DEC GKS

GKS$ Binding Reference Manual, Part 1

Order Number: AA–MJ31C–TE

June 1992

This manual describes the GKS$ native interface functions provided for DEC GKS™.

Revision/Update Information: This revised manual supersedes the information in the *DEC GKS GKS$ Binding Reference Manual* (Order No. AA–MJ31B–TE).

Digital Equipment Corporation
Maynard, Massachusetts

First Printing, March 1984
Revised, November 1984, May 1986, March 1987, April 1989, February 1990, June 1992

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ZK5676

This manual is available on CDROM.

This document was prepared using VAX DOCUMENT, Version 2.1.

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Preface

This manual contains complete descriptions for the GKS$ native interface binding functions provided for DEC GKS. Use this reference material to program DEC GKS on any supported operating system, using any of the languages supported by DEC GKS.

Intended Audience

This manual is for programmers who have experience developing graphics applications in one of the languages supported by DEC GKS. They also should be familiar with the principles of programming DEC GKS, as described in the *DEC GKS User's Guide*.

Structure of This Document

This manual is divided into two parts. Each chapter deals with a specific subject or group of functions, describing the syntax and arguments for each function. The appendixes provide additional information you may find useful. Part 1 includes the following chapters:

- Chapter 1 provides an introduction to DEC GKS.
- Chapter 2 provides information about DEC GKS and the VMS™ operating system.
- Chapter 3 provides information about DEC GKS and the ULTRIX™ operating system.
- Chapter 4 describes the functions you use to control DEC GKS and workstation environments.
- Chapter 5 describes the functions you use to generate output primitives.
- Chapter 6 describes the functions you use to generate attributes.
- Chapter 7 describes the functions you use to set up and perform normalization and workstation transformations.
- Chapter 8 describes the functions you use to store output primitives in segments.
- Chapter 9 describes the functions you use to accept input from workstations.
- Chapter 10 describes the functions you use to store graphic images as metafiles.

Part 2 includes the following chapters and appendixes:

- Chapter 11 describes the functions you use to inquire for information about the capabilities and state of the DEC GKS system.
- Chapter 12 describes the functions you use to handle errors.

- Appendix A lists DEC GKS error codes, along with the corresponding severity code and message for each one.
- Appendix B lists constants defined for the GKS$ binding interface.
- Appendix C provides a list of code examples available throughout this manual, listed alphabetically, by function.
- Appendix D provides language-specific programming information.
- Appendix E lists specific input values that apply to the DEC GKS workstations that perform both input and output.
- Appendix F provides implementation-specific information about DEC GKS.

Associated Documents

You may find the following documents useful when using DEC GKS:

- *DEC GKS User's Guide*—for programmers who need information that supplements the DEC GKS binding manuals
- *DEC GKS GKS3D$ Binding Reference Manual*—for programmers who need specific syntax and argument descriptions for the GKS3D$ binding
- *DEC GKS C Binding Reference Manual*—for programmers who need specific syntax and argument descriptions for the C binding
- *DEC GKS FORTRAN Binding Reference Manual*—for programmers who need specific syntax and argument descriptions for the FORTRAN binding
- *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*—for programmers who need information about specific devices
- *Building a Device Handler System for DEC GKS and DEC PHIGS*—for programmers who need to build workstation graphics handlers

Conventions

The following conventions are used in this manual:

Convention	Meaning
RETURN	The symbol RETURN represents a single stroke of the Return key on a terminal.
Boldface text	Boldface text represents the introduction of a new term. In interactive examples, user input appears in boldface type.
Italic text	Italic text indicates a parameter name or a book name. DEC GKS description table and state list entry names, and workstation description tables and state list entry names are also italicized.
UPPERCASE TEXT	Uppercase text indicates a DEC GKS function or symbol name.
. . .	A vertical ellipsis indicates that not all of the text of a program or program output is illustrated. Only relevant material is shown in the example.
. . .	A horizontal ellipsis indicates that additional arguments, options, or values can be entered. A comma preceding the ellipsis indicates that successive items must be separated by commas.
	Horizontal ellipses in illustrations indicate that there is information not illustrated that either precedes or follows the information included in the illustration itself.
[]	Square brackets, in function synopses and a few other contexts, indicate that a syntactic element is optional.

Introduction

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1
Introduction to DEC GKS

DEC GKS is a development tool that creates two- and three-dimensional graphics applications that are system and device independent. It is Digital's level 2c implementation, compliant with the Graphical Kernel System (GKS) defined by the American Standards Institute (ANSI X3.124–1985), the International Standard (ISO/IS 7942), and the Graphical Kernel System for Three Dimensions (GKS–3D) defined by the International Standard (ISO/IS 8805).

DEC GKS is a system- and device-independent graphics library that enables the development of GKS applications that can be moved to other platforms (hardware devices or operating systems) or that generate output on other graphic devices without modification to the source code. It provides functionality such as output primitives, logical workstation management, workstation-dependent and workstation-independent segment storage, six types of logical input devices, synchronous and asynchronous input, inquiries returning the system's capabilities, and metafile input and output.

DEC GKS implements syntactical language bindings. For DEC GKS, these include the DEC GKS FORTRAN and DEC GKS C bindings. The language bindings in general, and specifically the FORTRAN binding, provide standard function names and a standard number of function parameters. If you write programs to be transported across systems or across GKS implementations, you should use the appropriate language binding. Digital recommends that you use the C or FORTRAN language bindings, because you will have better portability and ease of use.

DEC GKS also implements the functional standard using function names beginning with the prefixes GKS$ and GKS3D$. If you use the GKS$ or GKS3D$ functions, you have to edit your program if you want to transport the program across systems or across GKS implementations.

1.1 GKS Function Categories

The DEC GKS function categories are as follows:

- Control
- Output
- Attribute
- Transformation
- Segment
- Input
- Metafile

- Inquiry
- Error-Handling

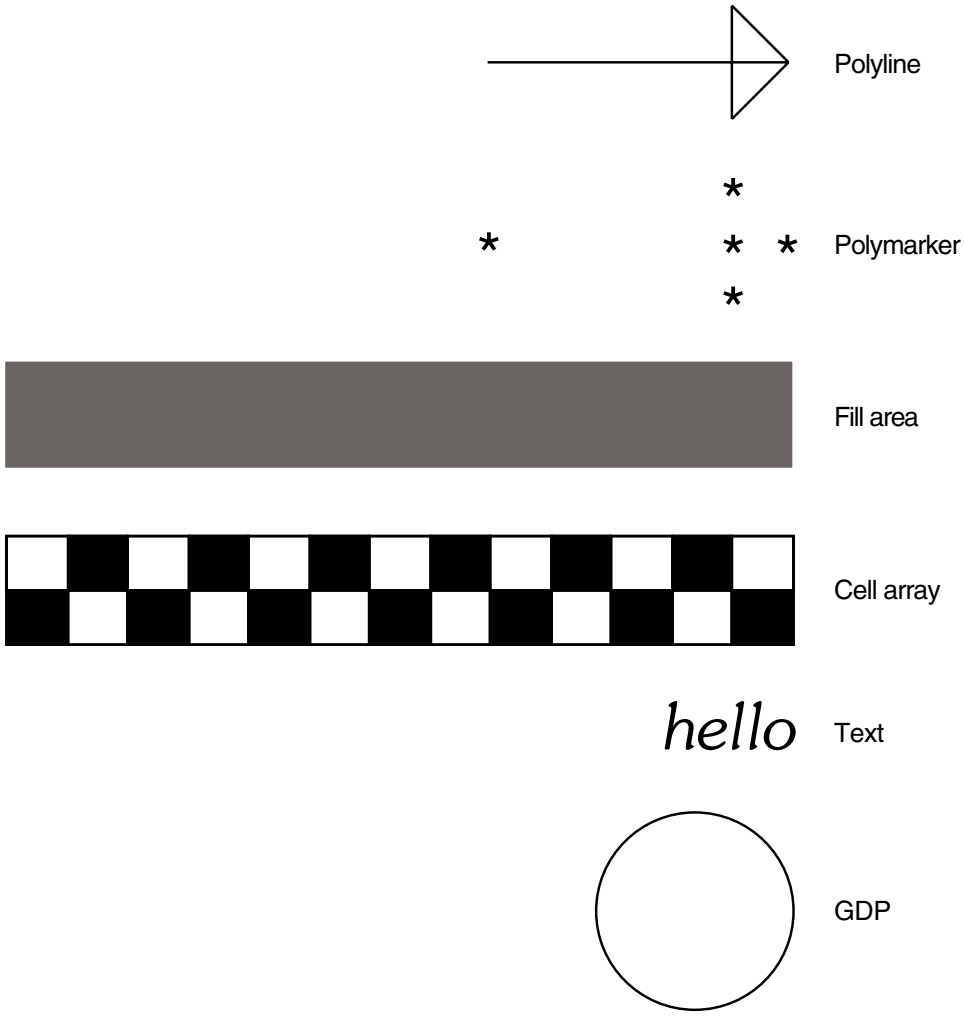
The control functions determine which DEC GKS functions you can call at a given point in your program. They also control the buffering of output and the regeneration of segments on the workstation surface.

The output functions produce picture components, called **primitives**, of the following types:

- Polylines—Lines
- Polymarkers—Symbols
- Fill Areas—Filled polygons
- Text—Character strings
- Cell Array—Filled cells of a rectangle
- Generalized Drawing Primitives—A workstation-dependent image such as a circle

Figure 1–1 illustrates possible representations of output primitives.

Figure 1–1 DEC GKS Output Primitives



Output attributes affect the appearance of a primitive. For example, by changing the line type attribute, you can produce solid, dashed, dotted, or dashed-dotted lines.

Transformations affect the composition of the graphic picture and the presentation of that picture. There are **normalization**, **workstation**, and **viewing** transformations. The normalization transformations allow you to use various coordinate ranges for different primitives within a single picture. In this way, you can use a coordinate range that suits each particular primitive in a large picture.

The workstation transformations control the portion of the picture that you see on the workstation's surface, and the portion of the surface used to display the picture. Using workstation transformations, you can pan across a picture, zoom into a picture, or zoom out of a picture.

The viewing transformations control the orientation and projection of the picture.

The segment functions store and manipulate groups of primitives called **segments**.

The input functions allow an application to accept data from a user.

The metafile functions allow you to store and recall an audit of calls to DEC GKS functions. Using metafiles, you can store a DEC GKS session so that another application can interpret that session, thus reproducing the picture created by the original application. For more information concerning metafiles, see Chapter 10, Metafile Functions.

The inquiry functions obtain either default or current information from the DEC GKS data structures.

The error-handling functions allow you to invoke a user-written error handler when a call to another DEC GKS function generates an error. For more information concerning error handling, see Chapter 12.

If you need more tutorial information concerning DEC GKS concepts, see the *DEC GKS User's Guide*.

1.2 GKS Levels

The GKS standard defines levels of a GKS implementation that address the most common classes of graphic devices and application needs. The levels are determined primarily by input and output capabilities. The output level values are represented by the characters m, 0, 1, and 2. The input level values are represented by the characters a, b, and c.

The DEC GKS software is a level 2c implementation, incorporating all the GKS output capabilities (level 2) and all the input capabilities (level c). This manual uses the term DEC GKS when describing the 2c level DEC GKS product.

Figure 1–2 defines the 12 upwardly compatible levels of GKS. DEC GKS implements all listed functionality.

Pick input is one of the DEC GKS logical input classes used to specify segments present on the surface of a device. Request, sample, and event are GKS input operating modes. DEC GKS supports all three input operating modes. For more information on pick input or operating modes, see Chapter 9, Input Functions.

Workstation independent segment storage (WISS) provides a way to store segments so that one segment can be transported to different devices. For more information, see Chapter 8, Segment Functions.

1.3 Function Presentation Format

The following sections describe the format used to present each of the DEC GKS function descriptions.

1.3.1 Function Header

Each function header in this manual includes the English version of the function name at the top of the page. This function name is located at the top of each subsequent page of the function description.

Figure 1–2 Functionality by GKS Levels

Output Levels \ Input Levels	a	b	c
m	No input, minimal control, individual attributes, one settable normalization transformation, subset of output and attribute functions.	Request input, set operating mode and initialize functions for input devices, no pick input.	Sample and event input no pick.
0	Basic control, bundled attributes, multiple normalization transformations, all output and attribute functions, optional metafiles.	Set viewport input priority.	All of level mc, above.
1	Full output including settable bundles, multiple workstations, basic segmentation, no workstation independent segment storage, metafiles.	Request pick, set operating mode and initialize functions for pick input.	Sample and event input for pick.
2	Workstation independent segment storage	All of level 1b, above.	

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1.3.2 Function Operating States

The operating states section lists the valid operating states during which a call to the function is permitted (for more information, see Chapter 4, Control Functions).

1.3.3 Function Syntax

The syntax section lists the syntax of a call to the DEC GKS function. This syntax includes the argument list. Each argument is described in the Syntax section.

The argument descriptions for each of the functions appear as follows:

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier

The arguments passed to DEC GKS functions must be of specific data types and must be passed by specific mechanisms. In the function descriptions, these data types are described following each of the argument names.

For each argument, the specified values include:

- The data type of the argument
- The type of access made by the argument
- The argument-passing mechanism and form

See the appropriate platform compiler documentation for compiler-dependent data types.

All the DEC GKS functions always return an integer condition status value. For the FORTRAN language, the status value is only accessible with a nonstandard extension of the FORTRAN binding. For a description of the status value, see Appendix A. For information concerning DEC GKS error handling, see Chapter 12.

1.3.4 Constants

The constants section lists the DEC GKS constants that are defined for each enumerated type and a description of each, in order of appearance in the function call. For a complete list of the DEC GKS constants, see Appendix B. Note that the constants are the same for all languages except Ada. The Ada constant names do not include the dollar sign ($). The constant names listed throughout this manual include the dollar sign ($).

1.3.5 Function Description

The description section describes the function in detail. The description contains pertinent information about the DEC GKS operating state, the GKS description table and state list, and the workstation description table and state list.

1.3.6 See Also Section

Most of the functions include a See Also section. This section lists related functions and gives pointers to code examples, located at the end of each chapter, that include the specified function.

Program Examples Section

Appendix C lists all the functions called in the code examples. The program examples are also available on line. They are located in GKS$EXAMPLES on VMS systems, and in /usr/lib/GKS/examples on ULTRIX systems. All programs are written in C for use with DECwindows™ workstations, for consistency in presentation.

In many of the C examples in this book, the following lines of code cause the program to pause, so you can view the image on the workstation surface as it is being created:

```
                    .
                    .
                    .
/* Release the deferred output and pause the display for "timeout"
   seconds. */

   update_flag = GKS$K_POSTPONE_FLAG;

   gks$update_ws( &ws_id, &update_flag);
   gks$await_event( &timeout, &ws_id, &input_class, &device_num );
                    .
                    .
                    .
```

Because DEC GKS allows workstations to **defer**, or buffer, output, you have to update the screen with a call to UPDATE WORKSTATION to view the picture created by all previous function calls in the program. The call to the AWAIT EVENT function causes program execution to pause.

Considering that the rate of deferral may differ on various workstations, you may wish to use the function INQUIRE WORKSTATION DEFERRAL AND UPDATE STATES to check the current deferral mode. If the deferral mode is anything other than ASAP, you may wish to update the workstation surface periodically when you are debugging your program. If you want to change the deferral mode so the workstation surface is always current, you can call the function SET DEFERRAL STATE to change the current deferral mode to ASAP.

For detailed information concerning the DEC GKS deferral mode, see Chapter 4, Control Functions.

Also, most program examples include the following lines of code:

```
                    .
                    .
                    .
   default_conid  = GKS$K_CONID_DEFAULT;
   default_wstype = GKS$K_WSTYPE_DEFAULT ;

   gks$open_ws( &ws_id, &default_conid, &default_wstype );
                    .
                    .
                    .
```

This code tells DEC GKS to use the default values for the connection identifier and the workstation type. The default values are defined by the logical names GKS$CONID and GKS$WSTYPE on VMS systems, and by the environment variables GKSconid and GKSwstype on ULTRIX systems. To change the default values of GKS$CONID and GKS$WSTYPE on a VMS system, enter the following commands:

```
$ DEFINE GKS$CONID FOOBAR::0 RETURN
$ DEFINE GKS$WSTYPE 211 RETURN
```

After entering these commands, the new value for GKS$CONID is the FOOBAR node, and the new value for GKS$WSTYPE is 211 (DECwindows™ XUI workstation).

To change the values of GKSconid and GKSwstype on an ULTRIX system, enter the following commands:

```
# setenv GKSconid FOOBAR::0 RETURN
# setenv GKSwstype 211 RETURN
```

After entering these commands, the new value for GKSconid is the FOOBAR node, and the new value for GKSwstype is 211 (DECwindows XUI workstation). For more information on specifying environment options on VMS and ULTRIX operating systems, see Chapter 2 and Chapter 3.

Following many of the program examples, there is an illustration representing the graphic image generated on the surface of the DECwindows XUI workstation. Because there are visual differences between the written page and the workstation surface, the image may appear different on your device surface. Also, different devices produce different results.

For example, the lines may not be as perfectly smooth as presented in the figure. The figures in this manual serve the purpose of showing relative positioning and general shape of the graphic image on the surface of a DECwindows XUI workstation.

VMS Programming

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2
VMS Programming Considerations

The specific method for using DEC GKS software depends on the features and conventions of each programming language. This section describes general issues that must be considered when using any programming language with DEC GKS on a VMS system.

The information contained in this chapter was correct when the manual went to press. However, the information may have been changed. For the most up-to-date information on using DEC GKS on VMS systems, see the following files:

SYS$HELP:DECGKS_GBIND_OP_SPEC.PS
SYS$HELP:DECGKS_GBIND_OP_SPEC.TXT

2.1 Including Definition Files

You use DEC GKS software primarily by placing calls to DEC GKS functions in your program. However, when using DEC GKS, you need statements in your program other than calls to GKS functions. The specific statements that are needed depend on the programming language you use.

DEC GKS constants and their values must be made available to all programs that call DEC GKS functions, regardless of the programming language you use. All high-level programming languages that use DEC GKS have a method for inserting an external file into the program source code stream at compile time. Incorporating an external file is the method for making DEC GKS constants available.

Your installation kit includes several files that contain DEC GKS constants, and separate files that contain DEC GKS completion status code constants. You incorporate these files into your program with a statement appropriate for the programming language you are using.

C provides the include statement for inserting an external file into a program. Therefore, any C program that uses the DEC GKS GKS$ binding should contain the following line:

```
# include <gksdefs.h>
```

In the previous statement, the angle brackets (< >) show the files containing DEC GKS constants are contained in the system library.

The language definition files located in SYS$LIBRARY are as follows:

Language	Definition File	Error Message File
ADA	gksdefs.ada	gksmsgs.ada
BASIC	gksdefs.bas	gksmsgs.bas

Language	Definition File	Error Message File
C	gksdefs.h gksdescrip.h	gksmsgs.h
COBOL	gksdefs.lib	gksmsgs.lib
FORTRAN	gksdefs.for	gksmsgs.for
MACRO	gksdefs.r32	gksmsgs.r32
Pascal	gksdefs.pas	gksmsgs.pas
PL/1	gksdefs.pli gksdefs.pl2	gksmsgs.pli

The files include comments that describe the exact method for using a given definition file.

2.2 Compiling, Linking, and Running Your Programs

A program that uses DEC GKS function calls should be compiled and executed as any other program. Use the compile command appropriate for the programming language you are using, and use the LINK and RUN commands to link the object file and execute the program image.

DEC GKS functions are supplied as an installed shareable image library, which makes linking faster and easier, makes the resulting executable image file smaller, and allows your application to be upgraded with new versions of DEC GKS without having to be rebuilt.

On VMS systems, a DEC GKS program can be linked with the following DCL command:

```
$ LINK program RETURN
```

2.3 Opening a Workstation

The following sections contain information on specifying the workstation connection identifier and workstation type.

2.3.1 Specifying the Connection Identifier

An application can specify the connection to a device by passing the connection identifier (ID) to the OPEN WORKSTATION function in any of the following ways:

- By logical name: Pass a logical name specifying the connection ID.
- By file or device name: Pass the connection ID as a string, by descriptor.
- By default: Pass either the value 0 or a null string. DEC GKS then attempts to translate the logical name GKS$CONID. If no translation exists, GKS uses GKS_DEFAULT.OUTPUT, which specifies a file in the current directory as the connected device. The user can define the VMS logical name GKS$CONID.

2.3.2 Specifying the Workstation Type

The application can specify the workstation type to the OPEN WORKSTATION function in either of the following ways:

- Use the DEC GKS workstation types. Pass any of the workstation types defined in the appropriate language file (SYS$LIBRARY:GKS$DEFS.*).
- Use the default workstation type by passing a value of 0. DEC GKS attempts to translate the VMS logical name GKS$WSTYPE. If no translation exists, DEC GKS uses the workstation type 35 (LA75™ printer). The user can define the VMS logical name GKS$WSTYPE.

2.4 DEC GKS Logical Names

Within DEC GKS there are a number of logical names that are interpreted at run time. These logical names allow a specific application (or system) to tailor DEC GKS to best suit the needs of the application or device. Each of the logical names controls some aspect of the overall run-time environment of the DEC GKS session. All the logical names have to be set before starting a GKS session and remain constant during a session. Altering logical names during a session has no effect on the logicals.

2.5 Defining Logical Names

On VMS systems, the logical names are defined at DCL level as follows:

```
$ define GKS$logical value
```

Logical names and values can be either uppercase or lowercase strings.

DEC GKS searches for VMS logical names in three different locations. Once the logicals are found, the search stops. The locations are searched in the following order:

1. The PROCESS logical table.
2. The GROUP logical table.
3. The SYSTEM logical table. This is the default location to define logical names.

2.6 Types of Logical Names

The DEC GKS logical names can be divided into two groups:

- General DEC GKS logical names
- Graphics-handler logical names

The following section describes the general logical names available with DEC GKS. For information on the graphics-handler logical names, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

2.6.1 General Logical Names

Table 2–1 lists the general logical names available with DEC GKS.

Table 2–1 General Logical Names for DEC GKS

Logical Name	Value	Description
GKS$ASF	INDIVIDUAL or BUNDLED	Specifies the default aspect source flag (ASF) setting to be either BUNDLED or INDIVIDUAL. The predefined value is INDIVIDUAL.
GKS$CONID	String containing any valid workstation connection identifier	Specifies the default workstation connection identifier to be used in the call to OPEN WORKSTATION, if the caller passes CONID 0. The predefined setting is platform-dependent.
GKS$DEF_MODE	ASAP, BNIG, BNIL or ASTI	Specifies the default deferral mode to be ASAP (as soon as possible), BNIG (before the next interaction globally), BNIL (before the next interaction locally), or ASTI (at some time). The predefined value is defined in the workstation description table.
GKS$ERRFILE	String containing any valid error file specification	Specifies the default error file to be used in the OPEN GKS function, if the user passes a NIL (0) error file descriptor. On VMS systems, this is set to SYS$ERROR: by default.
GKS$ERROR	ON or OFF	Specifies whether the default standard error checking is ON or OFF. The default value is ON. Note that if you turn error checking OFF, you may improve overall DEC GKS throughput, but DEC GKS may terminate in an uncontrolled way.
GKS$IRG	SUPPRESSED or ALLOWED	Specifies the default implicit regeneration mode (IRG) to be set to either SUPPRESSED or ALLOWED. The predefined value is defined in the workstation description table.
GKS$METAFILE_TYPE	GKSM or GKS3	Specifies the dimension of the metafile output. The value GKSM is for two-dimensional metafile output; GKS3 is for three-dimensional metafile output. The default value is GKS3.
GKS$NDC_CLIP	ON or OFF	Specifies the default normalized device coordinate (NDC) clipping to ON or OFF. The predefined value is ON.
GKS$STROKE_FONT1	String containing the file path for stroke font1	Specifies the default stroke font 1 to be used.
GKS$WSTYPE	String containing any valid workstation type number	Specifies the default workstation type to be used in the call to OPEN WORKSTATION, if the caller passes wstype 0. The predefined setting is platform-dependent.

2.7 Error Handling

The following sections contain information on error codes and error files.

2.7.1 Error Codes

Each DEC GKS function call returns a DEC GKS error value to the calling routine. All the returned error values are defined in the language file gksmsgs.h.

The function call can include a check of the returned status. The value GKS$_SUCCESS (0) is returned if the function has executed successfully. If this value is not returned, the function has failed to execute successfully. See Appendix A for more information about DEC GKS errors codes.

2.7.2 Error Files

Error messages are normally written to an error logging file. The application can specify the error logging file by passing the file name to the OPEN GKS function in either of the following ways:

- Explicitly, by specifying the file name.
- By logical: Pass a logical name specifying the error file, by descriptor.
- By default, by passing the value 0 or a null string.

  DEC GKS opens the default error file. To do this, it first attempts to translate GKS$ERRFILE. If no translation exists, DEC GKS uses SYS$ERROR as the file pointer. The user can define the VMS logical name GKS$ERRFILE.

If no messages have been written to the error file, a call to CLOSE GKS deletes the file.

ULTRIX Programming

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3
ULTRIX Programming Considerations

The specific method for using DEC GKS software depends on the features and conventions of each programming language. This section describes general issues that must be considered when using the ULTRIX™ C (cc) compiler with DEC GKS.

The information contained in this chapter was correct when the manual went to press. However, the information may have been changed. For the most up-to-date information on using DEC GKS on ULTRIX systems, see the following files:

/usr/lib/GKS/doc/decgks_gbind_op_spec.ps
/usr/lib/GKS/doc/decgks_gbind_op_spec.txt

3.1 Including Definition Files

You use DEC GKS software primarily by placing calls to DEC GKS functions in your program. However, when using DEC GKS, you need statements in your program other than calls to GKS functions. The specific statements that are needed depend on the programming language you use.

DEC GKS constants and their values must be made available to all programs that call DEC GKS functions, regardless of the programming language you use. Incorporating an external file is the method for making DEC GKS constants available.

Your installation kit includes several files that contain DEC GKS constants and separate files that contain DEC GKS completion status code constants.

The language definition files are as follows:

- /usr/include/GKS/gksdefs.h
- /usr/include/GKS/gksdefs.ada
- /usr/include/GKS/gksdescrip.h
- /usr/include/GKS/gksmsgs.h
- /usr/include/GKS/gksmsgs.ada

Only the `ld` linker is supported by Version 5.0 of DEC GKS for ULTRIX on RISC processors.

The files include comments that describe the exact method for using a given definition file.

You incorporate these files into your program with a statement appropriate for the language you are using. For example, C provides the include statement for inserting an external file into a program. Therefore, any C program that uses the DEC GKS GKS$ binding should contain the following line:

```
# include /usr/include/GKS/gks.h
```

3.2 Compiling, Linking, and Running Your Programs

A program that uses DEC GKS function calls should be compiled and executed as any other program. Use the compile command appropriate for the processor you are using. To run an executable program, type the executable file name that you specified. The following sections describe how to compile, link, and run your programs on ULTRIX systems with RISC processors.

3.2.1 Linking a C Program on ULTRIX Systems with RISC Processors

To compile and link a DEC GKS program on ULTRIX systems with RISC processors using any device handler except the DECwindows XUI device handler, use the following command:

```
# cc -I/usr/include/GKS -o program program.c \ RETURN
[gksconfig.c] -lGKSgksbnd -lGKS /usr/lib/DXM/lib/Mrm/libMrm.a \ RETURN
/usr/lib/DXM/lib/Xm/libXm.a /usr/lib/DXM/lib/Xt/libXt.a -lddif \ RETURN
-lcursesX -lc -lX11 -llmf -lm RETURN
```

To compile and link a DEC GKS program on ULTRIX systems with RISC processors using the DECwindows XUI device handler, use the following command:

```
# cc -I/usr/include/GKS -o program program.c \ RETURN
gks_decw_config.c -lGKSbnd -lGKS -lddif -ldwt -lcursesX -lc -lX11 \ RETURN
-llmf -lm RETURN
```

The gksconfig.c file is optional. The file gks_decw_config.c is required by the DECwindows XUI device handler.

A workstation or device handler can be deliberately excluded from the executable image to minimize image size and link time. This can be done by customizing the configuration file and specifying the customized version in the `link` command. The installed version of the configuration file is /usr/lib/GKS/gksconfig.c.

There is also an installed version of the configuration file that must be used when linking with the DECwindows XUI device handler. It is /usr/lib/GKS/gks_decw_config.c. See Section 3.9 for more information on how to use configuration files.

The options to the link command are required if certain default handlers are included in the configuration file, as follows:

- The switches [-lc] and [-lx11] are required for the DECwindows XUI and Motif® device handlers.
- The switch [-ldwt] is required for the DECwindows XUI device handler.
- The switch [-lddif] is required for the DDIF™ device handler.
- The library [-lcursesX] is required for any device handler for workstations capable of input, output, or both.
- The following libraries are required for the Motif device handler:

  /usr/lib/DXM/lib/Mrm/libMrm.a
  /usr/lib/DXM/lib/Xm/libXm.a
  /usr/lib/DXM/lib/Xt/libXt.a

3.3 Opening a Workstation

The following sections contain information on specifying the workstation connection identifier and workstation type.

3.3.1 Specifying the Connection Identifier

The application can specify the connection by passing the connection ID to the OPEN WORKSTATION function in any of the following ways:

- By environment variable: Pass an environment variable specifying the connection ID.
- By file or device name: Pass the connection ID as a string, by descriptor.
- By default: Pass either the value 0 or a null string. DEC GKS- then attempts to translate the environment variable GKSconid. If no translation exists, DEC GKS uses GKS_default.output, which specifies a file in the current directory as the connected device. To specify an environment option, the user can do either of the following:
  - Define the environment variable GKSconid.
  - Use the user defaults file ~/.GKSdefaults, or the system defaults file /usr/lib/GKS/.GKSdefaults.

3.3.2 Specifying the Workstation Type

The application can specify the workstation type to the OPEN WORKSTATION function in either of the following ways:

- Use the DEC GKS workstation types. Pass any of the workstation types defined in the language file /usr/include/GKS/gksdefs.*.
- Use the default workstation type by passing a value of 0. DEC GKS attempts to translate the environment variable GKSwstype. If no translation exists, DEC GKS uses the workstation type 35 (LA75 printer). The user can do either of the following:
  - Define the environment variable GKSwstype.
  - Use the user defaults file ~/.GKSdefaults, or the system defaults file /usr/lib/GKS/.GKSdefaults.

3.4 DEC GKS Environment Variables

Within DEC GKS there are a number of environment variables that are interpreted at run time. These environment variables allow a specific application (or system) to tailor DEC GKS to best suit the needs of the application or device. Each of the environment variables controls some aspect of the overall run-time environment of the DEC GKS session. All the environment variables have to be set before starting a GKS session, and remain constant during a session. Altering environment variables during a session has no effect on the value of the environment variable.

3.5 Defining Environment Variables

On ULTRIX systems, the environment variables are defined in a file named .GKSdefaults in the user's login directory, or in the system file /usr/lib/GKS/.GKSdefaults.

The following examples show the syntax you use to define environment variables in the .GKSdefaults file:

```
GKSconid          :  gks_default.output    # connection id, device, or file name
GKSwstype         :  35                    # workstation type (LA 75)
```

The environment variables can also be defined at the csh or sh level. To define an environment variable at csh level, use the following syntax:

```
# setenv GKSenvironment_variable value
```

To define an environment variable at sh level, use the following syntax:

```
# GKSenvironment_variable=value
```

The values you assign to environment variables can be either uppercase or lowercase strings. However, the environment variable names are case sensitive.

DEC GKS searches for the environment variables in three different locations. Once the environment variables are found, the search stops. The locations are searched in the following order:

1. User-specific ULTRIX environment variables.
2. User-specific environment variables defined in the file ~/.GKSdefaults. Digital recommends that you define the environment variables in this file.
3. System-wide environment variables defined in the file /usr/lib/GKS/.GKSdefaults.

3.6 The Default Environment Variable File

The default environment variable file, .GKSdefaults, contains the following:

```
!
! GKS Default Settings
!
GKSconid          :  gks_default.output    # connection id, device, or file name
GKSwstype         :  35                    # workstation type (LA 75)
GKSerror          :  on                    # on or off
GKSasf            :  individual            # bundled or individual
GKSndc_clip       :  on                    # on or off
GKSerrfile        :  stderr                # device or file name
GKSmetafile_type  :  gks3
GKSstroke_font1   :  /usr/lib/GFX/font/gfx_font_neg1 # Stroke font 1
!
! file : /usr/lib/GKS/.GKSdefaults
!
! GKS System-Wide Environment Definitions
! ========================================
!
! Environment variables allow you to customize the DEC GKS environment
! to suit your needs.
!
! i)  Modify the GKS system wide default settings.
!
! Edit this file to change GKS system-wide environment variable
! default settings.
!
```

```
! ii) Modify the GKS user-specific environment variable default settings
!     using the ~/.GKSdefaults file
!
! Copy this file into your login account i.e. ~/.GKSdefaults and
!       modify it to suit your needs.
!
! iii) Modify the GKS user-specific settings using ULTRIX
!      environment variables.
!
!      For example : setenv GKSwstype 10
!
!
!
! The DEC GKS search order for environment variables translation is :
! ------------------------------------------------------------------
!
! 1) User-specific ULTRIX environment variable
!
! 2) User-specific environment variables defined in the file ~/.GKSdefaults
!
! 3) System-wide environment variables defined in the file
!    /usr/lib/GKS/.GKSdefaults
!
!
! The allowed syntax in this file is :
! ----------------------------------
!
! Comments start with  ! or  #  character
!       Space, tabs, and  "  characters are ignored
!       Associations are done by the  =  (equal) or  :  (colon) character
!
```

3.7 Environment Variable Types

The DEC GKS environment variables can be divided into two groups:

- General DEC GKS environment variables
- Graphics-handler environment variables

The following section describes the general DEC GKS environment variables. For information on the graphics-handler environment variables, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

3.7.1 General Environment Variables

Table 3–1 lists the general environment variables available with DEC GKS.

