K/16/              ②
DATA VCM_SIZE/8/
VCM_ID=UIS$CREATE_COLOR_MAP(VCM_SIZE)      ③
VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,40.0,40.0,15.0,15.0,VCM_ID) ④
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','WINDOW #1')
CALL UIS$SET_COLOR(VD_ID,0,0.40,0.30,0.0)      ⑤
CALL UIS$SET_COLOR(VD_ID,1,0.5,0.5,0.5)         ⑥
CALL UIS$SET_COLOR(VD_ID,2,0.5,0.25,0.5)        ⑦
CALL UIS$SET_COLOR(VD_ID,3,0,0.7,0.3)           ⑧
CALL UIS$SET_COLOR(VD_ID,4,0.25,0.25,0.9)       ⑨
CALL UIS$SET_COLOR(VD_ID,5,0.90,0.5,0.0)        ⑩
CALL UIS$SET_COLOR(VD_ID,6,0.80,0.30,0.0)       ⑪
CALL UIS$SET_COLOR(VD_ID,7,0.35,0.65,0.95)      ⑫
```
CALL UIS$SET_WRITING_INDEX(VD_ID, 0, 9, 2)  
CALL UIS$SET_WRITING_INDEX(VD_ID, 0, 10, 3)  
CALL UIS$SET_WRITING_INDEX(VD_ID, 0, 11, 4)  
CALL UIS$SET_WRITING_INDEX(VD_ID, 0, 12, 5)  
CALL UIS$SET_WRITING_INDEX(VD_ID, 0, 13, 6)  

DO I=9,13,1  
CALL UIS$CIRCLE(VD_ID, I, J, 20.0, 10.0)  
J=J+2.0  
ENDDO  
PAUSE  

DO I=9,13  
CALL UIS$CIRCLE(VD_ID, I, 21.0, K, 10.0)  
K=K+2.0  
ENDDO  
PAUSE  
END

The counters \( j \) and \( k \) are declared and initialized 1 2.

An eight-entry virtual color map is created with no attributes specified 3.

The virtual color map is associated with the virtual display in UIS$CREATE_DISPLAY 4 during creation of the virtual display.

Each color value is loaded into a virtual color map using successive calls to UIS$SET_COLOR 5 6 7 8 9 10 11 12.

The default writing color attribute setting in attribute block 0 is modified such that five new default writing colors are associated with a virtual color map entry 13 14 15 16 17.

The \texttt{atb} argument in the call to UIS$CIRCLE within the DO loop references the modified attribute block. As a result, five circles are drawn horizontally 18 each with a different default writing color.

Five circles are drawn vertically 19 using the same colors as the horizontally drawn circles.
16.2.6 Program Development II

Programming Objective

To create and load a color map with more than one entry at a time.

Programming Task

1. Load the arrays with color component values.
2. Establish color map size.
3. Load eight color map entries in a single call using UIS$SET_COLORS.

```fortran
PROGRAM MULTIPLE_ENTRY
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL J,K
REAL R_VECTOR(8),G_VECTOR(8),B_VECTOR(8)
DATA J/17.0/
DATA K/16/
DATA R_VECTOR/0.40,0.50,0.50,0.0,0.25,0.90,0.80,0.35/
DATA G_VECTOR/0.30,0.50,0.25,0.70,0.25,0.50,0.30,0.65/
DATA B_VECTOR/0.0,0.50,0.50,0.30,0.90,0.0,0.0,0.95/
DATA VCM_SIZE/8/
VCM_ID=UIS$CREATE_COLOR_MAP(VCM_SIZE)
VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,40.0,40.0,15.0,15.0,VCM_ID)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','COLOR')
CALL UIS$SET_COLORS(VD_ID,0.8,R_VECTOR,G_VECTOR,B_VECTOR)
CALL UIS$SET_WRITING_INDEX(VD_ID,0.9,2)
CALL UIS$SET_WRITING_INDEX(VD_ID,0.10,3)
CALL UIS$SET_WRITING_INDEX(VD_ID,0.11,4)
CALL UIS$SET_WRITING_INDEX(VD_ID,0.12,5)
CALL UIS$SET_WRITING_INDEX(VD_ID,0.13,6)
DO I=9,13,1
CALL UIS$CIRCLE(VD_ID,I,J,20.0,10.0)
J=J+2.0
ENDDO
PAUSE
DO I=9,13
CALL UIS$CIRCLE(VD_ID,I,21.0,K,10.0)
K=K+2.0
ENDDO
PAUSE
END
```
Three arrays are declared 1 to hold eight R, G, and B color component values each. The counters \( j \) and \( k \) are declared and initialized 2 3.

The arrays R\_VECTOR, G\_VECTOR, and B\_VECTOR are loaded with color component values 4 5 6.

An eight-entry virtual color map is created 7 and associated with a newly created virtual display 8.

The R, G, and B color component values stored in the arrays are loaded in the virtual color map using a single call to UIS\$SET\_COLORS 9.

The remaining portions of the program are identical to the previous program SINGLE\_ENTRY.

16.2.6.1 Program Development III

Programming Objective

To create a shareable color map.

Programming Task

1. Load arrays containing color component values.

2. Create the color map attributes list specifying the shareable attribute.

3. Create a virtual display specifying a name for the color map.

4. Create a display window and display viewport.

5. Load color values into the color map.

6. Program 2 must perform steps 2 through 4 and reference the name of the color map specified in Program 1.

```fortran
PROGRAM SHAREABLE_MAP
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL J,K
REAL R_VECTOR(8),G_VECTOR(8),B_VECTOR(8)
INTEGER*4 VCM_ATTRIBUTES(3)
DATA J/17.0/
DATA K/16/
DATA R_VECTOR/0.40,0.50,0.50,0.0,0.25,0.90,0.80/  
DATA G_VECTOR/0.30,0.50,0.25,0.70,0.25,0.50,0.30/  
DATA B_VECTOR/0.0,0.50,0.50,0.30,0.90,0.0,0.0/  
DATA VCM_SIZE/8/
VCM_ATTRIBUTES(1)=VCMAL$C_ATTRIBUTES
VCM_ATTRIBUTES(2)=VCMAL$M_SHARE
VCM_ATTRIBUTES(3)=VCMAL$C_END_OF_LIST
```
The counters \( j \) and \( k \) are declared and initialized \( 1 \) \( 3 \) \( 4 \).

An integer array \texttt{VCM\_ATTRIBUTES} is declared to have three elements \( 2 \).

The array elements are assigned attribute values defined by UIS constants \( 5 \) \( 6 \) \( 7 \). The structure contains an attribute code followed by a longword value for that attribute. The final element contains a longword 0 to terminate the list.

An eight-entry virtual color map is created using \texttt{UIS\$CREATE\_COLOR\_MAP} and the array \texttt{VCM\_ATTRIBUTES} is used as an argument \( 8 \).

The newly created virtual display references the virtual color map \( 9 \). Objects drawn in the virtual display can use this virtual color map.

Different default writing color are defined \( 10 \) as in previous programs simply to highlight and differentiate the objects drawn.
A second virtual display is created. The second call to UIS$CREATE_DISPLAY references the same virtual color map identifier as the first. Both virtual displays will share the use of color value assignments in this virtual color map.

However, you must call UIS$SET_WRITING_INDEX again to change the default setting of the writing color so that objects will be drawn in colors identical to those drawn in the first virtual display.

Here is a portion of a second program that uses the virtual color map that uses the virtual color map LIVING_COLOR in the program SHAREABLE_MAP.

```
PROGRAM SECOND_PROGRAM

INTEGER*4 VCM_ATTRIBUTES(3)
DATA VCM_SIZE/8/  
VCM_ATTRIBUTES(1)=VCMAL$C_ATTRIBUTES
VCM_ATTRIBUTES(2)=VCMAL$M_SHARE
VCM_ATTRIBUTES(3)=VCMAL$C_END_OF_LIST
VCM_ID=UIS$CREATE_COLOR_MAP(VCM_SIZE,'LIVING_COLOR',VCM_ATTRIBUTES)
VD_ID2=UIS$CREATE_DISPLAY(1.0,1.0,35.0,35.0,10.0,10.0,VCM_ID)
WD_ID2=UIS$CREATE_WINDOW(VD_ID2,'SYS$WORKSTATION','PROCESS #2')
```

An array of virtual color map attributes specifying the same attributes as those indicated in the preceding program SHAREABLE_MAP. The application SECOND_PROGRAM must declare the virtual color map size as this is a required argument in UIS$CREATE_COLOR_MAP.

The shareable color map is referenced by name in a call to UIS$CREATE_COLOR_MAP.

### 16.3 Color Map Segments

Through the use of color map segments, you can control the binding of the virtual color map to the hardware color map.
16.3.1 Programming Options
Creating and Deleting Color Map Segments
You can create and delete color map segments using UIS$CREATE_COLOR_MAP_SEG and UIS$DELETE_COLOR_MAP_SEG.

16.3.2 Program Development
The program COLOR_SEG is a portion of a longer program and shows how to bind your virtual color map to the hardware color map.

```
PROGRAM COLOR_SEG
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
INTEGER*4 VCM_ATTRIBUTES(3)  
DATA VCM_SIZE,PLACEMENT_DATA/8,16/ 

VCM_ATTRIBUTES(1)=VCMAL$C_ATTRIBUTES  
VCM_ATTRIBUTES(2)=VCMAL$M_NOBIND  
VCM_ATTRIBUTES(3)=VCMAL$C_END_OF_LIST  
VCM_ID=UIS$CREATE_COLOR_MAP(VCM_SIZE,VCM_ATTRIBUTES)  
CMS_ID=UIS$CREATE_COLOR_MAP_SEG(VCM_ID,'SYS$WORKSTATION',2  
VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,30.0,30.0,10.0,10.0,VCM_ID)  
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')
```

Two declarations are established—an array VCM_ATTRIBUTES is declared and the virtual color map size is initialized to 8 2.

Because the color map segment is created with exact placement, the placement data argument of UIS$CREATE_COLOR_MAP_SEG must be initialized to the starting index in the hardware color map where binding is to occur.

The elements of array VCM_ATTRIBUTES are assigned an attribute code 3, an attribute value VCMAL$M_NOBIND 4, and a terminating value 5.

UIS$CREATE_COLOR_MAP is called before any other UIS routine.
16.3.3 Calling UIS$CREATE_COLOR_MAP_SEG

No special graphics effects are displayed on the VAXstation screen.

16.4 Color and Intensity Inquiry Routines

As mentioned previously in Chapter 12, certain routines called inquiry routines provide application with status information. There are several UIS color and intensity routines that return information to the application. Color and intensity inquiry routines return information about the color setup, virtual color map, and hardware color map. Such information can be used as direct input to your application.

16.4.1 Programming Options

Your application can use one or more inquiry routines, where appropriate. Table 16-3 lists color and intensity inquiry routines.

Table 16-3 Color and Intensity Inquiry Routines

<table>
<thead>
<tr>
<th>Routine</th>
<th>Information Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Virtual Color Map</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$GET_COLOR</td>
<td>Single RGB value from a virtual color map</td>
</tr>
<tr>
<td>UIS$GET_COLORS</td>
<td>Multiple RGB values from a virtual color map</td>
</tr>
<tr>
<td>UIS$GET_INTENSITIES</td>
<td>Multiple intensity values from a virtual color map</td>
</tr>
<tr>
<td>UIS$GET_INTENSITY</td>
<td>Single intensity value from a virtual color map</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Hardware Color Map</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$GET_HW_COLOR_INFO</td>
<td>Device type; number of indexes; number of colors; bits of precision for R, G, and B values; reserved entries; and regeneration characteristics.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Color Value Conversion</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$HLS_TO_RGB</td>
<td>Converts HLS color values to RGB color values</td>
</tr>
<tr>
<td>UIS$HSV_TO_RGB</td>
<td>Converts HSV color values to RGB color values</td>
</tr>
<tr>
<td>UIS$RGB_TO_HLS</td>
<td>Converts RGB color values to HLS color values</td>
</tr>
<tr>
<td>UIS$RGB_TO_HSV</td>
<td>Converts RGB color values to HSV color values</td>
</tr>
</tbody>
</table>
### 16.4.2 Program Development I

**Programming Objective**

To retrieve hardware color map information.

**Programming Tasks**

1. Create a virtual color map.
2. Create a virtual display.
3. Create a display window and viewport.
4. Obtain the number of color map indices, possible colors, maps, bits of precision for each color component, and reserved entries.

```plaintext
PROGRAM GET_INFO
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
REAL J,K
REAL R_VECTOR(8),G_VECTOR(8),B_VECTOR(8)
REAL RETR_VECTOR(8),RETG_VECTOR(8),RETB_VECTOR(8)
INTEGER*4 VCM_ATTRIBUTES(3)
DATA J/17.0/
DATA K/16/
DATA R_VECTOR/0.40,0.50,0.50,0.0,0.25,0.90,0.80,0.35/
DATA G_VECTOR/0.30,0.50,0.25,0.70,0.25,0.50,0.30,0.65/
DATA B_VECTOR/0.0,0.50,0.50,0.30,0.90,0.0,0.0,0.95/
VCM_ATTRIBUTES(1)=VCMAL$C_ATTRIBUTES
VCM_ATTRIBUTES(2)=VCMAL$M_SHARE
VCM_ATTRIBUTES(3)=VCMAL$C_END_OF_LIST
```
VCM_ID=UIS$CREATE_COLOR_MAP(VCM_SIZE,VCM_ATTRIBUTES)
VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,40.0,40.0,15.0,15.0,VCM_ID)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYSSWORKSTATION','COLOR')

CALL UIS$SET_COLORS(VD_ID,0,8,R_VECTOR,G_VECTOR,B VECTOR)
CALL UIS$SET_WRITING_INDEX(VD_ID,0,9,2)
CALL UIS$SET_WRITING_INDEX(VD_ID,0,10,3)
CALL UIS$SET_WRITING_INDEX(VD_ID,0,11,4)
CALL UIS$SET_WRITING_INDEX(VD_ID,0,12,5)
CALL UIS$SET_WRITING_INDEX(VD_ID,0,13,6)

CALL UIS$GET_COLORS(VD_ID,0,8,RETR VECTOR,RETG VECTOR,RET B VECTOR)

TYPE 50
50 format(T8,'RED',T18,'GREEN',T30,'BLUE')

TYPE 100,RETR VECTOR,RET G VECTOR,RET B VECTOR
100 FORMAT(F11.3,F11.3,F11.3)

CALL UIS$GET_HW_COLOR_INFO(, ,
2 INDICES,COLORS,MAPS, RBITS,GBITS,BBITS,,RES_INDICES)

TYPE 150,INDICES, COLORS
150 FORMAT(T2,'NO. OF INDICES=',I3,T22,'NO. OF COLORS=',I8)

TYPE 200,MAPS
200 FORMAT(T2,'NO. OF MAPS=',I3)

TYPE 225,RBITS,GBITS,BBITS
225 FORMAT(T2,'NO. OF BITS OF PRECISION',T28,'RED',I3,T37,'GREEN',I3,
2 T48,'BLUE',I3)

TYPE 250,RES_INDICES
250 FORMAT(T2,'NO. OF RESERVED ENTRIES',I3)

TYPE*,'VC M Indexes Used In Virtual Display 1' 

DO I=9,13,1
CALL UIS$CIRCLE(VD_ID,I,J,20.0,10.0)
INDEX=UIS$GET_WRITING_INDEX(VD_ID,I)  
TYPE*,INDEX
J=J+2.0
ENDDO

VD_ID2=UIS$CREATE_DISPLAY(1.0,1.0,40.0,40.0,15.0,15.0,VCM_ID)
WD_ID2=UIS$CREATE_WINDOW(VD_ID2,'SYSSWORKSTATION','WINDOW #2')

CALL UIS$SET_WRITING_INDEX(VD_ID2,0,9,2)
CALL UIS$SET_WRITING_INDEX(VD_ID2,0,10,3)
CALL UIS$SET_WRITING_INDEX(VD_ID2,0,11,4)
CALL UIS$SET_WRITING_INDEX(VD_ID2,0,12,5)
CALL UIS$SET_WRITING_INDEX(VD_ID2,0,13,6)
Programming in Color

With the inclusion of only three inquiry routines, a great deal of information is returned. A call to UIS$GET_COLORS returns the R, G, and B color component values in the color map entries of the virtual color map.

A call to UIS$GET_HW_COLOR_INFO returns the number of binary bits of precision for R, G, and B color map values. In addition, total number of hardware color map entries as well as the number of reserved entries.

Writing color information must be returned from two locations in the program. The first call to UIS$GET_WRITING_INDEX within the DO loop returns all the default writing indexes as they are being used in the first virtual display.

The second call to UIS$GET_WRITING_INDEX returns each writing index used to draw graphic objects in the second virtual display.

16.4.2.1 Calling UIS$GET_COLORS, UIS$GET_HW_COLOR_INFO, UIS$GET_WRITING_INDEX

Figure 16–1 shows the information returned in the user’s emulation window.
16.4.3 Program II—Creating an HSV Color Wheel

PROGRAM COLOR_WHEEL

This program draws a color wheel once and then continually changes its appearance by updating the virtual color map.

IMPLICIT INTEGER*4(A-Z)
PARAMETER DISPLAY_SIZE=4.0*2.54
REAL*4 R,G,B,H,L,S,V,START_DEG,END_DEG
REAL*4 R_VECTOR(0:255),G_VECTOR(0:255),B_VECTOR(0:255)
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
c Find out some information about the workstation color characteristics
 c
   CALL UIS$GET_HW_COLOR_INFO(, INDICES, MAPS, , , RES_INDICES, REGEN)
 c
 c Only attempt to run this program on color map hardware systems.
 c
   IF (MAPS .EQ. 0 .OR. REGEN .NE. UIS$C_DEV_RETRO) STOP
 c
 c Make the virtual color map size dependent upon the available
 c hardware, but no greater than 64 entries
 c
   MAP_SIZE=MIN(INDICES-RES_INDICES, 64)
   VCM_ID=UIS$CREATE_COLOR_MAP(MAP_SIZE)
 c
 c Create the virtual display and a single window
 c
   VD_ID=UIS$CREATE_DISPLAY(0.0, 0.0, 1.0, 1.0, 1, DISPLAY_SIZE, DISPLAY_SIZE, VCM_ID)
   WD_ID=UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION')
 c
 c Establish some attributes for drawing
 c
   CALL UIS$SET_ARC_TYPE(VD_ID, 0, 1, UIS$C_ARC_PIE)
   CALL UIS$SET_FONT(VD_ID, 1, 1, 'UIS$FILL_PATTERNS')
   CALL UIS$SET_FILL_PATTERN(VD_ID, 1, 1, PATT$C_FOREGROUND)
 c
 c Set window background to black and draw wedges of a circle.
 c The initial colors of the wedges are determined by traversing
 c 360 degrees around the HSV color model, varying H, while S and
 c V are both 1.0.
 c
   CALL UIS$SET_COLOR(VD_ID, 0, 0.0, 0.0, 0.0)
   DO I=1,MAP_SIZE-1
       START_DEG=(I-1)*((360.0/FLOAT(MAP_SIZE-1))
       END_DEG=START_DEG+(360.0/FLOAT(MAP_SIZE-1))
       CALL UIS$HSV_TO_RGB(START_DEG, 1.0, 1.0, R, G, B)
       CALL UIS$SET_COLOR(VD_ID, I, R, G, B)
       CALL UIS$SET_WRITING_INDEX(VD_ID, 1, 1, I)
       CALL UIS$CIRCLE(VD_ID, 1, 0.5, 0.5, 0.4, START_DEG, END_DEG)
   END DO
V=1.0

The next set of sequential and nested loops traverse the HSV color model cone.

CONTINUE

Vary S from 1.0 to 0.0 in 0.01 increments

DO IS=99,0,-1
S=FLOAT(IS)/100.0

DO I=1,MAP_SIZE-1
START_DEG=(I-1)*(360.0/FLOAT(MAP_SIZE-1))
IF (S.EQ.0.0) START_DEG=UIS$C_COLOR_UNDEFINED
CALL UIS$HSV_TO_RGB(START_DEG, S, V, 1 R_VECTOR(I), G_VECTOR(I), B_VECTOR(I))
END DO ! I
CALL UIS$SET_COLORS(VD_ID, 1, MAP_SIZE-1, 1 R_VECTOR(1), G_VECTOR(1), B_VECTOR(1))

end do ! s=1.0,0.0

Vary V from 1.0 to 0.0 in 0.01 increments

DO IV=99,0,-1
V=FLOAT(IV)/100.0

DO I=1,MAP_SIZE-1
START_DEG=(I-1)*(360.0/FLOAT(MAP_SIZE-1))
IF (S.EQ.0.0) START_DEG=UIS$C_COLOR_UNDEFINED
CALL UIS$HSV_TO_RGB(START_DEG, S, V, 1 R_VECTOR(I), G_VECTOR(I), B_VECTOR(I))
END DO ! I
CALL UIS$SET_COLORS(VD_ID, 1, MAP_SIZE-1, 1 R_VECTOR(1), G_VECTOR(1), B_VECTOR(1))

END DO ! V=1.0,0.0
Vary \( V \) from 0.0 to 1.0 in 0.01 increments

\[
\text{DO } IV=1,100, 1 \\
V=\text{FLOAT}(IV)/100.0
\]

\[
\text{DO } I=1,\text{MAP\_SIZE}-1 \\
\text{START\_DEG}=(I-1)\times(360.0/\text{FLOAT(MAP\_SIZE)-1}) \\
\text{IF } (S \text{ .EQ. 0.0}) \text{ START\_DEG=UIS\$C\_COLOR\_UNDEFINED} \\
\text{CALL UIS\$HSV\_TO\_RGB(START\_DEG, S, V,} \\
1 \quad \text{R\_VECTOR(I), G\_VECTOR(I), B\_VECTOR(I))} \\
\text{END DO } ! I \\
\text{CALL UIS\$SET\_COLORS(VD\_ID, 1, MAP\_SIZE-1,} \\
1 \quad \text{R\_VECTOR(I), G\_VECTOR(I), B\_VECTOR(I))} \\
\]

END DO  

! V=0.0,1.0

Vary \( S \) from 0.0 to 1.0 in 0.01 increments

\[
\text{DO } IS=1,100, 1 \\
S=\text{FLOAT(IS)/100.0}
\]

\[
\text{DO } I=1,\text{MAP\_SIZE}-1 \\
\text{START\_DEG}=(I-1)\times(360.0/\text{FLOAT(MAP\_SIZE)-1}) \\
\text{IF } (S \text{ .EQ. 0.0}) \text{ START\_DEG=UIS\$C\_COLOR\_UNDEFINED} \\
\text{CALL UIS\$HSV\_TO\_RGB(START\_DEG, S, V,} \\
1 \quad \text{R\_VECTOR(I), G\_VECTOR(I), B\_VECTOR(I))} \\
\text{END DO } ! I \\
\text{CALL UIS\$SET\_COLORS(VD\_ID, 1, MAP\_SIZE-1,} \\
1 \quad \text{R\_VECTOR(I), G\_VECTOR(I), B\_VECTOR(I))} \\
\]

END DO  

! S=0.0,1.0

Repeat HSV color cone traversal indefinitely

GOTO 100

END
Chapter 17
Asynchronous System Trap Routines

17.1 Overview

Frequently, an application program relies on certain run-time events to trigger the execution of an application-specific task. Such run-time events can range from power failure to simply striking a key on the keyboard. Several UIS routines enable this type of behavior for the duration of the program or until the enabling UIS routine is explicitly disabled. Such routines enable the use of asynchronous system trap (AST) routines. This chapter discusses AST routines and how they can be used to perform the following tasks:

- Creating a virtual keyboard
- Creating a pointer pattern
- Using a pointer
- Resizing a display window
- Closing a display window
- Shrinking a display viewport to an icon

The use of AST routines is not restricted to the tasks listed here.

17.1.1 Using AST Routines

Generally speaking, certain UIS routines associate or, bind, a specific run-time event or action to a subroutine. When that action occurs, control passes from the main program to a user-written subroutine. The subroutine then performs some application-specific task. When the subroutine completes execution, control is transferred to the next statement in the main program. However, the association between the run-time event and the execution of the subroutine remains in effect. If the action occurred again during program execution, the subroutine would be called again. The process executing the main program is suspended when the run-time event occurs and until the subroutine completes execution. Thus, execution of the
subroutine occurs asynchronously with respect to execution of the main program. The user-written subroutine is known as an *asynchronous system trap* routine or AST routine.

As with any subprogram or subroutine, the AST routine can be coded within the main program according to the conventions of the particular programming language or separately as a module in a library. However, to make use of such modules, you must compile and link them with your program.

### 17.1.2 AST-Enabling Routines

Several UIS routines enable AST routine execution whenever a particular run-time event occurs. The actual event may involve the keyboard, pointer, or the occurrence of a program-related event, such as the movement or resizing of a window. Such *AST-enabling* routines reference AST routines in their argument lists. Table 17-1 lists each AST-enabling routine and the event that triggers AST routine execution.

<table>
<thead>
<tr>
<th>Routine</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$SET_ADDOPT_AST</td>
<td>An additional option is chosen using the human interface.</td>
</tr>
<tr>
<td>UIS$SET_BUTTON_AST</td>
<td>A button is depressed or released on a pointer device.</td>
</tr>
<tr>
<td>UIS$SET_CLOSE_AST</td>
<td>A display window is deleted with the human interface.</td>
</tr>
<tr>
<td>UIS$SET_TB_AST</td>
<td>A digitizer is moved within a specified data region on the tablet.</td>
</tr>
<tr>
<td>UIS$SET_EXPAND_ICON_AST</td>
<td>An icon is expanded to display viewport with the user interface.</td>
</tr>
<tr>
<td>UIS$SET_GAIN_KB_AST</td>
<td>A virtual keyboard is bound to a physical keyboard.</td>
</tr>
<tr>
<td>UIS$SET_KB_AST</td>
<td>A key is struck.</td>
</tr>
<tr>
<td>UIS$SET_LOSE_KB_AST</td>
<td>A virtual keyboard is disconnected from a physical keyboard.</td>
</tr>
<tr>
<td>UIS$SET_MOVE_INFO_AST</td>
<td>A window is moved in the virtual display.</td>
</tr>
<tr>
<td>UIS$SET_POINTER_AST</td>
<td>A pointer moves into or exits an area of the virtual display.</td>
</tr>
<tr>
<td>UIS$SET_RESIZE_AST</td>
<td>A display window is resized with the human interface.</td>
</tr>
<tr>
<td>UIS$SET_SHRINK_ICON_TO_AST</td>
<td>A display viewport is shrunk with the human interface.</td>
</tr>
</tbody>
</table>
17.2 Using Keyboard and Pointer Devices

The keyboard and pointer devices are resources for use within your application program. The keyboard and pointer are mentioned here to illustrate routines that can make use of input from such workstation peripheral devices during application program execution. An effective way of using keyboard and pointer devices is in conjunction with AST routines.

17.2.1 Using AST Routines with Virtual Keyboards

You can use your keyboard as a virtual device whose characteristics are transportable from virtual display to virtual display. When the keyboard is used as a virtual device, you can create an unlimited number of them (subject to system and process resources) with different characteristics and associate each with any virtual display you choose.

17.2.1.1 Step 1—Creating a Virtual Keyboard

A virtual keyboard is created using UIS$CREATE_KB. There is no limit to the number of virtual keyboards you can create.

17.2.1.2 Step 2—Binding the Virtual Keyboard to the Display Window

In addition, you must bind the virtual keyboard to a specified display window using UIS$ENABLE_VIEWPORT_KB or UIS$ENABLE_KB. UIS$ENABLE_VIEWPORT_KB and UIS$ENABLE_KB also define how the physical keyboard and the virtual keyboard are assigned to each other.

If your display screen contains one or more display viewports and you have assigned virtual keyboards to their associated display windows, you can move from display viewport to viewport through the assignment list using the [CYCLE] key. An assignment list of display windows keeps track of which viewport is active.

A viewport is active when the KB icon background color on the viewport is highlighted. The physical keyboard is now assigned to a virtual keyboard. The virtual keyboard and all enabled characteristics can then be used with the physical keyboard. You can bind more than one display window to the same virtual keyboard. In this case, the KB icons in all display viewports are highlighted at the same time when the desired windows are assigned a physical keyboard.

Table 17–2 shows how each routine performs physical-to-virtual keyboards assignments.
17.4 Asynchronous System Trap Routines

Table 17-2 Connecting Physical Keyboards and Virtual Keyboards

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$ENABLE_VIEWPORT_KB</td>
<td>Adds the display window to the assignment list. Use the [CYCLE] key to move from viewport to viewport.</td>
</tr>
<tr>
<td>UIS$ENABLE_KB</td>
<td>Places the display window at the top of the assignment list and is active. Use the [CYCLE] key to move to other viewports.</td>
</tr>
</tbody>
</table>

To terminate the binding of the specified virtual keyboard to the physical keyboard, use UIS$DISABLE_VIEWPORT_KB or UIS$DISABLE_KB. Table 17-3 shows how each routine terminates physical-to-virtual keyboard assignments.

Table 17-3 Disconnecting Physical Keyboards and Virtual Keyboards

<table>
<thead>
<tr>
<th>Routine</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$DISABLE_VIEWPORT_KB</td>
<td>Removes a display window from the assignment list. Invoke UIS$ENABLE_VIEWPORT_KB or UIS$ENABLE_KB to make the viewport active.</td>
</tr>
<tr>
<td>UIS$DISABLE_KB</td>
<td>Places a display window at the bottom of the assignment list. Use the [CYCLE] key to make the viewport active.</td>
</tr>
</tbody>
</table>

17.2.1.3 Step 3—Enabling Virtual Keyboard AST Routines

Even though you have created a virtual keyboard and you have bound it to a specified display window, you still cannot write characters to that display window. You must associate the act of striking a key with the action taken by a subroutine using UIS$SET_KB_AST.

17.2.2 Programming Options

After you have created the virtual keyboard, your application may verify successful connection with the physical keyboard. You may want to be notified in the event such connections are made or broken. These and other options are available to your application.

Gaining and Losing Virtual Keyboards

Connecting and disconnecting virtual keyboards may occur many times within your application program. These events may be so significant that whenever a virtual keyboard is disconnected or lost, you may want your program to initiate some action through a subroutine. For example, UIS$SET_GAIN_KB_AST and UIS$SET_LOSE_KB_AST enable AST routines that could allow your program to perform
housekeeping functions such as deleting unused virtual keyboards, display windows, and display viewports when a virtual keyboard is disconnected.

**Enabling and Disabling Keyboard Characteristics**

Keyboard characteristics are assigned to specific virtual keyboards using UIS$SET_KB_ATTRIBUTES.

**Testing Physical Keyboards**

You can verify the connection between a specified virtual keyboard and the physical keyboard with UIS$TEST_KB.

**Deleting Virtual Keyboards**

To delete a virtual keyboard, use UIS$DELETE_KB.

### 17.2.3 Program Development

**Programming Objectives**

To type keyboard characters directly to the virtual display using AST routines.

**Programming Tasks**

1. Declare subroutine and the appropriate variables to be included in the COMMON statement.
2. Create a virtual display.
3. Create a virtual keyboard.
4. Create a display window and viewport.
5. Bind the virtual keyboard to the display window.
6. Enable keyboard AST routines using UIS$SET_KB_AST.
7. Create a subroutine to send each keystrike to the virtual display.

```plaintext
PROGRAM AST
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
LOGICAL*1 KEYBUF(4)
EXTERNAL KEYSTRIKE
COMMON KB_ID,VD_ID,KEYBUF,WD_ID,COUNT

VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,31.0,31.0,20.0,5.0)
KB_ID=UIS$CREATE_KB('SYS$WORKSTATION')
```
The name of the AST routine KEYSTRIKE is declared using the EXTERNAL statement. The EXTERNAL statement defines the symbolic name of the routine as an address. The routine name can then be used as an argument in a parameter list as in the astadr argument of an AST-enabling routine.
The COMMON statement allows certain variables used in both program units (the main program and the subroutine) to share the same storage area. You can use either the COMMON statement or the \texttt{astprm} argument in the AST-enabling routine to pass data to the AST routine.

The virtual keyboard is created and bound to a display window.

In our program the AST-enabling routine that references the subroutine KEYSTRIKE is \texttt{UIS\$SET\_KB\_AST}. Note that there is no separate call to the subroutine KEYSTRIKE.

Whenever a key is struck, the ASCII character code for that character is stored in the variable \texttt{keybuf} and subroutine KEYSTRIKE is executed. The subroutine KEYSTRIKE is an AST routine.

The subroutine KEYSTRIKE retrieves the character code stored in the variable \texttt{keybuf}. The data structure TEXT, a character string descriptor, is created. The variable DESC denoting a record is defined to have the same structure as TEXT. The address of \texttt{keybuf} is assigned to a longword in the descriptor. The subroutine KEYSTRIKE writes the character to the virtual display using UIS\$TEXT.

After the AST routine completes execution, control returns to the next statement in the main program. The next statement is a call to the SYS\$HIBER system service. The SYS\$HIBER allows the process to remain inactive until the next time the AST routine is executed, that is, when a key is struck.

The AST routine KEYSTRIKE also verifies that the virtual and physical keyboards are connected.

Whenever column 60 is reached or the [RETURN] key is pressed, text output moves to the next line. The ASCII character code for the [RETURN] key is 13.

### 17.2.4 Calling Keyboard Routines

The program AST creates a viewport to which characters are written as shown in Figure 17–1.
17.2.5 Using AST Routines with Pointer Devices

Pointer routines allow the pointer to act as an input device to your application program. Typically, application programs use such data to keep track of the location of the pointer device in the virtual display, or the location of a specified rectangle in the virtual display. An effective way of using pointers in this manner is through AST routines.

17.2.5.1 Mouse
The mouse is a relative pointing device and can be used with AST routines to return status information about mouse location to the application.

17.2.5.2 Tablet
Another pointing device that you can use is the digitizer. The tablet consists of a puck or stylus and a tablet. Digitizer support may be used only with a tablet.

Digitizing with a Tablet
Digitizing with a tablet requires that you establish a region on the tablet—the data rectangle. The data rectangle is the area on the tablet in which digitizing is active. If you do not specify a data rectangle, the whole tablet is used.

Only one data digitizing region may be active at one time.

The pointer position on the tablet is available to the user’s digitizing AST routine, if desired. If the pointer is within the data rectangle, then the user’s AST routine is executed.
Only one image may own the tablet at any one time. When a process connects to the tablet, the system hardware cursor is turned off and the connected process receives all the input from the tablet device. The process must use a software cursor if it wishes to track the pointer in a window. The process owns the tablet until it makes a call to UIS$ENABLE_TB to disconnect itself from the tablet.

**Mouse Operation**

A mouse cannot be used as a data digitizer. The UIS routine will report an error, if you attempt to digitize with the mouse.

**Terminating Data Digitizing**

Only the process that issues the data digitizing request may change or cancel the request. If the process is deleted and the channel is deassigned, data digitizing is immediately canceled, if a request is still outstanding.

Only one data digitizing region may be active at a time. Attempts by other processes to initiate will fail if another process has already declared a digitizing region.

**17.2.5.3 Step 1—Create an AST Routine**

You must write a program that includes an AST subroutine that performs a task. Typically, AST subroutines perform inquiry functions and return pointer information such as location to the main program. See Table 12-1 for a list of pointer routines that return information about the pointer. You are not restricted to using AST routines in this manner. For example, you can use AST routines with pointers to create menus.

**17.2.5.4 Step 2—Enable the AST Routine**

The AST routine will execute whenever a specific run-time event occurs. However, you must enable this behavior by including an AST-enabling routine in the main program. The following table lists pointer AST-enabling routines.

<table>
<thead>
<tr>
<th>Routine</th>
<th>Run-Time Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$SET_BUTTON_AST</td>
<td>The button on the pointer device is depressed.</td>
</tr>
<tr>
<td>UIS$SET_TB_AST</td>
<td>The digitizer is moved within a specified data region on the tablet.</td>
</tr>
<tr>
<td>UIS$SET_POINTER_AST</td>
<td>The pointer is moved into a specified region of virtual display.</td>
</tr>
</tbody>
</table>

**17.2.6 Programming Options**

Many graphics applications use the pointer position and movement as a means of drawing objects on the display screen. Graphics routines can use this information to generate objects.
17–10 Asynchronous System Trap Routines

Pointer Movement

Many application programs need to know where the pointer is. For example, the program might need to perform some type of action whenever the pointer moves within certain regions of the virtual display. The AST-enabling routine UIS$SET_POINTER_AST can be used whenever pointer movement plays an important role in program execution.

Pointer Position

Your application may need to establish the position of the pointer in world coordinates. In addition, UIS$SET_POINTER_POSITION returns a status value.

Pointer Pattern

You can change the appearance of the pointer cursor using UIS$SET_POINTER_PATTERN. Normally, this cursor appears as an arrow on the display screen. The pointer cursor, or pattern, represents bit settings within an array of 16 words. You can choose your own pointer pattern by assigning a value to each word in the array that will set the desired bits for the new pattern.

Optionally, you may request that the pointer also be bound to the region specified in the UIS$SET_POINTER_PATTERN call. When this region is unoccluded, the pointer pattern will not be allowed to exit after it has been positioned within the region. The cursor may leave the bound region, if it becomes occluded.

Tablet Information

Currently, two routines UIS$GET_TB_INFO and UIS$GET_TB_POSITION return information about tablet characteristics and position, respectively.

17.2.7 Program Development

Programming Objective

To change the default pointer pattern to a crosshair.

Programming Tasks

1. Declare the subroutine and the appropriate variables in the COMMON statement.
2. Create a virtual display.
3. Create a display window and viewport.
4. Enable pointer AST routine with UIS$SET_POINTER_AST.
5. Create a subroutine that defines the new cursor pattern.

```plaintext
PROGAM PATTERN
IMPLICIT INTEGER(A-Z)
EXTERNAL FIGURE
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
COMMON VD_ID,WD_ID

VD_ID=UIS$CREATE_DISPLAY(-1.0,-1.0,30.0,30.0,20.0,20.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','POINTER PATTERN')
CALL UIS$SET_POINTER_AST(VD_ID,WD_ID,FIGURE,0)
CALL SYS$HIBER()
END

SUBROUTINE FIGURE
IMPLICIT INTEGER(A-Z)
INTEGER*2 CURSOR(16)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
COMMON VD_ID,WD_ID

DATA CURSOR/7*896,65535,8*896/
CALL UIS$SET_POINTER_PATTERN(VD_ID,WD_ID,CURSOR,8,8)
RETURN
END
```

In this program, no world coordinates are specified for the display window, so the display window maps the entire virtual display space. The dimensions of the display viewport are also not specified. As a result, the display viewport size defaults to the dimensions specified in UIS$CREATE_DISPLAY.

The subroutine FIGURE is called whenever the pointer lies within the specified area of the display window. In the main program the subroutine is declared as an external procedure in the main program. The AST-enabling routine for the pointer devices UIS$SET_POINTER_AST is called. Because no rectangle is specified, the subroutine FIGURE is executed whenever the pointer is within the display window.

The array CURSOR is declared in the subroutine FIGURE and contains 16 elements. Each array element is declared as a word and is, therefore, 16 bits long. You should imagine the array as a 16 by 16-bit pattern, or matrix. Each array element is assigned a value which sets certain bits in the matrix to 1. The matrix represents the bitmap image of the new cursor pattern. The call to UIS$SET_POINTER_PATTERN references the new cursor pattern and the exact bit in the new cursor pattern used to calculate current pointer position.
17.2.8 Calling UIS$SET_POINT_ERN_AST and UIS$SET_POINT_ERN_PATTERN

When you run the program PATTERN, the display viewport is created. The pointer lies outside the display viewport and the default pointer pattern is in effect as shown in Figure 17–2.

**Figure 17–2 Default Pointer Pattern**

![Figure 17-2 Default Pointer Pattern](image)

The process executing the main program is hibernating, that is, waiting for you to move the pointer. As you can see in Figure 17–3, when you move the pointer within the display window, the pointer pattern changes from an arrow to a cross.
17.3 Manipulating Display Windows and Viewports

Default Shrinking Operation
The shrinking of viewports is performed using the Window Options Menu by default. When you choose the “Shrink to an Icon” menu item, UIS$SHRINK__TO__ICON is called. You can also expand icons to viewports with the user interface by placing the cursor in the icon and pressing the pointer button.

Default Resizing and Closing Operations
Resizing and closing display windows are performed using the Window Options Menu by default. When you choose the “Change the size” menu item, UIS$RESIZE__WINDOW is called and accepts the world coordinate values of the newly resized window.

Display windows are also closed using the Window Options Menu. When you choose the “Delete” menu item, UIS$CLOSE__WINDOW is called, which, in turn, calls SYS$EXIT system service. SYS$EXIT performs image rundown and deletes the process that owns the image.
17.3.1 Using AST Routines to Modify the Window Options Menu

Certain UIS routines can override the default actions listed in the Window Options Menu and enable user-written shrinking, expanding, resizing and closing AST routines that are activated whenever the "Shrink to an Icon", "Change the size", or "Delete" menu items are chosen. In this case, AST routines override the default shrinking, expansion, resizing, and closing UIS behavior.

17.3.1.1 Step 1—Create an AST Routine

In order to override one of the default actions listed in the Window Options Menu, you must write a program that includes an AST routine. When you execute the program and initiate the action through the user interface, the default action is no longer performed automatically.

You could code your AST routine so that it could perform any action. Most likely, you will modify the action of a menu item by adding additional actions to the default. If so, you must include in your AST routine a call to UIS$RESIZE_WINDOW in addition to code to perform any other special features you see fit. When the program executes, the AST routine will perform the resize as well as any other additional actions. The following table lists the task you wish to perform and the corresponding UIS routine that should be included in your subroutine.

<table>
<thead>
<tr>
<th>Task</th>
<th>Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close or delete a window</td>
<td>UIS$CLOSE_WINDOW</td>
</tr>
<tr>
<td>Expand an icon(^1)</td>
<td>UIS$EXPAND_ICON</td>
</tr>
<tr>
<td>Resize a viewport</td>
<td>UIS$RESIZE_WINDOW</td>
</tr>
<tr>
<td>Shrink a viewport</td>
<td>UIS$SHRINK_TO_ICON</td>
</tr>
</tbody>
</table>

\(^1\)Not listed in the Window Options Menu.

17.3.1.2 Step 2—Enable the AST Routine

You want your AST routine to execute whenever you wish to override the default features listed in the Window Options Menu. In order to execute the AST routine, a run-time event must occur to trigger the AST routine. Therefore, you must include in your main program an appropriate AST-enabling routine. The following table lists window AST-enabling routines that trigger AST routine execution for various run-time events.
Asynchronous System Trap Routines

<table>
<thead>
<tr>
<th>Routine</th>
<th>Run-Time Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$SET_CLOSE_AST</td>
<td>The “Delete” menu item is chosen using the user interface.</td>
</tr>
<tr>
<td>UIS$SET_EXPAND_ICON_AST</td>
<td>The pointer pattern is placed on an icon and the pointer button is depressed.</td>
</tr>
<tr>
<td>UIS$SET_RESIZE_WINDOW_AST</td>
<td>The “Change the size” menu item is chosen using the user interface</td>
</tr>
<tr>
<td>UIS$SET_SHRINK_TO_ICON_AST</td>
<td>The “Shrink to an icon” menu item is chosen using the user interface.</td>
</tr>
</tbody>
</table>

17.3.2 Programming Options

You can enable AST routine execution for the programming options listed below.

**Shrinking Viewports to Icons**

You can override the default display viewport shrinking operation by first calling the AST-enabling routine UIS$SET_SHRINK_TO_ICON_AST in your main program. Your AST routine will contain UIS$SHRINK_TO_ICON specifying icon attributes. Shrinking viewports to icons occurs as a five-step as follows:

1. The user initiates the shrinking operation using the user interface.
2. The viewport is moved offscreen using the invisible attribute.
3. The subroutine creates a small virtual display and viewport with no banner, the actual icon.
4. The subroutine using UIS$SHRINK_TO_ICON associates the icon name with the virtual display identifier of the offscreen viewport.

**Expanding Icons to Display Viewports**

You can override the default icon expansion operation by calling the AST-enabling routine UIS$SET_EXPAND_ICON_AST in your main program. Include UIS$EXPAND_ICON in your AST routine in order to specify viewport attributes.

**Resizing Display Windows**

You can override the default display window resize operation by first calling the AST-enabling routine UIS$SET_RESIZE_AST in your main program. Resizing occurs as a three-step process as follows:

1. The user initiates the resizing operation using the user interface.
2. The user interface returns values to the addresses specified in UIS$SET_RESIZE_AST.
3. The AST routine is called.

Your AST routine will include a call to UIS$RESIZE_WINDOW. A call to UIS$RESIZE_WINDOW can redefine the default resize behavior in the following ways:

- **Absolute position** — You can specify an absolute position, that is, a device coordinate position on the physical screen where the newly resized display viewport will be placed.

- **Size** — You can specify the dimensions of all newly resized display viewports. All subsequent display viewports are created with these dimensions.

- **World coordinate space** — You can specify the world coordinate space as the original display window. Typically, the coordinates that you specify here match the world coordinates of the original display window. However, this need not always be the case. If your original display window viewed a portion of the virtual display, you can view more or less of the virtual display depending on the world coordinate range you specify.

**Closing Display Windows**

To override the default close display window operation, you must first call the AST-enabling routine UIS$SET_CLOSE_AST in your main program.

The instructions that you include in your AST routine will override the default window closing behavior. Closing display windows occurs as a two-step process as follows:

1. The “Delete” menu item in the Window Option menu is chosen.
2. The AST routine is called.

**17.3.3 Program Development**

**Programming Objective**

To modify the display window shrinking, expanding, resizing, and closing operations listed in the Window Options Menu, whenever the “Shrink to icon”, “Change the size” or “Delete” menu item is chosen.

**Programming Tasks**

1. Declare the subroutines and the appropriate variables in the COMMON statement.
2. Create a virtual display.
3. Create a display window and viewport.
4. Draw two ellipses and a circle.
5. Enable viewport shrinking and icon expansion AST routines using UIS$SET_SHRINK_TO_ICON_AST and UIS$SET_EXPAND_ICON_AST.

6. Enable window resizing and closing AST routines using UIS$SET_RESIZE_AST and UIS$SET_CLOSE_AST.

7. Create viewport shrinking and icon expansion AST routines.

8. Create window resizing and closing AST routines.

```fortran
PROGRAM OVERRIDE
IMPLICIT INTEGER(A-Z)
EXTERNAL RESIZER, SHRINKER, EXPANDER, CLOSER
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
COMMON VD_ID, VD_ID2, WD_ID, WD_ID2, NEW_ABS_X, NEW_ABS_Y

VD_ID = UIS$CREATE_DISPLAY(0.0, 0.0, 50.0, 50.0, 10.0, 10.0)  \ 1
WD_ID = UIS$CREATE_WINDOW(VD_ID, 'SYS$WORKSTATION', 'USER')  \ 2
CALL UIS$ELLIPSE(VD_ID, 0.0, 10.0, 20.0, 5.0, 15.0)
CALL UIS$SET_FONT(VD_ID, 0.1, 'UIS$FILL_PATTERNS')
CALL UIS$SET_FILL_PATTERN(VD_ID, 1.1, PATT$C_VERT6_2)
CALL UIS$CIRCLE(VD_ID, 1.0, 25.0, 25.0, 20.0)
CALL UIS$ELLIPSE(VD_ID, 0.40.0, 20.0, 5.0, 15.0)

CALL UIS$SET_SHRINK_TO_ICON_AST(WD_ID, SHRINKER)  \ 3
CALL UIS$SET_EXPAND_ICON_AST(WD_ID, EXPANDER)  \ 4
CALL UIS$SET_CLOSE_AST(WD_ID, CLOSER, 0)  \ 5
CALL UIS$SET_RESIZE_AST(VD_ID, WD_ID, RESIZER, 0, NEW_ABS_X, NEW_ABS_Y,  \ 6
  NEW_WIDTH, NEW_HEIGHT, NEW_WC_X1, NEW_WC_Y1, NEW_WC_X2, NEW_WC_Y2)