Table 3–1 General Environment Variables for DEC GKS

Variable	Value	Description
GKSasf	INDIVIDUAL or BUNDLED	Specifies the default aspect source flag (ASF) setting to be either BUNDLED or INDIVIDUAL. The predefined value is INDIVIDUAL.
GKSconid	String containing any valid workstation connection identifier	Specifies the default workstation connection identifier to be used in the call to OPEN WORKSTATION, if the caller passes conid 0. The predefined setting is platform-dependent.

(continued on next page)

Table 3–1 (Cont.) General Environment Variables for DEC GKS

Variable	Value	Description
GKSdefmode	ASAP, BNIG, BNIL or ASTI	Specifies the default deferral mode to be ASAP (as soon as possible), BNIG (before the next interaction globally), BNIL (before the next interaction locally), or ASTI (at some time). The predefined value is defined in the workstation description table.
GKSerrfile	String containing any valid error file specification	Specifies the default error file to be used in the OPEN GKS function, if the user passes a NIL (0) error file descriptor. On ULTRIX systems, this is set to stderr by default.
GKSerror	ON or OFF	Specifies whether the default standard error checking is ON or OFF. The predefined value is ON. Note that if you turn error checking OFF, you may improve overall DEC GKS throughput, but DEC GKS may terminate in an uncontrolled way.
GKSirg	SUPPRESSED or ALLOWED	Specifies the default implicit regeneration mode (IRG) to be set to either SUPPRESSED or ALLOWED. The predefined value is defined in the workstation description table.
GKSmetafile_type	GKSM or GKS3	Specifies the dimension of the metafile output. The value GKSM is for two-dimensional metafiles; GKS3 is for three-dimensional metafiles. The default value is GKS3.
GKSndc_clip	ON or OFF	Specifies the default NDC clipping to ON or OFF. The predefined value is ON.
GKSstroke_font1	String containing the file path for stroke font1	Specifies the default stroke font 1 to be used.
GKSwstype	String containing any valid workstation type number	Specifies the default workstation type to be used in the call to OPEN WORKSTATION, if the caller passes wstype 0. The predefined setting is platform-dependent.

3.8 Error Handling

The following sections contain information on error codes and error files.

3.8.1 Error Codes

Each DEC GKS function call returns a DEC GKS error value to the calling routine. All the returned error values are defined in the following language files:

- /usr/include/GKS/gksmsgs.ada
- /usr/include/GKS/gksmsgs.h

The function call can include a check of the returned status. If the function has executed successfully, the value GKS_SUCCESS (0) is returned. If this value is not returned, the function has failed to execute successfully. See Appendix A for information about the DEC GKS errors returned.

3.8.2 Error Files

Error messages are normally written to an error logging file. The application can specify the error logging file by passing the file name to the OPEN GKS function in any of the following ways:

- Explicitly, by specifying the file name.
- By environment option: Pass an environment variable specifying the error file, by descriptor.
- By default, by passing the value 0 or a null string: This causes DEC GKS to open the default error file. To do this, it first attempts to translate GKSerrfile. If no translation exists, DEC GKS translates stderr to find the error logging file. The user can do either of the following:
  - Define the environment variable GKSerrfile.
  - Use the user defaults file ~/.GKSdefaults, or the system defaults file /usr/lib/GKS/.GKSdefaults.

If no messages have been written to the error file, a call to CLOSE GKS deletes the file.

3.9 Configuration Files

A configuration file contains the list of workstations to be linked with a DEC GKS application. There are two configuration files:

- gksconfig.c—for all device handlers except the DECwindows XUI handler
- gks_decw_config.c—for all device handlers except the Motif handler

You can use either of the two files, but you cannot use both. If you use the default configuration file (gksconfig.c) included in the DEC GKS libraries, all the device handlers supplied by Digital (except DECwindows XUI) will be linked into the program. If you use the gks_decw_config.c configuration file, all the device handlers supplied by Digital (except Motif) will be linked into the program. These files allow you to use numerous device handlers without relinking your program. However, this usually results in longer link times and larger executable images than are necessary. To reduce link time and image size, you can customize these files at either the system or user level. In either case, you customize the configuration file by changing either the INCLUDE macro to EXCLUDE, or vice versa for each device handler specified in the file. For a list of the workstation handlers and more information on the INCLUDE and EXCLUDE macros, see the configuration file gksconfig.c or gks_decw_config.c.

3.9.1 Customizing the Configuration File at System Level

To customize the file at the system level, edit the configuration file and exclude those handlers you do not wish to have included automatically in any program. Compile the file to create the new configuration module and use the command `ar(1)` to replace the file in the library /usr/lib/libGKS.a. When you replace the configuration module, other users must create their own copies of the configuration file (and link to it) to include handlers not contained in the system version of the file.

3.9.2 Customizing the Configuration File at User Level

To customize the file at the user level, make a private copy of the configuration file and edit it to include only the desired handlers. Compile the private copy of the file to create the new configuration module and link this private module before linking to the DEC GKS libraries.

Control Functions

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4
Control Functions

The control functions establish the DEC GKS and workstation environments, and control the workstation surface.

In a typical program, you need very few lines of code to tell DEC GKS about the type of implementation you are using, the type of device you are using for input or output, and the functionality allowed with that particular type of device. (Input, output, and other types of devices are called **workstations**.)

You usually start a GKS application by calling the functions OPEN GKS, OPEN WORKSTATION, and ACTIVATE WORKSTATION. These functions initiate actions by the DEC GKS kernel that involve various operating states, tables, and lists. The tables and lists that are accessible at a given time during program execution determine what types of tasks you can perform (such as input requests and output generation). The following sections describe the DEC GKS kernel, the DEC GKS operating states, and the various tables and lists involved in working with DEC GKS.

4.1 The Kernel, Graphics Handlers, and Description Tables

The DEC GKS **environment** consists of the kernel, one or more graphics handlers, at least two description tables, and a series of state lists. This section describes all but the state lists, which are described in detail in Section 4.1.2.

The DEC GKS **kernel** performs basic operations that do not depend on capabilities specific to input, output, or the use of storage devices. The kernel gives the DEC GKS functions access to the information and tools necessary to perform properly. The kernel operations include calling certain inquiry functions, maintaining certain tables, and issuing calls to graphics handlers.

The DEC GKS handlers consist of functions that the kernel calls to perform graphics operations on a particular workstation. The functions include obtaining input, relaying output, and responding to inquiries for workstation-specific information.

DEC GKS supplies graphics handlers for various devices such as Motif®, PostScript®, CGM, and DDIF™ (Digital Document Interchange Format). If you are uncertain which devices your DEC GKS programs will use, you should review the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*. In this way, you can become familiar with the range of capabilities of a particular device, and you can gain a sense of how the supported devices vary.

The DEC GKS **description table** contains constant information about the GKS implementation you are using. No matter what functions you call in your program or no matter what application you run, the information in the DEC GKS description table does not change. The DEC GKS kernel uses this constant information about DEC GKS to initialize sections of the GKS state list.

The DEC GKS description table contains information such as the level of GKS you are using (DEC GKS is level 2c), the number of available workstation types, the list of workstation types, the maximum allowable open workstations, and so on. The DEC GKS description table is contained in the DEC GKS kernel.

A **workstation description table** contains constant information about one particular device. No matter what functions you call in your program or what application you run, the information in a device's workstation description table does not change, as long as you always use the same graphics handler. Each graphics handler contains a workstation description table describing that particular device. The workstation description table is used to initialize sections of the workstation state list.

The workstation description table contains information such as the workstation type, the workstation category, the device-specific maximum coordinate values, the default bundled output attribute values, and so on.

4.1.1 Workstations

A **workstation** provides a common interface through which a DEC GKS application program controls a graphics device. A workstation is usually a physical device that has input capabilities, output capabilities, or both. (The GKSK_WSCAT_MO, GKSK_WSCAT_MI, and GKS$K_WSCAT_WISS workstations are exceptions and are described in Table 4–1.)

The various capabilities of the workstation determine the **workstation category**. Every workstation description table has an entry for the workstation category of that particular type of workstation. Table 4–1 describes the six workstation categories.

Table 4–1 Workstation Categories

Category	Description
GKS$K_WSCAT_OUTPUT	A workstation of category GKS$K_WSCAT_OUTPUT can only display graphic images on a single display surface. A workstation of this category can process all output functions. Because the generalized drawing primitive (GDP) functions are device-dependent, not all GDPs can be displayed on all output workstations. For more information concerning GDPs, see Chapter 5. For a list of the supported GDPs for a particular output device, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.
GKS$K_WSCAT_INPUT	A workstation of the category GKS$K_WSCAT_INPUT can only accept input, which must be accepted by at least one type of logical input device. A workstation of this category cannot accept the generation of graphic images by DEC GKS output functions. For more information concerning input functions, see Chapter 9.
GKS$K_WSCAT_OUTIN	A workstation of the category GKS$K_WSCAT_OUTIN combines the capabilities of GKS$K_WSCAT_OUTPUT and GKS$K_WSCAT_INPUT workstations. This type of workstation can display graphic images on the workstation surface as well as accept input from the logical input devices. Also, this type of workstation must include at least one logical input device of each class. For more information concerning logical input devices, see Chapter 9.

(continued on next page)

Table 4–1 (Cont.) Workstation Categories

Category	Description
GKS$K_WSCAT_MO	A workstation of the category GKS$K_WSCAT_MO (Metafile Output) stores image-specific data in a file for use in reproducing the graphic image at a later time, perhaps in another application program. For more information concerning metafiles, see Chapter 10.
GKS$K_WSCAT_MI	A workstation of the category GKS$K_WSCAT_MI (Metafile Input) allows an application program to read and *interpret* items in a file that contains image-specific data used to reproduce a graphic image. The file containing the data to be interpreted must be produced by a GKS$K_WSCAT_MO workstation. For more information concerning metafiles, see Chapter 10.
GKS$K_WSCAT_WISS	A workstation of the category GKS$K_WSCAT_WISS (workstation independent segment storage) can store output primitives as a single unit during the execution of a single application. The group of output primitives is called a **segment**. You can manipulate the group of output primitives within the defined segment as a single entity. The only way to transfer segments from one workstation to another is to store the segment in workstation independent segment storage (WISS) and then copy that segment to whichever open or active workstation you desire. For more information concerning segments, see Chapter 8.

4.1.2 Operating States and State Lists

The previous sections described the constructs, data structures, and tables needed to maintain the static attributes of the DEC GKS implementation and each workstation.

The DEC GKS and workstation states are not static. You can generate many types of output with many different effects on the surface of the workstation, use several devices, or create different segments. DEC GKS must keep track of the current state of both the DEC GKS and the workstation environments.

For example, the DEC GKS kernel must have access to a flag that designates whether the DEC GKS software has been initialized, allowing access to description tables and other structures. As another example, if you want to output to a workstation, DEC GKS must have access to another flag that designates whether that workstation is active or not.

To keep track of the information that is available to DEC GKS at a given time, DEC GKS maintains its **operating state** and several different **state lists**.

The DEC GKS operating states are as follows:

- GKCL—GKS is closed.
- GKOP—GKS is open.
- WSOP—At least one workstation is open.
- WSAC—At least one workstation is active.
- SGOP—A segment is open.

The following sections describe the DEC GKS operating states at various points in a program.

Open GKS

Before you invoke DEC GKS, the operating state value is GKCL. When DEC GKS is closed, you can call INQUIRE OPERATING STATE VALUE, which returns the current operating state; you can call OPEN GKS; or you can call DEC GKS functions to log and handle errors. To log and handle errors, DEC GKS maintains the **error state list**. The error state list contains entries that specify the error state and the error log file. If you attempt to call DEC GKS functions while DEC GKS is closed (other than those highlighted in this paragraph), the call generates an error message. For more information on inquiry functions, see Chapter 11; for more information on error codes, see Appendix A.

To perform more tasks using DEC GKS, you must set the operating state to GKOP. To do this, call to the control function OPEN GKS, and pass to the function the name of an error log file so DEC GKS knows where to write error messages. If you specify the default error file (or the value 0), and have not redefined that environment option, DEC GKS writes error messages to your terminal.

Once you open DEC GKS, you have enabled access to the DEC GKS description table and the workstation description tables of the supported graphics handlers. By calling OPEN GKS, you have also allowed access to the GKS **state list**. The GKS state list contains entries that designate changeable information reflecting the current status of DEC GKS (such as the set of open workstations, the current normalization number, and the current character height.)

Once DEC GKS is open, you can then specify output attributes (see Chapter 6, Attribute Functions), set normalization transformations (see Chapter 7, Transformation Functions), obtain values from the GKS state list, and obtain values from the DEC GKS and workstation description tables (see Chapter 11). If you attempt to call other functions, DEC GKS generates an error message.

Open a Workstation

To perform further tasks using DEC GKS (such as requesting input), you must open at least one workstation. When you open the first workstation, the DEC GKS operating state changes from GKOP to WSOP (at least one workstation open). To accomplish this, call OPEN WORKSTATION and pass a numeric **workstation identifier**, a physical device name or connection identifier, and a workstation type. (See OPEN WORKSTATION in this chapter for more information.) The workstation identifier is an integer value chosen by you for use in all references in the program to a specific, open or active workstation.

For each workstation you open, there exists a **workstation state list**. This list contains entries that specify whether output is deferred (buffered or on hold), whether you have to update the workstation surface (redraw the picture to fulfill a request for a picture change), whether the workstation surface is empty as defined by DEC GKS, whether the picture on the surface represents all the requests for output made thus far by the application program, and so on. Many control functions affect the values in this table. See Section 4.2.1 for more information.

Once at least one workstation is open, you can call all functions *except* those functions that open or close DEC GKS, perform output to a workstation, create or insert segments, or write an item to a metafile output workstation. If you attempt to call these functions, DEC GKS produces an appropriate error message.

Activate a Workstation

To perform output on a given workstation, you need to activate that workstation. When you activate the first workstation, the DEC GKS operating state changes from WSOP to WSAC (at least one workstation active). To activate a workstation, call the control function ACTIVATE WORKSTATION, and pass a workstation identifier specifying an open workstation. When DEC GKS is in this operating state, you can call all DEC GKS functions except OPEN GKS, CLOSE GKS, or CLOSE SEGMENT. If you attempt to call these functions, DEC GKS produces an error message.

Create a Segment

When you create a segment using the function CREATE SEGMENT, the DEC GKS operating state changes from WSAC to SGOP (segment open). You must pass a segment name to the CREATE SEGMENT function. The segment name is chosen by you for use in all references in the program to a specific segment. That segment is stored on all active workstations. To add output primitives to the segment, you need only call the desired DEC GKS output functions. Unless workstation independent segment storage (WISS) is open and active during segment creation, segments stored on workstations cannot be copied from one workstation to another. You can copy segments only from WISS to an open or active workstation; you cannot copy a segment from any other type of workstation.

When you create a segment, DEC GKS creates a **segment state list**. The segment state list contains entries that specify information about the current state of the segment, such as the segment name, the set of associated workstations, and the detectability of the segment.

In the SGOP operating state, you can call all GKS functions except those that open or close DEC GKS, associate or copy the open segment to another workstation, attempt to change the state of the workstation, clear the workstation (CLEAR WORKSTATION), or create segments (CREATE SEGMENT). If you attempt to call those functions, DEC GKS generates an error message.

Close a Segment

When you close the open segment using the CLOSE SEGMENT function, the DEC GKS kernel changes the operating state from SGOP to WSAC.

Deactivate and Close a Workstation

Calling the function DEACTIVATE WORKSTATION deactivates the specified workstation. If you deactivate the last active workstation, the kernel changes the DEC GKS operating state from WSAC to WSOP. Similarly, if you close the last open workstation (using the function CLOSE WORKSTATION), the kernel changes the DEC GKS operating state to GKOP.

Close GKS

The final call in a single DEC GKS session should be to CLOSE GKS; after the call, access to the DEC GKS environment is closed and your DEC GKS session ends.

As you end your DEC GKS session, you must close an open segment (if one exists), close and deactivate workstations, and close DEC GKS, in the correct order. If you do not, your DEC GKS session does not end properly.

For example, if you fail to deactivate and to close an active workstation before ending your program, the workstation may not return control to the user, depending on the device.

4.2 Controlling the Workstation Display Surface

Depending on the type of device with which you are working, and depending on the values of certain entries in the workstation description tables and state lists, there may be times during program execution when the picture does not contain all the changes previously requested by the application program. DEC GKS allows a workstation to delay the actions requested by a program to utilize most efficiently the capabilities of a workstation.

Output **deferral** is one workstation attribute that affects the rate of picture generation. By setting the deferral mode, you can **buffer** the generation of output images before transmission to the surface to improve overall rate of transmission, if a given workstation supports such buffering. Other times, you can release buffered output so the display surface reflects the picture defined by the application.

4.2.1 Output Deferral

DEC GKS supports four deferral modes for its supported workstations. The deferral modes, in *increasing order of deferral*, are as follows:

- ASAP—Generates output as soon as possible.
- BNIG—Generates output before the next interaction globally.
- BNIL—Generates output before the next interaction locally.
- ASTI—Generates output at some time (as defined by workstation).

An **interaction** is a request for input using the DEC GKS input functions. A local interaction happens on the workstation specified at the time of the surface update, and a global interaction happens on any open workstation.

Depending on the capabilities of the workstation, it can defer output at any level up to the level specified in the call to SET DEFERRAL STATE. If the workstation can defer output at the requested level, it does. If the workstation cannot defer output at the requested level, it defers output at the next supported lower level.

For example, if you specify ASAP in a call to SET DEFERRAL STATE, the workstation must generate output as soon as possible. If you specify BNIG, the workstation can defer output at either ASAP or BNIG, depending on its capabilities. If you specify BNIL, the workstation can defer output on any level up to and including BNIL, depending on its capabilities. If you specify ASTI, the workstation can defer output at any of the four levels, depending on its capabilities.

You can specify a suggested level of deferral by calling the function SET DEFERRAL STATE. To determine the default deferral state of a given workstation type, you can call INQUIRE DEFAULT DEFERRAL STATE VALUES. To determine the current state of the deferral mode, you can call INQUIRE WORKSTATION DEFERRAL AND UPDATE STATES.

Writing applications with other graphics programs, you need to “flush the output buffer” to include all output in your picture. The DEC GKS equivalent of this action is to “release deferred output” (if there is any). To see if generated output has been deferred by the workstation, you call the function INQUIRE WORKSTATION DEFERRAL AND UPDATE STATES. To release deferred output without updating the screen in any other way, call the function UPDATE WORKSTATION and pass the argument GKS$K_POSTPONE_FLAG. For example, DECwindows, Motif, and ReGIS devices such as the VT240™, VT330™,

and VT340™ defer output by default. If you are using those devices, you need to release deferred output if you want to place the current image on the workstation surface.

4.2.2 Implicit Surface Regenerations

Suppressed **implicit regeneration** of the currently generated output primitives is the second workstation attribute that can place the workstation surface out of date.

If you request a change to an output attribute bundle index, a segment attribute, or the current workstation window or viewport, the workstation can either make the change to the surface dynamically (IMM) or can implicitly regenerate the entire picture to comply with the requested change (IRG).

Whether a workstation makes the change dynamically or requires an implicit regeneration is a static capability of the particular workstation. You can call either the function INQUIRE DYNAMIC MODIFICATION OF SEGMENT ATTRIBUTES or INQUIRE DYNAMIC MODIFICATION OF WORKSTATION ATTRIBUTES to determine if a workstation can make a certain change immediately or if the picture must be implicitly regenerated.

If a workstation makes changes dynamically, only the output primitives in the picture affected by the change are regenerated and the surface does not become out of date. For example, for many of the supported workstations, a call to the function SET COLOUR REPRESENTATION (see Chapter 6, Attribute Functions) changes color table entries dynamically.

When an implicit regeneration occurs, the workstation clears the surface, implements the change, and then redraws only the segments on the workstation surface. You lose all output primitives not contained in segments. For example, for many of the supported workstations, a call to the function SET POLYLINE REPRESENTATION (see Chapter 6, Attribute Functions) causes an implicit regeneration on many workstations.

If a workstation makes changes by implicit regeneration, the workstation may or may not regenerate the workstation surface at that point in the program to implement the change. The *implicit regeneration mode* entry in the workstation state list specifies whether the workstation currently allows implicit regenerations, or if it suppresses them, leaving the workstation surface out of date. You can call the function INQUIRE WORKSTATION DEFERRAL AND UPDATE STATES to determine if the workstation is allowing regenerations (GKS$K_IRG_ALLOWED) or suppressing them (GKS$K_IRG_SUPPRESSED).

Many of the DEC GKS supported devices suppress implicit regenerations because of the possible loss of output primitives caused by an allowed regeneration. If you wish to change the implicit regeneration mode entry in the workstation state list, you can call the control function SET DEFERRAL STATE. Suppressing implicit regenerations allows you to make many changes to the picture without incurring the overhead of a regeneration for every change.

When you are ready to update the workstation surface, you can call UPDATE WORKSTATION, passing GKS$K_PERFORM_FLAG, to perform the single implicit regeneration. Remember that if you call UPDATE WORKSTATION to force a surface regeneration, you lose all primitives not contained in segments.

4.2.3 Workstation Surface State List Entries

When controlling the workstation surface, you should be aware of the *display surface empty* and the *new frame action necessary at update* entries in the workstation state list.

Several of the control functions clear the workstation surface if the *display surface empty* entry is GKS$K_EMPTY. Under certain conditions, when you are working with different clipping rectangles and generalized drawing primitives (GDPs), the entry may contain GKS$K_NOTEMPTY when the surface is actually empty. In such situations, when the entry contains GKS$K_NOTEMPTY, the application program must decide whether or not there exists any "invisible" output to the workstation surface.

Also, you may wish to check the *new frame action necessary at update* entry to determine if an implicit regeneration will occur if you update the surface by calling UPDATE WORKSTATION (passing GKS$K_PERFORM_FLAG as an argument). If the new frame entry is GKS$K_NEWFRAME_NOTNECESSARY, you can update the surface without the fear of losing primitives not contained in segments. If the new frame entry is GKS$K_NEWFRAME_NECESSARY, a call to UPDATE WORKSTATION with the GKS$K_PERFORM_FLAG argument will cause an implicit regeneration, causing all primitives not contained in segments to be lost.

4.3 Control Inquiries

The following list presents the inquiry functions that you should use to obtain control function information when writing device-independent code:

INQUIRE DYNAMIC MODIFICATION OF WORKSTATION ATTRIBUTES
INQUIRE LEVEL OF GKS
INQUIRE LIST OF AVAILABLE WORKSTATION TYPES
INQUIRE OPERATING STATE VALUE
INQUIRE SET OF ACTIVE WORKSTATIONS
INQUIRE SET OF OPEN WORKSTATIONS
INQUIRE WORKSTATION CATEGORY
INQUIRE WORKSTATION DEFERRAL AND UPDATE STATES
INQUIRE WORKSTATION MAXIMUM NUMBERS
INQUIRE WORKSTATION STATE
INQUIRE WORKSTATION CONNECTION AND TYPE

For more information concerning device-independent programming, see the *DEC GKS User's Guide*.

4.4 Function Descriptions

This section describes the DEC GKS control functions in detail.

ACTIVATE WORKSTATION

Operating States

WSOP, WSAC

Syntax

gks$activate_ws (ws_id)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier

Description

The ACTIVATE WORKSTATION function activates the specified workstation, allowing all subsequently generated output to be sent to the workstation. You must open DEC GKS and the workstation you wish to activate before calling this function. If the newly activated workstation is the only active workstation, DEC GKS changes the operating state from WSOP (at least one workstation open) to WSAC (at least one workstation active).

See Also

Example 4–1 for a program example using the ACTIVATE WORKSTATION function

CLEAR WORKSTATION

Operating States

WSOP, WSAC

Syntax

gks$clear_ws (ws_id, flag)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
flag	Integer (constant)	Read	Reference	Control flag

Constants

Defined Argument	Constant	Description
flag	GKS$K_CLEAR_ CONDITIONALLY	Clear conditionally
	GKS$K_CLEAR_ALWAYS	Clear always

Description

The CLEAR WORKSTATION function generates all deferred output and clears the display surface.

This function performs the following tasks:

1. Generates all deferred output (see the SET DEFERRAL STATE function).
2. If the *display surface* entry in the workstation state list is NOT EMPTY, this function always clears the surface. If the *display surface* entry is EMPTY, this function only clears the surface if you specify CLEAR ALWAYS as an argument. If no other workstations are associated with the segment, the segment is deleted.

After executing this function, DEC GKS sets the *display surface* entry in the workstation state list to EMPTY, the *workstation transformation update* entry to NOT PENDING, and the *new frame necessary at update* entry to NOT NECESSARY.

See Also

Example 4–1 for a program example using the CLEAR WORKSTATION function

CLOSE GKS

Operating States

GKOP

Syntax

gks$close_gks ()

Description

The CLOSE GKS function releases the DEC GKS buffers, closes the error log file, and deletes the file if it is empty. The function also releases the DEC GKS description table, the GKS state list, and the workstation description tables. You must end each DEC GKS session with a call to this function.

You must call both the DEACTIVATE WORKSTATION function for each active workstation and the CLOSE WORKSTATION function for each open workstation before you call CLOSE GKS. If you do not, DEC GKS logs an error message.

A call to this function changes the DEC GKS operating state from GKOP (GKS open) to GKCL (GKS closed).

See Also

DEACTIVATE WORKSTATION
OPEN GKS
Example 4–1 for a program example using the CLOSE GKS function

CLOSE WORKSTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$close_ws (ws_id)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier

Description

The CLOSE WORKSTATION function updates the workstation (equivalent to a call to the UPDATE WORKSTATION function with the regeneration mode argument), closes a workstation opened by a previous call to the OPEN WORKSTATION function, and releases the specified workstation's state list.

This function deassigns the channel used for both input and output to the device and removes the workstation from the set of open workstations in the GKS state list.

If you call this function to close the last open workstation, this function changes the DEC GKS operating state from WSOP (at least one workstation open) to GKOP (GKS open).

Be sure to deactivate a workstation with a call to the DEACTIVATE WORKSTATION function before you attempt to close a workstation with this function. If you do not, DEC GKS logs an error message.

See Also

DEACTIVATE WORKSTATION
OPEN WORKSTATION
Example 4–1 for a program example using the CLOSE WORKSTATION function

DEACTIVATE WORKSTATION

Operating States

WSAC

Syntax

gks$deactivate_ws (ws_id)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier

Description

The DEACTIVATE WORKSTATION function deactivates a specific workstation so subsequent output will not be sent to that workstation. This function removes the workstation from the set of active workstations in the GKS state list. Segments stored on the workstation are retained.

If a call to this function deactivates the last active workstation, this function changes the DEC GKS operating state from WSAC (at least one workstation active) to WSOP (at least one workstation open).

You must deactivate a workstation before you can close that workstation. Also, you must deactivate and close all workstations (if applicable) before you can close DEC GKS. Otherwise, DEC GKS logs an error message.

See Also

ACTIVATE WORKSTATION
Example 4–1 for a program example using the DEACTIVATE WORKSTATION function

ESCAPE

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$escape (func_id, in_data_rec, in_rec_size, out_data_rec, out_rec_size, total_rec_size)

Argument	Data Type	Access	Passed by	Description
func_id	Integer	Read	Reference	Function identifier.
in_data_rec	Record	Read	Reference	Pointer to input data record buffer.
in_rec_size	Integer	Read	Reference	Size of data record in bytes.
out_data_rec	Record	Modify	Reference	Pointer to output data record buffer.
out_rec_size	Integer	Modify	Reference	On input, the size of output record in bytes. On output, the size of the buffer actually containing the output data record.
total_rec_size	Integer	Write	Reference	Total size of the output data record in bytes.

Note

Some escapes use the input data record and others use the output data record. For those that use the output data record, if you pass the value 0 as the argument of *out_rec_size*, gks$escape checks for errors and returns the size of the output data record in *total_rec_size*.

Constants

Escape Identifier	Description
GKS$K_ESC_SET_SPEED	Set display speed
GKS$K_ESC_PRINT	Generate hardcopy of workstation surface
GKS$K_ESC_BEEP	Beep
GKS$K_ESC_POP_WORKSTATION	Pop workstation
GKS$K_ESC_PUSH_WORKSTATION	Push workstation
GKS$K_ESC_SET_ERROR_HANDLING_MODE	Set error handling mode
GKS$K_ESC_SET_VIEWPORT_EVENT	Set viewport event
GKS$K_ESC_ASSOC_WSTYPE_CONID	Associated workstation type and connection ID

Escape Identifier	Description
GKS$K_ESC_SET_SOFT_CLIP	Software clipping
GKS$K_ESC_SET_WRITING_MODE	Set writing mode
GKS$K_ESC_SET_LINE_CAP	Set line cap style
GKS$K_ESC_SET_LINE_JOIN	Set Line Join style
GKS$K_ESC_SET_EDGE_CTL	Set edge control flag
GKS$K_ESC_SET_EDGE_TYPE	Set edge type
GKS$K_ESC_SET_EDGE_WIDTH	Set edge width scale factor
GKS$K_ESC_SET_EDGE_COLOR_INDEX	Set edge color index
GKS$K_ESC_SET_EDGE_INDEX	Set edge index
GKS$K_ESC_SET_EDGE_ASF	Set edge aspect source flag (ASF)
GKS$K_ESC_BEGIN_TRANS_BLOCK	Begin transformation block
GKS$K_ESC_END_TRANS_BLOCK	End transformation block
GKS$K_ESC_SET_SEG_HIGH_METHOD	Set segment highlighting method
GKS$K_ESC_SET_HIGH_METHOD	Set highlighting method
GKS$K_ESC_SET_EDGE_REP	Set edge representation
GKS$K_ESC_SET_WINDOW_TITLE	Set window title
GKS$K_ESC_SET_RESET_STRING	Set reset string
GKS$K_ESC_SET_CANCEL_STRING	Set cancel string
GKS$K_ESC_SET_ENTER_STRING	Set enter string
GKS$K_ESC_SET_ICON_BITMAPS	Set icon bitmaps
GKS$K_ESC_INQ_WRITING_MODE	Inquire current writing mode
GKS$K_ESC_INQ_LINE_CAP	Inquire current line cap style
GKS$K_ESC_INQ_LINE_JOIN	Inquire current line join style
GKS$K_ESC_INQ_EDGE_ATTR	Inquire current edge attributes
GKS$K_ESC_INQ_VIEWPORT_DATA	Inquire viewport data
GKS$K_ESC_INQ_SPEED	Inquire current display speed
GKS$K_ESC_INQ_LIST_EDGE_INDEXES	Inquire list of edge indexes
GKS$K_ESC_INQ_SEGMENT_EXTENT	Inquire segment extent
GKS$K_ESC_INQ_WINDOW_IDS	Inquire window identifiers
GKS$K_ESC_INQ_SEG_HIGH_METHOD	Inquire segment highlighting method
GKS$K_ESC_INQ_HIGH_METHOD	Inquire highlighting method
GKS$K_ESC_INQ_PASTEBOARD_ID	Inquire pasteboard identifier
GKS$K_ESC_INQ_MENU_BAR_ID	Inquire menu bar identifier
GKS$K_ESC_INQ_SHELL_ID	Inquire shell identifier
GKS$K_ESC_INQ_LIST_ESC	Inquire list of available escapes
GKS$K_ESC_INQ_DEF_SPEED	Inquire default display speed
GKS$K_ESC_INQ_LINE_CAP_JOIN_FAC	Inquire line cap and join facilities
GKS$K_ESC_INQ_EDGE_FAC	Inquire edge facilities
GKS$K_ESC_INQ_PREDEF_EDGE_REP	Inquire predefined edge representation

Escape Identifier	Description
GKS$K_ESC_INQ_MAX_EDGE_BUNDLE	Inquire maximum number of edge bundles
GKS$K_ESC_INQ_LIST_HIGH	Inquire list of highlighting methods
GKS$K_ESC_INQ_EDGE_REP	Inquire edge representation
GKS$K_ESC_MAP_NDC_OF_WC	Evaluate NDC mapping of a WC point
GKS$K_ESC_MAP_DC_OF_NDC	Evaluate DC mapping of an NDC point
GKS$K_ESC_MAP_WC_OF_NDC	Evaluate WC mapping of an NDC point
GKS$K_ESC_MAP_NDC_OF_DC	Evaluate NDC mapping of a DC point
GKS$K_ESC_INQ_GDP_EXTENT	Inquire extent of a GDP
GKS$K_ESC_DOUBLE_BUFFER	Set double buffering
GKS$K_ESC_SET_BCKGRND_PIXMAP	Set background pixmap
GKS$K_ESC_INQ_DBUFFER_PIXMAP	Inquire double buffer pixmap
GKS$K_ESC_INQ_BCKGRND_PIXMAP	Inquire background pixmap

Description

The ESCAPE function invokes a specified escape function. This function provides a method for DEC GKS to access capabilities of a specific workstation that are not fully utilized by other functions.

For example, the DEC GKS implementation uses this function call to produce a hardcopy dump of a VT125 or VT240 terminal screen, or to set the LVP16™ plotter pen speed.

Note that there are two data record size arguments. On input, the *out_rec_size* argument specifies the size (in bytes) of the output data buffer. On output, it is the output buffer size (in bytes) actually written. The *total_rec_size* argument always returns the total record size (in bytes) required by the escape. After the call is completed, if the total size of the output data record does not match the *out_rec_size* argument, the record was truncated to fit in the allocated space.

For more information concerning the available escapes, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

When calling the control function ESCAPE, you may need to pass a data record. DEC GKS has a standard escape data record that contains three integer elements and up to four array addresses.

To use an escape data record, you need to perform the following tasks:

1. Determine the size and contents of the required data record (if one is required).
2. Declare the data record as determined by your particular programming language. Each of the seven elements of the data record is an integer value. The record is read only, passed by reference.

3. Pass to ESCAPE only the data record elements required by the escape. For example, if an escape requires only five data record elements, omit values from elements 6 and 7.
4. Pass to ESCAPE the exact size of the valid portion of the data record. For example, if an escape requires five valid elements to the data record, pass the value 20 as the data record size (each element being a longword in length).

The DEC GKS standard escape data record is as follows:

Element	Data Type	Description
1	Integer	Number of integer values passed in the data record
2	Integer	Number of real values passed in the data record
3	Integer	Number of string addresses passed in the data record
4	Integer (address)	Address of an array of integers with exactly as many elements as the number specified in element number 1
5	Integer (address)	Address of an array of real numbers with exactly as many elements as the number specified in element number 2
6	Integer (address)	Address of an array of string lengths with exactly as many elements as the number specified in element number 3
7	Integer (address)	Address of an array of string addresses with exactly as many elements as the number specified in element number 3

After performing a task, some escape functions pass information back to you through an output data record. This output data record is identical in format to the input data record, except that the elements of the output data record are modifiable. You pass the buffer sizes in the first three elements and the addresses of your buffers in the last four elements. DEC GKS modifies the first three elements to contain the number of elements DEC GKS actually used to write output data to each of the corresponding buffers.

If you use an escape function and need to determine the size required by the entire output data record buffer, you can pass the value 0 to the output record buffer size (documented as the argument *out_rec_size* in the ESCAPE function description.) When you pass the value 0 as this argument, ESCAPE does *not* perform the escape, but instead returns the size of the output data record to the argument *total_rec_size*. In this manner, you can be sure that you declared an output data record buffer large enough to hold the entire data record.

To place array addresses in the fourth, fifth, sixth, and seventh elements of the data record, you need to use a technique specific to your programming language. For more information concerning addresses and pointers, see the documentation set for your programming language.

Note

Remember that the DEC GKS input data records have a format that is completely different from the GKS standard escape data record format. To review the GKS standard input data records, see Chapter 9. To review the actual data records required by the DEC GKS graphics handlers, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SIZEOF
Example 4–2 for a program example using the ESCAPE function

MESSAGE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$message (ws_id, message)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
message	Character string	Read	Descriptor	Text of the message

Description

The MESSAGE function allows an application program to deliver a message to the user at an implementation-dependent location on the workstation surface, or on a separate device associated with the workstation. This function may have a local effect on the workstation. For example, the message might request that the operator change the paper in a plotter before a picture is generated.

See the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS* for more information on workstation-specific capabilities.

See Also

Example 9–1 for a program example using the MESSAGE function

OPEN GKS

Operating States

GKCL

Syntax

gks$open_gks (error_file [, memory])

Argument	Data Type	Access	Passed by	Description
error_file	Character string	Read	Descriptor	Either the logical name or physical name of a device or a file that points to the error log file.
memory	Integer	Read	Reference	Number of memory units available to DEC GKS (optional argument). Ignored by DEC GKS.

Description

The OPEN GKS function permits subsequent access to the GKS state list, DEC GKS description table, and the workstation description tables.

The function changes the DEC GKS operating state from GKCL (GKS closed) to GKOP (GKS open). The *error file* entry in the error state list is set to the value passed as an argument to this function.

When using DEC GKS, you usually call this function first. All functions except EMERGENCY CLOSE, ERROR HANDLING, ERROR LOGGING, and INQUIRE OPERATING STATE VALUE require at least the GKOP operating state.

See Also

CLOSE GKS
Example 4–1 for a program example using the OPEN GKS function

OPEN WORKSTATION

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$open_ws (ws_id, conn_id, ws_type)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
conn_id	Character string	Read	Descriptor	Connection identifier
ws_type	Integer	Read	Reference	Workstation type

Description

The OPEN WORKSTATION function initializes a workstation for use by DEC GKS, permitting subsequent access to the specified workstation's state list.

This function associates the workstation identifier with a particular device of a specified type, and initializes the workstation. If establishing the first open workstation, this function changes the DEC GKS operating state from GKOP (GKS open) to WSOP (at least one workstation open).

This function clears the display surface of previously generated images. You must call this function, followed by a call to the ACTIVATE WORKSTATION function, before you attempt to generate output to this workstation.

See Also

ACTIVATE WORKSTATION
Example 4–1 for a program example using the OPEN WORKSTATION function

REDRAW ALL SEGMENTS ON WORKSTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$redraw_seg_on_ws (ws_id)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier

Description

The REDRAW ALL SEGMENTS ON WORKSTATION function clears the screen and redraws all defined, visible segments.

This function performs the following tasks:

1. Generates all deferred output (see the SET DEFERRAL STATE function).
2. If the *display surface empty* entry in the workstation state list is NOT EMPTY, this function clears the surface.
3. Places into effect pending workstation transformations.
4. Redisplays all visible segments that existed on the workstation surface before the screen was cleared. All output not contained in segments is lost.

After executing this function, DEC GKS sets the *workstation transformation update* state list entry to NOT PENDING, and the *new frame necessary at update* state list entry to NOT NECESSARY.

Note

You should use this function if you need to redraw the picture regardless of the status of the *new frame necessary at update* entry. Otherwise, use the UPDATE WORKSTATION function.

See Also

UPDATE WORKSTATION
Example 8–1 for a program example using the REDRAW ALL SEGMENTS ON WORKSTATION function

SET DEFERRAL STATE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_defer_state (ws_id, defer_mode, regen_mode)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
defer_mode	Integer (constant)	Read	Reference	Deferral mode
regen_mode	Integer (constant)	Read	Reference	Implicit regeneration mode

Constants

Defined Argument	Constant	Description
defer_mode	GKS$K_ASAP	Generate images as soon as possible.
	GKS$K_BNIG	Generate images before next interaction globally, or before sample or event input occurs.
	GKS$K_BNIL	Generate images before next interaction locally, or before sample or event input occurs.
	GKS$K_ASTI	Generate images at some time. The exact time is determined by the workstation.
regen_mode	GKS$K_IRG_SUPPRESSED	Image regeneration is suppressed.
	GKS$K_IRG_ALLOWED	Image regeneration is allowed.

Description

The SET DEFERRAL STATE function sets the workstation state list entries *deferral mode* and *implicit regeneration mode*.

The deferral mode specifies the rate of output generation. Depending on the capabilities of the workstation, it can defer output at any level up to the level specified in the call to the SET DEFERRAL STATE function. If the workstation can defer output at the requested level, it does. If the workstation cannot defer output at the requested level, it defers output at the next supported lower level. Using this function, you can allow a workstation to defer output, or you can either suppress or allow implicit regenerations.

For example, if you specify ASAP in a call to this function, the workstation must generate output as soon as possible. If you specify BNIG, the workstation can defer output at either ASAP or BNIG, depending on its capabilities. If you specify BNIL, the workstation can defer output on any level up to and including BNIL, depending on its capabilities. If you specify ASTI, the workstation can defer output at any of the four levels, depending on its capabilities. (For more information concerning the definitions of the constants described in this paragraph, see the deferral mode argument description.)

The implicit regeneration mode determines whether implicit regenerations are allowed or suppressed. If you allow implicit regenerations, and the workstation supports implicit regeneration for the specified change, any pending or subsequent surface change requiring regeneration (for example, output bundle index changes, segment attribute changes, or workstation transformation changes) occurs at the time of request. If you suppress regenerations, changes requiring regenerations place the screen out of date (DEC GKS sets the *new frame necessary at update* entry in the workstation state list to NEWFRAME NECESSARY).

By suppressing implicit regenerations, you can make all necessary changes without altering the workstation surface. When you have requested all changes, call the UPDATE WORKSTATION function to perform all the suppressed actions in a single regeneration of the surface.

Note

When regenerating the surface of the workstation, DEC GKS clears the surface before redrawing only the visible segments. All output primitives not contained in segments are lost.

See Also

UPDATE WORKSTATION
Example 5–1 for a program example using the SET DEFERRAL STATE function

UPDATE WORKSTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$update_ws (ws_id, flag)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
flag	Integer (constant)	Read	Reference	Implicit regeneration flag

Constants

Defined Argument	Constant	Description
flag	GKS$K_POSTPONE_FLAG	Postpone regeneration of images
	GKS$K_PERFORM_FLAG	Perform regeneration of images

Description

The UPDATE WORKSTATION function generates all deferred output for the specified workstation and can also redisplay all visible segments.

If the *new frame necessary at update* entry in the workstation state list is NEWFRAME NECESSARY, and if you specify the value GKS$K_PERFORM_FLAG to this function, it performs the following tasks:

1. Clears the screen if the *display surface empty* entry in the workstation state list is NOT EMPTY.
2. Places into effect pending workstation transformations.
3. Redisplays all visible segments that were stored on the workstation. All output primitives not contained in segments are lost.

After executing these tasks, DEC GKS sets the *display surface empty* entry in the workstation state list to EMPTY or to NOT EMPTY according to the current state of the workstation surface, the *workstation transformation update state* entry to NOT PENDING, and the *new frame necessary at update* entry to NOT NECESSARY.

However, if at the call to this function the *new frame necessary at update* entry in the workstation state list is NOT NECESSARY, or if you specify the value GKS$K_POSTPONE_FLAG as an argument to this function, it initiates only the transmission of any deferred output.

See Also

Example 4–1 for a program example using the UPDATE WORKSTATION function

4.5 Program Examples

Example 4–1 illustrates the use of several control functions.

Example 4–1 CLEAR WORKSTATION and the GKS Control Functions

```
/*
 *  This program writes a text string to the screen, and then clears the
 *  screen using the function CLEAR WORKSTATION.
 *
 *  NOTE: To keep the example concise, no error checking is performed.
 */

# include <stdio.h>

# include <gksdescrip.h>         /* GKS descriptor file */
# include <gksdefs.h>            /* GKS$ binding definition file */

main ()
{
   int     clear_flag;
   int     default_conid;
   int     default_wstype;
   int     device_num;
   int     input_class;
   float   larger              = 0.03;
   float   start_x             = 0.1;
   float   start_y             = 0.5;
   struct  dsc$descriptor_s    text_dsc;
   char    *text_name          = "CLEAR WORKSTATION should erase this";
   float   timeout             = 10.00;
   int     update_flag;
   int     ws_id               = 1;

/*  Set up the string descriptor. */

    text_dsc.dsc$a_pointer = text_name;
    text_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text_dsc.dsc$w_length  = strlen( text_name );

/*
 *  Open the GKS environment. Specifying 0 for the two arguments tells
 *  DEC GKS to use the default values (output to the terminal surface
 *  and the default GKS error file).
 */

    gks$open_gks (0, 0);

/*
 *  Open the workstation environment.  When you call this function, you
 *  assign the workstation a numeric identifier (in this example, the
 *  number 1), a device name (in this example, DEC GKS translates the
 *  connection identifier environment option to determine the device name),
 *  and a workstation type (in this example, DEC GKS translates the workstation
 *  type environment option to determine the workstation type).
 */

    default_conid  = GKS$K_CONID_DEFAULT;
    default_wstype = GKS$K_WSTYPE_DEFAULT ;

    gks$open_ws (&ws_id, &default_conid, &default_wstype);
```

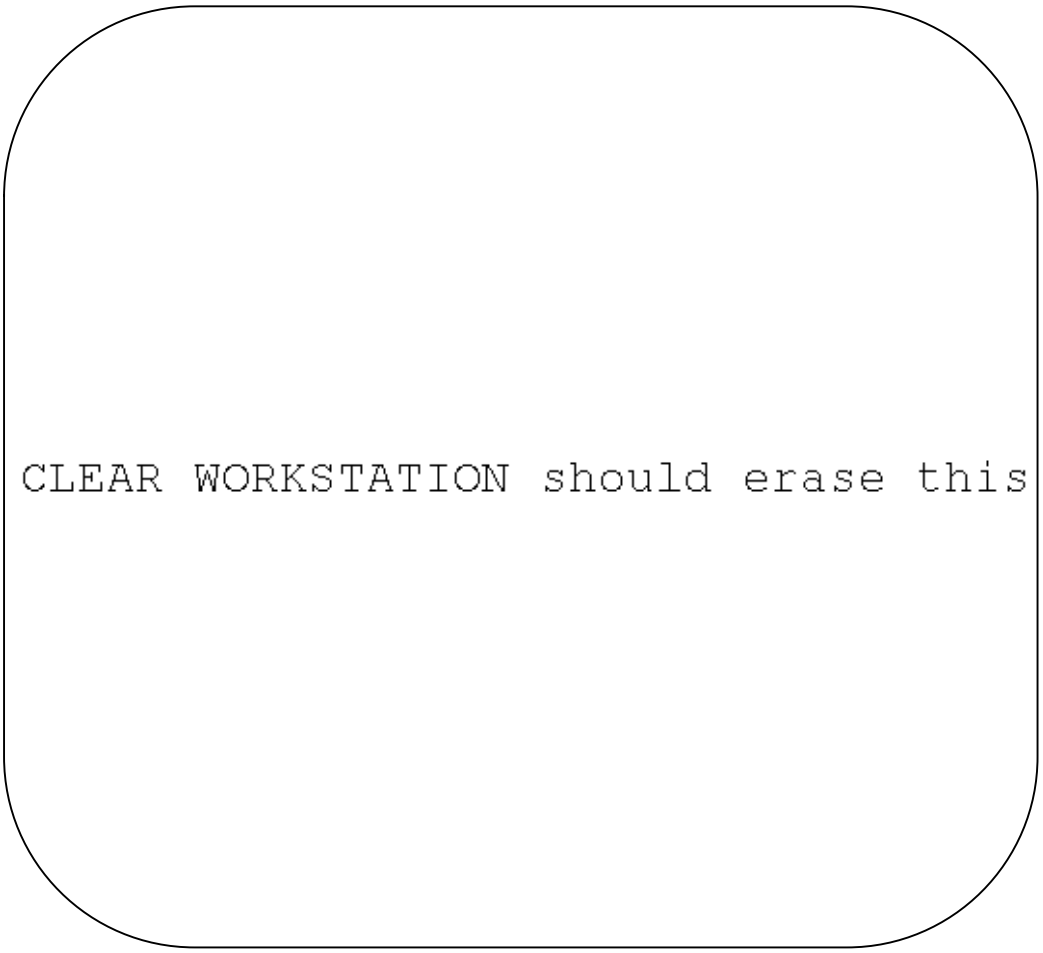
(continued on next page)

Example 4–1 (Cont.) CLEAR WORKSTATION and the GKS Control Functions

```
/*
 *  When activating a workstation using the function ACTIVATE WORKSTATION,
 *  use the workstation identifier you specified as the first argument in
 *  the call to OPEN WORKSTATION (in this example, the number 1).
 */

    gks$activate_ws (&ws_id );

/*
 *  Using the default windows and viewports, the TEXT function writes a
 *  character string to the screen starting at the WC (0.1, 0.5).
 */

    gks$set_text_height (&larger);
    gks$text (&start_x, &start_y, &text_dsc);

/*  Release the deferred output. Wait 10 seconds. */

    update_flag = GKS$K_POSTPONE_FLAG;

    gks$update_ws (&ws_id, &update_flag);
    gks$await_event (&timeout, &ws_id, &input_class, &device_num);

/*
 *  The CLEAR WORKSTATION function, when passed the flag
 *  GKS$K_CLEAR_CONDITIONALLY, clears the workstation under the condition
 *  that the surface contains output primitives.  Because the previous
 *  function call wrote a character string to the workstation surface,
 *  this call clears the screen.
 */

    clear_flag = GKS$K_CLEAR_CONDITIONALLY;

    gks$clear_ws (&ws_id, &clear_flag);

/*
 *  When deactivating and closing the open workstation, pass the numeric
 *  workstation identifier previously specified in the call to OPEN
 *  WORKSTATION (in this example, the value 1).
 */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();
}
```

Figure 4–1 shows the first screen displayed on a VAXstation™ workstation running DECwindows software. When the program ends, the screen is cleared.

Figure 4–1 CLEAR WORKSTATION and the GKS Control Functions



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Example 4–2 illustrates the use of the ESCAPE function.

Example 4–2 Supported Escapes Program

```
/*
 *  This program opens GKS and the default workstation, inquires the
 *  workstation type, queries the list of escapes supported by the workstation,
 *  tests a few of the escapes, and closes the workstation and GKS.
 */

# include <stdio.h>

# include <gksdescrip.h>       /* GKS descriptor file */
# include <gksdefs.h>          /* GKS binding definition file */
```

(continued on next page)

Example 4–2 (Cont.) Supported Escapes Program

```
#define FALSE         0
#define MAX_BUFFER   80
#define MAX_INTS    100
#define TRUE          1

/*
 *  This routine inquires the list of supported escapes for the specified
 *  workstation type.
 */

void inquire_escapes (wstype, escape_list)

int       escape_list[MAX_INTS];
int       wstype;

{

    int     escape_id;
    int     in_data_size;
    int     in_esc_data[7];
    int     out_data_size;
    int     out_esc_data[7];
    int     total_size;

    in_data_size = 4 * sizeof(int);
    in_esc_data[0] = 1;
    in_esc_data[1] = 0;
    in_esc_data[2] = 0;
    in_esc_data[3] = &wstype;

    out_data_size = 4 * sizeof(int);
    out_esc_data[0] = MAX_INTS;  /* maximum array dimension */
    out_esc_data[1] = 0;
    out_esc_data[2] = 0;
    out_esc_data[3] = escape_list;

    escape_id = GKS$K_ESC_INQ_LIST_ESC;

    gks$escape (&escape_id, in_esc_data, &in_data_size,
       out_esc_data, &out_data_size, &total_size);

} /* End inquire_escapes */


/*
 *  This routine determines whether the specified escape identifier (esc_id)
 *  is in the list of supported escapes (escape_list).  A value of TRUE is
 *  returned if the specified escape is supported.  A value of FALSE is returned
 *  if the specified escape is not supported.
 */

int esc_support (esc_id, escape_list)

int    esc_id;
int    escape_list[MAX_INTS];

{
    int   escape_supported;
    int   n;

    escape_supported = FALSE;
    for (n = 3; n < 3+escape_list[2]; n++)
       if (esc_id == escape_list[n])
           {
           escape_supported = TRUE;
           break;
           }
```

(continued on next page)

Example 4–2 (Cont.) Supported Escapes Program

```
    return (escape_supported);
} /* End esc_support */


/*
 *  This routine sets double buffering ON and OFF as requested.  Nothing
 *  will be done if the escape is not supported by the workstation type.
 */
void set_double_buffer (ws_id, escape_list, double_buffer_flag)
int    double_buffer_flag;
int    escape_list[MAX_INTS];
int    ws_id;
{
    int     escape_id;
    int     in_data_size;
    int     in_esc_data[7];
    int     int_array[2];
    int     out_data_size;
    int     out_esc_data[7];
    int     total_size;
/*  Determine if the escape is supported by the workstation. */
    if (!esc_support(GKS$K_ESC_DOUBLE_BUFFER, escape_list))
        return;
/*  Turn double buffering ON or OFF as requested. */
    in_data_size = 4 * sizeof (int);
    in_esc_data[0] = 2;
    in_esc_data[1] = 0;
    in_esc_data[2] = 0;
    in_esc_data[3]= int_array;
    int_array[0] = ws_id;
    int_array[1] = double_buffer_flag;
    out_data_size = 0;
    escape_id = GKS$K_ESC_DOUBLE_BUFFER;
    gks$escape (&escape_id, in_esc_data, &in_data_size,
       out_esc_data, &out_data_size, &total_size);
} /* End set_double_buffer */


/*
 *  This routine inquires the X window and display identifiers of
 *  the GKS workstation.  Nothing will be done if the escape is not supported
 *  by the workstation type.
 */
```

(continued on next page)

Example 4–2 (Cont.) Supported Escapes Program

```
void inq_window_ids (ws_id, escape_list, x_display_id, x_window_id)

int    escape_list[MAX_INTS];
int    ws_id;
int    *x_display_id;
int    *x_window_id;

{

    int     escape_id;
    int     in_data_size;
    int     in_esc_data[7];
    int     int_array[2];
    int     out_data_size;
    int     out_esc_data[7];
    int     total_size;

/*  Determine if the escape is supported by the workstation. */

    if (!esc_support(GKS$K_ESC_INQ_WINDOW_IDS, escape_list))
        return;

/*  Inquire the X display identifier and X window identifier. */

    in_data_size = 4 * sizeof (int);
    in_esc_data[0] = 1;
    in_esc_data[1] = 0;
    in_esc_data[2] = 0;
    in_esc_data[3] = &ws_id;

    out_data_size = 4 * sizeof (int);
    out_esc_data[0] = 2;
    out_esc_data[1] = 0;
    out_esc_data[2] = 0;
    out_esc_data[3] = int_array;

    escape_id = GKS$K_ESC_INQ_WINDOW_IDS;

    gks$escape (&escape_id, in_esc_data, &in_data_size,
       out_esc_data, &out_data_size, &total_size);

    *x_display_id = int_array[0];
    *x_window_id  = int_array[1];

    printf ("\n Escape: Inquire Window Identifiers\n");
    printf ("   X Display ID:      %x\n", *x_display_id);
    printf ("   X Window ID:       %x\n", *x_window_id);

} /* End inq_window_ids */


/*
 *  This routine sets the window title to the specified string.  Nothing
 *  will be done if the escape is not supported by the workstation type.
 */

void set_window_title (ws_id, escape_list, new_title)

int    escape_list[MAX_INTS];
char  *new_title;
int    ws_id;

{
```

(continued on next page)

Example 4–2 (Cont.) Supported Escapes Program

```
    int     escape_id;
    int     in_data_size;
    int     in_esc_data[7];
    int     new_title_size;
    int     out_data_size;
    int     out_esc_data[7];
    int     total_size;

/*  Determine if the escape is supported by the workstation. */

    if (!esc_support(GKS$K_ESC_SET_WINDOW_TITLE, escape_list))
        return;

/*  Change the window title. */

    in_esc_data[0] = 1;
    in_esc_data[1] = 0;
    in_esc_data[2] = 1;
    in_esc_data[3] = &ws_id;
    in_esc_data[4] = 0;
    in_esc_data[5] = &new_title_size;
    in_esc_data[6] = &new_title;
    in_data_size = 7 * sizeof(int);
    new_title_size = strlen(new_title);
    out_data_size = 0;

    escape_id = GKS$K_ESC_SET_WINDOW_TITLE;

    gks$escape (&escape_id, in_esc_data, &in_data_size,
       out_esc_data, &out_data_size, &total_size);

} /* End set_window_title */


main ( )
{
    char      conn_id[80];
    struct dsc$descriptor conn_id_dsc;
    int       conn_id_size;
    int       double_buffer_flag;
    int       error_ind;
    int       escape_list [MAX_INTS];
    int       n;
    int       ws_id = 1;
    int       wstype;
    int       x_window_id;
    int       x_display_id;

/*  Open GKS and the default workstation. */

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, 0, 0);

/*  Set up the descriptor.  Inquire the workstation type. */

    conn_id_dsc.dsc$w_length  = (unsigned short)(strlen(conn_id));
    conn_id_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    conn_id_dsc.dsc$b_class   = DSC$K_CLASS_S;
    conn_id_dsc.dsc$a_pointer = conn_id;

    gks$inq_ws_type (&ws_id, &error_ind, &conn_id_dsc,
       &wstype, &conn_id_size);
```

(continued on next page)

Example 4–2 (Cont.) Supported Escapes Program

```
/*  Inquire the list of supported escapes. */

    inquire_escapes (wstype, escape_list);
    if (escape_list[0] != 0)
        {
        gks$emergency_close ( );
        printf ("Error inquiring list of supported escapes %d\n",
                 escape_list[0]);
        exit ( );
        }

/*  Set the window title. */

    set_window_title (ws_id, escape_list, "DEC GKS puts life in perspective");

/*  Turn on double buffering. */

    double_buffer_flag = 1;

    set_double_buffer (ws_id, escape_list, double_buffer_flag);

/*  Inquire the X display identifier and X window identifier. */

    inq_window_ids (ws_id, escape_list, &x_display_id, &x_window_id);

/*  Close the workstation and GKS. */

    gks$close_ws (&ws_id);
    gks$close_gks ();

/*  Print the workstation type and its supported escapes. */

    printf ("\n Workstation type %d supports %d escapes (%d returned):\n",
             wstype, escape_list[1], escape_list[2]);
    for (n = 3; n < escape_list[2] + 3; n++)
        printf ("    %d\n", escape_list[n]);

} /* End main */
```

This program performs various escapes, depending on the workstation type. Example 4–3 shows the output from a VAXstation workstation running DECwindows software.

Example 4–3 VAXstation Output for Escape Program

```
 Escape: Inquire Window Identifiers
   X Display ID:      1f8010
   X Window ID:       700013
```

(continued on next page)

Example 4–3 (Cont.) VAXstation Output for Escape Program

```
 Workstation type 211 supports 35 escapes (35 returned):
    -104
    -105
    -151
    -152
    -103
    -150
    -309
    -308
    -307
    -106
    -107
    -206
    -304
    -202
    -203
    -204
    -205
    -500
    -501
    -502
    -503
    -109
    -401
    -403
    -303
    -358
    -108
    -110
    -251
    -252
    -253
    -305
    -350
    -400
    -402
```

Output Functions

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5
Output Functions

The DEC GKS output functions generate the basic components, or **primitives**, of all graphic pictures.

When you generate primitives on the workstation surface, you should be aware of the following:

- DEC GKS operating state
- DEC GKS coordinate systems
- Transformations
- Clipping
- Deferred transformations and output

The following sections describe these issues related to output, and point to the appropriate chapters in this manual that describe the topics in full detail.

5.1 Output and the DEC GKS Operating State

When you call control functions, DEC GKS allows access to certain tables and lists. You can never call a DEC GKS function that requires access to a table or list that has not yet been made available. To determine which tables and lists are accessible, and which DEC GKS functions you can call at a given point in the application program, DEC GKS maintains an operating state (see Section 4.1.2).

To call any of the output functions described in this chapter, the DEC GKS operating state must be WSAC or SGOP. To place DEC GKS into the WSAC operating state, you need to do the following:

- Open DEC GKS (by calling OPEN GKS).
- Open at least one workstation (by calling OPEN WORKSTATION).
- Activate at least one workstation (by calling ACTIVATE WORKSTATION).

If you call an output function, DEC GKS generates the primitive on all active workstations. If you call an output function during the SGOP operating state, the output primitive becomes part of a segment. (For complete information concerning segments, see Chapter 8, Segment Functions.)

If you wish to output to an active workstation, the workstation must be of type OUTPUT, OUTIN, or MO (see Table 4–1). Only workstations of those categories support image generation. OUTPUT and OUTIN workstations generate output primitives on the workstation surface; MO workstations store information about the function call in a file. For more information concerning metafiles, see Chapter 10, Metafile Functions. For more information concerning workstation categories or the DEC GKS operating states, see Chapter 4, Control Functions.

5.2 Output Attributes

All the output primitives have **attributes** that are stored in the GKS state list. Attributes are properties of the primitive, such as line thickness, color, and style. Each attribute has an initial value, provided as a default setting. When you call an output function, the current values of its attributes are bound to the function, so that the output primitive reflects the current attribute values.

Output attribute functions can radically affect how the output primitive appears on the workstation surface. For example, depending on the current text attribute values, the positioning point passed to the output function TEXT may be the center point for the text string, the position of the first character in the text string, or the position of the last character in the text string. The text output attributes also determine whether the string runs horizontal to the workstation X axis, vertical to the workstation X axis, or at a specified angle on the display surface.

This chapter requires that you be familiar with the following attribute issues:

- The types of attributes available for a primitive.
- The effects of using individual and bundled attributes.
- The use of nominal sizes and scale factors.
- The use of foreground and background color.

For complete information on these and any other output attribute topics, see Chapter 6, Attribute Functions.

5.3 Transformations and the DEC GKS Coordinate Systems

The DEC GKS transformation functions allow you to compose a picture, control how much of the picture is displayed on the workstation surface, orient the picture, and control how much of the workstation surface is used to display the picture.

When you request input and generate output on the workstation surface, you actually work with a number of coordinate systems. The image is transformed from one coordinate system to the next.

Using DEC GKS, you work with a geometric transformation pipeline. The pipeline consists of a number of transformations that affect various coordinate systems.

Note if you are working only with two-dimensional primitives, your WC system is an imaginary Cartesian coordinate system with the origin at (0, 0), and X and Y axes that extend to infinity in all directions. The two-dimensional WC plane is positioned at z = 0.

DEC GKS uses two separate transformations to translate your WC points to NDC points, and to translate your NDC points to device coordinate points. During this process, portions of your primitives may be removed from the final picture due to clipping. You need to be aware of the effects of transformations and clipping on your generated output primitives. For complete information concerning transformations, see Chapter 7, Transformation Functions.

5.4 Output Deferral

When you output primitives, a workstation may postpone the generation of the image on the workstation surface depending on the workstation's capabilities. This postponement is called output **deferral**.

DEC GKS supports four deferral modes for its supported workstations. The deferral modes, in increasing order of deferral, are ASAP (generates output as soon as possible), BNIG (generates output before the next interaction globally), BNIL (generates output before the next interaction locally), and ASTI (at some time).

You can specify a suggested level of deferral by calling the function SET DEFERRAL STATE. Depending on the capabilities of the workstation, it can defer output at the highest level up to the level specified in the call to SET DEFERRAL STATE.

For detailed information concerning SET DEFERRAL STATE and deferral, see Chapter 4, Control Functions.

5.5 Output Inquiries

The following list presents the inquiry functions that you can use to obtain output information when writing device-independent code:

INQUIRE GENERALIZED DRAWING PRIMITIVE
INQUIRE LIST OF AVAILABLE GENERALIZED DRAWING PRIMITIVES
INQUIRE OPERATING STATE
INQUIRE PIXEL
INQUIRE PIXEL ARRAY
INQUIRE PIXEL ARRAY DIMENSIONS
INQUIRE SET OF ACTIVE WORKSTATIONS
INQUIRE TEXT EXTENT

For more information concerning device-independent programming, see the *DEC GKS User's Guide*.

5.6 Function Descriptions

This section describes the DEC GKS output functions in detail.

CELL ARRAY

Operating States

WSAC, SGOP

Syntax

gks$cell_array (start_point_x, start_point_y, diag_point_x, diag_point_y, offset_col_num, offset_row_num, num_cols, num_rows, color_ind_val)

Argument	Data Type	Access	Passed by	Description
start_point_x	Real	Read	Reference	Starting point X coordinate in WC values
start_point_y	Real	Read	Reference	Starting point Y coordinate in WC values
diag_point_x	Real	Read	Reference	Diagonal point X coordinate in WC values
diag_point_y	Real	Read	Reference	Diagonal point Y coordinate in WC values
offset_col_num	Integer	Read	Reference	Column number offset into the color index array
offset_row_num	Integer	Read	Reference	Row number offset into the color index array
num_cols	Integer	Read	Reference	Number of columns in cell array rectangle
num_rows	Integer	Read	Reference	Number of rows in cell array rectangle
color_ind_val	2D array of integers	Read	Descriptor	Two-dimensional array containing color index values

Description

The CELL ARRAY function divides a designated rectangular area into cells, and displays each cell in a specified color or shade.

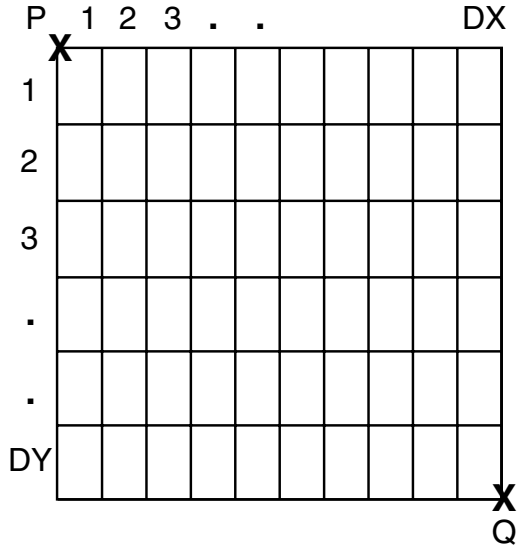
You pass a two-dimensional array containing color index values as one argument to this function. DEC GKS maps the color index values to corresponding cells within a rectangular area of the workstation surface. In addition to the color index array, you specify an offset into the color array (a starting element), and the number of array columns and rows to be mapped.