CALL SYS$HIBER()  \ 7
TYPE *, 'DISPLAY WINDOW HAS BEEN SUCCESSFULLY CLOSED'  \ 8
END

SUBROUTINE RESIZER
IMPLICIT INTEGER(A-Z)
COMMON VD_ID, VD_ID2, WD_ID, WD_ID2, NEW_ABS_X, NEW_ABS_Y

CALL UIS$RESIZE_WINDOW(VD_ID, WD_ID, NEW_ABS_X, NEW_ABS_Y, NEW_WIDTH, NEW_HEIGHT, NEW_WC_X1, NEW_WC_Y1, NEW_WC_X2, NEW_WC_Y2)  \ 9
RETURN
END
```
SUBROUTINE SHRINKER
IMPLICIT INTEGER(A-Z)
INCLUDE 'SYS$LIBRARY:UISENTRY'
INCLUDE 'SYS$LIBRARY:UISUSRDEF'
COMMON VD_ID, VD_ID2, WD_ID, WD_ID2, NEW_ABS_X, NEW_ABS_Y

STRUCTURE/AWAY/
INTEGER*4 CODE1
INTEGER*4 ATTR1
INTEGER*4 CODE2
INTEGER*4 ATTR2
INTEGER*4 END_LIST
END STRUCTURE

RECORD/AWAY/WINDOW
WINDOW.CODE1=WDPL$C_PLACEMENT
WINDOW.ATTR1=WDPL$M_INVISIBLE
WINDOW.CODE2=WDPL$C_END_OF_LIST
CALL UIS$MOVE_VIEWPORT(WD_ID, WINDOW)
WINDOW.CODE1=WDPL$C_ATTRIBUTES
WINDOW.ATTR1=WDPL$M_NOBANNER
WINDOW.CODE2=WDPL$C_END_OF_LIST
VD_ID2=UIS$CREATE_DISPLAY(0.0, 0.0, 5.0, 5.0, 2.54, 2.54)
WD_ID2=UIS$CREATE_WINDOW(VD_ID2, 'SYS$WORKSTATION', 2 , , , , , WINDOW)
CALL UIS$SET_FONT(VD_ID2, 0, 2, 'MY_FONT_5')
CALL UIS$TEXT(VD_ID2, 2, 'USER', 0.5, 3.5)
ICON_FLAGS=UIS$M_ICON_DEF_BODY
CALL UIS$SHRINK_TO_ICON(WD_ID, WD_ID2, ICON_FLAGS)
RETURN
END

SUBROUTINE EXPANDER
IMPLICIT INTEGER(A-Z)
COMMON VD_ID, VD_ID2, WD_ID, WD_ID2, NEW_ABS_X, NEW_ABS_Y
CALL UIS$EXPAND_ICON(WD_ID, WD_ID2)
RETURN
END

SUBROUTINE CLOSER
IMPLICIT INTEGER(A-Z)
COMMON VD_ID, VD_ID2, WD_ID, WD_ID2, NEW_ABS_X, NEW_ABS_Y
CALL UIS$ERASE(VD_ID)
CALL UIS$DELETE_WINDOW(WD_ID)
CALL UIS$DELETE_DISPLAY(VD_ID)
CALL SYS$WAKE(.)
RETURN
END

The main program OVERRIDE creates a virtual display 1 and a display window 2. The world coordinate space of the display window is a portion of the virtual display, the display window contains only those objects in the virtual display that lie within it.

A circle is drawn between two ellipses in the virtual display and appears in the display window and its associated display viewport.

Four AST-enabling routines, UIS$SET_SHRINK_TO_ICON_AST, UIS$SET_EXPAND_ICON_AST, UIS$SET_CLOSE_AST and UIS$SET_RESIZE_AST, 3 4 5 6 are called. The main program executes until the call to SYS$HIBER is reached 7.

The Window Options Menu is invoked from the MENU icon in the viewport WINDOW using the pointer. Assume that the menu item “Change the size” is chosen. Perform the following procedure:

1. Move the pointer to one of the flashing dots on the border of the viewport.
2. Press the button and the border of the display viewport is highlighted.
3. Hold the button down and move the pointer until the stretchy box is the desired size and release the pointer button.

The call to UIS$RESIZE_WINDOW 8 in the subroutine RESIZER 9 modifies the default resize behavior. UIS$RESIZE_WINDOW specifies the world coordinates of the existing virtual display as the world coordinates for all newly resized display windows. Therefore, a newly resized window always displays the entire virtual display space. If the aspect ratios of the virtual display and the resized display viewport are not equal, graphic objects are scaled.

The subroutine SHRINKER 10 modifies the default shrinking behavior. The window attributes data structure AWAY is created 11. A record WINDOW is defined to have the structure of AWAY 12. The fields of record WINDOW are assigned values 13 14 15. Note the use of the invisible placement attribute. A call to UIS$MOVE_VIEWPORT 16 references the display window identifier of the existing viewport and the current window attributes. The viewport is moved offscreen.

New window attribute values are assigned 17 18 19 to the fields of the record WINDOW.
A virtual display and display window are created for the icon. UIS$TEXT draws the character string in the icon. The flag UIS$M_ICON_DEF_BODY sets the appropriate in the mask icon_flags. When this bit is set, the area of the icon becomes a button AST region (for later icon expansion). UIS$SHRINK_TO_ICON associates the display window identifiers of the existing viewport and the icon.

The subroutine CLOSER overrides the default window closing behavior by deleting the display window, display viewport, and the virtual display. The process that owns the main program is awakened. The main program continues execution with the next statement after the call to SYS$HIBER, types the message "Display window has been successfully closed", and terminates.

17.3.4 Calling UIS$SET_RESIZE_AST

When the main program executes, a display window and its associated display viewport appear on the display screen as shown in Figure 17-4.

Figure 17-4 Unresized Window and Viewport

The menu item "Change the size" is selected and the display window and viewport are resized as shown in Figure 17-5.
17.3.5 Calling UIS$SET_SHRINK_TO_ICON_AST

The menu item "Shrink to icon" is selected and the display viewport is replaced with a user-defined icon as shown in Figure 17–6.

Figure 17–6 Icon
17.3.6 Calling UIS$SET_CLOSE_AST

When the menu item "Delete" is chosen, the display viewport, window, and virtual display are deleted and the message "Display window has been successfully closed" is written to the terminal emulation window.
PART III UIS Routines
Chapter 18

UIS Routine Descriptions

18.1 Overview

Each UIS and UISDC routine in Parts III and IV of this book is documented using a structured format. This section discusses the main headings of this format, the information that is presented under each heading, and the format used to present the information.

The purpose of this section, therefore, is to explain where to find information and how to read it correctly, not how to use it.

Some main headings in the routine template contain information that requires no further explanation beyond what is given in Table 18-1. However, the following main headings contain information that does require additional discussion; this discussion takes place in the remaining subsections of this section.

- Format Heading
- Returns Heading
- Arguments Heading

The following table lists the main headings in the UIS routines template.

<table>
<thead>
<tr>
<th>Main Heading</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routine Name</td>
<td>Required. The routine entry point name is usually, though not always, followed by the English name of the routine.</td>
</tr>
<tr>
<td>Routine Overview</td>
<td>Required. The routine overview appears directly below the routine name; the overview explains, usually in one or two sentences, what the routine does.</td>
</tr>
</tbody>
</table>
Table 18-1 (Cont.)  Main Headings in the Routine Template

<table>
<thead>
<tr>
<th>Main Heading</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Format</td>
<td>Required. The format heading follows the routine overview. The format gives the routine entry point name and the routine argument list.</td>
</tr>
<tr>
<td>Returns</td>
<td>Required. The returns heading follows the routine format. It explains what information is returned by the routine.</td>
</tr>
<tr>
<td>Arguments</td>
<td>Required. The arguments heading follows the returns heading. Detailed information about each argument is provided under the arguments heading. If a routine takes no arguments, the word “None” appears.</td>
</tr>
<tr>
<td>Description</td>
<td>Optional. The description heading follows the arguments heading. The description section contains information about specific actions taken by the routine: interaction between routine arguments, if any; operation of the routine within the context of VAX/VMS; user privileges needed to call the routine, if any; system resources used by the routine; and user quotas that may affect the operation of the routine. Note that any restrictions on the use of the routine are always discussed first in the description section; for example, any required user privileges or necessary system resources are explained first. For some simple routines, a description section is not necessary because the routine overview carries the needed information.</td>
</tr>
<tr>
<td>Examples</td>
<td>Optional. The examples heading appears following the description heading. The examples section contains programming examples that illustrate use of the routine. Following the example, an explanation of the example is given. All examples have been tested and should run when compiled (or assembled) and linked.</td>
</tr>
</tbody>
</table>
Table 18-1 (Cont.) Main Headings in the Routine Template

<table>
<thead>
<tr>
<th>Main Heading</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Output</td>
<td>Optional. The screen output heading contains either an actual display produced by the routine or information that the routine would normally return to the program. Please note that in many instances screen output contains annotations that serve only to explain the information returned. For example, UIS$GET_POSITION returns information about the current text position along the actual path. This information is displayed and described as an example of the kind of data that can be returned. In many cases such as the inquiry routines, the displayed information is formatted with headings and annotations for the purposes of presentation in this manual only.</td>
</tr>
<tr>
<td>Illustration</td>
<td>Optional. The illustration heading contains artwork that describes how to use the routine, how the routine functions, or what kind of information to expect from it. The illustrations may or may not be annotated.</td>
</tr>
</tbody>
</table>

18.1.1 Format Heading

The following types of information can be present in the format heading.

- Procedure call format
- Explanatory text

The procedure call format ensures that a routine call conforms to the procedure call mechanism described in the VAX Procedure Calling and Condition Handling Standard; for example, an entry mask is created, registers are saved, and so on.

Procedure call formats can appear in many forms. Four examples have been provided to illustrate the meaning of syntactical elements such as brackets and commas.

General rules of syntax governing how to use procedure call formats are shown in Table 18-2.

Example 1 This example illustrates the standard representation of optional arguments and best describes the use of commas as delimiters. Arguments enclosed within square brackets are optional, but if an optional argument other than a trailing optional argument is omitted, you must include a comma as a delimiter for the omitted argument.

ENTRY-POINT-NAME arg1 [, [arg2 [, arg3]]]

Typically, VAX RMS system routines use this format where at most three arguments appear in the argument list.
Example 2 When the argument list contains three or more optional arguments, the syntax does not provide enough information. If the optional arguments \texttt{arg3} and \texttt{arg4} are omitted and the trailing argument \texttt{arg5} is specified, commas must be used to delimit the positions of the omitted arguments.

\begin{verbatim}
ENTRY-POINT-NAME  \texttt{arg1, arg2, [arg3], nullarg[,arg4][,arg5]}
\end{verbatim}

Typically, VAX/VMS system services, utility routines, and VAX Run-Time Library routines contain call formats with more than three arguments.

Example 3 In the following call format example, the trailing four arguments are optional as a group, that is, either you specify \texttt{arg2, arg3, arg4, and arg5} or none of them. Therefore, if the optional arguments are not specified, commas need not be used to delimit unoccupied positions.

However, if a hypothetical required argument or a separate optional argument were specified after \texttt{arg5}, commas must be used when \texttt{arg2, arg3, arg4, and arg5} are omitted.

\begin{verbatim}
ENTRY-POINT-NAME  \texttt{arg1[,arg2,arg3,arg4,arg5]}
\end{verbatim}

Example 4 In the following example, you may specify \texttt{arg2} and omit \texttt{arg3}. However whenever you specify \texttt{arg3}, you must specify \texttt{arg2}.

\begin{verbatim}
ENTRY-POINT-NAME  \texttt{arg1[,arg2[,arg3]]}
\end{verbatim}

Explanatory Text

Explanatory text may follow one or both of the above formats. This text is present only when needed to clarify the format. For example, the call format indicates that arguments are optional by enclosing them in brackets ([ ]). However, brackets alone cannot convey all the important information that may apply to optional arguments. For example, in some routines that have many optional arguments, if one optional argument is selected, another optional argument must also be selected. In such cases, text following the format clarifies this fact.

Table 18-2 General Rules of Syntax

<table>
<thead>
<tr>
<th>Element</th>
<th>Syntax Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry point names</td>
<td>Entry point names are always shown in uppercase characters.</td>
</tr>
<tr>
<td>Argument names</td>
<td>Argument names are always shown in lowercase characters.</td>
</tr>
<tr>
<td>Spaces</td>
<td>One or more spaces are used between the entry point name and the first argument, and between each argument.</td>
</tr>
<tr>
<td>Braces</td>
<td>Braces surround two or more arguments. You must choose one of the arguments.</td>
</tr>
<tr>
<td>Brackets ([ ])</td>
<td>Brackets surround optional arguments. Note that commas too can be optional (see the comma element).</td>
</tr>
</tbody>
</table>
Table 18-2 (Cont.) General Rules of Syntax

<table>
<thead>
<tr>
<th>Element</th>
<th>Syntax Rule</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commas</td>
<td>Between arguments, the comma always follows the space. If the argument is optional, the comma may appear inside the brackets or outside the brackets, depending on the position of the argument in the list and on whether surrounding arguments are optional or required.</td>
</tr>
<tr>
<td>Null arguments</td>
<td>A null argument is a place-holding argument. It is used for either of the following reasons: (1) to hold a place in the argument list for an argument that has not yet been implemented by DIGITAL but may be in the future or (2) to mark the position of an argument that was used in earlier versions of the routine but is not used in the latest version (upward compatibility is thereby ensured because arguments that follow the null argument in the argument list keep their original positions). A null argument is always given the name <code>nullarg</code>. In the argument list constructed on the stack when a procedure is called, both null arguments and omitted optional arguments are represented by longword argument list entries containing the value 0. The programming language syntax required to produce argument list entries containing 0 differ from language to language, so see your language user's guide for language-specific syntax.</td>
</tr>
</tbody>
</table>

18.1.2 Returns Heading

Under the returns heading appears information that describes what information, if any, is returned by the routine to the caller. Programs written in VAX MACRO return information in R0. The information that is returned is a longword value.

The high-level language programmer receives status information in the return (or status) variable he or she uses when making the call. The run-time environment established for the high-level language program allows the status information in R0 to be moved automatically to the user's return variable. The information that is returned is always a longword value.
18.1.3 Arguments Heading

Under the arguments heading appears detailed information about each argument listed in the call format. Arguments are described in the order in which they appear in the call format. If the routine has no arguments, the term "none" appears.

The following format is used to describe each argument:

- argument-name
- VMS Usage: argument-VMS-data-type
- type: argument-data-type
- access: argument-access
- mechanism: argument-passing-mechanism

One paragraph of structured text, followed by other paragraphs of text, as needed.

18.2 Functional Organization of UIS Routines

The UIS routines perform many functions within an application program. Besides, creating the graphic objects that you see on the display screen, there are routines that manage the input devices and routines that return information to the program to name a few.

Figure 18–1 lists each UIS routine by functional category.
Figure 18-1  Functional Categories of UIS Routines

**AST-Enabling Routines**
- UIS$SET_ADDOPT_AST
- UIS$SET_BUTTON_AST
- UIS$SET_CLOSE_AST
- UIS$SET_EXPAND_ICON_AST
- UIS$SET_GAIN_KB_AST
- UIS$SET_KB_AST
- UIS$SET_LOSE_KB_AST
- UIS$SET_MOVE_INFO_AST
- UIS$SET_POINTER_AST
- UIS$SET_RESIZE_AST
- UIS$SET_SHRINK_TO_ICON_AST
- UIS$SET_TB_AST

**Attribute Routines**
- UIS$SET_ARC_TYPE
- UIS$SET_BACKGROUND_INDEX
- UIS$SET_CHAR_ROTATION
- UIS$SET_CHAR_SIZE
- UIS$SET_CHAR_SLANT
- UIS$SET_CHAR_SPACING
- UIS$SET_CLIP
- UIS$SET_FILL_PATTERN
- UIS$SET_FONT
- UIS$SET_LINE_STYLE
- UIS$SET_LINE_WIDTH
- UIS$SET_TEXT_FORMATTING
- UIS$SET_TEXT_MARGINS
- UIS$SET_TEXT_PATH
- UIS$SET_TEXT_SLOPE
- UIS$SET_WRITING_INDEX
- UIS$SET_WRITING_MODE

**Color Routines**
- UIS$CREATE_COLOR_MAP
- UIS$CREATE_COLOR_MAP_SEG
- UIS$DELETE_COLOR_MAP
- UIS$DELETE_COLOR_MAP_SEG
- UIS$HLS_TO_RGB
- UIS$HSV_TO_RGB
- UIS$RESTORE_CMS_COLORS
- UIS$RGB_TO_HLS
- UIS$RGB_TO_HSV
- UIS$SET_COLOR
- UIS$SET_COLORS
- UIS$SET_INTENSITIES
- UIS$SET_INTENSITY

**Display List Routines**
- UIS$BEGIN_SEGMENT
- UIS$COPY_OBJECT
- UIS$DELETE_OBJECT
- UIS$DELETEPRIVATE
- UIS$DISABLE.Display_LIST
- UIS$ENABLE_Display_LIST
- UIS$END_SEGMENT
- UIS$ERASE
- UIS$EXECUTE
- UIS$EXECUTE_DISPLAY
- UIS$EXTRACT_HEADER
- UIS$EXTRACT_OBJECT
- UIS$EXTRACTPRIVATE
- UIS$EXTRACT_REGION
- UIS$EXTRACT_TRAILER
- UIS$FIND_PRIMITIVE
- UIS$FIND_SEGMENT
- UIS$INSERT_OBJECT
- UIS$MOVE_AREA
- UIS$PRIVATE
- UIS$SET_INSERTION_POSITION
- UIS$TRANSFORM_OBJECT

**Graphics Routines**
- UIS$CIRCLE
- UIS$ELLIPSE
- UIS$IMAGE
- UIS$LINE
- UIS$LINE_ARRAY
- UIS$PLOT
- UIS$PLOT_ARRAY

**Inquiry Routines**
- UIS$GET_ABS_POINTER_POS
- UIS$GET_ALIGNED_POSITION
- UIS$GET_ARC_TYPE
- UIS$GET_BACKGROUND_INDEX
- UIS$GET_BUTTONS
- UIS$GET_CHAR_ROTATION
- UIS$GET_CHAR_SIZE
- UIS$GET_CHAR_SLANT
- UIS$GET_CHAR_SPACING
- UIS$GET_CLIP
- UIS$GET_COLOR
- UIS$GET_COLORS
- UIS$GET_CURRENT_OBJECT

(Continued on next page)
### Functional Categories of UIS Routines

#### Inquiry Routines (cont.)
- UIS$GET_DISPLAY_SIZE
- UIS$GET_FILL_PATTERN
- UIS$GET_FONT
- UIS$GET_FONT_ATTRIBUTES
- UIS$GET_FONT_SIZE
- UIS$GET_HW_COLOR_INFO
- UIS$GET_INTENSITIES
- UIS$GET_INTENSITY
- UIS$GET_KB_ATTRIBUTES
- UIS$GET_LINE_STYLE
- UIS$GET_LINE_WIDTH
- UIS$GET_NEXT_OBJECT
- UIS$GET_OBJECT_ATTRIBUTES
- UIS$GET_PARENT_SEGMENT
- UIS$GET_POINTER_POSITION
- UIS$GET_POSITION
- UIS$GET_PREVIOUS_OBJECT
- UIS$GET_ROOT_SEGMENT
- UIS$GET_TAB_INFO
- UIS$GET_TAB_POSITION
- UIS$GET_TEXT_FORMATTING
- UIS$GET_TEXT_MARGINS
- UIS$GET_TEXT_PATH
- UIS$GET_TEXT_SLOPE
- UIS$GET_VCM_ID
- UIS$GET_VIEWPORT_ICON
- UIS$GET_VIEWPORT_POSITION
- UIS$GET_VIEWPORT_SIZE
- UIS$GET_VISIBILITY
- UIS$GET_WINDOW_ATTRIBUTES
- UIS$GET_WINDOW_SIZE
- UIS$GET_WRITING_INDEX
- UIS$GET_WRITING_MODE
- UIS$GET_WS_COLOR
- UIS$GET_WS_INTENSITY

#### Keyboard Routines (cont.)
- UIS$READ_CHAR
- UIS$SET_KB_ATTRIBUTES
- UIS$SET_KB_COMPOSE2
- UIS$SET_KB_COMPOSE3
- UIS$SET_KB_KEYTABLE
- UIS$TEST_KB

#### Pointer Routines
- UIS$CREATE_TB
- UIS$DELETE_TB
- UIS$DISABLE_TB
- UIS$ENABLE_TB
- UIS$CREATE_TB
- UIS$DISABLE_TB
- UIS$ENABLE_TB

#### Sound Routines
- UIS$SOUND_BELL
- UIS$SOUND_CLICK

#### Text Routines
- UIS$MEASURE_TEXT
- UIS$NEW_TEXT_LINE
- UIS$SET_ALIGNED_POSITION
- UIS$SET_POSITION
- UIS$TEXT

#### Windowing Routines
- UIS$CLOSE_WINDOW
- UIS$CREATE_DISPLAY
- UIS$CREATE_TERMINAL
- UIS$CREATE_TRANSFORMATION
- UIS$CREATE_WINDOW
- UIS$DELETE_DISPLAY
- UIS$DELETE_TRANSFORMATION
- UIS$DELETE_WINDOW
- UIS$EXPAND_ICON
- UIS$MOVE_VIEWPORT
- UIS$MOVE_WINDOW
- UIS$POP_VIEWPORT
- UIS$PUSH_VIEWPORT
- UIS$RESIZE_WINDOW
- UIS$SHRINK_TO_ICON
**UIS$BEGIN_SEGMENT**

Begins a new segment in the virtual display.

**Format**

\[
\text{seg}_id = \text{UIS$BEGIN\_SEGMENT} \quad \text{vd}_id
\]

**Returns**

VMS Usage: identifier  
Type: longword (unsigned)  
Access: write only  
Mechanism: by value

Longword value returned as the segment identifier in the variable \textit{seg}_id or R0 (VAX MACRO). The segment identifier uniquely identifies a segment and is used as an argument in other routines.

UIS$BEGIN\_SEGMENT signals all errors; no condition values are returned.

**Argument**

\textit{vd}_id  
VMS Usage: identifier  
Type: longword (unsigned)  
Access: read only  
Mechanism: by reference

Virtual display identifier. The \textit{vd}_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY for more information about the \textit{vd}_id argument.

**Description**

All values of attribute blocks 0 to 255 are propagated to the new segment, but all changes to attribute blocks in this segment will be local to this segment only and not the parent.

You can also nest segments.
Illustration
UIS$CIRCLE

Draws an arc along the circumference of a circle.

Format

UIS$CIRCLE  vd_id, atb, center_x, center_y, xradius
            [,start_deg ,end_deg]

Returns

UIS$CIRCLE signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Virtual display identifier. The vd_id argument is the address of a longword
that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for
more information about the vd_id argument.

atb
VMS Usage:  longword_unsigned
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Attribute block number. The atb argument is the address of a longword
integer that specifies an attribute block that controls the appearance of the
circle or arc.

center_x, center_y
VMS Usage:  floating_point
type:  f_floating
access:  read only
mechanism:  by reference

Center position x and y world coordinates. The center_x and center_y
arguments are the addresses of f_floating point numbers that define a point
in the virtual display that is the center of the arc or circle.
UIS$CIRCLE

**xradius**

VMS Usage: floating_point  
type: f_floating  
access: read only  
mechanism: by reference

Radius of the circle specified as an x world coordinate width. The `xradius` argument is the address of an f_floating point number that defines the distance from the center of the circle to the circumference of the circle.

**start_deg, end_deg**

VMS Usage: floating_point  
type: f_floating  
access: read only  
mechanism: by reference

Degree at which the arc starts and ends. The `start_deg` and `end_deg` arguments are the addresses of f_floating point numbers that define the starting and ending point on the circumference of the circle where the arc or circle will be drawn. Degrees are measured clockwise from the top of the circle. If these arguments are not specified, 0.0 degrees and 360.0 degrees are assumed, respectively.

**Description**

UIS$CIRCLE draws an arc specified by a center position and a radius for the range of the degrees specified.

The arc can be closed by drawing one or more lines between the endpoints. The arc type associated with the attribute block specifies the way in which the arc is closed. The arc is not closed off by default. See UIS$SET_ARC_TYPE for details.

The points are drawn with the current line pattern and width, and filled with the current fill pattern if enabled.

UIS$CIRCLE does not support the following combination of attributes:

- Line width not equal to 1 and line style not equal to $FFFFF16$
- Line width not equal to 1 and complement writing mode

Circles are distorted by differences between the aspect ratios of the display window and display viewport.
Screen Output
UIS$CLOSE_WINDOW

Calls the system service SYS$EXIT to exit the current image.

Format

**UIS$CLOSE_WINDOW**  *wd_id*

Returns

UIS$CLOSE_WINDOW signals all errors; no condition values are returned.

Argument

*wd_id*

VMS Usage:  *identifier*

type:  *longword (unsigned)*

access:  *read only*

mechanism:  *by reference*

Display window identifier. The *wd_id* argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the *wd_id* argument.

Description

UIS$CLOSE_WINDOW is invoked as the default action taken by the "Delete" menu item in the Window Options Menu. See UIS$SET_CLOSE_AST for information about overriding this routine.
UIS$COPY_OBJECT

Copies the specified object and its private data within the virtual display. It may also transform the coordinates or attributes or both of the specified object. The original object remains unchanged in the virtual display.

Format

\[ \text{copy\_id=UIS$COPY\_OBJECT} \left\{ \text{obj\_id} \right. \left\{ \text{seg\_id} \right. \left[ \text{matrix} \right]\left[ \text{atb} \right] \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the copy identifier in the variable \text{copy\_id} or R0 (VAX MACRO). The copy identifier uniquely identifies a newly copied object. UIS$COPY_OBJECT signals all errors; no condition values are returned.

Arguments

\text{obj\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Object identifier. The \text{obj\_id} argument is the address of a longword that uniquely identifies an object.

\text{seg\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Segment identifier. The \text{seg\_id} argument is the address of a longword that uniquely identifies the segment. See UIS$BEGIN\_SEGMENT for more information about the \text{seg\_id} argument.
**matrix**

VMS Usage: `vector_longword_signed`
type: `f_floating`
access: `read only`
mechanism: `by reference`

Transformation matrix. The *matrix* argument is the address of a 2 x 3 matrix of longwords containing scaling, translation, and/or rotation data.

**Structure of a VAX FORTRAN Two-Dimensional Array**

A two-dimensional array declared as `ARRAY(2,3)` has the following structure.

```
<table>
<thead>
<tr>
<th>1,1</th>
<th>1,2</th>
<th>1,3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,1</td>
<td>2,2</td>
<td>2,3</td>
</tr>
</tbody>
</table>
```

Different languages allocate memory for array elements in different orders. This description assumes the order used by VAX FORTRAN. If you call `UIS$COPY_OBJECT` from another language, make sure that the array elements are in the same order.

Memory addresses of array elements range from lowest to highest in the following order: (1,1), (2,1), (1,2), (2,2), (1,3), and (2,3). The order of array element is shown in the following figure.

```
<table>
<thead>
<tr>
<th>1</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>
```

Pairs of array elements govern how displayed objects are scaled, rotated, and translated. UIS computes the transformed coordinates in the following manner.

\[
x_1 = A(1,1) \times x + A(1,2) \times y + A(1,3) \\
y_1 = A(2,1) \times x + A(2,2) \times y + A(2,3)
\]
Translation

When translation alone is performed, the following array elements are assigned values. $D_x$ and $D_y$ represent distances between the original coordinates and the new coordinates.

\[
\begin{array}{ccc}
1 & 0 & D_x \\
0 & 1 & D_y \\
\end{array}
\]

Scaling

When scaling alone is performed, the following array elements are assigned values.

\[
\begin{array}{ccc}
S_x & 0 & 0 \\
0 & S_y & 0 \\
\end{array}
\]

Rotation

When rotation alone is performed, the following array elements are assigned values, where "@" is the desired angle of rotation measured clockwise. The values returned from the VAX FORTRAN SIN and COS functions are stored in the appropriate array elements.

\[
\begin{array}{ccc}
\cos (@) & \sin (@) & 0 \\
-sin (@) & \cos (@) & 0 \\
\end{array}
\]

An unlimited number of transformations can be performed at one time by simply multiplying the matrices together into a single matrix using matrix multiplication.
In order to multiply two matrices together, you must add a row to the bottom of each matrix.

\[
\begin{array}{ccc}
0 & 0 & 1 \\
\end{array}
\]

After the multiplication is performed, remove the last row of the result.

\textit{atb}

VMS Usage: \textbf{longword\_unsigned}

<table>
<thead>
<tr>
<th>type</th>
<th>longword (unsigned)</th>
</tr>
</thead>
<tbody>
<tr>
<td>access</td>
<td>read only</td>
</tr>
<tr>
<td>mechanism</td>
<td>by reference</td>
</tr>
</tbody>
</table>

Attribute block number. The \textit{atb} argument is the address of a longword that identifies an attribute block whose attribute settings override current segment attributes.

\section*{Description}

Either the coordinates can be transformed, or the attributes can be overridden or both.

After a transformation, occluded objects may not appear correctly on the display screen. This can be corrected by calling UIS$EXECUTE to correctly refresh the display screen.
UIS$CREATE_COLOR_MAP

Creates a virtual color map of the specified size and with the specified attributes.

**Format**

\[ vcm\_id=UIS$\text{CREATE}\_COLOR\_MAP \quad vcm\_size \]

\[ [, vcm\_name] \]

\[ [, vcm\_attributes] \]

**Returns**

VMS Usage: identifier

type: longword (unsigned)

access: write only

mechanism: by value

Longword value returned as the virtual color map identifier in the variable \( vcm\_id \) or R0 (VAX MACRO). The virtual color map identifier uniquely identifies the virtual color map and must be specified in UIS$CREATE DISPLAY. It is also used as an argument in other color routines.

UIS$CREATE_COLOR_MAP signals all errors; no condition values are returned.

**Arguments**

\( vcm\_size \)

VMS Usage: longword unsigned

type: longword (unsigned)

access: read only

mechanism: by reference

Size of the virtual color map. The \( vcm\_size \) argument is the address of a longword that defines the number of entries in the virtual color map.

\( vcm\_name \)

VMS Usage: char_string

type: character string

access: read only

mechanism: by descriptor
Name of the virtual color map. The `vcm_name` argument is the address of a string descriptor of the name of the virtual color map. Specify the name of an existing shareable color map. If your application is creating the shareable color map, specify a valid color map name.

The virtual color map name should not exceed 15 characters.

**vcm_attributes**

VMS Usage: `item_list_pair`  
Type: `longword (unsigned)`  
Access: `read only`  
Mechanism: `by descriptor`

Virtual color map attributes. The `vcm_attributes` argument is the address of data structure of longword pairs that specify virtual color attributes.

The following figure describes the structure of this argument.

```
<table>
<thead>
<tr>
<th>Attribute code</th>
</tr>
</thead>
<tbody>
<tr>
<td>(VCMAL$C_xxxx)</td>
</tr>
<tr>
<td>Longword value for attribute</td>
</tr>
<tr>
<td>specified in previous longword</td>
</tr>
<tr>
<td>2nd attribute code</td>
</tr>
<tr>
<td>2nd attribute value</td>
</tr>
<tr>
<td>...</td>
</tr>
<tr>
<td>End of list = 0</td>
</tr>
<tr>
<td>(VCMAL$C_END_OF_LIST)</td>
</tr>
</tbody>
</table>
```

All of the following virtual color map attributes are optional.
### Attributes Function

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCMAL$C_ATTRIBUTES</td>
<td>General attributes</td>
</tr>
<tr>
<td>VCMAL$M_RESIDENT</td>
<td>Set for resident virtual color map</td>
</tr>
<tr>
<td>VCMAL$M_SHARE</td>
<td>Set for shareable virtual color map</td>
</tr>
<tr>
<td>VCMAL$M_SYSTEM$1,2</td>
<td>Set for system shareable virtual color map</td>
</tr>
<tr>
<td>VCMAL$M_NO_BIND</td>
<td>Set to disable automatic hardware color map binding</td>
</tr>
</tbody>
</table>

1. VCMAL$M_SHARE must also be set.
2. SYSGBL privilege is required.

### Illustration

```
\begin{center}
\begin{tabular}{|c|}
\hline
0 \\
1 \\
2 \\
3 \\
4 \\
5 \\
\vdots \\
n \\
\hline
\end{tabular}
\end{center}
```

Color Map Index

Color Map Entry
UIS$CREATE_COLOR_MAP_SEG

Allocates one or more hardware color map indices and binds them to a virtual color map.

Format

cms_id=UIS$CREATE_COLOR_MAP_SEG vcm_id
[,devnam]
[,place_mode]
[,place_data]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the color map segment identifier in the variable cms_id or R0 (VAX MACRO). The color map segment identifier uniquely identifies the color map segment and is used as an argument in other routines.

UIS$CREATE_COLOR_MAP_SEG signals all errors; no condition values are returned.

Arguments

vcm_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual color map identifier. The vcm_id argument is the address of a longword that uniquely identifies the virtual color map. See UIS$CREATE_COLOR_MAP for more information about the vcm_id argument.

NOTE: This routine can only be used once for each virtual color map identifier.
**UIS$CREATE_COLOR_MAP_SEG**

**devnam**

VMS Usage:  device_name

Type: character string

Access: read only

Mechanism: by descriptor

Device name. The devnam argument is the address of a character string descriptor of the workstation device name. Specify the device name SYS$WORKSTATION in the devnam argument.

**place_mode**

VMS Usage:  longword_unsigned

Type: longword (unsigned)

Access: read only

Mechanism: by reference

Placement mode. The place_mode argument is the address of a longword that specifies the placement mode, that is, which hardware color map entries can be allocated. The following table lists valid placement modes.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_GENERAL</td>
<td>General placement—Allocates any available entries in the hardware color map.</td>
</tr>
<tr>
<td>UIS$C_COLOR_EXACT</td>
<td>Exact placement—Allocates map entries starting at the specified entry and aligned on a natural entry boundary. Given the size of the virtual color map, UIS computes a working size that is the smallest power of 2 greater than or equal to the requested size. The natural alignment of a map is a starting index that is a multiple of the working size. For example, a six-entry color map could be placed at indices 0, 8, 16 and so on.</td>
</tr>
<tr>
<td>UIS$C_COLOR_BASED</td>
<td>Based placement (default)—Allocates entries such that writing modes using Boolean logic operations on pixel values can correctly display color intersections.</td>
</tr>
</tbody>
</table>

**place_data**

VMS Usage:  longword_unsigned

Type: longword (unsigned)

Access: read only

Mechanism: by reference

Placement data. The place_data argument is the address of a longword that contains the first index to be allocated. The placement_data argument is used with exact placement mode.
Description

For hardware supporting bit plane write masks, the segment will be based at an index that is a power of 2 and that write operation will be performed using the appropriate mask. The virtual color map entry index specified in the place_data argument indicates the binding between the virtual color map and the hardware color map entries allocated by UIS$CREATE_COLOR_MAP_SEG. The default value is 0, that is, the first allocated map entry is bound to virtual color map entry 0, the second allocated map entry is bound to virtual color map entry 1, and so on.

If the appropriate entries cannot be allocated, an error is signaled. In addition to failure due to resource depletion, a call to UIS$CREATE_COLOR_MAP_SEG can fail because UIS has already issued this call for the application. This occurs if the flag VCMAL$M_NO_BIND is not set when the virtual color map is created, and internal processing required a binding to hardware resources. For example, UIS$CREATE_WINDOW allocates and binds hardware color map resources when creating a display viewport.

Conversely, if VCMAL$M_NO_BIND is set, but UIS$CREATE_COLOR_MAP_SEG was not called, calls to some UIS routines such as UIS$SET_COLOR and UIS$SET_INTENSITY may fail.

NOTE: The recommended procedure for using this routine is as follows:

1. Specify the flag VCMAL$M_NO_BIND when creating the virtual color map with UIS$CREATE_COLOR_MAP.
2. Invoke UIS$CREATE_COLOR_MAP_SEG before calling any other UIS routine.
3. Initialize the color map using UIS$SET_COLORS. By definition all colors are black.
UIS$CREATE_DISPLAY

Creates a virtual display.

Format

$$vd_id=UIS$CREATE_DISPLAY \ x_1, y_1, x_2, y_2, width, height$$

[,,vcm_id]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the virtual display identifier in the variable
$$vd_id$$ or R0 (VAX MACRO). The virtual display identifier uniquely identifies
the virtual display and is used as a parameter in all output and attribute
routines.

UIS$CREATE_DISPLAY signals all errors; no condition values are returned.

Arguments

$$x_1, y_1, x_2, y_2$$
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

World coordinates of the virtual display space. The $$x_1$$ and $$y_1$$ arguments are
the addresses of f_floating point numbers that define the lower-left corner of
the virtual display space. The $$x_2$$ and $$y_2$$ are the addresses of f_floating point
numbers that define the upper-right corner of the virtual display.

These arguments define mapping and scaling factors and are not the
boundaries of the virtual display.

$$width, height$$
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference
Width and height of the display viewport. The **width** and **height** arguments are the addresses of floating point numbers that define both the width and height of the display viewport in centimeters.

**vcm_id**
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual color map identifier. The vcm_id argument is the address of a longword that uniquely identifies the virtual color map. See UIS$CREATE_COLOR_MAP for more information about the vcm_id argument.

If vcm_id is not specified, a two-entry virtual color map is created for the virtual display by default.

**Description**

To avoid distorting the resulting graphic image, the aspect ratio of the world coordinate range of the display window must be equal to the aspect ratio of the display viewport. See UIS$CREATE_WINDOW for more information about aspect ratios.
UIS$CREATE_KB

Creates a virtual keyboard on the specified device.

Format

\[ kb\_id = \text{UIS$CREATE\_KB} \quad \text{devnam} \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the virtual keyboard identifier in the variable \( kb\_id \) or R0 (VAX MACRO). The virtual keyboard identifier uniquely identifies the virtual keyboard. The variable \( kb\_id \) is used as an argument in other routines.

UIS$CREATE\_KB signals all errors; no condition values are returned.

Argument

\textit{devnam}

VMS Usage: device_name
type: character string
access: read only
mechanism: by descriptor

Device name string. The \textit{devnam} argument is the address of a character string descriptor of the workstation device name. Specify the logical name SYS$WORKSTATION as the device name string.

Description

UIS$CREATE\_KB generates a value for the \( kb\_id \) argument which is referenced in subsequent routines that use \( kb\_id \) as a parameter.
Example

VD_ID=UIS$CREATE_DISPLAY(-5.0,-5.0,50.0,45.0,15.0,15.0)
KB_ID=UIS$CREATE_KB('SYS$WORKSTATION')  1
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','VIEWPORT TITLE',
                        10.0,10.0,25.0,25.0)
CALL UIS$ENABLE_VIEWPORT_KB(KB_ID,WD_ID)  2

CALL UIS$DISABLE_VIEWPORT_KB(WD_ID)  3

The preceding example creates a virtual keyboard 1 and binds the virtual keyboard to a display window 2. In order to use the virtual keyboard and its characteristics with the desired viewport, you must assign the physical keyboard to the desired virtual keyboard and viewport. Press the F5 or [CYCLE] key until the KB icon in the appropriate viewport is highlighted.

The call to UIS$DISABLE_VIEWPORT_KB 3 explicitly disables the binding between the virtual keyboard and the display window. Also, the ability to assign the physical keyboard to the appropriate virtual keyboard, that is, to cycle from viewport to viewport, is disabled.

If UIS$ENABLE_KB were called after UIS$ENABLE_VIEWPORT_KB, the KB icon would have been highlighted as soon as the program executed.
Illustration

Virtual Displays

WD_ID1
WD_ID2

Virtual Keyboards

WD_ID3
WD_ID4

Physical Keyboard

ZK-5452-86
UIS$CREATE_TB

Creates a tablet digitizer identifier that allows you to connect your process to the tablet.

Format

\[ tb\_id=UIS$CREATE\_TB \quad devnam \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by reference

Longword value returned as the tablet identifier in the variable \( tb\_id \) or R0 (VAX MACRO). The tablet identifier uniquely identifies the tablet device and can be used in other routines where appropriate.

UIS$CREATE_TB signals all errors; no condition values are returned.

Argument

\( devnam \)

VMS Usage: device_name
type: character string
access: read only
mechanism: by descriptor

Device name. The \( devnam \) argument is the address of a character string descriptor of the workstation device name. Specify SYS$WORKSTATION as the default device name character string.

Description

UIS$CREATE_TB creates a tablet digitizer identifier. When you want to connect to the tablet, you must specify this identifier in a call to UIS$ENABLE_TB.
UIS$CREATE_TERMINAL

Creates a terminal emulation window of the specified type.

Format

\[
\text{UIS}\$\text{CREATE}_-\text{TERMINAL} \quad \text{termtype} [,\text{title}] [,\text{attributes}] \\
[,\text{devnam}] [,\text{devlen}]
\]

Returns

UIS$CREATE_TERMINAL signals all errors; no condition values are returned.

Arguments

\text{termtype}
VMS Usage: char_string

(type): character string

(access): read only

(mechanism): by descriptor

Terminal type. The \text{termtype} argument is the address of a character string descriptor of the terminal type. Specify either WT for a VT220 emulation window or TK for a TEK4010/4014 emulation window.

\text{title}
VMS Usage: char_string

(type): character string

(access): read only

(mechanism): by descriptor

Window title. The \text{title} argument is the address of a descriptor of a character string that is the title of the terminal emulation window.

\text{attributes}
VMS Usage: item_list_pair

(type): longword

(access): read only

(mechanism): by reference

Window attributes list. The \text{attributes} argument is the address of a data structure that contains two or more longwords. The list consists of one or more longword pairs, or \text{doublets}. The first longword contains an attribute
code, while the second longword holds an attribute value (which can be real or integer). The constant WDPL$C_END_OF_LIST terminates the list.

The window attributes list has the same format as defined in the UIS$CREATE_WINDOW service. If your application program is written in FORTRAN, use the RECORD data type to construct the attribute list. Refer to UIS$CREATE_WINDOW for a description of the attribute list.

**devnam**

VMS Usage: device_name  
type: character string  
access: write only  
mechanism: by descriptor

New terminal emulation device name. The devnam argument is the address of a character string descriptor of a location that receives the new terminal emulation device name string.

**devlen**

VMS Usage: word_unsigned  
type: word (unsigned)  
access: write only  
mechanism: by reference

Length of the terminal emulation device name string. The devlen argument is the address of a word that receives the length of the terminal device name character string.

---

**Description**

UIS$CREATE_TERMINAL creates a pseudodevice in the VMS database and returns the device name string for the device. The window may not appear on the screen until a channel is assigned to the device using the SYS$ASSIGN system service and the first write to the device is performed.

The pseudodevice is created without any initial owner. Once a channel is assigned to the device, it is owned by that process, which is usually the same process that issued the UIS$CREATE_TERMINAL call. After all channels have been deassigned, the pseudodevice will be removed automatically from the system. If a permanent pseudodevice is required, then the application should specify a process that maintains a permanent channel to the device.
UIS$CREATE_TRANSFORMATION

Creates a two-dimensional world coordinate transformation into an existing virtual display's coordinate space. It provides for two-dimensional translation and scaling, but not rotation.

Format

\[ tr\_id=UIS$CREATE\_TRANSFORMATION \quad vd\_id, \ x_1, \ y_1, \ x_2, \ y_2 \ [,\ vdx_1, \ vdy_1, \ vdx_2, \ vdy_2] \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the transformation identifier in the variable \( tr\_id \) or R0 (VAX MACRO). The transformation identifier uniquely identifies a transformation coordinate space. See the “DESCRIPTION” section below for more information about \( tr\_id \).

UIS$CREATE_TRANSFORMATION signals all errors; no condition values are returned.

Arguments

\( vd\_id \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \( vd\_id \) argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the \( vd\_id \) argument.

\( x_1, \ y_1, \ x_2, \ y_2 \)

VMS Usage: floating_point
type: f-floating
access: read only
mechanism: by reference
World coordinates of the new coordinate space. The $x_1$ and $y_1$ arguments and the $x_2$ and $y_2$ arguments are the addresses of f_floating point numbers that define the lower-left corner and upper-right corner of the new transformation coordinate space, respectively.

$vdX_1, vdy_1, vdx_2, vdy_2$

VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

World coordinates of the original virtual display space. The $vdx_1$ and $vdy_1$ arguments are the addresses of f_floating point numbers that define the lower-left corner of the corresponding virtual display space. The $vdx_2$ and $vdy_2$ arguments are the addresses of f_floating point numbers that define the upper-right corner of the corresponding virtual display space. If these optional arguments are not specified, the world coordinates specified in UIS$CREATE_DISPLAY are used.

Description

Once the transformation is created, it can be used in any routine that accepts a vd_id argument except UIS$DELETE_DISPLAY by substituting the tr_id argument instead. When the tr_id value is used, it indicates the same virtual display but that the coordinates are mapped relative to the transformation coordinate space, and not the original virtual display coordinate space. Each routine automatically performs the transformation.
**UIS Routine Descriptions**

**UIS$CREATE_TRANSFORMATION**

**Illustration**

```
vd_id = UIS$CREATE_DISPLAY

(0,0) ---------- (50,30)

Original World Coordinate Space
```

```
tr_id = UIS$CREATE_TRANSFORMATION

(0,0) ---------- (30,30)

New World Coordinate Space
```

ZK-5368-86
UIS$CREATE_WINDOW

Creates a display window and an associated display viewport. See UIS$GET_WINDOW-ATTRIBUTES for information about window attributes.

Format

\[ wd\_id = \text{UIS$CREATE\_WINDOW} \quad vd\_id, \text{devnam} [,title] [,x_1, y_1, x_2, y_2] [,width, height] [,attributes] \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the display window identifier in the variable \( wd\_id \) or R0 (VAX MACRO). The display window identifier uniquely identifies the display window and is used as an argument in other routines.

UIS$CREATE_WINDOW signals all errors; no condition values are returned.

Arguments

\( vd\_id \)
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \( vd\_id \) argument is the address of a longword value that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the \( vd\_id \) argument.

\( \text{devnam} \)
VMS Usage: device_name
type: character string
access: read only
mechanism: by descriptor
UIS Routine Descriptions

UIS$CREATE_WINDOW

Device name. The devnam argument is the address of a character string descriptor of the display device on which the display viewport is created. Specify the logical name SYS$WORKSTATION as the name of the device.

title

VMS Usage: char_string
type: character string
access: read only
mechanism: by descriptor

Banner title. The title argument is the address of a descriptor of the character string to be inserted into the banner of the display viewport. If the argument title is not specified, the display banner is created without a title.

\( x_1, y_1, x_2, y_2 \)

VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

World coordinates of the display window. The \( x_1, y_1 \) and \( x_2, y_2 \) arguments are addresses of f_floating point numbers that define the lower-left corner and upper-right corner of the display window rectangle. The display window rectangle defines the visible portion of the virtual display. The world coordinate space of the display window rectangle is mapped to the display screen as the display viewport.

If these coordinates are not specified, the entire world coordinate space specified in the UIS$CREATE_DISPLAY routine is used.

width, height

VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Initial dimensions of the display viewport. The width and height arguments are addresses of f_floating point numbers that define the width and height of the display viewport in centimeters. If the width and height arguments of the display viewport specified in UIS$CREATE_WINDOW are different from the width and height arguments specified in the UIS$CREATE_DISPLAY routine, the default values of UIS$CREATE_DISPLAY are overridden and scaling occurs.

If the world coordinates of the display window are specified and the width and height arguments are not specified, the default dimensions of the display viewport are calculated from the ratios of the world coordinate values and the width and height specified in UIS$CREATE_DISPLAY. See
the Description section for more information about calculating the default display viewport dimensions.

Display viewports that are too large to fit on the screen are automatically proportionally scaled in size.

**attributes**

VMS Usage: item_list_pair

type: longword integer (signed) or f_floating

access: read only

mechanism: by reference

Display viewport attribute list. The attributes argument is the address of a data structure that contains longword pairs, or doublets. The first longword stores an attribute ID code and the second longword holds the attribute value (which can be real or integer). The constant WDPL$C_END_OF_LIST terminates this list. FORTRAN application programs should create a record using the RECORD statement to construct this list. It has the following format.

<table>
<thead>
<tr>
<th>Attribute ID code</th>
<th>Longword value for attribute identified in previous longword</th>
</tr>
</thead>
<tbody>
<tr>
<td>2nd attribute ID code</td>
<td></td>
</tr>
<tr>
<td>2nd attribute value</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td></td>
</tr>
</tbody>
</table>

End of list = 0 (WDPL$C_END_OF_LIST)

Window attributes are optional and control window placement and attributes.
### UIS Routine Descriptions

#### UIS$CREATE_WINDOW

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDPL$C_ABS_POS_X</td>
<td>Exact x placement on the screen. This attribute defines the x origin of the viewport relative to the lower-left corner of the screen. The value is expressed as an <em>floating point number of centimeters</em>. Note that the actual point WDPL$C_ABS_POS_X defines is the lower left corner of the display viewport without the border. Along with WDPL$C_ABS_POS_Y, this provides the ability to place exactly a new viewport at a specific position anywhere on the workstation screen.</td>
</tr>
<tr>
<td>WDPL$C_ABS_POS_Y</td>
<td>Exact y placement on the screen. This attribute defines the y origin of the viewport relative to the lower-left corner of the screen. The value is expressed as an <em>floating point number of centimeters</em>. Note that the actual point WDPL$C_ABS_POS_Y defines is the lower-left corner of the display viewport without the border. Along with WDPL$C_ABS_POS_X, this attribute provides the ability to place exactly a new viewport at a specific position anywhere on the workstation screen.</td>
</tr>
<tr>
<td>WDPL$C_PLACEMENT</td>
<td>Display viewport placement flags. The attribute list is a longword bit vector providing viewport placement information. The preference masks (top, bottom, left, and right) may be combined by setting more than one bit in the bit vector. If the screen becomes crowded, the system may override the preference masks.</td>
</tr>
</tbody>
</table>

- **WDPL$M_TOP** — The display viewport is placed near the top of the physical display
- **WDPL$M_BOTTOM** — The display viewport is placed near the bottom of the physical display
- **WDPL$M_LEFT** — The display viewport is placed near the left side of the physical display
- **WDPL$M_RIGHT** — The display viewport is placed near the right side of the physical display
- **WDPL$M_CENTER** — The display viewport is centered over the position specified by WDPL$C_ABS_POS_X and WDPL$C_ABS_POS_Y.
**WDPL$C-ATTRIBUTES**

Display viewport attributes.

This data structure argument causes the display viewport to be created with one or more of the following attributes. These attributes are specified as bits in a longword mask.

- **WDPL$M_INVISIBLE** — The display viewport is created invisibly, that is, off the screen and, hence, cannot be seen.
- **Other bits** — The remaining bits are reserved to DIGITAL and must be set to zero.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDPL$M_INVISIBLE</td>
<td>The display viewport is created invisibly, that is, off the screen and, hence, cannot be seen.</td>
</tr>
<tr>
<td>WDPL$M_ALIGNED</td>
<td>The left inner edge of the display viewport is to be aligned on byte boundaries. Applications, such as the VT220 terminal emulator, can use WDPL$M_ALIGNED to take advantage of text drawing performance optimizations when 8-bit characters are written on byte boundaries.</td>
</tr>
<tr>
<td>WDPL$M_NOBANNER</td>
<td>The display viewport is created without a banner. If a banner title was specified, it is ignored.</td>
</tr>
<tr>
<td>WDPL$M_NOBORDER</td>
<td>The display viewport is created without a border. When you specify WDPL$M_NOBORDER, the attribute WDPL$M_NOBANNER is implied. A viewport created without a border cannot be moved with the user interface.</td>
</tr>
<tr>
<td>WDPL$M_NOKB_ICON</td>
<td>The display viewport banner is created without a KB icon. Specify this attribute, if you are sure the application will never require a KB icon or if you wish to add more space in the banner for the title. Otherwise, UIS saves an extra quarter of an inch in the banner for the KB icon.</td>
</tr>
<tr>
<td>WDPL$M_NOMENU_ICON</td>
<td>The display viewport banner is created without a menu icon. Therefore, the Window Options Menu cannot be activated.</td>
</tr>
<tr>
<td>Other bits</td>
<td>The remaining bits are reserved to DIGITAL and must be zero.</td>
</tr>
</tbody>
</table>
UIS Routine Descriptions

**UIS$CREATE_WINDOW**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDPL$C_END_OF_LIST</td>
<td>Terminates attributes list.</td>
</tr>
<tr>
<td></td>
<td>This must be the last longword in the attribute list. It does not require</td>
</tr>
<tr>
<td></td>
<td>an associated longword value.</td>
</tr>
</tbody>
</table>

**Description**

**UIS$CREATE_WINDOW** defines a portion of the virtual display that lies within the display window and that is mapped to the display screen as the display viewport.

**Default Dimensions of the Display Viewport**

Whenever the world coordinates of the display window are defined, but the dimensions of the display viewport are not specified, the system calculates the default dimensions of the display viewport using the appropriate arguments from each routine as shown in the following figure. The size of the display viewport is based on the `width` and `height` arguments in **UIS$CREATE_DISPLAY** in the following manner:

\[
\begin{align*}
\text{UIS$CREATE\_DISPLAY} & \quad \text{UIS$CREATE\_WINDOW} \\
\text{width} & = \frac{x_2 - x_1}{new\_width} \\
\text{height} & = \frac{y_2 - y_1}{new\_height}
\end{align*}
\]

The variables `new_width` and `new_height` represent unknown quantities, the default dimensions of the display viewport. All other variables are the parameters used in the respective routine calls.

For example, the viewport that is created in the following example is 4 centimeters wide and 2 centimeters high.

\[
\begin{align*}
\text{vd_id} & = \text{UIS$CREATE\_DISPLAY}(0.0,0.0,1.0,1.0,8.0,4.0) \\
\text{wd_id} & = \text{UIS$CREATE\_WINDOW}(\text{vd_id},'SYS$WORKSTATION', 'TEST WINDOW', 0.0,0.0,0.5,0.5)
\end{align*}
\]

Otherwise, these values can be overridden with the optional `width` and `height` arguments in **UIS$CREATE\_WINDOW**.
Display Viewport Creation

Display viewports are always created completely on or off the display screen.

Distortion of Graphic Objects

To avoid distortion of graphic objects, the aspect ratios of the display window and the display viewport must be equal.

In the preceding illustration, the aspect ratio of the display window on the left does not appear to be equal to the aspect ratio of the viewport on the right.

You can compare aspect ratios using the following equation.

\[
\frac{|y_1 - y_0|}{|x_1 - x_0|} = \frac{\text{viewport height}}{\text{viewport width}}
\]

The aspect ratio of the display viewport is the absolute value of the height divided by the absolute value of the width.
Routine Descriptions

UIS$CREATE_WINDOW

Example

```
PROGRAM EXAMPLE_A

  ...

  STRUCTURE/STRUCT/                      ①
    INTEGER*4 CODE_1
    REAL*4  ATTRIB_1
    INTEGER*4 CODE_2
    REAL*4  ATTRIB_2
    INTEGER*4 CODE_3
    INTEGER*4 ATTRIB_3
    INTEGER*4 END
  END STRUCTURE

RECORD/STRUCT/WINDOW                      ②
  WINDOW.CODE_1=WDPL$C_ABS_POS_X
  WINDOW.ATTRIB_1=10.5
  WINDOW.CODE_2=WDPL$C_ABS_POS_Y
  WINDOW.ATTRIB_2=13.25
  WINDOW.CODE_3=WDPL$C_ATTRIBUTES
  WINDOW.ATTRIB_3=WDPL$M_NOKB_ICON .OR. WDPL$M_NOMENU_ICON
  WINDOW.END=WDPL$C_END_OF_LIST

  ...

  VD_ID=UIS$CREATE_DISPLAY(-10.0,-10.0,35.5,35.5,16.0,16.0)               ③
  WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','LOOK',2.0,2.0,28.0,28.0
    2          20.0,20.0,WINDOW)                        ④

  ...
```

The preceding example describes how to construct the data structure argument used in UIS$CREATE_WINDOW to enable viewport placement and characteristics ① ②. In addition, the example illustrates the minimum number of calls used to create a display window ③ ④.
Screen Output

Menu Icon

Viewport Title

Banner

Border
UIS$DELETE_COLOR_MAP

Deletes a virtual color map.

**Format**

```plaintext
UIS$DELETE_COLOR_MAP  vcm_id
```

**Returns**

UIS$DELETE_COLOR_MAP signals all errors; no condition values are returned.

**Argument**

`vcm_id`

VMS Usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Virtual color map identifier. The `vcm_id` argument is the address of a longword that uniquely identifies the virtual color map. See UIS$CREATE_COLOR_MAP for more information about the `vcm_id` argument.

**Description**

An attempt to delete an active virtual color map, that is, a virtual color map associated with one or more virtual displays, signals an error.

All virtual displays that reference the virtual color map should be deleted first using UIS$DELETE_DISPLAY.
UIS$DELETE_COLOR_MAP_SEG

Deletes the specified color map segment.

Format

\texttt{UIS$DELETE\_COLOR\_MAP\_SEG\ cms\_id}

Returns

UIS$DELETE\_COLOR\_MAP\_SEG\ signals all errors; no condition values are returned.

Argument

\texttt{cms\_id}

VMS Usage: \texttt{identifier}

\texttt{type: longword (unsigned)}

\texttt{access: read only}

\texttt{mechanism: by reference}

Color map segment identifier. The \texttt{cms\_id} argument is the address of a longword that uniquely identifies the color map segment to be deleted. See UIS$CREATE\_COLOR\_MAP\_SEG for more information about the \texttt{cms\_id} argument.

Description

Color map segment deletion has no effect on the colors being mapped by the hardware color map. The deletion of color map segments marks the corresponding entries as available for allocation.

An attempt to delete an active color map segment, that is, a color map segment referenced by a virtual color map, signals an error.

The virtual color map should be deleted first using UIS$DELETE\_COLOR\_MAP.
UIS$DELETE_DISPLAY

Deletes the virtual display, all associated windows, and viewports.

Format

`UIS$DELETE_DISPLAY`  `vd_id`

Returns

UIS$DELETE_DISPLAY signals all errors; no condition values are returned.

Argument

```
vd_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference
```

Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

Description

You cannot substitute the `tr_id` argument for the virtual display identifier in this routine.
UIS$DELETE_KB

Deletes a virtual keyboard. If the specified virtual keyboard is bound to a window or to the physical keyboard, those bindings are terminated.

Format

UIS$DELETE_KB \ kb_id

Returns

UIS$DELETE_KB signals all errors; no condition values are returned.

Argument

kb_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual keyboard identifier. The kb_id argument is the address of a longword that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the kb_id argument.

Description

UIS$DELETE_KB may be used to delete a virtual keyboard at any time within a program.
**UIS$DELETE_OBJECT**

Deletes the specified object from the virtual display.

**Format**

```
UIS$DELETE_OBJECT { obj_id } { seg_id }
```

**Returns**

UIS$DELETE_OBJECT signals all errors; no condition values are returned.

**Arguments**

- **obj_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Object identifier. The `obj_id` argument is the address of a longword that uniquely identifies the object to be deleted.

- **seg_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Segment identifier. The `seg_id` argument is the address of a longword that uniquely identifies the segment. See UIS$BEGIN_SEGMENT for more information about the `seg_id` argument.

**Description**

The screen is updated immediately to reflect the new state of the virtual display. If it is impossible to modify only those portions which have changed, then the entire display may be replotted. Occluded objects are always refreshed.
UIS$DELETE_PRIVATE

Deletes the private data associated with the object.

Format

```
UIS$DELETE_PRIVATE { obj_id } { seg_id }
```

Returns

UIS$DELETE_PRIVATE signals all errors; no condition values are returned.

Arguments

- **obj_id**
  VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Object identifier. The **obj_id** argument is the address of a longword that uniquely identifies an object.

- **seg_id**
  VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Segment identifier. The **seg_id** argument is the address of a longword that uniquely identifies the segment. See UIS$BEGIN_SEGMENT for more information about the **seg_id** argument.

Description

If more than one private data item exists, all private data items are deleted.
UIS$DELETE_TB

Deletes the tablet digitizer identifier and disconnects the application from the tablet.

Format

UIS$DELETE_TB  \( \text{tb\_id} \)

Returns

UIS$DELETE_TB signals all errors; no condition values are returned.

Argument

\( \text{tb\_id} \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Tablet identifier. The \( \text{tb\_id} \) argument is the address of a longword that uniquely identifies the tablet device. See UIS$CREATE_TB for more information about the \( \text{tb\_id} \) argument.

Description

UIS$DELETE_TB deletes a tablet digitizing identifier. When your process has completed digitizing, you should call this routine to delete the identifier.
UIS$DELETE_TRANSFORMATION

Deletes a world coordinate transformation of a virtual display. The corresponding virtual display is not affected.

Format

UIS$DELETE_TRANSFORMATION  tr_id

Returns

UIS$DELETE_TRANSFORMATION signals all errors; no condition values are returned.

Argument

tr_id

VMS Usage:  identifier
  type:  longword (unsigned)
  access:  read only
  mechanism:  by reference

Transformation identifier. The tr_id argument is the address of a longword that uniquely identifies the transformation to be deleted. See UIS$CREATE_TRANSFORMATION for more information about the tr_id argument.
UIS$DELETE_WINDOW

Deletes an existing display window and viewport.

Format

\texttt{UIS$DELETE\_WINDOW \ \ wd\_id}

Returns

UIS$DELETE\_WINDOW signals all errors; no condition values are returned.

Argument

\texttt{wd\_id}

\[
\text{VMS Usage: identifier} \\
\text{type: longword (unsigned)} \\
\text{access: read only} \\
\text{mechanism: by reference}
\]

Display window identifier. The \texttt{wd\_id} argument is the address of a longword that uniquely identifies the display window to be deleted. See UIS$CREATE\_WINDOW for more information about the argument \texttt{wd\_id}.

Description

UIS$DELETE\_WINDOW deletes the display window specified by the \texttt{wd\_id} argument. The associated viewport is removed from the screen. The virtual display associated with this display window is neither modified nor destroyed during the execution of this service.
UIS$DISABLE_DISPLAY_LIST

Disables specified display list functions.

Format

\texttt{UIS$DISABLE\_DISPLAY\_LIST \ vd\_id [\text{display\_flags}]}

Returns

UIS$DISABLE\_DISPLAY\_LIST signals all errors; no condition values are returned.

Arguments

\texttt{vd\_id}

VMS Usage: \texttt{identifier}

\texttt{type: longword (unsigned)}

\texttt{access: read only}

\texttt{mechanism: by reference}

Virtual display identifier. The \texttt{vd\_id} argument is the address of a longword that uniquely identifies the virtual display whose display list should be disabled. See UIS$CREATE\_DISPLAY for more information about the \texttt{vd\_id} argument.

\texttt{display\_flags}

VMS Usage: \texttt{mask\_longword}

\texttt{type: longword (unsigned)}

\texttt{access: read only}

\texttt{mechanism: by reference}

Display list flags. The \texttt{display\_flags} argument is address of a longword mask that controls display screen and display list updates.

The following table describes the flags and masks.
UIS Routine Descriptions

UIS$DISABLE_DISPLAY_LIST

<table>
<thead>
<tr>
<th>Flag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$M_DL_ENHANCE_LIST</td>
<td>Controls making additions to the display list. When disabled, no new display list entries are made. This flag is set by default when a virtual display is created.</td>
</tr>
<tr>
<td>UIS$M_DL_MODIFY_LIST</td>
<td>Controls display list modifications. When disabled, no display list editing is allowed. This flag is set by default when a virtual display is created.</td>
</tr>
<tr>
<td>UIS$M_DL_UPDATE_WINDOW</td>
<td>Controls drawing. When disabled, no drawing or update occurs. This flag is set by default when a virtual display is created.</td>
</tr>
</tbody>
</table>

The following table lists UIS routines that check the flags.

<table>
<thead>
<tr>
<th>Flag</th>
<th>UIS Routine</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$M_DL_MODIFY_LIST</td>
<td>UIS$COPY_OBJECT&lt;br&gt;UIS$DELETE_OBJECT&lt;br&gt;UIS$ERASE&lt;br&gt;UIS$INSERT_OBJECT&lt;br&gt;UIS$MOVE_AREA&lt;br&gt;UIS$TRANSFORM_OBJECT</td>
</tr>
<tr>
<td>UIS$M_DL_ENHANCE_LIST</td>
<td>UIS$CIRCLE&lt;br&gt;UIS$ELLIPSE&lt;br&gt;UIS$EXECUTE&lt;br&gt;UIS$EXECUTE_DISPLAY&lt;br&gt;UIS$IMAGE&lt;br&gt;UIS$LINE&lt;br&gt;UIS$LINE_ARRAY&lt;br&gt;UIS$PLOT&lt;br&gt;UIS$PLOT_ARRAY&lt;br&gt;UIS$TEXT</td>
</tr>
</tbody>
</table>

1 All routines listed under UIS$M_DL_ENHANCE_LIST and UIS$M_DL_MODIFY_LIST will also check the state of UIS$M_DL_UPDATE_WINDOW before doing any screen updates.

If a bit is set in the mask, the corresponding function is disabled. If the bit is 0, the corresponding function is not changed. See UIS$ENABLE_DISPLAY_LIST for information on how to enable functions.

If display_flags is not specified, UIS$M_DL_ENHANCE_LIST is disabled.
UIS Routine Descriptions

UIS$DISABLE_DISPLAY_LIST

Description

UIS$DISABLE_DISPLAY_LIST is useful in applications such as animation. In such a case, display list additions are neither necessary nor desired because of the additional overhead.

Example

At some point in your application you may wish to perform several modifications to the display list without seeing the screen change.

display_flags = UIS$M_DL_UPDATE_WINDOW

CALL UIS$DISABLE_DISPLAY_LIST(VD_ID, DISPLAY_FLAGS)

Insert your modifications here

CALL UIS$ENABLE_DISPLAY_LIST(VD_ID, DISPLAY_FLAGS)
CALL UIS$EXECUTE(VD_ID) ! Erases and redraws the virtual display
UIS$DISABLE_KB

Disconnects the physical keyboard from the specified virtual keyboard. See the example in UIS$CREATE_KB for more information.

Format

    UIS$DISABLE_KB   kb_id

Returns

    UIS$DISABLE_KB signals all errors; no condition values are returned.

Argument

    kb_id

    VMS Usage: identifier
    type: longword (unsigned)
    access: read only
    mechanism: by reference

    Virtual keyboard identifier. The kb_id argument is the address of a longword that uniquely identifies the virtual keyboard to be disabled. See UIS$CREATE_KB for more information about the kb_id argument.
**UIS$DISABLE_TB**

Disconnects the digitizing tablet.

---

**Format**

```
UIS$DISABLE_TB  tb_id
```

---

**Returns**

UIS$DISABLE_TB signals all errors; no condition values are returned.

---

**Argument**

- **tb_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference

  Tablet identifier. The `tb_id` argument is the address of longword that uniquely identifies the tablet device. See UIS$CREATE_TB for more information about the `tb_id` argument.

---

**Description**

UIS$DISABLE_TB disconnects your process from the tablet. This routine reenables the system pointer and frees the tablet for use by another process.
UIS$DISABLE_VIEWPORT_KB

Prevents the user from assigning the physical keyboard to a viewport. See the example in UIS$CREATE_KB for more information.

Format

UIS$DISABLE_VIEWPORT_KB  wd_id

Returns

UIS$DISABLE_VIEWPORT_KB signals all errors; no condition values are returned.

Argument

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. The associated viewport of the display window is disabled. See UIS$CREATE_WINDOW for more information about the wd_id argument.

Description

UIS$DISABLE_VIEWPORT_KB removes the display window from the assignment list. You can no longer use the [CYCLE] key to make the viewport active. Use UIS$ENABLE_VIEWPORT_KB or UIS$ENABLE_KB to place the display window on the assignment list.
UIS$ELLIPSE

Draws an arc along the circumference of an ellipse.

Format

UIS$ELLIPSE vd_id, atb, center_x, center_y, xradius, yradius [,start_deg ,end_deg]

Returns

UIS$ELLIPSE signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about vd_id argument.

atb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The atb argument is the address of a longword integer that identifies the attribute block that will modify the ellipse. If you specify 0 in the atb argument, the default settings of attribute block 0 are used.

center_x, center_y
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference
Center position x and y world coordinates. The `center_x` and `center_y` arguments are the addresses of `f_floating` point numbers that define a point in the virtual display that is the center of the ellipse or arc.

**xradius**

VMS Usage: `floating_point`  
type: `f_floating`  
access: `read only`  
mechanism: `by reference`

Radius of the ellipse specified as an x world coordinate width. The `xradius` argument is the address of an `f_floating` point number that defines the distance from the center of the ellipse to the circumference of the ellipse or arc.

**yradius**

VMS Usage: `floating_point`  
type: `f_floating`  
access: `read only`  
mechanism: `by reference`

Radius of the ellipse specified as a y world coordinate width. The `yradius` argument is the address of an `f_floating` point number that defines the distance from the center of the ellipse to the circumference of the ellipse or arc.

**start_deg, end_deg**

VMS Usage: `floating_point`  
type: `f_floating`  
access: `read only`  
mechanism: `by reference`

Degree at which the arc starts and ends. The `start_deg` and `end_deg` arguments are the addresses of `f_floating` numbers that define the starting point and ending point in degrees on the circumference of the ellipse where the arc or ellipse will be drawn. Degrees are measured clockwise from the top of the ellipse. If these arguments are not specified, 0.0 and 360.0 degrees are assumed. If both arguments are not specified, a complete ellipse is drawn.

---

**Description**

UIS$ELLIPSE uses center position coordinates and x and y radii to construct an ellipse. Along the circumference of this ellipse, UIS$ELLIPSE draws an arc for a specified range of degrees.
The arc is closed by drawing one or more lines between the endpoints. The type of arc associated with the attribute block specifies the way in which the arc is closed. See the UIS$SET_ARC_TYPE routine.

The points are drawn with the current line pattern and width, and filled with the current fill pattern, if enabled.

UIS$ELLIPSE does not support the following combination of attributes:

- Line width not equal to 1 and line style not equal to $FFFFFFFF_{16}$
- Line width not equal to 1 and complement writing mode

Ellipses are distorted by differences between the aspect ratios of the virtual display and display window.
Screen Output
UIS$ENABLE_DISPLAY_LIST

Reenables automatic additions to the display list.

Format

\texttt{UIS\$ENABLE\_DISPLAY\_LIST \ vd\_id [,display\_flags]}

Returns

UIS$ENABLE_DISPLAY_LIST signals all errors; no condition values are returned.

Arguments

\texttt{vd\_id}

VMS Usage: identifier
type: \texttt{longword (unsigned)}
access: read only
mechanism: by reference

Virtual display identifier. The \texttt{vd\_id} argument is the address of a longword that uniquely identifies the virtual display whose display list is to be enabled. See UIS$CREATE_DISPLAY for more information about the \texttt{vd\_id} argument.

\texttt{display\_flags}

VMS Usage: mask\_longword
type: \texttt{longword (unsigned)}
access: read only
mechanism: by reference

Display list flags. The \texttt{display\_flags} argument is the address of a longword mask that controls display screen and display list updates.

The following table describes the flags and masks.
### UIS Routine Descriptions

#### UIS$ENABLE_DISPLAY_LIST

<table>
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</thead>
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<td>UIS$COPY_OBJECT, UIS$DELETE_OBJECT, UIS$ERASE, UIS$INSERT_OBJECT, UIS$MOVE_AREA, UIS$TRANSFORM_OBJECT</td>
</tr>
<tr>
<td>UIS$M_DL_ENHANCE_LIST¹</td>
<td>UIS$CIRCLE, UIS$ELLIPSE, UIS$EXECUTE, UIS$EXECUTE_DISPLAY, UIS$IMAGE, UIS$LINE, UIS$LINE_ARRAY, UIS$PLOT, UIS$PLOT_ARRAY, UIS$TEXT</td>
</tr>
</tbody>
</table>

¹All routines listed under UIS$M_DL_ENHANCE_LIST and UIS$M_DL_MODIFY_LIST will also check the state of UIS$M_DL_UPDATE_WINDOW before doing any screen updates.

If a bit is set in the mask, the corresponding function is disabled. If the bit is 0, the corresponding function is not changed.

If `display_flags` is not specified, UIS$M_DL_ENHANCE_LIST is disabled.
Example

At some point in your application you may wish to perform several modifications to the display list without seeing the screen change.