There is a one-to-one correspondence between the number of specified array columns and rows, and the number of columns and rows by which DEC GKS divides the cell array rectangle. Each of the columns within the rectangle is of equal width, and each of the rows within the rectangle is of equal height. DEC GKS maps the color index values from each specified color index array element to the corresponding cell, moving from the starting point towards the diagonal point along the X axis.

For more information on the initial color index values for a given workstation, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

To alter the color associated with a certain index value, you can use the GKS function SET COLOUR REPRESENTATION.

The following figure illustrates how the cells are arranged in the cell array primitive.



CELL ARRAY
DX x DY CELLS

ZK–4581A–GE

See Also

SET COLOUR REPRESENTATION
Example 5–1 for a program example using the CELL ARRAY function

FILL AREA

Operating States

WSAC, SGOP

Syntax

gks$fill_area (num_points, x_points, y_points)

Argument	Data Type	Access	Passed by	Description
num_points	Integer	Read	Reference	Number of points in the polygon
x_points	Array of reals	Read	Reference	X coordinates in WC points
y_points	Array of reals	Read	Reference	Y coordinates in WC points

Description

The FILL AREA function draws a polygon and fills it with an interior style that has already been selected. If you do not specify a closed polygon, DEC GKS connects the last point specified to the first point.

The fill area interior style can be either hollow, solid, hatched, or patterned. For example, the default fill area interior style for most supported workstation types is hollow. In that case, the function draws the outline of the polygon, leaving the interior hollow.

See Also

SET FILL AREA COLOUR INDEX
SET FILL AREA INTERIOR STYLE
SET FILL AREA STYLE INDEX
SET PATTERN REFERENCE POINT
SET PATTERN REPRESENTATION
SET PICK IDENTIFIER
Example 6–1 for a program example using the FILL AREA function

GENERALIZED DRAWING PRIMITIVE

Operating States

WSAC, SGOP

Syntax

gks$gdp (num_points, x_points, y_points, gdp_id, data_rec, data_rec_size)

Argument	Data Type	Access	Passed by	Description
num_points	Integer	Read	Reference	Number of points in the GDP.
x_points	Array of reals	Read	Reference	X coordinates in WC values.
y_points	Array of reals	Read	Reference	Y coordinates in WC values.
gdp_id	Integer	Read	Reference	GDP identifier.
data_rec	Record	Read	Reference	GDP data record. See the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS* for the appropriate data record.
data_rec_size	Integer	Read	Reference	GDP data record size in bytes.

Constants

Defined Argument	Constant	Description
gdp_id	GKS$K_GDP_DISJOINT_PLINE	Disjoint polyline
	GKS$K_GDP_CIRCLE_CTR_PT	Circle: center and point on circumference
	GKS$K_GDP_CIRCLE_3PT	Circle: three points on circumference
	GKS$K_GDP_CIRCLE_CTR_RAD	Circle: center and radius
	GKS$K_GDP_CIRCLE_2PT_RAD	Circle: two points on circumference, and radius
	GKS$K_GDP_ARC_CTR_2PT	Arc: center and two points on arc
	GKS$K_GDP_ARC_3PT	Arc: three points on circumference
	GKS$K_GDP_ARC_CTR_2VEC_RAD	Arc: center, two vectors, and a radius
	GKS$K_GDP_ARC_2PT_RAD	Arc: two points on arc and radius
	GKS$K_GDP_ARC_CTR_PT_ANG	Arc: center, starting point, and angle
	GKS$K_GDP_ELLIPSE_CTR_AXES	Ellipse: center, and two axis vectors
	GKS$K_GDP_ELLIPSE_FOCII_PT	Ellipse: focal points and point on circumference

Defined Argument	Constant	Description
	GKS$K_GDP_ELIARC_CTR_AXES_2VEC	Elliptic arc: center, two axis vectors, and two vectors
	GKS$K_GDP_ELIARC_FOCII_2PT	Elliptic arc: focal points and two points on circumference
	GKS$K_GDP_RECT_2PT	Rectangle: two corners
	GKS$K_GDP_FILL_AREA_SET	Fill area set
	GKS$K_GDP_FCIRCLE_CTR_PT	Filled circle: center and point on circumference
	GKS$K_GDP_FCIRCLE_3PT	Filled circle: three points on circumference
	GKS$K_GDP_FCIRCLE_CTR_RAD	Filled circle: center and radius
	GKS$K_GDP_FCIRCLE_2PT_RAD	Filled circle: two points on circumference, and radius
	GKS$K_GDP_FARC_CTR_2PT	Filled arc: center and two points on arc
	GKS$K_GDP_FARC_3PT	Filled arc: three points on circumference
	GKS$K_GDP_FARC_CTR_2VEC_RAD	Filled arc: center, two vectors, and a radius
	GKS$K_GDP_FARC_2PT_RAD	Filled arc: two points on arc, and radius
	GKS$K_GDP_FARC_CTR_PT_ANG	Filled arc: center, starting point, and angle
	GKS$K_GDP_FELLIPSE_CTR_AXES	Filled ellipse: center, and two axis vectors
	GKS$K_GDP_FELLIPSE_FOCII_PT	Filled ellipse: focal points and point on circumference
	GKS$K_GDP_FELIARC_CTR_AXES_2VEC	Filled elliptic arc: center, two axis vectors, and two vectors
	GKS$K_GDP_FELIARC_FOCII_2PT	Filled elliptic arc: focal points and two points on circumference
	GKS$K_GDP_FRECT_2PT	Filled rectangle: two corners
	GKS$K_GDP_IMAGE_ARRAY	Packed cell array

Description

The GENERALIZED DRAWING PRIMITIVE function generates a generalized drawing primitive (GDP) of the type you specify, using specified points and any additional information contained in a data record.

A GDP is a device-specific primitive that is not supported as a primitive by GKS. For example, using DEC GKS, you can pass a center WC point and a perimeter WC point to this function, and the specified workstation that supports such a GDP draws a circle on the workstation surface.

The definition of the particular GDP primitive specifies which sets of attributes the workstation uses to generate the primitive. For example, the GDPs that generate circles use the set of polyline attributes.

Depending on the workstation-dependent requirements of the GDP, DEC GKS may or may not generate the primitive if certain points fall outside the current workstation window. If a workstation cannot generate a GDP because points fall outside of the current workstation window, DEC GKS generates an error message.

For more information on GDPs, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SIZEOF
Example 5–2 for a program example using the GENERALIZED DRAWING PRIMITIVE function

POLYLINE

Operating States

WSAC, SGOP

Syntax

gks$polyline (num_points, x_points, y_points)

Argument	Data Type	Access	Passed by	Description
num_points	Integer	Read	Reference	Number of points
x_points	Array of reals	Read	Reference	X coordinates in WC values
y_points	Array of reals	Read	Reference	Y coordinates in WC values

Description

The POLYLINE function draws one or more straight lines, connecting the WC points passed to this function in the order specified. By default, this function draws line segments as solid lines, at the nominal width, in the foreground color.

See Also

SET LINETYPE
SET LINEWIDTH SCALE FACTOR
SET PICK IDENTIFIER
SET POLYLINE COLOUR INDEX
Example 6–3 for a program example using the POLYLINE function

POLYMARKER

Operating States

WSAC, SGOP

Syntax

gks$polymarker (num_points, x_points, y_points)

Argument	Data Type	Access	Passed by	Description
num_points	Integer	Read	Reference	Number of points
x_points	Array of reals	Read	Reference	X coordinates in WC values
y_points	Array of reals	Read	Reference	Y coordinates in WC values

Description

The POLYMARKER function places one or more special symbols called polymarkers at the specified WC points. By default, this function produces an asterisk polymarker, at the nominal size, in the workstation-specific default foreground color.

If clipping is enabled, and if the polymarker coordinate point is outside of the clipping rectangle, DEC GKS clips the entire polymarker. If clipping is enabled, if the polymarker coordinate point is inside of the clipping rectangle, and if portions of the polymarker exceed the boundaries of the clipping rectangle, the extent of the clipping is device dependent.

See Also

SET MARKER SIZE SCALE FACTOR
SET MARKER TYPE
SET PICK IDENTIFIER
SET POLYMARKER COLOUR INDEX
Example 6–4 for a program example using the POLYMARKER function

TEXT

Operating States

WSAC, SGOP

Syntax

gks$text (x_point, y_point, text_string)

Argument	Data Type	Access	Passed by	Description
x_point	Real	Read	Reference	X starting position in WC points
y_point	Real	Read	Reference	Y starting position in WC points
text_string	Character string	Read	Descriptor	Text string

Description

The TEXT function writes a character string that DEC GKS positions according to the specified WC point and the current text attributes.

Depending on the current text attributes, DEC GKS positions the first character, the last character, or the middle of the text string at this WC point. By default, DEC GKS positions the first character in the string at this point and writes subsequent characters to the right of the starting point.

The shape of the characters within the text string may vary depending on the current text attributes, the current normalization transformation, and the particular workstation capabilities.

There are text attributes that control the nongeometric text properties (text font and precision, character expansion factor, character spacing, and text color index) and the geometric text properties (character height, character up vector, character path, and character alignment).

The portion of the string that DEC GKS clips depends on both the current text attributes and the workstation capabilities as follows:

- String precision: The string is clipped in a workstation-dependent manner.
- Character precision: The string is clipped character by character.
- Stroke precision: The string is clipped exactly at the normalization viewport.

See Also

SET CHARACTER EXPANSION FACTOR
SET CHARACTER HEIGHT
SET CHARACTER SPACING
SET CHARACTER UP VECTOR
SET PICK IDENTIFIER
SET TEXT ALIGNMENT
SET TEXT COLOUR INDEX
SET TEXT FONT AND PRECISION
SET TEXT PATH
Example 6–4 for a program example using the TEXT function

5.7 Program Examples

Example 5–1 illustrates the use of the CELL ARRAY function.

Example 5–1 Cell Array Output

```
/*
 *  This code example draws alternating white and black vertical stripes
 *  using the CELL ARRAY function.
 *
 *  NOTE: To keep the example concise, no error checking is performed.
 */

# include <stdio.h>

# include <gksdescrip.h>      /* GKS descriptor file */
# include <gksdefs.h>         /* GKS$ binding definition file */

# define XDIM 10
# define YDIM 1

main()
{
   int    colia[XDIM][YDIM];
   int    default_conid;
   int    default_wstype;
   int    defer_mode;
   int    device_num;
   float  diag_x;
   float  diag_y;
   int    i;
   int    input_class;
   int    input_status;
   float  loc_x;
   float  loc_y;
   int    num_ydim;
   int    num_xdim;
   int    offset_x;
   int    offset_y;
   int    regen_mode;
   float  start_x;
   float  start_y;
   float  timeout;
   int    update_flag;
   int    ws_id;
   int    xform;

/*
 *  Set up the color 2D array descriptor. See gksdescrip.h for more
 *  information.
 */

# define   DIMCT  2
```

(continued on next page)

Example 5–1 (Cont.) Cell Array Output

```
    struct
      {
      struct  dsc$descriptor_a dsc;
      char   *dsc$a_a0;
      long    dsc$l_m [DIMCT];
      struct
        {
        long  dsc$l_l;  /* Lower bound */
        long  dsc$l_u;  /* Upper bound */
        } dsc$bounds [DIMCT];
    } colia_d;

/*
 *  Initialize the color array descriptor.
 *
 *  An alternate coding method is to use the macro INIT_CC_INT_2DARRAY, which
 *  is defined in gksdescrip.h.  The syntax is as follows:
 *  INIT_CC_INT_2DARRAY (colia_d, colia, XDIM, YDIM)
 *  See gksdescrip.h for more information on the descriptor elements.
 */

    colia_d.dsc.dsc$w_length       = sizeof(int);
    colia_d.dsc.dsc$b_dtype        = DSC$K_DTYPE_L;
    colia_d.dsc.dsc$b_class        = DSC$K_CLASS_A;
    colia_d.dsc.dsc$a_pointer      = (char *)colia;
    *(char *)&colia_d.dsc.dsc$b_aflags = 0;
    *(char *)&colia_d.dsc.dsc$b_aflags =
                           (0<<4) | (0<<5) | (1<<6) | (1<<7);
    colia_d.dsc.dsc$b_dimct        = 2;
    colia_d.dsc.dsc$l_arsize       = XDIM * YDIM * sizeof(int);
    colia_d.dsc$a_a0               = (char *)colia;
    colia_d.dsc$l_m[0]             = XDIM;
    colia_d.dsc$l_m[1]             = YDIM;
    colia_d.dsc$bounds[0].dsc$l_l  = 0;
    colia_d.dsc$bounds[0].dsc$l_u  = XDIM-1;
    colia_d.dsc$bounds[1].dsc$l_l  = 0;
    colia_d.dsc$bounds[1].dsc$l_u  = YDIM-1;

/*  Initialize the color index array. */

    for (i = 0; i < 10; i += 2)
      {
      colia[i][0]   = 0;
      colia[i+1][0] = 1;
      }

/*  Open the GKS and workstation environments. */

    default_conid    = GKS$K_CONID_DEFAULT;
    default_wstype   = GKS$K_WSTYPE_DEFAULT;
    defer_mode       = GKS$K_ASAP;
    regen_mode       = GKS$K_IRG_ALLOWED;
    ws_id = 1;

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &default_wstype);
    gks$activate_ws (&ws_id);
    gks$set_defer_state (&ws_id, &defer_mode, &regen_mode);
```

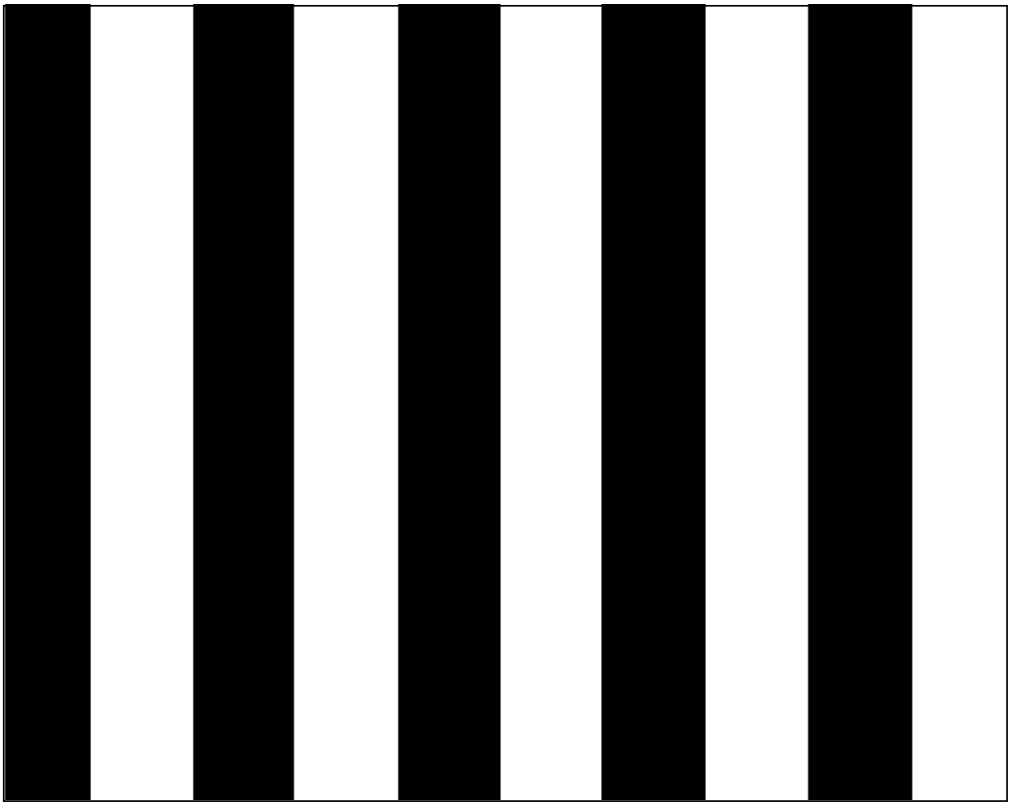
(continued on next page)

Example 5–1 (Cont.) Cell Array Output

```
/*  Draw the stripes. Wait 5 seconds. */

    diag_x       = 1.0;
    diag_y       = 1.0;
    num_xdim     = XDIM;
    num_ydim     = YDIM;
    offset_x     = 0;
    offset_y     = 0;
    start_x      = 0.0;
    start_y      = 0.0;
    timeout      = 5.0;
    update_flag  = GKS$K_POSTPONE_FLAG;

    gks$cell_array (&start_x, &start_y, &diag_x, &diag_y, &offset_x,
       &offset_y, &num_xdim, &num_ydim, &colia_d);
    gks$update_ws (&ws_id, &update_flag);
    gks$await_event (&timeout, &ws_id, &input_class, &device_num);

/*  Release the GKS and workstation environments. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();
}
```

Figure 5–1 shows the program's effect on a VAXstation workstation running DECwindows software.

Figure 5–1 Cell Array Output



ZK–4015A–GE

Example 5–2 illustrates the use of the GENERALIZED DRAWING PRIMITIVE function.

Example 5–2 Generalized Drawing Primitive Output

```
/*
 *  This program creates an unfilled circle using the GDP
 *  GKS$K_GDP_CIRCLE_3PT (-102).
 *
 *  NOTE: To keep the example concise, no error checking is performed.
 */

# include <stdio.h>

# include <gksdescrip.h>       /* GKS descriptor file */
# include <gksdefs.h>          /* GKS$ binding definition file */
```

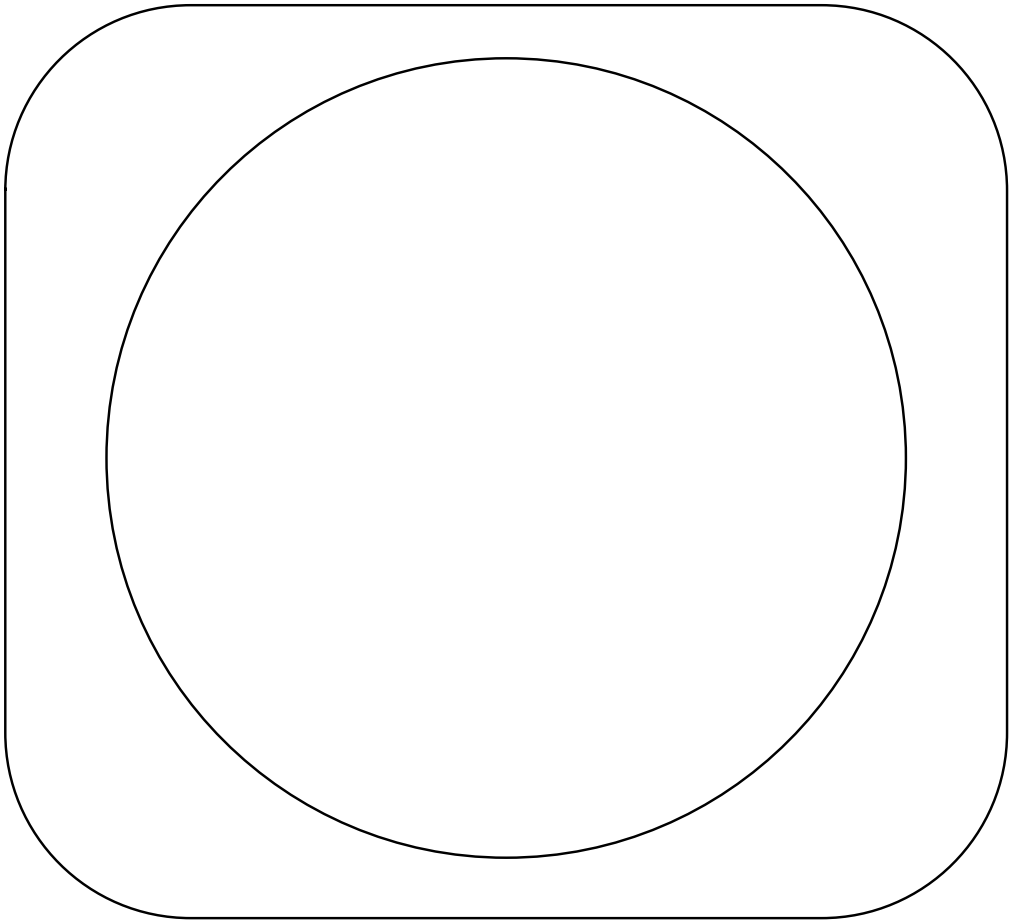
(continued on next page)

Example 5–2 (Cont.) Generalized Drawing Primitive Output

```
main()
{
    int   data_record[1];
    int   default_conid;
    int   default_wstype;
    int   device_num;
    int   gdp_id;
    int   input_class;
    int   num_points    = 3;
    float px[3];
    float py[3];
    int   record_size   = 0;
    float timeout       = 5.00;
    int   update_flag;
    int   ws_id         = 1;

/*  Open the GKS and workstation environments. */

    default_conid  = GKS$K_CONID_DEFAULT;
    default_wstype = GKS$K_WSTYPE_DEFAULT;

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &default_wstype);
    gks$activate_ws (&ws_id);

/*  Specify the points that define the circle. */

    px[0] = 0.1;   py[0] = 0.5;
    px[1] = 0.5;   py[1] = 0.1;
    px[2] = 0.9;   py[2] = 0.5;

/*
 *  The constant GKS$K_GDP_CIRCLE_3PT specifies the GDP identification
 *  number -102.  This GDP creates a circle using three points on a circle's
 *  circumference.  This particular GDP does not require a data record to
 *  perform its task.  Notice that DEC GKS uses the current polyline
 *  attributes to create the circle.
 */

    gdp_id      = GKS$K_GDP_CIRCLE_3PT;
    update_flag = GKS$K_PERFORM_FLAG;

    gks$gdp (&num_points, px, py, &gdp_id, data_record,
       &record_size);
    gks$update_ws (&ws_id, &update_flag);
    gks$await_event (&timeout, &ws_id, &input_class, &device_num);

/*  Release the GKS and workstation environments. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks();
}
```

Figure 5–2 shows the program's effect on a VAXstation workstation running DECwindows software.

Figure 5–2 Generalized Drawing Primitive Output



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Attribute Functions

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6
Attribute Functions

The DEC GKS attribute functions affect the appearance of generated output primitives.

The GKS state list stores the current value of the attributes for each output function. These attributes specify the exact appearance of the object drawn. For example, when you call POLYLINE, the attributes line type, width scale factor, and color specify the form, thickness, and color of the line. In the GKS state list, these current attributes are stored in the entries *current line type*, *current line width scale factor*, and *current polyline color index*.

When you call a DEC GKS output function, the attributes are bound to the primitive. If the primitive's attributes are *individual*, then you cannot change these attributes; changes to attributes only affect subsequent output. If the primitive's attributes are *bundled*, then you may be able to change the attributes of previously generated primitives by calling one of the representation functions, depending on the capabilities of your device. See Section 6.2 for more information concerning individual and bundled attributes.

6.1 Types of Attributes

Attributes can affect **geometric**, **nongeometric**, **viewing**, and **pick identification** aspects of a graphic image. The geometric, nongeometric, and viewing aspects of a graphic image directly affect how the primitive appears on the workstation surface. The viewing attributes are the view index and the HLHSR identifier. The view index is a pointer to a workstation view table entry. The HLHSR identifier provides hidden line and hidden surface information about the primitive. For more information on viewing, see Chapter 7. The pick identification attribute is used to identify a primitive, or group of primitives, in a segment when that segment is picked. For complete details concerning pick input, see Chapter 9.

Most output functions have nongeometric attributes that are changeable. Nongeometric attributes affect the style and the pattern of the output primitives (such as polyline color, text spacing, and fill area interior style). Because the nongeometric attributes are scale factors and **nominal** sizes, the effects of these attributes are device dependent.

Nominal sizes are the default sizes of markers and line widths as defined by a graphics handler. In most cases the nominal size is also the smallest size that a workstation can produce, but not always. DEC GKS multiplies the scale factor values by the nominal size to reset a marker size or polyline width. The default value for a scale factor is 1.0 (the nominal size multiplied by the value 1.0, producing no change in size).

Geometric attributes affect the size or positioning of text, fill area, and fill area set primitives (such as text height, character path, and pattern size). Text, fill area, and fill area set are the only output primitives that have changeable geometric attributes. The geometric attributes are specified in world coordinate (WC) units. Therefore, because the WC units are device independent, the geometric attributes are device independent.

Table 6–1 lists the attributes and whether an attribute is geometric or nongeometric.

Table 6–1 Geometric and Nongeometric Attributes

Function	Attribute	Type
Polyline	Polyline index	Nongeometric
	Line type	Nongeometric
	Line width scale factor	Nongeometric
	Polyline color index	Nongeometric
Polymarker	Polymarker index	Nongeometric
	Marker type	Nongeometric
	Marker size scale factor	Nongeometric
	Polymarker color index	Nongeometric
Text	Text index	Nongeometric
	Text font and precision	Nongeometric
	Character expansion factor	Nongeometric
	Character spacing	Nongeometric
	Text color index	Nongeometric
	Character height	Geometric
	Character up vector	Geometric
	Text path	Geometric
	Text alignment	Geometric
Fill area	Fill area index	Nongeometric
	Fill area interior style	Nongeometric
	Fill area style index	Nongeometric
	Fill area color index	Nongeometric
	Pattern size	Geometric
	Pattern reference point and vectors	Geometric

Notice that there are no geometric or nongeometric attribute functions specifically designed to alter the cell array or the generalized drawing primitives (GDPs). A cell array is simply an array of indexes that point to the workstation's color table.

The GDP has no geometric or nongeometric attributes specifically designed for it. Depending on the workstation-specific GDP data record, you may need to specify any number of the polyline, polymarker, text, or fill area attribute values, depending on the nature of the GDP.

6.2 Individual and Bundled Attribute Values

The current values of each attribute are listed individually in the GKS state list. By default, a call to an output function uses these individual attribute values to generate the primitive. Because DEC GKS stores these individual attributes in the GKS state list, they are device independent. If you specify attributes individually, you cannot change a primitive's appearance on the workstation surface once you have generated it.

However, there is a second method used to specify attribute values. Each workstation can define a number of attribute **bundles** for an output primitive. Each bundle is an entry in a table that contains attribute values for each of the nongeometric values of that particular output primitive. DEC GKS stores bundle tables in the workstation state lists, thereby making the bundle table entries device dependent. You specify bundle table entries by specifying a bundle index value that points into the table. Most workstations provide a fill area bundle index 1, but the resulting fill area can look different on each workstation.

For example, a polyline bundle contains table entries for *polyline index*, *line type*, *line width scale factor*, and *polyline color index*. A workstation can define a bundle table entry with the index 1 that specifies a solid line type. The same workstation can define another bundle table entry with the index 2 that specifies a dashed line type. The attributes associated with a bundle table index constitute that index's **representation**.

When you call an output function, DEC GKS uses the current individual output values stored in the GKS state list, by default. If you wish to use the device-dependent bundle table indexes, you must change the attribute's aspect source flag (ASF). The ASFs are described in Section 6.2.1.

If you use bundled attributes for primitives, you can change the appearance of the generated primitive by redefining its bundle index representation. For many workstations, changing index representations requires an implicit regeneration, which erases all primitives not contained in segments. For complete information concerning the representation functions, see Section 6.2.2.

To review the initial individual attributes and the bundle tables available on a given workstation, see Appendix E.

6.2.1 Aspect Source Flags (ASFs)

When you call an output function, DEC GKS uses the individual output attributes by default. To use bundle tables of attributes, you must establish a set of aspect source flags (ASFs).

The set of ASFs is a 13-element integer array, one element for every nongeometric attribute. Each element contains either the value GKS$K_ASF_BUNDLED (0) or the value GKS$K_ASF_INDIVIDUAL (1). By passing this array to the function SET ASPECT SOURCE FLAGS, DEC GKS uses either the individual attribute value or the bundled value in the bundle table specified by the current bundle index.

For a complete description of ASFs, see the SET ASPECT SOURCE FLAGS function description in this chapter.

Note

If you store primitives in a segment and if you want to be able to change the primitive's appearance elsewhere in the program, you must set the primitive's ASF to be GKS$K_ASF_BUNDLED before you generate the primitive. In this way, the primitive's ASF is stored in the segment with the primitive. If you want to change the primitive's appearance, call the appropriate SET REPRESENTATION function (see Section 6.2.2) for the primitive's bundle index. If you store the primitive in a segment using individual attributes, the appearance of the primitive cannot be changed.

6.2.2 Dynamic Changes and Implicit Regeneration

When working with bundled attributes, you can use any bundle index value predefined by your workstation. You can even alter the existing bundles table entries, or create new entries, using the representation functions (SET POLYLINE REPRESENTATION, SET POLYMARKER REPRESENTATION, and so on).

If you use the SET . . . REPRESENTATION functions, use caution. Depending on the capabilities of your workstation, DEC GKS may implement the change immediately, or the change may require an implicit regeneration of the surface. An implicit regeneration clears the screen and only redraws the visible segments. You lose all primitives not contained in segments. Many of the DEC GKS supported workstations suppress implicit regenerations because of the loss of all primitives not contained in segments.

For a detailed description of implicit regeneration, see Chapter 4.

6.3 Foreground and Background Colors

The default color index value is 1, which corresponds to the workstation's foreground color. All the default individual color indexes in the GKS state list are set to the value 1.

On an OUTIN or OUTPUT workstation, the color of a "blank" surface is called the background color. The color of characters written to the workstation surface is called the foreground color.

Unless you change these color index values using the function SET COLOUR REPRESENTATION, the color index value 0 corresponds to the workstation's background color, and the color index value 1 corresponds to the workstation's default foreground color. If the workstation supports more than two color indexes, values greater than 1 correspond to alternative foreground colors.

6.4 Attribute Inquiries

The following list presents the inquiry functions that you can use to obtain attribute information when writing device-independent code:

INQUIRE COLOUR FACILITIES
INQUIRE COLOUR REPRESENTATION
INQUIRE CURRENT INDIVIDUAL ATTRIBUTE VALUES
INQUIRE CURRENT PRIMITIVE ATTRIBUTE VALUES

INQUIRE FILL AREA FACILITIES
INQUIRE FILL AREA REPRESENTATION
INQUIRE LIST OF COLOUR INDICES
INQUIRE LIST OF FILL AREA INDICES
INQUIRE LIST OF PATTERN INDICES
INQUIRE LIST OF POLYLINE INDICES
INQUIRE LIST OF POLYMARKER INDICES
INQUIRE LIST OF TEXT INDICES
INQUIRE MAXIMUM LENGTH OF WORKSTATION STATE TABLES
INQUIRE PATTERN FACILITIES
INQUIRE PATTERN REPRESENTATION
INQUIRE POLYLINE FACILITIES
INQUIRE POLYLINE REPRESENTATION
INQUIRE POLYMARKER FACILITIES
INQUIRE POLYMARKER REPRESENTATION
INQUIRE PREDEFINED COLOUR REPRESENTATION
INQUIRE PREDEFINED FILL AREA REPRESENTATION
INQUIRE PREDEFINED PATTERN REPRESENTATION
INQUIRE PREDEFINED POLYLINE REPRESENTATION
INQUIRE PREDEFINED POLYMARKER REPRESENTATION
INQUIRE PREDEFINED TEXT REPRESENTATION
INQUIRE SET OF OPEN WORKSTATIONS
INQUIRE TEXT FACILITIES
INQUIRE TEXT REPRESENTATION

For more information concerning device-independent programming, see the *DEC GKS User's Guide*.

6.5 Function Descriptions

This section describes the DEC GKS attribute functions in detail.

SET ASPECT SOURCE FLAGS

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_asf (flags)

Argument	Data Type	Access	Passed by	Description
flags	Array of integers	Read	Reference	Aspect source flags

Constants

Defined Argument	Constant	Description
flags	GKS$K_ASF_BUNDLED	Bundled attributes.
	GKS$K_ASF_INDIVIDUAL	Individual attributes. This is the default value.

Description

The SET ASPECT SOURCE FLAGS function specifies to DEC GKS whether to use the bundled or the individual method for designating each of the nongeometric output attributes.

There are 13 nongeometric ASFs. These flags are as follows:

1. Polyline type
2. Polyline width
3. Polyline color
4. Polymarker type
5. Polymarker size
6. Polymarker color
7. Text font and precision
8. Character expansion
9. Character spacing
10. Text color
11. Fill area interior style
12. Fill area style index
13. Fill area color

If the value in the corresponding element is GKS$K_ASF_INDIVIDUAL, DEC GKS uses the individual attribute setting. If the value in the corresponding element is GKS$K_ASF_BUNDLED, DEC GKS uses the bundle table index to find the attribute setting.