```
.
.
.
display_flags= UIS$M_DL_UPDATE_WINDOW
.
.
CALL UIS$DISABLE_DISPLAY_LIST(VD_ID, DISPLAY_FLAGS)
.
.
Insert your modifications here
.
.
CALL UIS$ENABLE_DISPLAY_LIST(VD_ID, DISPLAY_FLAGS)
CALL UIS$EXECUTE(VD_ID)    ! Erases and redraws the virtual display
```


UIS$ENABLE_KB

Connects the physical keyboard to the specified virtual keyboard. See the example in UIS$CREATE_KB for more information.

Format

```
UIS$ENABLE_KB  kb_id [,wd_id]
```

Returns

UIS$ENABLE_KB signals all errors; no condition values are returned.

Arguments

- **kb_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Virtual keyboard identifier. The `kb_id` argument is the address of a longword that uniquely identifies the virtual keyboard to be connected to a physical keyboard. See UIS$CREATE_KB for more information about the `kb_id` argument.

- **wd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies the display window whose KB icon should be highlighted. See UIS$CREATE_WINDOW for more information about the `wd_id` argument.
Because it is desirable to leave control of the keyboard to the user, it is recommended that you use the UIS$ENABLE_KB as little as possible. However, there are times when you may want to use it.

- When you are starting up a new application. In this case, the user may want the workstation keyboard to be implicitly connected to a new application.

- When the physical keyboard is already connected to the application (as determined by the UIS$TEST_KB routine). In this case, the application may wish to facilitate movement of the keyboard between its windows.

Note that these are not restrictions imposed by the workstation software.
**UIS$ENABLE_TB**

Assigns the tablet to the calling process.

**Format**

```plaintext
UIS$ENABLE_TB  tb_id
```

**Returns**

UIS$ENABLE_TB signals all errors; no condition values are returned.

**Argument**

- **tb_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference

Tablet identifier. The `tb_id` argument is the address of a longword that uniquely identifies a tablet device. See UIS$CREATE_TB for more information about the `tb_id` argument.

**Description**

Only one application may own the tablet at one time. When a process connects to the tablet, the system hardware cursor is turned off and the connected process receives all the input from the tablet device. The process owns the tablet until it calls UIS$DISABLE_TB to disconnect itself from the tablet.

The process must use a software cursor to track the pointer in a display window.
UIS$ENABLE_VIEWPORT_KB

Allows the user to assign a virtual keyboard to the physical keyboard and signals binding through the KB icon in the viewport banner. See the example in UIS$CREATE_KB for more information.

Format

UIS$ENABLE_VIEWPORT_KB  kb_id, wd_id

Returns

UIS$ENABLE_VIEWPORT_KB signals all errors; no condition values are returned.

Arguments

**kb_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual keyboard identifier. The kb_id argument is the address of a longword that uniquely identifies the virtual keyboard. See UIS$CREATE_KB for more information about the kb_id argument.

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

Description

UIS$ENABLE_VIEWPORT_KB makes the display window as a KB handle.

The viewport contains a nonhighlighted KB icon.
UIS$END_SEGMENT

Ends a current segment in a virtual display.

Format

UIS$END_SEGMENT  \( vd\_id \)

Returns

UIS$END_SEGMENT signals all errors; no condition values are returned.

Argument

\( vd\_id \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \( vd\_id \) argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the \( vd\_id \) argument.

Description

Context is returned to the parent segment. All values of attribute blocks 0 to 255 are restored to the current values of the parent’s attribute blocks.
UIS$ERASE

Erases the specified rectangle in the virtual display and removes all entities that lie completely within the rectangle from the display list.

Format

UIS$ERASE vd_id [x1, y1, x2, y2]

Returns

UIS$ERASE signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display containing the specified rectangle. See UIS$CREATE.DISPLAY for more information about the vd_id argument.

x1, y1, x2, y2
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

World coordinate pairs. The x1 and y1 arguments are the addresses of f_floating point numbers that define the lower-left corner of the rectangle in the virtual display. The x2 and y2 arguments are the addresses of f_floating point numbers that define the upper-right corner of the rectangle in the virtual display. If no rectangle is specified, the entire virtual display is erased.
Description

UIS$ERASE removes all graphics entities that lie completely within the rectangle from the display list as if they had never been written. Objects that do not lie completely within the specified rectangle are not erased. Empty segments are not deleted.

Areas within the display window affected by this routine are filled with color specified by entry 0 in the color map of the virtual display.
UIS$EXECUTE

Executes a binary encoding stream in a specified virtual display.

Format

UIS$EXECUTE  vd_id [,buflen] [,bufaddr]

Returns

UIS$EXECUTE signals all errors; no condition values are returned.

Arguments

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference

  Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

- **buflen**
  - VMS Usage: longword_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference

  Length of the binary encoding stream. The buflen argument is the address of longword that contains the length of the binary encoding stream.

- **bufaddr**
  - VMS Usage: vector_longword_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: reference

  Binary encoding stream. The bufaddr argument is the address of an array of longwords that comprise the binary encoding stream.
Description

If the buffer is omitted, all display windows are erased and refreshed.

Note the effects of the display list flags.
UIS$EXECUTE_DISPLAY

Creates a virtual display from a display list.

Format

\[ vd\_id=UIS$EXECUTE\_DISPLAY \quad buflen, \quad bufaddr \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by value

Longword value returned as the virtual display identifier in the variable \( vd\_id \) or R0 (VAX MACRO).

UIS$EXECUTE_DISPLAY signals all errors; no condition values are returned.

Arguments

\textbf{buflen}

VMS Usage: longword\_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Buffer length. The \textit{buflen} argument is the address of a longword that defines the length of the buffer.

\textbf{bufaddr}

VMS Usage: vector\_byte\_signed
type: byte integer (signed)
access: read only
mechanism: by reference

Buffer address. The \textit{bufaddr} argument is the address of an array of integer bytes that contains the binary encoded stream.

The binary encoded stream is executed in the virtual display.
Replaces an icon with its associated viewport.

**Format**

```
UIS$EXPAND_ICON  wd_id [,icon_wd_id] [,attributes]
```

**Returns**

UIS$EXPAND_ICON signals all errors; no condition values are returned.

**Arguments**

- **wd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies the display window. See **UIS$CREATE_WINDOW** for more information about the `wd_id` argument.

- **icon_wd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Icon window identifier. The `icon_wd_id` argument is the address of a longword that uniquely identifies the icon window.

  If the `icon_wd_id` argument is specified, it must match the value of the `icon_wd_id` argument specified in **UIS$SHRINK_TO_ICON**.

- **attributes**
  - VMS Usage: item_list_pair
  - type: longword integer (signed) or f_floating
  - access: read only
  - mechanism: by reference
  
  Viewport attributes list. The `attributes` argument is the address of data structure such as an array or record. The `attributes` can be used to specify exact placement of the display viewport.
See the **attributes** argument in UIS$CREATE_WINDOW for more information.
Screen Output
UIS$EXTRACT_HEADER

Returns the header information needed to create a UIS metafile.

**Format**

UIS$EXTRACT_HEADER vd_id, [buflen, bufaddr] [,retlen]

**Returns**

UIS$EXTRACT_HEADER signals all errors; no condition values are returned.

**Arguments**

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

- **buflen**
  - VMS Usage: longword_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Buffer length. The buflen argument is the address of a longword that defines the length of the buffer.

- **bufaddr**
  - VMS Usage: vector_byte_signed
  - type: byte integer (signed)
  - access: read only
  - mechanism: by reference
  
  Buffer address. The bufaddr argument is the address of an array of bytes that receives the binary encoding stream.
retlen
VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Return length. The retlen argument is the address of a longword that receives the length of the buffer.

Description

Header information must be at the beginning of all UIS metafiles.

Allocating Space for the Buffer

If you want to know how much space to allocate for the buffer, specify obj_id and retlen only.

Format of Header Information

The format of header binary instructions is as follows:

<table>
<thead>
<tr>
<th>Op code</th>
<th>Length</th>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>16 bits</td>
<td></td>
</tr>
</tbody>
</table>

If the length field exceeds 32,767 bytes, an extended format is used. The length field should be set to UIS$C_LENGTH_DIFF and the extra length field should be set to the total number of bytes in the binary instruction.

<table>
<thead>
<tr>
<th>Op code</th>
<th>Length</th>
<th>Extra Length</th>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>16 bits</td>
<td>32 bits</td>
<td></td>
</tr>
</tbody>
</table>
UIS$EXTRACTOBJECT

Returns the binary encoding stream for the desired object (segment or primitive).

Format

```
UIS$EXTRACTOBJECT { obj_id 
seg_id } [, buflen , bufaddr ] 
[, retlen ]
```

Returns

UIS$EXTRACTOBJECT signals all errors; no condition values are returned.

Arguments

**obj_id**

- VMS Usage: identifier
- type: longword (unsigned)
- access: read only
- mechanism: by reference

Object identifier. The obj_id argument is the address of a longword that uniquely identifies the object.

**seg_id**

- VMS Usage: identifier
- type: longword (unsigned)
- access: read only
- mechanism: by reference

Segment identifier. The seg_id argument is the address of a longword that uniquely identifies the segment. See UIS$BEGINSEGMENT for more information about the seg_id argument.

**buflen**

- VMS Usage: longword unsigned
- type: longword (unsigned)
- access: read only
- mechanism: by reference

Length of buffer. The buflen argument is the address of a longword that specifies the length of the buffer that receives the binary encoding stream.
**UIS Routine Descriptions**

**UIS$EXTRACT_OBJECT**

---

**bufaddr**

VMS Usage: vector_byte_unsigned  
Type: byte (unsigned)  
Access: read only  
Mechanism: by reference

Name of an array. The `bufaddr` argument is the address of an array of bytes that receives the binary encoding stream.

**retnlen**

VMS Usage: longword_unsigned  
Type: longword (unsigned)  
Access: write only  
Mechanism: by reference

Length of the binary encoding stream. The `retnlen` argument is the address of a longword that receives the length of the binary encoding stream.

---

**Description**

If you want to know how much space to allocate for the buffer, specify `obj_id` and `retnlen` only.

If the extracted object lies within a segment, a binary instruction denoting the beginning of the segment precedes all binary instructions associated with the extracted object. A binary instruction denoting the end of the segment follows the binary instructions associated with the extracted object.
UIS$EXTRACT_PRIVATE

Returns the binary data associated with the specified object.

Format

\[
\text{UIS$EXTRACT_PRIVATE} \{ \text{obj\_id} \, \text{seg\_id} \} [\text{buflen} \, \text{bufaddr}] [\text{retlen}]
\]

Returns

UIS$EXTRACT_PRIVATE signals all errors; no condition values are returned.

Arguments

- **obj\_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Object identifier. The \text{obj\_id} argument is the address of a longword that uniquely identifies an object.

- **seg\_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Segment identifier. The \text{seg\_id} argument is the address of a longword that uniquely identifies the segment. See UIS$BEGIN\_SEGMENT for more information about the \text{seg\_id} argument.

- **buflen**
  - VMS Usage: longword unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Length of the buffer. The \text{buflen} argument is the address of a longword that contains the length of the buffer that receives the binary encoding stream.
**UIS Routine Descriptions**

**UIS$EXTRACT_PRIVATE**

**bufaddr**

VMS Usage: `vector_byte_unsigned`  
Type: `byte (unsigned)`  
Access: `read only`  
Mechanism: `by reference`

Buffer address. The `bufaddr` argument is the address of an array of bytes that receives the binary encoding stream.

**retlen**

VMS Usage: `longword_unsigned`  
Type: `longword (unsigned)`  
Access: `write only`  
Mechanism: `by reference`

Length of the binary encoding stream. The `retlen` is the address of longword that receives the length of the binary encoding stream.

---

**Description**

If more than one private data item is associated with the specified object, all private data items are returned. The following figure describes the format of the data. If you want to know how much space to allocate for the returned encoding, specify the `obj_id` and `retlen` arguments only.

**Format of a Private Data Binary Instruction**

The format of binary encoding returned is as follows:

<table>
<thead>
<tr>
<th>Op code</th>
<th>Length</th>
<th>ATB</th>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>16 bits</td>
<td>16 bits</td>
<td></td>
</tr>
</tbody>
</table>

If the length field exceeds 32,767 bytes, an extended format is used. The length field should be set to `UIS$C_LENGTH_DIFF` and the extra length field should be set to the total number of bytes in the binary instruction.
Attribute modification instructions precede the binary instruction of the extracted object. The binary instructions of any private data associated with the extracted object follow the binary instruction of the extracted object.
UIS$EXTRACT_REGION

Locates all output primitives and portions of output primitives that lie entirely within the specified rectangle, and returns the binary encoding stream for the selected display.

Format

**UIS$EXTRACT_REGION**  
`vd_id [,x1,y1, x2,y2] [,buflen ,bufaddr] [,retlen]`

Returns

UIS$EXTRACT_REGION signals all errors; no condition values are returned.

Arguments

**vd_id**

VMS Usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

**x1,y1,x2,y2**

VMS Usage: floating_point  
type: f_floating  
access: read only  
mechanism: by reference

World coordinates of the specified rectangle. The x1,y1 and x2,y2 arguments are the addresses of f_floating point numbers that define the lower-left and upper-right corners of the specified rectangle.

If you specify a region within the virtual display, UIS$EXTRACT_REGION returns the entire display list except for the following:

- Objects that do not lie completely within the specified region
- Segments that do not contain any objects that fall completely within the specified region
If these arguments are not specified, the coordinates of the entire virtual display are used.

**buflen**

VMS Usage:  **longword** _unsigned_

type:  **longword** *(unsigned)*

access:  **read only**

mechanism:  **by reference**

Length of a buffer. The **buflen** is the address of a longword that contains the length of the buffer that receives the binary encoding stream.

**bufaddr**

VMS Usage:  **vector** _byte_ _unsigned_

type:  **byte** _unsigned_

access:  **read only**

mechanism:  **by reference**

Buffer address. The **bufaddr** argument is the address of an array of bytes that receives the binary encoding stream.

**relen**

VMS Usage:  **longword** _unsigned_

type:  **longword** *(unsigned)*

access:  **write only**

mechanism:  **by reference**

Length of the binary encoding stream. The **relen** argument is the address of a longword that receives the length of the binary encoding stream.

---

**Description**

If you want to know how much space to allocate for the returned encoding, do not specify the **buflen** and **bufaddr** arguments.

**Format of Binary Instructions**

The format of binary instructions is as follows:

<table>
<thead>
<tr>
<th>Op code 16 bits</th>
<th>Length 16 bits</th>
<th>Arguments</th>
</tr>
</thead>
</table>

ZK-5472-86
If the length field exceeds 32,767 bytes, an extended format is used. The length field should be set to `UIS$C_LENGTH_DIFF` and the extra length field should be set to the total number of bytes in the binary instruction.

<table>
<thead>
<tr>
<th>Op code</th>
<th>Length</th>
<th>Extra Length</th>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>16 bits</td>
<td>32 bits</td>
<td></td>
</tr>
</tbody>
</table>

ZK 5473 86
UIS$EXTRACT_TRAILER

Returns trailer information needed to create a UIS metafile.

Format

UIS$EXTRACT_TRAILER  vd_id [,buflen, bufaddr] [,retlen]

Returns

UIS$EXTRACT_TRAILER signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

buflen
VMS Usage:  longword_unsigned
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Buffer length. The buflen argument is the address of a longword that defines the length of the buffer.

bufaddr
VMS Usage:  vector_byte_signed
type:  byte integer (signed)
access:  read only
mechanism:  by reference

Buffer address. The bufaddr argument is the address of an array of bytes that receive the binary encoded stream.
retlen
VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Return length. The retlen argument is the address of a longword that defines the returned length of the buffer.

Description
Trailer information must appear at the end of all UIS metafiles.

Allocating Space for the Buffer
If you want to know how much space to allocate for the buffer, specify obj_id and retlen only.

Format of Trailer Information
The format of trailer binary instructions is as follows:

<table>
<thead>
<tr>
<th>Op code</th>
<th>Length</th>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>16 bits</td>
<td></td>
</tr>
</tbody>
</table>

If the length field exceeds 32,767 bytes, an extended format is used. The length field should be set to UIS$C_LENGTH_DIFF and the extra length field should be set to the total number of bytes in the binary instruction.

<table>
<thead>
<tr>
<th>Op code</th>
<th>Length</th>
<th>Extra Length</th>
<th>Arguments</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 bits</td>
<td>16 bits</td>
<td>32 bits</td>
<td></td>
</tr>
</tbody>
</table>
UIS$FIND_PRIMITIVE

Locates the next output primitive that intersects the specified rectangle.

Format

\[
\text{obj\_id=UIS$FIND\_PRIMITIVE \ vd\_id, } x_1, y_1, x_2, y_2 [,context] [,extent]
\]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the object identifier in the variable \text{obj\_id} or R0 (VAX MACRO). The object identifier uniquely identifies the object and is used as an argument in other routines.

UIS$FIND\_PRIMITIVE signals all errors; no condition values are returned.

Arguments

\text{vd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \text{vd\_id} argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{vd\_id} argument.

\[x_1, y_1, x_2, y_2\]

VMS Usage: floating_point
type: \text{f\_floating}
access: read only
mechanism: by reference

World coordinates of the selection rectangle. The \(x_1, y_1\) and \(x_2, y_2\) are the addresses of \text{f\_floating} points numbers that define the lower-left and upper-right corners of the rectangle.
UIS Routine Descriptions

UIS$FIND_PRIMITIVE

**context**
VMS Usage: **context**
type: **longword (unsigned)**
access: **modify**
mechanism: **by reference**

Context value. The *context* argument is the address of a longword that stores the state of the search and should not be modified if repetitive searches are desired. If this argument is omitted, only the first match can be found in the display list.

You must initialize the *context* argument to 0 before starting a search operation.

**extent**
VMS Usage: **vector_longword_unsigned**
type: **longword (unsigned)**
access: **write only**
mechanism: **by reference**

Address of the extent rectangle array. The *extent* argument is an array of four longwords that receives the world coordinate values of the lower-left and upper-right corner of the extent rectangle.

---

**Description**

When you try to locate the specified object closest to the specified location, the size of the rectangle controls the object or primitive matching granularity. Normally, when you search for the primitive nearest a position, the rectangle would surround the position, and have a small width and height (perhaps equivalent to 1 to 10 pixels), depending on the desired granularity.

Once the primitive is located, it returns an object identifier which can be used later to reference the primitive, for example, UIS$EXTRACT_OBJECT or UIS$DELETE_OBJECT.

Each time UIS$FIND_PRIMITIVE is called, it continues the search operation from where it left off, using the context longword to keep track of the current state.

Generally, in order to find all matches, UIS$FIND_PRIMITIVE is called repeatedly with the same context longword until it returns a value of 0.
UIS$FIND_SEGMENT

Locates the next segment that contains any objects or primitives that intersect with the specified rectangle.

Format

\[
\text{seg\_id=} \text{UIS$FIND\_SEGMENT} \quad \text{vd\_id}, \ x_1, \ y_1, \ x_2, \ y_2 [, \text{context}] \\
[ , \text{extent}] 
\]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the segment identifier in the variable \text{seg\_id} or R0 (VAX MACRO). The segment identifier uniquely identifies the segment and is used as an argument in other routines.

UIS$FIND\_SEGMENT signals all errors; no condition values are returned.

Arguments

\text{vd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \text{vd\_id} argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{vd\_id} argument.

\(x_1, y_1, x_2, y_2\)

VMS Usage: floating_point
type: f\_floating
access: read only
mechanism: by reference

World coordinates of the selection rectangle. The \(x_1, y_1\) and \(x_2, y_2\) arguments are the addresses of f\_floating point numbers that define the lower-left and upper-right corners of the rectangle.
UIS$FIND_SEGMENT

**context**

VMS Usage: `context`

*type:* longword (unsigned)

*access:* modify

*mechanism:* by reference

Context value. The `context` argument is the address of a longword that stores the state of the search and should not be modified if repetitive searches are desired. If this argument is omitted, only the first match can be found in the display list.

You must initialize the `context` argument to 0 before starting a search operation.

**extent**

VMS Usage: `vector_longword_unsigned`

*type:* longword (unsigned)

*access:* write only

*mechanism:* by reference

Address of the extent rectangle array. The `extent` argument is the address of an array of four longwords that receives the world coordinate pairs that define the lower-left and upper-right corners of the extent rectangle containing the segment.

**Description**

The size of the rectangle controls the matching granularity when trying to locate the primitive closest to a specific position. Normally, when searching for the primitive nearest a position, the rectangle would surround the position, and have a small width and height (perhaps equivalent to 1 to 10 pixels), depending on the desired granularity.

Once the object is located, UIS$FIND_SEGMENT returns the object identifier for the segment containing that object.

Each time this routine is called, it continues the search operation from where it left off, using the context longword to keep track of the search state.

Generally, in order to find all matches, UIS$FIND_SEGMENT is called repeatedly with the same context longword until it returns a value of 0.
UIS$GET_ABS_POINTER_POS

Returns the current pointer position relative to the lower-left corner of the workstation screen.

Format

UIS$GET_ABS_POINTER_POS devnam, retx, rety

Returns

UIS$GET_ABS_POINTER_POS signals all errors; no condition values are returned.

Arguments

devnam
VMS Usage: device_name
type: character string
access: read only
mechanism: by descriptor

Device name string. The devnam argument is the address of a character string descriptor of the workstation device name. Specify the logical name SYS$WORKSTATION as the device name string.

retx, rety
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Absolute device coordinate pair. The retx and rety arguments are the addresses of f_floating point longwords that receive the x and y coordinate positions of the pointer in centimeters relative to the lower-left corner of the display screen.
UIS$GET_ALIGNED_POSITION

Returns the current position for text output which is the upper-left corner of the character cell.

Format

UIS$GET_ALIGNED_POSITION vd_id, atb, retx, rety

Returns

UIS$GET_ALIGNED_POSITION signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block. The atb argument is the address of a longword integer that identifies an attribute block that contains the font to use in calculating the aligned position.

retx, rety
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference
World coordinate pair. The \texttt{retx} and \texttt{rety} arguments are the addresses of floating point longwords that receive the current position as \textit{x} and \textit{y} world coordinate positions.

\section*{Description}

\texttt{UIS\$GET\_ALIGNED\_POSITION} differs from \texttt{UIS\$GET\_POSITION} in that the current position refers to the upper-left corner of the character cell of the next character to be output. This is useful for applications that require the position of the upper-left corner, but do not know enough about the font baseline to determine the proper alignment point. The position is converted into the proper alignment point using the font specified in the given attribute block. See \texttt{UIS\$SET\_ALIGNED\_POSITION}.

\section*{Screen Output}

```
$ run get_aligned
x world coordinate = 18.19  y world coordinate = 5.02
FORTRAN PAUSE
$ 
```

Iron with use grows bright
UIS$GET_ARC_TYPE

Returns the current arc type attribute code. See UIS$SET_ARC_TYPE for more information about arc types.

Format

\[
\text{arc_type} = \text{UIS$GET\_ARC\_TYPE} \quad \text{v}d\_\text{id}, \ atb
\]

Returns

VMS Usage: longword_unsigned
  type: longword (unsigned)
  access: write only
  mechanism: by value

Longword value returned as the current arc type code in the variable \text{arc_type}. The arc type code is an integer value representing one of the following UIS constants: UIS$C\_ARC\_OPEN, UIS$C\_ARC\_PIE, and UIS$C\_ARC\_CHORD. See UIS$SET\_ARC\_TYPE for a description of the constants.

UIS$GET\_ARC\_TYPE signals all errors; no condition values are returned.

Arguments

\text{v}d\_\text{id}

VMS Usage: identifier
  type: longword (unsigned)
  access: read only
  mechanism: by reference

Virtual display identifier. The \text{v}d\_\text{id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{v}d\_\text{id} argument.

\text{atb}

VMS Usage: longword_unsigned
  type: longword (unsigned)
  access: read only
  mechanism: by reference

Attribute block identifier. The \text{atb} argument is the address of a longword integer that identifies the attribute block from which the arc type is obtained.
UIS Routine Descriptions

UIS$GET_ARC_TYPE

Description

Refer to Section 6.6 for more information about UIS symbols and symbol definition files.
UIS$GETBACKGROUND_INDEX

Returns the background color index for text and graphics output.

Format

\[
\text{index=UIS$GETBACKGROUND_INDEX} \quad \text{vd\_id, atb}
\]

Returns

VMS Usage: longword\_unsigned  
Type: longword (unsigned)  
Access: write only  
Mechanism: by value

Longword value returned as the color map index in the variable index or R0 (VAX MACRO).

UIS$GETBACKGROUND_INDEX signals all errors; no condition values are returned.

Arguments

\textbf{vd\_id}

VMS Usage: identifier  
Type: longword (unsigned)  
Access: read only  
Mechanism: by reference

Virtual display identifier. The vd\_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the vd\_id argument.

\textbf{atb}

VMS Usage: longword\_unsigned  
Type: longword (unsigned)  
Access: read only  
Mechanism: by reference

Attribute block number. The atb argument is the address of a longword integer that identifies the attribute block from which the background color index is obtained.
UIS$GET_BUTTONS

Returns the current state of the pointer buttons.

Format

\[ \text{status} = \text{UIS$GET\_BUTTONS} \quad \text{wd\_id, retstate} \]

Returns

VMS Usage: boolean
type: longword (unsigned)
access: write only
mechanism: by value

Boolean value is returned in the variable status or R0 (VAX MACRO). A value of 1 is returned, if the pointer is within the visible portion of the viewport. If the pointer is outside the visible portion of the viewport, a value of 0 is returned.

UIS$GET_BUTTONS signals all errors; no condition values are returned.

Arguments

\textbf{wd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \texttt{wd\_id} argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the \texttt{wd\_id} argument.

\textbf{retstate}

VMS Usage: mask_longword
type: longword (unsigned)
access: write only
mechanism: by reference

State of the pointer buttons. The \texttt{retstate} argument is the address of a longword that receives the current state of the pointer buttons. The state of pointer buttons is returned in a longword whose bits indicate the state of each pointer button, for example, 1 is up and 0 is down. The symbolic definitions for these bits are UIS$M\_POINTER\_BUTTON\_1, and UIS$M\_...
Description

The returned status value should always be tested when using this function, because it is always possible that the pointer could be outside the window when the function is called.
UIS$GET_CHAR_ROTATION

Returns the angle of character rotation in degrees.

Format

\[
angle = \text{UIS$GET\_CHAR\_ROTATION} \ v_d\_id, \ atb
\]

Returns

VMS Usage: floating_point

Type: f_float

Access: write only

Mechanism: by value

Longword value returned as the angle of character rotation in degrees in the variable \(angle\) or R0 (VAX MACRO). The baseline vector and the actual path of text drawing form the angle of character rotation. The character rotates on its baseline point.

UIS$GET\_CHAR\_ROTATION signals all errors; no condition values are returned.

Arguments

\(vd\_id\)

VMS Usage: longword_unsigned

Type: longword (unsigned)

Access: read only

Mechanism: by reference

Virtual display identifier. The \(vd\_id\) argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY for more information about the \(vd\_id\) argument.

\(atb\)

VMS Usage: longword_unsigned

Type: longword (unsigned)

Access: read only

Mechanism: by reference

Attribute block number. The \(atb\) argument is the address of a number that identifies an attribute block containing the character rotation attribute used to calculate character rotation.
UIS$GET_CHAR_SIZE

Returns both a value indicating whether or not character scaling is enabled and the character size used.

Format

boolean=UIS$GET_CHAR_SIZE vd_id, atb [char],[width][,height]

Returns

VMS Usage: boolean
type: longword (unsigned)
access: write only
mechanism: by value

Boolean value returned to indicate the status of character scaling in a status variable or R0 (VAX MACRO).

UIS$GET_CHAR_SIZE signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The atb argument is the address of a longword that identifies an attribute block that contains the character size attribute setting.
char
VMS Usage: char_string
Type: character_string
Access: write only
Mechanism: by descriptor

Single character. The char argument is the address of a character string descriptor of a single char. The char is specified only for proportionally spaced fonts. It is used as a reference point against which other characters are scaled.

width
VMS Usage: floating_point
Type: f_floating
Access: write only
Mechanism: by reference

Character width. The width argument is the address of an f_floating point longword that receives the character width in world coordinates.

height
VMS Usage: floating_point
Type: f_floating
Access: write only
Mechanism: by reference

Character height. The height argument is the address of an f_floating point longword that receives the character height in world coordinates.
UIS$GET_CHAR_SLANT

Returns the angle of character slant in degrees.

Format

\[
angle = \text{UIS$GET\_CHAR\_SLANT} \ v_d\_id, \ atb
\]

Returns

VMS Usage: \text{floating\_point}

type: \text{f\_floating}

access: \text{write only}

mechanism: \text{by value}

Longword value returned as the angle of character slant in degrees in the variable \text{angle} or R0 (VAX MACRO). The character cell up vector and the baseline vector form the angle of character slant.

UIS$GET\_CHAR\_SLANT$ signals all errors; no condition values are returned.

Arguments

\text{vd\_id}

VMS Usage: \text{identifier}

type: \text{longword (unsigned)}

access: \text{read only}

mechanism: \text{by reference}

Virtual display identifier. The \text{vd\_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY$ for more information about the \text{vd\_id} argument.

\text{atb}

VMS Usage: \text{longword\_unsigned}

type: \text{longword (unsigned)}

access: \text{read only}

mechanism: \text{by reference}

Attribute block number. The \text{atb} argument is the address of a number that identifies an attribute block containing the character slant attribute setting to be returned.
Screen Output

```
$ run get_charslant
The angle of character slant is 35.00 degrees
FORTRAN PAUSE
$
```

A life of leisure
UIS$GET_CHAR_SPACING

Returns the character spacing factors.

Format

UIS$GET_CHAR_SPACING  vd_id, atb, dx, dy

Returns

UIS$GET_CHAR_SPACING signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage:  longword_unsigned
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Attribute block number. The atb argument is the address of a longword integer that identifies the attribute block from which the character spacing factors are obtained.

dx
VMS Usage:  floating_point
type:  f_floating
access:  write only
mechanism:  by reference

Additional x spacing factor. The dx argument is the address of an f_floating point longword that receives the x spacing factor. The x spacing factor
represents the relative width of the character cell. If 0 is returned, no additional spacing factor was specified.

*dy*

**VMS Usage:** floating_point  
**Type:** f_floating  
**Access:** write only  
**Mechanism:** by reference

Additional y spacing factor. The *dy* argument is the address of an f_floating point longword that receives the y spacing factor. The y spacing factor represents the relative height of the character cell. If 0 is returned, no additional spacing factor was specified.

---

**Screen Output**

```
$ run get_charspace
x spacing factor = 0.00  y spacing factor = 0.00
x spacing factor = 3.00  y spacing factor = 5.00
x spacing factor = 0.00  y spacing factor = 0.00
x spacing factor = 4.00  y spacing factor = 6.00
FORTRAN PAUSE
```

---

Great wits have short memories
G r e a t   w i t s

Never spur a willing horse
N e v e r s p
UIS$GET_CLIP

Returns the clipping mode.

Format

\texttt{status=UIS$GET\_CLIP \ vd\_id,\ atb, [x_1, y_1, x_2, y_2]}

Returns

VMS Usage: \texttt{boolean}
type: \texttt{longword}
access: \texttt{write only}
mechanism: \texttt{by value}

Boolean value returned as the clipping mode in a status variable or R0 (VAX MACRO). If clipping is enabled, a boolean TRUE is returned. If clipping is disabled, a boolean FALSE is returned.

UIS$GET\_CLIP$ signals all errors; no condition values are returned.

Arguments

\texttt{vd\_id}

VMS Usage: \texttt{identifier}
type: \texttt{longword (unsigned)}
access: \texttt{read only}
mechanism: \texttt{by reference}

Virtual display identifier. The \texttt{vd\_id} argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY$ for more information about the \texttt{vd\_id} argument.

\texttt{atb}

VMS Usage: \texttt{longword\_unsigned}
type: \texttt{longword (unsigned)}
access: \texttt{read only}
mechanism: \texttt{by reference}

Attribute block number. The \texttt{atb} argument is the address of a longword integer that identifies the attribute block from which the clipping rectangle and mode are obtained.
\( x_1, y_1, x_2, y_2 \)

VMS Usage: `floating_point`

Type: `f_floating`

Access: `write only`

Mechanism: `by reference`

World coordinate pair. The \( x_1 \) and \( y_1 \) arguments are addresses of \( f \)-floating point longwords that receive the coordinates of the lower-left corner of the world coordinate clipping rectangle. The \( x_2 \) and \( y_2 \) arguments are the addresses of \( f \)-floating point longwords that receive the coordinates of the upper-right corner of the world coordinate clipping rectangle.
Screen Output

```plaintext
$ run get_clip
Is clipping enabled? F = FALSE T = TRUE
F
FORTRAN PAUSE
```

```
$ cont
Is clipping enabled? F = FALSE T = TRUE
T
FORTRAN PAUSE
```
UIS$GET_COLOR

Returns a single red green blue (RGB) color value associated with an entry in a virtual color map.

Format

UIS$GET_COLOR  vd_id, index, retr, retg, retb [,wd_id]

Returns

UIS$GET_COLOR signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

index
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual color map index. The index argument is the address of a longword that specifies the index of the virtual color map entry to be returned.

retr
VMS Usage: floating_point
type: f_float
type: read only
mechanism: by reference

Red value. The retr argument is the address of an f_float longword that receives the red value. The red value is in the range of 0.0 to 1.0, inclusive.
UIS$GET_COLOR

**reng**
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Green value. The reng argument is the address of an f_floating point longword that receives the green value. The green value is in the range of 0.0 to 1.0, inclusive.

**retb**
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Blue value. The retb argument is the address of an f_floating point longword that receives the blue value. The blue value is in the range of 0.0 to 1.0, inclusive.

**wd_id**
VMS Usage: object_id
type: longword
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. If this argument is specified, it must be a valid wd_id associated with the virtual display. The colors returned are the realized colors for the specific device for which the window was created. See UIS$CREATE_WINDOW for more information about the wd_id argument.

If wd_id is not specified, the set color values, that is, the actual color values in the specified color map entry are returned.
Illustration

- Color Map Index
- Virtual Color Map

<table>
<thead>
<tr>
<th>Color Value</th>
<th>8</th>
<th>0.10 Red Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color Value</td>
<td>9</td>
<td>0.20 Green Value</td>
</tr>
<tr>
<td>Color Value</td>
<td>10</td>
<td>0.30 Blue Value</td>
</tr>
<tr>
<td>Color Value</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
UIS$GET_COLORS

Returns red, green, and blue (RGB) color values associated with one or more entries in the virtual color map.

Format

UIS$GET_COLORS vd_id, index, count, retr_vector, retg_vector, retb_vector [,wd_id]

Returns

UIS$GET_COLORS signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

index
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Starting color map index. The index argument is the address of a longword that specifies the index of the first color map entry to be returned.

If the specified index exceeds the maximum index for the virtual color map, an error is signaled.

count
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference
Number of virtual color map indices. The count argument is the address of a longword that defines the total number of color map entries in the virtual color map to be returned including the starting index.

If the total number of indices exceeds the maximum number of indices in the virtual color, an error is signaled.

**retr_vector**

VMS Usage: vector_longword_signed  
type: f_floating  
access: write only  
mechanism: by reference

Red values. The retr_vector argument is the address of an array of f_floating point longwords that receives the red color values. Each red value is in the range of 0.0 to 1.0, inclusive.

**refg_vector**

VMS Usage: vector_longword_signed  
type: f_floating  
access: write only  
mechanism: by reference

Green values. The reftg_vector argument is the address of an array of f_floating point longwords that receives the green color values. Each green value is in the range of 0.0 to 1.0, inclusive.

**reth_vector**

VMS Usage: vector_longword_signed  
type: f_floating  
access: write only  
mechanism: by reference

Blue values. The retb_vector argument is the address of an array of f_floating point longwords that receives the blue color values. Each blue value is in the range of 0.0 to 1.0, inclusive.

**wd_id**

VMS Usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. If specified, the wd_id argument must be a valid display window identifier associated with the virtual display. See UIS$CREATE_WINDOW for more information about the wd_id argument.
The color values returned are the realized color values for the specific device for which the display window was created.

If the `wd_id` argument is not specified, the red, green, and blue color values returned are the set color values originally established by `UIS$SET_COLOR` or `UIS$SET_COLORS`.

### Illustration

<table>
<thead>
<tr>
<th>Color Map Index</th>
<th>Red Value</th>
<th>Green Value</th>
<th>Blue Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Red Value</td>
<td>Green Value</td>
<td>Blue Value</td>
</tr>
<tr>
<td>5</td>
<td>Red Value</td>
<td>Green Value</td>
<td>Blue Value</td>
</tr>
<tr>
<td>6</td>
<td>Red Value</td>
<td>Green Value</td>
<td>Blue Value</td>
</tr>
<tr>
<td>7</td>
<td>Red Value</td>
<td>Green Value</td>
<td>Blue Value</td>
</tr>
<tr>
<td>8</td>
<td>Red Value</td>
<td>Green Value</td>
<td>Blue Value</td>
</tr>
<tr>
<td>9</td>
<td>Red Value</td>
<td>Green Value</td>
<td>Blue Value</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Red Value</th>
<th>Green Value</th>
<th>Blue Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.10</td>
<td>0.20</td>
<td>0.30</td>
</tr>
<tr>
<td>0.40</td>
<td>0.50</td>
<td>0.60</td>
</tr>
<tr>
<td>0.70</td>
<td>0.80</td>
<td>0.90</td>
</tr>
</tbody>
</table>
UIS$GET_CURRENT_OBJECT

Returns the identifier of the last object drawn in the virtual display and added to the display list.

Format

\[ \text{current}_\text{id}=\text{UIS$GET\_CURRENT\_OBJECT} \quad \text{vd}_\text{id} \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the identifier of the current object in the variable \text{current}_\text{id} or R0 (VAX MACRO).

UIS$GET\_CURRENT\_OBJECT signals all errors; no condition values are returned.

Argument

\text{vd}_\text{id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \text{vd}_\text{id} argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{vd}_\text{id} argument.

Description

If there are no objects in the display list, the root segment identifier is returned. If UIS$GET\_CURRENT\_OBJECT is called after a call to UIS$SET\_INSERTION\_POSITION, the returned identifier is based on the current insertion position in the segment.
Screen Output

```bash
$ run get_currobj
Identifier of current object = 114752
FORTRAN PAUSE
$
```

![Screen Output](image-url)
UIS$GET_DISPLAY_SIZE

Obtains the dimensions of the workstation display screen.

**Format**

```
UIS$GET_DISPLAY_SIZE devnam, retwidth, retheight
[,retresolx, retresoly] [,retppwidth, retppheight]
```

**Returns**

UIS$GET_DISPLAY_SIZE signals all errors; no condition values are returned.

**Arguments**

- **devnam**
  - VMS Usage: `device_name`
  - type: `character string`
  - access: `read only`
  - mechanism: `by descriptor`

  Device name string. The `devnam` argument is the address of a character string descriptor of the workstation device name. Specify SYS$WORKSTATION as the device name character string.

- **retwidth, retheight**
  - VMS Usage: `floating_point`
  - type: `f_floating`
  - access: `write only`
  - mechanism: `by reference`

  VAXstation display screen size. The `retwidth` and `retheight` arguments are the addresses of `f_floating` point longwords that receive the physical display screen width and height in centimeters.

- **retresolx, retresoly**
  - VMS Usage: `floating_point`
  - type: `f_floating`
  - access: `write only`
  - mechanism: `by reference`

  The `retresolx` and `retresoly` arguments are the addresses of `f_floating` point longwords that receive the resolution of the display screen in centimeters.
VAXstation display screen resolution. The retresolx and retresoly arguments are the addresses of floating point longwords that receive the x and y resolution in pixels per centimeters.

_retpwidth, retpheight_

VMS Usage: longword unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

VAXstation screen size in pixels. The retpwidth and retpheight arguments are the addresses of integer longwords that receive the width and height of the screen in pixels.

Description

The height and width dimensions can be used when deciding the size of a virtual display or viewport. The resolution values can be used when it is important for the application to determine the exact physical size (or world coordinate dimensions) that map to a single pixel.
Screen Output

```
$ run get_display
Display screen characteristics
width = 33.58 cm  height = 28.34 cm
x resolution = 30.49 pixels/cm
y resolution = 30.49 pixels/cm
width = 1024 pixels  height = 864 pixels
FORTRAN PAUSE
$
```
UIS Routine Descriptions

UIS$GET_FILL_PATTERN

Returns the index of the fill pattern.

Format

status=UIS$GET_FILL_PATTERN vd_id, atb [,index]

Returns

VMS Usage: boolean
type: longword
access: write only
mechanism: by value

Boolean value returned as the filling mode in a status variable or R0 (VAX MACRO). The boolean TRUE is returned if filling is enabled, otherwise the boolean value is FALSE.

UIS$GET_FILL_PATTERN signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The atb argument is the address of a longword integer that identifies the attribute block from which the fill pattern index is obtained.
index

VMS Usage: longword_unsigned

type: longword (unsigned)

access: write only

mechanism: by reference

Index of the fill pattern. The index argument is the address of a longword that receives the value of the fill pattern symbol index. This is the index of a glyph in a fill pattern font.
Screen Output

```
$ run get_fill
Are fill patterns enabled? F = FALSE T = TRUE
T
What is the index of the current fill pattern?
7
FORTRAN PAUSE
$
```
UIS$GET_FONT

Returns the name of font file.

**Format**

```
UIS$GET_FONT  vd_id, atb, bufferdesc [,length]
```

**Returns**

UIS$GET_FONT signals all errors; no condition values are returned.

**Arguments**

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

- **atb**
  - VMS Usage: longword_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Attribute block number. The `atb` argument is the address of a longword integer that identifies the attribute block from which the font file name is obtained.

- **bufferdesc**
  - VMS Usage: char_string
  - type: character string
  - access: write only
  - mechanism: by descriptor
  
  Font file name string. The `bufferdesc` argument is the address of a character string descriptor of a location that receives the font file name character string.
**UIS Routine Descriptions**

**UIS$GET_FONT**

---

**length**

VMS Usage: *word_signed*

Type: *word (signed)*

Access: *write only*

Mechanism: *by reference*

Length of the font file character string. The `length` argument is the address of a word that receives the length of font file name character string.

---

**Screen Output**

```
$ run get_fontname
font name is DTABEROR07SK00GG0001UZZZZ02A000
length of font name is 31 characters
FORTRAN PAUSE
```

---

The more the merrier
UIS$GET_FONT_ATTRIBUTES

Returns information about the ascender, descender, height, width, and font parameters.

Format

UIS$GET_FONT_ATTRIBUTES  font_id, ascender, descender, height [,maximum_width] [item_list]

Returns

UIS$GET_FONT_ATTRIBUTES signals all errors; no condition values are returned.

Arguments

font_id
VMS Usage:  char_string
  type: character string
  access: read only
  mechanism: by descriptor

Font file name. The font_id argument is the address of a string descriptor of the font file name only. UIS searches the directory SYS$FONT for the correct file type.

ascender
VMS Usage:  longword_unsigned
  type: longword (unsigned)
  access: write only
  mechanism: by reference

Character ascender. The ascender argument is the address of a longword that receives the distance between the font baseline and the top of the character cell in pixels.

descender
VMS Usage:  longword_unsigned
  type: longword (unsigned)
  access: write only
  mechanism: by reference

Character descender. The descender argument is the address of a longword that receives the distance between the font baseline and the bottom of the character cell in pixels.
Character descender. The descender argument is the address of a longword that receives the distance between the font baseline and the bottom of the character cell in pixels.

**height**

VMS Usage: `longword_unsigned`  
**type:** `longword (unsigned)`  
**access:** `write only`  
**mechanism:** `by reference`

Height of the character cell. The `height` argument is the address of a longword that receives the height of the character cell in pixels.

**maximum_width**

VMS Usage: `longword_unsigned`  
**type:** `longword (unsigned)`  
**access:** `write only`  
**mechanism:** `by reference`

Maximum width of a character cell. The `average_width` argument is the address of a longword that receives the maximum width of a character cell in the font in pixels.

**item_list**

VMS Usage: `item_list_3`  
**type:** `longword (unsigned)`  
**access:** `read only`  
**mechanism:** `by reference`

Item list specifying additional font information to be returned. The `item_list` argument is the address of a list of item descriptors, each of which describes an item of information. A longword value of 0 terminates the list of item descriptors.

The structure of the item list is described in the following figure.

```
+-------------------+-------------------+----------+
<table>
<thead>
<tr>
<th>31</th>
<th>15</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>item code</td>
<td>buffer length</td>
<td></td>
</tr>
<tr>
<td>buffer address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>return length</td>
<td></td>
<td>address</td>
</tr>
</tbody>
</table>
```
The following table lists valid item codes.

<table>
<thead>
<tr>
<th>Item Code</th>
<th>Information Returned</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Character Information</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$C_FNT_FIRST_CHAR</td>
<td>First character in the font</td>
</tr>
<tr>
<td>UIS$C_FNT_LAST_CHAR</td>
<td>Last defined character in the font</td>
</tr>
<tr>
<td>UIS$C_FNT_GUTPERPIX_X</td>
<td>x resolution of the font in gutenbergs per pixel</td>
</tr>
<tr>
<td>UIS$C_FNT_GUTPERPIX_Y</td>
<td>y resolution of the font in gutenbergs per pixel</td>
</tr>
<tr>
<td>UIS$C_FNT_AVERAGE_GUT(^1)</td>
<td>Average width of a character in the font</td>
</tr>
<tr>
<td>UIS$C_FNT_WIDTH</td>
<td>Width in pixels of all glyphs in the font, if the font is monospaced. A zero is returned, if the font is proportionally spaced.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Font Flags(^2)</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_FNT_FIXED</td>
<td>True, if the font is monospaced</td>
</tr>
<tr>
<td></td>
<td>False, if the font is proportionally spaced.</td>
</tr>
<tr>
<td>UIS$C_FNT_CELLEQRAST</td>
<td>True, if the cell width of all glyphs in the font equals the width the glyph’s raster.</td>
</tr>
<tr>
<td>UIS$C_FNT_VA_FONT</td>
<td>True, if this is a VA font.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Font Name</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_FNT_FONT_ID</td>
<td>Font identifier string</td>
</tr>
</tbody>
</table>

\(^1\)The font designer assigns this number. Although, the graphics subsystem copies the number, no interpretation is applied to it. UIS does not use the number.

\(^2\)The value 1 is returned, if TRUE, and 0, if FALSE.
Screen Output

```fortran
$ run get_fontattr
font name is DTABER0R07SK00GG0001UZZZZ02A000
length of font name is 31 characters
FORTRAN PAUSE
$ cont
length of ascender 26 pixels
length of descender 4 pixels
height of character cell 30 pixels
FORTRAN PAUSE
$
```

The more the merrier
UIS$GET_FONT_SIZE

Obtains the size of a character or string of characters in the specified font in physical dimensions.

Format

UIS$GET_FONT_SIZE  fontid, text_string, retwidth, retheight

Returns

UIS$GET_FONT_SIZE signals all errors; no condition values are returned.

Arguments

*fontid*
VMS Usage: char_string
type: character string
access: read only
mechanism: by descriptor

Font identifier. The fontid argument is the address of a character string descriptor of a font file name. Specify only the font file name. UIS searches the directory SYS$FONT for the correct file type.

*text_string*
VMS Usage: char_string
type: character string
access: read only
mechanism: by descriptor

Text string. The text_string argument is the address of a descriptor of a character or character string.

*retwidth, retheight*
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

String width and height. The retwidth and retheight arguments are the addresses of f_floating point longwords that receive the width and height of the character or character string in centimeters.
UIS$GET_FONT_SIZE

Description

UIS$GET_FONT_SIZE can be used to determine the proper size of a display viewport based on the size of the characters in a given font.

Screen Output

```
$ run get_fontsize
string length = 11.01970 cm
character height = 0.4919507 cm
FORTRAN PAUSE
$
```

Bad news travels fast
UIS$GET_HW_COLOR_INFO

Returns information about the hardware color map.

Format

```
UIS$GET_HW_COLOR_INFO  devnam [,type] [,indices] 
[,colors] [,maps] [,rbits] [,gbits] 
[,bbits] [,ibits] [,res_indices] 
[,regen]
```

Returns

UIS$GET_HW_COLOR_INFO signals all errors; no condition values are returned.

Arguments

- **devnam**
  
  VMS Usage: device_name
  
  type: character string
  
  access: read only
  
  mechanism: by descriptor

  Device name. The **devnam** argument is the address of a character string descriptor of the workstation device name. Specify SYS$WORKSTATION in the **devnam** argument.

- **type**
  
  VMS Usage: longword_unsigned
  
  type: longword (unsigned)
  
  access: write only
  
  mechanism: by reference

  Device type. The **type** argument is the address of a longword that receives the device type. The following table lists device type values.
UIS Routine Descriptions

UIS$GET_HW_COLOR_INFO

<table>
<thead>
<tr>
<th>Device Type</th>
<th>Value</th>
<th>Possible Colors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monochrome</td>
<td>UIS$C_DEV-MONO</td>
<td>Black and white</td>
</tr>
<tr>
<td>Intensity</td>
<td>UIS$C_DEV-INTENSITY</td>
<td>Up to $2^{24}$ gray tones</td>
</tr>
<tr>
<td>Color</td>
<td>UIS$C_DEV-COLOR</td>
<td>Up to $2^{24}$ chromatic colors</td>
</tr>
</tbody>
</table>

*indices*

VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Number of entries or simultaneous colors. The *indices* argument is the address of longword that receives the number of entries or simultaneous colors in the hardware color map.

*colors*

VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Number of possible colors. The *colors* argument is the address of a longword that receives the number of possible colors represented in the color map. For example monochrome equals 2.

*maps*

VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Number of hardware color maps. The *maps* argument is the address of a longword that receives the number of hardware color maps.

*rbits*

VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Number of binary bits of precision for red. The *rbits* argument is the address of a longword that receives the number of binary bits of precision for the color red.
**gbits**

**VMS Usage:** *longword unsigned*

**type:** *longword (unsigned)*

**access:** *write only*

**mechanism:** *by reference*

Number of binary bits of precision for green. The `gbits` argument is the address of a longword that receives the number of binary bits of precision for the color green.

**bbits**

**VMS Usage:** *longword unsigned*

**type:** *longword (unsigned)*

**access:** *write only*

**mechanism:** *by reference*

Number of binary bits of precision for blue. The `bbits` argument is the address of a longword that receives the number of binary bits of precision for the color blue.

**ibits**

**VMS Usage:** *longword unsigned*

**type:** *longword (unsigned)*

**access:** *write only*

**mechanism:** *by reference*

Number of binary bits of precision for intensity. The `ibits` argument is the address of a longword that receives the number of binary bits of precision for intensity.

**res_indices**

**VMS Usage:** *longword unsigned*

**type:** *longword (unsigned)*

**access:** *write only*

**mechanism:** *by reference*

Number entries in the hardware color map reserved for special use. The `res_indices` argument is the address of a longword that receives the number entries in the hardware color map reserved for special use.

**regen**

**VMS Usage:** *longword unsigned*

**type:** *longword (unsigned)*

**access:** *write only*

**mechanism:** *by reference*

Color regeneration characteristics. The `regen` argument is the address of a longword that receives the color regeneration characteristics. The `regen`
argument indicates whether the color and intensity changes affect previously drawn display objects that specified the same color index in the hardware look up table. The following symbols are valid values: UIS$C_DEV_RETRO or UIS$C_DEV_NONRETRO.

The following table summarizes regeneration characteristics of direct and mapped color systems.

<table>
<thead>
<tr>
<th>System</th>
<th>Regeneration Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct color</td>
<td>Usually sequential</td>
</tr>
<tr>
<td>Mapped color</td>
<td>Usually retroactive</td>
</tr>
</tbody>
</table>
**UIS$GET__INTENSITIES**

Returns intensity values associated with one or more entries in the virtual color map.

---

**Format**

```
UIS$GET__INTENSITIES vd_id, index, count, reti_vector [,wd_id]
```

---

**Returns**

UIS$GET__INTENSITIES signals all errors; no condition values are returned.

---

**Arguments**

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE__DISPLAY for more information about the `vd_id` argument.

- **index**
  - VMS Usage: longwordUnsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Starting color map index. The `index` argument is the address of a longword that specifies the index of the first color map entry to be returned. If the specified index exceeds the maximum index of the virtual color map, an error is signaled.

- **count**
  - VMS Usage: longwordUnsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Number of entries to return.
Number of indices. The count argument is the address of a longword that specifies the total number of color map entries to be returned including the starting index. If the specified count exceeds the maximum number of virtual color map entries, an error is signaled.

\texttt{reti\_vector}

VMS Usage: \texttt{vector\_longword\_signed}

\begin{itemize}
\item type: \texttt{f\_floating}
\item access: \texttt{write only}
\item mechanism: \texttt{by reference}
\end{itemize}

Intensity values. The \texttt{reti\_vector} argument is the address of an array of \texttt{f\_floating} point longwords that receives the intensity values. Each intensity value is in the range of 0.0 to 1.0, inclusively.

\texttt{wd\_id}

VMS Usage: \texttt{identifier}

\begin{itemize}
\item type: \texttt{longword (unsigned)}
\item access: \texttt{read only}
\item mechanism: \texttt{by reference}
\end{itemize}

Display window identifier. The \texttt{wd\_id} argument is the address of a longword that uniquely identifies a display window. If the \texttt{wd\_id} argument is specified, it must be a valid display window identifier associated with the virtual display. The returned values are the realized intensities for the specific device for which the display window was created. See UIS$\texttt{CREATE\_WINDOW}$ for more information about the \texttt{wd\_id} argument.

If the \texttt{wd\_id} argument is not specified, the intensity values returned are set color values originally established by a call to UIS$\texttt{SET\_INTENSITY}$ or UIS$\texttt{SET\_INTENSITIES}$.
Illustration

UIS Routine Descriptions
UIS$GET\_INTENSITIES

10
11
12
13
14
15
16

Color Map Index

\[ \cdot \cdot \cdot \]

\begin{align*}
10 & \text{Intensity Value} \\
11 & \text{Intensity Value} \\
12 & \text{Intensity Value} \\
13 & \text{Intensity Value} \\
14 & \text{Intensity Value} \\
15 & \text{Intensity Value} \\
16 & \text{Intensity Value} \\
\end{align*}

Count

\[
\begin{align*}
& 0.10 \\
& 0.15 \\
& 0.26 \\
\end{align*}
\]

ZK-5445-86
UIS$GET_INTENSITY

Returns the intensity value associated with a single entry in the color map.

Format

UIS$GET_INTENSITY vd_id, index, reti [, wd_id]

Returns

UIS$GET_INTENSITY signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

index
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Color map index. The index argument is the address of a longword integer that identifies the index of an entry in the color map associated with the virtual display. If the specified index exceeds the maximum number of indices in the virtual color map, an error is signaled.

reti
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Intensity value. The reti argument is the address of an f_floating point longword that receives the intensity value. The intensity value is in the range of 0.0 to 1.0, inclusive.
UIS Routine Descriptions

UIS$GET_INTENSITY

**wd_id**

VMS Usage: **identifier**
type: **longword (unsigned)**
access: **read only**
mechanism: **by reference**

Display window identifier. The *wd_id* is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the *wd_id* argument. If this argument is specified, it must be a valid *wd_id* associated with the virtual display, and the returned values are the *realized* intensities for the specific device for which the window was created.

If the *wd_id* argument is not specified, the returned intensity values are set intensity originally established by a call to UIS$SET_INTENSITY or UIS$SET_INTENSITIES.

---

Illustration

```
  · ·
  6 Intensity Value
  7 Intensity Value
  8 Intensity Value
  9 Intensity Value
 10 Intensity Value
 11 Intensity Value
  · ·

Color Map Index

0.55
```
UIS$GET_KB_ATTRIBUTES

Returns the virtual keyboard characteristics.

Format

UIS$GET_KB_ATTRIBUTES kb_id [enable_items]
[disable_items][,click_volume]

Returns

UIS$GET_KB_ATTRIBUTES signals all errors; no condition values are returned.

Arguments

kb_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual keyboard identifier. The kb_id argument is the address of a
longword that uniquely identifies the virtual keyboard. See
UIS$CREATE_KB for more information about the kb_id argument.

enable_items
VMS Usage: mask_longword
type: longword (unsigned)
access: write only
mechanism: by reference

Enabled keyboard characteristics. The enable_items argument is the address
of a longword mask that receives the bit mask of the enabled keyboard
characteristics.

disable_items
VMS Usage: mask_longword
type: longword (unsigned)
access: write only
mechanism: by reference

Enabled keyboard characteristics. The disable_items argument is the address
of a longword mask that receives the bit mask of the disabled keyboard
characteristics.
Disabled keyboard characteristics. The \texttt{disable\_items} argument is the address of a longword mask that receives the bit mask of the disabled keyboard characteristics.

\textit{click\_volume}

\textbf{VMS Usage: \texttt{longword\_unsigned}}

\textbf{type: \texttt{longword (unsigned)}}

\textbf{access: write only}

\textbf{mechanism: by reference}

Key click volume level. The \texttt{click\_volume} argument is the address of a longword that receives the key click volume level. The key click volume is in the range of 1 to 8, inclusively, where 1 is quiet and 8 is loud.

\textbf{Description}

The enable and disable item lists are longword masks containing bits designating the characteristics to be enabled or disabled. The valid bits in the keyboard characteristics enable and disable masks are:

\begin{tabular}{ll}
\textbf{Symbol} & \textbf{Description}\textsuperscript{1} \\
\hline
\texttt{UIS\$M\_KB\_AUTORPT} & Enable/disable keyboard autorepeat \\
\texttt{UIS\$M\_KB\_KEYCLICK} & Enable/disable keyboard keyclick \\
\texttt{UIS\$M\_KB\_UDF6} & Enable/disable up button transitions for $\text{[F8]}$ to $\text{[F10]}$ keys \\
\texttt{UIS\$M\_KB\_UDF11} & Enable/disable up button transitions for $\text{[F11]}$ to $\text{[F14]}$ keys \\
\texttt{UIS\$M\_KB\_UDF17} & Enable/disable up button transitions for $\text{[F17]}$ to $\text{[F20]}$ keys \\
\texttt{UIS\$M\_KB\_HELPDO} & Enable/disable up button transitions for $\text{[HELP]}$ and $\text{[DO]}$ keys \\
\texttt{UIS\$M\_KB\_UDE1} & Enable/disable up button transitions for $\text{[E1]}$ to $\text{[E6]}$ keys \\
\texttt{UIS\$M\_KB\_ARROW} & Enable/disable up button transitions for arrow keys \\
\texttt{UIS\$M\_KB\_KEYPAD} & Enable/disable up button transitions for numeric keypad keys \\
\end{tabular}

\textsuperscript{1}By default down button transitions are enabled.
UIS$GET_LINE_STYLE

Returns the line style patterns.

Format

\[ \text{style} = \text{UIS$GET_LINESTYLE} \quad \text{vd}_i, \text{atb} \]

Returns

VMS Usage: \text{longword\_unsigned}

- type: \text{longword (unsigned)}
- access: \text{write only}
- mechanism: \text{by value}

Longword value returned as the line style bit vector in the variable \text{style} or R0 (VAX MACRO).

UIS$GET_LINE_STYLE signals all errors; no condition values are returned.

Arguments

\text{vd\_id}

VMS Usage: \text{identifier}

- type: \text{longword (unsigned)}
- access: \text{read only}
- mechanism: \text{by reference}

Virtual display identifier. The \text{vd\_id} argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{vd\_id} argument.

\text{atb}

VMS Usage: \text{longword\_unsigned}

- type: \text{longword (unsigned)}
- access: \text{read only}
- mechanism: \text{by reference}

Attribute block number. The \text{atb} argument is the address of a longword integer that identifies an attribute block from which the line style pattern or bit vector is obtained.
Screen Output

```
$ run get_linestyle
line no.1 style = FOFOFOFO
line no.2 style = F00F00F0
line no.3 style = C0C0C0C0
FORTRAN PAUSE
```

![Graphical representation of the line styles](image-url)
UIS$GET_LINE_WIDTH

Returns the line width.

Format

\[
\text{width=} \text{UIS$GET\_LINE\_WIDTH} \text{ \ vd\_id, atb [,mode]}
\]

Returns

VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by value

Floating point value returned as the line width in the variable width or R0 (VAX MACRO).

UIS$GET_LINE_WIDTH signals all errors; no condition values are returned.

Arguments

\text{vd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \text{vd\_id} argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{vd\_id} argument.

\text{atb}

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The \text{atb} argument is the address of a longword integer that identifies the attribute block from which the line width is obtained.
**mode**

VMS Usage: longword_unsigned  
Type: longword (unsigned)  
Access: write only  
Mechanism: by reference

Line width mode. The optional mode argument is the address of a longword that receives the line width specification mode (WDPL$C_WIDTH_WORLD or WDPL$C_WIDTH_PIXELS). If WDPL$C_WIDTH_WORLD is returned, the line width is interpreted as world coordinates. If WDPL$C_WIDTH_PIXELS is returned, the line width is interpreted as pixels.
UIS Routine Descriptions

UIS$GET_LINE_WIDTH

Screen Output

```plaintext
$ run get_linewidth
line width = 1.00 pixels
line width = 2.00 pixels
line width = 2.00 pixels
line width = 3.00 pixels
line width = 4.00 pixels
line width = 5.00 pixels
line width = 6.00 pixels
FORTRAN PAUSE

$```

![Screen Output Diagram](image-url)
UIS$GET_NEXT_OBJECT

Returns the identifier of the next object in the display list.

Format

\[ \text{next}_id = \text{UIS$GET\_NEXT\_OBJECT} \{ \{ \text{obj}_id \} \{ \text{seg}_id \} } [\text{flags}] \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by reference

Longword value returned as the next object identifier in the variable \text{next}_id or R0 (VAX MACRO). The next object identifier uniquely identifies the next specified object in the display list and is used as an argument in other routines.

UIS$GET\_NEXT\_OBJECT signals all errors; no condition values are returned.

Arguments

\textbf{obj}_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Object identifier. The \text{obj}_id argument is the address of a longword that uniquely identifies the object.

\textbf{seg}_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Segment identifier. The \text{seg}_id argument is the address of a longword that uniquely identifies the segment.
**flags**

VMS Usage: `mask_longword`

Type: `longword (unsigned)`

Access: `read only`

Mechanism: `by reference`

Flags. The `flags` argument is the address of a longword that controls how the display list is searched. If the `flags` argument is set using `UIS$M_DLSAME_SEGMENT`, the next object in the segment containing the object specified is returned.

If the `flags` argument is omitted, the next object in the display list, regardless of the segment in which it is contained, is returned.

---

**Description**

If a zero is returned, the next object was not found.
UIS$GET_OBJECT_ATTRIBUTES

Returns the type and extent of the specified object.

Format

\[
\text{type}=\text{UIS$GET\_OBJECT\_ATTRIBUTES} \{ \text{obj\_id} \ \text{seg\_id} \}[,\text{extent}]
\]

Returns

VMS Usage: longword unsigned

type: longword (unsigned)

access: write only

mechanism: by value

Longword value returned as the object type in the variable type or R0 (VAX MACRO). An object type identifies a graphic object such as images, points, lines, or ellipses, a display list structure such as a segment, or the occurrence of an event such as movement to a new text line. Possible valid objects are listed in the following table.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_OBJECT_SEGMENT</td>
<td>Segment</td>
</tr>
<tr>
<td>UIS$C_OBJECT_PLOT</td>
<td>Point, line, connected lines, or polygon</td>
</tr>
<tr>
<td>UIS$C_OBJECT_TEXT</td>
<td>Characters</td>
</tr>
<tr>
<td>UIS$C_OBJECT_ELLIPSE</td>
<td>Elliptical or circular arcs, circles and ellipses</td>
</tr>
<tr>
<td>UIS$C_OBJECT_IMAGE</td>
<td>Raster image</td>
</tr>
<tr>
<td>UIS$C_OBJECT_LINE</td>
<td>Unconnected lines</td>
</tr>
</tbody>
</table>

UIS$GET\_OBJECT\_ATTRIBUTES signals all errors; no condition values are returned.

Arguments

\( \text{obj\_id} \)

VMS Usage: identifier

type: longword (unsigned)

access: read only

mechanism: by reference
Object identifier. The `obj_id` argument is the address of a longword that uniquely identifies the object.

`seg_id`

VMS Usage: `identifier`

- type: `longword (unsigned)`
- access: `read only`
- mechanism: `by reference`

Segment identifier. The `seg_id` argument is the address of a longword that uniquely identifies the segment. See UIS$BEGIN_SEGMENT for more information about the `seg_id` argument.

`extent`

VMS Usage: `vector_longword_signed`

- type: `f_floating`
- access: `write only`
- mechanism: `by reference`

World coordinates of the extent rectangle. The `extent` argument is the address of an array of four longwords that receives the values of the world coordinates of the lower-left corner and the upper-right corner of the extent rectangle containing the object.
Screen Output

$ RUN WALK
DISPLAY LIST ELEMENTS

<table>
<thead>
<tr>
<th>IDENTIFIER</th>
<th>OBJECT TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>113992</td>
<td>UIS$C_OBJECT_SEGMENT</td>
</tr>
<tr>
<td>115328</td>
<td>UIS$C_OBJECT_ELLIPSE</td>
</tr>
<tr>
<td>115575</td>
<td>UIS$C_OBJECT_PLOT</td>
</tr>
<tr>
<td>115822</td>
<td>UIS$C_OBJECT_PLOT</td>
</tr>
<tr>
<td>116069</td>
<td>UIS$C_OBJECT_PLOT</td>
</tr>
<tr>
<td>116316</td>
<td>UIS$C_OBJECT_PLOT</td>
</tr>
<tr>
<td>116810</td>
<td>UIS$C_OBJECT_PLOT</td>
</tr>
<tr>
<td>117057</td>
<td>UIS$C_OBJECT_LINE</td>
</tr>
</tbody>
</table>

FORTRAN PAUSE

The footsteps of fortune are slippery
Mirth without measure is madness
UIS$GET_PARENT_SEGMENT

Returns the parent segment identifier of the specified object.

Format

\[
\text{parent\_id}=\text{UIS$GET\_PARENT\_SEGMENT} \begin{cases} \text{obj\_id} \\ \text{seg\_id} \end{cases}
\]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the parent segment identifier in the variable parent\_id or R0 (VAX MACRO). The parent segment identifier uniquely identifies a parent segment and is used as an argument in other routines.

UIS$GET\_PARENT\_SEGMENT signals all errors; no condition values are returned.

Arguments

\text{obj\_id}
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Object identifier. The \text{obj\_id} argument is the address of a longword that uniquely identifies the object.

\text{seg\_id}
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Segment identifier. The \text{seg\_id} argument is the address of a longword that uniquely identifies the segment. See UIS$BEGIN\_SEGMENT for more information about the \text{seg\_id} argument.
**Description**

If the specified object is the outermost segment or root segment, its own object identifier is returned.
UIS$GET_POINTER_POSITION

Returns the current pointer position in world coordinates.

Format

\[
\text{status} = \text{UIS$GET\_POINTER\_POSITION} \quad \text{vd\_id, wd\_id, retx, rety}
\]

Returns

VMS Usage: boolean
type: longword
access: write only
mechanism: by value

Boolean value returned as the current position of the pointer in a status variable. UIS$GET\_POINTER\_POSITION returns the boolean TRUE value 1 if the pointer is within the visible portion of the viewport, 0 is returned if the pointer is outside the visible portion of the viewport. In the latter case, the x and y values are returned as 0,0.

UIS$GET\_POINTER\_POSITION signals all errors; no condition values are returned.

Arguments

vd\_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd\_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the vd\_id argument.

wd\_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference
Display window identifier. The \texttt{wd\_id} argument is the address of a longword that uniquely identifies the display window. See \texttt{UIS\$CREATE\_WINDOW} for more information about the \texttt{wd\_id} argument.

\textbf{retx, rety}

\textbf{VMS Usage:} floating\_point
type: \texttt{f\_floating}
access: write only
mechanism: by reference

World coordinate pair. The \texttt{retx} and \texttt{rety} arguments are the addresses of \texttt{f\_floating} point longwords that receives the pointer \textsc{x} and \textsc{y} world coordinates.

\section*{Description}

Note that the returned status value should always be tested when using this routine, since it is always possible that the pointer could be outside the window when the service is called and the \textsc{x, y} values would be meaningless.
UIS$GET_POSITION

Returns the current baseline position for text output.

Format

UIS$GET_POSITION  vd_id, retx, rety

Returns

UIS$GET_POSITION signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

retx, rety
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

World coordinate pair. The retx and rety arguments are addresses of f_floating point longwords that receive the x and y world coordinate positions.

Description

UIS$TEXT and UIS$NEW_TEXT_LINE recognize the concept of current position. The position refers to the alignment point on the baseline of the next character to be output.
UIS Routine Descriptions
UIS\$GET\_POSITION

Screen Output

$ run get_pos
What is the current text position in world coordinates?
x coordinate = 18.10
y coordinate = 13.58

What is the current text position in world coordinates?
x coordinate = 18.10
y coordinate = 3.54
FORTRAN PAUSE

Current position after text drawing (18.10, 13.58)
No rose without a thorn

Current position after text drawing (18.10, 3.54)
No rose without a thorn

Baseline Vector
UIS$GET_PREVIOUS_OBJECT

Returns the identifier of the previous object in the display list.

Format

\[ \text{prev\_id} = \text{UIS$GET\_PREVIOUS\_OBJECT} \{ \text{obj\_id} \} [,\text{flags}] \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the previous object identifier in the variable \text{prev\_id} or R0 (VAX MACRO). The previous object identifier uniquely identifies the previous object in the display list and is used as an argument in other routines.

UIS$GET_PREVIOUS_OBJECT signals all errors; no condition values are returned.

Arguments

\text{obj\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Object identifier. The \text{obj\_id} argument is the address of a longword that uniquely identifies an object.

\text{seg\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Segment identifier. The \text{seg\_id} argument is the address of a longword that uniquely identifies a segment. See UIS$BEGIN_SEGMENT for more information about the \text{seg\_id} argument.
**flags**

VMS Usage: `mask_longword`

Type: `longword (unsigned)`

Access: `read only`

Mechanism: `by reference`

Flags. The `flags` argument is the address of a longword that controls how the display list is searched. If the `flags` argument is specified using `UIS$M_DLSAME_SEGMENT`, the previous object in the segment containing the object specified is returned.

If the `flags` argument is omitted, the previous object in the display list, regardless of the segment in which it is contained, is returned.

---

**Description**

If no previous object is found, a zero is returned.

---

**Illustration**

The following figure illustrates how `UIS$GET_PREVIOUS_OBJECT` of each previous object within the same segment.

![Diagram](image.png)

The following figure illustrates how `UIS$GET_PREVIOUS_OBJECT` returns the object identifier of all objects in the display list.
UIS Routine Descriptions

UIS$GET_PREVIOUS_OBJECT

Root Segment

Level 0
- Plot (prev_id)
- Ellipse (prev_id)
- Text (prev_id)
- Segment (prev_id)
- Text (prev_id)

Level 1
- Image (prev_id)
- Plot (prev_id)
- New Text Line (prev_id)
- Text (prev_id)
- Ellipse (current_id)

ZK 5364 86
UIS$GET_ROOT_SEGMENT

Returns the root segment of the specified virtual display.

Format

\[
root\_id = \text{UIS}$\text{GET\_ROOT\_SEGMENT}\ v d\_i d
\]

Returns

| VMS Usage: | identifier |
| type:      | longword (unsigned) |
| access:    | write only |
| mechanism: | by value |

Longword value returned as the root segment identifier in the variable \( root\_id \) or R0 (VAX MACRO). The root segment identifier uniquely identifies the root segment.

UIS$GET_ROOT_SEGMENT signals all errors; no condition values are returned.

Argument

\( v d\_i d \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \( v d\_i d \) argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the \( v d\_i d \) argument.

Description

UIS$GET_ROOT_SEGMENT can be used with UIS$EXTRACT_OBJECT to extract an entire display list.
Screen Output

$ run get_rootseg
The root segment identifier for virtual display is 112968
FORTRAN PAUSE
$
UIS Routine Descriptions

UIS$GET_TB_INFO

Returns the characteristics of the tablet device.

Format

\[
\text{status} = \text{UIS$GET\_TB\_INFO} \quad \text{devnam}, \text{retwidth}, \text{retheight}, \text{retresolx}, \text{retresoly} \>[,\text{retpwidth}, \text{retpheight}]
\]

Returns

VMS Usage: \text{longword\_unsigned}  
\hspace{1cm} \text{type: longword (unsigned)}  
\hspace{1cm} \text{access: read only}  
\hspace{1cm} \text{mechanism: by reference}

Longword value returned in a status variable. If the value 1 is returned, the pointing device is a tablet. If the value 0 is returned, the pointing device is a mouse and the returned information will be zeros. A tablet is required for digitizing.

UIS$GET\_TB\_INFO$ signals all errors; no condition values are returned.

Arguments

\text{devnam}

VMS Usage: \text{device\_name}  
\hspace{1cm} \text{type: character string}  
\hspace{1cm} \text{access: read only}  
\hspace{1cm} \text{mechanism: by descriptor}

Device name. The \text{devname} argument is the address of a character string descriptor of the workstation device name. Specify the logical name SYS$WORKSTATION.

\text{retwidth}

VMS Usage: \text{floating\_point}  
\hspace{1cm} \text{type: f\_floating}  
\hspace{1cm} \text{access: write only}  
\hspace{1cm} \text{mechanism: by reference}

Tablet width. The \text{retwidth} argument is the address of an f\_floating point longword that receives the width of the tablet in centimeters.
rettheight
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Tablet height. The rettheight argument is the address of an f_floating point longword that receives the height of the tablet in centimeters.

retresolx
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Tablet x resolution. The retresolx argument is the address of an f_floating longword that receives the x resolution of the tablet in centimeters per pixel.

retresoly
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Tablet y resolution. The retresoly argument is the address of an f_floating point longword that receives the y resolution of the tablet in centimeters per pixel.

retpwidth
VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Tablet width. The retpwidth argument is the address of a longword that receives the width of the tablet in pixels.

retpheight
VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Tablet height. The retpheight argument is the address of a longword that receives the height of the tablet in pixels.
A call to UIS$GET_TB_INFO is recommended prior to establishing digitizing. UIS$GET_TB_INFO returns a value indicating whether the device is a mouse or tablet. A tablet is required for digitizing.

Note that you may invalidate the results of this call, if you unplug the tablet and replace it with a mouse while running an application.
UIS$GET_TB_POSITION

Polls for the position of the pointing device on the tablet.

Format

UIS$GET_TB_POSITION  tb_id ,retx ,rety

Returns

UIS$GET_TB_POSITION signals all errors; no condition values are returned.

Arguments

**tb_id**
- VMS Usage: identifier
- type: longword (unsigned)
- access: read only
- mechanism: by reference

Tablet identifier. The _tb_id argument is the address of a longword that uniquely identifies the tablet. See UIS$CREATE_TB for more information about the _tb_id argument.

**retx, rety**
- VMS Usage: floating_point
- type: f_floating
- access: write only
- mechanism: by reference

Digitizer position. The _retx, _rety arguments are the addresses of _f_floating numbers that define the current digitizer position.

Description

The digitizer’s position will not be available if the pointing device is a mouse.

If the pointer is not on the tablet, UIS$GET_TB_POSITION returns the last pointer that was reported.
**UIS$GET_TEXT_FORMATTING**

Returns a mask describing the enabled text formatting modes.

**Format**

\[
\text{formatting=}\text{UIS$GET_TEXT_FORMATTING}\quad \text{vd\_id, atb}
\]

**Returns**

VMS Usage: \text{mask\_longword}

- **type:** longword (unsigned)
- **access:** write only
- **mechanism:** by value

Longword mask returned as the current formatting mode in the variable `formatting` or R0 (VAX MACRO). The following table lists the formatting modes.

<table>
<thead>
<tr>
<th>Formatting Mode</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_TEXT_FORMAT_LEFT</td>
<td>Left justified, ragged right (default)</td>
</tr>
<tr>
<td>UIS$C_TEXT_FORMAT_RIGHT</td>
<td>Right justified, left ragged</td>
</tr>
<tr>
<td>UIS$C_TEXT_FORMAT_CENTER</td>
<td>Centered line between left and right margin</td>
</tr>
<tr>
<td>UIS$C_TEXT_FORMAT_JUSTIFY</td>
<td>Justified lines, space filled to right margin</td>
</tr>
<tr>
<td>UIS$C_TEXT_FORMAT_NOJUSTIFY</td>
<td>No text justification</td>
</tr>
</tbody>
</table>

UIS$GET_TEXT_FORMATTING signals all errors; no condition values are returned.

**Arguments**

- **vd\_id**

  - VMS Usage: \text{identifier}
  - **type:** longword (unsigned)
  - **access:** read only
  - **mechanism:** by reference

  Virtual display identifier. The \text{vd\_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{vd\_id} argument.
UIS$GET_TEXT_FORMATTING

**atb**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The `atb` argument is the address of a longword that identifies an attribute block containing the text formatting attribute setting to be returned.
UIS$GET_TEXT_MARGINS

Returns the text margins for a line of text.

Format

```
UIS$GET_TEXT_MARGINS vd_id,atb,x,y[,margin_length]
```

Returns

UIS$GET_TEXT_MARGINS signals all errors; no condition values are returned.

Arguments

**vd_id**

VMS Usage: identifier

* type: longword (unsigned)
  * access: read only
  * mechanism: by reference

Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

**atb**

VMS Usage: longword_unsigned

* type: longword (unsigned)
  * access: read only
  * mechanism: by reference

Attribute block number. The `atb` argument is the address of a longword that identifies an attribute block containing the modified text margins attribute.

**x,y**

VMS Usage: floating_point

* type: f_floating
  * access: write only
  * mechanism: by reference

Starting margin position. The `x,y` arguments are the addresses of `f_floating` longwords that receive the starting margin relative to the direction of text drawing.
**UIS$GET_TEXT_MARGINS**

*margin_length*

**VMS Usage:** floating-point  
**Type:** f_floating  
**Access:** write only  
**Mechanism:** by reference

Ending margin position. The *margin_length* is the address of an f_floating longword that receives the distance to the end margin. The margin is measured along the actual path of text drawing in the direction of the major text path.

---

**Screen Output**

```plaintext
$ run get_margins
margin settings
left margin x coordinate 5.00
left margin y coordinate 15.00
distance from left margin to right margin 20.00
FORTRAN PAUSE
$
```

---

```
Hoist your sail when the wind is fair
Hoist your sail when the wind is fair
Hoist your sail when the wind is fair
Hoist your sail when the wind is fair
Hoist your sail when the wind is fair
```
UIS$GET_TEXT_PATH

Returns text path types. See UIS$SET_TEXT_PATH for information about valid text path types.

Format

UIS$GET_TEXT_PATH   vd_id, atb [,major] [,minor]

Returns

UIS$GET_TEXT_PATH signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type:    longword (unsigned)
access:  read only
mechanism: by reference
Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage: longword_unsaved
type:    longword (unsigned)
access:  read only
mechanism: by reference
Attribute block number. The atb argument is the address of a number that identifies an attribute block containing the text path attribute setting to be returned.

major
VMS Usage: longword_unsaved
type:    longword (unsigned)
access:  write only
mechanism: by reference
Major text path type. The major argument is the address of a code that identifies a major text path type. The major text path of text drawing is the direction of text drawing along a line.
**UIS Routine Descriptions**

**UIS$GET_TEXT_PATH**

**minor**

VMS Usage: `longword_unsigned`  
Type: `longword (unsigned)`  
Access: `write only`  
Mechanism: `by reference`

Minor text path type. The *minor* argument is the address of a code that identifies a minor text path type. The minor path of text drawing is the direction used for new text line creation.

---

**Description**

The following table contains symbols for valid character drawing directions.

<table>
<thead>
<tr>
<th>Path</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_TEXT_PATH_RIGHT</td>
<td>Left to right (default major text path)</td>
</tr>
<tr>
<td>UIS$C_TEXT_PATH_LEFT</td>
<td>Right to left</td>
</tr>
<tr>
<td>UIS$C_TEXT_PATH_UP</td>
<td>Bottom to top</td>
</tr>
<tr>
<td>UIS$C_TEXT_PATH_DOWN</td>
<td>Top to bottom (default minor text path)</td>
</tr>
</tbody>
</table>
UIS$GET_TEXT_SLOPE

Returns the angle of the actual path of text drawing relative to the major path in degrees.

Format

\[ \text{angle} = \text{UIS$GET\_TEXT\_SLOPE} \quad \text{vd}\_id, \text{atb} \]

Returns

VMS Usage: floating_point

<table>
<thead>
<tr>
<th>Type</th>
<th>f_floating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>write only</td>
</tr>
<tr>
<td>Mechanism</td>
<td>by value</td>
</tr>
</tbody>
</table>

Longword value returned as the angle of the actual path of text drawing relative to the major path in degrees in the variable \( \text{angle} \) or R0 (VAX MACRO). Degrees are measured counterclockwise.

UIS$GET_TEXT_SLOPE signals all errors; no condition values are returned.

Arguments

\( \text{vd}\_id \)

VMS Usage: identifier

<table>
<thead>
<tr>
<th>Type</th>
<th>longword (unsigned)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>read only</td>
</tr>
<tr>
<td>Mechanism</td>
<td>by reference</td>
</tr>
</tbody>
</table>

Virtual display identifier. The \( \text{vd}\_id \) argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the \( \text{vd}\_id \) argument.

\( \text{atb} \)

VMS Usage: longword_unsigned

<table>
<thead>
<tr>
<th>Type</th>
<th>longword (unsigned)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access</td>
<td>read only</td>
</tr>
<tr>
<td>Mechanism</td>
<td>by reference</td>
</tr>
</tbody>
</table>

Attribute block number. The \( \text{atb} \) argument is the address of a longword that identifies an attribute block from which the text slope attribute setting is to be returned.
$ run get_slope
The angle of the text baseline is 0.00 degrees
The angle of the text baseline is 34.00 degrees
The angle of the text baseline is 68.00 degrees
The angle of the text baseline is 102.00 degrees
The angle of the text baseline is 136.00 degrees
The angle of the text baseline is 170.00 degrees
The angle of the text baseline is 204.00 degrees
The angle of the text baseline is 238.00 degrees
The angle of the text baseline is 272.00 degrees
The angle of the text baseline is 306.00 degrees
The angle of the text baseline is 340.00 degrees
FORTAN PAUSE
$
UIS$GET_VCM_ID

Returns the virtual color map identifier used by the specified virtual display.

Format

\[ vcm\_id = \text{UIS$GET\_VCM\_ID} \ v_d\_id \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the virtual color map identifier in the variable \( vcm\_id \) or R0 (VAX MACRO). The virtual color map identifier uniquely identifies a virtual color map for a specified virtual display. See UIS$CREATE_COLOR-MAP for more information about the \( vcm\_id \) argument.

UIS$GET_VCM_ID signals all errors; no condition values are returned.

Argument

\( v_d\_id \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \( v_d\_id \) argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the \( v_d\_id \) argument.
**UIS$GET_VIEWPORT_ICON**

Returns boolean value indicating whether or not the icon is visible.

**Format**

```
boolean = UIS$GET_VIEWPORT_ICON  wd_id [,icon_wd_id]
```

**Returns**

VMS Usage: `boolean`
- type: longword (unsigned)
- access: write only
- mechanism: by value

Boolean value returned in a status variable or R0 (VAX MACRO) indicating whether an icon has replaced a viewport, a 1 denotes a TRUE condition; a 0 denotes a FALSE condition.

UIS$GET_VIEWPORT_ICON signals all errors; no condition values are returned.

**Arguments**

*wd_id*
- VMS Usage: identifier
- type: longword (unsigned)
- access: read only
- mechanism: by reference

Display window identifier. The *wd_id* argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the *wd_id* argument.

*icon_wd_id*
- VMS Usage: identifier
- type: longword (unsigned)
- access: write only
- mechanism: by reference

Icon identifier. The *icon_wd_id* argument is the address of a longword that uniquely identifies the icon.
Screen Output

$ run window_options
Is the icon is visible? F = FALSE T = TRUE

\[ \text{icon} \]
UIS$GET_VIEWPORT_POSITION

Returns the position of the lower-left corner of the display viewport relative to the lower-left corner of the screen.

Format

UIS$GET_VIEWPORT_POSITION  wd_id, retx, rety

Returns

UIS$GET_VIEWPORT_POSITION signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE for more information about the wd_id argument.

retx, rety
VMS Usage:  floating_point
type:  f_floating
access:  write only
mechanism:  by reference

Absolute device coordinate pair. The retx and rety arguments are the addresses of f_floating point longwords that receive the x and y coordinates of the display viewport origin in centimeters.

These coordinates refer to the inside of the viewport and do not include the border.
UIS$GET_VIEWPORT_POSITION

Description

UIS$GET_VIEWPORT_POSITION is useful in the exact placement of windows.

Screen Output

See UIS$GET_VIEWPORT_SIZE.
UIS$GET_VIEWPORT_SIZE

Returns the size of the display viewport associated with the specified display window.

Format

UIS$GET_VIEWPORT_SIZE wd_id, retwidth, retheight

Returns

UIS$GET_VIEWPORT_SIZE signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

retwidth, retheight
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Display viewport width and height. The retwidth and retheight arguments are the addresses of f_floating point longwords that receive the display viewport width and height in centimeters.
UIS Routine Descriptions

UIS$GET_VIEWPORT_SIZE

Screen Output

$ run get_viewpos_size
The viewport position on the display screen in absolute coordinates
x coordinate = 12.86 cm y coordinate = 1.97 cm
The physical dimensions of the display viewport
width of viewport 9.97 cm height of viewport 9.97 cm
FORTRAN PAUSE
$

[Image of screen output with grid and ellipse]
UIS$GET_VISIBILITY

Returns a boolean value that indicates whether or not the specified rectangle in the display window is visible.

Format

\[ status = \text{UIS$GET\_VISIBILITY} \; \text{vd}\_id, \; \text{wd}\_id \left[ \; x_1, \; y_1 \; \right], \; x_2, \; y_2] \]

Returns

VMS Usage: boolean
type: longword
access: write only
mechanism: by value

Boolean value returned in a status variable or R0 (VAX MACRO). The returned value, the visibility status, is a boolean TRUE only if the entire area is visible, and a boolean FALSE if even a portion of the area is occluded or clipped.

UIS$GET_VISIBILITY signals all errors; no condition values are returned.

Arguments

\text{vd}\_id

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \text{vd}\_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{vd}\_id argument.

\text{wd}\_id

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \text{wd}\_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE\_WINDOW for more information about the \text{wd}\_id argument.
World coordinates of a rectangle in the display window. The $x_1$ and $y_1$ arguments are addresses of $f_{-}$floating point numbers that define the lower-left corner of a rectangle in the display window. The $x_2$ and $y_2$ arguments are addresses of $f_{-}$floating point numbers that define the upper-right corner of a rectangle in the display window.

If the coordinates of the rectangle are not specified, the dimensions of the entire display window are used by default.

If only one point is specified, only that point is checked.
UIS$GET_WINDOW_ATTRIBUTES

Returns the value of the mask WDPL$C_ATTRIBUTES used in the creation of the specified window. See UIS$CREATE_WINDOW for more information about window and viewport attributes.

Format

\[ attributes = UIS$GET_WINDOW_ATTRIBUTES \quad wd\_id \]

Returns

VMS Usage: \textbf{mask\_longword}

- type: longword
- access: write only
- mechanism: by value

Longword mask representing one or more attributes of the specified display window and returned in the variable \textit{attributes} or R0 (VAX MACRO). See UIS$CREATE_WINDOW for more information.

UIS$GET_WINDOW_ATTRIBUTES signals all errors; no condition values are returned.

Argument

\textbf{wd\_id}

VMS Usage: \textbf{identifier}

- type: longword (unsigned)
- access: read only
- mechanism: by reference

Display window identifier. The \textit{wd\_id} argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the \textit{wd\_id} argument.
UIS$GET_WINDOW_SIZE

Returns the dimensions of the display window.

Format

UIS$GET_WINDOW_SIZE  vd_id, wd_id, x1, y1, x2, y2

Returns

UIS$GET_WINDOW_SIZE signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE DISPLAY for more information about vd_id.

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE WINDOW for more information about wd_id.

x1,y1,x2,y2
VMS Usage: floating-point
type: f_floating
access: write only
mechanism: by reference

World coordinate pairs. The x1,y1 and the x2,y2 arguments are the addresses of f_floating longwords that receive the locations of the lower-left and upper-right corners of the display window in world coordinates.
UIS$GET_WRITING_INDEX

Returns the writing color index for text and graphics output.

Format

\[ index = \text{UIS$GET\_WRITING\_INDEX} \quad vd\_id, \ atb \]

Returns

VMS Usage: longword\_unsigned
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the color map index in the variable \( index \) or R0 (VAX MACRO).

UIS$GET\_WRITING\_INDEX signals all errors; no condition values are returned.

Arguments

\( vd\_id \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \( vd\_id \) argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE.DISPLAY for more information about the \( vd\_id \) argument.

\( atb \)

VMS Usage: longword\_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The \( atb \) argument is the address of a longword integer that identifies an attribute block from which the writing color index is obtained.
$ run get_writindex
The current writing index is 1
FORTRAN PAUSE
$
UIS$GET_WRITING_MODE

Returns the writing mode.

Format

\[ \text{mode} = \text{UIS$GET\_WRITING\_MODE} \quad \text{vd\_id, atb} \]

Returns

VMS Usage: \text{longword\_unsigned}
Type: \text{longword (unsigned)}
Access: write only
Mechanism: by value

Longword value returned as a UIS writing modes in the variable \text{mode} or R0 (VAX MACRO). See Table 9-2 for more information about writing modes.

UIS$GET\_WRITING\_MODE signals all errors; no condition values are returned.

Arguments

\text{vd\_id}

VMS Usage: \text{identifier}
Type: \text{longword (unsigned)}
Access: read only
Mechanism: by reference

Virtual display identifier. The \text{vd\_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY for more information about the \text{vd\_id} argument.

\text{atb}

VMS Usage: \text{longword\_unsigned}
Type: \text{longword (unsigned)}
Access: read only
Mechanism: by reference

Attribute block number. The \text{atb} argument is the address of a longword integer that identifies an attribute block from which the writing mode is obtained.
UIS$GET_WS_COLOR

Returns the R (red), G (green), and B (blue) values associated with the workstation standard color.

Format

UIS$GET_WS_COLOR vd_id, color_id, retr, retg, retb [,wd_id]

Returns

UIS$GET_WS_COLOR signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

color_id
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Workstation standard color. The color_id argument is the address of a longword integer that identifies a symbolic code for the workstation standard color. If the color_id argument is invalid, an error is signaled.

The following table lists possible workstation standard color symbols and their current values.
UIS Routine Descriptions

UIS$GET_WS_COLOR

<table>
<thead>
<tr>
<th>Standard Color</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Background</td>
<td>UIS$C_WS_BCOLOR</td>
</tr>
<tr>
<td>Foreground</td>
<td>UIS$C_WS_FCOLOR</td>
</tr>
<tr>
<td>Black</td>
<td>UIS$C_WS_BLACK</td>
</tr>
<tr>
<td>White</td>
<td>UIS$C_WS_WHITE</td>
</tr>
<tr>
<td>Red</td>
<td>UIS$C_WS_RED</td>
</tr>
<tr>
<td>Green</td>
<td>UIS$C_WS_GREEN</td>
</tr>
<tr>
<td>Blue</td>
<td>UIS$C_WS_BLUE</td>
</tr>
<tr>
<td>Cyan</td>
<td>UIS$C_WS_CYAN</td>
</tr>
<tr>
<td>Yellow</td>
<td>UIS$C_WS_YELLOW</td>
</tr>
<tr>
<td>Magenta</td>
<td>UIS$C_WS_MAGENTA</td>
</tr>
<tr>
<td>Grey (25%)</td>
<td>UIS$C_WS_GREY25</td>
</tr>
<tr>
<td>Grey (50%)</td>
<td>UIS$C_WS_GREY50</td>
</tr>
<tr>
<td>Grey (75%)</td>
<td>UIS$C_WS_GREY75</td>
</tr>
</tbody>
</table>

**ret**

VMS Usage: floating_point

type: f_floating

access: write only

mechanism: by reference

Red value. The `ret` argument is the address of an f_floating point longword that receives the red value. The red value is in the range of 0.0 to 1.0, inclusive.

**retg**

VMS Usage: floating_point

type: f_floating

access: write only

mechanism: by reference

Green value. The `retg` argument is the address of an f_floating point longword that receives the green value. The green value is in the range of 0.0 to 1.0, inclusive.

**retb**

VMS Usage: floating_point

type: f_floating

access: write only

mechanism: by reference
Blue value. The `retb` argument is the address of an f-floating point longword that receives the blue value. The blue value is in the range of 0.0 to 1.0, inclusive.

`wd_id`
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the `wd_id` argument. If this argument is specified, then it must be a valid `wd_id` associated with the virtual display, and the returned values are the realized colors for the specific device for which the window was created.
UIS$GET_WS_INTENSITY

Returns the intensity values associated with a workstation standard color.

Format

UIS$GET_WS_INTENSITY  vd_id, color_id, reti [, wd_id]

Returns

UIS$GET_WS_INTENSITY signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

color_id
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Workstation standard color identifier. The color_id argument is the address of a longword that identifies a symbolic code for the workstation standard color. If the color_id argument is invalid, an error is signaled.

The following table lists possible workstation standard color symbols.
Standard Color | Symbol
---|---
Background | UIS$C_WS_BCOLOR
Foreground | UIS$C_WS_FCOLOR
Black | UIS$C_WS_BLACK
White | UIS$C_WS_WHITE
Red | UIS$C_WS_RED
Green | UIS$C_WS_GREEN
Blue | UIS$C_WS_BLUE
Cyan | UIS$C_WS_CYAN
Yellow | UIS$C_WS_YELLOW
Magenta | UIS$C_WS_MAGENTA
Grey (25%) | UIS$C_WS_GREY25
Grey (50%) | UIS$C_WS_GREY50
Grey (75%) | UIS$C_WS_GREY75

**reti**

VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Intensity value. The reti argument is the address of an f_floating longword that receives the intensity value. The intensity value is in the range of 0.0 to 1.0, inclusive.

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

If this argument is specified, then it must be a valid wd_id associated with the virtual display, and the returned values are the realized intensities for the specific device for which the window was created.
UIS$HLS\_TO\_RGB

Converts color representation values of hue, lightness, and saturation (HLS) to red, green, and blue (RGB) values.

Format

\[ \text{UIS$HLS\_TO\_RGB} \quad H, L, S, \text{retr}, \text{retg}, \text{retb} \]

Returns

UIS$HLS\_TO\_RGB$ signals all errors; no condition values are returned.

Arguments

\[ H \]

VMS Usage: floating_point

Type: f\_floating

Access: read only

Mechanism: by reference

Hue. The \( H \) argument is the address of an f\_floating number that defines the hue of a color.

\[ L \]

VMS Usage: floating_point

Type: f\_floating

Access: read only

Mechanism: by reference

Lightness. The \( L \) argument is the address of an f\_floating number that defines the lightness of a color.

\[ S \]

VMS Usage: floating_point

Type: f\_floating

Access: read only

Mechanism: by reference

Saturation. The \( S \) argument is the address of an f\_floating number that defines color saturation.
**ret**

VMS Usage: floating point

- type: f_floating
- access: write only
- mechanism: by reference

Red value. The `ret` argument is the address of an `f_floating` point longword that receives the red value.

**retg**

VMS Usage: floating point

- type: f_floating
- access: write only
- mechanism: by reference

Green value. The `retg` argument is the address of an `f_floating` point longword that receives the green value.

**retb**

VMS Usage: floating point

- type: f_floating
- access: write only
- mechanism: by reference

Blue value. The `retb` argument is the address of an `f_floating` point longword that receives the blue value.
UIS$HSV_TO_RGB

Converts color representation values of hue, saturation, and value (HSV) to red, green, and blue (RGB) values.

Format

UIS$HSV_TO_RGB  H, S, V, retr, retg, retb

Returns

UIS$HSV_TO_RGB signals all errors; no condition values are returned.

Arguments

\( H \)

VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Hue. The \( H \) argument is the address of an f_floating number that defines the hue of a color.

\( S \)

VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Saturation. The \( S \) argument is the address of an f_floating number that defines the saturation of a color.

\( V \)

VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Value. The \( V \) argument is the address of an f_floating number that defines the value of a color.
retr
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Red value. The retr argument is the address of an f_floating longword that receives the red color value.

retg
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Green value. The retg argument is the address of an f_floating longword that receives the green color value.

retb
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Blue value. The retb argument is the address of an f_floating longword that receives the blue color value.
**UIS$IMAGE**

Draws a raster image in a specified rectangle in the display viewport.

**Format**

```plaintext
UIS$IMAGE  vd_id, atb, x_1, y_1, x_2, y_2, rasterwidth, rasterheight, bitsperpixel, rasteraddr
```

**Returns**

UIS$IMAGE signals all errors; no condition values are returned.

**Arguments**

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

- **atb**
  - VMS Usage: longword unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Attribute block number. The `atb` argument is the address of a longword integer that identifies an attribute block that modifies the image.

- **x_1, y_1, x_2, y_2**
  - VMS Usage: floating-point
  - type: f-floating
  - access: read only
  - mechanism: by reference
  - World coordinates of the rectangle in the virtual display. The `x_1` and `y_1` arguments are the addresses of f-floating point numbers that define the lower-left corner of the rectangle in the virtual display. The `x_2` and `y_2`
arguments are the addresses of floating point numbers that define the upper-right corner of the rectangle in the virtual display.

**rasterwidth**

VMS Usage: `longword_unsigned`

*Type:* `longword (unsigned)`

*Access:* `read only`

*Mechanism:* `by reference`

Width of the raster image. The `rasterwidth` argument is the address of a longword that defines the width of the raster image in pixels.

**rasterheight**

VMS Usage: `longword_unsigned`

*Type:* `longword (unsigned)`

*Access:* `read only`

*Mechanism:* `by reference`

Height of the raster image. The `rasterheight` is the address of a longword that defines the height of the raster image in pixels.

**bitsperpixel**

VMS Usage: `longword_unsigned`

*Type:* `longword (unsigned)`

*Access:* `read only`

*Mechanism:* `by reference`

Number of bits per pixel in the raster image. The `bitsperpixel` argument is the address of a longword that defines the number of bits per pixel in the raster image. The `bitsperpixel` argument is currently required to be 1 or 8.

If the value 8 is specified for `bitsperpixel` on a single plane system, the results are unpredictable.

**rasteraddr**

VMS Usage: `vector_longword_unsigned`

*Type:* `longword_unsigned`

*Access:* `read only`

*Mechanism:* `by reference`

Bitmap image. The `rasteraddr` argument is the address of an array that defines a bitmap image. You must first create a bitmap by defining a data structure such as a record or array. When you assign values to the field or array element in the data structure, you are setting the bits of the image to be drawn by UIS$IMAGE. See the Description section for information about setting bits.
Description

The bitmap image is drawn to the display viewport as a raster image. The raster image dimensions are described by the width, height, and bits per pixel parameters. The width and height give the number of pixels in each dimension, and bits per pixel represents the number of bits that makes up each pixel. The raster is read from memory as “height” bit vectors each of which is “width” pixels long and each pixel is “bits/pixel” bits long.

If the destination rectangle is larger than the raster size by at least an integer multiple, the raster is automatically scaled on a per pixel basis to the space available. Thus, a 1 x 1 raster can be written into an arbitrarily large destination rectangle, and the entire region is filled with the pattern.

If the destination rectangle is not an exact multiple of the raster size, then the remaining space on the right and top will not be written.

The procedure for mapping values in the bitmap to the raster image is as follows:

1. Each bit in the raster is set from left-most bit to the right-most bit
2. Each row is filled from the top row to the bottom row.

**NOTE:** The raster image is not byte- or word-aligned.

The following figure illustrates the setting of bits in the bitmap.
Example

INTEGRER*2 BITMAP(20)
DATA BITMAP/2*0,2*16380,5*12,2*1020,7*12,2*0/

VD_ID=UIS$CREATE_DISPLAY(0.0,0.0,40.0,40.0,10.0,10.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION')

CALL UIS$IMAGE(VD_ID,0,0.0,0.0,20.0,20.0,16,20,1,BITMAP)
Screen Output

![Screen Output Image]

ZK:5267-86
**UIS$INSERT_OBJECT**

Inserts the specified object into the display list at the position specified by the insertion pointer. See UIS$SET_INSERTION_POSITION for information about setting the pointer in the display list.

**Format**

\[
\text{UIS$INSERT\_OBJECT} \{ \text{obj\_id} \} \{ \text{seg\_id} \}
\]

**Returns**

UIS$INSERT_OBJECT signals all errors; no condition values are returned.

**Arguments**

- **obj\_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Object identifier. The obj\_id argument is the address of a longword that uniquely identifies an object.

- **seg\_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Segment identifier. The seg\_id argument is the address of a longword that uniquely identifies a segment. See UIS$BEGIN\_SEGMENT for more information about the seg\_id argument.
**UIS$LINE**

Draws an unfilled point, line, or series of unconnected lines depending on the number of positions specified.

**Format**

\[
\text{UIS$LINE \ vd\_id, atb, } x_1, y_1 [, x_2, y_2 [\ldots x_n, y_n]]
\]

**Returns**

UIS$LINE signals all errors; no condition values are returned.

**Arguments**

- **vd\_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference

  Virtual display identifier. The \textit{vd\_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY for more information about the \textit{vd\_id} argument.

- **atb**
  - VMS Usage: longword\_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference

  Attribute block number. The \textit{atb} argument is the address of a longword integer that identifies an attribute block that modifies line style and line width or both.

- **x, y**
  - VMS Usage: floating\_point
  - type: f\_floating
  - access: read only
  - mechanism: by reference

  World coordinate pair. The \textit{x} and \textit{y} arguments are the addresses of f\_floating point numbers that define a point in the virtual display. If the arguments are repeated to specify a second position, a line is created. Up to 126 world
coordinate pairs may be specified as arguments. See the "DESCRIPTION" section below for more information about this argument.

**Description**

If one position is specified, then a point is drawn. If two positions are specified, a single vector is drawn. If more than two positions are specified, unconnected lines are drawn. Up to 252 arguments can be specified, a maximum of a 126 unconnected lines are drawn using this routine. If a larger number of points must be specified in a single call, UIS$LINE-ARRAY should be used.

The points or lines are drawn with the line pattern and width for the attribute block. UIS$LINE ignores the fill pattern attribute.