The initial value for each ASF is GKS$K_ASF_INDIVIDUAL, which causes the output functions to use the current individual value for each nongeometric attribute. Remember that when specified individually, attributes are workstation-independent; when specified as a bundle, the attributes are workstation-dependent. For example, most workstations provide a fill area bundle index 1, but the resulting fill area can look different on each workstation. For more information concerning the bundle table indexes available for your workstation, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET FILL AREA INDEX
SET POLYLINE INDEX
SET POLYMARKER INDEX
SET TEXT INDEX
Example 6–2 for a program example using the SET ASPECT SOURCE FLAGS function

SET CHARACTER EXPANSION FACTOR

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_expfac (exp_fac)

Argument	Data Type	Access	Passed by	Description
exp_fac	Real	Read	Reference	Character expansion factor

Description

The SET CHARACTER EXPANSION FACTOR function sets the *current character expansion factor* entry in the GKS state list to the specified value. This function alters the width of the generated characters, but not the height. The character expansion factor is multiplied by the width-to-height ratio specified in the original font specification to give the new character width.

The default for the current character expansion factor is the value 1.0, which displays text using the width-to-height ratio specified in the font design.

When DEC GKS calculates the character width using the default character height, the resulting text string is legible. However, certain normalization transformations distort the text. You can use either the SET CHARACTER EXPANSION FACTOR function or the SET CHARACTER HEIGHT function to reestablish a legible character width.

See Also

SET ASPECT SOURCE FLAGS
SET CHARACTER HEIGHT
SET CHARACTER SPACING
SET TEXT INDEX
SET TEXT REPRESENTATION
TEXT

SET CHARACTER HEIGHT

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_height (height)

Argument	Data Type	Access	Passed by	Description
height	Real	Read	Reference	Character height in WC units

Description

The SET CHARACTER HEIGHT function sets the geometric attribute, *current character height* entry in the GKS state list to the specified WC unit value.

DEC GKS uses the value specified in the call to SET CHARACTER HEIGHT for all subsequent calls to TEXT until you specify another value. If you specify a new height to this function, DEC GKS expands text output to the closest height the workstation is capable of producing. The default for the current text height is the WC unit value 0.01. This is 0.01 of the default normalization window height (1.0). Exercise caution if you change the size of the current normalization window, as you may also have to readjust the character height.

Also remember that changing the text height automatically changes the character expansion factor and the character spacing, in proportion to the text height adjustment.

See Also

SELECT NORMALIZATION TRANSFORMATION
SET WINDOW
Example 6–4 for a program example using the SET CHARACTER HEIGHT function

SET CHARACTER SPACING

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_spacing (space_percent)

Argument	Data Type	Access	Passed by	Description
space_ percent	Real	Read	Reference	Character spacing factor. The default value is 0.0.

Description

The SET CHARACTER SPACING function sets the *current text spacing* entry in the GKS state list to the specified value.

DEC GKS measures the spacing between characters as a fraction of the character height; adjusting character height automatically adjusts spacing proportionately. The character spacing value 0.0 places the character bodies next to each other without any separating space contained in the font specification for the letter bodies. Whether the characters actually touch depends on the type of font you are using. Positive spacing values increase the space between characters; negative values decrease the space. Using negative spacing values, it is possible to overlap characters, or to actually reverse the text so that characters are written in the opposite direction.

See Also

SET ASPECT SOURCE FLAGS
SET TEXT FONT AND PRECISION
SET TEXT INDEX
SET TEXT REPRESENTATION
TEXT

SET CHARACTER UP VECTOR

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_upvec (x_vector, y_vector)

Argument	Data Type	Access	Passed by	Description
x_vector	Real	Read	Reference	Horizontal component of the slope of the character up vector. The default value is 0.0.
y_vector	Real	Read	Reference	Vertical component of the slope of the up character vector. The default value is 1.0.

Description

The SET CHARACTER UP VECTOR function sets the geometric attribute, *current character up vector* entry in the GKS state list to the specified value.

DEC GKS uses the value specified in the call to SET CHARACTER UP VECTOR for all subsequent calls to TEXT until you specify another value. When you call TEXT, you specify the starting point for the text. To establish an imaginary line on which to output text, you must establish an upward direction. Once an upward direction has been established, DEC GKS draws an imaginary line perpendicular to this upward direction that runs through the starting point. This perpendicular line is the imaginary line on which you can output text, by positioning the text extent rectangle.

You specify the upward direction for character placement as a directional vector. The vector begins at the starting point and proceeds in the direction of the *current character up vector* entry. You establish the character up vector by specifying a slope for the line.

For example, if you specify the WC unit values (1.0, 1.0) as the character up vector, the up direction for the display of text follows the line passing from the starting point to the point one point above and one point to the right of the starting point. This would correspond to a 45-degree angle of rotation. Specifying the values (200.0, 200.0), or the values (5.0, 5.0), is equivalent to specifying (1.0, 1.0).

The initial value for the *current character up vector* entry is (0.0, 1.0), which orients text perpendicular to the X axis and parallel to the Y axis, if the current character path is RIGHT or LEFT.

See Also

SET CHARACTER HEIGHT
SET TEXT PATH

SET COLOUR REPRESENTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_color_rep (ws_id, color_ind, red_inten, green_inten, blue_inten)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
color_ind	Integer	Read	Reference	Color index
red_inten	Real	Read	Reference	Red intensity
green_inten	Real	Read	Reference	Green intensity
blue_inten	Real	Read	Reference	Blue intensity

Description

The SET COLOUR REPRESENTATION function allows the user to redefine an existing color index representation, or to define a new representation, by specifying the RGB color triplet associated with a specified bundle index. The workstation maps the color you specify to the nearest available color the workstation can produce. The triplet component values must be in the range 0.0 to 1.0.

All workstations define default color table entry indexes 0 and 1. By default, the value 0 corresponds to the default background color (the color of an empty display surface), and the value 1 corresponds to the default foreground color. Values greater than 1 correspond to alternative foreground colors.

Depending on the capabilities of your workstation, a call to this function may cause DEC GKS to implicitly regenerate the workstation surface.

Attribute values passed to this function must be valid for the specified workstation. For more information concerning device-specific attributes, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

INQUIRE COLOUR FACILITIES
INQUIRE COLOUR REPRESENTATION
Example 6–1 for a program example using the SET COLOUR REPRESENTATION function

SET FILL AREA COLOUR INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_fill_color_index (color_ind)

Argument	Data Type	Access	Passed by	Description
color_ind	Integer	Read	Reference	Color index. The default value is 1.

Description

The SET FILL AREA COLOUR INDEX function sets the *current fill area color index* entry in the GKS state list to the specified index value. The specified index value is used for the display of subsequent FILL AREA output primitives, created when the current fill area color index ASF is INDIVIDUAL. This value does not affect the display of subsequent FILL AREA output primitives, created when the current fill area color index ASF is BUNDLED.

If the specified color index is not present in a workstation color table, a workstation-dependent color index is used on that workstation.

See Also

SET ASPECT SOURCE FLAGS
SET COLOUR REPRESENTATION
SET FILL AREA INDEX
SET FILL AREA REPRESENTATION
Example 6–1 for a program example using the SET FILL AREA COLOUR INDEX function

SET FILL AREA INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_fill_index (index)

Argument	Data Type	Access	Passed by	Description
index	Integer	Read	Reference	Fill area bundle index. The default value is 1.

Description

The SET FILL AREA INDEX function establishes the index value pointing into the fill area bundle table. This table contains entries for the attribute values, fill area interior style, fill area style index, and fill area color index. When calling the SET FILL AREA INDEX function, DEC GKS uses the bundle table only if the corresponding ASF has been set to BUNDLED.

See Also

SET ASPECT SOURCE FLAGS
SET FILL AREA REPRESENTATION
Example 6–2 for a program example using the SET FILL AREA INDEX function

SET FILL AREA INTERIOR STYLE

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_fill_int_style (int_style)

Argument	Data Type	Access	Passed by	Description
int_style	Integer (constant)	Read	Reference	Fill area interior style

Constants

Defined Argument	Constant	Description
int_style	GKS$K_INTSTYLE_HOLLOW	Interior style hollow. This is the default value.
	GKS$K_INTSTYLE_SOLID	Interior style solid.
	GKS$K_INTSTYLE_PATTERN	Interior style pattern.
	GKS$K_INTSTYLE_HATCH	Interior style hatch.

Description

The SET FILL AREA INTERIOR STYLE function sets the *current fill area interior style* entry in the GKS state list to be hollow, solid, pattern, or hatched. If you set the fill area interior style to SOLID, the FILL AREA function fills the color designated by the current fill area color index.

If you select pattern, the FILL AREA function replicates a pattern (alternating colors) to fill the interior of the polygon. The fill area attributes, pattern size, and pattern reference point define the size and position of the start of the pattern (see the SET PATTERN SIZE and the SET PATTERN REFERENCE POINT functions). The fill area style index specifies the pattern to replicate (see the SET FILL AREA STYLE INDEX function). Patterns cover underlying primitives.

If you select hatched, the FILL AREA function fills the interior of the polygon with a series of parallel or cross-hatch lines in the color specified by the fill area color index. The fill area style index specifies the chosen hatch style. The space between the parallel or cross-hatch lines is transparent.

See the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS* for information on the hatch patterns available on your device.

See Also

FILL AREA
SET ASPECT SOURCE FLAGS
SET FILL AREA INDEX
SET FILL AREA REPRESENTATION
SET FILL AREA STYLE INDEX
SET PATTERN REFERENCE POINT
SET PATTERN SIZE
Example 6–1 for a program example using the SET FILL AREA INTERIOR STYLE function

SET FILL AREA REPRESENTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_fill_rep (ws_id, fill_ind, int_style, style_ind, color_ind)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
fill_ind	Integer	Read	Reference	Fill area index value
int_style	Integer (constant)	Read	Reference	Interior style
style_ind	Integer	Read	Reference	Fill area style index
color_ind	Integer	Read	Reference	Fill area color index

Constants

Defined Argument	Constant	Description
int_style	GKS$K_INTSTYLE_HOLLOW	Interior style hollow. This is the default value.
	GKS$K_INTSTYLE_SOLID	Interior style solid.
	GKS$K_INTSTYLE_PATTERN	Interior style pattern.
	GKS$K_INTSTYLE_HATCH	Interior style hatch.

Description

The SET FILL AREA REPRESENTATION function allows the user to redefine an existing fill area bundle table index representation, or to define a new fill area bundle table index value, by specifying the fill area interior style, fill area style index value, and fill area color index associated with the specified bundle index.

Depending on the capabilities of your workstation, a call to the SET FILL AREA REPRESENTATION function may cause DEC GKS to implicitly regenerate the workstation surface.

Attribute values passed to this function must be valid for the specified workstation. For more information concerning device-specific attributes, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET ASPECT SOURCE FLAGS
SET FILL AREA INDEX
SET FILL AREA INTERIOR STYLE
Example 6–2 for a program example using the SET FILL AREA REPRESENTATION function

SET FILL AREA STYLE INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_fill_style_index (style_ind)

Argument	Data Type	Access	Passed by	Description
style_ind	Integer	Read	Reference	Fill area style index. The default is 1.

Description

The SET FILL AREA STYLE INDEX function sets the *current fill area style index* entry in the GKS state list to the specified index value.

If the interior style is hollow or solid, the current style index is ignored for the call to FILL AREA. If the interior style is pattern, you must pass a pattern index value to this function. If the interior style is hatch, you must pass a hatch style value to this function. For device-dependent hatch styles, the hatch style index is always a negative number.

If the requested style index is not available on the specified workstation, the workstation uses the style index 1. If style index 1 is not present on the workstation, the resulting output is workstation dependent.

See Also

SET ASPECT SOURCE FLAGS
SET FILL AREA INDEX
SET FILL AREA INTERIOR STYLE
SET FILL AREA REPRESENTATION
SET PATTERN REFERENCE POINT
SET PATTERN REPRESENTATION
SET PATTERN SIZE

SET LINETYPE

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pline_linetype (line_type)

Argument	Data Type	Access	Passed by	Description
line_type	Integer (constant)	Read	Reference	Line type

Constants

Defined Argument	Constant	Description
line_type	GKS$K_LINETYPE_SOLID	Line type solid. This is the default value.
	GKS$K_LINETYPE_DASHED	Line type dashed.
	GKS$K_LINETYPE_DOTTED	Line type dotted.
	GKS$K_LINETYPE_DASHED_DOTTED	Line type dashed-dotted.

Note

Other, nonstandard, polyline types are available. See Appendix B.

Description

The SET LINETYPE function sets the *current polyline type* entry in the GKS state list to solid, dashed, dotted, dashed-dotted, or any one of the device-dependent types.

Every workstation capable of output (DEC GKS workstation category OUTPUT or OUTIN) defines at least four line types. For more information concerning possible polyline type values, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET POLYLINE REPRESENTATION
Example 6–3 for a program example using the SET LINETYPE function

SET LINEWIDTH SCALE FACTOR

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pline_linewidth (pline_width_sf)

Argument	Data Type	Access	Passed by	Description
pline_width_sf	Real	Read	Reference	Line width scale factor. The default value is 1.0.

Description

The SET LINEWIDTH SCALE FACTOR function sets the *current polyline width scale factor* entry in the GKS state list.

DEC GKS calculates line width as the nominal line width, multiplied by the line width scale factor. The line width scale factor is a real number that you pass to this function. The graphics handler maps the value to the nearest available line width defined by the graphics handler.

SET MARKER SIZE SCALE FACTOR

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pmark_size (marker_size_sf)

Argument	Data Type	Access	Passed by	Description
marker_size_sf	Real	Read	Reference	Polymarker size scale factor. The default value is 1.0.

Description

The SET MARKER SIZE SCALE FACTOR function sets the *current marker size scale factor* entry in the GKS state list to the specified value for all polymarker types.

DEC GKS calculates polymarker size for all types (except the dot polymarker type) as the nominal polymarker size multiplied by the polymarker size scale factor. The polymarker size scale factor is a real number that you pass to this function. The graphics handler maps the value to the nearest available polymarker size defined by the handler. (The dot polymarker type is always the smallest dot that the workstation can produce.)

See Also

POLYMARKER
SET ASPECT SOURCE FLAGS
SET POLYMARKER INDEX
SET POLYMARKER REPRESENTATION

SET MARKER TYPE

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pmark_type (marker_type)

Argument	Data Type	Access	Passed by	Description
marker_type	Integer (constant)	Read	Reference	Polymarker type

Constants

Defined Argument	Constant	Description
marker_type	GKS$K_MARKERTYPE_DOT	Marker type dot.
	GKS$K_MARKERTYPE_PLUS	Marker type plus.
	GKS$K_MARKERTYPE_ ASTERISK	Marker type asterisk. This is the default value.
	GKS$K_MARKERTYPE_CIRCLE	Marker type circle.

Note

Other, nonstandard, marker types are available. See Appendix B.

Description

The SET MARKER TYPE function sets the *current marker type* entry in the GKS state list to be dot, plus sign, asterisk, circle, diagonal cross, or any of the device-dependent types.

Every workstation capable of output (DEC GKS workstation category OUTPUT or OUTIN) defines at least five polymarker types. For more information concerning predefined polymarker type values, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See also

POLYMARKER
SET MARKER SIZE SCALE FACTOR
SET POLYMARKER COLOUR INDEX
SET POLYMARKER INDEX
SET POLYMARKER REPRESENTATION
Example 6–4 for a program example using the SET MARKER TYPE function

SET PATTERN REFERENCE POINT

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pat_ref_pt (x_point, y_point)

Argument	Data Type	Access	Passed by	Description
x_point	Real	Read	Reference	X coordinate of pattern starting in WC values
y_point	Real	Read	Reference	Y coordinate of pattern starting in WC values

Description

The SET PATTERN REFERENCE POINT function sets the geometric attribute, *current pattern reference point* entry in the GKS state list.

The current pattern reference point attribute represents the starting point for a pattern used to fill the designated area. DEC GKS uses this value for all subsequent calls to FILL AREA until you specify another value.

Most of the DEC GKS supported workstations do not fully support this function. They do accept the function call, but do not make any changes to the pattern. For more information concerning patterns, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

FILL AREA
SET FILL AREA INTERIOR STYLE
SET FILL AREA STYLE INDEX
SET PATTERN SIZE

SET PATTERN REPRESENTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_pat_rep (ws_id, pattern_ind, offset_col_num, offset_row_num, num_cols, num_rows, color_ind_arr)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
pattern_ind	Integer	Read	Reference	Pattern bundle table index value
offset_col_num	Integer	Read	Reference	Column offset into color index array
offset_row_num	Integer	Read	Reference	Row offset into color index array
num_cols	Integer	Read	Reference	Number of columns to map from the color index array
num_rows	Integer	Read	Reference	Number of rows to map from the color index array
color_ind_arr	2D array of integers	Read	Descriptor	Array containing color index values

Description

The SET PATTERN REPRESENTATION function allows the user to redefine an existing pattern bundle table index representation, or to define a new pattern bundle table index value, by specifying the number of cells high, the number of cells wide, and an array containing each cell's color index fill area associated with the specified bundle index.

Depending on the capabilities of your workstation, a call to the SET PATTERN REPRESENTATION function may cause DEC GKS to implicitly regenerate the workstation surface.

Attribute values passed to this function must be valid for the specified workstation. For more information concerning device-specific attributes, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

CELL ARRAY
SET FILL AREA INTERIOR STYLE
SET FILL AREA STYLE INDEX
SET PATTERN REFERENCE POINT
SET PATTERN SIZE

SET PATTERN SIZE

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pat_size (pattern_width, pattern_height)

Argument	Data Type	Access	Passed by	Description
pattern_ width	Real	Read	Reference	Pattern width in WC units
pattern_ height	Real	Read	Reference	Pattern height in WC units

Description

The SET PATTERN SIZE function specifies the geometric attribute, *current pattern size* entry in the GKS state list, which is the height and width vectors in WC units.

DEC GKS begins replicating the pattern representation at the pattern reference point, and continues until the polygonal fill area in WC space is full. DEC GKS uses this value for all subsequent calls to FILL AREA until you specify another value.

Most of the DEC GKS supported workstations do not fully support this function. They do accept the function call, but do not make any changes to the pattern. For more information concerning patterns, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

FILL AREA
SET FILL AREA INTERIOR STYLE
SET FILL AREA STYLE INDEX

SET PICK IDENTIFIER

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pick_id (pick_id)

Argument	Data Type	Access	Passed by	Description
pick_id	Integer	Read	Reference	New pick identifier

Description

The SET PICK IDENTIFIER function sets the *current pick identifier* entry in the GKS state list to the specified value. All subsequent output primitives stored in segments are assigned the value specified to the SET PICK IDENTIFIER function, until you change it.

Setting pick identifiers allows you another level of naming sections within segments so that a user can pick portions of a segment without having to pick the whole segment.

Note

DEC GKS continues to recognize the last pick identifier specified, even after you close a segment. If you open another segment, DEC GKS continues to associate the current segment identifier with the newly output images. Consequently, if you specify a pick identifier in one segment, make sure that you set the pick identifier properly when opening another segment.

See Also

GET PICK
REQUEST PICK
SAMPLE PICK
Example 9–2 for a program example using the SET PICK IDENTIFIER function

SET POLYLINE COLOUR INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pline_color_index (color_ind)

Argument	Data Type	Access	Passed by	Description
color_ind	Integer	Read	Reference	Color index. The default value is 1, which designates the default for the foreground color.

Description

The SET POLYLINE COLOUR INDEX function sets the *current polyline color index* entry in the GKS state list to the specified index value. The specified index value is used for the display of subsequent polyline output primitives, created when the current polyline color index ASF is INDIVIDUAL. This value does not affect the display of subsequent polyline output primitives created when the current fill area color index ASF is BUNDLED.

If the specified color index is not present in a workstation color table, a workstation-dependent color index is used on that workstation.

See Also

SET COLOUR REPRESENTATION
Example 6–4 for a program example using a SET . . . COLOUR INDEX function

SET POLYLINE INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pline_index (index)

Argument	Data Type	Access	Passed by	Description
index	Integer	Read	Reference	Polyline index. The default value is 1.

Description

The SET POLYLINE INDEX function establishes the index value pointing into the polyline bundle table.

The polyline bundle table contains entries for the attribute values, polyline color index, polyline type, and polyline width scale factor. When calling this function, DEC GKS uses the bundle table only if the corresponding ASF has been set to BUNDLED.

See Also

SET ASPECT SOURCE FLAGS
SET POLYLINE REPRESENTATION
Example 6–2 for a program example using a SET . . . INDEX function

SET POLYLINE REPRESENTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_pline_rep (ws_id, pline_ind, line_type, pline_width_sf, color_ind)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
pline_ind	Integer	Read	Reference	Polyline bundle table index value
line_type	Integer (constant)	Read	Reference	Line type
pline_width_sf	Real	Read	Reference	Line width scale factor
color_ind	Integer	Read	Reference	Color index

Constants

Defined Argument	Constant	Description
line_type	GKS$K_LINETYPE_SOLID	Line type solid. This is the default value.
	GKS$K_LINETYPE_DASHED	Line type dashed.
	GKS$K_LINETYPE_DOTTED	Line type dotted.
	GKS$K_LINETYPE_DASHED_DOTTED	Line type dashed-dotted.

Note

Other, nonstandard, polyline types are available. See Appendix B.

Description

The SET POLYLINE REPRESENTATION function allows the user to redefine an existing polyline bundle table index representation, or to define a new polyline bundle table index value, by specifying the line type, the line width, and the line color index associated with the specified bundle index.

Depending on the capabilities of your workstation, a call to the SET POLYLINE REPRESENTATION function may cause DEC GKS to implicitly regenerate the workstation surface.

Attribute values passed to this function must be valid for the specified workstation. For more information concerning device-specific attributes, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET ASPECT SOURCE FLAGS
SET LINETYPE
SET LINEWIDTH SCALE FACTOR
SET POLYLINE COLOUR INDEX
Example 6–1 for a program example using a SET . . . REPRESENTATION function

SET POLYMARKER COLOUR INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pmark_color_index (color_ind)

Argument	Data Type	Access	Passed by	Description
color_ind	Integer	Read	Reference	Polymarker color index value. The default value is 1, which designates the default foreground color.

Description

The SET POLYMARKER COLOUR INDEX function sets the *current polymarker color index* entry in the GKS state list to the specified value. The specified index value is used for the display of subsequent polymarker output primitives, created when the current polymarker color index ASF in the GKS state list is INDIVIDUAL. This value does not affect the display of subsequent polymarker output primitives created when the current fill area color index ASF in the GKS state list is BUNDLED.

If the specified color index is not present in a workstation color table, a workstation-dependent color index is used on that workstation.

See Also

SET ASPECT SOURCE FLAGS
SET POLYMARKER INDEX
SET POLYMARKER REPRESENTATION
Example 6–4 for a program example using the SET POLYMARKER COLOUR INDEX function

SET POLYMARKER INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_pmark_index (index)

Argument	Data Type	Access	Passed by	Description
index	Integer	Read	Reference	Polymarker bundle index value. The default value is 1.

Description

The SET POLYMARKER INDEX function establishes the index value pointing into the polymarker bundle table. This table contains entries for the attribute values, polymarker color index, polymarker type, and polymarker size scale factor. When calling the SET POLYMARKER INDEX function, DEC GKS uses the bundle table only if the corresponding ASF has been set to BUNDLED.

See Also

SET ASPECT SOURCE FLAGS
SET POLYMARKER REPRESENTATION
Example 6–2 for a program example using a SET . . . INDEX function

SET POLYMARKER REPRESENTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_pmark_rep (ws_id, pmark_ind, marker_type, marker_size, color_ind)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
pmark_ind	Integer	Read	Reference	Polymarker bundle table index
marker_type	Integer (constant)	Read	Reference	Polymarker type
marker_size	Real	Read	Reference	Polymarker size scale factor
color_ind	Integer	Read	Reference	Polymarker color index

Constants

Defined Argument	Constant	Description
marker_type	GKS$K_MARKERTYPE_DOT	Marker type dot.
	GKS$K_MARKERTYPE_PLUS	Marker type plus.
	GKS$K_MARKERTYPE_ ASTERISK	Marker type asterisk. This is the default value.
	GKS$K_MARKERTYPE_CIRCLE	Marker type circle.

Note

Other, nonstandard, polymarker types are available. See Appendix B.

Description

The SET POLYMARKER REPRESENTATION function allows the user to redefine an existing polymarker bundle table index representation, or to define a new polymarker bundle table index value, by specifying the polymarker type, the polymarker size, and the polymarker color index associated with the specified bundle index.

Depending on the capabilities of your workstation, a call to the SET POLYMARKER REPRESENTATION function may cause DEC GKS to implicitly regenerate the workstation surface.

Attribute values passed to this function must be valid for the specified workstation. For more information concerning device-specific attributes, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET ASPECT SOURCE FLAGS
SET MARKER SIZE SCALE FACTOR
SET MARKER TYPE
SET POLYMARKER COLOUR INDEX
SET POLYMARKER INDEX
Example 6–1 for a program example using a SET . . . REPRESENTATION function

SET TEXT ALIGNMENT

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_align (horizontal, vertical)

Argument	Data Type	Access	Passed by	Description
horizontal	Integer (constant)	Read	Reference	Horizontal alignment
vertical	Integer (constant)	Read	Reference	Vertical alignment

Constants

Defined Argument	Constant	Description
horizontal	GKS$K_TEXT_HALIGN_ NORMAL	Normal horizontal alignment. This is the default value.
	GKS$K_TEXT_HALIGN_LEFT	Left horizontal alignment.
	GKS$K_TEXT_HALIGN_ CENTER	Center horizontal alignment.
	GKS$K_TEXT_HALIGN_RIGHT	Right horizontal alignment.
vertical	GKS$K_TEXT_VALIGN_ NORMAL	Normal vertical alignment. This is the default value.
	GKS$K_TEXT_VALIGN_TOP	Top vertical alignment.
	GKS$K_TEXT_VALIGN_CAP	Cap vertical alignment.
	GKS$K_TEXT_VALIGN_HALF	Half vertical alignment.
	GKS$K_TEXT_VALIGN_BASE	Base vertical alignment.
	GKS$K_TEXT_VALIGN_ BOTTOM	Bottom vertical alignment.

Description

The SET TEXT ALIGNMENT function sets the *current text alignment* entry in the GKS state list to a value that specifies the positioning of the text extent rectangle.

DEC GKS uses the value specified in a call to SET TEXT ALIGNMENT for all subsequent calls to TEXT until you specify another value. Once you have determined the starting point, the text path (see the SET TEXT PATH function), and the character up vector (see the SET CHARACTER UP VECTOR function), you have in effect established an imaginary line running through the starting point, on which to output text. At this point, you can use this function to shift the text extent rectangle along this established line.

The values passed to this function establish the horizontal and vertical position of the text extent rectangle on the imaginary text line. For example, you can position the text extent rectangle horizontally so the starting point is to the left, in the center, or to the right of the text extent rectangle.

Not only can you position the text extent rectangle horizontally along the imaginary text line, but you can also position the rectangle vertically along the same line. For example, you can position the text extent rectangle so the starting point is aligned with the top of the characters in the string, with the cap of the characters, with the half line of the characters, with the base line of the characters, or with the bottom line of the characters.

See Also

SET CHARACTER UP VECTOR
SET TEXT PATH
Example 6–4 for a program example using the SET TEXT ALIGNMENT function

SET TEXT COLOUR INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_color_index (color_ind)

Argument	Data Type	Access	Passed by	Description
color_ind	Integer	Read	Reference	Color index. The default value is 1, which is the default foreground color.

Description

The SET TEXT COLOUR INDEX function sets the *current text color index* entry in the GKS state list to the specified value.

If the current text font ASF is set to INDIVIDUAL, the text color index value is used in subsequent text and text 3 primitives. If the ASF setting is BUNDLED, the value has no effect. If the specified color is not available, a workstation-dependent color is used on that workstation.

See Also

SET COLOUR REPRESENTATION
Example 6–4 for a program example using a SET . . . COLOUR INDEX function

SET TEXT FONT AND PRECISION

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_fontprec (font_val, prec_val)

Argument	Data Type	Access	Passed by	Description
font_val	Integer	Read	Reference	Text font. The default value is 1.
prec_val	Integer (constant)	Read	Reference	Text precision.

Constants

Defined Argument	Constant	Description
prec_val	GKS$K_TEXT_PRECISION_ STRING	String precision. DEC GKS evaluates character height and width attributes only. This is the default precision value.
	GKS$K_TEXT_PRECISION_ CHAR	Character precision. DEC GKS evaluates each character for compliance with all other specified text attributes.
	GKS$K_TEXT_PRECISION_ STROKE	Stroke precision. DEC GKS looks for the exact compliance with all specified text attributes.

Description

The SET TEXT FONT AND PRECISION function sets the *current text font and precision* entry in the GKS state list to the specified value. In calls to this function, the types of fonts available depend on which precision value you pass as an argument. The values, in order of increasing precision, are as follows:

- String
- Character
- Stroke

As the precision value increases, the precision of clipping, character size, character spacing, character expansion factor, and the character up vector all improve.

If you specify string precision and a starting position for the string located outside of the current normalization viewport, a call to this function causes the entire text string to be clipped. If the starting point for the string is located inside of the current normalization viewport, this function may cause the string to be clipped by character or by stroke depending on the capabilities of the workstation.

If you specify character precision, a call to this function causes the text string to be clipped at the current normalization viewport on a character-by-character basis.

If you require string or character precision, you cannot use the DEC GKS software fonts; you can only specify the numbers of the device-dependent fonts available on your particular workstation. For more information concerning the fonts available on a workstation, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

If you specify stroke precision, a call to this function causes the text string to be clipped exactly at the current normalization viewport. This is the highest precision. When using this precision, you may make use of the device-independent fonts that are available on all workstations.

Be aware that all images are clipped at the current workstation window.

Together, text font and precision specify the display quality of text and the speed at which the text is displayed. Typically, use of a software font in stroke precision produces higher-quality character symbols than use of a hardware font in either character or string precision. However, character and string precision use the workstation character generator (if available) to display text, and thus, produce the images somewhat faster than stroke precision. Also, since character and string precision are less precise in the application of the other text attributes (for example, height and width), they require less calculation to represent each character in a text string.

The default value for the *current text font and precision* entry specifies the hardware font number 1, and string precision.

See Also

SET TEXT REPRESENTATION

SET TEXT INDEX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_index (index)

Argument	Data Type	Access	Passed by	Description
index	Integer	Read	Reference	Text bundle index value. The default value is 1.

Description

The SET TEXT INDEX function establishes the index value pointing into the text bundle table. This table contains entries for the attribute values, text font and precision, character expansion factor, character spacing, and text color index. When calling this function, DEC GKS uses the bundle table only if the corresponding ASF has been set to BUNDLED.

See Also

SET ASPECT SOURCE FLAGS
SET TEXT REPRESENTATION
Example 6–2 for a program example using a SET . . . INDEX function

SET TEXT PATH

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_text_path (text_path)

Argument	Data Type	Access	Passed by	Description
text_path	Integer (constant)	Read	Reference	Text path

Constants

Defined Argument	Constant	Description
text_path	GKS$K_TEXT_PATH_RIGHT	Text string reads from left to right. This is the default value.
	GKS$K_TEXT_PATH_LEFT	Text string reads from right to left.
	GKS$K_TEXT_PATH_UP	Text string reads from bottom to top.
	GKS$K_TEXT_PATH_DOWN	Text string reads from top to bottom.

Description

The SET TEXT PATH function sets the geometric attribute, *current text path* entry in the GKS state list to be the writing direction for the display of text.

DEC GKS uses the value specified in a call to SET TEXT PATH for all subsequent calls to TEXT until you specify another value. Once you have determined the starting point and the character up vector (see the SET CHARACTER UP VECTOR function), you have in effect established an imaginary line running through the starting point to use when generating text primitives. You can output your text string with your aligned letter at the starting point (see the SET TEXT ALIGNMENT function). According to the current text path, the string reads either to the right along the imaginary line (the default), to the left along the imaginary line, upwards in a perpendicular direction from the imaginary line, or downwards in a perpendicular direction from the imaginary line.

If using the default text alignment (see the SET TEXT ALIGNMENT function), DEC GKS places the first letter of this string at the starting point, and subsequent letters are written along the imaginary line in the direction specified by a call to this function. The default text path is left to right along the imaginary line (text path RIGHT).

See Also

SET CHARACTER UP VECTOR
SET TEXT ALIGNMENT
Example 6–4 for a program example using the SET TEXT PATH function

SET TEXT REPRESENTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_text_rep (ws_id, text_index, font_val, prec_val, exp_fac, char_space, color_ind)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
text_index	Integer	Read	Reference	Text index value
font_val	Integer	Read	Reference	Text font value
prec_val	Integer (constant)	Read	Reference	Text precision
exp_fac	Real	Read	Reference	Character expansion factor
char_space	Real	Read	Reference	Character spacing factor
color_ind	Integer	Read	Reference	Text color index

Constants

Defined Argument	Constant	Description
prec_val	GKS$K_TEXT_PRECISION_STRING	String precision. DEC GKS evaluates character height and width attributes only. This is the default precision value.
	GKS$K_TEXT_PRECISION_CHAR	Character precision. DEC GKS evaluates each character for compliance with all other specified text attributes.
	GKS$K_TEXT_PRECISION_STROKE	Stroke precision. DEC GKS looks for the exact compliance with all specified text attributes.