**Example**

```call uis$line(vd_id,0.3,0.5,0.5.0,15.0,5.0,5.0,7.0,15.0,7.0,5.0,29.0,15.0,29.0,5.0,11.0,15.0,11.0,5.0,13.0,15.0,2,13.0,5.0,15.0,15.0,15.0,5.0,17.0,15.0)```

A single call to UIS$LINE draws five unconnected lines.
Screen Output

[Image of a menu screen with several vertical lines drawn on it]
UIS$LINE_ARRAY

Draws an unfilled point, line, or series of unconnected lines depending on the number of positions specified. This routine performs the same functions as UIS$LINE except that x and y coordinates are stored in arrays.

Format

UIS$LINE_ARRAY  vd_id, atb, count, x_vector, y_vector

Returns

UIS$LINE_ARRAY signals all errors; no condition values are returned.

Arguments

 vd_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

 atb
VMS Usage:  longword_unsigned
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Attribute block number. The atb argument is the address of a longword integer that identifies an attribute block that modifies line style or line width or both.

 count
VMS Usage:  longword_unsigned
type:  longword (unsigned)
access:  read only
mechanism:  by reference
Number of points. The `count` argument is the address of longword integer that denotes the number of world coordinate pairs defined in the arguments `x_vector` and `y_vector`.

**x_vector, y_vector**

VMS Usage: `vector_longword_signed`  
Type: `f_floating`  
Access: `read only`  
Mechanism: `by reference`

Array of `x` and `y` world coordinates. The `x_vector` argument is the address of an array of `f_floating` numbers whose elements are the `x` world coordinate values of points defined in the virtual display. The `y_vector` argument is the address of an array of `f_floating` numbers whose elements are the `y` world coordinate values of points defined in the virtual display.

**Description**

A maximum of 32,767 points can be plotted in a single call. UIT$LINE$ARRAY is the same as UIT$LINE$ except that the `x` and `y` coordinates are specified using two arrays, each of length `count` points.
**UIS$MEASURE_TEXT**

Measures a text string as if it were output in a virtual display.

**Format**

```plaintext
UIS$MEASURE_TEXT vd_id, atb, text_string, retwidth, retheight, [,ctlid, ctllen] [,posarray]
```

**Returns**

UIS$MEASURE_TEXT signals all errors; no condition values are returned.

**Arguments**

- **vd_id**
  - VMS Usage: *identifier*
  - type: `longword (unsigned)`
  - access: `read only`
  - mechanism: `by reference`

  Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

- **atb**
  - VMS Usage: `longword_unsigned`
  - type: `longword (unsigned)`
  - access: `read only`
  - mechanism: `by reference`

  Attribute block number. The `atb` argument is the address of a longword integer that identifies an attribute block that modifies text output.

- **text_string**
  - VMS Usage: `char_string`
  - type: `character string`
  - access: `read only`
  - mechanism: `by descriptor`

  Text string. The `text_string` argument is the address of a character string descriptor of a text string.
**UIS$MEASURE_TEXT**

*retwidth, retheight*

VMS Usage: `floating_point`
Type: `f_floating`
Access: `write only`
Mechanism: `by reference`

World coordinate width. The *retwidth* and *retheight* arguments are the addresses of `f_floating` point longwords that receive the world coordinate width and height of the text.

*ctl*list*

VMS Usage: `vector_longword_unsigned`
Type: `longword (unsigned)`
Access: `read only`
Mechanism: `by reference`

Text formatting control list. The *ctl*list argument is the address of an array of longwords that describe the font, text rendition, format, and positioning of fragments of the text string. See UIS$TEXT for a description of the control list and its commands.

The control list consists of a sequence of data elements, each two longwords in length. The first longword of each element is a tag. The second longword is either a value particular to the type of element specified or zero. Following is a diagram showing the structure of a text control list.
The following table describes valid formatting commands.

<table>
<thead>
<tr>
<th>Formatting Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commands Without Values</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$C_TEXT_NOP</td>
<td>Nil operation</td>
</tr>
<tr>
<td>UIS$C_TEXT_RESTORE_POSITION</td>
<td>Restores the current writing position</td>
</tr>
<tr>
<td>UIS$C_TEXT_SAVE_POSITION</td>
<td>Saves the current writing position</td>
</tr>
<tr>
<td><strong>Commands Requiring Values</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$C_TEXT_ATB</td>
<td>Specifies an attribute block number</td>
</tr>
<tr>
<td>UIS$C_TEXT_HPOS_ABSOLUTE</td>
<td>Specifies a new current x position</td>
</tr>
<tr>
<td>UIS$C_TEXT_HPOS_RELATIVE</td>
<td>Modifies the current x position by a delta</td>
</tr>
<tr>
<td>UIS$C_TEXT_IGNORE</td>
<td>Skips $n$ characters</td>
</tr>
</tbody>
</table>

1 Second longword must be zero.
### UIS$MEASURE_TEXT

#### Formatting Command

<table>
<thead>
<tr>
<th>Formatting Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>### Commands Requiring Values</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>UIS$C_TEXT_NEW_LINE</td>
<td>Skips ( n ) new lines and positions at the left margin</td>
</tr>
<tr>
<td>UIS$C_TEXT_TAB_ABSOLUTE</td>
<td>Writes white space to the new absolute position</td>
</tr>
<tr>
<td>UIS$C_TEXT_TAB_RELATIVE</td>
<td>Writes white space to the new relative position</td>
</tr>
<tr>
<td>UIS$C_TEXT_VPOS_ABSOLUTE</td>
<td>Writes a new current y position</td>
</tr>
<tr>
<td>UIS$C_TEXT_VPOS_RELATIVE</td>
<td>Modifies the current y position by a delta</td>
</tr>
<tr>
<td>UIS$C_TEXT_WRITE</td>
<td>Writes ( n ) characters</td>
</tr>
<tr>
<td>### Commands Not Requiring a Second Longword</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>UIS$C_TEXT_END_OF_LIST</td>
<td>Terminates the control list</td>
</tr>
</tbody>
</table>

When UIS encounters illegal commands and values within the control list, it skips the invalid item and signals an error.

**ctllen**

VMS Usage: longword_unsigned  
Type: longword (unsigned)  
Access: read only  
Mechanism: by reference

Length of the text formatting control list. The ctllen argument is the address of a longword that specifies the length of the text formatting control list in longwords.

**posarray**

VMS Usage: vector_longword_signed  
Type: f_floating  
Access: write only  
Mechanism: by reference

Character position array. The posarray argument is the address of an array of longwords that receives the character positions in world coordinates, that is, relative offsets at which each character would have been displayed. Following is a diagram showing the format of the character position array.
The width and height of the text string is calculated according to the formatting described in the atb and ctllist arguments.

**Description**

UIS$MEASURE__TEXT is used in justification and text positioning applications. The routine returns the height and width of the text string in world coordinates.
Screen Output

$ run measure

string width in world coordinates = 16.95
string height in world coordinates = 4.92
The contents of the character position array are
x coordinate = 0.00  y coordinate = 0.00
x coordinate = 0.81  y coordinate = 0.00
x coordinate = 1.61  y coordinate = 0.00
x coordinate = 2.42  y coordinate = 0.00
x coordinate = 3.23  y coordinate = 0.00
x coordinate = 4.04  y coordinate = 0.00

FORTRAN PAUSE

$
**UIS$MOVE-AREA**

Shifts a portion of a virtual display to another position in the display window.

**Format**

```
UIS$MOVE-AREA vd_id, x1, y1, x2, y2, new_x, new_y
```

**Returns**

UIS$MOVE-AREA signals all errors; no condition values are returned.

**Arguments**

**vd_id**

VMS Usage: identifier

type: longword (unsigned)

access: read only

mechanism: by reference

Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

**x1, y1, x2, y2**

VMS Usage: floating_point

type: f_floating

access: read only

mechanism: by reference

World coordinates of the source rectangle. The `x1` and `y1` arguments are the addresses of f_floating point numbers that define the lower-left corner of the source rectangle. The `x2` and `y2` are the addresses of f_floating point numbers that define the upper-right corner of the source rectangle.

**new_x, new_y**

VMS Usage: floating_point

type: f_floating

access: read only

mechanism: by reference

World coordinate pair. The `new_x` and `new_y` arguments are the addresses of f_floating point numbers that define the lower-left corner of
the destination rectangle. The proportions of the coordinate space of the destination rectangle are the same as those of the source rectangle.

**Description**

Note that display objects that are only partially contained within the specified source rectangle, though partially moved within existing display windows will be completely moved within the display list.

The nonoccluding portion of the source rectangle (if any) is erased after the operation.

**NOTE:** To avoid distortion within the destination rectangle, the aspect ratios of the source rectangle and the display viewport must be equal.
Screen Output

```
FL
LF
```
UIS$MOVE_VIEWPORT

Moves the display viewport on the workstation screen.

Format

\texttt{UIS$MOVE\_VIEWPORT \ wd\_id, \ attributes}

Returns

UIS$MOVE\_VIEWPORT signals all errors; no condition values are returned.

Arguments

\textit{wd\_id}

VMS Usage: \texttt{identifier}
type: \texttt{longword (unsigned)}
access: \texttt{read only}
mechanism: \texttt{by reference}

Display window identifier. The \texttt{wd\_id} argument is the address of a
longword that uniquely identifies a display window. See UIS$CREATE\_WINDOW
for more information about the \texttt{wd\_id} argument.

\textit{attributes}

VMS Usage: \texttt{item\_list\_pair}
type: \texttt{longword}
access: \texttt{read only}
mechanism: \texttt{by reference}

Display viewport attribute list. The \texttt{attributes} argument is the address of
data structure that contains longword pairs, or \texttt{doublets}. The first longword
stores an attribute ID code and the second longword holds the attribute value
(which can be real or integer).

The following figure describes the structure of the window attributes list.
Only positional attributes are significant.
UIS$MOVE_WINDOW

Redefines the world coordinates of the specified display window.

Format

UIS$MOVE_WINDOW vd_id, wd_id, x1, y1, x2, y2

Returns

UIS$MOVE_WINDOW signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

x1, y1, x2, y2
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

World coordinates of the new display window. The x1 and y1 arguments are the addresses of f_floating point numbers that define that lower-left corner of the display window. The x2 and y2 arguments are the addresses
of floating point numbers that define the upper-right corner of the new display window.

**Description**

UIS$MOVE_WINDOW redefines the world coordinates of the specified display window. As a result, what is displayed in the associated display viewport may change. You can pan around a virtual display or scroll through a virtual display. If the display window rectangle changes dimensions or aspect ratio, then scaling is performed to map the new window size to the existing display viewport size.
UIS$NEW_TEXT_LINE

Moves the current text position along the actual path of text drawing to the starting margin, and then in the direction of the minor text path. Depending on the minor text path, the width or height of the character cell is used for spacing between characters and lines.

Format

UIS$NEW_TEXT_LINE  vd_id, atb

Returns

UIS$NEW_TEXT.getLine signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage: longword_unsigned
type: longword
access: read only
mechanism: by reference

Attribute block number. The atb argument is the address of a longword integer that identifies an attribute block that modifies text output.

Description

Font, text path, character spacing, and text slope attributes influence the behavior.
UIS$PLOT

Draws a filled or unfilled point, line, or polygon depending on the number of positions specified.

Format

UIS$PLOT vd_id, atb, x_1, y_1 [x_2, y_2 [..., x_n, y_n]]

Returns

UIS$PLOT signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The atb argument is the address of a longword integer that identifies an attribute block that modifies line style and line width or both.

x, y
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

World coordinate pair. The x and y arguments are the addresses of f_floating point numbers that define a point in the virtual display. If the arguments are repeated to specify a second position, a line is created. Up to 126 world
coordinate pairs may be specified as arguments. See the Description section below for more information about this argument.

Description

If one position is specified, then a point is drawn. If two positions are specified, a single vector is drawn. If more than two positions are specified, a connected polygon is drawn. Up to 252 arguments can be specified, giving a maximum of a 126-point polygon using this routine. If a larger number of points must be specified in a single call, UIS$PLOT-ARRAY should be used.

The points or lines are drawn with the line pattern and width for the attribute block, and if the fill pattern attribute is enabled for the attribute block, the enclosed area is filled with the current fill pattern.

NOTE: VAX PASCAL application programs should use UIS$PLOT-ARRAY to create lines and polygons.

Example

```
.
.
REAL*4 I

VD_ID=UIS$CREATE_DISPLAY(0.0,-1.1,360.0,1.1,10.0,10.0)
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','SINE CURVE')
CALL UIS$PLOT(VD_ID,0.0,0.0,360.0,0.0)
DO I=1,360
CALL UIS$PLOT(VD_ID,0,I,SIND(I))
ENDDO
.
.
```

The preceding example draws a sine curve.
Screen Output

UIS Routine Descriptions

UIS$PLOT

Sine curve
UIS$PLOT_ARRAY

Draws an unfilled or filled point, line or polygon depending on the number of positions specified. This routine performs the same functions as UIS$PLOT.

Format

UIS$PLOT_ARRAY vd_id, atb, count, x_vector, y_vector

Returns

UIS$PLOT_ARRAY signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The atb argument is the address of a longword integer that identifies an attribute block that modifies line style or line width or both.

count
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference
Number of points. The count argument is the address of longword integer that denotes the number of world coordinate pairs defined in the arguments x_vector and y_vector.

**x_vector, y_vector**

VMS Usage: vector_Longword_Signed
type: f_floating
access: read only
mechanism: by reference

Array of x and y world coordinates. The x_vector argument is the address of an array of f_floating numbers whose elements are the x world coordinate values of points defined in the virtual display. The y_vector argument is the address of an array of f_floating numbers whose elements are the y world coordinate values of points defined in the virtual display.

---

**Description**

A maximum of 65,535 points can be plotted in a single call. UIS$PLOT_ARRAY is the same as UIS$PLOT except that the x and y coordinates are specified using two arrays, each of length count points.
UIS$POP_VIEWPORT

Pops the viewport associated with the display window to the forefront of the screen, over any other viewports that currently occlude it.

Format

UIS$POP_VIEWPORT  wd_id

Returns

UIS$POP_VIEWPORT signals all errors; no condition values are returned.

Argument

wd_id

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.
Screen Output
UIS$PRESENT

Verifies that UIS software is installed on the system.

Format

\[ status = \text{UIS$PRESENT} \ [\text{major\_version}][,\text{minor\_version}] \]

Returns

VMS Usage: cond\_value
- type: longword (unsigned)
- access: write only
- mechanism: by value

Longword value returned in the variable status or R0 (VAX MACRO). A value of 1 TRUE indicates that UIS is installed on the system. Otherwise, the error status SHR$_$PROD_NOTINS is returned if UIS$PRESENT is executed on a VAX/VMS system running the stub UIS shareable image. The stub shareable image is currently installed on non-VAXstation systems.

Arguments

major\_version
- VMS Usage: word\_unsigned
- type: word (unsigned)
- access: write only
- mechanism: by reference

Major version number. The major\_version argument is the address of a word that receives the major version number. For UIS Version 3.0, the major version number 3 is returned.

minor\_version
- VMS Usage: word\_unsigned
- type: word (unsigned)
- access: write only
- mechanism: by reference

Minor version number. The minor\_version argument is the address of a word that receives the minor version number. For UIS Version 3.0, the minor version number 0 is returned.
UIS$PRIVATE

Associates application-specific data with the most recently output graphic information (graphics or text) or with the specified graphic object.

Format

```
UIS$PRIVATE { obj_id } facnum buffer vd_id
```

Returns

UIS$PRIVATE signals all errors; no condition values are returned.

Arguments

**obj_id**
- VMS Usage: identifier
- type: longword (unsigned)
- access: read only
- mechanism: by reference

Object identifier. The obj_id argument is the address of a longword that uniquely identifies an object.

**vd_id**
- VMS Usage: identifier
- type: longword (unsigned)
- access: read only
- mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

**facnum**
- VMS Usage: longword unsigned
- type: longword (unsigned)
- access: read only
- mechanism: by reference

Facility number. The facnum argument is the address of a longword that identifies the creator of the private data.
Values defined with the high bit set are reserved to DIGITAL.

**buffer**

VMS Usage: `vector_byte_unsigned`

- **type:** `byte (unsigned)`
- **access:** `read only`
- **mechanism:** `by descriptor`

Location of the private data. The **buffer** argument is a descriptor of an array of bytes. The byte array contains the private data.

---

**Description**

If you select a graphic item and store it in a file, the application-specific data will be copied with it. If nothing has been output since the beginning of a segment, the data will be associated with the segment.

Many private data items can be associated with the same graphic object.
**UIS$PUSH_VIEWPORT**

Pushes the viewport associated with the display window to the background of the screen, behind any other viewports it occludes.

**Format**

```c
UIS$PUSH_VIEWPORT wd_id
```

**Returns**

UIS$PUSH_VIEWPORT signals all errors; no condition values are returned.

**Arguments**

- **wd_id**
  - VMS Usage: *identifier*
  - type: *longword (unsigned)*
  - access: *read only*
  - mechanism: *by reference*

Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the `wd_id` argument.
UIS Routine Descriptions

UIS$PUSH_VIEWPORT

Screen Output

[Diagram showing a square and a triangle with grid lines]

[Diagram showing a triangle with a shaded pattern]
**UIS$READ_CHAR**

Allows an application to read a single character from the keyboard.

---

**Format**

\[keybuf=UIS$READ_CHAR \ kb\_id [,flags]\]

---

**Returns**

- **VMS Usage:** longword\_unsigned
- **Type:** longword (unsigned)
- **Access:** write only
- **Mechanism:** by reference

Longword integer returned key information in the variable `keybuf` or R0 (VAX MACRO). The `keybuf` variable is the address of a longword buffer that receives the key information. The low two bytes are the key code. The key codes are based on the codes found in the module $SMGDEF in SYS$LIBRARY:STARLET.MLB. Bit \(<31>\) is set to 1 to indicate that the key is down. For additional information about `keybuf`, see the DESCRIPTION section.

UIS$READ_CHAR signals all errors; no condition values are returned.

---

**Arguments**

- **kb\_id**
  - **VMS Usage:** identifier
  - **Type:** longword (unsigned)
  - **Access:** read only
  - **Mechanism:** by reference

Virtual keyboard identifier. The `kb\_id` argument is the address of a longword that uniquely identifies a virtual keyboard. See UIS$CREATE\_KB for more information about the `kb\_id` argument.

- **flags**
  - **VMS Usage:** mask\_longword
  - **Type:** longword (unsigned)
  - **Access:** read only
  - **Mechanism:** by reference

Flags. The `flags` argument is the address of a longword mask that controls whether UIS$READ_CHAR executes immediately or until a character is
received. If bit \(<0>\) is clear, UIS$READ_CHAR waits until a character is typed. If bit \(<0>\) is set and no character is currently waiting, UIS$READ_CHAR returns a value of 0.

Specify UIS$M_NOWAIT to set bit \(<0>\) in the longword mask.

**Description**

The following table defines the bits in the high- and lower-order word.

<table>
<thead>
<tr>
<th>Field</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-16</td>
<td>UIS$W_KEY_CODE</td>
</tr>
<tr>
<td>28</td>
<td>UIS$V_KEY_SHIFT(^1)</td>
</tr>
<tr>
<td>29</td>
<td>UIS$V_KEY_CTRL(^1)</td>
</tr>
<tr>
<td>30</td>
<td>UIS$V_KEY_LOCK(^1)</td>
</tr>
<tr>
<td>31</td>
<td>UIS$V_KEY_DOWN(^1)</td>
</tr>
</tbody>
</table>

\(^1\)This symbol is returned as SET if the corresponding key on the keyboard was down when the input event occurred.
UIS$RESIZE_WINDOW

Deletes the old display window and creates a new window. The routine reexecutes the display list of the virtual display, if it exists.

Format

UIS$RESIZE_WINDOW vd_id, wd_id [,new_abs_x, new_abs_y] [,new_width, new_height] [,new_wc_x1, new_wc_y1, new_wc_x2, new_wc_y2]

Returns

UIS$RESIZE_WINDOW signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.
UIS$RESIZE_WINDOW

**new_abs_x, new_abs_y**

VMS Usage: floating_point

type: f_floating

access: read only

mechanism: by reference

Absolute device coordinate pair. The new_abs_x and new_abs_y arguments are the addresses of f_floating point numbers that define the location of the newly resized display viewport in centimeters.

**new_width, new_height**

VMS Usage: floating_point

type: f_floating

access: read only

mechanism: by reference

Width and height of the newly resized display viewport. The width and height arguments are the addresses of f_floating point numbers that define the width and height of the newly resized display viewport in centimeters.

**new_wc_x1, new_wc_y1, new_wc_x2, new_wc_y2**

VMS Usage: floating_point

type: f_floating

access: read only

mechanism: by reference

World coordinates of the newly resized display window. The x1 and y1 arguments are the addresses of f_floating point numbers that define the location of the lower-left corner of the resized display window in world coordinates. The x2 and y2 arguments are the addresses of f_floating point numbers that define the location of the upper-right corner of the resized display window in world coordinates.

**Description**

The viewport resize operation of the user interface uses UIS$RESIZE_WINDOW by default.

If UIS$RESIZE_WINDOW is called outside an AST routine, the value of all unspecified parameters defaults to those specified in UIS$CREATE_WINDOW.

If UIS$RESIZE_WINDOW is called within an AST routine, the value of all unspecified parameters defaults to the current values associated with the absolute position, dimensions, and world coordinate range of the stretchy box.
UIS$RESTORE_CMS_COLORS

Resets the appropriate entries in the hardware color map to the current RGB values in the color map segment.

Format

UIS$RESTORE_CMS_COLORS  cms_id

Returns

UIS$RESTORE_CMS_COLORS signals all errors; no condition values are returned.

Argument

cms_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Color map segment identifier. The cms_id argument is the address of a longword that uniquely identifies the color map segment. See UIS$CREATE_COLOR_MAP_SEG for more information about the cms_id argument.

Description

An application running in an unfavorable environment (where other applications are sharing hardware color map entries) can use UIS$RESTORE_CMS_COLORS to reestablish all its entries when it is the active application. Normally, this call is not required since the UIS window management software transparently handles the multiplexing of the hardware color map. If possible, the update is synchronized to the display’s vertical retrace.
UIS$RGB_TO_HLS

Converts red, green, and blue (RGB) color representation values to hue, lightness, and saturation (HLS) color values.

Format

UIS$RGB_TO_HLS  R, G, B, reth, retl, rets

Returns

UIS$RGB_TO_HLS signals all errors; no condition values are returned.

Arguments

R
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference
Red value. The R argument is the address of a longword that defines the red color value.

G
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference
Green value. The G argument is the address of a longword that defines the green color value.

B
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference
Blue value. The B argument is the address of a longword that defines the blue color value.
**ret**

VMS Usage: floating_point

type: f_floating

access: write only

mechanism: by reference

Hue. The reth argument is the address of an f_floating point longword that receives the hue color value.

**retl**

VMS Usage: floating_point

type: f_floating

access: write only

mechanism: by reference

Lightness. The retl argument is the address of an f_floating point longword that receives the lightness value.

**ret**

VMS Usage: floating_point

type: f_floating

access: write only

mechanism: by reference

Saturation. The rets argument is the address of an f_floating point longword that receives the color saturation value.
UIS$RGB_TO_HSV

Converts color representation values of red, green, and blue (RGB) to hue, saturation, and value (HSV).

Format

UIS$RGB_TO_HSV R, G, B, reth, rets, retv

Returns

UIS$RGB_TO_HSV signals all errors; no condition values are returned.

Arguments

R
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Red value. The R argument is the address of an f_floating number that defines the red color value.

G
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Green value. The G argument is the address of an f_floating number that defines the green color value.

B
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Blue value. The B argument is the address of an f_floating number that defines the blue color value.
UIS Routine Descriptions

UIS$RGB_TO_HSV

**reth**
VMS Usage: floating-point
type: f_floating
access: write only
mechanism: by reference

Hue. The **reth** argument is the address of an f_floating longword that receives the hue value.

**retv**
VMS Usage: floating-point
type: f_floating
access: write only
mechanism: by reference

Value. The **retv** argument is the address of an f_floating longword that receives the value of the color.

**rets**
VMS Usage: floating-point
type: f_floating
access: write only
mechanism: by reference

Saturation. The **rets** argument is the address of an f_floating longword that receives the saturation value.
UIS$SET_ADDOPT_AST

Specifies a user-requested AST routine to be executed whenever the "Additional Options" menu item is selected in the Window Options Menu.

Format

    UIS$SET_ADDOPT_AST  wd_id, [astadr [,astprm]]

Returns

    UIS$SET_ADDOPT_AST signals all errors; no condition values are returned.

Arguments

    wd_id
    VMS Usage: identifier
    type: longword (unsigned)
    access: read only
    mechanism: by reference

    Display window identifier. The wd_id argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

    astadr
    VMS Usage: ast_procedure
    type: procedure entry mask
    access: read only
    mechanism: by reference

    AST routine. The astadr argument is the address of a procedure entry mask of a user-supplied subroutine that is called at AST level whenever the "Additional Options" item in the Window Options Menu is selected.

    astprm
    VMS Usage: user_arg
    type: longword (unsigned)
    access: read only
    mechanism: by reference

    AST parameter. The astprm argument is the address of a single argument or data structure such as an array or record to be used by the AST routine.
Calls to UIS$SET_ADDOPT_AST in VAX FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

**Description**

Additional options are disabled by default.
UIS$SET_ALIGNED_POSITION

Sets the current position for text output at the upper-left corner of the character cell of the next character. See UIS$GET_ALIGNED_POSITION for information about returning text alignment data.

Format

UIS$SET_ALIGNED_POSITION  \textit{vd\_id, atb, x, y}

Returns

UIS$SET_ALIGNED_POSITION signals all errors; no condition values are returned.

Arguments

\textit{vd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \textit{vd\_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the \textit{vd\_id} argument.

\textit{atb}

VMS Usage: longword\_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The \textit{atb} is the address of a longword that identifies an attribute block.

\textit{x, y}

VMS Usage: floating\_number
type: f\_floating
access: read only
mechanism: by reference

World coordinate pair. The \textit{x} and \textit{y} arguments are the addresses of f\_floating point numbers that define the current position for text output.
UIS$SET_ALIGNED_POSITION

**Description**

UIS$SET_ALIGNED_POSITION is useful in applications that know the position of the upper left corner, but also do not know enough about the font baseline to determine the proper alignment point. The position is converted into the proper alignment point using the font specified in the given attribute block.

UIS maintains the current text position as a baseline position.

**Screen Output**

One reason is as good as fifty

Text alignment along top of the character cell
UIS$SET_ARC_TYPE

Sets the current arc type used in the UIS$ELLIPSE and UIS$CIRCLE routines.

Format

**UIS$SET_ARC_TYPE**  \textit{vd}_id, \textit{iatb}, \textit{oatb}, \textit{arc_type}

Returns

UIS$SET_ARC_TYPE signals all errors; no condition values are returned.

Arguments

\textit{vd}_id
- VMS Usage: \textit{identifier}
- type: \textit{longword} (unsigned)
- access: read only
- mechanism: by reference

Virtual display identifier. The \textit{vd}_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the \textit{vd}_id argument.

\textit{iatb}
- VMS Usage: \textit{longword} (unsigned)
- type: \textit{longword} (unsigned)
- access: read only
- mechanism: by reference

Input attribute block number. The \textit{iatb} argument is the address of a longword integer that identifies an attribute block.

\textit{oatb}
- VMS Usage: \textit{longword} (unsigned)
- type: \textit{longword} (unsigned)
- access: read only
- mechanism: by reference

Output attribute block number. The \textit{oatb} argument is the address of a longword that identifies a newly modified attribute block that controls the appearance of an arc.
**UIS$SET_ARC_TYPE**

*arc_type*

VMS Usage: longword_unsigned

type: longword (unsigned)

access: read only

mechanism: by reference

Arc type code. The *arc_type* argument is the address of a longword value that redefines the attribute setting of the input attribute block. Specify one of the following constants UIS$C_ARC_PIE, UIS$C_CHORD, or UIS$C_ARC_OPEN.

The following table lists symbols for arc types and their functions.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_ARC_CHORD</td>
<td>Draws a line connecting the end points of the arc</td>
</tr>
<tr>
<td>UIS$C_ARC_OPEN</td>
<td>Does not draw any lines (default)</td>
</tr>
<tr>
<td>UIS$C_ARC_PIE</td>
<td>Draws radii to the end points of the arc</td>
</tr>
</tbody>
</table>
Screen Output

pie, open, and chord
UIS$SET_BACKGROUND_INDEX

Sets the background color index for text and graphics output.

Format

UIS$SET_BACKGROUND_INDEX vd_id, iatb, oatb, index

Returns

UIS$SET_BACKGROUND_INDEX signals all errors; no condition values are returned.

Arguments

**vd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

**iatb**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Input attribute block number. The `iatb` argument is the address of a longword integer that specifies the attribute block to be modified.

**oatb**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Output attribute block number. The `oatb` argument is the address of a longword integer that identifies the newly modified attribute block.
**index**

VMS Usage: `longword_unsigned`

- Type: `longword (unsigned)`
- Access: `read only`
- Mechanism: `by reference`

Color map index. The **index** argument is the address of a longword that specifies the color map index. If the index exceeds the maximum index for the associated color map, an error is signaled.
UIS$SET_BUTTON_AST

Allows an application to find out when a button on the pointing device is depressed or released in a given rectangle within a display viewport.

Format

UIS$SET_BUTTON_AST    vd_id, wd_id [,astadr [,astprm] ]
                          ,keybuf] [, x1, y1, x2, y2]

Returns

UIS$SET_BUTTON_AST signals all errors; no condition values are returned.

Arguments

\textit{vd\_id}

VMS Usage: identifier

\begin{itemize}
  \item type: \texttt{longword (unsigned)}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

Virtual display identifier. The \texttt{vd\_id} argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the \texttt{vd\_id} argument.

\textit{wd\_id}

VMS Usage: identifier

\begin{itemize}
  \item type: \texttt{longword (unsigned)}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

Display window identifier. The \texttt{wd\_id} argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE\_WINDOW for more information about the \texttt{wd\_id} argument.

\textit{astadr}

VMS Usage: ast\_procedure

\begin{itemize}
  \item type: \texttt{procedure entry mask}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

AST routine. The \texttt{astadr} argument is the address of an entry mask to a procedure that is called at AST level whenever a pointer button is depressed.
or released. To cancel the AST-enabling request of UIS$SET_BUTTON_AST, specify 0 in the astadr argument.

**astprm**

VMS Usage: `user_arg`

type: longword (unsigned)

access: read only

mechanism: by reference

AST parameter. The astprm argument is the address of a single argument or data structure, such as a record or an array, to be passed to the AST routine. Calls to UIS$SET_BUTTON_AST in FORTRAN application programs should be coded as follows: `%REF(%LOC(astprm))`.

**keybuf**

VMS Usage: `address`

type: longword (unsigned)

access: write only

mechanism: by reference

Key buffer. The keybuf argument is the address of a longword buffer that receives button information whenever a pointer button is depressed or released. The low two bytes are the key code. The buttons are located on the left, center, and right of the device and are defined as UIS$C.POINTER_BUTTON_1, UIS$C.POINTER_BUTTON_2, UIS$C.POINTER_BUTTON_3, and UIS$C.POINTER_BUTTON_4 respectively.

The bit <31> is set to 1 if the button has been pressed, and 0 if the button has been released. The buffer is not overwritten with subsequent button transitions until the AST routine completes.

The following table defines the bits in the high- and lower-order word.

<table>
<thead>
<tr>
<th>Field</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-16</td>
<td>UIS$W.KEY_CODE</td>
</tr>
<tr>
<td>28</td>
<td>UIS$V.KEY_SHIFT</td>
</tr>
<tr>
<td>29</td>
<td>UIS$V.KEY_CTRL</td>
</tr>
<tr>
<td>30</td>
<td>UIS$V.KEY_LOCK</td>
</tr>
<tr>
<td>31</td>
<td>UIS$V.KEY_DOWN</td>
</tr>
</tbody>
</table>

1 This symbol is returned as SET if the corresponding key on the keyboard was down when the input event occurred.
UIS Routine Descriptions

UIS$SET_BUTTON_AST

$x_1, y_1, x_2, y_2$

VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

World coordinates of a rectangle in the display window. The $x_1$ and $y_1$ arguments are the addresses of f_floating point numbers that define the lower-left corner of a rectangle in the display window. The $x_2$ and $y_2$ arguments are the addresses of f_floating point numbers that define the upper-right corner of a rectangle in the display window. If no rectangle is specified, the entire display window is assumed.

Description

This function can be called any number of times for different rectangles within the same display window or many display windows.

To disable UIS$SET_BUTTON_AST, omit the astadr, astprm, and keybuf arguments.

Pointer Region Priorities

UIS pointer regions are placed on the VAXstation screen in the order in which they are created. Therefore, if you create two overlapping viewports, and then use UIS$SET_POINTER_PATTERN, UIS$SET_BUTTON_AST, or UIS$SET_POINTER_AST to define different pointer patterns for each viewport, the correctness of the result will depend on the order in which you both created the viewports and defined the cursor regions. For example, if you create the viewports and define the cursor patterns in the following manner, the viewport 1 cursor pattern will have a higher priority than viewport 2 cursor pattern in the overlapping region.

1. Create viewport 1
2. Create overlapping viewport 2
3. Define viewport 2 cursor pattern
4. Define viewport 1 cursor pattern
The preceding example causes the unexpected result that the viewport 1 cursor pattern will take priority over the viewport 2 cursor pattern in the overlapping region. This problem can be corrected by creating the viewports and defining the cursor patterns in the same order. To correct the problem, create the viewports and define cursor patterns in the following order:

1. Create viewport 1
2. Define viewport 1 cursor pattern
3. Create overlapping viewport 2
4. Define viewport 2 cursor pattern

The solution is for either UIS or your application to always pop the viewport before defining the cursor region for it.
UIS$SET_CHAR_ROTATION

Sets the angle of character rotation, measured counterclockwise relative to the actual path of text drawing.

Format

UIS$SET_CHAR_ROTATION  vd_id,iatb,oatb,angle

Returns

UIS$SET_CHAR_ROTATION signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type:     longword (unsigned)
access:   read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

iatb
VMS Usage: longword unsigned
type:     longword (unsigned)
access:   read only
mechanism: by reference

Input attribute block number. The iatb argument is the address of a number that identifies an attribute block to be modified.

oatb
VMS Usage: longword unsigned
type:     longword (unsigned)
access:   read only
mechanism: by reference

Output attribute block number. The oatb argument is the address of a modified attribute block.
**UIS$SET_CHAR_ROTATION**

**angle**

VMS Usage: *floating_point*
type: *f_floating*
access: *read only*
mechanism: *by reference*

Angle of character rotation. The *angle* argument is the address of an f_floating point number that defines the angle of character rotation in degrees counterclockwise about the baseline point relative to the actual path of text drawing.

---

**Description**

For example, an angle of 0 degrees (the default) means that the character’s baseline vector and the actual path of text drawing form an angle of 0 degrees.

---

**Example**

```plaintext
CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_5')
CALL UIS$SET_TEXT_MARGINS(VD_ID,1,1,1.0,20.0,18.0)
CALL UIS$SET_ALIGNED_POSITION(VD_ID,1,1.0,20.0)
DO I=0,360,40
   CALL UIS$TEXT(VD_ID,1,'Slow down---')
   CALL UIS$SET_CHAR_ROTATION(VD_ID,1,2,FLOAT(I))
   CALL UIS$TEXT(VD_ID,2,'Avoid skidding!')
   CALL UIS$NEW_TEXT_LINE(VD_ID,2)
ENDDO
```
Screen Output

Slow down---Avoid skidding!
Slow down---Avoid skidding!
Slow down---Avoid skidding!
Slow down---Avoid skidding!
Slow down---Avoid skidding!
Slow down---Avoid skidding!
Slow down---Avoid skidding!
Slow down---Avoid skidding!
**UIS$SET_CHAR_SIZE**

Sets the world coordinate size of a specified character set.

### Format

```
UIS$SET_CHAR_SIZE  vd_id, iatb, oatb [,char] [,width] [,height]
```

### Returns

UIS$SET_CHAR_SIZE signals all errors; no condition values are returned.

### Arguments

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

- **iatb**
  - VMS Usage: longword_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Input attribute block number. The `iatb` argument is the address of a longword that identifies an attribute block to be modified.

- **oatb**
  - VMS Usage: longword_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Output attribute block number. The `oatb` argument is the address of a longword that identifies a modified attribute block.
**UIS Routine Descriptions**

**UIS$SET_CHAR_SIZE**

**char**
VMS Usage: char_string  
type: character string  
access: read only  
mechanism: by descriptor

Single character. The char argument is the address of a descriptor of a single character.

If char is not specified, the widest character in the font is chosen.

**width**
VMS Usage: floating_point  
type: f_float  
access: read only  
mechanism: by reference

Character width. The width argument is the address of an f_float longword that defines the character width in world coordinates.

See DESCRIPTION section for information about omitting the width argument.

**height**
VMS Usage: floating_point  
type: f_float  
access: read only  
mechanism: by reference

Character height. The height argument is the address of an f_float longword that defines the character height in world coordinates.

See DESCRIPTION section for information about omitting the height argument.

---

**Description**

To disable character scaling, omit all of the following arguments: char, width, and height.

To scale characters to their nominal size as specified in the font, do not specify width and height. Scaling is only visible when you use a window that does not have the same aspect ratio as the virtual display. The particular character you specify in the argument char makes no difference in this case.
If you specify either **width** or **height** only, characters are scaled to the size you specify and in the direction you specify. In the unspecified direction, characters are scaled so as to maintain the same ratio of width and height as the unscaled characters.
Screen Output

today is the scholar of yesterday

today is the scholar of yesterday

today is the scholar of yesterday

today is the scholar of yesterday

today is the scholar of yesterday

today is the scholar of yesterday

today is the scholar of yesterday

today is the scholar of yesterday

today is the scholar of yesterday

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today is the scholar of yesterday

today is the scholar of yesterday
UIS$SET_CHAR_SLANT

Sets the character slant angle.

Format

\texttt{UIS$SET\_CHAR\_SLANT \ vd\_id, iatb, oatb, angle}

Returns

UIS$SET\_CHAR\_SLANT$ signals all errors; no condition values are returned.

Arguments

\textit{vd\_id}

VMS Usage: \texttt{identifier}

\begin{itemize}
  \item type: \texttt{longword\ (unsigned)}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

Virtual display identifier. The \texttt{vd\_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY$ for more information about the \texttt{vd\_id} argument.

\textit{iatb}

VMS Usage: \texttt{longword\_unsigned}

\begin{itemize}
  \item type: \texttt{longword\ (unsigned)}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

Input attribute block number. The \texttt{iatb} argument is the address of a number that identifies an attribute block to be modified.

\textit{oatb}

VMS Usage: \texttt{longword\_unsigned}

\begin{itemize}
  \item type: \texttt{longword\ (unsigned)}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

Output attribute block number. The \texttt{oatb} argument is the address of a number that identifies a modified attribute block.
angle
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Angle of character slant. The angle argument is the address of an f_floating point number that defines the angle of character slant in degrees.

The character slant angle refers to an angle formed by the character's up vector and baseline vector.

For example, 0 degrees (the default) indicates that the character up vector is perpendicular to the baseline vector, and the character is not slanted. A counterclockwise movement from 0 degrees produces a negative angle of character slant. A clockwise movement from 0 degrees produces a positive angle of character slant.

Screen Output
UIS$SET_CHAR_SPACING

Sets the attribute that controls the amount of additional spacing between text characters (x factor) and between text lines (y factor) when the UIS$NEW_LINE_TEXT routine is used.

Format

UIS$SET_CHAR_SPACING  vd_id, iatb, oatb, dx, dy

Returns

UIS$SET_CHAR_SPACING signals all errors; no condition values are returned.

Arguments

vd_id

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

iatb

VMS Usage: longwordUnsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Input attribute block number. The iatb argument is the address of a longword value that identifies an attribute block to be modified. Either the attribute block 0 or a previously modified attribute block may be specified.

oatb

VMS Usage: longwordUnsigned
type: longword (unsigned)
access: read only
mechanism: by reference
UIS Routine Descriptions

UIS$SET_CHAR_SPACING

Output attribute block number. The oatb argument is the address of a longword value that identifies the newly modified attribute block that controls the spacing between characters.

**dx**

VMS Usage: floating_point  
type: f_floating  
access: read only  
mechanism: by reference

Additional x factor spacing. The dx argument is the address of an f_floating point longword value that defines the x spacing factor. If this argument is 0.0, no additional spacing is performed. Negative values are allowed, characters may overlap.

**dy**

VMS Usage: floating_point  
type: f_floating  
access: read only  
mechanism: by reference

Additional y factor spacing. The dy argument is an f_floating point longword value that defines the y spacing factor. If this argument is 0.0, no additional spacing is performed. Negative values are allowed, characters may overlap.

### Description

The values of the x and y factors are multiplied by the width or height of the character, and the resulting value is used as the additional spacing distance.

Proportionally spaced characters maintain their appropriate spacing.

The default is no extra spacing.
UIS Routine Descriptions

UIS\$SET_CHAR_SPACING

Screen Output

```
x spacing
so what!!
so what!!
so what!!
so what!!
so what!!
so what!!
so what!!
so what!!
so what!!
so what!!
so what!!
```

ZX:5254 86
<table>
<thead>
<tr>
<th>Nature does nothing in vain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nature does nothing in vain</td>
</tr>
<tr>
<td>Nature does nothing in vain</td>
</tr>
<tr>
<td>Nature does nothing in vain</td>
</tr>
<tr>
<td>Nature does nothing in vain</td>
</tr>
<tr>
<td>Nature does nothing in vain</td>
</tr>
<tr>
<td>Nature does nothing in vain</td>
</tr>
<tr>
<td>Nature does nothing in vain</td>
</tr>
</tbody>
</table>
watch out!
watch out!
watch out!
watch out!
watch out!
watch out!
watch out!
**UIS$SET_CLIP**

Sets a clipping rectangle in the virtual display and enables clipping for this attribute block.

---

**Format**

```
UIS$SET_CLIP vd_id, iatb, oatb [,x1, y1, x2, y2]
```

---

**Returns**

UIS$SET_CLIP signals all errors; no condition values are returned.

---

**Arguments**

- **vd_id**
  - VMS Usage: **identifier**
  - type: **longword (unsigned)**
  - access: **read only**
  - mechanism: **by reference**
  
  Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

- **iatb**
  - VMS Usage: **longword_unsigned**
  - type: **longword (unsigned)**
  - access: **read only**
  - mechanism: **by reference**
  
  Input attribute block number. The `iatb` argument is the address of a longword value that identifies an attribute block to be modified. Either the attribute block 0 or a previously modified attribute block can be specified.

- **oatb**
  - VMS Usage: **longword_unsigned**
  - type: **longword (unsigned)**
  - access: **read only**
  - mechanism: **by reference**
  
  Output attribute block number. The `oatb` argument is the address of a longword value that identifies a newly modified attribute block.
**UIS Routine Descriptions**

**UIS$SET_CLIP**

\(x_1, y_1, x_2, y_2\)

**VMS Usage:** `floating_point`

**type:** `f_floating`

**access:** `read only`

**mechanism:** `by reference`

World coordinates of the clipping rectangle. The \(x_1\) and \(y_1\) arguments are the addresses of `f_floating` point numbers that define the lower left corner of the clipping rectangle in world coordinates. The \(x_2\) and \(y_2\) arguments are the addresses of `f_floating` point numbers that define the upper right corner of the clipping rectangle in world coordinates. Only graphic objects and portions of graphic objects drawn within the clipping rectangle are seen.

If the world coordinates of the clipping rectangle corners are not specified, then clipping is disabled for this attribute block.

---

**Example**

```plaintext
WD_ID1=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','AFTER')
CALL UIS$SET_CLIP(VD_ID,0,1,5.0,5.0,15.0,15.0)
CALL UIS$PLOT(VD_ID,1,2.0,2.0,2.0,18.0,18.0,2.0,18.0,2.0,2.0,2.0,2.0)
CALL UIS$PLOT(VD_ID,1,2.0,2.0,18.0,18.0,)
CALL UIS$PLOT(VD_ID,1,2.0,18.0,18.0,2.0)
```
Screen Output

Before:

After:
**UIS$SET_CLOSE_AST**

Specifies a user-requested AST routine to be executed when the "Delete" menu item is selected in the Window Options Menu.

---

**Format**

```
UIS$SET_CLOSE_AST  wd_id [,astadr [,astprm]]
```

---

**Returns**

UIS$SET_CLOSE_AST signals all errors; no condition values are returned.

---

**Arguments**

- **wd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the `wd_id` argument.

- **astadr**
  - VMS Usage: ast_procedure
  - type: procedure entry mask
  - access: read only
  - mechanism: by reference
  
  AST routine. The `astadr` argument is the address of a procedure entry mask of a user-supplied subroutine that is called at AST level whenever the delete item in the Window Options Menu is selected. See the Description section for more information about disabling close AST routines.

- **astprm**
  - VMS Usage: user_arg
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  AST parameter. The `astprm` is the address of a single argument or data structure, such as an array or record, to be used by the AST routine. Calls to
UIS\$SET\_CLOSE\_AST in FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

---

**Description**

Typically, UIS\$SET\_CLOSE\_AST is called to override the default window closing behavior. If a CLOSE AST routine are not specified, UIS calls UIS\$CLOSE\_WINDOW by default. If this behavior is not sufficient, the application program may call UIS\$SET\_CLOSE\_AST with its own close routine.

If the application has previously enabled close ASTs, but no longer needs to do special tasks when closing a window, it may specify UIS\$CLOSE\_WINDOW as the astadr parameter to reenable the default UIS action.

Closing a window may be completely disabled in any of the following ways:

- Specify 0 in the astadr argument
- Specify only the wd\_id argument.
- Omit the astadr and astprm arguments.

When window closing is disabled, the “Delete” menu item in the Window Options Menu changes from boldface to lightface.

To reenable the default window closing behavior, specify UIS\$C\_DEFAULT\_CLOSE as the astadr argument in a subsequent call to UIS\$SET\_CLOSE\_AST.
UIS$SET_COLOR

Sets a single entry in the virtual color map associated with the virtual display. The color map entry is an RGB value for a specific color.

Format

UIS$SET_COLOR \ vd_id, index, R, G, B

Returns

UIS$SET_COLOR signals all errors; no condition values are returned.

Arguments

\vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the \vd_id argument.

index
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Color map index. The index argument is the address of a longword value that identifies an entry in the color map. If the index exceeds the maximum index for the associated color map, an error is signaled.

R
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Red value. The R argument is the address of an f_floating point number that defines the red value. The red value is in the range of 0.0 to 1.0, inclusive.
UIS $SET\_COLOR

**G**
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Green value. The G argument is the address of an f_floating point number that defines the green value. The green value is in the range of 0.0 to 1.0, inclusive.

**B**
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Blue value. The B argument is the address of an f_floating point number that defines the blue value. The blue value is in the range of 0.0 to 1.0, inclusive.

---

**Description**

To maximize compatibility between monochrome and color display devices, UIS $SET\_COLOR performs an internal transformation of the red, green, and blue values when the actual workstation display is monochromatic.

A single intensity value in the range of 0.0 to 1.0 is derived using the following formula.

\[ I = (0.30 \times R) + (0.59 \times G) + (0.11 \times B) \]

On monochrome systems, this derived intensity value is then compared to 0.5. If the value is greater than or equal to 0.5, then white pixels are written. Otherwise, black pixels are written.
UIS$SET_COLORS

Sets more than one color entry in the virtual color map.

Format

`UIS$SET_COLORS vd_id, index, count, r_vector, g_vector, b_vector`

Returns

UIS$SET_COLORS signals all errors; no condition values are returned.

Arguments

`vd_id`

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

`index`

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Starting color map index. The `index` argument is the address of a longword that defines the starting index in the virtual color map.

If the index exceeds the maximum index for the virtual color map, an error is signaled.

`count`

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

The `count` argument specifies the number of entries to be set in the virtual color map.
Number of indices. The count argument is the address of a longword that contains the number of indices including the starting index of the color map. If the count exceeds the maximum number of virtual color map entries, an error is signaled.

\textit{r\_vector}

\textbf{VMS Usage:} vector\_longword\_signed  
\textbf{type:} f\_floating  
\textbf{access:} read only  
\textbf{mechanism:} by reference

Red values. The \textit{r\_vector} argument is the address of an array of f\_floating point numbers that define the red values.

\textit{g\_vector}

\textbf{VMS Usage:} vector\_longword\_signed  
\textbf{type:} f\_floating  
\textbf{access:} read only  
\textbf{mechanism:} by reference

Green values. The \textit{g\_vector} argument is the address of an array of f\_floating point numbers that define the green values.

\textit{b\_vector}

\textbf{VMS Usage:} vector\_longword\_signed  
\textbf{type:} f\_floating  
\textbf{access:} read only  
\textbf{mechanism:} by reference

Blue values. The \textit{b\_vector} argument is the address of an array of f\_floating point numbers that define the blue values.

\section*{Description}

On color and intensity systems, color map updates of greater than approximately 80 entries cause visible screen disturbance, which appears as a black bar across the top inch of the display screen. This anomaly is caused by a hardware restriction that precludes large lookup table updates within the vertical blanking interval of the raster scan.
Illustration

Red Value | Green Value | Blue Value
----------|------------|------------
Red Value  | Green Value| Blue Value |
Red Value  | Green Value| Blue Value |
Red Value  | Green Value| Blue Value |

Color Map Index

<table>
<thead>
<tr>
<th>Color Index</th>
<th>Red</th>
<th>Green</th>
<th>Blue</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.0</td>
<td>0.25</td>
<td>0.36</td>
</tr>
<tr>
<td>1</td>
<td>0.15</td>
<td>0.38</td>
<td>0.40</td>
</tr>
<tr>
<td>2</td>
<td>0.30</td>
<td>0.50</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Count
UIS$SET_EXPAND_ICON_AST

Specifies a user-requested AST routine to be executed whenever an icon is to be replaced with its associated display viewport.

Format

UIS$SET_EXPAND_ICON_AST  wd_id [,astadr [,astprm]]

Returns

UIS$SET_EXPAND_ICON_AST signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \texttt{wd} argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the \texttt{wd_id} argument.

astadr
VMS Usage: ast_procedure
type: procedure entry mask
access: read only
mechanism: by reference

AST routine. The \texttt{astadr} argument is the address of an entry mask of a user-written procedure called at AST level whenever the "Expand Icon" menu item in the Window Options Menu is selected.

To cancel the AST-enabling request of UIS$SET_EXPAND_ICON_AST, specify 0 in the \texttt{astadr} argument.

astprm
VMS Usage: user_arg
type: longword (unsigned)
access: read only
mechanism: by reference
AST parameter. The astprm argument is the address of a single argument or data structure, such as an array or record, to be passed to the AST routine. Calls to UIS$SET_EXPAND_ICON_AST in VAX FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

Description

The user interface for replacing an icon with a display viewport can be disabled by calling UIS$SET_EXPAND_ICON_AST with the wd_id argument only.

To reenable the default behavior of UIS$SET_EXPAND_ICON_AST, specify the constant UIS$C_DEFAULT_EXPAND_ICON in the astadr argument.
UIS$SET_FILL_PATTERN

Sets the current fill pattern used in area fill operations.

Format

UIS$SET_FILL_PATTERN vd_id, iatb, oatb [,index]

Returns

UIS$SET_FILL_PATTERN signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

iatb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Input attribute block number. The iatb argument is the address of a longword integer value that identifies an attribute block to be modified. Either the attribute block 0 or a previously modified attribute block may be specified.

oatb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference
Output attribute block number. The oatb argument is the address of a longword integer value that identifies the newly modified attribute block that controls the fill pattern.

index
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Index of the fill pattern in the current font. The index argument is the address of a longword value that identifies a character glyph in the current font. The value specified in the index argument modifies the current fill pattern index specified in the input attribute block.

If the index argument is not specified, fill patterns are disabled.

Description
The fill pattern is expressed as a character glyph in the font currently associated with the same attribute block. There are usually several font files reserved to store fill patterns (rasters). At present, fill patterns of width greater than 32 bits are not supported.

UIS provides a font file containing a variety of fill patterns. This font file is referenced by UIS$FILL_PATTERNS. Entries in the UIS$FILL_PATTERNS font are symbolically referenced by the symbols PATT$C_xxx.

To get a listing of all fill pattern symbols available to application programs, see Section 6.6 for a list of symbol definition files.

Refer to Appendix D for illustrations showing each UIS fill pattern.

Example

```
CALL UIS$SET_FONT(VD_ID, 0, 1, 'UIS$FILL_PATTERNS')  
CALL UIS$SET_FILL_PATTERNS(VD_ID, 1, 1, PATT$C_VERT1_7)  
CALL UIS$SET_FONT(VD_ID, 1, 2, 'UIS$FILL_PATTERNS')  
CALL UIS$SET_FILL_PATTERNS(VD_ID, 2, 2, PATT$C_HORIZ1_7)  
CALL UIS$CIRCLE(VD_ID, 1, 10, 0, 10, 0, 8, 0)  
```
The preceding example fills the circle with a vertical fill pattern and a square with a horizontal fill pattern. Please note that enabling fill patterns for a single graphic object is a two-step process:

1. Modify the font attribute specifying the fill pattern file in SYS$FONT. Use the logical name UIS$FILL_PATTERNS.
2. Modify the fill pattern file specifying the fill pattern to be used.
UIS$SET_FONT

Specifies the fonts to be used in text drawing (UIS$TEXT) and area filling (UIS$PLOT).

Format

UIS$SET_FONT vd_id, iatb, oatb, font_id

Returns

UIS$SET_FONT signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword value that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the argument vd_id.

iatb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Input attribute block number. The iatb argument is the address of a longword value that specifies the attribute block to be modified. The font attribute in the input attribute block is modified to reflect the new font file specified in the font_id argument. Either the attribute block 0 or a previously modified attribute block may be specified.

oatb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference
Output attribute block number. The oatb argument is the address of a longword value that specifies the newly modified attribute block.

**font_id**

VMS Usage: char_string
type: character string
access: read only
mechanism: by descriptor

Font file name string. The font_id argument is the address of a character string descriptor pointing to a file specification that identifies the desired font. System font files are located in the SYS$FONT directory. Fonts should be specified using only the file name. You do not need to specify the file type.

---

**Description**

See UIS$SET_FILL__PATTERN.
UIS$SET_GAIN_KB_AST

Specifies an AST routine to be executed when the specified virtual keyboard is attached to the physical keyboard.

Format

UIS$SET_GAIN_KB_AST  kb_id [,astadr [,astprm]]

Returns

UIS$SET_GAIN_KB_AST signals all errors; no condition values are returned.

Arguments

kb_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual keyboard identifier. The kb_id argument is the address of a longword value that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the kb_id argument.

astadr
VMS Usage: ast_procedure
type: procedure mask
access: read only
mechanism: by reference

AST routine. The astadr argument is the address of an entry mask to a procedure that is called at AST level whenever a specified virtual keyboard is attached to the physical keyboard.

astprm
VMS Usage: user_arg
type: longword (unsigned)
access: read only
mechanism: by reference

AST parameter. The astprm argument is the address of a single argument or data structure, such as an array or record, to be used by the AST routine.
Calls to UIS$SET_GAIN_KB_AST in FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

---

**Description**

To disable UIS$SET_GAIN_KB_AST, omit the *astadr* and *astprm* arguments.
**UIS$SET_INSERTION_POSITION**

Positions the editing pointer in the display list.

**Format**

```
UIS$SET_INSERTION_POSITION { obj_id
  seg_id
  vd_id
},[flags]
```

**Returns**

UIS$SET_INSERTION_POSITION signals all errors; no condition values are returned.

**Arguments**

- **obj_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Object identifier. The obj_id argument is the address of a longword that uniquely identifies an object. See the Description section for information about using this argument.

- **seg_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Segment identifier. The seg_id argument is the address of a longword that uniquely identifies the segment. When seg_id is specified as the first argument, the second argument is not specified. See the Description section for information about using this argument. See also UIS$BEGIN_SEGMENT for more information about the seg_id argument.
**UIS$SET_INSERTION_POSITION**

- **vd_id**
  - **VMS Usage:** identifier
  - **type:** longword (unsigned)
  - **access:** read only
  - **mechanism:** by reference
  
  Virtual display identifier. The *vd_id* argument is the address of a longword that uniquely identifies the virtual display. See the Description section for information about using this argument. See also UIS$CREATE_DISPLAY for more information about the *vd_id* argument.

- **flags**
  - **VMS Usage:** mask_longword
  - **type:** longword (unsigned)
  - **access:** read only
  - **mechanism:** by reference
  
  Flags. The *flags* argument is the address of a longword mask whose bits define how entries are added to the display list.

  The following table lists the flags and their functions.

<table>
<thead>
<tr>
<th>Flags</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$M_DL_INSERT_AT_BEGIN</td>
<td>Inserts object before first object in the specified structure.</td>
</tr>
<tr>
<td>UIS$M_DL_INSERT_AFTER_OBJECT</td>
<td>Inserts object before specified object in the same segment.</td>
</tr>
<tr>
<td>UIS$M_DL_INSERT_BEFORE_OBJECT</td>
<td>Inserts object after specified object in the same segment.</td>
</tr>
</tbody>
</table>

See the DESCRIPTION section for more information about how these flags are evaluated.

**Description**

UIS$SET_INSERTION_OBJECT examines different options in the *flags* argument depending on the type of object you specify in the first argument. The following table lists the effect of the flags on the different types of objects.
<table>
<thead>
<tr>
<th>Flags Checked</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Specifying the Virtual Display Identifier</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$M_DL_INSERT_AT_BEGIN&lt;sup&gt;1&lt;/sup&gt;</td>
<td>If this bit is set, the editing pointer is placed at the beginning of the root segment and all new objects are inserted there. If this bit is not set, the editing pointer is placed at the end of the root segment and all new objects are appended to the end of the root segment.</td>
</tr>
<tr>
<td><strong>Specifying the Segment Identifier</strong></td>
<td></td>
</tr>
<tr>
<td>All three bits&lt;sup&gt;2&lt;/sup&gt;</td>
<td>If any bit is set, UIS$SET_INSERTION_POSITION sets the editing pointer at the place directed by that bit. If no bits are set, the editing pointer is placed at the end of the specified segment and any new objects are appended to the end of the specified segment.</td>
</tr>
<tr>
<td><strong>Specifying the Object Identifier</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$M_DL_INSERT_AFTER_OBJECT&lt;sup&gt;1&lt;/sup&gt;</td>
<td>If any bit is set, UIS$SET_INSERTION_POSITION sets the editing pointer at the place directed by that bit. If no bits are set, the editing pointer is placed at the specified object and any new objects are inserted before the specified object.</td>
</tr>
<tr>
<td>UIS$M_DL_INSERT_BEFORE_OBJECT</td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup>If UIS$M_DL_INSERT_BEFORE_OBJECT or UIS$M_DL_INSERT_AFTER_OBJECT are set, the routine signals an error.<br>
<sup>2</sup>If two bits are set, the routine signals an error.
UIS$SET_INTENSITIES

Loads one or more intensity values in the virtual color map.

Format

UIS$SET_INTENSITIES  vd_id, index, count, i_vector

Returns

UIS$SET_INTENSITIES signals all errors; no condition values are returned.

Arguments

`vd_id`
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

`index`
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Starting color map index. The `index` argument is the address of a longword that identifies the starting color map index in the virtual color map.

If an index exceeds the maximum index for the virtual color map, an error is signaled.

`count`
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Number of indices. The `count` argument is the address of a longword that defines the number of indices in the virtual color map (including the starting index) whose entries are to be loaded with intensity values.
If `count` exceeds the maximum number of virtual color map entries, an error is signaled.

`i_vector`

VMS Usage: `vector_longword_signed`

- type: `f_float`
- access: `read only`
- mechanism: `by reference`

Intensity values. The `i_vector` argument is the address of an array of `f_float` point numbers that define the intensity values of the virtual color map entries.

---

**Illustration**

![Illustration of virtual color map entries and intensity values](image-url)
UIS$SET_INTENSITY

Loads a single entry in the virtual color map with an intensity value.

Format

UIS$SET_INTENSITY  vd_id, index, I

Returns

UIS$SET_INTENSITY signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword value that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

index
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Color map index. The index argument is the address of a longword value that identifies an entry in the color map. If the index exceeds the maximum index for the associated color map, an error is signaled.

I
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Intensity value. The I argument is the address of an f_floating point number that defines the intensity. The intensity value is in the range of 0.0 to 1.0, inclusive.
Illustration

- Intensity Value
  - 0.75 Intensity Value

Color Map Index
UIS$SET_KB_AST

 Associates a key strike with the execution of a user-written AST routine.

Format

UIS$SET_KB_AST  \textit{kb\_id [,astadr [,astprm],keybuf]}

Returns

UIS$SET_KB_AST signals all errors; no condition values are returned.

Arguments

\texttt{kb\_id}

VMS Usage: identifier

\begin{itemize}
  \item type: longword (unsigned)
  \item access: read only
  \item mechanism: by reference
\end{itemize}

Virtual keyboard identifier. The \texttt{kb\_id} argument is the address of a longword value that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the \texttt{kb\_id} argument.

\texttt{astadr}

VMS Usage: ast\_procedure

\begin{itemize}
  \item type: procedure entry mask
  \item access: read only
  \item mechanism: by reference
\end{itemize}

AST routine. The \texttt{astadr} argument is the address of the entry mask to a procedure to be called at AST level whenever a key is struck. To cancel a previous AST-enabling request of UIS$SET_KB_AST, specify 0 as the \texttt{astadr} argument.

\texttt{astprm}

VMS Usage: user\_arg

\begin{itemize}
  \item type: longword (unsigned)
  \item access: read only
  \item mechanism: by reference
\end{itemize}

AST parameter. The \texttt{astprm} argument is the address of a single argument or data structure, such as an array or record to be passed to the AST routine.
Calls to UIS$SET_KB_AST in FORTRAN application programs that use this argument should be coded as follows: %REF(%LOC(astprm)).

**keybuf**

VMS Usage: address
type: longword (unsigned)
access: read only
mechanism: by reference

Key buffer. The keybuf argument is the address of a longword buffer that receives the key information with the execution of each AST routine. The low two bytes are the key code. The key codes are based on the codes found in the module $SMGDEF in SYS$LIBRARY:STARLET.MLB. Bit <31> is set to 1 to indicate that the key is down. The AST routine is called only on the downstroke of the key. The buffer is not overwritten with subsequent keys until the AST routine completes.

The following table defines the bits in the high- and lower-order word.

<table>
<thead>
<tr>
<th>Field</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-16</td>
<td>UIS$W_KEY_CODE</td>
</tr>
<tr>
<td>28</td>
<td>UIS$V_KEY_SHIFT1</td>
</tr>
<tr>
<td>29</td>
<td>UIS$V_KEY_CTRL1</td>
</tr>
<tr>
<td>30</td>
<td>UIS$V_KEY_LOCK1</td>
</tr>
<tr>
<td>31</td>
<td>UIS$V_KEY_DOWN1</td>
</tr>
</tbody>
</table>

1 This symbol is returned as SET if the corresponding key on the keyboard was down when the input event occurred.

**Description**

The terminal emulators use this routine to get all keyboard input. Other applications that perform asynchronous single character input can also use UIS$SET_KB_AST.

To disable UIS$SET_KB_AST, omit the astadr and astprm arguments.
UIS$SET_KB_ATTRIBUTES

Modifies the keyboard characteristics.

Format

UIS$SET_KB_ATTRIBUTES  kb_id [,enable_items]
                        [,disable_items] [,click_volume]

Returns

UIS$SET_KB_ATTRIBUTES signals all errors; no condition values are returned.

Arguments

kb_id
VMS Usage: identifier
type:     longword (unsigned)
access:   read only
mechanism: by reference

Virtual keyboard identifier. The kb_id argument is the address of a longword that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the kb_id argument.

enable_items
VMS Usage: mask_longword
type:     longword (unsigned)
access:   read only
mechanism: by reference

Keyboard characteristics to be enabled. The enable_items argument is the address of a longword mask that identifies the keyboard characteristics to be enabled.

disable_items
VMS Usage: mask_longword
type:     longword (unsigned)
access:   read only
mechanism: by reference
Keyboard characteristics to be disabled. The **disable_items** argument is the address of a longword mask that identifies the keyboard characteristics to be disabled.

**click_volume**

VMS Usage: **longword_unsigned**  
Type: **longword (unsigned)**  
Access: **read only**  
Mechanism: **by reference**

Click volume level. The **click_volume** argument is the address of a longword value that modifies the keyboard click volume for keyboard input to this window. The value is in the range 1 to 8, where the value 1 is the minimum volume level, and the value 8 is the maximum volume level. The default volume level is controlled by the workstation setup menu mechanism.

**Description**

All keyboard characteristics will be in effect only when the physical keyboard is attached to the specified virtual keyboard. Each virtual keyboard maintains its own keyboard characteristics and the human interface automatically switches the characteristics when the keyboard is associated with another virtual keyboard.

The enable and disable item lists are longword masks containing bits designating the characteristics to be enabled or disabled. The valid bits in the keyboard characteristics enable and disable masks are:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$M_KB_AUTORPT</td>
<td>Enable/disable keyboard autorepeat</td>
</tr>
<tr>
<td>UIS$M_KB_KEYCLICK</td>
<td>Enable/disable keyboard keyclick</td>
</tr>
<tr>
<td>UIS$M_KB_UDF6</td>
<td>Enable/disable up button transitions for [F8] to [F10] keys</td>
</tr>
<tr>
<td>UIS$M_KB_UDF11</td>
<td>Enable/disable up button transitions for [F11] to [F14] keys</td>
</tr>
<tr>
<td>UIS$M_KB_UDF17</td>
<td>Enable/disable up button transitions for [F17] to [F20] keys</td>
</tr>
<tr>
<td>UIS$M_KBHelpDO</td>
<td>Enable/disable up button transitions for [HELP] and [DO] keys</td>
</tr>
<tr>
<td>UIS$M_KB_UDE1</td>
<td>Enable/disable up button transitions for [E1] to [E6] keys</td>
</tr>
</tbody>
</table>

1 By default down button transitions are enabled.
UIS Routine Descriptions

UIS$SET_KB_ATTRIBUTES

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$M_KB_ARROW</td>
<td>Enable/disable up button transitions for arrow keys</td>
</tr>
<tr>
<td>UIS$M_KB_KEYPAD</td>
<td>Enable/disable up button transitions for numeric keypad keys</td>
</tr>
</tbody>
</table>

1By default down button transitions are enabled.

Example

```
enable_items=UIS$M_KB_HELPDO .OR. UIS$M_KB_UDE1 .OR. UIS$M_KB_ARROW
disable_items=UIS$M_KB_AUTORPT .OR. UIS$M_KB_KEYCLICK
CALL UIS$SET_KB_ATTRIBUTES(KB_ID, ENABLE_ITEMS, DISABLE_ITEMS)
```

The preceding example describes how to enable and disable more than one keyboard characteristic at a time.
UIS$SET_KB_COMPOSE2

Loads a two-stroke compose sequence table for the specified virtual keyboard.

Format

UIS$SET_KB_COMPOSE2  kb_id [,table, tablelen]

Returns

UIS$SET_KB_COMPOSE2 signals all errors; no condition values are returned.

Arguments

kb_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Virtual keyboard identifier. The kb_id argument is the address of a longword value that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the kb_id argument.

Table
VMS Usage:  vector_longword_unsigned
type:  longword array
access:  read only
mechanism:  by reference

Compose table. The table argument is the address of an array that identifies the compose table. If no table is specified, the system default table is reestablished.

Tablelen
VMS Usage:  word_unsigned
type:  word
access:  read only
mechanism:  by reference

Length of the compose table in bytes. The tablelen argument is the address of word that defines the length of the compose table in bytes.
Description

You can use compose sequences to create characters that do not exist as standard keys on your keyboard.

Two-stroke sequences can be used on all keyboards except the North American keyboard. Two-stroke sequences do not use the COMPOSE key. Although faster to use than the three-stroke sequence, two-stroke sequences are limited to sequences starting with the following nonspacing diacritical marks: grave accent (‘), acute accent (´), circumflex accent (ˆ), tilde mark (~), diaeresis mark (¨), and the ring mark. Instead of using the COMPOSE key, as in a three-stroke sequence, you use a nonspacing diacritical mark to initiate the two-stroke sequence. You then enter a standard character that, together with that diacritical mark, results in a valid compose sequence.

Please refer to the MicroVMS Workstation Video Device Driver Manual for a description of this table and the macros to generate it. An application wishing to modify a table can use these macros to build a new table.

The MicroVMS Workstation contains a copy of the DIGITAL standard two-stroke compose table residing within the driver. This can be changed by performing a call to the SYS$QIO system service to the QVSS device driver.

NOTE: DIGITAL standard two-stroke compose sequences are not supported on the North American keyboard.
UIS$SET_KB_COMPOSE3

Loads a three-stroke compose sequence for the specified virtual keyboard.

Format

UIS$SET_KB_COMPOSE3  kb_id [,table, tablelen]

Returns

UIS$SET_KB_COMPOSE3 signals all errors; no condition values are returned.

Arguments

kb_id
VMS Usage:  identifier
type:        longword (unsigned)
access:      read only
mechanism:   by reference

Virtual keyboard identifier. The kb_id argument is the address of a longword value that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the kb_id argument.

table
VMS Usage:  vector_longword_unsigned
type:        longword array
access:      read only
mechanism:   by reference

Compose table. The table argument is the address of an array that identifies the compose table.

tablelen
VMS Usage:  word Unsigned
type:        word
access:      read only
mechanism:   by reference

Length of the compose table in bytes. The tablelen argument is the address of a word that defines the length of the compose table in bytes.
Description

You can use compose sequences to create characters that do not exist as standard keys on your keyboard. There are two types of compose sequences: two-stroke sequences and three-stroke sequences.

Three-stroke sequences can be used on all keyboards. They are performed by first pressing the \texttt{COMPOSE} key and then pressing two standard keys.

Please refer to the \textit{MicroVMS Workstation Video Device Driver Manual} for a description of this table and the macros to generate it. An application wishing to modify a table can use these macros to build a new table.

The MicroVMS Workstation contains a copy of the DIGITAL standard three-stroke compose tables residing within the driver. This can be changed by performing a call to the \texttt{SYS$QIO} system service to the QVSS device driver.
UIS$SET_KB_KEYTABLE

Loads a keyboard equivalence table for the specified virtual keyboard.

Format

UIS$SET_KB_KEYTABLE  kb_id [,table, tablelen]

Returns

UIS$SET_KB_KEYTABLE signals all errors; no condition values are returned.

Arguments

kb_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Virtual keyboard identifier. The kb_id argument is the address of a longword that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the kb_id argument.

table
VMS Usage:  vector_longword_unsigned
type:  longword array
access:  read only
mechanism:  by reference

Keyboard table. The table argument is the address of an array that contains the keyboard table. If no table is specified, the system default table is reestablished.

tablelen
VMS Usage:  word unsigned
type:  word
access:  read only
mechanism:  by reference

Length of the keyboard table. The tablelen argument is the address of a word that specifies the length of the keyboard table in bytes.
UIS$SET_KB_KEYTABLE is a routine that lets you change the ASCII character returned by a key on the keyboard. This allows for customization of the keyboard mapping to suit specific needs.

**Keyboard Table Description and Macros**

Please refer to the *MicroVMS Workstation Video Device Driver Manual* for a description of the table and the macro to build it. An application wishing to modify a table can use these macros to build a new table.

**Keyboard Table Modification Using the Programming Interface**

The MicroVMS Workstation contains a copy of the North American table established as the default keyboard table. You can modify the default keyboard table at the driver (QVSS) level by calling the SYS$QIO system service.

**Keyboard Table Modification Through the User Interface**

If you want to create a keyboard table that any user can load using the Workstation Setup menus, see the command file DVORAK.COM in the directory SYS$EXAMPLES. It provides an example of how to create, compile, and install the DVORAK simplified keyboard. The user interface can be used to modify the default key table.
UIS$SET_LINE_STYLE

Sets the line style bit vector.

Format

UIS$SET_LINE_STYLE vd_id, iatb, oatb, style

Returns

UIS$SET_LINE_STYLE signals all errors; no condition values are returned.

Arguments

vd_id

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

iatb

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Input attribute block number. The iatb argument is the address of a longword integer that specifies an attribute block to be modified.

oatb

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Output attribute block number. The oatb argument is the address of a longword integer that specifies the newly modified attribute block that controls the line style.
**UIS$SET_LINE_STYLE**

**style**

VMS Usage: *mask_longword*

Type: *longword*

Access: *read only*

Mechanism: *by reference*

Line style bit vector. The *style* argument is the address of a longword bit vector that specifies whether to use foreground or background when drawing each pixel. It is repeated as many times as necessary to draw all the pixels in the line.

---

**Example**

```plaintext
CALL UIS$SET_LINE_STYLE(VD_ID, 0, 1, 'FFFFFFFF0'x)
CALL UIS$PLOT(VD_ID, 0.0, 0.0, 5.0, 20.0)

CALL UIS$SET_LINE_STYLE(VD_ID, 0, 2, 'FFFOFFFO'x)
CALL UIS$PLOT(VD_ID, 2.0, 0.0, 10.0, 20.0)
```

The preceding example produces the first two dashed lines shown in the next section.
UIS Routine Descriptions

UIS\$SET\_LINE\_STYLE

Screen Output

![Screen Output Diagram](image-url)
UIS$SET_LINE_WIDTH

Sets the width of lines drawn on the screen.

Format

`UIS$SET_LINE_WIDTH vd_id, iatb, oatb, width [,mode]`

Returns

UIS$SET_LINE_WIDTH signals all errors; no condition values are returned.

Arguments

`vd_id`

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

`iatb`

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Input attribute block number. The `iatb` argument is the address of a longword that specifies an attribute block to be modified.

`oatb`

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Output attribute block number. The `oatb` argument is the address of a longword that specifies an attribute block that controls line width.
UIS Routine Descriptions
UIS$SET_LINE_WIDTH

**width**
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Width of the line. The width argument is the address of an floating point number that defines the line width. See the DESCRIPTION section for more information about specifying the line width with UIS$C_WIDTH_WORLD. The default value is 1.

**mode**
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Mode. The mode argument is the address of a longword that indicates whether the line width should be interpreted as an absolute number of pixels or as an x world coordinate width. Specify the mode using one of the following constants:

- UIS$C_WIDTH_PIXELS
- UIS$C_WIDTH_WORLD

If mode is not specified, line width is interpreted as an absolute number of pixels (UIS$C_WIDTH_PIXELS).

See DESCRIPTION for more information about the constant UIS$C_WIDTH_WORLD.

---

**Description**

The line width is specified as a floating point number that is multiplied by the normal line width to produce line width actually drawn.

If you specify 0.0 in the width argument when the mode argument is UIS$C_WIDTH_WORLD, the minimum line width is generated.
Example

```
CALL UIS$SET_LINE_WIDTH(VD_ID,0,1,2.0,WDPL$C_WIDTH_WORLD)
CALL UIS$PLOT(VD_ID,1,0.0,0.0,10.0,20.0)
CALL UIS$SET_LINE_WIDTH(VD_ID,0,2,4.0,WDPL$C_WIDTH_WORLD)
CALL UIS$PLOT(VD_ID,2,0.0,0.0,15.0,20.0)
```

The preceding example describes how to specify line width as x world coordinate width.
Screen Output
UIS$SET_LOSE_KB_AST

Enables an AST routine that is executed when the specified virtual keyboard is detached from the physical keyboard.

Format

UIS$SET_LOSE_KB_AST  kb_id [,astadr [,astprm]]

Returns

UIS$SET_LOSE_KB_AST signals all errors; no condition values are returned.

Arguments

*kb_id*

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual keyboard identifier. The *kb_id* argument is the address of a longword that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the *kb_id* argument.

*astadr*

VMS Usage: ast_procedure
type: procedure entry mask
access: read only
mechanism: by reference

AST routine. The *astadr* argument is the address of the entry mask to a procedure that is called at AST level whenever the virtual keyboard is disconnected from the physical keyboard.

*astprm*

VMS Usage: user_arg
type: longword (unsigned)
access: read only
mechanism: by reference

AST parameter. The *astprm* argument is the address of a single argument or data structure, such as an array or record, to be passed to the AST routine.
Calls to UIS$SET_LOSE_KB_AST in VAX FORTRAN application programs should reference this argument as follows: %REF(%LOC(astprm)).

---

**Description**

To cancel the AST-enabling request of UIS$SET_LOSE_KB_AST, specify 0 in the **astadr** argument or omit the **astadr** and **astprm** arguments.
UIS$SET_MOVE_INFO_AST

Enables an AST routine execution whenever the specified display viewport has been moved.

Format

UIS$SET_MOVE_INFO_AST  wd_id, [,astadr [,astprm]]

Returns

UIS$SET_MOVE_INFO_AST signals all errors; no condition values are returned.

Arguments

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The **wd_id** argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the **wd_id** argument.

**astadr**

VMS Usage: ast_procedure
type: procedure entry mask
access: read only
mechanism: by reference

AST routine. The **astadr** argument is the address of an entry mask to a procedure that is called at AST level whenever the specified display viewport is moved.

**astprm**

VMS Usage: user_arg
type: longword (unsigned)
access: read only
mechanism: by reference

AST parameter. The **astprm** argument is the address of a single argument or data structure, such as an array or record, that is passed to the AST routine.
Calls to UIS$SET_MOVE_INFO_AST in VAX FORTRAN application programs should code this argument as follows: %REF(%LOC(astprm)).

**Description**

A MOVE notification AST can be used when an image needs to keep several display viewports in a particular arrangement. If one is moved, the AST routine can recreate the other display viewports in the correct positions around the moved viewport.

To cancel the AST-enabling request of UIS$SET_MOVE_INFO_AST, perform any of the following actions:

- Specify the **wd_id** argument only.
- Specify 0 in the optional **astadr** argument.
- Omit the **astadr** and **astprm** arguments.
UIS$SET_POINTER_AST

Allows an application to find out when the pointer is moved within, into, and out of a specified rectangle in the display window.

Format

`UIS$SET_POINTER_AST vd_id, wd_id [,astadr [,astprm]] [,x1, y1, x2, y2] [,exitastadr [,exitastprm]]`

Returns

UIS$SET_POINTER_AST signals all errors; no condition values are returned.

Arguments

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

- **wd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  
  Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

- **astadr**
  - VMS Usage: ast_procedure
  - type: procedure entry mask
  - access: read only
  - mechanism: by reference
  
  Specifies the address of the pointer motion routine that is called when the pointer enters, moves within, or leaves the specified rectangle in the display window.
AST routine. The astadr argument is the address of the entry mask to a procedure that is called at AST level whenever the pointer is moved within a rectangle in the virtual display.

To cancel the AST-enabling request of UIS$SET_POINTER_AST for this argument only, specify 0 in the astadr argument and the coordinates of the rectangle.

\texttt{astprm}

**VMS Usage:** user_arg  
**type:** longword (unsigned)  
**access:** read only  
**mechanism:** by reference

AST parameter. The astprm argument is the address of a single argument or data structure, such as an array or record, passed to the AST routine. Calls to UIS$SET_POINTER_AST in VAX FORTRAN application programs should be coded as follows: \%REF(\%LOC(astprm)).

\(x_1, y_1, x_2, y_2\)

**VMS Usage:** floating_point  
**type:** f_floating  
**access:** read only  
**mechanism:** by reference

World coordinates of the rectangle. The \(x_1\) and \(y_1\) arguments are the addresses of f_floating point numbers that define the lower-left corner of the rectangle of the display window. The \(x_2\) and \(y_2\) arguments are the addresses of f_floating point numbers that define the upper-right corner of the rectangle of the display window.

If no rectangle is specified, the entire display window is assumed.

To cancel an AST-enabling request, specify 0 in either the astadr or the exitastadr arguments or both and the coordinates of the rectangle.

\texttt{exitastadr}

**VMS Usage:** ast_procedure  
**type:** procedure entry mask  
**access:** read only  
**mechanism:** by reference

Exit AST routine. The exitastadr argument is the address of the entry mask to a procedure that is called at AST level whenever the pointer leaves the rectangle.

To cancel the AST-enabling request of UIS$SET_POINTER_AST for the EXIT AST routine only, specify 0 in the exitastadr argument and the coordinates of the rectangle.
UIS$SET_POINTER_AST

**exitastprm**

VMS Usage: user_arg  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Exit AST parameter. The `exitastprm` argument is the address of a single argument or data structure, such as an array or record, to be passed to the AST routine. Calls to UIS$SET_POINTER_AST in FORTRAN application programs should be coded as follows: `%REF(%LOC(exitastprm))`.

**Description**

The Set Pointer AST routine also allows an application to keep track of the pointer in its own way. This routine can be called any number of times for different rectangles.

Note that an application need not enable both AST routines. It may specify one or the other.

UIS$SET_POINTER_AST can be used by the application to highlight the display or some other application-specific function, as the user moves the pointer over specific areas of the display window. This might be used to define a number of regions within a menu, and execute an AST routine when the pointer enters or leaves any of these regions.

If both AST routines are enabled and the value 0 is specified in the `astadr` argument, the first AST routine is canceled.

To disable AST-enabling behavior for pointers entering a region, omit the `astadr` and `astprm` arguments.

To disable AST-enabling behavior for pointers leaving a region, omit the `exitastadr` and `exitastprm` arguments.

**Pointer Region Priorities**

UIS pointer regions are placed on the VAXstation screen in the order in which they are created. Therefore, if you create two overlapping viewports, and then use UIS$SET_POINTER_PATTERN, UIS$SET_BUTTON_AST, or UIS$SET POINTER_AST to define different pointer patterns for each viewport, the correctness of the result will depend on the order in which you both created the viewports and defined the cursor regions. For example, if you create the viewports and define the cursor patterns in the following manner, the viewport 1 cursor pattern will have a higher priority than viewport 2 cursor pattern in the overlapping region.
1. Create viewport 1
2. Create overlapping viewport 2
3. Define viewport 2 cursor pattern
4. Define viewport 1 cursor pattern

The preceding example causes the unexpected result that the viewport 1 cursor pattern will take priority over the viewport 2 cursor pattern in the overlapping region. This problem can be corrected by creating the viewports and defining the cursor patterns in the same order. To correct the problem, create the viewports and define cursor patterns in the following order:

1. Create viewport 1
2. Define viewport 1 cursor pattern
3. Create overlapping viewport 2
4. Define viewport 2 cursor pattern

The solution is for either UIS or your application to always pop the viewport before defining the cursor region for it.
UIS$SET_POINTER_PATTERN

Allows an application to specify a special pointer cursor pattern for a specified rectangle in the virtual display.

Format

UIS$SET_POINTER_PATTERN vd_id, wd_id

[.pattern_array,
 pattern_count, activex,
 activey] [, x1, y1, x2, y2]
[.flags]

Returns

UIS$SET_POINTER_PATTERN signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.
**pattern_array**

VMS Usage: `vector_word_unsigned`

type: `word_unsigned`

access: `read only`

mechanism: `by reference`

16- x 16-bit cursor pattern. The `pattern_array` argument is the address of one or more 16-bit arrays of 16 words that represents a bitmap image of the cursor pattern.

You can define two patterns that are executable on color and intensity systems using two arrays—a color plane and a mask plane. However, monochrome systems use a single array to specify the cursor pattern.

If two arrays are specified in an application running on a single-plane system, the first array is used.

**NOTE:** The bitmap image of the new pointer pattern is mapped in reverse order to the display screen.

**pattern_count**

VMS Usage: `longword_unsigned`

type: `longword (unsigned)`

access: `read only`

mechanism: `by reference`

Number of 16- x 16-bit cursor patterns defined. The `pattern_count` argument is the address of a longword that contains the number of cursor pattern arrays defined in the `pattern_array` argument.

**activex, activey**

VMS Usage: `longword_unsigned`

type: `longword (unsigned)`

access: `read only`

mechanism: `by reference`

The `activex` and `activey` arguments are used to specify the actual bit in the cursor pattern that should be used to calculate the current pointer position. The arguments are expressed as bit offsets from the lower-left corner of the cursor pattern.

\( x_1, y_1, x_2, y_2 \)

VMS Usage: `floating_point`

**World coordinates of the rectangle in the virtual display.** The \( x_1 \) and \( y_1 \) arguments are the addresses of \( f \_floating \) point numbers that define the
lower-left corner of the rectangle in the display window. The \( x_2 \) and \( y_2 \) arguments are the addresses of floating point numbers that define the upper-right corner of the rectangle in the display window.

**flags**

VMS Usage: longword_mask  
Type: longword (unsigned)  
Access: read only  
Mechanism: by reference

Flags. The flags argument is the address of a longword mask whose bits determine whether or not the cursor is confined to the display window rectangle.

When specified, UIS$M_BIND_POINTER sets the appropriate bit in the mask.

**Description**

UIS$SET_POINTER_PATTERN allows an application to specify a special pointer pattern to be used when the pointer is within the display window region specified by the optional rectangle. If no rectangle is given, then the entire display window is assumed. This function can be called any number of times for different rectangles.

To disable UIS$SET_POINTER_PATTERN, omit the pattern_array, pattern_count, activex, activey, and flags arguments.
UIS$SET_Pointer_Position

Specifies a new current pointer position in world coordinates. It is only effective if the new pointer position is within the specified display window and visible.

Format

\[ \text{status} = \text{UIS$SET\_POINTER\_POSITION} \; \text{vd}\_id, \text{wd}\_id, x, y \]

Returns

VMS Usage: boolean  
type: longword  
access: write only  
mechanism: by value

Boolean value returned in a status variable or R0 (VAX MACRO). A status of 1 is returned, if the operation is successful, otherwise a 0 is returned.

UIS$SET\_POINTER\_POSITION signals all errors; no condition values are returned.

Arguments

vd\_id

VMS Usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Virtual display identifier. The vd\_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE\_DISPLAY for more information about the vd\_id argument.

wd\_id

VMS Usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Display window identifier. The wd\_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE\_WINDOW for more information about the wd\_id argument.
UIS Routine Descriptions
UIS$SET_POINTER_POSITION

\[ x, y \]
VMS Usage: \texttt{floating\_point}
type: \texttt{f\_floating}
access: \texttt{read only}
mechanism: \texttt{by reference}

World coordinates of the new pointer position. The \( x \) and \( y \) arguments are the addresses of \texttt{f\_floating} point numbers that define the new pointer position.
UIS$SET_POSITION

Sets the current position for text output. The current position is the point of alignment on the baseline of the next character to be output.

Format

\texttt{UIS$SET\_POSITION \ vd\_id, x,y}

Returns

UIS$SET\_POSITION$ signals all errors; no condition values are returned.

Arguments

\texttt{vd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The \texttt{vd\_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY$ for more information about the \texttt{vd\_id} argument.

\texttt{x, y}

VMS Usage: floating_point
type: \texttt{f\_floating}
access: read only
mechanism: by reference

\texttt{x} and \texttt{y} world coordinate position. The \texttt{x} and \texttt{y} arguments are the addresses of \texttt{f\_floating} point numbers that define the current position for text output.
Example

```plaintext
REAL*4 Y
DATA Y/4.0/

DO I=1,5
   CALL UIS$SET_POSITION(VD_ID,FLOAT(I),Y)
   CALL UIS$PLOT(VD_ID,1,0.0,Y,FLOAT(I),Y)
   Y=Y-1.0
   CALL UIS$SET_FONT(VD_ID,1,1,'MY_FONT_11')
   CALL UIS$TEXT(VD_ID,1,'Full speed ahead!')
ENDDO
```

Screen Output
**UIS$SET_RESIZE_AST**

Specifies a user-requested AST routine to be executed when a display window has been resized using the user interface.

**Format**

```
UIS$SET_RESIZE_AST vd_id, wd_id [,astadr [,astprm]]
[ ,new_abs_x, new_abs_y]
[ ,new_width, new_height]
[ ,new_wc_x1, new_wc_y1,]
new_wc_x2, new_wc_y2]
```

**Returns**

UIS$SET_RESIZE_AST signals all errors; no condition values are returned.

**Arguments**

- **vd_id**
  
  VMS Usage: identifier
  
  type: longword (unsigned)
  
  access: read only
  
  mechanism: by reference

  Virtual display identifier. The `vd_id` argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the `vd_id` argument.

- **wd_id**
  
  VMS Usage: identifier
  
  type: longword (unsigned)
  
  access: read only
  
  mechanism: by reference

  Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the `wd_id` argument.
AST routine. The *astadr* argument is the address of the entry mask of a procedure that is called at AST level whenever the “Change the size” item in the Window Options Menu is selected and a display window has been resized.

See the Description section for information about disabling UIS$SET-RESIZE_AST.

**astprm**

VMS Usage: *user_arg*
type: *longword (unsigned)*
access: *read only*
mechanism: *by reference*

AST parameter. The *astprm* argument is the address of a single argument or data structure, such as an array or record, to be passed to the AST routine. Calls to UIS$SET-RESIZE_AST in FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

**new_abs_x, new_abs_y**

VMS Usage: *floating_point*
type: *f_float*
access: *write only*
mechanism: *by reference*

Absolute device coordinate pair. The *new_abs_x* and *new_abs_y* arguments are the addresses of *f_float* longwords that receive the exact location of the newly resized display window in centimeters.

**new_width, new_height**

VMS Usage: *floating_point*
type: *f_float*
access: *write only*
mechanism: *by reference*

Width and height of the resized window. The *new_width* and *new_height* arguments are the addresses of *f_float* longwords that receive the dimensions of the newly resized display window in centimeters.
new\_wc\_x\_1, new\_wc\_y\_1, new\_wc\_x\_2, new\_wc\_y\_2

VMS Usage: floating\_point
type: f\_floating
access: write only
mechanism: by reference

World coordinates of the resized window. The new\_wc\_x\_1 and new\_wc\_y\_1 arguments are the addresses of f\_floating point longwords that receive the world coordinates of the lower-left corner of the newly resized display window. The new\_wc\_x\_2 and new\_wc\_y\_2 arguments are the addresses of f\_floating point longwords that receive the world coordinates of the upper-right corner of the newly resized display window.

**Description**

Typically, a call to UIS\$SET\_RESIZE\_AST in an application program indicates that the default resizing behavior is to be overridden.

By default, if a resize AST has not been enabled in an application program, UIS calls UIS\$RESIZE\_WINDOW. If this behavior is not sufficient, the application program may call UIS\$SET\_RESIZE\_AST with its own resize routine.

To reenable the default behavior, specify UIS\$C\_DEFAULT\_RESIZE as the astadr argument in a subsequent call to UIS\$SET\_RESIZE\_AST.

Resizing a window may be completely disabled in the following ways:

- By specifying the required wd\_id argument and a value of 0 in the astadr argument
- By specifying only the required wd\_id argument
- Omit the astadr and astprm arguments.

When window resizing is disabled, the option, “Change the size” displayed in the Window Options Menu changes from boldface to halftone.

The parameters for the resized window’s new location, dimensions, and world coordinate range will not be overwritten with subsequent values until the AST has completed.
Example

VD_ID=UIS$CREATE_DISPLAY(1.0,1.0,40.0,40.0,15.0,15.0)  
WD_ID=UIS$CREATE_WINDOW(VD_ID,'SYS$WORKSTATION','RESIZE',
2 5.0,5.0,25.0,25.0)  

CALL UIS$SET_RESIZE_AST(VD_ID,WD_ID,resize_me,0,new_abs_x,new_abs_y,
2 new_width,new_height,new_wc_x1,new_wc_y1,
2 new_wc_x2,new_wc_y2)  

CALL SYS$HIBER()  

END  !end of main program  

SUBROUTINE RESIZE_ME  

CALL UIS$RESIZE_WINDOW(VD_ID,WD_ID,new_abs_x,new_abs_y,,
2 1.0,1.0,40.0,40.0)  

RETURN  
END  

In the preceding example, the call to UIS$CREATE_DISPLAY  establishes the initial viewport size as a square.

The coordinate space of the initial display window is defined to be a subset of the virtual display 2. When the original window is displayed it will show only a portion of the virtual display.
The call to UIS$SET_RESIZE_AST indicates that the program will override the default window resizing operation by enabling a user-written AST routine RESIZE_ME.

The parameter list of UIS$RESIZE_WINDOW indicates how the resize operation is redefined. The absolute position and size of all viewports will default as usual to the final position and dimensions of the stretchy box.

However, the world coordinate range of the newly resized window is defined explicitly as the coordinate range of the virtual display. All newly resized windows will show the entire virtual display. If you tried to resize a previously resized window, you would still see the contents of the entire virtual display.

Distortion of objects displayed in the viewport will occur whenever the aspect ratio of the newly resized viewport does not equal the aspect ratio of the newly resized display window.
UIS Routine Descriptions

UIS$SET_SHRINK_TO_ICON_AST

UIS$SET_SHRINK_TO_ICON_AST

Specifies a user-requested AST routine to be executed whenever a display viewport is shrunk using the human interface.

Format

UIS$SET_SHRINK_TO_ICON_AST  wd_id [,astadr [,astprm]]

Returns

UIS$SET_SHRINK_TO_ICON_AST signals all errors; no condition values are returned.

Arguments

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The **wd_id** argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the **wd_id** argument.

**astadr**

VMS Usage: ast_procedure
type: procedure entry mask
access: read only
mechanism: by reference

AST routine. The **astadr** argument is the address of an entry mask of a procedure called at AST level whenever “Shrink to Icon” item in the Window Options Menu is selected.

**astprm**

VMS Usage: user_arg
type: longword (unsigned)
access: read only
mechanism: by reference

AST parameter. The **astprm** argument is the address of a single argument or data structure, such as an array or record, to be passed to the AST routine.
Calls to UIS$SET_SHRINK_TO_ICON_AST in VAX FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

---

**Description**

The user interface for replacing a display viewport with an icon can be disabled by calling UIS$SET_SHRINK_TO_ICON_AST with the `wd_id` only.

To reenable the default behavior of UIS$SET_SHRINK_TO_ICON_AST, specify the constant UIS$C_DEFAULT_SHRINK_TO_ICON in the `astadr` argument.
UIS$SET_TB_AST

Specifies a user-requested AST routine to be executed whenever the digitizer lies within a specified rectangle on the tablet.

Format

\texttt{UIS$SET\_TB\_AST \ tb\_id, [\text{data\_astadr},}
\texttt{[\text{data\_astprm}], [\text{x\_pos}, \text{y\_pos}]}
\texttt{[\text{data\_x\_1, data\_y\_1, data\_x\_2, data\_y\_2}]}
\texttt{[\text{button\_astadr}}
\texttt{[\text{button\_astprm}, \text{button\_keybuf}]}\n
Returns

UIS$SET\_TB\_AST$ signals all errors; no condition values are returned.

Arguments

\textit{tb\_id}

VMS Usage: \textbf{identifier}

type: \textbf{longword (unsigned)}

access: \textbf{read only}

mechanism: \textbf{by reference}

Tablet identifier. The \textit{tb\_id} argument is the address of a longword that uniquely identifies the tablet. See UIS$CREATE\_TB$ for more information about the \textit{tb\_id} argument.

\textit{data\_astadr}

VMS Usage: \textbf{ast\_procedure}

type: \textbf{procedure entry mask}

access: \textbf{read only}

mechanism: \textbf{by reference}

AST routine. The \textit{data\_astadr} argument is the address of an entry mask of a procedure that is called at AST level for each data point whenever the digitizer is moved within the specified active data region defined on the tablet.

See the Description section for information about disabling the digitizing region.
data.astprm
VMS Usage: user_arg
type: longword (unsigned)
access: read only
mechanism: reference

AST parameter. The data.astprm is the address of a single argument or data structure, such as an array or record, to be passed to the AST routine. Calls to UIS$SET_TB_AST in VAX FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

x_pos,y_pos
VMS Usage: floating_point
type: f_floating
access: write only
mechanism: by reference

Absolute device coordinate pair. The x_pos, y_pos arguments are the addresses of f_floating longwords that receive the current x and y tablet positions in centimeters relative to the lower-left corner of the tablet, when a data AST occurs.

data_x1,data_y1
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Absolute device coordinate pair. The data_x1,data_y1 arguments are the addresses of f_floating point numbers that define the lower-left corner of the data or digitizer region specified on the tablet. The data rectangle defines an area on the tablet in which data should be collected.

data_x2,data_y2
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Absolute device coordinate pair. The data_x2,data_y2 arguments are the addresses of f_floating point numbers that define the upper-right corner of the data or digitizer region specified on the tablet.

button.astadr
VMS Usage: ast_procedure
type: procedure entry mask
access: read only
mechanism: by reference
18-348  UIS Routine Descriptions

**UIS$SET_TB_AST**

AST routine. The `button_astadr` argument is the address of an entry mask of a procedure that is called at AST level whenever a button is depressed or released within the specified active data region defined on the tablet.

See the "DESCRIPTION" section for information about disabling the digitizing region.

**button_astprm**

VMS Usage: `user_arg`
type: `longword (unsigned)`
access: `read only`
mechanism: `reference`

AST parameter. The `button_astprm` is the address of a single argument or data structure, such as an array or record, to be passed to the AST routine. Calls to UIS$SET_TB_AST in VAX FORTRAN application programs should be coded as follows: `%REF(%LOC(astprm)).`

**button_keybuf**

VMS Usage: `longword_unsigned`
type: `longword (unsigned)`
access: `write only`
mechanism: `by reference`

Button information. The `button_keybuf` argument is the address of a longword that receives button information.

---

**Description**

The data rectangle specifies the active data region on the tablet. Only points within this rectangle are returned to the application. The data rectangle is specified using a centimeter coordinate system that is based at the lower-left corner of the tablet.

If no data rectangle is specified, the entire tablet is assumed.

**Button AST Routines**

To disable button AST routines, specify 0 in the `button_ast_rtn` argument.
UIS$SET_TEXT_FORMATTING

Sets the text formatting justification mode.

Format

UIS$SET_TEXT_FORMATTING  vd_id, iatb, oatb, mode

Returns

UIS$SET_TEXT_FORMATTING signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier  
type:  longword (unsigned)  
access:  read only  
mechanism:  by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

iatb
VMS Usage: longword_unsigned  
type:  longword (signed)  
access:  read only  
mechanism:  by reference

Input attribute block number. The iatb argument is the address of a longword that identifies an attribute block to be modified.

oatb
VMS Usage: longword_unsigned  
type:  longword (unsigned)  
access:  read only  
mechanism:  by reference

Output attribute block number. The oatb argument is the address of a longword that identifies a newly modified attribute block.
Routine Descriptions
UIS$SET_TEXT_FORMATTING

mode
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Text formatting mode. The mode argument is the address of a longword mask that sets the text formatting mode. The following table lists valid text formatting modes.

<table>
<thead>
<tr>
<th>Formatting Mode</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_TEXT_FORMAT_LEFT</td>
<td>Left justified, ragged right</td>
</tr>
<tr>
<td>UIS$C_TEXT_FORMAT_RIGHT</td>
<td>Right justified, left ragged</td>
</tr>
<tr>
<td>UIS$C_TEXT_FORMAT_CENTER</td>
<td>Centered line between left and right margin</td>
</tr>
<tr>
<td>UIS$C_TEXT_FORMAT_JUSTIFY</td>
<td>Justified lines, space filled to right margin</td>
</tr>
<tr>
<td>UIS$C_TEXT_FORMAT_NOJUSTIFY</td>
<td>No text justification (default)</td>
</tr>
</tbody>
</table>

All other values are reserved to DIGITAL for future use.

Description

Text justification occurs at the end of every UIS$TEXT or UIS$MEASURE_TEXT call. Text justification also occurs when a UIS$C_TEXT_NEW_LINE item is encountered in a UIS$TEXT or UIS$MEASURE_TEXT control list. The formatting mode and margins that are used are based on either the attribute block specified in the routine call or the last attribute block specified before the UIS$C_TEXT_NEW_LINE item code is encountered.

NOTE: Lines of text that do not fit completely within the margins will extend beyond the margin.
Example

CALL UIS$SET_TEXT_MARGINS(VD_ID,0,1,3.0,27.0,24.0)
CALL UIS$PLOT(VD_ID,0,3.0,30.0,3.0,0.0)
CALL UIS$PLOT(VD_ID,0,27.0,30.0,27.0,0.0)

CALL UIS$SET_TEXT_FORMATTING(VD_ID,1,1,UIS$C_TEXT_FORMAT_JUSTIFY)
CALL UIS$SET_ALIGNED_POSITION(VD_ID,1,3.0,28.0)

DO I= 1,4
CALL UIS$TEXT(VD_ID,2,'What has been, may be')
CALL UIS$NEW_TEXT_LINE(VD_ID,2)
ENDDO

.
Screen Output

**left justified**

Sooner begun, sooner done
Sooner begun, sooner done
Sooner begun, sooner done
Sooner begun, sooner done
Sooner begun, sooner done

**right justified**

The biter is sometimes bit
The biter is sometimes bit
The biter is sometimes bit
The biter is sometimes bit
The biter is sometimes bit

**centered**

A crowd is no company
A crowd is no company
A crowd is no company
A crowd is no company
A crowd is no company

**fully justified**

What has been, may be
What has been, may be
What has been, may be
What has been, may be
What has been, may be
UIS$SET_TEXT_MARGINS

Sets the text margins for a line of text.

Format

```
UIS$SET_TEXT_MARGINS  vd_id, iatb, oatb, x, y, margin_length
```

Returns

UIS$SET_TEXT_MARGINS signals all errors; no condition values are returned.

Arguments

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

- **iatb**
  - VMS Usage: longword_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Input attribute block number. The iatb argument is the address of a longword that identifies an attribute block to be modified.

- **oatb**
  - VMS Usage: longword_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Output attribute block number. The oatb argument is the address of a longword that identifies an attribute block.
UIS Routine Descriptions

UIS$SET_TEXT_MARGINS

\( x,y \)

VMS Usage: floating_point

type: \( f\_\text{floating} \)

access: read only

mechanism: by reference

Starting margin position. The \( x,y \) arguments are the addresses of \( f\_\text{floating} \) numbers that define a point on the margin. The margin is the minor text path when slope equals zero.

\( \text{margin\_length} \)

VMS Usage: floating_point

type: \( f\_\text{floating} \)

access: read only

mechanism: by reference

Ending margin position. The \text{margin\_length} is the address of an \( f\_\text{floating} \) number that defines the distance in world coordinates from the starting margin to the end margin.

---

**Description**

Lines of text do not automatically wrap to the next line.
**UIS$SET_TEXT_PATH**

Sets the direction of text drawing and the direction of new text lines.

**Format**

\[
\text{UIS$SET\_TEXT\_PATH}\ \vd_id, \ iatb, \ oatb, \ major \ [,\ minor]\]

**Returns**

UIS$SET\_TEXT\_PATH$ signal all errors; no condition values are returned.

**Arguments**

- **vd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Virtual display identifier. The \text{vd_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY$ for more information about the \text{vd_id} argument.

- **iatb**
  - VMS Usage: longword\_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Input attribute block number. The \text{iatb} argument is the address of a number that identifies an attribute block to be modified.

- **oatb**
  - VMS Usage: longword\_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Output attribute block number. The \text{oatb} argument is the address of a number that identifies a modified attribute block.
**UIS$SET_TEXT_PATH**

**major**
- **VMS Usage:** longword_unsigned
- **type:** longword (unsigned)
- **access:** read only
- **mechanism:** by reference

Major text path. The major argument is the address of a symbol that identifies the major text path type. The major path of text drawing is the direction of text drawing along a line. See the Description section for more information.

**minor**
- **VMS Usage:** longword_unsigned
- **type:** longword (unsigned)
- **access:** read only
- **mechanism:** by reference

Minor text path. The minor argument is the address of a symbol that identifies the minor text path type. The minor path of text drawing refers to the direction of new text line creation. See the Description section for more information.

### Description

The following table contains symbols for valid character drawing directions.

<table>
<thead>
<tr>
<th>Path</th>
<th>Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_TEXT_PATH_RIGHT</td>
<td>Left to right (default major text path)</td>
</tr>
<tr>
<td>UIS$C_TEXT_PATH_LEFT</td>
<td>Right to left</td>
</tr>
<tr>
<td>UIS$C_TEXT_PATH_UP</td>
<td>Bottom to top</td>
</tr>
<tr>
<td>UIS$C_TEXT_PATH_DOWN</td>
<td>Top to bottom (default minor text path)</td>
</tr>
</tbody>
</table>

### Example

```c
CALL UIS$SET_TEXT_PATH(VD_ID, 0, 1, UIS$C_TEXT_PATH_LEFT,
                        2, UIS$C_TEXT_PATH_DOWN)

CALL UIS$SET_FONT(VD_ID, 1, 1, 'MY_FONT_5')

CALL UIS$SET_ALIGNED_POSITION(VD_ID, 1, 38.0, 38.0)
```
CALL UIS$TEXT(VD_ID,1,'Knowledge is power!')
CALL UIS$NEW_TEXT_LINE(VD_ID,1)

The preceding example illustrates how to alter the default major text drawing path to produce the output shown in the next section.

Screen Output

![Screen Output Image]
UIS$SET_TEXT_SLOPE

Sets the angle of the actual path of text drawing relative to the major path.

Format

\[ \text{UIS$SET\_TEXT\_SLOPE} \ vd\_id,iatb,oatb,angle \]

Returns

UIS$SET\_TEXT\_SLOPE signals all errors; no condition values are returned.

Arguments

\[ \text{vd\_id} \]
VMS Usage: identifier
Type: longword (unsigned)
Access: read only
Mechanism: by reference

Virtual display identifier. The vd\_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY for more information about the vd\_id argument.

\[ \text{iatb} \]
VMS Usage: longword\_unsigned
Type: longword (unsigned)
Access: read only
Mechanism: by reference

Input attribute block number. The iatb argument is the address of a number that identifies an attribute block to be modified.

\[ \text{oatb} \]
VMS Usage: longword\_unsigned
Type: longword (unsigned)
Access: read only
Mechanism: by reference

Output attribute block number. The oatb argument is the address of a number that identifies an attribute block.
angle

VMS Usage: floating_point

type: f_floating

access: read only

mechanism: by reference

Angle of text slope. The angle argument is the address of an f_floating point number that defines the angle of the actual path of text drawing relative to the major path measured counterclockwise in degrees. The default angle of text slope is 0 degrees.

Example

CALL UIS$SET_FONT(VD_ID,0,1,'MY_FONT_13')
CALL UIS$SET_TEXT_SLOPE(VD_ID,1,2,45.0)

DO I=1,10
CALL UIS$SET_ALIGNED_POSITION(VD_ID,2,0.0,Y)
CALL UIS$TEXT(VD_ID,2,'water seeks its own level!')
Y=Y-2.0
ENDDO

PAUSE

DO I=1,10
CALL UIS$SET_ALIGNED_POSITION(VD_ID,2,X,1.0)
CALL UIS$TEXT(VD_ID,2,'water seeks its own level!')
X=X+2.0
ENDDO
Screen Output
UIS$SET_WRITING_INDEX

Sets the writing color index for text and graphics output.

Format

\texttt{UIS$SET\_WRITING\_INDEX \ vd\_id, iatb, oatb, index}

Returns

UIS$SET\_WRITING\_INDEX$ signals all errors; no condition values are returned.

Arguments

\texttt{vd\_id}

VMS Usage: \texttt{identifier}

type: \texttt{longword (unsigned)}

access: \texttt{read only}

mechanism: \texttt{by reference}

Virtual display identifier. The \texttt{vd\_id} argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE\_DISPLAY$ for more information about the \texttt{vd\_id} argument.

\texttt{iatb}

VMS Usage: \texttt{longword\_unsigned}

type: \texttt{longword (unsigned)}

access: \texttt{read only}

mechanism: \texttt{by reference}

Input attribute block number. The \texttt{iatb} argument is the address of a longword integer that specifies the attribute block to be modified.

\texttt{oatb}

VMS Usage: \texttt{longword\_unsigned}

type: \texttt{longword (unsigned)}

access: \texttt{read only}

mechanism: \texttt{by reference}

Output attribute block number. The \texttt{oatb} argument is the address of a longword integer that identifies the newly modified attribute block.
UIS Routine Descriptions

UIS$SET_WRITING_INDEX

*index*

VMS Usage: longword\_unsigned

- **type:** longword (unsigned)
- **access:** read only
- **mechanism:** by reference

Color map index. The *index* argument is the address of a longword integer that specifies a color map index. If the index exceeds the maximum index for the associated color map, an error is signaled.
UIS$SET_WRITING_MODE

Sets the text and graphics mode.

Format

UIS$SET_WRITING_MODE  vd_id, iatb, oatb, mode

Returns

UIS$SET_WRITING_MODE signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

iatb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Input attribute block number. The iatb argument is the address of a longword integer that specifies an attribute block to be modified.

oatb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Output attribute block number. The oatb argument is the address of a longword integer that specifies a newly modified attribute block that controls the writing mode.
**UIS Routine Descriptions**

**UIS$SET_WRI TING_MODE**

- **mode**
  - VMS Usage: `longword unsigned`
  - type: `longword (unsigned)`
  - access: `read only`
  - mechanism: `by reference`

  Writing mode. The **mode** argument is the address of a longword that specifies the writing mode (UIS$C_MODE_xxxx). The default writing mode is overlay.

---

**Description**

Table 9-2 lists and describes all UIS writing modes.
UIS$SHRINK_TO_ICON

Replaces a display viewport with its associated icon.

**Format**

```
UIS$SHRINK_TO_ICON  wd_id [,icon_wd_id] [,icon_flags] [,icon_name] [,attributes]
```

**Returns**

UIS$SHRINK_TO_ICON signals all errors; no condition values are returned.

**Arguments**

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the `wd_id` argument.

**icon_wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Icon window identifier. The `icon_wd_id` argument is the address of a longword that uniquely identifies an icon.

**icon_flags**

VMS Usage: mask_longword
type: longword (unsigned)
access: read only
mechanism: by reference

Icon flags. The `icon_flags` is the address of a longword mask of flags that may be used to specify whether default icon behavior should be extended to an application-supplied icon. By default, no modifications are made to the application-supplied icon. The following table lists valid icon flags.
UIS$SHRINK_TO_ICON

<table>
<thead>
<tr>
<th>Flag</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$M_ICON_DEF_KB</td>
<td>UIS manages keyboard ownership. If the display window is enabled for keyboard ownership, UIS$DISABLE_VIEW_PORT_KB is called during window shrinking and UIS$ENABLE_KB is called during icon expansion.</td>
</tr>
<tr>
<td>UIS$M_ICON_DEF_BODY</td>
<td>UIS places a button AST region over the body of the icon window and uses that AST to trigger icon expansion.</td>
</tr>
<tr>
<td>All other bits</td>
<td>The remaining bits are set to 0 and are reserved to DIGITAL.</td>
</tr>
</tbody>
</table>

**icon_name**

VMS Usage: char_string
type: character string
access: read only
mechanism: by descriptor

Icon name. The icon_name argument is the address of a descriptor of the text to be used as the icon name.

**attributes**

VMS Usage: item_list_pair
type: longword (unsigned)
access: read only
mechanism: by reference

Window attributes list. The attributes argument is the address of data structure, such as an array or record. The attributes argument may be used to specify exact placement of the icon on the display screen.

The following figure describes the structure of the window attributes list.
UIS Routine Descriptions

UIS$SHRINK_TO_ICON

<table>
<thead>
<tr>
<th>Attribute ID code</th>
<th>(WDPL$C___xxx)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longword value for attribute identified in previous longword</td>
<td></td>
</tr>
<tr>
<td>2nd attribute ID code</td>
<td></td>
</tr>
<tr>
<td>2nd attribute value</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td></td>
</tr>
<tr>
<td>•</td>
<td></td>
</tr>
<tr>
<td>End of list = 0</td>
<td></td>
</tr>
<tr>
<td>(WDPL$C__END_OF__LIST)</td>
<td></td>
</tr>
</tbody>
</table>

See UIS$CREATE__WINDOW for more information.
Screen Output
UIS$SOUND_BELL

Actuates the keyboard bell to ring once.

Format

UIS$SOUND_BELL  devnam [,bell_volume]

Returns

UIS$SOUND_BELL signals all errors; no condition values are returned.

Arguments

devnam
VMS Usage:  device_name
type:       character string
access:     read only
mechanism:  by descriptor

Device name string. The devnam argument is the address of a character string descriptor of the workstation device name. Specify ‘SYS$WORKSTATION’ as the default device name.

bell_volume
VMS Usage:  longword_unsigned
type:       longword (unsigned)
access:     read only
mechanism:  by reference

Bell volume level. The bell_volume argument is the address of a longword that specifies the bell volume. The bell_volume argument can be supplied explicitly as a number from 0 to 8, where 0 is the most quiet; and 8 is the loudest. If the bell_volume argument is not specified, the default volume specified in the workstation setup menu is used.

Description

On the LK201 keyboard, the bell sound differs from a key click sound in the frequency and tone.
UIS$SOUND_CLICK

Actuates the keyboard click sound once.

Format

UIS$SOUND_CLICK  devnam [,click_volume]

Returns

UIS$SOUND_CLICK signals all errors; no condition values are returned.

Arguments

devnam
VMS Usage: device_name
type: character string
access: read only
mechanism: by descriptor

Device name string. The devnam argument is the address of a character string descriptor of the workstation device name. Specify SYS$WORKSTATION as the device name.

click_volume
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Key click volume level. The click_volume argument is the address of a longword that specifies the key click volume level. The click_volume argument is specified explicitly as a number from 0 to 8, where 0 is the most quiet and 8 is the loudest. If the click_volume argument is not specified, the default volume is used from the workstation setup menu mechanism.

Description

On the LK201 keyboard, the key click sound differs from a bell sound in the frequency and tone.
UIS$TEST_KB

Returns a boolean value indicating whether the physical keyboard is currently bound to the specified virtual keyboard.

Format

\[ \text{status} = \text{UIS$TEST_KB} \ kb\_id \]

Returns

VMS Usage: boolean
type: longword
access: write only
mechanism: by value

Boolean value returned in a status variable or R0 (VAX MACRO). The boolean value TRUE is returned if the physical keyboard is bound to the virtual keyboard, otherwise a boolean value FALSE is returned.

UIS$TEST_KB signals all errors; no condition values are returned.

Arguments

\[ kb\_id \]

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual keyboard identifier. The \text{kb\_id} argument is the address of a longword that uniquely identifies a virtual keyboard. See UIS$CREATE_KB for more information about the \text{kb\_id} argument.
UIS$TEXT

Draws a series of characters.

Format

UIS$TEXT  vd_id, atb, text_string [,x,y] [,ctllist,ctllen]

Returns

UIS$TEXT signals all errors; no condition values are returned.

Arguments

vd_id
VMS Usage:  identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Virtual display identifier. The vd_id argument is the address of a longword that uniquely identifies a virtual display. See UIS$CREATE_DISPLAY for more information about the vd_id argument.

atb
VMS Usage:  longword_unsigned
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Attribute block number. The atb argument is the address of a longword integer that specifies an attribute block that modifies text output. When a control list is specified, the atb argument defines the initial attribute settings of the text string.

text_string
VMS Usage:  char_string
type:  character string
access:  read only
mechanism:  by descriptor

Text string. The text_string argument is the address of a character string descriptor of a text string.
Starting point of text output. The \( x \) and \( y \) arguments are the addresses of floating-point numbers that define in world coordinates of the starting point of text output. The starting point is the upper-left corner of the character cell of the next character to be drawn.

If this argument is not specified, the current text position is used. (See the `UIS$SET-ALIGNED-POSITION` routine for more information.)

When a control list is specified, the \( x,y \) arguments specify the starting coordinate for the first character of the character string.

The control list consists of a sequence of data elements, each two longwords in length. The first longword of each element is a tag. The second longword is either a value particular to the type of element specified or zero. Following is a diagram showing the structure of a text control list.
The following table describes valid formatting commands.

<table>
<thead>
<tr>
<th>Formatting Command</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Commands Without Values</strong>¹</td>
<td></td>
</tr>
<tr>
<td>UIS$C_TEXT_NOP</td>
<td>Nil operation</td>
</tr>
<tr>
<td>UIS$C_TEXT_RESTORE_POSITION</td>
<td>Restores the current writing position</td>
</tr>
<tr>
<td>UIS$C_TEXT_SAVE_POSITION</td>
<td>Saves the current writing position</td>
</tr>
<tr>
<td><strong>Commands Requiring Values</strong></td>
<td></td>
</tr>
<tr>
<td>UIS$C_TEXT_ATB</td>
<td>Specifies an attribute block number</td>
</tr>
<tr>
<td>UIS$C_TEXT_HPOS_ABSOLUTE</td>
<td>Specifies a new current x position</td>
</tr>
<tr>
<td>UIS$C_TEXT_HPOS_RELATIVE</td>
<td>Modifies the current x position by a delta</td>
</tr>
<tr>
<td>UIS$C_TEXT_IGNORE</td>
<td>Skips ( n ) characters</td>
</tr>
</tbody>
</table>

¹ Second longword must be zero
### Formatting Command

<table>
<thead>
<tr>
<th>Commands Requiring Values</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_TEXT_NEW_LINE</td>
<td>Skips $n$ new lines and positions at the left margin</td>
</tr>
<tr>
<td>UIS$C_TEXT_TAB_ABSOLUTE</td>
<td>Writes white space to the new absolute position</td>
</tr>
<tr>
<td>UIS$C_TEXT_TAB_RELATIVE</td>
<td>Writes white space to the new relative position</td>
</tr>
<tr>
<td>UIS$C_TEXT_VPOS_ABSOLUTE</td>
<td>Writes a new current y position</td>
</tr>
<tr>
<td>UIS$C_TEXT_VPOS_RELATIVE</td>
<td>Modifies the current y position by a delta</td>
</tr>
<tr>
<td>UIS$C_TEXT_WRITE</td>
<td>Writes $n$ characters</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Commands Not Requiring a Second Longword</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$C_TEXT_END_OF_LIST</td>
<td>Terminates the control list</td>
</tr>
</tbody>
</table>

When UIS encounters illegal commands and values within the control list, it skips the invalid item and signals an error.

**ctllen**

VMS Usage: `longword_unsigned`

type: `longword (unsigned)`

access: `read only`

mechanism: `by reference`

Length of formatting control list. The `ctllen` argument is the address of a longword that specifies the length of the formatting control list in longwords.

### Description

Nonprinting characters such as tab and line feed are not handled in any special way. The character is obtained from the font and is displayed like any other character.
UIS$TRANSFORM_OBJECT

Transforms the coordinates or attributes or both of the specified object within
the display list.

Format

UIS$TRANSFORM_OBJECT \{ obj_id \ seg_id \} [matrix] [atb]

Returns

UIS$TRANSFORM_OBJECT signals all errors; no condition values are
returned.

Arguments

obj_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Object identifier. The obj_id argument is the address of a longword that
uniquely identifies the object.

seg_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Segment identifier. The seg_id argument is the address of a longword that
uniquely identifies the segment. See UIS$BEGIN_SEGMENT for more
information about the seg_id argument.

matrix
VMS Usage: vector_longword_signed
type: F_floating
access: read only
mechanism: by reference

Transformation matrix. The matrix argument is the address of an array of
longword integers that define the values to be used for scaling, rotation,
and/or translation. A two-dimensional array declared as ARRAY(2,3) has the following structure.