Description

The SET TEXT REPRESENTATION function allows the user to redefine an existing text bundle table index representation, or to define a new text bundle table index value, by specifying the text font and precision, the character expansion factor, the character spacing, and the text color index associated with the specified bundle index.

This function allows you to change numerous text attributes, including the character expansion factor and the character spacing. When you change the value for the character expansion factor, the new value is multiplied by the width-to-height ratio specified in the original font specification to determine the new character width. The character height remains the same.

If you change the character spacing, using a positive number increases the spacing between letters (for example, the value 0.1 sets spacing to 0.1 times the character height). Using a negative number decreases the spacing and characters may overlap. The value 0.0 makes the bodies of the characters adjacent, without any separating space other than that defined as part of the character body by the font design.

Depending on the capabilities of your workstation, a call to the SET TEXT REPRESENTATION function may cause DEC GKS to implicitly regenerate the workstation surface.

Attribute values passed to this function must be valid for the specified workstation. For more information concerning device-specific attributes, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET ASPECT SOURCE FLAGS
SET CHARACTER SPACING
SET TEXT FONT AND PRECISION
SET TEXT INDEX
Example 6–1 for a program example using a SET . . . REPRESENTATION function

6.6 Program Examples

Example 6–1 illustrates the use of the SET COLOUR REPRESENTATION function.

Example 6–1 SET COLOUR REPRESENTATION Function

```
/*
 * This program calls the SET COLOR REPRESENTATION function to change
 * the color representation of a particular index from color1 to color2.
 * This program assumes an RGB color model. To avoid making such
 * an assumption, use the SET COLOR MODEL function to set the color
 * model to RGB explicity.
 *
 * NOTE: To keep the example concise NO error checking is performed.
*/

# include <stdio.h>

# include <gksdescrip.h>    /* GKS Descriptor  file      */
# include <gksdefs.h>       /* GKS GKS$ definition file  */


main ()
{

   int color1            = 4;
   float color2_comp1;
   float color2_comp2;
   float color2_comp3;
   int device_num;
   int figure            = 1;
   int input_class;
   int int_style;
   int n_points          = 20;
   float px[20];
   float py[20];
   float timeout         = 5.00;
   int update_flag;
   int ws_id             = 1;

/* Data declaration to interact with the workstation. */

   int default_conid     = GKS$K_CONID_DEFAULT;
   int default_wstype    = GKS$K_WSTYPE_DEFAULT;

/* Open the GKS and workstation environments. */

   gks$open_gks (0, 0);
   gks$open_ws (&ws_id, &default_conid, &default_wstype);
   gks$activate_ws (&ws_id);


/*
 * Store the figure in a segment. Set the fill index
 * to color1, set the fill interior style to solid,
 * initialize the fill area points, draw the figure,
 * and close the segment.
*/

   gks$create_seg (&figure);
   gks$set_fill_color_index (&color1);
   int_style = GKS$K_INTSTYLE_SOLID;
```

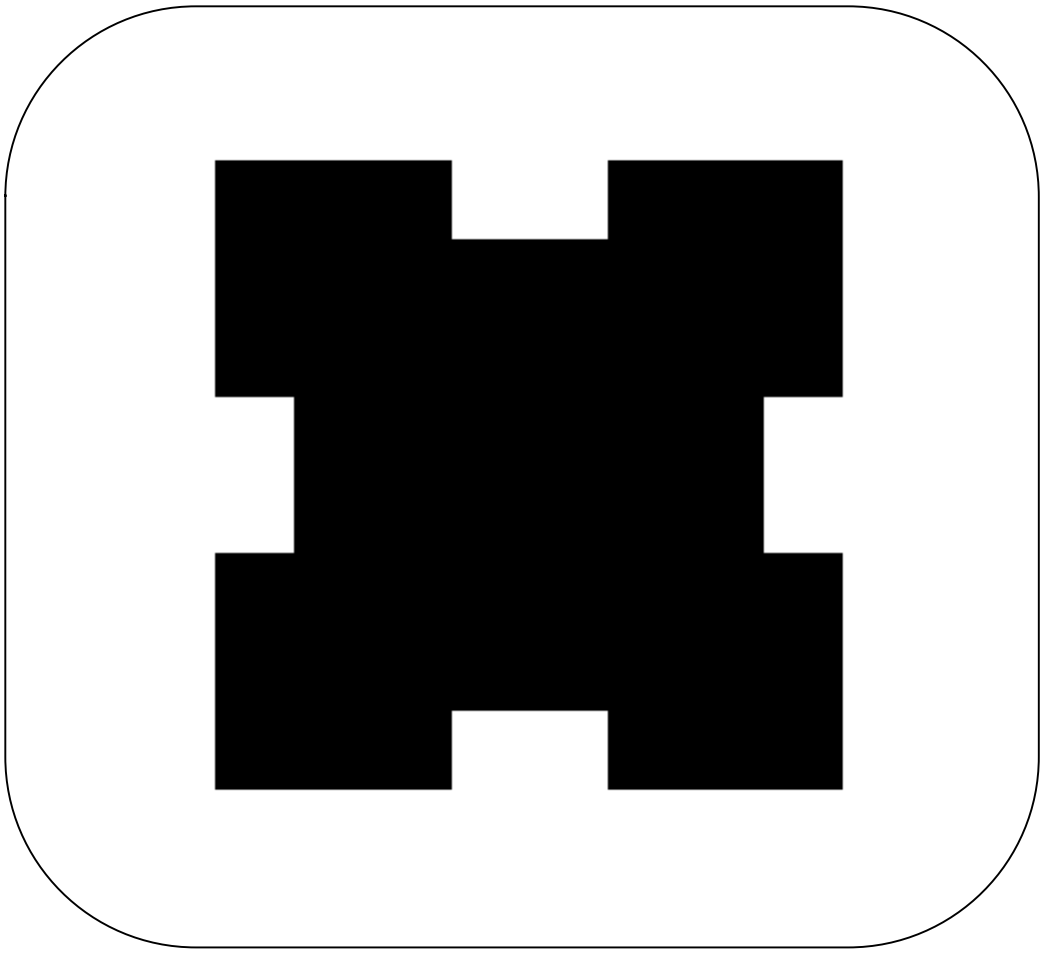
(continued on next page)

Example 6–1 (Cont.) SET COLOUR REPRESENTATION Function

```
   px[0] = 0.1;         py[0] = 0.1;
   px[1] = 0.4;         py[1] = 0.1;
   px[2] = 0.4;         py[2] = 0.2;
   px[3] = 0.6;         py[3] = 0.2;
   px[4] = 0.6;         py[4] = 0.1;
   px[5] = 0.9;         py[5] = 0.1;
   px[6] = 0.9;         py[6] = 0.4;
   px[7] = 0.8;         py[7] = 0.4;
   px[8] = 0.8;         py[8] = 0.6;
   px[9] = 0.9;         py[9] = 0.6;
   px[10] = 0.9;        py[10] = 0.9;
   px[11] = 0.6;        py[11] = 0.9;
   px[12] = 0.6;        py[12] = 0.8;
   px[13] = 0.4;        py[13] = 0.8;
   px[14] = 0.4;        py[14] = 0.9;
   px[15] = 0.1;        py[15] = 0.9;
   px[16] = 0.1;        py[16] = 0.6;
   px[17] = 0.2;        py[17] = 0.6;
   px[18] = 0.2;        py[18] = 0.4;
   px[19] = 0.1;        py[19] = 0.4;

   gks$set_fill_int_style (&int_style);
   gks$fill_area (&n_points, px, py);
   gks$close_seg ();


/* Keep the output for at least 5 seconds. */

   update_flag = GKS$K_POSTPONE_FLAG;
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout, &ws_id, &input_class, &device_num);

/*
 * Change the color representation of color1 to color2. This will
 * change the fill color of the figure from color1 to color2.
 * Keep the output for at least 5 seconds.
*/

   color2_comp1 = 1.0;
   color2_comp2 = 0.43;
   color2_comp3 = 0.09;
   gks$set_color_rep (&ws_id, &color1, &color2_comp1,
                      &color2_comp2, &color2_comp3);
   update_flag = GKS$K_PERFORM_FLAG;
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout, &ws_id, &input_class, &device_num);

/* Close the GKS and workstation environments. */

   gks$deactivate_ws (&ws_id);
   gks$close_ws (&ws_id);
   gks$close_gks ();
}
```

Figure 6–1 shows the program's effect on a VAXstation workstation running DECwindows software.

Figure 6–1 SET COLOUR REPRESENTATION Output



ZK–4010A–GE

Example 6–2 illustrates the use of the SET FILL AREA REPRESENTATION function.

Example 6–2 SET FILL AREA REPRESENTATION Function

```
/*
 * This program sets the Attribute Source Flags (ASFs) to bundled,
 * shows the fill area corresponding to the index 6, and then
 * changes the attributes associated with fill area index 6, using
 * the SET FILL AREA REPRESENTATION function.
 *
 * NOTE: To keep the example concise NO error checking is performed.
*/

# include <stdio.h>

# include <gksdescrip.h>   /* GKS Descriptor  file      */
# include <gksdefs.h>      /* GKS GKS$ definition file  */
```

(continued on next page)

Example 6–2 (Cont.) SET FILL AREA REPRESENTATION Function

```
main ()

{
   int device_num;
   int figure            = 1;
   int fill_index        = 6;
   int fill_int_style;
   int flags[13];
   int input_class;
   int n_points          = 20;
   int new_fill_color;
   int new_fill_int_style;
   int new_fill_style;
   float px[20];
   float py[20];
   float timeout         = 5.00;
   int update_flag;
   int ws_id             = 1;

/* Data declaration to interact with the workstation. */

   int default_conid     = GKS$K_CONID_DEFAULT;
   int default_wstype    = GKS$K_WSTYPE_DEFAULT;

/* Open the GKS and workstation environments. */

   gks$open_gks (0, 0);
   gks$open_ws (&ws_id, &default_conid, &default_wstype);
   gks$activate_ws (&ws_id);


/* Set the Attribute Source Flags (ASFs) to bundled. */

   flags[0] = GKS$K_ASF_BUNDLED;
   flags[1] = GKS$K_ASF_BUNDLED;
   flags[2] = GKS$K_ASF_BUNDLED;
   flags[3] = GKS$K_ASF_BUNDLED;
   flags[4] = GKS$K_ASF_BUNDLED;
   flags[5] = GKS$K_ASF_BUNDLED;
   flags[6] = GKS$K_ASF_BUNDLED;
   flags[7] = GKS$K_ASF_BUNDLED;
   flags[8] = GKS$K_ASF_BUNDLED;
   flags[9] = GKS$K_ASF_BUNDLED;
   flags[10] = GKS$K_ASF_BUNDLED;
   flags[11] = GKS$K_ASF_BUNDLED;
   flags[12] = GKS$K_ASF_BUNDLED;
   gks$set_asf (flags);


/*
 * Create a segment for the output, use the attributes
 * associated with a fill area index of 6, initialize the
 * points describing the fill area, output the fill area,
 * and close the segment.
*/

   gks$create_seg (&figure);
   gks$set_fill_index (&fill_index);
```

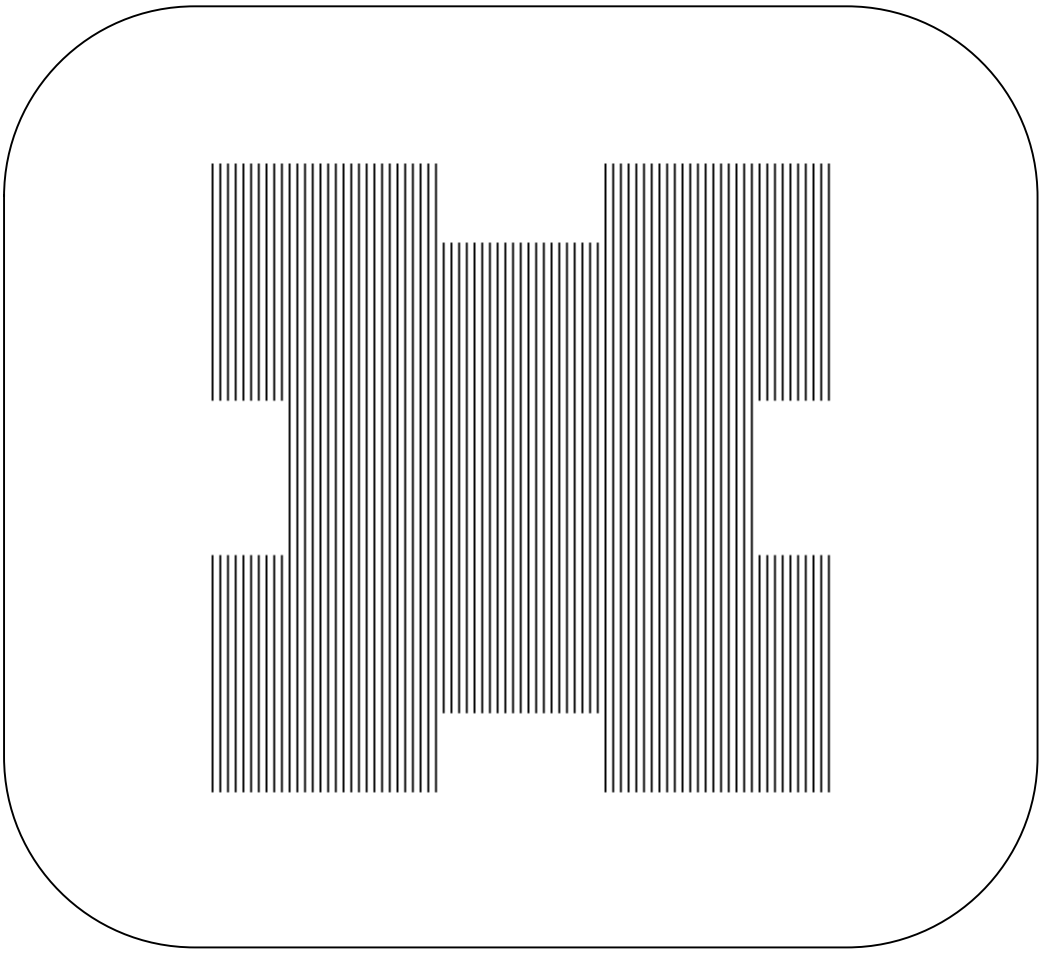
(continued on next page)

Example 6–2 (Cont.) SET FILL AREA REPRESENTATION Function

```
   px[0] = 0.1;         py[0] = 0.1;
   px[1] = 0.4;         py[1] = 0.1;
   px[2] = 0.4;         py[2] = 0.2;
   px[3] = 0.6;         py[3] = 0.2;
   px[4] = 0.6;         py[4] = 0.1;
   px[5] = 0.9;         py[5] = 0.1;
   px[6] = 0.9;         py[6] = 0.4;
   px[7] = 0.8;         py[7] = 0.4;
   px[8] = 0.8;         py[8] = 0.6;
   px[9] = 0.9;         py[9] = 0.6;
   px[10] = 0.9;        py[10] = 0.9;
   px[11] = 0.6;        py[11] = 0.9;
   px[12] = 0.6;        py[12] = 0.8;
   px[13] = 0.4;        py[13] = 0.8;
   px[14] = 0.4;        py[14] = 0.9;
   px[15] = 0.1;        py[15] = 0.9;
   px[16] = 0.1;        py[16] = 0.6;
   px[17] = 0.2;        py[17] = 0.6;
   px[18] = 0.2;        py[18] = 0.4;
   px[19] = 0.1;        py[19] = 0.4;

   gks$fill_area (&n_points, px, py);
   gks$close_seg ();

/* Keep the output for at least 5 seconds. */

   update_flag = GKS$K_POSTPONE_FLAG;
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout, &ws_id, &input_class, &device_num);


/* Change the attributes associated with fill area index 6. */

   new_fill_int_style = GKS$K_INTSTYLE_HATCH;
   new_fill_style = -9;
   new_fill_color = 1;
   gks$set_fill_rep (&ws_id, &fill_index, &new_fill_int_style,
                     &new_fill_style, &new_fill_color);

/*
 * Cause a regeneration of the screen to see the change
 * on the workstation and keep the output for at least
 * 5 seconds.
*/

   update_flag = GKS$K_PERFORM_FLAG;
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout, &ws_id, &input_class, &device_num);

/* Close the GKS and workstation environments. */

   gks$deactivate_ws (&ws_id);
   gks$close_ws (&ws_id);
   gks$close_gks ();
}
```

Figure 6–2 shows the program's effect on a VAXstation workstation running DECwindows software.

Figure 6–2 SET FILL AREA REPRESENTATION Output



ZK–4011A–GE

Example 6–3 illustrates the use of the SET LINETYPE function.

Example 6–3 SET LINETYPE Function

```
/*
 * This program calls the SET LINETYPE function to set the
 * line type to the dashed and dotted line. The program
 * draws a line figure displaying the set line type.
 *
 * NOTE: To keep the example concise NO error checking is performed.
*/

# include <stdio.h>

# include <gksdescrip.h>    /* GKS Descriptor file        */
# include <gksdefs.h>       /* GKS GKS$ definitions files */
```

(continued on next page)

Example 6–3 (Cont.) SET LINETYPE Function

```
main ()
{
   int device_num;
   int input_class;
   int line_type;
   int n_points          = 29;
   float px[29];
   float py[29];
   float timeout         = 5.00;
   int update_flag;
   int ws_id = 1;

/* Data declaration to interact with the workstation. */

   int default_conid     = GKS$K_CONID_DEFAULT;
   int default_wstype    = GKS$K_WSTYPE_DEFAULT;

/* Open the GKS and workstation environments. */

   gks$open_gks (0, 0);
   gks$open_ws (&ws_id, &default_conid, &default_wstype);
   gks$activate_ws (&ws_id);


/*
 * Set the linetype to dashed and dotted lines, initialize
 * the points describing the line, and draw the line figure.
*/

   line_type = GKS$K_LINETYPE_DASHED_DOTTED;
   gks$set_pline_linetype (&line_type);

   px[0] = 0.4;         py[0] = 0.9;
   px[1] = 0.1;         py[1] = 0.9;
   px[2] = 0.1;         py[2] = 0.6;
   px[3] = 0.2;         py[3] = 0.6;
   px[4] = 0.2;         py[4] = 0.4;
   px[5] = 0.1;         py[5] = 0.4;
   px[6] = 0.1;         py[6] = 0.1;
   px[7] = 0.4;         py[7] = 0.1;
   px[8] = 0.4;         py[8] = 0.2;
   px[9] = 0.6;         py[9] = 0.2;
   px[10] = 0.6;        py[10] = 0.1;
   px[11] = 0.9;        py[11] = 0.1;
   px[12] = 0.9;        py[12] = 0.4;
   px[13] = 0.8;        py[13] = 0.4;
   px[14] = 0.8;        py[14] = 0.6;
   px[15] = 0.9;        py[15] = 0.6;
   px[16] = 0.9;        py[16] = 0.9;
   px[17] = 0.6;        py[17] = 0.9;
   px[18] = 0.6;        py[18] = 0.8;
   px[19] = 0.3;        py[19] = 0.8;
   px[20] = 0.3;        py[20] = 0.3;
   px[21] = 0.7;        py[21] = 0.3;
   px[22] = 0.7;        py[22] = 0.7;
   px[23] = 0.4;        py[23] = 0.7;
   px[24] = 0.4;        py[24] = 0.4;
   px[25] = 0.6;        py[25] = 0.4;
   px[26] = 0.6;        py[26] = 0.6;
   px[27] = 0.5;        py[27] = 0.6;
   px[28] = 0.5;        py[28] = 0.5;
   gks$polyline (&n_points, px, py);
```

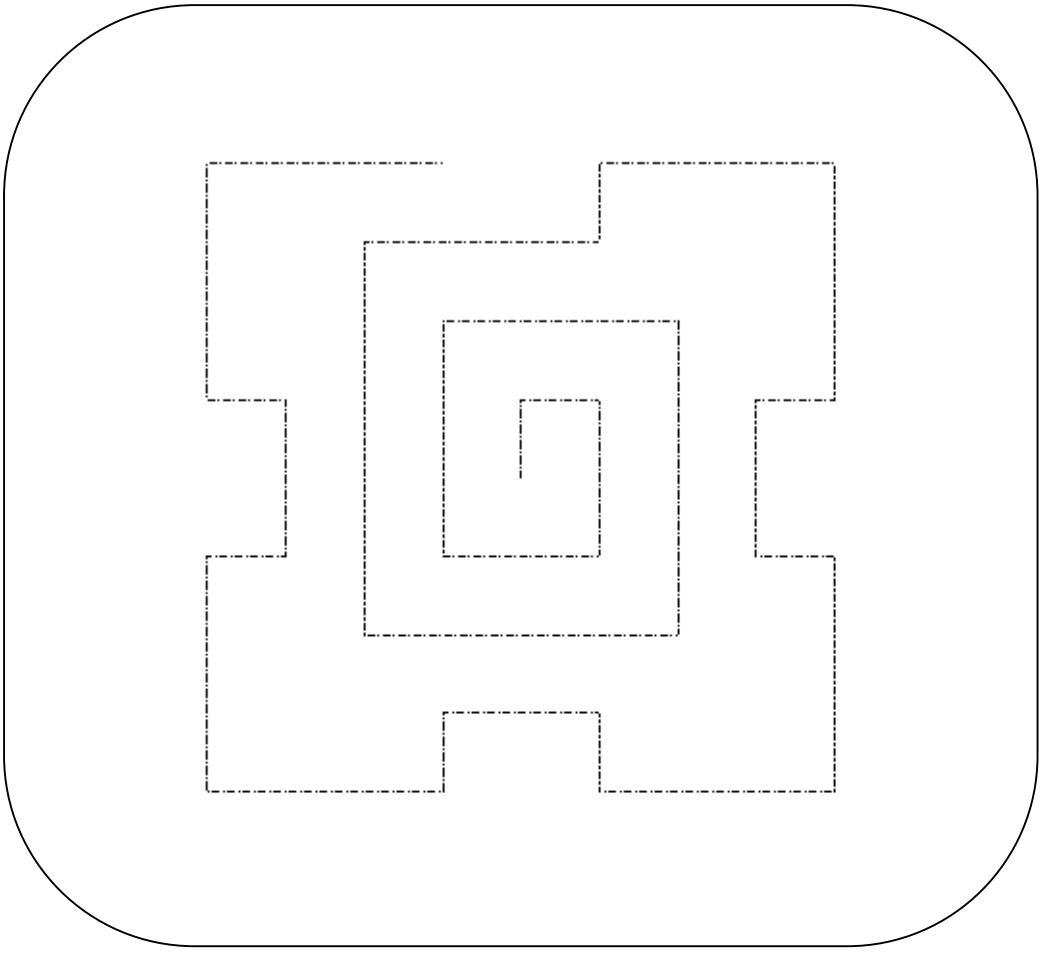
(continued on next page)

Example 6–3 (Cont.) SET LINETYPE Function

```
/* Keep the output for at least 5 seconds. */

   update_flag = GKS$K_POSTPONE_FLAG;
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout, &ws_id, &input_class, &device_num);

/* Close the GKS and workstation environments. */

   gks$deactivate_ws (&ws_id);
   gks$close_ws (&ws_id);
   gks$close_gks ();
}
```

Figure 6–3 shows the program's effect on a VAXstation workstation running DECwindows software.

Figure 6–3 SET LINETYPE Output



ZK–4012A–GE

Example 6–4 illustrates the use of the SET TEXT ALIGNMENT function.

Example 6–4 SET TEXT ALIGNMENT Output

```
/*
 * This program calls the SET TEXT ALIGNMENT function to write a
 * string to the workstation using the normal text alignments for
 * each of four text paths.
 *
 * NOTE: To keep the example concise NO error checking is performed.
*/

# include <stdio.h>

# include <gksdescrip.h>    /* GKS Descriptor file          */
# include <gksdefs.h>       /* GKS GKS$ binding definitions */


main ()

{
#define TEXT_STRING1 " TEXT LINE 1"
#define TEXT_STRING2 " TEXT LINE 2"
#define TEXT_STRING3 " TEXT LINE 3"
#define TEXT_STRING4 " TEXT LINE 4"

   struct dsc$descriptor_s  text_dsc;
   int device_num;
   int horizon_align;
   int input_class;
   float larger = 0.07;
   int one_pmark         = 1;
   int path_down;
   int path_left;
   int path_right;
   int path_up;
   int pmark_type;
   int red               = 2;
   float start_pt_x;
   float start_pt_y;
   float timeout1        = 1.00;
   float timeout2        = 5.00;
   int update_flag;
   int vertical_align;
   int ws_id             = 1;

/* Data declaration to interact with the workstation. */

   int default_conid     = GKS$K_CONID_DEFAULT;
   int default_wstype    = GKS$K_WSTYPE_DEFAULT;

/* Open the GKS and workstation environments. */

   gks$open_gks (0, 0);
   gks$open_ws (&ws_id, &default_conid, &default_wstype);
   gks$activate_ws (&ws_id);
```

(continued on next page)

Example 6–4 (Cont.) SET TEXT ALIGNMENT Output

```
/*
 * Set the polymarker color index and the polymarker type.
 * Draw the polymarker to provide a point of reference for
 * the lines of text.
*/

   pmark_type = GKS$K_MARKERTYPE_PLUS;
   gks$set_pmark_color_index (&red);
   gks$set_pmark_type (&pmark_type);
   start_pt_x = 0.5;
   start_pt_y = 0.5;
   gks$polymarker (&one_pmark, &start_pt_x, &start_pt_y);
   update_flag = GKS$K_POSTPONE_FLAG;
   gks$update_ws (&ws_id, &update_flag);

/* Set the text character height and the text alignment. */

   gks$set_text_height (&larger);
   horizon_align = GKS$K_TEXT_HALIGN_NORMAL;
   vertical_align = GKS$K_TEXT_VALIGN_NORMAL;
   gks$set_text_align (&horizon_align, &vertical_align);


/*
 * Set a rightward text path and write a character string.
 * Keep the output for at least 1 second.
*/

   path_right = GKS$K_TEXT_PATH_RIGHT;
   gks$set_text_path (&path_right);
   text_dsc.dsc$a_pointer = TEXT_STRING1;
   text_dsc.dsc$b_dtype = DSC$K_DTYPE_T;
   text_dsc.dsc$b_class = DSC$K_CLASS_S;
   text_dsc.dsc$w_length = strlen (TEXT_STRING1);
   gks$text (&start_pt_x, &start_pt_y, &text_dsc);
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout1, &ws_id, &input_class, &device_num);


/*
 * Set a leftward text path, and write a character string.
 * Keep the output for at least 1 second.
*/

   path_left = GKS$K_TEXT_PATH_LEFT;
   gks$set_text_path (&path_left);
   text_dsc.dsc$a_pointer = TEXT_STRING2;
   text_dsc.dsc$b_dtype = DSC$K_DTYPE_T;
   text_dsc.dsc$b_class = DSC$K_CLASS_S;
   text_dsc.dsc$w_length = strlen (TEXT_STRING2);
   gks$text (&start_pt_x, &start_pt_y, &text_dsc);
   update_flag = GKS$K_POSTPONE_FLAG;
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout1, &ws_id, &input_class, &device_num);
```

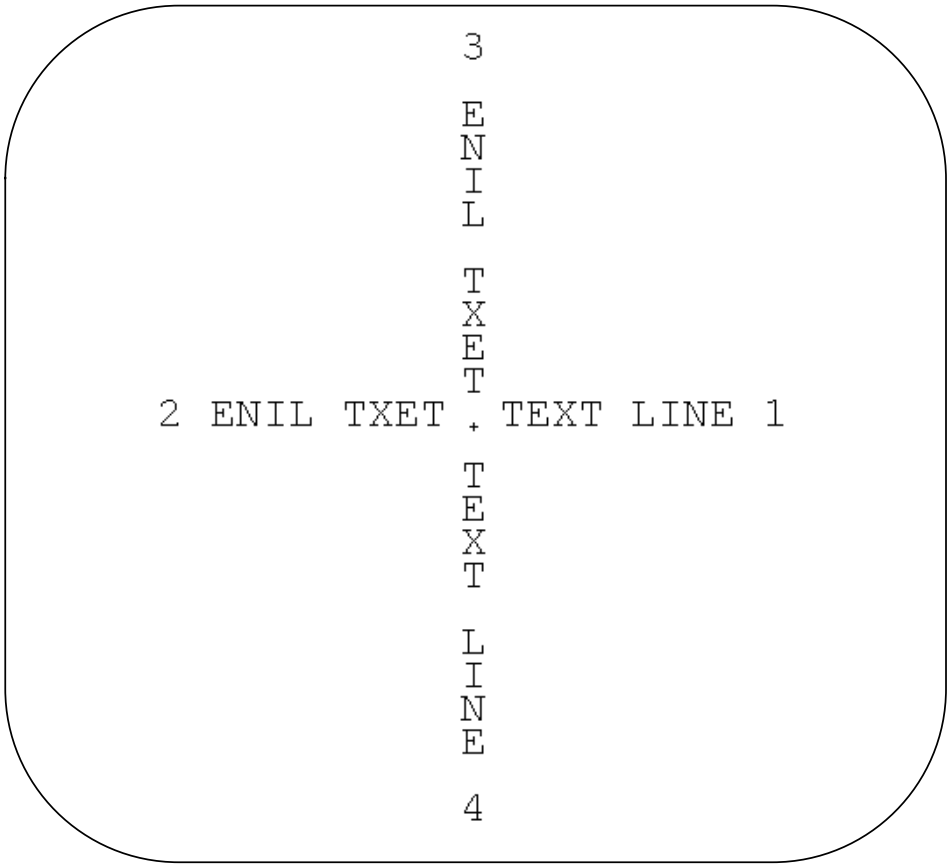
(continued on next page)

Example 6–4 (Cont.) SET TEXT ALIGNMENT Output

```
/*
 * Set an upward text path, and write a character string.
 * Keep the output for at least 1 second.
*/

   path_up = GKS$K_TEXT_PATH_UP;
   gks$set_text_path (&path_up);
   gks$set_text_align (&horizon_align, &vertical_align);
   text_dsc.dsc$a_pointer = TEXT_STRING3;
   text_dsc.dsc$b_dtype = DSC$K_DTYPE_T;
   text_dsc.dsc$b_class = DSC$K_CLASS_S;
   text_dsc.dsc$w_length = strlen (TEXT_STRING3);
   gks$text (&start_pt_x, &start_pt_y, &text_dsc);
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout1, &ws_id, &input_class, &device_num);


/*
 * Set a downward text path, and write a character string.
 * Keep the output for at least 5 seconds.
*/

   path_down = GKS$K_TEXT_PATH_DOWN;
   gks$set_text_path (&path_down);
   gks$set_text_align (&horizon_align, &vertical_align);
   text_dsc.dsc$a_pointer = TEXT_STRING4;
   text_dsc.dsc$b_dtype = DSC$K_DTYPE_T;
   text_dsc.dsc$b_class = DSC$K_CLASS_S;
   text_dsc.dsc$w_length = strlen (TEXT_STRING4);
   gks$text (&start_pt_x, &start_pt_y, &text_dsc);
   gks$update_ws (&ws_id, &update_flag);
   gks$await_event (&timeout2, &ws_id, &input_class, &device_num);

/* Close the GKS and workstation environments. */

   gks$deactivate_ws (&ws_id);
   gks$close_ws (&ws_id);
   gks$close_gks ();
}
```

Figure 6–4 shows the program's effect on a VAXstation workstation running DECwindows software.

Figure 6–4 SET TEXT ALIGNMENT Output



ZK–4009A–GE

Transformation Functions

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7
Transformation Functions

The DEC GKS transformation functions allow you to compose a picture, control how much of the picture is displayed on the workstation surface, and control how much of the workstation surface is used to display the picture.

When you request input and generate output on the workstation surface, you actually work with a number of coordinate systems. The image is transformed from one coordinate system to the next.

Using the two-dimensional features of DEC GKS, you work with three coordinate systems, as follows:

- World coordinate (WC) system
- Normalized device coordinate (NDC) system
- Device coordinate system

The WC system is an imaginary coordinate plane used to plot a graphic image. The NDC system is a device-independent, imaginary coordinate plane on which you compose a picture using designated portions of the WC plane. Once you compose a picture on the NDC space, you can zoom in on the picture, pan across the picture, or zoom out of the picture, while controlling what portion of the device coordinate system is used to display the picture. You can display all or part of the picture in NDC space on the surface of the physical device.

When you call one of the DEC GKS output functions, you specify WC points. Using a series of default windows and viewports, the output primitive is transformed from an image on the WC plane, to an image on the NDC plane, and finally, to the surface of the workstation.

If you do not change the default transformation settings, image shape and position are consistent, and your ability to compose complex pictures may be limited to what you can form on one area of the WC system. The DEC GKS transformation functions allow you to set the windows, viewports, and other transformation features that control the transformation process, and usually, how generated output appears on the workstation surface.

7.1 World Coordinates and Normalization Transformations

The WC system is an imaginary, Cartesian coordinate system whose X and Y axes extend infinitely in all four directions. The origin of the system is the point (0.0, 0.0). Depending on the type of data needed to plot your images, you can use any portion of the WC plane. For example, if the necessary data contains negative numbers, you can use the portions of the WC system that extend into the negative portions of the axes.

By default, DEC GKS transforms images according to a square WC range whose lower left corner is the point (0.0, 0.0) and whose sides extend from the point 0.0 to 1.0 on both the X and Y axes. (From this point forward, this manual documents rectangular regions such as the default range as follows: ([0,1] x [0,1]), 0 to 1 on both the X and Y axes.) This range is called the default normalization **window**.

DEC GKS transforms the plotted images, according to the current window, to an area on the NDC plane. You can reset the window many times while generating output primitives, or you can use only the default window, depending on the needs of your application. If your image is composed of points that lie outside of the world window, then those points may or may not be part of the image on the NDC plane depending on the current **clipping** indicator. Clipping is described in detail in Section 7.1.1.

As an example, consider the formation of a picture of a house on the WC plane. To illustrate resetting the normalization window, consider a coordinate range of ([0,10] x [0,10]). The following code example shows how to set such a range for the normalization window:

```
      .
      .
      .
house = 1;
num_points = 9;
window = { 0.0, 10.0, 0.0, 10.0 };
      .
      .
      .
px[0] = 4.0;
py[0] = 1.0;
px[1] = 1.0;
py[1] = 1.0;
px[2] = 1.0;
py[2] = 7.0;
px[3] = 4.0;
py[3] = 7.0;
px[4] = 2.5;
py[4] = 9.0;
px[5] = 1.0;
py[5] = 7.0;
px[6] = 4.0;
py[6] = 1.0;
px[7] = 4.0;
py[7] = 7.0;
px[8] = 1.0;
py[8] = 1.0;

gks$set_window( &house, &window );
gks$select_xform( 1 )
gks$polyline( &num_points, &px, &py );
```

PX contains the X WC values for the house and *PY* contains the Y WC values. For example, the first element in both arrays specifies the lower right corner of the house (4.0, 1.0).

In the call to SET WINDOW, the X axis minimum value of the house is set to the point 0.0 and its maximum value is set to 10.0. The Y axis minimum and maximum values of the house are set to the same WC values. These dimensions establish the rectangle used as the normalization window.

The first argument to SET WINDOW specifies a **normalization transformation** number. A normalization transformation is a transposition of an image from the WC plane to the NDC plane. When you select normalization transformation number 1 by calling SELECT NORMALIZATION TRANSFORMATION, DEC GKS establishes a window of the range ([0,10] x [0,10]) to be the current normalization window. When you generate output using this code example, DEC GKS maps the current window to a default portion of the NDC space. Section 7.1.1 describes the NDC plane in detail.

7.1.1 The Normalized Device Coordinate System

As mentioned in the previous section, the normalization transformation is the transposition of WC points to NDC points. The NDC plane is a device-independent coordinate plane on which you compose graphic pictures. The NDC plane has an X and a Y axis that in theory extends infinitely in all four directions with an origin at point (0.0, 0.0), but in practice, only images contained in the range ([0,1] x [0,1]) can ultimately be transformed to the surface of a physical device.

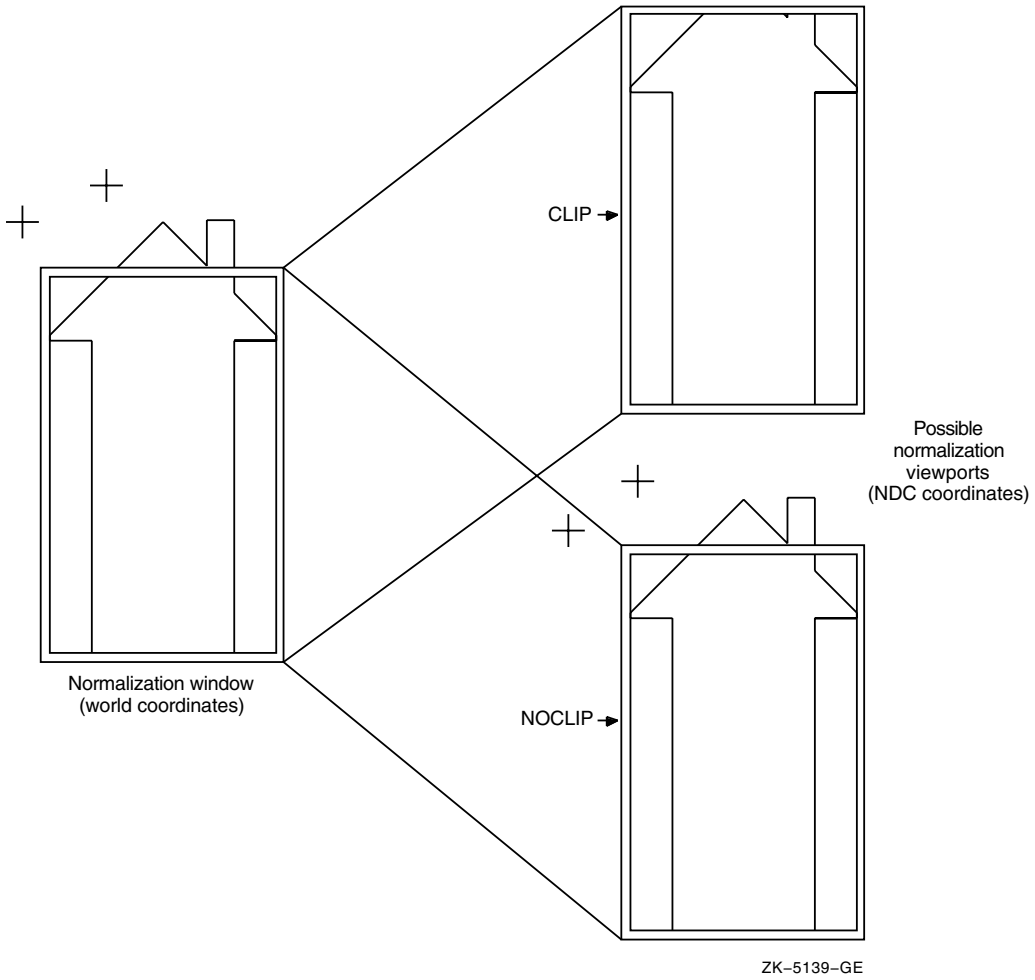
When DEC GKS transforms an image from the normalization window to the NDC plane, there must be a corresponding rectangle on which to map the contents of the window. This rectangular portion of the NDC space is called the normalization **viewport**. The default viewport has the range ([0,1] x [0,1]) in NDC point values. The previous code example, by default, maps the contents of the current window to this default viewport.

By default, DEC GKS maps the normalization window ([0,1] x [0,1]) in WC points to the viewport ([0,1] x [0,1]) in NDC points. This transformation is called the **unity** transformation, which has the normalization transformation number 0. You cannot reset the window and viewport associated with the unity transformation.

Think of the normalization process as a way of transposing a number of areas of the WC plane onto the NDC plane with respect to current normalization window and viewport. For example, DEC GKS maps the contents of the current normalization window onto the current viewport. If clipping is enabled (which is the default), the effect is like cutting the window from the WC plane, mapping, and then pasting the window to the viewport on the NDC plane. DEC GKS maps only images or portions of images plotted within the boundaries of the normalization window to the area within the viewport on NDC space. If clipping is disabled, DEC GKS maps points that lie outside of the normalization window boundary to NDC space outside of the normalization viewport but within the range ([0,1] x [0,1]).

Because DEC GKS clips images at the boundary of the normalization viewport, this viewport is also called the **clipping rectangle**. You can enable and disable clipping by calling the function SET CLIPPING INDICATOR. Figure 7–1 illustrates the clipping process according to the argument passed to SET CLIPPING INDICATOR.

Figure 7–1 The Clipping Rectangle



When creating a picture, consider that you can select different normalization transformations with different windows and viewports, thus mapping various portions of the WC space onto different portions of the NDC space. (In DEC GKS, valid normalization transformation numbers range from 0 to 255, and you can associate windows and viewports with all but the unity transformation number 0.) You can achieve the same effect by reassigning different windows and viewports to a single normalization number.

In essence, you use the WC space as a scratch pad and the NDC space as a pasteboard on which to compose an entire picture. For example, if you want an output primitive to appear on the right side of a picture displayed on the workstation surface, you map the primitive to the right side of the NDC space during the normalization transformation. All picture composition is done using normalization transformations. Once you compose a picture on the NDC plane, you can output all or part of the picture to all or part of various workstation surfaces.

7.1.2 Overlapping Viewports

When you define normalization viewports, it is possible to cause them to overlap on the NDC plane. You must consider the effects this has during input requests. Viewport input priority does not affect output; the order of the output function calls determines which primitive overwrites the other. If you are working with segments, the segment priorities affect overlapping segments. (For more information on segments, see Chapter 8.)

To illustrate the need for a viewport priority list during input, consider two viewports: the viewport of the unity (identity) transformation number 0 having the range ([0,1] x [0,1]), and a viewport, belonging to normalization transformation number 1, having the range ([0.5,1] x [0.5,1]) in NDC points. Notice that the viewport of normalization transformation number 1 overlaps the right side of the unity viewport.

During stroke and locator input, the user positions the cursor on the device surface, which returns one point (locator) or a series of points (stroke) in device coordinates. DEC GKS translates the device coordinates to NDC points (Section 7.2 describes this process in detail).

Once the device coordinates are transformed to NDC points, DEC GKS must transform the NDC points to WC points. To transform the point, DEC GKS transforms the point from its viewport (NDC) value to the corresponding window (WC) value. However, if the user chooses a point on the right half of the default viewport, DEC GKS must calculate whether to use the unity viewport or the overlapping viewport of transformation number 1 to transform the point to WC values. DEC GKS needs to know to which normalization window the point is to be mapped: the window that corresponds to either normalization transformation number 0 or number 1.

To calculate which viewport has a higher input priority, DEC GKS maintains a priority list. By default, DEC GKS assigns the highest priority to the unity transformation (0). So, in the previous example concerning overlapping viewports, DEC GKS would use the unity viewport to transform the NDC point. The viewports of all remaining transformations decrease in priority as their transformation numbers increase (viewport 0 higher than viewport 1, 1 higher than 2, 2 higher than 3, and so on).

To change the order of the viewport input priority list, call the function SET VIEWPORT INPUT PRIORITY. You specify a normalization transformation number whose priority is to be changed (for example, 1), a normalization transformation number as a reference (for example, 0), and a flag that specifies that the first transformation is to have a lower or higher priority than the reference transformation.

If you call SET VIEWPORT INPUT PRIORITY to give transformation number 1 a higher transformation (1 higher than 0, 0 higher than 2, 2 higher than 3, and so on), DEC GKS would use the viewport corresponding to transformation number 1 in all cases when viewports 1 and 0 overlap during locator and stroke input.

For more information concerning locator and stroke input, see Chapter 9.

7.2 Workstation Transformations

DEC GKS must map the picture on the NDC plane to the surface of one or more workstations. To do this, DEC GKS uses a second window and a viewport called the **workstation window** and the **workstation viewport**. The workstation window is a rectangular portion of the NDC plane that is mapped onto the rectangular portion of the workstation surface, called the workstation viewport. There can be numerous normalization transformations, but only one current workstation window and one current workstation viewport.

DEC GKS uses a default workstation window of the range ([0,1] x [0,1]) in NDC points, and uses a default workstation viewport, which starts at the lower left corner. The viewport is the largest rectangle on the device surface that maintains the shape of the picture in the workstation window. (Section 7.3 describes in detail the shape of the picture in the workstation window.) If you choose, you can change the workstation window, but the new boundaries can be no larger than the default workstation window boundaries ([0,1] x [0,1]). DEC GKS clips all points that exceed the default workstation window boundaries before it transforms the picture to device coordinates, regardless of the current clipping flag setting.

The normalization transformation composes the picture on NDC space, and the workstation transformation presents all or part of the picture on all or part of the device surface. For example, by setting the workstation window with the SET WORKSTATION WINDOW function, you can create the illusion of panning across a picture, showing successive portions of it at a time, or zooming in, showing smaller portions of a picture at a time. The *DEC GKS User's Guide* describes this process in detail.

Your application may require that you change the portion of the workstation surface used to display the picture. However, if your program runs on several devices, you may not know the proportions of the device coordinate system with which you are working. The proportions of the device coordinate system are completely device dependent; each device can have a completely dissimilar device coordinate plane with dissimilar maximum X and Y coordinate values.

To determine the maximum boundary of the workstation viewport, you should use the function, INQUIRE DISPLAY SPACE SIZE, which returns the maximum X and Y values of the workstation display surface. (For more information, see Chapter 11, and SET WORKSTATION VIEWPORT in this chapter.)

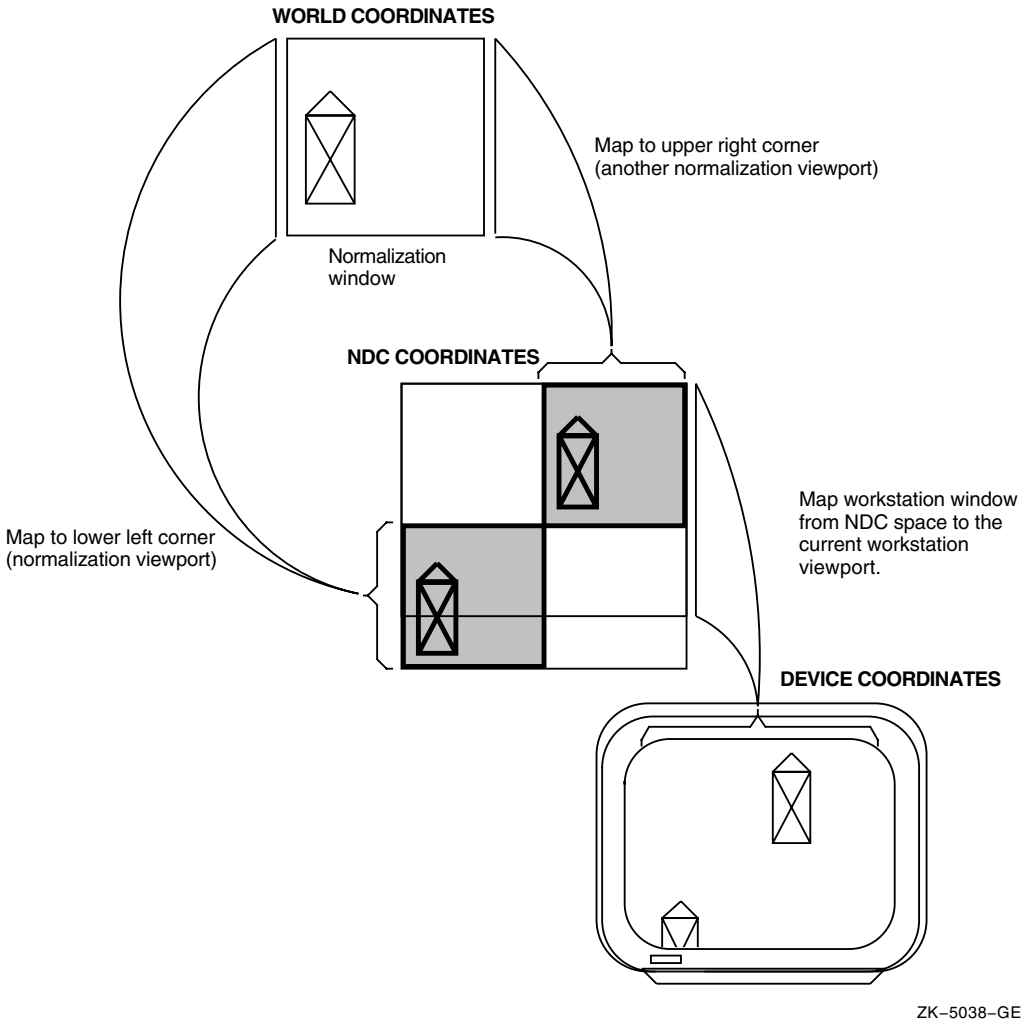
When you set the workstation window (by calling SET WORKSTATION WINDOW) or the workstation viewport (by calling SET WORKSTATION VIEWPORT), the new window or viewport may not come into effect immediately, depending on the capabilities of your device. Depending on your device, the new workstation window or workstation viewport may become current immediately, or the workstation surface may need to be implicitly regenerated before the new window or viewport becomes current. If the workstation needs to regenerate its surface to make a workstation transformation current, the screen is cleared and only the primitives stored in segments are redrawn. You lose all primitives not contained in segments.

In most cases, the workstation does not use the entire workstation viewport to display the picture. DEC GKS uses the portion of device coordinate space, starting at the lower left point, that is the largest rectangle within the current workstation viewport that maintains the shape of the picture contained in the workstation window. To map the entire workstation window to the entire viewport, you need to make sure that the window and viewport have the same

proportions. See Section 7.3 for more information concerning window and viewport proportions.

The entire process of an image generation, from normalization transformation to workstation transformation, is illustrated in Figure 7–2.

Figure 7–2 The Entire DEC GKS Transformation Process



7.3 Relative Positioning and Shape

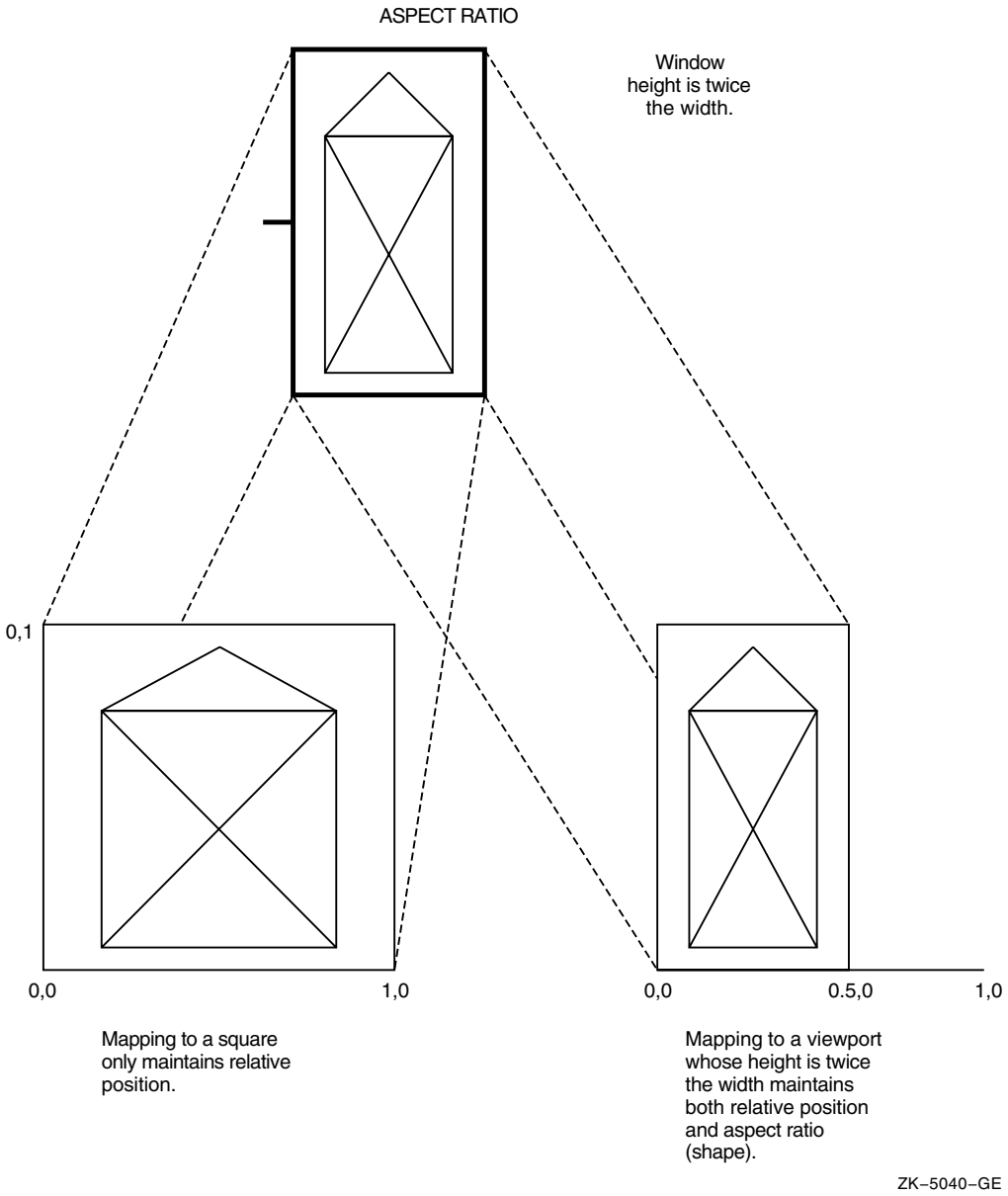
There is one final consideration when redefining the normalization and workstation window and viewport values, and that is the shape of the object to be drawn. By default, the image is mapped from a square WC plane, to a square portion of the NDC plane, and finally to a square portion of the display surface plane. Logically, if you draw a tall, thin house in WC values using the default transformations, you would see a tall, thin house on the workstation surface. However, if you define a tall, thin rectangular **normalization window** that contains your house and then map that window onto the default, square normalization viewport, the tall, thin house would appear shorter and wider due to mapping from window to viewport.

Consequently, you should be aware of the difference between the **relative position** of the image and the **aspect ratio** of the image. In the case of the tall, thin house, all the points retain their relative position when mapped from the normalization window to the viewport. If the X value of the tip of the house is located two-thirds of the way along the X axis in the window, it is also located two-thirds of the way along the X axis in the viewport. Relatively speaking, if the house is located in the center of the window, it will be located in the center of the viewport.

If you want to retain the shape, or aspect ratio, of the image, you must map images from a window to a viewport that has the same proportion, or height-to-width ratio. For example, if the X axis is two-thirds as large as the Y axis in the normalization window, you must map to a viewport whose X axis is two-thirds as large as the Y axis to retain the aspect ratio of your image.

Figure 7–3 shows the difference between relative position and aspect ratio. Like the window and viewport on the left, all normalization transformations retain the relative position. The window and viewport on the right retain the aspect ratio of the tall, thin house as well as its relative position.

Figure 7–3 Relative Position and Aspect Ratio



In contrast to the normalization transformations, DEC GKS automatically retains the aspect ratio of the workstation window when mapping to the workstation viewport. The mapping from workstation window to workstation viewport is not necessarily one-to-one; DEC GKS might not use the entire defined workstation viewport. By default, DEC GKS uses the largest rectangle, starting at the lower left corner, *within* the workstation viewport that retains the shape of the picture contained in the workstation window.

For more information concerning normalization transformations, workstation transformations, relative positioning, and aspect ratio, see the *DEC GKS User's Guide*. For more information concerning segments and transformations, see Chapter 8.

7.4 Transformation Inquiries

You can use the following inquiry functions to obtain transformation information when writing device-independent code:

INQUIRE CLIPPING
INQUIRE CURRENT NORMALIZATION TRANSFORMATION NUMBER
INQUIRE DISPLAY SPACE SIZE
INQUIRE LIST OF NORMALIZATION TRANSFORMATION NUMBERS
INQUIRE MAXIMUM NORMALIZATION TRANSFORMATION
INQUIRE NORMALIZATION TRANSFORMATION
INQUIRE WORKSTATION TRANSFORMATION

For more information concerning device-independent programming, see the *DEC GKS User's Guide*. For more information on the inquiry functions, see Chapter 11.

7.5 Function Descriptions

This section describes the DEC GKS transformation functions in detail.

ACCUMULATE TRANSFORMATION MATRIX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$accum_xform_matrix (old_xform_mat, fix_pt_x, fix_pt_y, transl_vec_x, transl_vec_y, rotation, scale_x, scale_y, coord_type, new_xform_mat)

Argument	Data Type	Access	Passed by	Description
old_xform_mat	Array of reals	Read	Reference	6-element segment transformation matrix created previously by a call to EVALUATE TRANSFORMATION MATRIX or ACCUMULATE TRANSFORMATION MATRIX.
fix_pt_x	Real	Read	Reference	X coordinate of the fixed point for the rotation and scaling.
fix_pt_y	Real	Read	Reference	Y coordinate of the fixed point for the rotation and scaling.
transl_vec_x	Real	Read	Reference	X coordinate of the shift vector. Pass the value 0.0 to avoid translating the segment in the X direction.
transl_vec_y	Real	Read	Reference	Y coordinate of the shift vector. Pass the value 0.0 to avoid translating the segment in the Y direction.
rotation	Real	Read	Reference	Angle of rotation in radians. 360 degrees = 2*pi radians. Pass the value 0.0 to avoid rotating the segment.
scale_x	Real	Read	Reference	X scale factor. Pass the value 1 to avoid scaling the segment in the Y direction.
scale_y	Real	Read	Reference	Y scale factor. Pass the value 1 to avoid scaling the segment in the X direction.
coord_type	Integer (constant)	Read	Reference	Coordinate switch.
new_xform_mat	Array of reals	Write	Reference	New 6-element transformation matrix. It results from the composition of the transformation defined by the new scaling, rotation, and translation component values, with the matrix provided in the agrument *old_xform_mat*.

Constants

Defined Argument	Constant	Description
coord_type	GKS$K_COORDINATES_WC	The fixed point and shift vectors, which are WC values.
	GKS$K_COORDINATES_NDC	The fixed point and shift vectors, which are NDC values.

Description

The ACCUMULATE TRANSFORMATION MATRIX function accepts a specified transformation matrix, concatenates new segment transformation component values, and then writes the accumulated transformation to the last argument of the function.

The order of transformation is:

1. Specified input matrix
2. Scale (relative to the specified fixed point)
3. Rotate (relative to the specified fixed point)
4. Shift

See the *DEC GKS User's Guide* for a description of segment transformation and transformation matrixes.

See Also

EVALUATE TRANSFORMATION MATRIX
INSERT SEGMENT
SET SEGMENT TRANSFORMATION
Example 7–1 for a program example using the ACCUMULATE TRANSFORMATION MATRIX function

EVALUATE TRANSFORMATION MATRIX

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$eval_xform_matrix (fix_pt_x, fix_pt_y, transl_vec_x, transl_vec_y, rotation, scale_x, scale_y, coord_type, trans_mat)

Argument	Data Type	Access	Passed by	Description
fix_pt_x	Real	Read	Reference	X value for the fixed point for rotation and scaling.
fix_pt_y	Real	Read	Reference	Y value for the fixed point for rotation and scaling.
transl_vec_x	Real	Read	Reference	X value of the shift vector. Pass the value 0.0 to avoid translating the segment in the X direction.
transl_vec_y	Real	Read	Reference	Y value of the shift vector. Pass the value 0.0 to avoid translating the segment in the Y direction.
rotation	Real	Read	Reference	Angle of rotation, in radians (360 degrees = 2*pi radians). Pass the value 0.0 to avoid rotating the segment.
scale_x	Real	Read	Reference	X scale factor. Pass the value 1.0 to avoid scaling the segment in the X direction.
scale_y	Real	Read	Reference	Y scale factor. Pass the value 1.0 to avoid scaling the segment in the Y direction.
coord_type	Integer (constant)	Read	Reference	WC or NDC coordinate flag.
trans_mat	Array of reals	Write	Reference	6-element output transformation matrix resulting from the evaulation of the scaling, rotation, and translation component values. Use this value as the argument to SET SEGMENT TRANSFORMATION to establish a segment transformation.

Constants

Defined Argument	Constant	Description
coord_type	GKS$K_COORDINATES_WC	The fixed point and shift vector are WC values.
	GKS$K_COORDINATES_NDC	The fixed point and shift vector are NDC values.

Description

The EVALUATE TRANSFORMATION MATRIX function accepts scaling, rotation, and translation component values, and then writes a transformation matrix to the last argument of the function. This function can be used to construct the transformation that can be used as an argument to SET SEGMENT TRANSFORMATION to establish a segment transformation.

The order of transformation is:

1. Scale (relative to the specified fixed point)
2. Rotate (relative to the specified fixed point)
3. Shift

Segment transformation and transformation matrixes are described in the *DEC GKS User's Guide*.

See Also

ACCUMULATE TRANSFORMATION MATRIX
INSERT SEGMENT
SET SEGMENT TRANSFORMATION
Example 7–2 for a program example using the EVALUATE TRANSFORMATION MATRIX function

SELECT NORMALIZATION TRANSFORMATION

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$select_xform (trans_num)

Argument	Data Type	Access	Passed by	Description
trans_num	Integer	Read	Reference	Normalization transformation number

Description

The SELECT NORMALIZATION TRANSFORMATION function sets the *normalization transformation number* entry in the GKS state list as the current transformation, and uses the associated window and viewport to transform points from the WC system to the NDC system for subsequent output generation.

To set or reset windows and viewports associated with a transformation number, pass the normalization transformation number to SET WINDOW and SET VIEWPORT. After selecting this number, any subsequent calls to output functions use the window and viewport associated with this number.

By default, DEC GKS uses the unity normalization transformation number 0. Use the default when you want to map the default normalization window to the default NDC viewport.

See Also

SET VIEWPORT
SET WINDOW
Example 7–3 for a program example using the SELECT NORMALIZATION TRANSFORMATION function

SET CLIPPING INDICATOR

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_clipping (clip)

Argument	Data Type	Access	Passed by	Description
clip	Integer (constant)	Read	Reference	Clipping indicator

Constants

Defined Argument	Constant	Description
clip	GKS$K_NOCLIP	Clipping disabled
	GKS$K_CLIP	Clipping enabled

Description

The SET CLIPPING INDICATOR function enables or disables clipping of the image at the normalization viewport boundary by setting the clipping flag in the GKS state list.

If clipping is enabled, DEC GKS clips all generated output primitives at the normalization viewport boundary. If clipping is disabled, primitives may exceed the normalization viewport boundaries. By default, DEC GKS clips primitives.

Note

This function works only for the normalization viewport. Pictures are always clipped at the workstation window, despite the current status of the clipping flag.

See Also

INSERT SEGMENT
Example 7–3 for a program example using the SET CLIPPING INDICATOR function

SET VIEWPORT

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_viewport (trans_num, min_x, max_x, min_y, max_y)

Argument	Data Type	Access	Passed by	Description
trans_num	Integer	Read	Reference	Normalization transformation number
min_x	Real	Read	Reference	Minimum X NDC value
max_x	Real	Read	Reference	Maximum X NDC value
min_y	Real	Read	Reference	Minimum Y NDC value
max_y	Real	Read	Reference	Maximum Y NDC value

Description

The SET VIEWPORT function specifies the viewport limits for the specified normalization transformation.

The normalization transformation maps output primitives and geometric attributes from WC units to NDC units. This mapping is defined by specifying a rectangle in WC points (the normalization window) that is to be mapped to a specified rectangle in NDC points (the normalization viewport). If the two rectangles do not have the same aspect ratios, mapping is not uniform.

SET VIEWPORT modifies the X and Y components of the specified normalization viewport. By default, all normalization transformations have their windows set to [0,1] in X and Y, and their viewports set to [0,1] in X and Y.

See Also

SELECT NORMALIZATION TRANSFORMATION
SET VIEWPORT INPUT PRIORITY
SET WINDOW
Example 7–3 for a program example using the SET VIEWPORT function

SET VIEWPORT INPUT PRIORITY

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_viewport_priority (trans_num, ref_trans_num, rel_priority)

Argument	Data Type	Access	Passed by	Description
trans_num	Integer	Read	Reference	Normalization transformation number
ref_trans_num	Integer	Read	Reference	Reference normalization transformation number
rel_priority	Integer	Read	Reference	Relative priority of normalization transformation number over reference transformation number

Constants

Defined Argument	Constant	Description
rel_priority	GKS$K_INPUT_PRIORITY_HIGHER	Higher priority
	GKS$K_INPUT_PRIORITY_LOWER	Lower priority

Description

The SET VIEWPORT INPUT PRIORITY function sets the viewport input priority of the specified normalization transformation.

Viewport input priority determines which normalization transformation is selected to map locator and stroke points from NDC points to WC points. By default, the normalization transformations are ordered in a sequential list so that transformation number 0 has the highest viewport input priority and transformation number 255 has the lowest. If you specify HIGHER priority, DEC GKS places the first number directly in front of this reference number in the sequential priority list. If you specify LOWER priority, the first number is placed directly behind this reference number in the sequential priority list.

If the normalization transformation number and the reference normalization transformation numbers are the same, this function has no effect.

See Also

GET LOCATOR
GET STROKE
REQUEST LOCATOR
REQUEST STROKE
SAMPLE LOCATOR
SAMPLE STROKE
SELECT NORMALIZATION TRANSFORMATION
SET WINDOW

SET WINDOW

Operating States

GKOP, WSOP, WSAC, SGOP

Syntax

gks$set_window (trans_num, min_x, max_x, min_y, max_y)

Argument	Data Type	Access	Passed by	Description
trans_num	Integer	Read	Reference	Normalization transformation number
min_x	Real	Read	Reference	X minimum WC value
max_x	Real	Read	Reference	X maximum WC value
min_y	Real	Read	Reference	Y minimum WC value
max_y	Real	Read	Reference	Y maximum WC value

Description

The SET WINDOW function specifies the window limits for the specified normalization transformation.

The normalization transformation maps output primitives and geometric attributes from WC units to NDC units. This mapping is defined by specifying a rectangle in WC points (the normalization window) that is to be mapped to a specified rectangle in NDC points (the normalization viewport). If the two rectangles do not have the same aspect ratios, mapping is not uniform.

SET WINDOW modifies the X and Y components of the specified normalization window. By default, all normalization transformations have their windows set to [0,1] in X and Y; and their viewports set to [0,1] in X and Y.