```
<table>
<thead>
<tr>
<th>1,1</th>
<th>1,2</th>
<th>1,3</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,1</td>
<td>2,2</td>
<td>2,3</td>
</tr>
</tbody>
</table>
```

VAX FORTRAN allocates memory for the array elements. Memory addresses of array elements range from lowest to highest in the following order: (1,1),(2,1), (1,2),(2,2),(1,3), and (2,3). UIS assigns values to array elements in the order shown in the following illustration.

**NOTE:** For the purposes of assigning values to array elements, UIS treats all transformation matrices as VAX FORTRAN arrays regardless of the programming language of the application.

```
<table>
<thead>
<tr>
<th>1</th>
<th>3</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>4</td>
<td>6</td>
</tr>
</tbody>
</table>
```

Pairs of array elements govern how displayed objects are scaled, rotated, and translated. UIS computes the transformed coordinates in the following manner.

\[
x_1 = A(1,1)x + A(1,2)y + A(1,3)
\]
\[
y_1 = A(2,1)x + A(2,2)y + A(2,3)
\]

**Translation**

When translation alone is performed, the following array elements are assigned values. \(D_x\) and \(D_y\) represent distances between the original coordinates and the new coordinates.
Scaling

When scaling alone is performed, the following array elements are assigned values.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>Dx</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>Dy</td>
</tr>
</tbody>
</table>

Rotation

When rotation alone is performed, the following array elements are assigned values, where \( @ \) is the desired angle of rotation. The values returned from the FORTRAN \texttt{SIN} and \texttt{COS} functions are stored in the appropriate array elements.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Sx</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>Sy</td>
<td>0</td>
</tr>
</tbody>
</table>

An unlimited number of transformations can be performed at one time by simply multiplying the matrices together into a single matrix using matrix multiplication.

In order to multiply two matrices together, you must add a row to the bottom of each matrix.
After the multiplication is performed, remove the last row of the result.

**atb**

VMS Usage: *longwordUnsigned*

type: *longword (unsigned)*

access: *read only*

mechanism: *by reference*

Attribute block number. The atb argument is the address of a longword that identifies an attribute block to override current attribute settings.

---

**Description**

Either the coordinates can be transformed, or the attributes can be overridden or both.

After a transformation, occluded objects may not appear correctly. This can be corrected by calling UIS$EXECUTE to refresh the display screen.

---

**Example**

```plaintext
REAL*4 MATRIX(2,3)

CALL UIS$PLOT(VD_ID,0,5.0,5.0,15.0,5.0,10.0,15.0,5.0,5.0)

CURRENT_ID=UIS$GET_CURRENT_OBJECT(VD_ID)

OBJ_ID=CURRENT_ID
```
CALL UIS$SET_FONT(VD_ID,0,1,'UIS$FILL.Patterns')
CALL UIS$SET_FILL_PATTERN(VD_ID,1,1,PATT$C_HORIZ1_7)

PAUSE
MATRIX(1,1)=1.0
MATRIX(2,1)=0.0
MATRIX(1,2)=0.0
MATRIX(2,2)=1.0
MATRIX(1,3)=-10.0
MATRIX(2,3)=-10.0
CALL UIS$TRANSFORM_OBJECT(OBJ_ID,MATRIX,1)

PAUSE

MATRIX(1,1)=2.0
MATRIX(2,1)=0.0
MATRIX(1,2)=0.0
MATRIX(2,2)=2.0
MATRIX(1,3)=0.0
MATRIX(2,3)=0.0
CALL UIS$TRANSFORM_OBJECT(OBJ_ID,MATRIX,1)

PAUSE

CALL UIS$SET_FONT(VD_ID,0,2,'UIS$FILL.Patterns')
CALL UIS$SET_FILL_PATTERN(VD_ID,2,2,PATT$C_VERT1_7)

MATRIX(1,1)=1.0
MATRIX(2,1)=0.0
MATRIX(1,2)=0.0
MATRIX(2,2)=1.0
MATRIX(1,3)=-13.0
MATRIX(2,3)=-13.0
CALL UIS$TRANSFORM_OBJECT(OBJ_ID,MATRIX,2)

.
Screen Output

- Top left: A single triangle.
- Top right: A single vertical structure.
- Bottom left: Multiple stacked triangles forming a pyramid.
- Bottom right: A series of horizontal bars forming a wave pattern.
PART IV  UIS Device Coordinate (UISDC) Routines
Chapter 19
UIS Device Coordinate Graphics Routines

19.1 Overview

This section introduces the MicroVMS workstation UISDC (device coordinate) graphics system services. It contains a reference section of all UISDC routines and pertinent information on how they are used.

19.2 UISDC Routines—How to Use Them

In addition to the world coordinate interface (UIS), the MicroVMS workstation software provides a device-coordinate, or pixel-level, interface (UISDC) to the graphics system services. UISDC allows applications to create UIS windows, but manipulate the contents of those windows at the pixel level.

Programming in device coordinates requires that an application make mixed use of UIS and UISDC routines. Only those UIS routines that use or modify world coordinate positions have been duplicated as UISDC routines. Most informational, attribute, windowing, and display routines exist only in UIS format and are shared by the two programming levels.

The major differences between UISDC and UIS are:

- The UISDC drawing surface is a display window, as opposed to a virtual display as it is with UIS. Therefore, the UISDC output routines utilize display window identifiers instead of virtual display identifiers.

- Most UISDC positions are expressed in viewport-relative device coordinates.

The lower-left corner of the display viewport is pixel (0,0). The upper-right corner is (width multiplied by x resolution, height multiplied by y resolution), where width and height are expressed in centimeters and resolution is expressed in pixels per centimeter.
• UISDC does not maintain or manage a display list. Automatic zooming, panning, and playback of a display are not supported.

Mixed use of UIS and UISDC output routines is allowed. Therefore, it is possible to do the following UIS and UISDC operations simultaneously:

• Draw to a virtual display that contains a window, using world coordinates.
• Draw directly to the same window, using viewport-relative device coordinates.

Separate current text positions, character size, text margins, and clipping rectangles are maintained for both coordinate systems.

The following section of this chapter lists the UISDC routines and their arguments in alphabetical order.
UISDC$ALLOCATE_DOP

Allocates a drawing operation primitive (DOP) for a particular display window in VAXstation color and intensity systems.

Format

dop=UISDC$ALLOCATE_DOP  wd_id ,size ,atb

Returns

VMS Usage: address
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the address of the drawing operation primitive in the variable dop or R0 (VAX MACRO).

UISDC$ALLOCATE_DOP signals all errors; no condition values are returned.

Arguments

wd_id

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

size

VMS Usage: longword_unsigned
type: longword (unsigned)
access: modify
mechanism: by reference

Size of the variable portion of the drawing operation primitive. The size argument is the address of a number that defines the size of the variable portion of the drawing operation primitive to allocated.
UISDC Routines

UISDC$ALLOCATE_DOP

The size of the variable portion of the allocated DOP is returned in the size field. The size of the allocated DOP may be smaller than the requested size.

\textit{atb}

VMS Usage: \texttt{longword\_unsigned}

type: \texttt{longword (unsigned)}

access: \texttt{read only}

mechanism: \texttt{by reference}

Attribute block number. The \texttt{atb} argument is the address of an attribute block.

---

\textbf{Description}

UISDC$ALLOCATE_DOP writes the following information from the specified attribute block into portions of the DOP data structure and returns the address of the DOP.

- Clipping rectangle
- Writing mode
- Writing mask

See the \textit{MicroVMS Workstation Video Device Driver Manual} for more information.
**UISDC$CIRCLE**

Draws an arc along the circumference of a circle.

**Format**

```
UISDC$CIRCLE   wd_id, atb, center_x, center_y, xradius
               [,start_deg, end_deg]
```

**Returns**

UISDC$CIRCLE signals all errors; no condition values are returned.

**Arguments**

**wd_id**

VMS Usage: identifier

type: longword (unsigned)

access: read only

mechanism: by reference

Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the `wd_id` argument.

**atb**

VMS Usage: longword_unsigned

type: longword (unsigned)

access: read only

mechanism: by reference

Attribute block number. The `atb` argument is the address of a longword integer that specifies an attribute block that controls the appearance of the circle or arc.

**center_x, center_y**

VMS Usage: longword_unsigned

type: longword (unsigned)

access: read only

mechanism: by reference

Center position x and y viewport-relative device coordinates. The `center_x` and `center_y` arguments are the addresses of integers that define a point in the virtual display that is the center of the arc or circle.
UISDC Routines

UISDC$CIRCLE

xradius
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Radius of the circle specified as an x viewport-relative device coordinate width. The xradius argument is the address of an integer that defines the distance from the center of the circle to the circumference of the circle.

start_deg, end_deg
VMS Usage: floating_point
type: f_floating
access: read only
mechanism: by reference

Degree at which the arc starts. The start_deg and end_deg arguments are the addresses of f_floating numbers that define the starting and ending point on the circumference of the circle where the arc or circle will be drawn. Degrees are measured clockwise from the top of the circle. If these arguments are not specified, 0.0 degrees and 360.0 degrees are assumed, respectively.

Description

UISDC$CIRCLE draws an arc specified by a center position and a radius for the range of the degrees specified.

The arc is closed by drawing one or more lines between the endpoints. The arc type associated with the attribute block specifies the way in which the arc is closed. The arc is not closed off by default. See UIS$SET_ARC_TYPE for details.

The points are drawn with the current line pattern and width, and filled with the current fill pattern, if enabled.

UISDC$CIRCLE does not support the following combination of attributes:

- Line width not equal to 1 and line style not equal to FFFFFFFF_{16}
- Line width not equal to 1 and complement writing mode

Circles are distorted by virtual display/display window aspect ratio distortion.
UISDC$ELLIPSE

Draws an arc at a starting position along the circumference of an ellipse.

Format

```
UISDC$ELLIPSE  wd_id, atb, center_x, center_y, xradius, yradius [,start_deg, end_deg]
```

Returns

UISDC$ELLIPSE signals all errors; no condition values are returned.

Arguments

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The *wd_id* argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_DISPLAY for more information about the *wd_id* argument.

**atb**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The *atb* argument is the address of a longword that identifies the attribute block that will modify the ellipse. If you specify 0 in the *atb* argument, the default settings of attribute block 0 are used.

**center_x, center_y**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Center position x and y viewport-relative device coordinates. The *center_x* and *center_y* arguments are the addresses of integers that define a point in the display window that is the center of the ellipse or arc.
**UISDC$ELLIPSE**

**xradius**
VMS Usage: longword_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Radius of the ellipse specified as an x device coordinate width. The xradius argument is the address of an integer that defines the distance from the center of the ellipse to the circumference of the ellipse or arc.

**yradius**
VMS Usage: longword_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Radius of the ellipse specified as a y device coordinate width. The yradius argument is the address of an integer that defines the distance from the center of the ellipse to the circumference of the ellipse or arc.

**start_deg, end_deg**
VMS Usage: floating_point  
type: f_floating  
access: read only  
mechanism: by reference

Degree at which the arc starts and ends. The start_deg and end_deg arguments are the addresses of floating_point numbers that define the starting point and ending point in degrees on the circumference of the ellipse where the arc or ellipse will be drawn. Degrees are measured clockwise from the top of the ellipse.

If these arguments are not specified, 0.0 and 360.0 degrees are assumed. If both arguments are not specified, a complete ellipse is drawn.

**Description**

UISDC$ELLIPSE uses center position coordinates and x and y radii to construct an ellipse. Along the circumference of this ellipse, UISDC$ELLIPSE draws an arc for a specified range of degrees.

The arc is closed by drawing one or more lines between the endpoints. The type of arc associated with the attribute block specifies the way in which the arc is closed. See the UIS$SET_ARC_TYPE routine for more information.

The points are drawn with the current line pattern and width, and filled with the current fill pattern, if enabled.
UISDC$ELLIPSE does not create thick patterned ellipses and thick ellipses that are undefined in complement mode.

UISDC$ELLIPSE does not support the following combination of attributes:

- Line width not equal to 1 and line style not equal to $FFFFFFF_{16}$
- Line width not equal to 1 and complement writing mode
UISDC$ERASE

Erases the specified rectangle in the display window.

Format

UISDC$ERASE  wd_id [,x1, y1, x2, y2]

Returns

UISDC$ERASE signals all errors; no condition values are returned.

Arguments

\textit{wd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \textit{wd\_id} argument is the address of a longword that uniquely identifies the display window containing the specified rectangle. See UIS$CREATE\_WINDOW for more information about the \textit{wd\_id} argument.

\textit{x1, y1, x2, y2}

VMS Usage: longword\_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinate pairs. The \textit{x1} and \textit{y1} arguments are the addresses of integers that define the lower-left corner of the rectangle in the display window. The \textit{x2} and \textit{y2} arguments are the addresses of integers that define the upper-right corner of the rectangle in the display window. If no rectangle is specified, the entire display window is erased.

Description

Areas within display windows affected by this call are filled with the color specified by entry 0 in the virtual display color map.
UISDC$EXECUTE_DOP_ASYNCH

Starts the execution of the specified drawing operation primitive (DOP) in the specified display window of VAXstation color and intensity systems and returns control to the application immediately.

Format

UISDC$EXECUTE_DOP_ASYNCH  wd_id, dop, iosb

Returns

UISDC$EXECUTE_DOP_ASYNCH signals all errors; no condition values are returned.

Arguments

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

**dop**

VMS Usage: vector_byte_unsigned
type: byte_unsigned
access: read only
mechanism: by reference

Drawing operation primitive. The dop argument is the address of an array of bytes that comprise the drawing operation primitive.

**iosb**

VMS Usage: io_status_block
type: quadword (unsigned)
access: write only
mechanism: by reference
UISDC Routines

**UISDC$EXECUTE_DOP-ASYNCH**

I/O status block. The `iosb` argument is the address of an I/O status block that receives a value indicating that the drawing operation primitive is queued for execution.

---

**Description**

`UISDC$EXECUTE_DOP-ASYNCH` queues the specified DOP for execution in the specified window.

You may later use the SYS$SYNCH system service to determine when the DOP has been drawn. See the *MicroVMS Workstation Video Device Driver Manual* for more details.
**UISDC$EXECUTE_DOP_SYNCH**

Queues the drawing operation primitive (DOP), waits for the specified DOP to complete execution in the specified display window, and then returns control to the application.

**Format**

`UISDC$EXECUTE_DOP_SYNCH  wd_id ,dop`

**Returns**

`UISDC$EXECUTE_DOP_SYNCH` signals all errors; no condition values are returned.

**Arguments**

`wd_id`

VMS Usage: identifier  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Display window identifier. The `wd_id` argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the `wd_id` argument.

`dop`

VMS Usage: vector_byte_unsigned  
type: byte_unsigned  
access: read only  
mechanism: by reference

Drawing operation primitive. The `dop` argument is the address of an array of bytes that comprises the drawing operation primitive.

**Description**

`UISDC$EXECUTE_DOP_SYNCH` queues the specified drawing operation primitive for execution in the specified window and returns when the drawing operation is complete.

See *MicroVMS Workstation Video Device Driver Manual* for more information.
UISDC Routines

UISDC$GET_ALIGNED_POSITION

UISDC$GET_ALIGNED_POSITION

Returns the current position for text output—the upper-left corner of the next character cell.

Format

UISDC$GET_ALIGNED_POSITION  wd_id, atb, retx, rety

Returns

UISDC$GET_ALIGNED_POSITION signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage: identifier
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

atb
VMS Usage:  longword_unsigned
type:  longword (unsigned)
access:  read only
mechanism:  by reference

Attribute block. The atb argument is the address of a longword that identifies an attribute block that contains a modified font attribute.

retx, rety
VMS Usage:  longword_unsigned
type:  longword (unsigned)
access:  write only
mechanism:  by reference

Viewport-relative device coordinate pair. The retx and rety arguments are the addresses of longwords that receive the current position as x and y viewport-relative device coordinate positions.
Description

UISDC$GET_ALIGNED_POSITION differs from UISDC$GET_POSITION in that the current position refers to the upper-left corner of the next character to be output using the specified attribute block. This is useful for applications that require the position of the upper-left corner, but do not have enough information about the font baseline to determine the proper alignment point. The position is converted into the proper alignment point using the font specified in the given attribute block. See UISDC$SET_ALIGNED_POSITION.
UISDC$GET_CHAR_SIZE

Returns both a value indicating whether or not character scaling is enabled and the character size used.

Format

\[ \text{boolean} = \text{UISDC$GET\_CHAR\_SIZE} \ \text{wd\_id, atb} \ \text{[char], [width][,height]} \]

Returns

VMS Usage: boolean
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as a Boolean to indicate the status of character scaling in the variable boolean or R0 (VAX MACRO).

UISDC$GET_CHAR_SIZE signals all errors; no condition values are returned.

Arguments

\text{wd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \text{wd\_id} argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the \text{wd\_id} argument.

\text{atb}

VMS Usage: longword\_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The \text{atb} argument is the address of a longword that identifies an attribute block containing the character size attribute setting.
char
VMS Usage: char_string
type: character_string
access: write only
mechanism: by descriptor

Single character. The char argument is the address of a character string descriptor of a single char.

width
VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Character width. The width argument is the address of a longword that receives the character width in viewport-relative device coordinates.

height
VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Character height. The height argument is the address of a longword that receives the character height in viewport-relative device coordinates.
UISDC$GET_CLIP

Returns the clipping mode.

Format

\[ \text{status} = \text{UISDC$GET_CLIP} \ \text{wd} \_\text{id}, \ \text{atb} \ [x_1, \ y_1, \ x_2, \ y_2] \]

Returns

VMS Usage: boolean

type: longword (unsigned)

access: write only

mechanism: by value

Boolean value returned as the clipping mode in a status variable or R0 (VAX MACRO). If clipping is enabled, a Boolean TRUE is returned. If clipping is disabled, a Boolean FALSE is returned.

UISDC$GET_CLIP signals all errors; no condition values are returned.

Arguments

\text{wd} \_\text{id}

VMS Usage: identifier

type: longword (unsigned)

access: read only

mechanism: by reference

Display window identifier. The \text{wd} \_\text{id} argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the \text{wd} \_\text{id} argument.

\text{atb}

VMS Usage: longword unsigned

type: longword (unsigned)

access: read only

mechanism: by reference

Attribute block number. The \text{atb} argument is the address of a longword that identifies the attribute block that modifies the clipping mode.
$x_1, y_1, x_2, y_2$

VMS Usage: longword_unsigned

type: longword (unsigned)

access: write only

mechanism: by reference

Viewport-relative device coordinate pairs. The $x_1$ and $y_1$ arguments are the addresses of longwords that receive the viewport-relative device coordinates of the lower-left corner of the clipping rectangle. The $x_2$ and $y_2$ arguments are the addresses of longwords that receive the viewport-relative device coordinates of the upper-right corner of the clipping rectangle.
UISDC$GET POINTER POSITION

Returns the current pointer position in viewport-relative device coordinates.

Format

\[ \text{status} = \text{UISDC$GET \_POINTER\_POSITION \ (wd\_id, \ retx, \ rety) \ } \]

Returns

VMS Usage: boolean
type: longword (unsigned)
access: write only
mechanism: by value

Boolean value returned as the current position of the pointer in a status variable. UISDC$GET POINTER POSITION returns the Boolean TRUE value 1 if the pointer is within the visible portion of the viewport, 0 is returned if the pointer is outside the visible portion of the viewport. In the latter case, the x and y values are returned as 0,0.

UISDC$GET POINTER POSITION signals all errors; no condition values are returned.

Arguments

\( \text{wd\_id} \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \text{wd\_id} argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE WINDOW for more information about the \text{wd\_id} argument.

\( \text{retx}, \ \text{rety} \)

VMS Usage: longword unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Viewport-relative device coordinate pair. The \text{retx} and \text{rety} arguments are the addresses of longwords that receive the pointer position in viewport-relative device coordinates.
Description

Note that the returned status value should always be tested when using this routine, since it is always possible that the pointer could be outside the window when the service is called and the x,y values would be meaningless.
UISDC$GET_POSITION

Returns the current baseline position for text output.

Format

UISDC$GET_POSITION  wd_id, retx, rety

Returns

UISDC$GET_POSITION signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

retx, rety
VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference

Viewport-relative device-coordinate pair. The retx and rety arguments are addresses of longwords that receive the current position of text output in viewport-relative device coordinate positions.

Description

UIS$NEW_TEXT_LINE and UIS$TEXT recognize the concept of current position. The position refers to the alignment point on the baseline of the next character to be output. (See the UIS$SET_POSITION routine.)
UISDC$GET_TEXT_MARGINS

Returns the text margins for a line of text. See UISDC$SET_TEXT_MARGINS for more information.

Format

UISDC$GET_TEXT_MARGINS  wd_id, atb, x, y
[margin_length]

Returns

UISDC$GET_TEXT_MARGINS signals all errors; no condition values are returned.

Arguments

**wd_id**
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Virtual display identifier. The *wd_id* argument is the address of a longword that uniquely identifies the virtual display. See UIS$CREATE_WINDOW for more information about the *wd_id* argument.

**atb**
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The *atb* argument is the address of a longword that identifies an attribute block.

**x, y**
VMS Usage: longword_unsigned
type: longword (unsigned)
access: write only
mechanism: by reference
Starting margin position. The \(x, y\) arguments are the addresses of longwords that receive the starting margin relative to the direction of text drawing in viewport-relative device coordinates.

### margin_length

VMS Usage: \texttt{longword\_unsigned}

- \texttt{type: longword (unsigned)}
- \texttt{access: write only}
- \texttt{mechanism: by reference}

Ending margin position. The \texttt{margin\_length} is the address of a longword that receives the distance to the end margin in viewport-relative device coordinates. The margin is measured along the actual path of text drawing.
UISDC$GET_VISIBILITY

Returns a Boolean value that indicates whether or not the specified rectangle in the display window is visible.

Format

Boolean=UISDC$GET_VISIBILITY wd_id [,x1, y1 [,x2, y2]]

Returns

VMS Usage: boolean
type: longword (unsigned)
access: write only
mechanism: by value

Boolean value returned in a status variable or R0 (VAX MACRO). The returned value, the visibility status, is a Boolean TRUE only if the entire area is visible, and a Boolean FALSE if even a portion of the area is occluded or clipped.

UISDC$GET_VISIBILITY signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

x1, y1, x2, y2
VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinates of a rectangle in the display window. The x1 and y1 arguments are addresses of integers that define the lower-left corner of a rectangle in the display window. The x2 and y2 arguments are
addresses of integers that define the upper-right corner of a rectangle in the display window.

If the coordinates of the rectangle are not specified, the dimensions of the entire display window are used by default.

Description

UIS$GET_VISIBILITY determines if a single position is visible by specifying the same coordinate for both minimum and maximum values.
UISDC$IMAGE

Draws a raster image into a specified display rectangle.

Format

```
UISDC$IMAGE  wd_id, atb, x1, y1, x2, y2, rasterwidth, rasterheight, bitsperpixel, rasteraddr
```

Returns

UISDC$IMAGE signals all errors; no condition values are returned.

Arguments

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The **wd_id** argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the **wd_id** argument.

**atb**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The **atb** argument is the address of a longword that identifies an attribute block that modifies the writing mode.

**x1, y1, x2, y2**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinates of the rectangle in the display window. The **x1** and **y1** arguments are the addresses of integers that define the lower-left corner of the rectangle in the display window. The **x2** and **y2** arguments
are the addresses of integer pixels that define the upper-right corner of the rectangle in the display window.

**rasterwidth**
VMS Usage: longword(unsigned)
type: longword (unsigned)
access: read only
mechanism: by reference

Width of the raster image. The *rasterwidth* argument is the address of a longword that defines the width of the raster image in pixels.

**rasterheight**
VMS Usage: longword(unsigned)
type: longword (unsigned)
access: read only
mechanism: by reference

Height of the raster image. The *rasterheight* is the address of a longword that defines the height of the raster image in pixels.

**bitsperpixel**
VMS Usage: longword(unsigned)
type: longword (unsigned)
access: read only
mechanism: by reference

Number of bits per pixel in the raster image. The *bitsperpixel* argument is the address of a longword that defines the number of bits per pixel in the raster image. The *bitsperpixel* argument is currently required to be either 1 or 8.

If *bitsperpixel* is specified as 8 on a single-plane system, the results are unpredictable.

**rasteraddr**
VMS Usage: vector_longword_unsigned
type: longword_unsigned
access: read only
mechanism: by reference

Raster image. The *rasteraddr* argument is the address of an array that defines a raster image.
Description

The raster dimensions are described by the width, height, and bits per pixel parameters. The width and height give the number of pixels in each dimension, and bits per pixel represents the number of bits that makes up each pixel. The raster is read from memory as "height" bit vectors each of which is "width" pixels long and each pixel is "bits/pixel" bits long.

UISDC$IMAGE never scales. If the size of the destination rectangle is larger than the size of the raster, then the remaining space on the right and top will not be written.

The procedure for assignment of bits in the bitmap is as follows:

1. Each bit in the array is set from left-most bit to the right-most bit
2. Each row is filled from the top row to the bottom row.

NOTE: The bitmap is not byte- or word-aligned.

The following figure illustrates the setting of bits in the bitmap.
UISDC$LINE

Draws a line or series of unconnected lines.

Format

UISDC$LINE  wd_id, atb, x_1, y_1 [,x_2,y_2 [,...x_n,y_n]]

Returns

UISDC$LINE signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

atb
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The atb argument is the address of a longword integer that identifies an attribute block that modifies line style and line width or both.

x, y
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinate pair. The x and y arguments are the addresses of integers that define a point in the display window.

If the arguments are repeated to specify a second position, a line is created.
If one coordinate pair is specified, a point is drawn. If any other odd number of coordinate pairs is specified, the final coordinate pair is ignored.

Up to 126 world coordinate pairs may be specified as arguments. See the “DESCRIPTION” section below for more information about this argument.

**Description**

If one position is specified, then a point is drawn. If two positions are specified, a single vector is drawn.

Up to 252 arguments can be specified, that is, 63 unconnected lines may be drawn. If a larger number of points must be specified in a single call, UISDC$LINE-ARRAY should be used.

The points or lines are drawn with the line pattern and width for the attribute block. Fill pattern attribute settings are ignored.
UISDC$LINE.ARRAY

Draws an unfilled point, line, or a series of unconnected lines depending on the number of positions specified.

Format

UISDC$LINE.ARRAY  wd_id, atb, count, x_vector, y_vector

Returns

UISDC$LINE.ARRAY signals all errors; no condition values are returned.

Arguments

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The **wd_id** argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the **wd_id** argument.

**atb**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The **atb** argument is the address of a longword integer that identifies an attribute block that modifies line style or line width or both.

**count**

VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Number of points. The **count** argument is the address of longword integer that denotes the number of viewport-relative device coordinate pairs defined in the arguments **x_vector** and **y_vector**.
x_vector, y_vector

VMS Usage: vector_longword_unsigned

- type: longword (unsigned)
- access: read only
- mechanism: by reference

Array of x and y viewport-relative device coordinates. The x_vector and y_vector arguments are the addresses of arrays of integers whose elements together define in viewport-relative device coordinates the starting and end points of lines drawn in the display window.

Description

UISDC$LINE_ARRAY performs the same functions as UISDC$LINE except that x and y coordinates are stored in arrays.

A maximum of 32,767 points can be plotted in a single call. UISDC$LINE_ARRAY is the same as UISDC$LINE except that the x and y coordinates are specified using two arrays, each of length count points.
UISDC$LOAD_BITMAP

Loads a bitmap into offscreen memory on VAXstation color and intensity systems.

Format

\[ \text{bitmap}_\text{id} = \text{UISDC$LOAD_BITMAP} \quad \text{wd}_\text{id}, \text{bitmap}_\text{adr}, \text{bitmap}_\text{len}, \text{bitmap}_\text{width}, \text{bits}_\text{per}_\text{pixel} \]

Returns

VMS Usage: identifier
type: longword (unsigned)
access: write only
mechanism: by value

Longword value returned as the bitmap identifier in the variable \( \text{bitmap}_\text{id} \) or R0 (VAX MACRO) for use in DOP$L_BITMAP-ID field of a drawing operation primitive (DOP).

UISDC$LOAD_BITMAP signals all errors; no condition values are returned.

Arguments

\( \text{wd}_\text{id} \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \( \text{wd}_\text{id} \) argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the \( \text{wd}_\text{id} \).

\( \text{bitmap}_\text{adr} \)

VMS Usage: address
type: longword (unsigned)
access: read only
mechanism: by reference

Bitmap address. The \( \text{bitmap}_\text{adr} \) argument is the address of a bitmap.
UISDC$LOAD_BITMAP

bitmap_len
VMS Usage: longword_unsigned
Type: longword (unsigned)
Access: read only
Mechanism: by reference

Bitmap length. The bitmap_len argument is the address of the number that defines the length of the bitmap in bytes. The length must be a multiple of 2.

bitmap_width
VMS Usage: longword_unsigned
Type: longword (unsigned)
Access: read only
Mechanism: by reference

Width of the bitmap. The bitmap_width argument is the address of a number that defines the width of the bitmap in pixels. If the number of bits per pixel is 1, the specified width must be a multiple of 16.

If the width of the bitmap should not exceed 1024.

bits_per_pixel
VMS Usage: longword_unsigned
Type: longword (unsigned)
Access: read only
Mechanism: by reference

The bits_per_pixel argument is the address of a number that defines the number of bits per pixel. Currently, the values 1 and 8 are supported.

Description

See the MicroVMS Workstation Video Device Driver Manual for more information.
UISDC$MEASURE_TEXT

Measures a text string as if it were output in a display window.

Format

\[
\text{UISDC$MEASURE\_TEXT} \quad \text{wd\_id, atb, text\_string, retwidth, retheight, [,ctllist, ctilen] [,posarray]}
\]

Returns

UISDC$MEASURE_TEXT signals all errors; no condition values are returned.

Arguments

\textit{wd\_id}

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \textit{wd\_id} argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE\_WINDOW for more information about the \textit{wd\_id} argument.

\textit{atb}

VMS Usage: longword\_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Attribute block number. The \textit{atb} argument is the address of a longword that identifies an attribute block that modifies text output.

\textit{text\_string}

VMS Usage: char\_string
type: character string
access: read only
mechanism: by descriptor

Text string. The \textit{text\_string} argument is the address of a character string descriptor of a text string.
**UISDC Routines**

**UISDC$MEASURE_TEXT**

**retwidth, retheight**

VMS Usage: longword unsigned  
Type: longword (unsigned)  
Access: write only  
Mechanism: by reference

Dimensions of the text string. The `retwidth` and `retheight` arguments are the addresses of longwords that receive the width and height of the text in centimeters.

**ctlIist**

VMS Usage: vector_longword_unsigned  
Type: longword (unsigned)  
Access: read only  
Mechanism: by reference

Text formatting list. The `ctlIist` argument is the address of an array of longwords that describes the font, text rendition, format, and positioning of text string fragments. See UIS$_TEXT$ for a complete description of the formatting control list.

**ctlIen**

VMS Usage: longword unsigned  
Type: longword (unsigned)  
Access: read only  
Mechanism: by reference

Length of the text formatting control list. The `ctlIen` argument is the address of a longword that defines the length of the text formatting control list.

**posarray**

VMS Usage: vector_longword_unsigned  
Type: longword (unsigned)  
Access: write only  
Mechanism: by reference

Character position array. The `posarray` argument is the address of an array of longwords that receives character positions in pixels that are relative offsets at which each character would have been displayed. See UIS$_MEASURE_TEXT$ for a complete description of the character position array.

**Description**

UISDC$MEASURE_TEXT$ is used in justification and text positioning applications. The routine returns the height and width of the text string in viewport-relative device coordinates.
UISDC$MOVE AREA

Shifts a portion of a display window to another position in the window.

Format

UISDC$MOVE AREA  wd_id, x1, y1, x2, y2, new_x, new_y

Returns

UISDC$MOVE AREA signals all errors; no condition values are returned.

Arguments

wd_id

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE WINDOW for more information about the wd_id argument.

x1, y1, x2, y2

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinates of the source rectangle. The x1 and y1 arguments are the addresses of integers that define the lower-left corner of the source rectangle. The x2 and y2 are the addresses of integers that define the upper-right corner of the source rectangle.

new_x, new_y

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinate pair. The new_x and new_y arguments are the addresses of integers that define the lower-left corner of the
destination rectangle. The height and width of the destination rectangle is implied from the height and width of the source rectangle.

### Description

Note that display objects that are only partially contained within the specified source rectangle, though partially moved within existing display windows will be completely moved within the display list.

The nonoccluding portion of the source rectangle (if any) is erased after the operation.
UISDC$NEW_TEXT_LINE

Moves the current text position along the actual path of text drawing to the starting margin and then along the margin in the direction of the minor text path. Depending on the minor text path, either the width or height of the character cell is used for spacing between characters and lines.

Format

**UISDC$NEW_TEXT_LINE**  \( wd\_id, atb \)

Returns

UISDC$NEW_TEXT_LINE signals all errors; no condition values are returned.

Arguments

\( wd\_id \)

VMS Usage: \textbf{identifier}

type: \textbf{longword (unsigned)}

access: \textbf{read only}

mechanism: \textbf{by reference}

Display window identifier. The \( wd\_id \) argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the \( wd\_id \) argument.

\( atb \)

VMS Usage: \textbf{longword_unsigned}

type: \textbf{longword (unsigned)}

access: \textbf{read only}

mechanism: \textbf{by reference}

Attribute block number. The \( atb \) argument is the address of a longword that identifies an attribute block.
UISDC$PLOT

Draws a filled or unfilled point, line, or polygon depending on the number of positions specified.

Format

\[
\text{UISDC$PLOT \quad \text{wd\_id}, \text{atb}, x_1, y_1 [,x_2,y_2 [,\ldots,x_n,y_n]]}
\]

Returns

UISDC$PLOT signals all errors; no condition values are returned.

Arguments

\textit{wd\_id}

VMS Usage: \textbf{identifier}

type: \textbf{longword (unsigned)}

access: \textbf{read only}

mechanism: \textbf{by reference}

Display window identifier. The \textit{wd\_id} argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE\_WINDOW for more information about the \textit{wd\_id} argument.

\textit{atb}

VMS Usage: \textbf{longword\_unsigned}

type: \textbf{longword (unsigned)}

access: \textbf{read only}

mechanism: \textbf{by reference}

Attribute block number. The \textit{atb} argument is the address of a longword that identifies an attribute block that modifies line style and line width.

\textit{x, y}

VMS Usage: \textbf{longword\_unsigned}

type: \textbf{longword (unsigned)}

access: \textbf{read only}

mechanism: \textbf{by reference}

Viewport-relative device coordinate pair. The \textit{x} and \textit{y} arguments are the addresses of integers that define a point in the display window. If the argument be used to specify a second position, a line is created. Up to 126
viewport-relative device coordinate pairs may be specified as arguments. See the DESCRIPTION section below for more information about this argument.

---

**Description**

If one position is specified, then a point is drawn. If two positions are specified, a single vector is drawn. If more than two positions are specified, a connected polygon is drawn. Up to 252 arguments can be specified, giving a maximum of a 126-point polygon using this routine. If a larger number of points must be specified in a single call, UISDC$PLOT-ARRAY should be used.

The points or lines are drawn with the line pattern and width for the attribute block, and if FILL is enabled for the attribute block, the enclosed area is filled with the current fill pattern.

**NOTE:** VAX PASCAL application programs that draw lines and polygons should use UISDC$PLOT-ARRAY.
UISDC$PLOT__ARRAY

Draws an unfilled or filled point, line or polygon depending on the number of positions specified. This routine performs the same functions as UISDC$PLOT.

Format

UISDC$PLOT__ARRAY  wd_id, atb, count, x_vector, y_vector

Returns

UISDC$PLOT__ARRAY signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage: identifier
type:        longword (unsigned)
access:      read only
mechanism:   by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

atb
VMS Usage:  longword_unsigned
type:       longword (unsigned)
access:     read only
mechanism:  by reference

Attribute block number. The atb argument is the address of a longword that identifies an attribute block that modifies line style or line width or both.

count
VMS Usage:  longword_unsigned
type:       longword (unsigned)
access:     read only
mechanism:  by reference

Number of points. The count argument is the address of longword that denotes the number of viewport-relative device coordinate pairs defined in the x_vector and y_vector arguments.
**x_vector, y_vector**

VMS Usage: `vector_longword_signed`

*type*: `longword_signed`

*access*: `read only`

*mechanism*: `by reference`

Array of x and y viewport-relative device coordinates. The `x_vector` argument is the address of an array of integers whose elements are the x viewport-relative device coordinate values of points defined in the window display. The `y_vector` argument is the address of an array of integers whose elements are the y viewport-relative device coordinate values of points defined in the display window.

---

**Description**

A maximum of 65,535 points can be plotted in a single call. `UISDC$PLOT_ARRAY` is the same as `UISDC$PLOT` except that the x and y viewport-relative device coordinates are specified using two arrays, each of length n points.
UISDC$QUEUE_DOP

Queues the specified drawing operation primitive (DOP) for execution in the specified window and then returns control to the application.

Format

UISDC$QUEUE_DOP  wd_id, dop

Returns

UISDC$QUEUE_DOP signals all errors; no condition values are returned.

Arguments

wd_id

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

dop

VMS Usage: vector_byte_unsigned
type: byte_unsigned
access: read only
mechanism: by reference

Drawing operation primitive. The dop argument is the address of an array of bytes that contains the drawing operation primitive.

Description

UISDC$EXECUTE_DOPASYNCH queues the specified drawing operation primitive (DOP) for execution in the specified window. To obtain notification that the DOP has completed execution, see UISDC$EXECUTE_DOPASYNCH and UISDC$EXECUTE_DOP_SYNCH. See the MicroVMS Workstation Video Device Driver Manual for more information about DOPs.
UISDC$READ_IMAGE

Reads a raster image from within a specified rectangle contained by a display window.

Format

UISDC$READ_IMAGE  wd_id, x1, y1, x2, y2, rasterwidth, rasterheight, bitsperpixel, [rasteraddr], rasterlen

Returns

UISDC$READ_IMAGE signals all errors; no condition values are returned.

Arguments

\( wd\_id \)
VMS Usage: object_id
type: longword
access: read only
mechanism: by reference

Display window identifier. The \( wd\_id \) argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the \( wd\_id \) argument.

\( x1, y1 \)
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinates of lower-left corner of the specified rectangle. The \( x1,y1 \) arguments are the addresses of integers that define the lower-left corner of the rectangle in the display window.

\( x2, y2 \)
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference
Viewport-relative device coordinates of the upper-right corner of the rectangle. The $x_2,y_2$ arguments are the addresses of integers that define the upper-right corner of the specified rectangle in the display window.

**rasterwidth**

VMS Usage: longword_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Width of the raster image in pixels. The `rasterwidth` argument is the address of a longword that receives the width of the raster image in pixels.

**rasterheight**

VMS Usage: longword_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Height of the raster image in pixels. The `rasterheight` argument is the address of a longword that receives the height of the raster image in pixels.

**bitsperpixel**

VMS Usage: longword_unsigned  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Number of bits per pixel in the raster image. The `bitsperpixel` argument is the address of a longword that receives the number of bits per pixel in the raster image.

**rasteraddr**

VMS Usage: vector_byte_unsigned  
type: byte  
access: write only  
mechanism: by reference

Address of buffer in which to return the raster image. The `rasteraddr` argument is the address of an array of bytes that receives the raster image.

**rasterlen**

VMS Usage: longword_unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Size in bytes of the buffer. The `rasterlen` argument is the address of a longword that specifies the size in bytes of the buffer.
Description

The raster image contained within the rectangle described by \( x_1, y_1 \) and \( x_2, y_2 \) is returned in the specified buffer. The actual dimensions, in pixels, of the returned buffer is written to rasterwidth and rasterheight. The number of bits per pixel is written to bitsperpixel. If the size of the buffer specified by rasterlen is not large enough to accept the entire bitmap raster, then rasterwidth, rasterheight, and bitsperpixel are returned as 0 and no data is written to the buffer.

If the buffer length is specified as 0, values are returned in rasterwidth, rasterheight, and bitsperpixel. These values can be used to calculate the size of the buffer needed to contain the raster image.

You should specify a buffer length of 0 to obtain the width, height, and bits per pixels. Use these returned values to do the following:

1. Calculate the correct buffer size
2. Reissue the call with the correct data
UISDC$SET_ALIGNED_POSITION

Sets the current position for text output. This routine differs from
UISDC$SET_POSITION in that the position refers to the upper-left corner of
the next character to the output.

Format

UISDC$SET_ALIGNED_POSITION  wd_id, atb, x, y

Returns

UISDC$SET_ALIGNED_POSITION signals all errors; no condition values
are returned.

Arguments

wd_id
VMS Usage: identifier
type:          longword (unsigned)
access:        read only
mechanism:     by reference

Display window identifier. The wd_id argument is the address of a
longword that uniquely identifies a display window. See UIS$CREATE_WINDOW
for more information about the wd_id argument.

atb
VMS Usage: longword_unsigned
type:          longword (unsigned)
access:        read only
mechanism:     by reference

Attribute block number. The atb is the address of a longword that identifies
an attribute block that contains the appropriate font attribute text attribute
setting.

x, y
VMS Usage: longword_unsigned
type:          longword (unsigned)
access:        read only
mechanism:     by reference
UISDC Routines 19-51
UISDC$SET_ALIGNED POSITION

Viewport-relative device coordinate pair. The x and y arguments are the addresses of integers that define the current position for text output.

Description

UISDC$SET_ALIGNED_POSITION is useful in applications that know the position of the upper-left corner, but also don’t know enough about the font baseline to determine the proper alignment point. The position is converted into the proper alignment point using the font specified in the given attribute block. The alignment point is stored internally.
UISDC$SET_BUTTON_AST

Allows an application to find out when a button on the pointing device is depressed or released in a given rectangle of the display window.

Format

```
UISDC$SET_BUTTON_AST  wd_id [,astadr, [astprm],keybuf] [,x1, y1, x2, y2]
```

Returns

UISDC$SET_BUTTON_AST signals all errors; no condition values are returned.

Arguments

- **wd_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Display window identifier. The wd_id argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

- **astadr**
  - VMS Usage: ast_procedure
  - type: procedure entry mask
  - access: read only
  - mechanism: by reference
  - AST routine. The astadr argument is the address of an entry mask to a procedure that is called at AST level whenever a pointer button is depressed or released. To cancel the AST-enabling request of UISDC$SET_BUTTON_AST, specify 0 in the astadr argument. To disable UIS$SET_BUTTON_AST, omit the astadr argument.
**astprm**

VMS Usage: user_arg  
type: longword (unsigned)  
access: read only  
mechanism: by reference

AST parameter. The astprm argument is the address of a single argument or data structure, such as a record or an array, to be passed to the AST routine. Calls to UISDC$SET_BUTTON_AST in FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

**keybuf**

VMS Usage: address  
type: longword (unsigned)  
access: write only  
mechanism: by reference

Key buffer. The keybuf argument is the address of a longword buffer that receives button information whenever a pointer button is depressed or released. The low two bytes are the key code. The buttons are located on the left, center and right of the pointing device and are defined as UIS$C_Pointer_BUTTON_1, UIS$C_Pointer_BUTTON_2, UIS$C_Pointer_BUTTON_3, and UIS$C_Pointer_BUTTON_4 respectively. The bit <31> is set to 1 if the button has been pressed, and 0 if the button has been released. The buffer is not overwritten with subsequent button transitions until the AST routine completes.

**x1, y1, x2, y2**

VMS Usage: longword unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Viewport-relative device coordinates of a rectangle in the display window. The x1 and y1 arguments are the addresses of integers that define the lower-left corner of a rectangle in the display window. The x2 and y2 arguments are the addresses of integer pixels that define the upper-right corner of a rectangle in the display window.

If no rectangle is specified, the entire display window is assumed.

---

**Description**

This function can be called any number of times for different rectangles within the same display window or many display windows.

See the DESCRIPTION section of UISD$SET_BUTTON_AST for information about pointer region priorities.
UISDC$SET_CHAR_SIZE

Sets the viewport-relative device coordinate size of the specified character.

Format

**UISDC$SET_CHAR_SIZE**  \( wd\_id, \ iatb, \ oatb, \ [char], \ [width][,height] \)

Returns

UISDC$SET_CHAR_SIZE signals all errors; no condition values are returned.

Arguments

**wd_id**

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \( wd\_id \) argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the \( wd\_id \) argument.

**iatb**

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Input attribute block number. The \( iatb \) argument is the address of a longword that identifies an attribute block to be modified.

**oatb**

VMS Usage: longword unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Output attribute block number. The \( oatb \) argument is the address of a longword that identifies a modified attribute block.
**char**

VMS Usage: character string

type: character string

access: read only

mechanism: by descriptor

Single character. The char argument is the address of a descriptor of a single character. You may specify any character in the font. Specify this argument when you are using proportionally spaced fonts to establish spacing and scaling factors among characters within the font. The char has no effect on monospaced fonts.

If char is not specified or if the specified character is invalid, the widest character in the font is chosen.

**width**

VMS Usage: longword (unsigned)

type: longword (unsigned)

access: read only

mechanism: by reference

Character width. The width argument is the address of an integer that defines the character width in viewport-relative device coordinates.

**height**

VMS Usage: longword (unsigned)

type: longword (unsigned)

access: read only

mechanism: by reference

Character height. The height argument is the address of an integer that defines the character height in viewport-relative device coordinates.

---

**Description**

To disable character scaling, omit all of the following arguments: char, width, and height.

To scale characters to their nominal size as specified in the font, do not specify width or height. Scaling is only visible when you use a window that does not have the same proportions as the virtual display.

If you specify either width or height only, characters are scaled to the size you specify and in the direction you specify. In the unspecified direction, characters are scaled so as to maintain the same ratio of height and width as the unscaled character.
UISDC$SET_CLIP

Sets a clipping rectangle within the display window.

Format

UISDC$SET_CLIP  wd_id, iatb, oatb [x1, y1, x2, y2]

Returns

UISDC$SET_CLIP signals all errors; no condition values are returned.

Arguments

\textit{wd}_id

VMS Usage: \texttt{identifier}

\begin{itemize}
  \item type: \texttt{longword (unsigned)}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

Display window identifier. The \textit{wd}_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the \textit{wd}_id argument.

\textit{iatb}

VMS Usage: \texttt{longword unsigned}

\begin{itemize}
  \item type: \texttt{longword (unsigned)}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

Input attribute block number. The \textit{iatb} argument is the address of a longword value that identifies an attribute block to be modified. Either the attribute block 0 or a previously modified attribute block can be specified.

\textit{oatb}

VMS Usage: \texttt{longword unsigned}

\begin{itemize}
  \item type: \texttt{longword (unsigned)}
  \item access: \texttt{read only}
  \item mechanism: \texttt{by reference}
\end{itemize}

Output attribute block number. The \textit{oatb} argument is the address of a longword value that identifies a newly modified attribute block that controls the dimensions of the clipping rectangle.
**UISDC$SET_CLIP**

\( x_1, y_1, x_2, y_2 \)

**VMS Usage:** `longword_unsigned`

**type:** `longword (unsigned)`

**access:** `read only`

**mechanism:** `by reference`

Viewport-relative device coordinates of the clipping rectangle. The \( x_1 \) and \( y_1 \) arguments are the addresses of integers that define the lower-left corner of the clipping rectangle in viewport-relative device coordinates. The \( x_2 \) and \( y_2 \) arguments are the addresses of integers that define the upper-right corner of the clipping rectangle in viewport-relative device coordinates. Only graphic objects and portions of graphic objects drawn **within** the clipping rectangle are seen.

If the device coordinates of the clipping rectangle corners are not specified, then clipping is disabled for this attribute block.
UISDC$SET_POINTEAST

Allows an application to find out when the pointer is moved in a given rectangle of the display window.

Format

UISDC$SET_POINTEAST \(wd\_id[,astadr[,astprm]]\)[,\(x_1, y_1, x_2, y_2\)][,exitastadr[,exitastprm]]

Returns

UISDC$SET_POINTEAST AST signals all errors; no condition values are returned.

Arguments

\(wd\_id\)

VMS Usage: \textit{identifier}
type: \textit{longword (unsigned)}
access: \textit{read only}
 mechanism: \textit{by reference}

Display window identifier. The \(wd\_id\) argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE\_WINDOW for more information about the \(wd\_id\) argument.

\(astadr\)

VMS Usage: \textit{ast\_procedure}
type: \textit{procedure entry mask}
access: \textit{read only}
 mechanism: \textit{by reference}

AST routine. The \(astadr\) argument is the address of the entry mask to a procedure that is called at AST level whenever the pointer is moved within a rectangle in the display window.

To cancel the AST-enabling request of UISDC$SET_POINTEAST for this argument only, specify 0 in the \(astadr\) argument and the coordinates of the rectangle.
**astprm**

VMS Usage: user_arg  
type: longword (unsigned)  
access: read only  
mechanism: by reference

AST parameter. The astprm argument is the address of a single argument or data structure, such as an array or record, passed to the AST routine. Calls to UISDC$SET_POINTER_AST in VAX FORTRAN application programs should be coded as follows: %REF(%LOC(astprm)).

**x1, y1, x2, y2**

VMS Usage: longword unsigned  
type: longword (unsigned)  
access: read only  
mechanism: by reference

Viewport-relative device coordinates of the rectangle of the display window. The x1 and y1 arguments are the addresses of integers that define the lower-left corner of the rectangle of the display window. The x2 and y2 arguments are the addresses of integer pixels that define the upper-right corner of the rectangle of the display window.

If no rectangle is specified, the entire display window is assumed.

To cancel an AST-enabling request, specify 0 in either the astadr or the exitastadr arguments or both and the coordinates of the rectangle.

**exitastadr**

VMS Usage: ast_procedure  
type: procedure entry mask  
access: read only  
mechanism: by reference

Exit AST routine. The exitastadr argument is the address of the entry mask to a procedure that is called at AST level whenever the pointer leaves the rectangle.

To cancel the AST-enabling request of UISDC$SET_POINTER_AST for the EXIT AST routine only, specify 0 in the exitastadr argument and the coordinates of the rectangle.

**exitastprm**

VMS Usage: user_arg  
type: longword  
access: read only  
mechanism: by reference
UISDC Routines

UISDC$SET_POINTER_AST

Exit AST parameter. The exitastprm argument is the address of a single argument or data structure, such as an array or record, to be passed to the AST routine. Calls to UISDC$SET_POINTER_AST in VAX FORTRAN application programs should be coded as follows: %REF(%LOC(exitastprm)).

Description

UISDC$SET POINTER AST also allows an application to keep track of the pointer in its own way. This routine can be called any number of times for different rectangles.

Note that an application need not enable both AST routines. It may specify one or the other.

UISDC$SET_POINTER_AST can be used by the application to highlight the display or some other application-specific function, as the user moves the pointer over specific areas of the display window. This might be used to define a number of regions within a menu, and execute an AST when the pointer enters or leaves any of these regions.

If both AST routines are enabled and the value 0 is specified in the astadr argument, the first AST routine is canceled.

See the DESCRIPTION section of UIS$SET_BUTTON_AST for information about pointer region priorities.
UISDC$SET_POINTER_PATTERN

Allows an application to specify a special pointer cursor pattern.

Format

**UISDC$SET_POINTER_PATTERN**  
wd_id [,pattern_array, pattern_count, activex, activey] [x1, y1, x2, y2] [flags]

Returns

UISDC$SET_POINTER_PATTERN signals all errors; no condition values are returned.

Arguments

**wd_id**
VMS Usage: identifier

- type: longword (unsigned)
- access: read only
- mechanism: by reference

Display window identifier. The **wd_id** argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the **wd_id** argument.

**pattern_array**
VMS Usage: vector_word_unsigned

- type: word (unsigned)
- access: read only
- mechanism: by reference

16 x 16 bit cursor pattern. The **pattern_array** argument is the address of one or more arrays of 16 words that represents a bitmap image of the cursor.

Color and intensity applications can define two patterns that are also executable on monochrome systems.
If two arrays are specified in an application running on a single-plane system, the first array is used.

**NOTE:** The bitmap image of the new pointer pattern is mapped in reverse order to display screen.

**pattern_count**

VMS Usage: longword_unsigned

Type: longword (unsigned)

Access: read only

Mechanism: by reference

Number of 16- x 16-bit cursor pattern. The **pattern_count** argument is the address of a longword that contains the number of cursor pattern arrays defined in the **pattern_array** argument.

**activex, activey**

VMS Usage: longword_unsigned

Type: longword (unsigned)

Access: read only

Mechanism: by reference

The **activex** and **activey** arguments are used to specify the actual bit in the cursor pattern that should be used to calculate the current pointer position. The arguments are expressed as bit offsets from the lower-left corner of the cursor pattern.

**x1, y1, x2, y2**

VMS Usage: longword_unsigned

Type: longword (unsigned)

Access: read only

Mechanism: by reference

Viewport-relative device coordinates of the rectangle in the display window. The **x1** and **y1** arguments are the addresses of integers that define the lower-left corner of the rectangle in the display window. The **x2** and **y2** arguments are the addresses of integer pixels that define the upper-right corner of the rectangle in the display window.

**flags**

VMS Usage: longword_mask

Type: longword (unsigned)

Access: read only

Mechanism: by reference

Flags. The **flags** argument is the address of a longword mask whose bits determine whether or not the cursor is confined to the display window rectangle.
When specified, UIS$M_BIND_POINTER sets the appropriate bit in the mask.

**Description**

UISDC$SET_POINTER_PATTERN allows an application to specify a special pointer pattern to be used when the pointer is within the display window region specified by the optional rectangle. If no rectangle is given, then the entire display window is assumed. This function can be called any number of times for different rectangles.

To disable UISDC$SET_POINTER_PATTERN, omit the `pattern_array`, `pattern_count`, `activex`, and `activey` arguments.

See the DESCRIPTION section of UIS$SET_BUTTON_AST for information about pointer region priorities.
UISDC$SET_POINTER_POSITION

Specifies a new current pointer position in device coordinates. It is only effective if the new pointer position is within the specified display window and visible.

Format

\[ \text{status} = \text{UISDC$SET\_POINTER\_POSITION \ wd\_id, \ x, \ y} \]

Returns

Longword value returned as boolean in the variable \( \text{status} \) or R0 (VAX MACRO) to indicate that the position is set.

UISDC$SET\_POINTER\_POSITION signals all errors; no condition values are returned.

Arguments

\( \text{wd\_id} \)

VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The \( \text{wd\_id} \) argument is the address of a longword that uniquely identifies a display window. See UISDC$CREATE\_WINDOW for more information about the \( \text{wd\_id} \) argument.

\( \text{x, y} \)

VMS Usage: longword\_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinates of the new pointer position. The \( x \) and \( y \) arguments are the addresses of integers that define the new pointer position.
UISDC$SET_POSITION

Sets the current position for text output. The current position is the point of alignment on the baseline of the next character to be output.

Format

UISDC$SET_POSITION  wd_id, x,y

Returns

UISDC$SET_POSITION signals all errors; no condition values are returned.

Arguments

wd_id
VMS Usage: identifier
type: longword (unsigned)
access: read only
mechanism: by reference

Display window identifier. The wd_id argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE_WINDOW for more information about the wd_id argument.

x, y
VMS Usage: longword_unsigned
type: longword (unsigned)
access: read only
mechanism: by reference

Viewport-relative device coordinate pair. The x and y arguments are the addresses of integers that define the current position for text output.
UISDC$SET_TEXT_MARGINS

Sets the text margins for a line of text.

Format

```
UISDC$SET_TEXT_MARGINS  vd_id,iatb,oatb,x,y,
                          ,margin_length
```

Returns

UISDC$SET_TEXT_MARGINS signals all errors; no condition values are returned.

Arguments

- **vd_id**
  - VMS Usage: **identifier**
  - type: **longword (unsigned)**
  - access: **read only**
  - mechanism: **by reference**
  - Display window identifier. The `vd_id` argument is the address of a longword that uniquely identifies the display window. See UIS$CREATE_WINDOW for more information about the `vd_id` argument.

- **iatb**
  - VMS Usage: **longword_unmodified**
  - type: **longword (unsigned)**
  - access: **read only**
  - mechanism: **by reference**
  - Input attribute block number. The `iatb` argument is the address of a longword that identifies an attribute block to be modified.

- **oatb**
  - VMS Usage: **longword_unmodified**
  - type: **longword (unsigned)**
  - access: **read only**
  - mechanism: **by reference**
  - Output attribute block number. The `oatb` argument is the address of a longword that identifies an attribute block.
**x,y**

VMS Usage: `longword_unsigned`

Type: `longword (unsigned)`

Access: `read only`

Mechanism: `by reference`

Starting margin position. The `x`, `y` arguments are the addresses of integers that define a point on the starting margin in viewport-relative device coordinates. The starting margin is the minor text path when the angle of text slope equals 0 degrees.

**margin_length**

VMS Usage: `longword_unsigned`

Type: `longword (unsigned)`

Access: `read only`

Mechanism: `by reference`

Ending margin position. The `margin_length` is the address of a number that defines the distance from the starting margin to the end margin in viewport-relative device coordinates.
UISDC$TEXT

Draws a series of encoded characters.

Format

\[
\text{UISDC$TEXT} \hspace{1em} \text{wd\_id}, \hspace{1em} \text{atb}, \hspace{1em} \text{text\_string} \hspace{1em} [,x,y] \hspace{1em} [,ctlist ,ctllen]
\]

Returns

UISDC$TEXT signals all errors; no condition values are returned.

Arguments

- **wd\_id**
  - VMS Usage: identifier
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Display window identifier. The \text{wd\_id} argument is the address of a longword that uniquely identifies a display window. See UIS$CREATE\_WINDOW for more information about the \text{wd\_id} argument.

- **atb**
  - VMS Usage: longword\_unsigned
  - type: longword (unsigned)
  - access: read only
  - mechanism: by reference
  - Attribute block number. The \text{atb} argument is the address of a longword that specifies an attribute that modifies text output.

- **text\_string**
  - VMS Usage: char\_string
  - type: character string
  - access: read only
  - mechanism: by descriptor
  - Text string. The \text{text\_string} argument is the address of a character string descriptor of a text string.
\( x, y \)
VMS Usage: \texttt{longword\_unsigned}
type: \texttt{longword (unsigned)}
access: read only
mechanism: by reference

Viewport-relative device coordinates pair. The \( x \) and \( y \) arguments are the addresses of integers that define the viewport-relative device coordinates of the starting point of text output at the upper-left corner of the character cell.

If this argument is not specified, the current text position is used. (See the UISDC\$SET\_ALIGNED\_POSITION routine for more information.)

\texttt{ctllist}
VMS Usage: \texttt{vector\_longword\_unsigned}
type: \texttt{longword (unsigned)}
access: read only
mechanism: by reference

Text control formatting list. The \texttt{ctllist} argument is the address of an array of longwords that describe the font, text rendition, format, and positioning of text string fragments. See UIS$TEXT for a complete description of the text formatting control list.

\texttt{ctllen}
VMS Usage: \texttt{longword\_unsigned}
type: \texttt{longword (unsigned)}
access: read only
mechanism: by reference

Length of the text formatting control list. The \texttt{ctllen} argument is the address of an integer that defines the length of the text formatting control list in longwords.

---

**Description**

Nonprinting characters such as tab and linefeed are not handled in any special way. The character is obtained from the font and is displayed like any other character.
Appendix A
Summary of UIS Calling Sequences

A.1 UIS Calling Sequences

Table A-1 lists return values, entry point names, and parameter lists of all UIS routines.

Table A-1 Summary of UIS Calling Sequences

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td>seg_id</td>
<td>UIS$BEGIN_SEGMENT</td>
<td>vd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$CIRCLE</td>
<td>vd_id, atb, center_x, center_y, xradius, [start_deg] [end_deg]</td>
</tr>
<tr>
<td></td>
<td>UIS$CLOSE_WINDOW</td>
<td>wd_id</td>
</tr>
<tr>
<td>copy_id</td>
<td>UIS$COPY_OBJECT</td>
<td>{ obj_id } [matrix] [atb]</td>
</tr>
<tr>
<td>vcm_id</td>
<td>UIS$CREATE_COLOR_MAP</td>
<td>vcm_size [vcm_name] [vcm_attributes]</td>
</tr>
<tr>
<td>cms_id</td>
<td>UIS$CREATE_COLOR_MAP_SEG</td>
<td>vcm_id, [devnam] [place_mode] [place_data]</td>
</tr>
<tr>
<td>vd_id</td>
<td>UIS$CREATE_DISPLAY</td>
<td>x1, y1, x2, y2, width, height [vcm_id]</td>
</tr>
<tr>
<td>kb_id</td>
<td>UIS$CREATE_KB</td>
<td>devnam</td>
</tr>
<tr>
<td></td>
<td>UIS$CREATE_TERMINAL</td>
<td>terrtype [title] [attributes] [devnam] [devlen]</td>
</tr>
<tr>
<td>tb_id</td>
<td>UIS$CREATE_TB</td>
<td>devname</td>
</tr>
<tr>
<td>tr_id</td>
<td>UIS$CREATE_TRANSFORMATION</td>
<td>vd_id, x1, y1, x2, vdx2, y2, vdy2 [vdx1, vdy1, vdx2, vdy2]</td>
</tr>
</tbody>
</table>

1 VAX PASCAL and VAX PL/I applications must specify the obj_id argument.
# Summary of UIS Calling Sequences

**UIS Calling Sequences**

## Table A-1 (Cont.) Summary of UIS Calling Sequences

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td>wd_id</td>
<td>UIS$CREATE_WINDOW</td>
<td>vd_id, devnam [title] [x1, y1, x2, y2] [width,height] [attributes]</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE.COLOR_MAP</td>
<td>vcm_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE.COLOR_MAP_SEG</td>
<td>cms_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE.DISPLAY</td>
<td>vd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE_KB</td>
<td>kb_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE_OBJECT</td>
<td>{ obj_id } [seg_id]</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE_PRIVATE</td>
<td>obj_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE_TB</td>
<td>tb_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE_TRANSFORMATION</td>
<td>tr_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DELETE_WINDOW</td>
<td>wd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DISABLE_DISPLAY_LIST</td>
<td>vd_id [display_flags]</td>
</tr>
<tr>
<td></td>
<td>UIS$DISABLE_KB</td>
<td>kb_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DISABLE_TB</td>
<td>tb_id</td>
</tr>
<tr>
<td></td>
<td>UIS$DISABLE_VIEWPORT_KB</td>
<td>wd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$ELLIPSE</td>
<td>vd_id, atb, center_x, center_y, xradius, yradius, [start_deg] [.end_deg]</td>
</tr>
<tr>
<td></td>
<td>UIS$ENABLE_DISPLAY_LIST</td>
<td>vd_id [display_flags]</td>
</tr>
<tr>
<td></td>
<td>UIS$ENABLE_KB</td>
<td>kb_id [wd_id]</td>
</tr>
<tr>
<td></td>
<td>UIS$ENABLE_TB</td>
<td>tb_id</td>
</tr>
<tr>
<td></td>
<td>UIS$ENABLE_VIEWPORT_KB</td>
<td>kb_id, wd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$END_SEGMENT</td>
<td>vd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$ERASE</td>
<td>vd_id [x1 y1 x2 y2]</td>
</tr>
<tr>
<td></td>
<td>UIS$EXECUTE</td>
<td>vd_id [buflen] [bufaddr]</td>
</tr>
<tr>
<td>vd_id</td>
<td>UIS$EXECUTE_DISPLAY</td>
<td>buflen, bufaddr</td>
</tr>
<tr>
<td></td>
<td>UIS$EXPAND_ICON</td>
<td>wd_id [icon_wd_id] [attributes]</td>
</tr>
<tr>
<td></td>
<td>UIS$EXTRACT_HEADER</td>
<td>vd_id [buflen, bufaddr], [retlen]</td>
</tr>
<tr>
<td></td>
<td>UIS$EXTRACT_OBJECT</td>
<td>{ obj_id } [seg_id] [,buflen, bufaddr], [retlen]</td>
</tr>
</tbody>
</table>

1VAX PASCAL and VAX PL/I applications must specify the *obj_id* argument.
<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td>UIS$EXTRACT_PRIVATE&lt;sup&gt;1&lt;/sup&gt;</td>
<td>{ \texttt{obj}<em>{id} } { \texttt{seg}</em>{id} } { \texttt{buflen} \texttt{bufaddr} } { \texttt{retlen} }</td>
<td></td>
</tr>
<tr>
<td>UIS$EXTRACT_REGION</td>
<td>\texttt{vd}<em>{id} { x</em>{1},y_{1},x_{2},y_{2} } { \texttt{buflen} \texttt{bufaddr} } { \texttt{retlen} }</td>
<td></td>
</tr>
<tr>
<td>UIS$EXTRACT_TRAILER</td>
<td>\texttt{vd}_{id} { \texttt{buflen} \texttt{bufaddr} } { \texttt{retlen} }</td>
<td></td>
</tr>
<tr>
<td>\texttt{obj}_{id}</td>
<td>UIS$FIND_PRIMITIVE</td>
<td>\texttt{vd}<em>{id} { x</em>{1},y_{1},x_{2},y_{2} } { \texttt{context} } { \texttt{extent} }</td>
</tr>
<tr>
<td>\texttt{seg}_{id}</td>
<td>UIS$FIND_SEGMENT</td>
<td>\texttt{vd}<em>{id} { x</em>{1},y_{1},x_{2},y_{2} } { \texttt{context} } { \texttt{extent} }</td>
</tr>
<tr>
<td>\texttt{arc}_{type}</td>
<td>UIS$GET_ABS_POINTER_POS</td>
<td>devnam, \texttt{retx}, \texttt{rety}</td>
</tr>
<tr>
<td>\texttt{index}</td>
<td>UIS$GET_ALIGNED_POSITION</td>
<td>\texttt{vd}_{id} { \texttt{atb} } { \texttt{retx} } { \texttt{rety} }</td>
</tr>
<tr>
<td>\texttt{status}</td>
<td>UIS$GET_BUTTONS</td>
<td>\texttt{wd}_{id} { \texttt{retstate} }</td>
</tr>
<tr>
<td>\texttt{angle}</td>
<td>UIS$GET_CHAR_ROTATION</td>
<td>\texttt{vd}_{id} { \texttt{atb} }</td>
</tr>
<tr>
<td>\texttt{boolean}</td>
<td>UIS$GET_CHAR_SIZE</td>
<td>\texttt{vd}_{id} { \texttt{atb} } { \texttt{char} } { \texttt{width}, \texttt{height} }</td>
</tr>
<tr>
<td>\texttt{angle}</td>
<td>UIS$GET_CHAR_SLANT</td>
<td>\texttt{vd}_{id} { \texttt{atb} }</td>
</tr>
<tr>
<td>\texttt{status}</td>
<td>UIS$GET_CLIP</td>
<td>\texttt{vd}<em>{id} { \texttt{atb} } { x</em>{1},y_{1},x_{2},y_{2} }</td>
</tr>
<tr>
<td>\texttt{UIS}$GET_COLOR</td>
<td>\texttt{vd}<em>{id} { \texttt{index}, \texttt{retr}, \texttt{retg}, \texttt{retb} } { \texttt{wd}</em>{id} }</td>
<td></td>
</tr>
<tr>
<td>\texttt{UIS}$GET_COLORS</td>
<td>\texttt{vd}<em>{id} { \texttt{index}, \texttt{count}, \texttt{retr_vector}, \texttt{retg_vector}, \texttt{retb_vector} } { \texttt{wd}</em>{id} }</td>
<td></td>
</tr>
<tr>
<td>\texttt{current}_id</td>
<td>UIS$GET_CURRENT_OBJECT</td>
<td>\texttt{vd}_{id}</td>
</tr>
<tr>
<td>\texttt{UIS}$GET_DISPLAY_SIZE</td>
<td>devnam, \texttt{retwidth}, \texttt{reheight} { \texttt{retresolx}, \texttt{retresoly} } { \texttt{retpwidth} \texttt{retpheight} }</td>
<td></td>
</tr>
<tr>
<td>\texttt{status}</td>
<td>UIS$GET_FILL_PATTERN</td>
<td>\texttt{vd}_{id} { \texttt{atb} } { \texttt{index} }</td>
</tr>
<tr>
<td>\texttt{UIS}$GET_FONT</td>
<td>\texttt{vd}_{id} { \texttt{atb}, \texttt{bufferdesc} { \texttt{length} }</td>
<td></td>
</tr>
<tr>
<td>\texttt{UIS}$GET_FONT_ATTRIBUTES</td>
<td>\texttt{vd}_{id} { \texttt{ascender}, \texttt{descender}, \texttt{height}, { \texttt{maximum_width} } { \texttt{item_list} }</td>
<td></td>
</tr>
<tr>
<td>\texttt{UIS}$GET_FONT_SIZE</td>
<td>\texttt{fontid}, \texttt{text_string}, \texttt{retwidth}, \texttt{reheight}</td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup>VAX PASCAL and VAX PL/I applications must specify the \texttt{obj}\_id argument.
### A-4 Summary of UIS Calling Sequences

#### UIS Calling Sequences

Table A-1 (Cont.) Summary of UIS Calling Sequences

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UIS$GET_INTENSITIES</td>
<td>vd_id, index, count, reti_vector [,wd_id]</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_INTENSITY</td>
<td>vd_id, index, reti [,wd_id]</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_KB_ATTRIBUTES</td>
<td>kb_id [,enable_items] [,disable_items] [,click_volume]</td>
</tr>
<tr>
<td>style</td>
<td>UIS$GET_LINE_STYLE</td>
<td>vd_id, atb</td>
</tr>
<tr>
<td>width</td>
<td>UIS$GET_LINE_WIDTH</td>
<td>vd_id, atb [,mode]</td>
</tr>
<tr>
<td>next_id</td>
<td>UIS$GET_NEXT_OBJECT$</td>
<td>{ obj_id } [,flags]</td>
</tr>
<tr>
<td>type</td>
<td>UIS$GET_OBJECT_ATTRIBUTES$</td>
<td>{ obj_id } [,extent]</td>
</tr>
<tr>
<td>parent_id</td>
<td>UIS$GET_PARENT_SEGMENT$</td>
<td>{ obj_id }</td>
</tr>
<tr>
<td></td>
<td></td>
<td>{ seg_id }</td>
</tr>
<tr>
<td>status</td>
<td>UIS$GET_POINTER_POSITION</td>
<td>vd_id, wd_id, retx, rety</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_POSITION</td>
<td>vd_id, retx, rety</td>
</tr>
<tr>
<td>prev_id</td>
<td>UIS$GET_PREVIOUS_OBJECT$</td>
<td>{ obj_id } [,flags]</td>
</tr>
<tr>
<td>root_id</td>
<td>UIS$GET_ROOT_SEGMENT</td>
<td>vd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_TB_INFO</td>
<td>devnam, retwidth, retheight, retresolx, retresoly [,retpwidth, retpheight]</td>
</tr>
<tr>
<td>formatting</td>
<td>UIS$GET_TEXTURE_FORMATTING</td>
<td>vd_id, atb</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_TEXTURE_MARGINS</td>
<td>vd_id, atb, x, y [,margin_length]</td>
</tr>
<tr>
<td>angle</td>
<td>UIS$GET_TEXTURE_PATH</td>
<td>vd_id, atb [,major][,minor]</td>
</tr>
<tr>
<td>vcm_id</td>
<td>UIS$GET_VCM_ID</td>
<td>vd_id</td>
</tr>
<tr>
<td>boolean</td>
<td>UIS$GET_VIEWPORT_ICON</td>
<td>wd_id [icon_wd_id]</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_VIEWPORT_POSITION</td>
<td>wd_id, retx, rety</td>
</tr>
<tr>
<td>status</td>
<td>UIS$GET_VISIBILITY</td>
<td>vd_id, wd_id [,x1, y1 [,x2, y2]]</td>
</tr>
</tbody>
</table>

1 VAX PASCAL and VAX PL/I applications must specify the obj_id argument.
### Table A-1 (Cont.)  Summary of UIS Calling Sequences

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td>attributes</td>
<td>UIS$GET_WINDOW_ATTRIBUTES</td>
<td>wd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_WINDOW_SIZE</td>
<td>vd_id, wd_id, x1, y1, x2, y2</td>
</tr>
<tr>
<td>index</td>
<td>UIS$GET_WRITING_INDEX</td>
<td>vd_id, atb</td>
</tr>
<tr>
<td>mode</td>
<td>UIS$GET_WRITING_MODE</td>
<td>vd_id, atb</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_WS_COLOR</td>
<td>vd_id, color_id, retr, retg, retb [,wd_id]</td>
</tr>
<tr>
<td></td>
<td>UIS$GET_WS_INTENSITY</td>
<td>vd_id, color_id, reti [,wd_id]</td>
</tr>
<tr>
<td></td>
<td>UIS$HLS_TO_RGB</td>
<td>H, L, S, retr, retg, retb</td>
</tr>
<tr>
<td></td>
<td>UIS$HSV_TO_RGB</td>
<td>H, S, V, retr, retg, retb</td>
</tr>
<tr>
<td></td>
<td>UIS$IMAGE</td>
<td>vd_id, atb, x1, y1, x2, y2, rasterwidth, rasterheight, bitsperpixel, rasteraddr</td>
</tr>
<tr>
<td></td>
<td>UIS$INSERT_OBJECT1</td>
<td>{ obj_id }</td>
</tr>
<tr>
<td></td>
<td>UIS$LINE</td>
<td>vd_id, atb, x1, y1 [,x2, y2 [,...xn, yn]]</td>
</tr>
<tr>
<td></td>
<td>UIS$LINE_ARRAY</td>
<td>vd_id, atb, count, x_vector, y_vector</td>
</tr>
<tr>
<td></td>
<td>UIS$MEASURE_TEXT</td>
<td>vd_id, atb, text_string, retwidth, retheight [,ctllist, cttlen] [,posarray]</td>
</tr>
<tr>
<td></td>
<td>UIS$MOVE_AREA</td>
<td>vd_id, x1, y1, x2, y2, new_x, new_y</td>
</tr>
<tr>
<td></td>
<td>UIS$MOVE_VIEWPORT</td>
<td>wd_id, attributes</td>
</tr>
<tr>
<td></td>
<td>UIS$MOVE_WINDOW</td>
<td>vd_id, wd_id, x1, y1, x2, y2</td>
</tr>
<tr>
<td></td>
<td>UIS$NEW_TEXT_LINE</td>
<td>vd_id, atb</td>
</tr>
<tr>
<td></td>
<td>UIS$PLOT</td>
<td>vd_id, atb, x1, y1 [,x2, y2 [,...xn, yn]]</td>
</tr>
<tr>
<td></td>
<td>UIS$PLOT_ARRAY</td>
<td>vd_id, atb, count, x_vector, y_vector</td>
</tr>
<tr>
<td></td>
<td>UIS$POP_VIEWPORT</td>
<td>wd_id</td>
</tr>
<tr>
<td>status</td>
<td>UIS$PRESENT</td>
<td>[major_version], [minor_version]</td>
</tr>
<tr>
<td></td>
<td>UIS$PRIVATE1</td>
<td>{ obj_id }</td>
</tr>
<tr>
<td></td>
<td>UIS$PUSH_VIEWPORT</td>
<td>wd_id</td>
</tr>
<tr>
<td>keybuf</td>
<td>UIS$READ_CHAR</td>
<td>kb_id [,flags]</td>
</tr>
</tbody>
</table>

1VAX PASCAL and VAX PL/1 applications must specify the obj_id argument.
## Table A-1 (Cont.) Summary of UIS Calling Sequences

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UIS$RESIZE_WINDOW</td>
<td>vd_id, wd_id [new_abs_x, new_abs_y] [new_width, new_height] [new_wc_x1, new_wc_y1, new_wc_x2, new_wc_y2]</td>
</tr>
<tr>
<td></td>
<td>UIS$RESTORE_CMS_COLORS</td>
<td>cms_id</td>
</tr>
<tr>
<td></td>
<td>UIS$RGB_TO_HLS</td>
<td>R, G, B, reth, retl, rets</td>
</tr>
<tr>
<td></td>
<td>UIS$RGB_TO_HSV</td>
<td>R, G, B, reth, rets, retv</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_ADDOPT_AST</td>
<td>vd_id [astadr, astprm]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_ALIGNED_POSITION</td>
<td>vd_id, atb, x, y</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_ARC_TYPE</td>
<td>vd_id, iatb, oatb, arc_type</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_BACKGROUND_INDEX</td>
<td>vd_id, iatb, oatb, index</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_BUTTON_AST</td>
<td>vd_id, wd_id [astadr, astprm], keybuf [x1, y1, x2, y2]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_CHAR_ROTATION</td>
<td>vd_id, iatb, oatb, angle</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_CHAR_SIZE</td>
<td>vd_id, iatb, oatb [char], [width], [height]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_CHAR_SLANT</td>
<td>vd_id, iatb, oatb</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_CHAR_SPACING</td>
<td>vd_id, iatb, oatb, dx, dy</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_CLIP</td>
<td>vd_id [x1, y1, x2, y2]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_CLOSE_AST</td>
<td>wd_id [astadr, astprm]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_COLOR</td>
<td>vd_id, index, R, G, B</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_COLORS</td>
<td>vd_id, index, count, r_vector, g_vector, b_vector</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_EXPAND_ICON_AST</td>
<td>wd_id [astadr, astprm]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_FILL_PATTERN</td>
<td>vd_id, iatb, oatb [index]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_FONT</td>
<td>vd_id, iatb, oatb, font_id</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_GAIN_KB_AST</td>
<td>kb_id [astadr, astprm]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_INSERTION_POSITION</td>
<td>obj_id [seg_id, flags], vd_id</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_INTENSITIES</td>
<td>vd_id, index, count, i_vector</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_INTENSITY</td>
<td>vd_id, index, I</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_KB_AST</td>
<td>kb_id [astadr, astprm], keybuf</td>
</tr>
</tbody>
</table>

---

1 VAX PASCAL and VAX PL/I applications must specify the **obj_id** argument.
### Table A-1 (Cont.) Summary of UIS Calling Sequences

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>UIS$SET_KB_ATTRIBUTES</td>
<td>kb_id [,enable_items] [,disable_items] [click_volume]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_KB_COMPOSE2</td>
<td>kb_id [,table, tablelen]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_KB_COMPOSE3</td>
<td>kb_id [,table, tablelen]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_KB_KEYTABLE</td>
<td>kb_id [,table, tablelen]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_LINE_STYLE</td>
<td>vd_id, iatb, oatb, style</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_LINE_WIDTH</td>
<td>vd_id, iatb, oatb, width [,mode]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_LOSE_KB_AST</td>
<td>kb_id [astadr [,astprm]]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_MOVE_INFO_AST</td>
<td>wd_id [astadr [,astprm]]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_POINTER_AST</td>
<td>vd_id, wd_id [astadr [,astprm]] [,x1, y1, x2, y2] [exitastadr [,exitastprm]]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_POINTER_PATTERN</td>
<td>vd_id, wd_id [,pattern_array, pattern_count, activex, activey] [,x1, y1, x2, y2] [,flags]</td>
</tr>
<tr>
<td>status</td>
<td>UIS$SET_POINTER_POSITION</td>
<td>vd_id, wd_id, x, y</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_POSITION</td>
<td>vd_id, x, y</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_RESIZE_AST</td>
<td>vd_id, wd_id [astadr [,astprm]] [,new_abs_x, new_abs_y] [,new_width, new_height] [,new_wc_x1, new_wc_y1, new_wc_x2, new_wc_y2]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_SHRINK_TO_ICON_AST</td>
<td>wd_id [astadr [,astprm]]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_TB_AST</td>
<td>tb_id, [data_astadr, [data_astprm]], [x_pos,y_pos] [,data_x1, data_y1, data_x2, data_y2] [,button_astadr [,button_astprm],button_keybuf]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_TEXT_FORMATTING</td>
<td>vd_id, iatb, oatb, mode</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_TEXT_MARGINS</td>
<td>vd_id, iatb, oatb, x, y, margin_length</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_TEXT_PATH</td>
<td>vd_id, iatb, oatb, major[minor]</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_TEXT_SLOPE</td>
<td>vd_id, iatb, oatb, angle</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_WRITING_INDEX</td>
<td>vd_id, iatb, oatb, index</td>
</tr>
<tr>
<td></td>
<td>UIS$SET_WRITING_MODE</td>
<td>vd_id, iatb, oatb, mode</td>
</tr>
</tbody>
</table>
Table A-1 (Cont.) Summary of UIS Calling Sequences

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td>status</td>
<td>UIS$SOUND_BELL</td>
<td>devnam [,bell_volume]</td>
</tr>
<tr>
<td></td>
<td>UIS$SOUND_CLICK</td>
<td>devnam [,click_volume]</td>
</tr>
<tr>
<td></td>
<td>UIS$TEST_KB</td>
<td>kb_id</td>
</tr>
<tr>
<td></td>
<td>UIS$TEXT</td>
<td>vd_id, atb, text_string [,x, y], [ctllist, ctllen]</td>
</tr>
<tr>
<td></td>
<td>UIS$TRANSFORM_OBJECT&lt;sup&gt;1&lt;/sup&gt;</td>
<td>{ obj_id } [,matrix] [,atb]</td>
</tr>
</tbody>
</table>

<sup>1</sup>VAX PASCAL and VAX PL/I applications must specify the obj_id argument.
Appendix B

Summary of UISDC Calling Sequences

B.1 UISDC Calling Sequences

The following table summarizes UISDC calling sequences.

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td>dop</td>
<td>UISDC$ALLOCATE_DOP</td>
<td>wd_id, size, atb</td>
</tr>
<tr>
<td></td>
<td>UISDC$CIRCLE</td>
<td>wd_id, atb, center_x, center_y, xradius [start_deg] [end_deg]</td>
</tr>
<tr>
<td></td>
<td>UISDC$ELLIPSE</td>
<td>wd_id, atb, center_x, center_y, xradius, yradius, [start_deg] [end_deg]</td>
</tr>
<tr>
<td></td>
<td>UISDC$ERASE</td>
<td>wd_id, [x1,y1,x2, y2]</td>
</tr>
<tr>
<td>boolean</td>
<td>UISDC$EXECUTE_DOP_ASYNC</td>
<td>wd_id, dop, iosb</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$EXECUTE_DOP_SYNCH</td>
<td>wd_id, dop</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$GET_ALIGNED_POSITION</td>
<td>wd_id, atb, retx, rety</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$GET_CHAR_SIZE</td>
<td>wd_id, atb, [char],[width],[height]</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$GET_CLIP</td>
<td>wd_id, atb, [x1,y1, x2,y2]</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$GET_POINTER_POSITION</td>
<td>wd_id, retx, rety</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$GET_POSITION</td>
<td>wd_id, retx, rety</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$GET_TEXT_MARGINS</td>
<td>wd_id, atb, x, y [margin_length]</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$GET_VISIBILITY</td>
<td>wd_id, [x1,y1 [x2,y2]]</td>
</tr>
<tr>
<td></td>
<td>UISDC$IMAGE</td>
<td>wd_id, atb, x1, y1, x2, y2, rasterwidth, rasterheight, bitsperpixel, rasteraddr</td>
</tr>
<tr>
<td></td>
<td>UISDC$LINE</td>
<td>wd_id, atb, x1,y1, [x2,y2 [...xn, yn]]</td>
</tr>
</tbody>
</table>
### UISDC Calling Sequences

#### Table B-1 (Cont.)  Summary of UISDC Calling Sequences

<table>
<thead>
<tr>
<th>Return Value</th>
<th>Routine</th>
<th>Argument List</th>
</tr>
</thead>
<tbody>
<tr>
<td>bitmap_id</td>
<td>UISDC$LOAD_BITMAP</td>
<td>wd_id, bitmap_adr, bitmap_len, bitmap_width, bits_per_pixel</td>
</tr>
<tr>
<td></td>
<td>UISDC$MEASURE_TEXT</td>
<td>wd_id, atb, text_string, retwidth, retheight [ctllist ,ctllen] [,posarray]</td>
</tr>
<tr>
<td></td>
<td>UISDC$MOVE_AREA</td>
<td>wd_id, x1,y1,x2, y2, new_x, new_y</td>
</tr>
<tr>
<td></td>
<td>UISDC$NEW_TEXT_LINE</td>
<td>wd_id, atb</td>
</tr>
<tr>
<td></td>
<td>UISDC$PLOT</td>
<td>wd_id, atb, x1,y1, [x2,y2 [...x_n, y_n]]</td>
</tr>
<tr>
<td></td>
<td>UISDC$PLOT_ARRAY</td>
<td>wd_id, atb, count, x_vector, y_vector</td>
</tr>
<tr>
<td></td>
<td>UISDC$QUEUE_DOP</td>
<td>wd_id, dop</td>
</tr>
<tr>
<td></td>
<td>UISDC$READ_IMAGE</td>
<td>wd_id, x1, y1, x2, y2, rasterwidth, rasterheight, bitsperpixel, rasteraddr, rastelen</td>
</tr>
<tr>
<td></td>
<td>UISDC$SET_ALIGNED_POSITION</td>
<td>wd_id, atb, x, y</td>
</tr>
<tr>
<td></td>
<td>UISDC$SET_BUTTON_AST</td>
<td>wd_id [astadr, [astprm], keybuf] [x1, y1, x2, y2]</td>
</tr>
<tr>
<td></td>
<td>UISDC$SET_CHAR_SIZE</td>
<td>wd_id, iatb, oatb [char][width][height]</td>
</tr>
<tr>
<td></td>
<td>UISDC$SET_CLIP</td>
<td>wd_id, iatb, oatb [x1, y1, x2, y2]</td>
</tr>
<tr>
<td></td>
<td>UISDC$SET_POINTER_AST</td>
<td>wd_id [astadr [astprm]] [x1, y1, x2, y2] [exitastadr [exitastprm]]</td>
</tr>
<tr>
<td></td>
<td>UISDC$SET_POINTER_PATTERN</td>
<td>wd_id [pattern_array, pattern_count, activex, activey] [x1, y1, x2, y2][flags]</td>
</tr>
<tr>
<td>status</td>
<td>UISDC$SET_POINTER_POSITION</td>
<td>wd_id, x, y</td>
</tr>
<tr>
<td></td>
<td>UISDC$SET_POSITION</td>
<td>wd_id, x, y</td>
</tr>
<tr>
<td></td>
<td>UISDC$SET_TEXT_MARGINS</td>
<td>wd_id, iatb, oatb, x, y, margin_length</td>
</tr>
<tr>
<td></td>
<td>UISDC$TEXT</td>
<td>wd_id atb, text_string [x, y] [ctllist, ctllen]</td>
</tr>
</tbody>
</table>
Appendix C
UIS Fonts

C.1 Overview

This appendix contains figures and tables illustrating the UIS multinational character and technical fonts and font names contained in the directory SYS$FONT.

C.2 UIS Multinational Character Set Fonts

There are 14 multinational character set font files in the directory SYS$FONT. The figure captions below identify each UIS font with an arbitrarily assigned font number. For more information about font characteristics, match this number with the appropriate table in Section C.2.1.

Figure C-1  Font 1

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890-=!@#$%^&*()_+
<>./?"';:\[]{}
```

ZK-4565-85

Figure C-2  Font 2

```
ABCDEFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890-=!@#$%^&*()_+
<>./?"';:\[]{}
```

ZK-4566-85
C-2  UIS Fonts
UIS Multinational Character Set Fonts

Figure C-3  Font 3

```
ABCD EFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890-=!@#$%^&*()_+
<>,./?;:'"\[\]{}
```

ZK-4567-85

Figure C-4  Font 4

```
ABCD EFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890-=!@#$%^&*()_+
<>,./?;:'"\[\]{}
```

ZK-4568-85

Figure C-5  Font 5

```
ABCD EFGHIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890-=!@#$%^&*()_+
<>,./?;:'"\[\]{}
```

ZK-4569-85
Figure C-6  Font 6

```
ABCDEFHGIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890-!@#$%^&*()_+
<>.,/?:;"\[]{} 
```

ZK-4570-85

Figure C-7  Font 7

```
ABCDEFHGIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890-!@#$%^&*()_+
<>.,/?:;"\[]{} 
```

ZK-4571-85

Figure C-8  Font 8

```
ABCDEFHGIJKLMNOPQRSTUVWXYZ
abcdefghijklmnopqrstuvwxyz
1234567890-!@#$%^&*()_+
<>.,/?:;"\[]{} 
```

ZK-4572-85
C-4  UIS Fonts
UIS Multinational Character Set Fonts

Figure C-9  Font 9

<table>
<thead>
<tr>
<th>ABCDEFGHIJKLMNOPQRSTUVWXYZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>abcdefghijklmnopqrstuvwxyz</td>
</tr>
<tr>
<td>1234567890-=!@#$%^&amp;*()_+</td>
</tr>
<tr>
<td>&lt;&gt;,./?;:'&quot;[]{}</td>
</tr>
</tbody>
</table>

Figure C-10  Font 10

<table>
<thead>
<tr>
<th>ABCDEFGHIJKLMNOPQRSTUVWXYZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>abcdefghijklmnopqrstuvwxyz</td>
</tr>
<tr>
<td>1234567890-=!@#$%^&amp;*()_+</td>
</tr>
<tr>
<td>&lt;&gt;,./?;:'&quot;[]{}</td>
</tr>
</tbody>
</table>

Figure C-11  Font 11

<table>
<thead>
<tr>
<th>ABCDEFGHIJKLMNOPQRSTUVWXYZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>abcdefghijklmnopqrstuvwxyz</td>
</tr>
<tr>
<td>1234567890-=!@#$%^&amp;*()_+</td>
</tr>
<tr>
<td>&lt;&gt;,./?;:'&quot;[]{}</td>
</tr>
</tbody>
</table>
C.2.1 UIS Multinational Character Set Font Specifications

Each font file name, included in the following table captions contains typographical information about a UIS font. The accompanying tables analyzes the first 16 characters of the font file name.
# UIS Fonts

## UIS Multinational Character Set Fonts

### Table C-1  Font 1—DTABER0003WK00PG0001UZZZ02A000

<table>
<thead>
<tr>
<th>Field</th>
<th>Field Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registration code</td>
<td>D</td>
<td>Registered by DIGITAL</td>
</tr>
<tr>
<td>2-7</td>
<td>Type Family ID</td>
<td>TABER</td>
<td>Taber</td>
</tr>
<tr>
<td>8</td>
<td>Spacing</td>
<td>0</td>
<td>Proportionally spaced</td>
</tr>
<tr>
<td>9-11</td>
<td>Type size</td>
<td>03W₃₆</td>
<td>14 points (140 decipoints)</td>
</tr>
<tr>
<td>12</td>
<td>Scale factor</td>
<td>K</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>13-14</td>
<td>Style</td>
<td>00₃₆</td>
<td>Roman</td>
</tr>
<tr>
<td>15</td>
<td>Weight</td>
<td>G</td>
<td>Regular</td>
</tr>
<tr>
<td>16</td>
<td>Proportion</td>
<td>G</td>
<td>Regular</td>
</tr>
</tbody>
</table>

### Table C-2  Font 2—DTABER0I03WK00GG0001UZZZ02A000

<table>
<thead>
<tr>
<th>Field</th>
<th>Field Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registration code</td>
<td>D</td>
<td>Registered by DIGITAL</td>
</tr>
<tr>
<td>2-7</td>
<td>Type Family ID</td>
<td>TABER</td>
<td>Taber</td>
</tr>
<tr>
<td>8</td>
<td>Spacing</td>
<td>I</td>
<td>9 pitch (monospaced)</td>
</tr>
<tr>
<td>9-11</td>
<td>Type size</td>
<td>03W₃₆</td>
<td>14 points (140 decipoints)</td>
</tr>
<tr>
<td>12</td>
<td>Scale factor</td>
<td>K</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>13-14</td>
<td>Style</td>
<td>00₃₆</td>
<td>Roman</td>
</tr>
<tr>
<td>15</td>
<td>Weight</td>
<td>G</td>
<td>Regular</td>
</tr>
<tr>
<td>16</td>
<td>Proportion</td>
<td>G</td>
<td>Regular</td>
</tr>
</tbody>
</table>

### Table C-3  Font 3—DTABER0M03CK00GG0001UZZZ02A000

<table>
<thead>
<tr>
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<th>Field Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registration code</td>
<td>D</td>
<td>Registered by DIGITAL</td>
</tr>
<tr>
<td>2-7</td>
<td>Type Family ID</td>
<td>TABER</td>
<td>Taber</td>
</tr>
<tr>
<td>8</td>
<td>Spacing</td>
<td>M</td>
<td>13 pitch (monospaced)</td>
</tr>
<tr>
<td>9-11</td>
<td>Type size</td>
<td>03C₃₆</td>
<td>12 points (120 decipoints)</td>
</tr>
<tr>
<td>12</td>
<td>Scale factor</td>
<td>K</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>13-14</td>
<td>Style</td>
<td>00₃₆</td>
<td>Roman</td>
</tr>
<tr>
<td>15</td>
<td>Weight</td>
<td>G</td>
<td>Regular</td>
</tr>
<tr>
<td>16</td>
<td>Proportion</td>
<td>G</td>
<td>Regular</td>
</tr>
</tbody>
</table>
## Table C-4  Font 4—DTABER0R03WK00GG0001UZZZZ02A000

<table>
<thead>
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<th>Field</th>
<th>Field Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registration code</td>
<td>D</td>
<td>Registered by DIGITAL</td>
</tr>
<tr>
<td>2-7</td>
<td>Type Family ID</td>
<td>TABER0</td>
<td>Taber</td>
</tr>
<tr>
<td>8</td>
<td>Spacing</td>
<td>R</td>
<td>18 pitch (monospaced)</td>
</tr>
<tr>
<td>9-11</td>
<td>Type size</td>
<td>03W36</td>
<td>14 points (140 decipoints)</td>
</tr>
<tr>
<td>12</td>
<td>Scale factor</td>
<td>K</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>13-14</td>
<td>Style</td>
<td>0036</td>
<td>Roman</td>
</tr>
<tr>
<td>15</td>
<td>Weight</td>
<td>G</td>
<td>Regular</td>
</tr>
<tr>
<td>16</td>
<td>Proportion</td>
<td>G</td>
<td>Regular</td>
</tr>
</tbody>
</table>

## Table C-5  Font 5—DTABER0R07SK00GG0001UZZZZ02A000

<table>
<thead>
<tr>
<th>Field</th>
<th>Field Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Registration code</td>
<td>D</td>
<td>Registered by DIGITAL</td>
</tr>
<tr>
<td>2-7</td>
<td>Type Family ID</td>
<td>TABER0</td>
<td>Taber</td>
</tr>
<tr>
<td>8</td>
<td>Spacing</td>
<td>R</td>
<td>18 pitch (monospaced)</td>
</tr>
<tr>
<td>9-11</td>
<td>Type size</td>
<td>07S36</td>
<td>28 points (280 decipoints)</td>
</tr>
<tr>
<td>12</td>
<td>Scale factor</td>
<td>K</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>13-14</td>
<td>Style</td>
<td>0036</td>
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**C-8 UIS Fonts**

*UIS Multinational Character Set Fonts*

### Table C-7 Font 7—DTERMINM06OK00PG0001UZZZZ02A000

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<td>24 points (240 decipoints)</td>
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<td>Scale factor</td>
<td>K</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>13-14</td>
<td>Style</td>
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<td>Roman</td>
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<td>Weight</td>
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<td>Scale factor</td>
<td>K</td>
<td>1 (normal)</td>
</tr>
<tr>
<td>13-14</td>
<td>Style</td>
<td>00_{36}</td>
<td>Roman</td>
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<td>Weight</td>
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<td>Style</td>
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<tr>
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<td>Scale factor</td>
<td>K</td>
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<tr>
<td>13-14</td>
<td>Style</td>
<td>00₃₆</td>
<td>Roman</td>
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C-10  UIS Fonts
UIS Multinational Character Set Fonts

Table C-13  Font 13—DTABER0R07SK00PG0001UZZZ02A000

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<td>Spacing</td>
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<td>1 (normal)</td>
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<tr>
<td>13-14</td>
<td>Style</td>
<td>00_{36}</td>
<td>Roman</td>
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<tr>
<td>15</td>
<td>Weight</td>
<td>P</td>
<td>Bold</td>
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Table C-14  Font 14—DTERMINM03CK00PG0001UZZZ02A000

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<tr>
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<td>12 points (120 decipoints)</td>
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<td>K</td>
<td>1 (normal)</td>
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<tr>
<td>13-14</td>
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<td>00_{36}</td>
<td>Roman</td>
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<td>Weight</td>
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<td>Bold</td>
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<tr>
<td>16</td>
<td>Proportion</td>
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<td>Regular</td>
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C.3  UIS Technical Character Set Fonts

There are 12 technical character set font files in SYS$FONT. The figure captions below identify each UIS font with an arbitrarily assigned font number. For more information about font characteristics, match this number with the appropriate table in Section C.3.1.

Figure C-15  Font 15

α β γ δ ε ζ η θ ι κ λ μ ν ξ ο π ρ σ τ υ ψ ω Ξ Π Σ Ψ Ω
Figure C-16  Font 16
\[ \text{Symbols} \]

Figure C-17  Font 17
\[ \text{Symbols} \]

Figure C-18  Font 18
\[ \text{Symbols} \]

Figure C-19  Font 19
\[ \text{Symbols} \]
C-12  UIS Fonts
UIS Technical Character Set Fonts

Figure C-20  Font 20

Figure C-21  Font 21

Figure C-22  Font 22
Figure C-23  Font 23

α β γ δ ε θ η θ θ θ.

Figure C-24  Font 24

α β γ δ ε θ η θ θ θ.

Figure C-25  Font 25

α β γ δ ε θ η θ θ θ.
C.3.1 UIS Technical Character Set Font Specifications

Each technical font file name, included in the following table captions contains typographical information about a UIS technical character set font. The accompanying table describes the first 16 characters of the technical font file name.

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### Table C-17  **Font 17—DVWSVT0I03WK00GG0001QZZZZ02A000**

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Appendix  D

UIS Fill Patterns

All fill patterns are located together in SYS$FONT in a separate file named DEUISPATAAAAAAAF000000000DA.VWS$FONT. This file can be accessed with the logical name UIS$FILL__PATTERNS.

The pairs of fill patterns shown in the following figures were drawn in OVERLAY writing mode on a white background. The figure caption contains the symbol name for each fill pattern. The symbol name represents an index to the appropriate fill pattern.

Symbol names are located in language-specific symbol definition files in SYS$LIBRARY. Refer to Table 6-2 for a list of symbol definition files.

Figure D-1  PATT$C_VERT1_1 and PATT$C_VERT1_3
Figure D-2  PATT$C\_VERT2\_2 and PATT$C\_VERT3\_1

Figure D-3  PATT$C\_VERT1\_7 and PATT$C\_VERT2\_6

Figure D-4  PATT$C\_VERT4\_4 and PATT$C\_VERT6\_2
Figure D-5  PATT$C\_HORIZ1\_1$ and PATT$C\_HORIZ1\_3$

Figure D-6  PATT$C\_HORIZ2\_2$ and PATT$C\_HORIZ3\_1$

Figure D-7  PATT$C\_HORIZ1\_7$ and PATT$C\_HORIZ2\_6$
D-4 UIS Fill Patterns

Figure D-8 PATT$C\_HORIZ4\_4 and PATT$C\_HORIZ6\_2

Figure D-9 PATT$C\_GRID4 and PATT$C\_GRID8

Figure D-10 PATT$C\_UPDIAG1\_3 and PATT$C\_UPDIAG2\_2
Figure D-11  PATT$C\_UPDIAG3\_1 and PATT$C\_UPDIAG1\_7

Figure D-12  PATT$C\_UPDIAG2\_6 and PATT$C\_UPDIAG4\_4

Figure D-13  PATT$C\_UPDIAG6\_2 and PATT$C\_DOWNDIAG1\_3
Figure D-14  PATT$C\_DOWNDIAG2\_2 \text{ and } PATT$C\_DOWNDIAG3\_1

Figure D-15  PATT$C\_DOWNDIAG1\_7 \text{ and } PATT$C\_DOWNDIAG2\_6

Figure D-16  PATT$C\_DOWNDIAG4\_4 \text{ and } PATT$C\_DOWNDIAG6\_2
Figure D-17  PATT$C\_BRICK\_HORIZ and PATT$C\_BRICK\_VERT

Figure D-18  PATT$C\_BRICK\_DOWNDIAG and PATT$C\_BRICK\_UPDIAG

Figure D-19  PATT$C\_GREY4\_16D and PATT$C\_GREY12\_16D
D-8  UIS Fill Patterns

Figure D-20  PATT$C\_BASKET\_WEAVE and PATT$C\_SCALE\_DOWN

Figure D-21  PATT$C\_SCALE\_UP and PATT$C\_SCALE\_RIGHT

Figure D-22  PATT$C\_SCALE\_LEFT and PATT$C\_GREY1\_16
Figure D-23  PATT$C\_GREY2\_16 and PATT$C\_GREY3\_16

Figure D-24  PATT$C\_GREY4\_16 and PATT$C\_GREY5\_16

Figure D-25  PATT$C\_GREY6\_16 and PATT$C\_GREY7\_16
Figure D-26  PATTC\_GREY8\_16 and PATTC\_GREY9\_16

Figure D-27  PATTC\_GREY10\_16 and PATTC\_GREY11\_16

Figure D-28  PATTC\_GREY12\_16 and PATTC\_GREY13\_16
Figure D–29  PATT$C\_GREY14\_16 and PATT$C\_GREY15\_16
Appendix E

Error Messages

This appendix contains the messages which may be generated by the MicroVMS workstation graphics software. Each message description consists of the message text, a brief explanation of the message, and the possible remedy.

BAD_ATB, illegal attempt to modify attribute block 0 (read-only).

Explanation: An attempt was made to modify an attribute in attribute block #0, which is defined to be read-only. The modification request is ignored.

User Action: Check for a programming error.

BAD_DISP, Display list has been corrupted.

Explanation: An illegal display list type code has been encountered while traversing a display list.

User Action: Check the validity of the UIS metafile you are executing.

BAD_KB, illegal virtual keyboard identifier.

Explanation: An illegal virtual keyboard identifier was given to a UIS routine as an argument.

User Action: Check for a programming error.

BADTITLE, illegal window title string.

Explanation: An illegal window title string was passed when attempting to create a window.

User Action: Shorten the title.

BAD_TR, illegal transformation identifier.

Explanation: An illegal transformation identifier was given to a UIS routine as an argument.

User Action: Check for a programming error.
E-2  Error Messages

BAD_VD,  Illegal virtual display identifier.

Explanation: An illegal virtual display identifier was given to a UIS routine as an argument.

User Action: Check for a programming error.

BAD_VOLUME,  Illegal volume level specified.

Explanation: An illegal volume level was given to the UIS$SOUND routine. The volume must be in the range of 1 to 8.

User Action: Check for a programming error.

BAD_WD,  Illegal display window identifier.

Explanation: An illegal display window identifier was given to a UIS routine as an argument.

User Action: Check for a programming error.

BADWDPL,  Window placement attribute list has an invalid format.

Explanation: An illegal window attribute list was passed when attempting to create a window.

User Action: Check for illegal item types in the window attribute list.

INSFARG,  Insufficient arguments.

Explanation: A required argument was not specified.

User Action: Check for a programming error.

NO_FONT,  The font cannot be found.

Explanation: An attempt was made to reference a font which could not be satisfied, even by looking for other fonts which might be similar. All references to the attribute block specifying this font will produce this same error. The program may continue after this error.

User Action: Specify font contained in the SYS$FONT directory.

NOURG,  Cannot disable region AST because no matching region can be found.

Explanation: An attempt was made to disable a user region AST by using an ASTADR=0 and the region boundary used in the original enable request. However, no entry can be found with matching boundary coordinates. The program must ensure that the boundary coordinates match exactly in order to disable an existing request.

User Action: Check for a programming error.
VPTOOSMALL,  Requested size of the viewport is too small.

Explanation: The desired size of the viewport is too small to be displayed on the screen.

User Action: Request larger viewport.
Appendix  F

Obsolete Routines

The following routines are obsolete and will no longer be documented.

• UIS$GET_LEFT_MARGINS
• UIS$SET_LEFT_MARGINS
• UISDC$GET_LEFT_MARGINS
• UISDC$SET_LEFT_MARGINS
array: Any organized arrangement of related elements.

address: A 32-bit VAX address positioned in a longword item.

argument list: A vector of longwords that represents a procedure parameter list and possibly a function value.

aspect ratio: The ratio between the height and width of a graphic object. In reference to a virtual display, the aspect ratio is a comparison of the relative proportions of the vertical and horizontal components of objects in the virtual display.

attribute: A quality or characteristic that determines the appearance of an object displayed on the screen. For example, the attributes of a line are its width, style, and color.

baseline: The side of a geometric object or drawing from which the object is constructed or drawn.

call: The transfer of processing control to a specified subroutine.

Cartesian coordinate system: A system of measuring distances in which the location of a point is defined as its distance from two straight lines that intersect at right angles. It is used as the basis of coordinate measurements in computer graphics systems.

clipping: Any graphic data outside a specified boundary that are removed from the display or the file. It is often used in mapping applications to remove data that would otherwise confuse the image being represented.

clipping rectangle: The physical limit in a graphics file beyond which data are either not visible or automatically deleted.
**condition value:** A 32-bit value used to identify uniquely an exception condition. A condition value may be returned to a calling program as a function value or signaled using the VAX signaling mechanism.

**current text position:** The world coordinate position that defines the current drawing location for UIS text routines.

**cursor:** A position indicator used on a display screen to pinpoint where data will be displayed. The cursor is often represented by a blinking block character.

**data tablet:** The name for a variety of data entry devices consisting of a stylus (pen) or puck, and a board with a coordinate grid superimposed on its surface. When the input object (pen or puck) touches the board, graphic information describing the location of the point touched is transmitted as input information. The data tablet is an absolute pointing device.

**descriptor:** A mechanism for passing parameters in which the address of a descriptor is provided in the longword argument list entry. The descriptor contains the address of the parameter, the data type, size, and additional information needed to describe fully the data passed.

**device coordinates:** The device-dependent Cartesian coordinates that specify positions on the MicroVMS display screen. Sometimes referred to as physical device coordinates, these coordinates are involved in mapping of the display window to the display screen.

**display viewport:** The area of the physical display screen into which a display window is mapped. It is the physical region on the terminal screen that is created by the MicroVMS workstation and controlled by the user.

**display window:** The portion of world coordinate space mapped to the graphics viewport. The display window is used to control how much of the virtual display is potentially available for the user to view.

**emulated terminal:** A virtual I/O device whose programming interface matches the programming interface of a specific physical terminal and whose appearance on the MicroVMS workstation screen is similar to the appearance of the physical terminal.

**exception condition:** A hardware- or software-detected event that alters the normal flow of instruction execution.
**font**: A specific representation of a text character. The attributes of a font are family (type face), type size, and rendition.

**function**: A procedure that returns a single value according to standard conventions. If additional values are returned, they are returned by means of the argument list.

**graphics data tablet**: An optional input device that consists of a rigid tablet, and a puck containing a crosshair cursor and a number of buttons, or a pen. The position of the cursor can be read by application programs. The tablet is an absolute pointing device.

**graphics display**: Describes any graphics data output device that can present an image of graphic data derived from a computer graphics system. An example of a graphics display is a display screen or a printer.

**graphic object**: The graphic image constructed by an application program using UIS routines. A graphic object could be a simple line or a complex drawing.

**graphics text**: Text output primitives displayed using the UIS routines.

**grey scale**: The level of brightness that describes the illumination of a cathode-ray tube screen.

**image**: The output form of on-line graphics data. That is, a displayed or drawn representation of a graphics file.

**language-support procedures**: Procedures called implicitly to implement high-level language constructs. They are not intended to be called explicitly from user programs.

**library procedures**: Procedures called explicitly using the equivalent of a CALL statement or function reference. They are usually language independent.

**mapping**: Any process by which a graphics system translates graphic data from one coordinate system into a form useful on another coordinate system.

**mouse**: A data entry device consisting of a small control box, on rollers, that is pushed along a surface and transmits its changing position to the workstation. Often, function keys or buttons are mounted on the device and can be used to enter information or make selections. This device is the user’s means for pointing to and selecting objects on the screen. The mouse is a relative pointing device.
output primitive: A part of an image created with UIS procedures, such as a graphics object or a text string, that has a specific appearance. Values of attributes determine some aspects of this appearance.

physical device coordinates: Device-dependent Cartesian coordinates that specify the addressable points on a physical device.

pixel: The density of one picture element. The smallest displayable unit on a display screen.

pointer: The cursor on the screen that tracks movements of the mouse. The shape of the pointer depends upon its current use.

primitives: The most basic graphic entities available on a graphics system, such as points, line segments, or characters.

procedure: A closed sequence of instructions that is entered from, and returns control to, the calling program.

puck: A hand-held graphics device with a cross hair sight used to pinpoint coordinates on a data tablet or digitizer.

raster: A pattern of scanning lines in a cathode-ray tube which divide the display area into addressable points.

reference: A mechanism for passing parameters in which the address of the parameter is provided in the longword argument list by the calling program.

resizing: The process of scaling or changing the size of a graphics viewport according to predetermined data.

stretchy box: The outline of a clipping rectangle used in the UIS functions PRINT SCREEN and RESIZE WINDOW. This rectangle can be manipulated to assume practically any rectangular dimensions and is limited only by the display screen size.

subroutine: A procedure that does not return a value according to the standard conventions. If values are returned, they are returned by means of the argument list.

transformations: The ability of the UIS graphics system to manipulate coordinate data. Transformations occur when mapping one coordinate system into another coordinate system.
**tablet:** A device which can convert a stylus position into Cartesian coordinates. When connected to a graphic display screen, it can control the real-time positioning of a cursor or pointer.

**UIS:** The graphics software called User Interface Services.

**value:** A mechanism for passing input parameters in which the actual value is provided in the longword argument list entry by the calling program.

**viewport:** A rectangle that maps the image defined by a window into a virtual display onto the display screen. The user controls the visibility and placement of viewports on the physical screen.

**viewing transformation:** The viewing transformation is the process of mapping the world coordinates of a graphic object in a display window to the device coordinates of a display viewport on a physical display device.

**virtual display:** The world coordinate space defined by an application program. An application program uses a virtual display as a place in which to build graphic images. It can be thought of as a virtual output device that has the properties of a physical screen, but is not necessarily visible on a physical screen.

**virtual keyboard:** A virtual input device associated with a window. When users select a window into a virtual display with a virtual keyboard, input from the physical keyboard is directed to the virtual keyboard and can be read by an application program.

**window:** A defined area within a virtual display that can be used for viewing the virtual display. A window is the area of the virtual display that is to be mapped to a viewport.

**world coordinates:** Device-independent Cartesian coordinates defined by the application program in order to describe objects to UIS.

**x axis:** The reference line of a rectangular coordinate system used to determine horizontal distance and positions.

**x-height:** The height of lowercase characters excluding descenders and ascenders.
y axis: The reference line of a rectangular coordinate system used to determine vertical distance and positions.

zooming: The process by which the perspective on a displayed graphics file moves rapidly closer or farther from the operator.
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