See Also

SELECT NORMALIZATION TRANSFORMATION
SET VIEWPORT
SET VIEWPORT INPUT PRIORITY
Example 7–3 for a program example using the SET WINDOW function

SET WORKSTATION VIEWPORT

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_ws_viewport (ws_id, min_x, max_x, min_y, max_y)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
min_x	Real	Read	Reference	Minimum X device coordinate value
max_x	Real	Read	Reference	Maximum X device coordinate value
min_y	Real	Read	Reference	Minimum Y device coordinate value
max_y	Real	Read	Reference	Maximum Y device coordinate value

Description

The SET WORKSTATION VIEWPORT function establishes the portion of the workstation surface on which DEC GKS maps the workstation window. Make sure the X and Y values are located within the display surface limits of the specified workstation. Use the function INQUIRE DISPLAY SPACE SIZE to determine the maximum X and Y values of the workstation display surface.

The default workstation viewport is the largest square on the workstation surface, beginning with the lower left corner. If you define a new workstation viewport or window such that the two are not proportionally equivalent, DEC GKS may not use the entire viewport. DEC GKS only uses the portion of the viewport that maintains the shape of the picture in the workstation window.

Note

If your workstation cannot implement an immediate change to the workstation window or viewport, the surface needs to be regenerated to establish the requested settings. If the surface is regenerated, the surface is cleared and only output primitives stored in segments are redrawn. You lose any primitives not contained in segments.

See Also

INQUIRE DISPLAY SPACE
SET WORKSTATION WINDOW
Example 7–4 for a program example using the SET WORKSTATION VIEWPORT function

SET WORKSTATION WINDOW

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_ws_window (ws_id, min_x, max_x, min_y, max_y)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
min_x	Real	Read	Reference	X minimum NDC value
max_x	Real	Read	Reference	X maximum NDC value
min_y	Real	Read	Reference	Y minimum NDC value
max_y	Real	Read	Reference	Y maximum NDC value

Description

The SET WORKSTATION WINDOW function establishes the portion of the composed picture, on the NDC plane, that DEC GKS maps to the current workstation viewport.

Despite the current value of the clipping flag, DEC GKS clips all pictures at the workstation window boundary. By default, DEC GKS uses the entire picture, mapping the default workstation window range ([0,1] $\times$ [0,1]) onto the largest square that the workstation can produce.

Note

If your workstation cannot implement an immediate change to the workstation window or viewport, the surface needs to be regenerated to establish the current settings. If the surface is regenerated, the surface is cleared and only output primitives stored in segments are redrawn. You lose any primitives not contained in segments.

See Also

SET WORKSTATION VIEWPORT

7.6 Program Examples

Example 7–1 illustrates the use of the ACCUMULATE TRANSFORMATION MATRIX function.

Example 7–1 Showing the Cumulative Effect of ACCUMULATE TRANSFORMATION MATRIX

```
/*
 *  This program shows how using the ACCUMULATE TRANSFORMATION MATRIX
 *  function lets you add transformation components to a previously
 *  set transformation.
 *
 *  NOTE: To keep the example concise, no error checking is performed.
 */

# include <stdio.h>
# include <gksdefs.h>       /* GKS$ definitions file */

main ()
{
    int         clip_indicator    = GKS$K_NOCLIP;
    int         coord_flag        = GKS$K_COORDINATES_WC;
    int         default_conid     = GKS$K_CONID_DEFAULT;
    int         device_num        = 1;
    int         house             = 1;
    int         in_class;
    int         lower_left_corner = 1;
    float       no_change         = 1.0;
    float       null              = 0.0;
    float       max_x             = 0.5;
    float       max_y             = 0.5;
    float       min_x             = 0.0;
    float       min_y             = 0.0;
    int         num_points        = 9;
    float       px[9];
    float       py[9];
    int         regen_flag        = GKS$K_PERFORM_FLAG;
    float       time_out          = 5.00;
    float       vector_x          = 0.2;
    float       vector_y          = 0.2;
    int         ws_id             = 1;
    int         ws_type           = GKS$K_WSTYPE_DEFAULT;
    float       xform_matrix[6];

/*  Open and activate GKS and the workstation environment. */

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &ws_type);
    gks$activate_ws (&ws_id);

/*
 *  Set the viewport limits for the specified normalization
 *  transformation.
 */

    gks$set_viewport (&lower_left_corner, &min_x, &max_x, &min_y, &max_y);
```

(continued on next page)

Example 7–1 (Cont.) Showing the Cumulative Effect of ACCUMULATE TRANSFORMATION MATRIX

```
/*
 *  This call selects a normalization transformation with the
 *  new viewport.
 */

    gks$select_xform (&lower_left_corner);
    gks$set_clipping (&clip_indicator);

/*  Create the segment. */

    gks$create_seg (&house);

    px[0] = 0.4;    py[0] = 0.1;
    px[1] = 0.1;    py[1] = 0.1;
    px[2] = 0.1;    py[2] = 0.7;
    px[3] = 0.4;    py[3] = 0.7;
    px[4] = 0.25;   py[4] = 0.9;
    px[5] = 0.1;    py[5] = 0.7;
    px[6] = 0.4;    py[6] = 0.1;
    px[7] = 0.4;    py[7] = 0.7;
    px[8] = 0.1;    py[8] = 0.1;

    gks$polyline (&num_points, px, py);
    gks$close_seg ();

/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Shift the house upwards and sidewards by 0.2 world coordinates points. */

    gks$eval_xform_matrix (&null, &null, &vector_x, &vector_y, &null,
       &no_change, &no_change, &coord_flag, xform_matrix);

/*
 *  Transform the segment and update the screen.  Calling SET SEGMENT
 *  TRANSFORMATION changes the segment transformation in the segment list,
 *  and sets flags in the workstation state list, telling GKS that the
 *  display surface is out of date and that an update is necessary.
 */

    gks$set_seg_xform (&house, xform_matrix);

/*
 *  Calling UPDATE WORKSTATION updates the position of the image on the
 *  workstation surface.  Wait 5 seconds.
 */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*
 *  Using ACCUMULATE TRANSFORMATION MATRIX, you can add transformation
 *  components to a previously set transformation.  The house gradually
 *  moves upward, one Y world coordinate point at a time.
 */

    gks$accum_xform_matrix (xform_matrix, &null, &null, &vector_x,
       &vector_y, &null, &no_change, &no_change, &coord_flag, xform_matrix);

/*  Transform the segment and update the screen. */

    gks$set_seg_xform (&house, xform_matrix);
```

(continued on next page)

Example 7–1 (Cont.) Showing the Cumulative Effect of ACCUMULATE TRANSFORMATION MATRIX

```
/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Again, shift the house upwards by 1 more world coordinate. */

    gks$accum_xform_matrix (xform_matrix, &null, &null, &vector_x,
       &vector_y, &null, &no_change, &no_change, &coord_flag, xform_matrix);

/*  Transform the segment.  */

    gks$set_seg_xform (&house, xform_matrix);

/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Deactivate and close the workstation environment and GKS. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();

}
```

Figure 7–4 and Figure 7–5 show the first and last position of the house. Each of the four house positions illustrates an added transformation component in the ACCUMULATE TRANSFORMATION MATRIX function.

Figure 7–4 First Transformation Component of ACCUMULATE TRANSFORMATION MATRIX

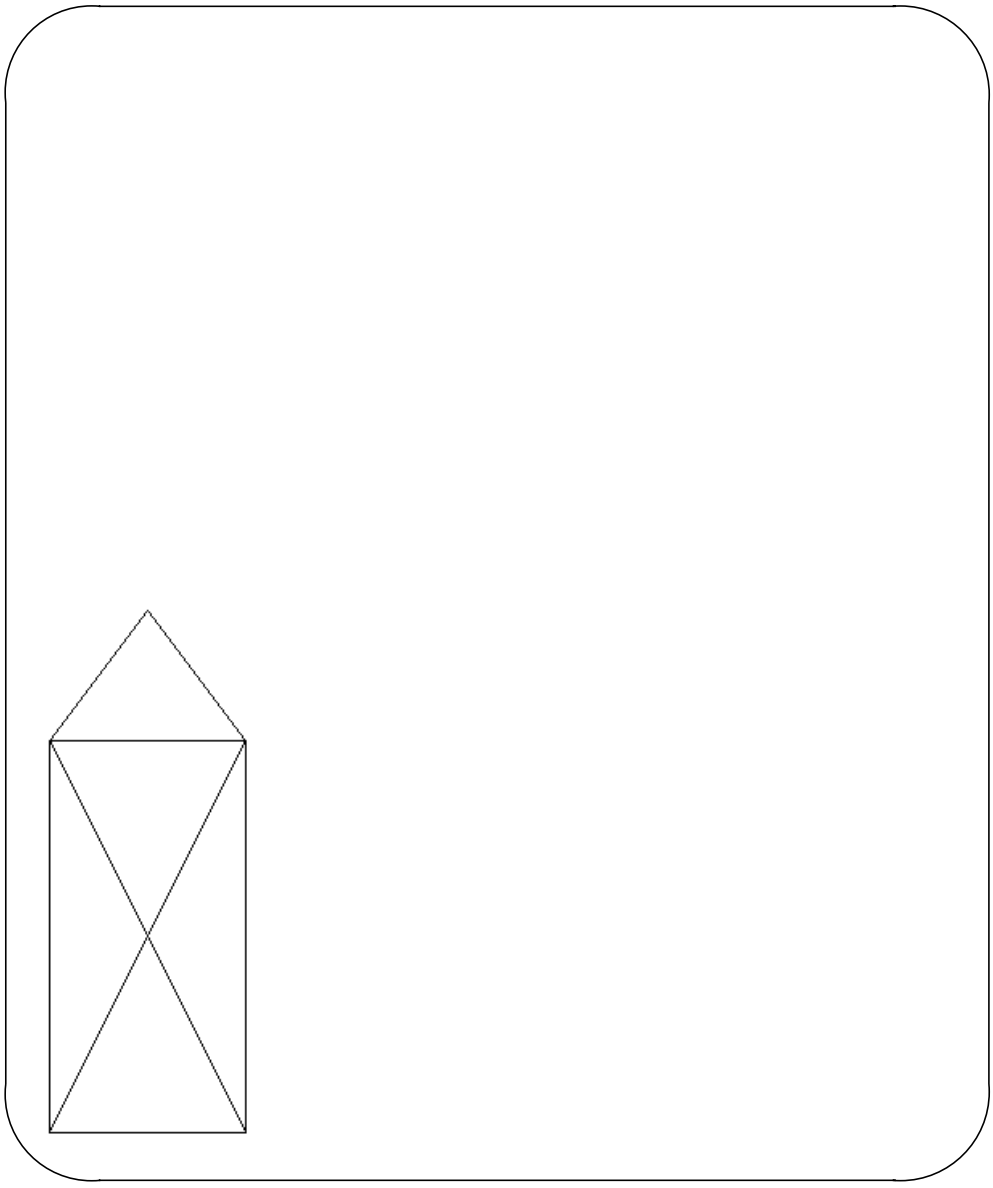


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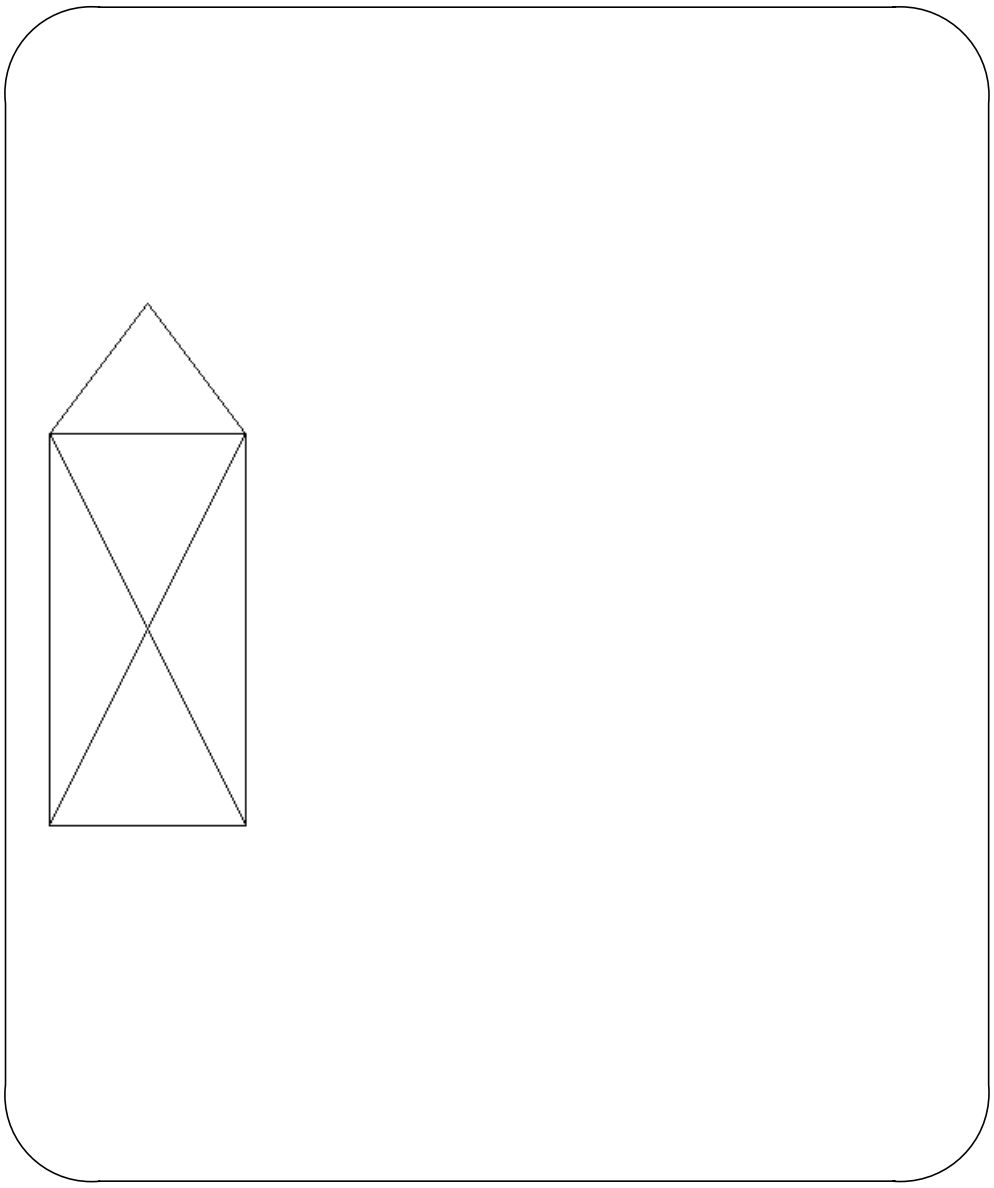
Figure 7–5 Fourth Transformation Component of ACCUMULATE TRANSFORMATION MATRIX



ZK–4022A–GE

Example 7–2 illustrates the use of the EVALUATE TRANSFORMATION MATRIX function.

Example 7–2 The Effects of a Segment Transformation

```
/*
 *  This program transforms the house contained in a segment.  The
 *  program shows the effects of segment transformation through the
 *  use of the EVALUATE TRANSFORMATION MATRIX function.
 *
 *  NOTE:  To keep the example concise, no error checking is performed.
 */

# include <stdio.h>
# include <gksdefs.h>        /* GKS$ definitions file */

main ()
{
    int         clip_indicator  = GKS$K_NOCLIP;
    int         coord_flag      = GKS$K_COORDINATES_WC;
    int         default_conid   = GKS$K_CONID_DEFAULT;
    int         device_num      = 1;
    float       fixed_x         = 0.25;
    float       fixed_y         = 0.9;
    int         house           = 1;
    int         in_class;
    int         lower_left_corner = 1;
    float       max_x           = 0.5;
    float       max_y           = 0.5;
    float       min_x           = 0.0;
    float       min_y           = 0.0;
    int         num_points      = 9;
    float       px[9];
    float       py[9];
    int         regen_flag_1    = GKS$K_POSTPONE_FLAG;
    int         regen_flag_2    = GKS$K_PERFORM_FLAG;
    float       rotation;
    float       scale_x         = .5;
    float       scale_y         = .5;
    float       time_out        = 5.00;
    float       vector_x        = .0;
    float       vector_y        = .2;
    int         ws_id           = 1;
    int         ws_type         = GKS$K_WSTYPE_DEFAULT;
    float       xform_matrix[6];

/*  Open and activate GKS and the workstation environment. */

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &ws_type);
    gks$activate_ws (&ws_id);

/*  Set the viewport limits for the specified normalization transformation. */

    gks$set_viewport (&lower_left_corner, &min_x, &max_x, &min_y, &max_y);
    gks$select_xform (&lower_left_corner);
    gks$set_clipping (&clip_indicator);
```

(continued on next page)

Example 7–2 (Cont.) The Effects of a Segment Transformation

```
/*  Create the segment. */

    gks$create_seg (&house);

    px[0] = 0.4;    py[0] = 0.1;
    px[1] = 0.1;    py[1] = 0.1;
    px[2] = 0.1;    py[2] = 0.7;
    px[3] = 0.4;    py[3] = 0.7;
    px[4] = 0.25;   py[4] = 0.9;
    px[5] = 0.1;    py[5] = 0.7;
    px[6] = 0.4;    py[6] = 0.1;
    px[7] = 0.4;    py[7] = 0.7;
    px[8] = 0.1;    py[8] = 0.1;

    gks$polyline (&num_points, px, py);
    gks$close_seg ();

/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag_1);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Rotation equals pi divided by 6 (30 degrees). */

    rotation = 3.14/6.0;

/*
 *  You can change the segment transformation that affects the
 *  rotation, scaling, and translation components of segment
 *  appearance.  The EVALUATE TRANSFORMATION MATRIX call assists in the
 *  creation of a new transformation matrix, that will permit you to
 *  specify rotation, scaling, and translation values.
 */

    gks$eval_xform_matrix (&fixed_x, &fixed_y, &vector_x, &vector_y,
       &rotation, &scale_x, &scale_y, &coord_flag, xform_matrix);

/*  Transform the segment. */

    gks$set_seg_xform (&house, xform_matrix);

/*
 *  The UPDATE WORKSTATION function updates the position of the image on
 *  the workstation surface.  All output not contained in segments is lost.
 *  Wait 5 seconds.
 */

    gks$update_ws (&ws_id, &regen_flag_2);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Deactivate and close the workstation environment and GKS. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();

}
```

Figure 7–6 shows the house before the segment transformation.

Figure 7–6 Output Prior to Segment Transformation

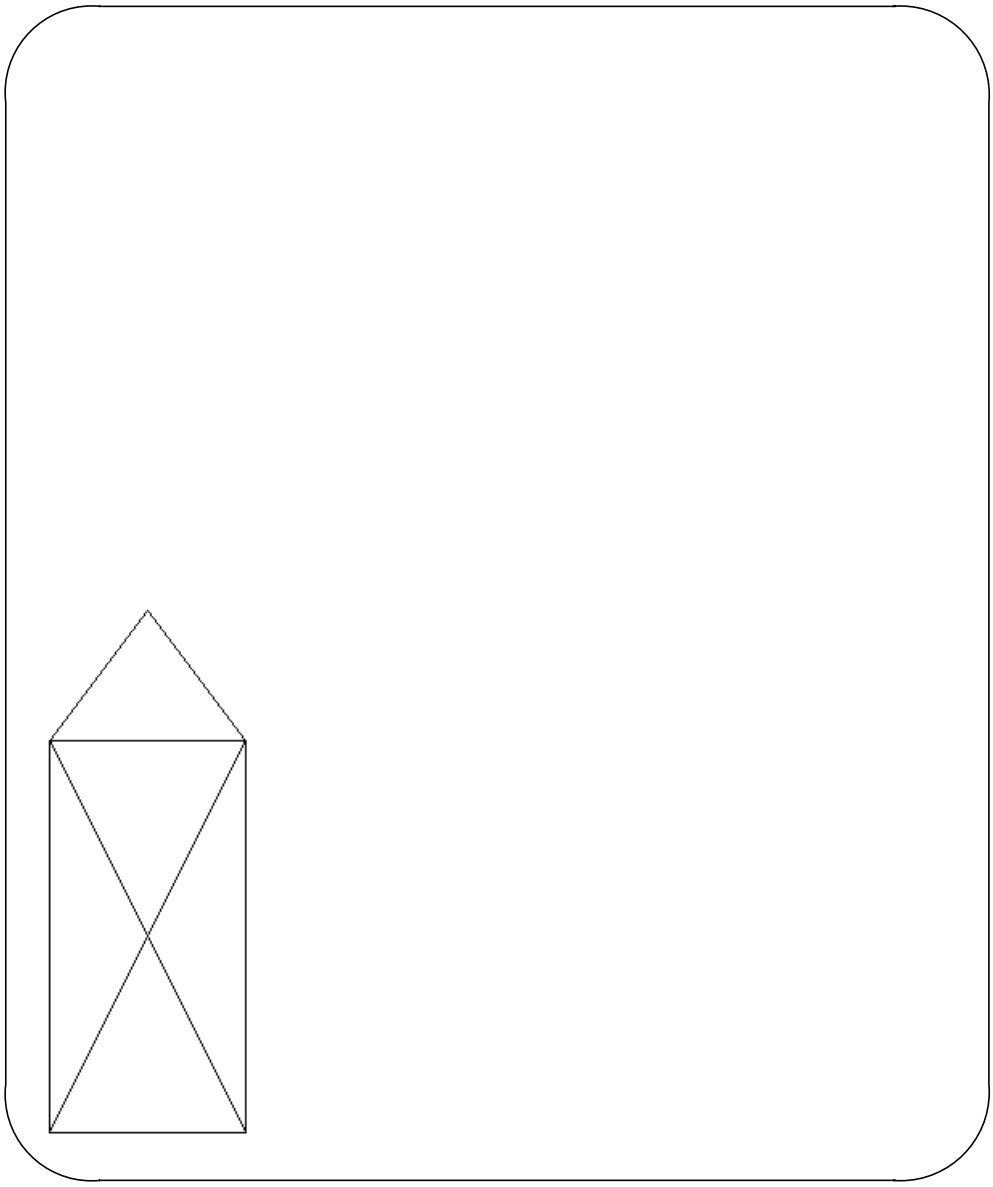


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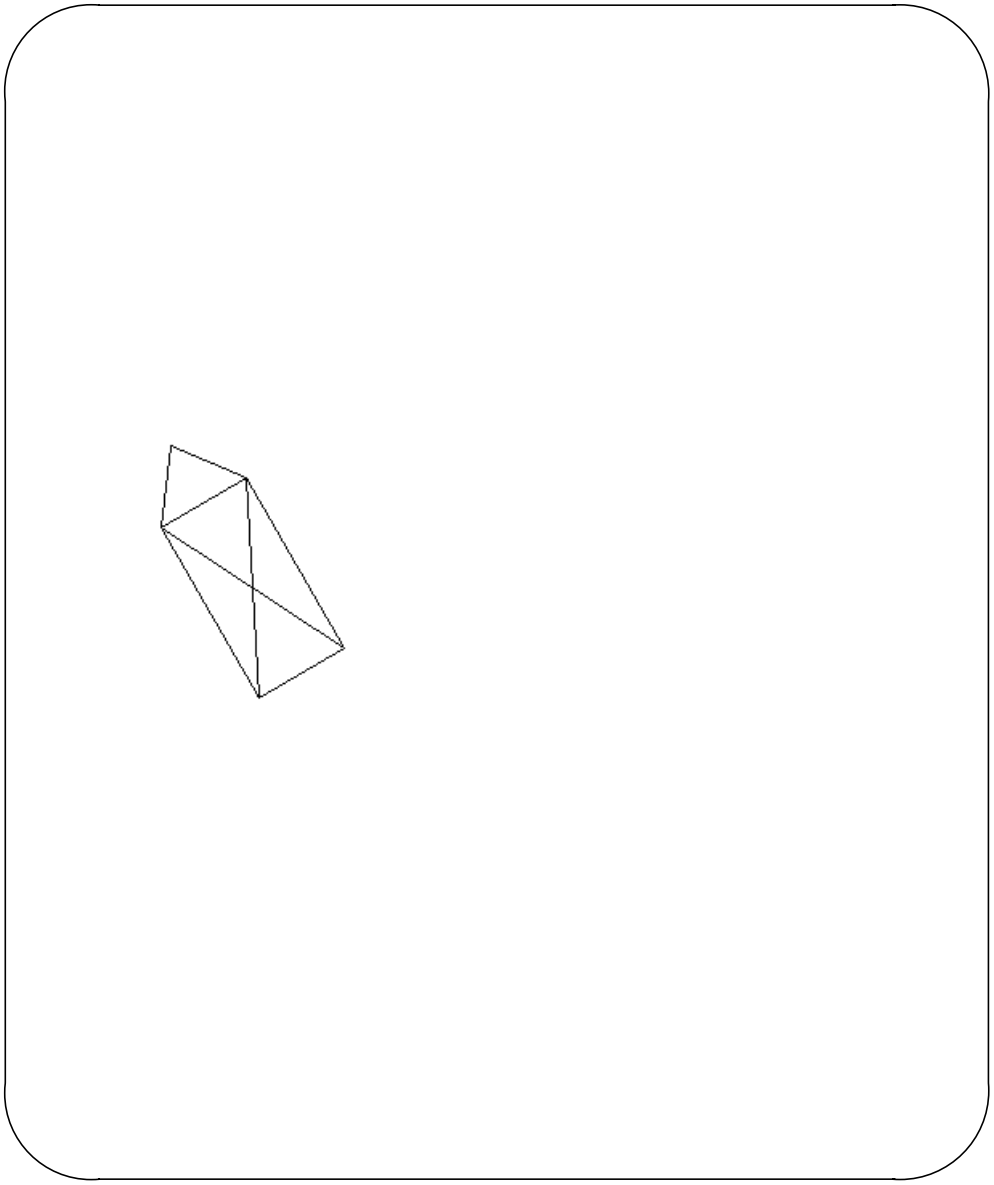
Figure 7–7 shows the house after the effects of the segment transformation.

Figure 7–7 Effect of Segment Transformation



ZK–4020A–GE

Example 7–3 illustrates the use of the SET CLIPPING INDICATOR function.

Example 7–3 Controlling Clipping at the World Viewport

```
/*
 *  This program illustrates the SET CLIPPING INDICATOR function.
 *  It generates a "tall, thin house" that overlaps the
 *  normalization window and viewport. You can see the overlapping
 *  portion if clipping is disabled
 *
 *  To keep the example concise, no error checking is performed.
 */

# include <stdio.h>
# include <gksdefs.h>        /* GKS$ definitions file */

main ()
{
  int         clip_indicator  = GKS$K_NOCLIP;
  int         default_conid   = GKS$K_CONID_DEFAULT;
  int         device_num      = 1;
  int         half            = 1;
  int         in_class;
  int         low_left_corner = 1;
  float       max_x;
  float       max_y;
  float       min_x;
  float       min_y;
  int         num_points;
  float       px[9];
  float       py[9];
  int         regen_flag   = GKS$K_PERFORM_FLAG;
  float       time_out     = 5.0;
  int         ws_id        = 1;
  int         ws_type      = GKS$K_WSTYPE_DEFAULT;

/*  Open and activate GKS and the workstation environments. */

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &ws_type);
    gks$activate_ws (&ws_id);

/*
 *  Outlining the default world window results in the outlining of
 *  the NDC plane, the workstation window, and the workstation
 *  viewport, by default.
 */

    num_points = 5;

    px[0] = 0.0;    py[0] = 0.0;
    px[1] = 0.5;    py[1] = 0.0;
    px[2] = 0.5;    py[2] = 0.5;
    px[3] = 0.0;    py[3] = 0.5;
    px[4] = 0.0;    py[4] = 0.0;

    gks$polyline (&num_points, px, py);
```

(continued on next page)

Example 7–3 (Cont.) Controlling Clipping at the World Viewport

```
/*
 * This window (half of the default window) and viewport (lower
 * left corner of the default viewport) are associated with
 * normalization transformation number 1.
 */

    min_x = 0.0;    max_x = 0.9;
    min_y = 0.0;    max_y = 0.5;

    gks$set_window (&half, &min_x, &max_x, &min_y, &max_y);

    min_x = 0.0;    max_x = 0.5;
    min_y = 0.0;    max_y = 0.5;

    gks$set_viewport (&low_left_corner, &min_x, &max_x, &min_y, &max_y);
    gks$select_xform (&low_left_corner);

/*  Draw the polyline and show the clipping. */

    num_points = 9;
    px[0] = 0.4;    py[0] = 0.1;
    px[1] = 0.1;    py[1] = 0.1;
    px[2] = 0.1;    py[2] = 0.7;
    px[3] = 0.4;    py[3] = 0.7;
    px[4] = 0.25;   py[4] = 0.9;
    px[5] = 0.1;    py[5] = 0.7;
    px[6] = 0.4;    py[6] = 0.1;
    px[7] = 0.4;    py[7] = 0.7;
    px[8] = 0.1;    py[8] = 0.1;

    gks$polyline (&num_points, px, py);

/*  Release the deferred output and pause to view the screen. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Disable clipping. */

    gks$set_clipping (&clip_indicator);

/* Draw the polyline again. */

    gks$polyline (&num_points, px, py);

/* Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Deactivate and close the workstation environments and GKS. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();

}
```

Figure 7–8 illustrates the house while clipping is enabled.

Figure 7–8 SET CLIPPING INDICATOR with Clipping Enabled

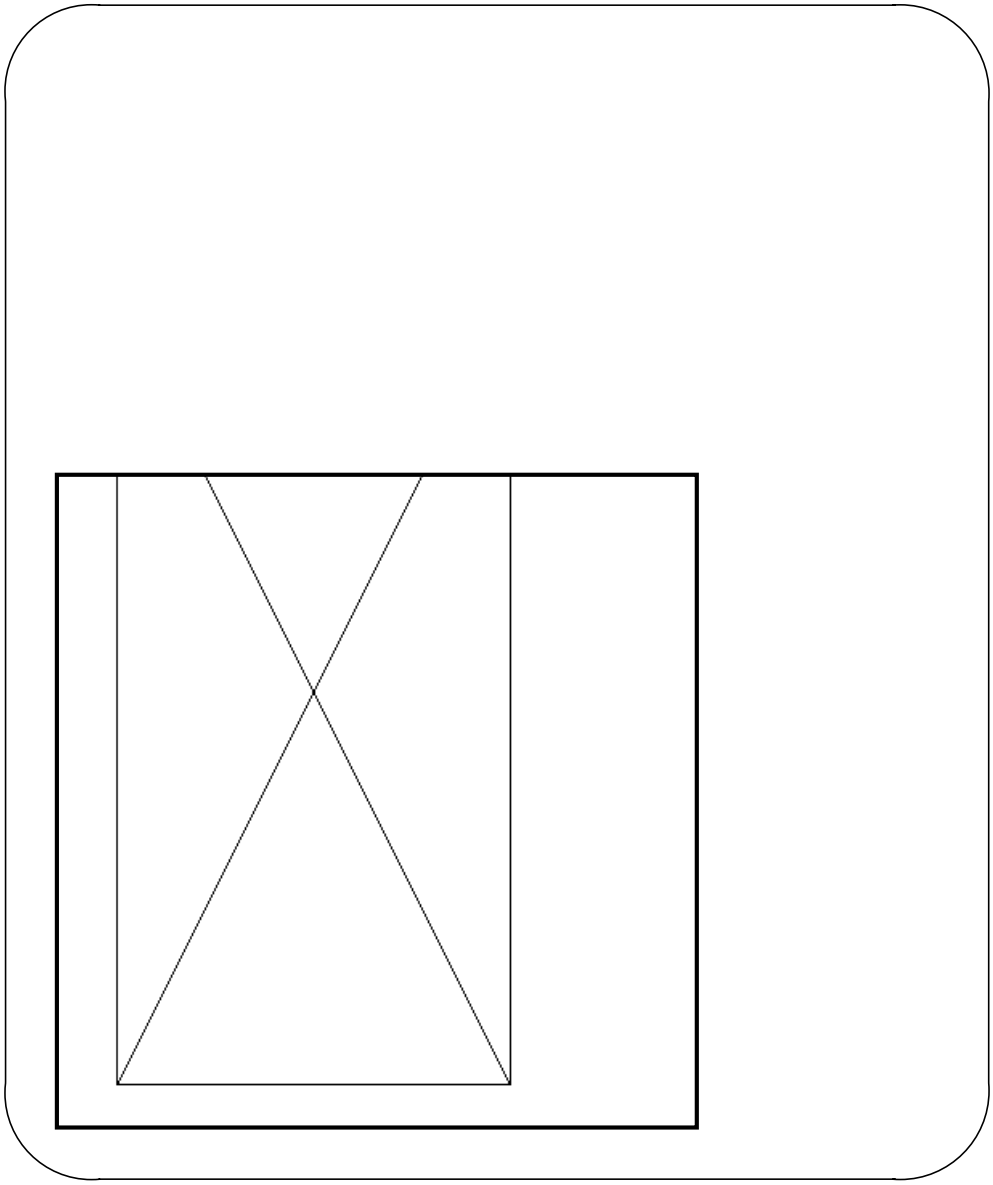
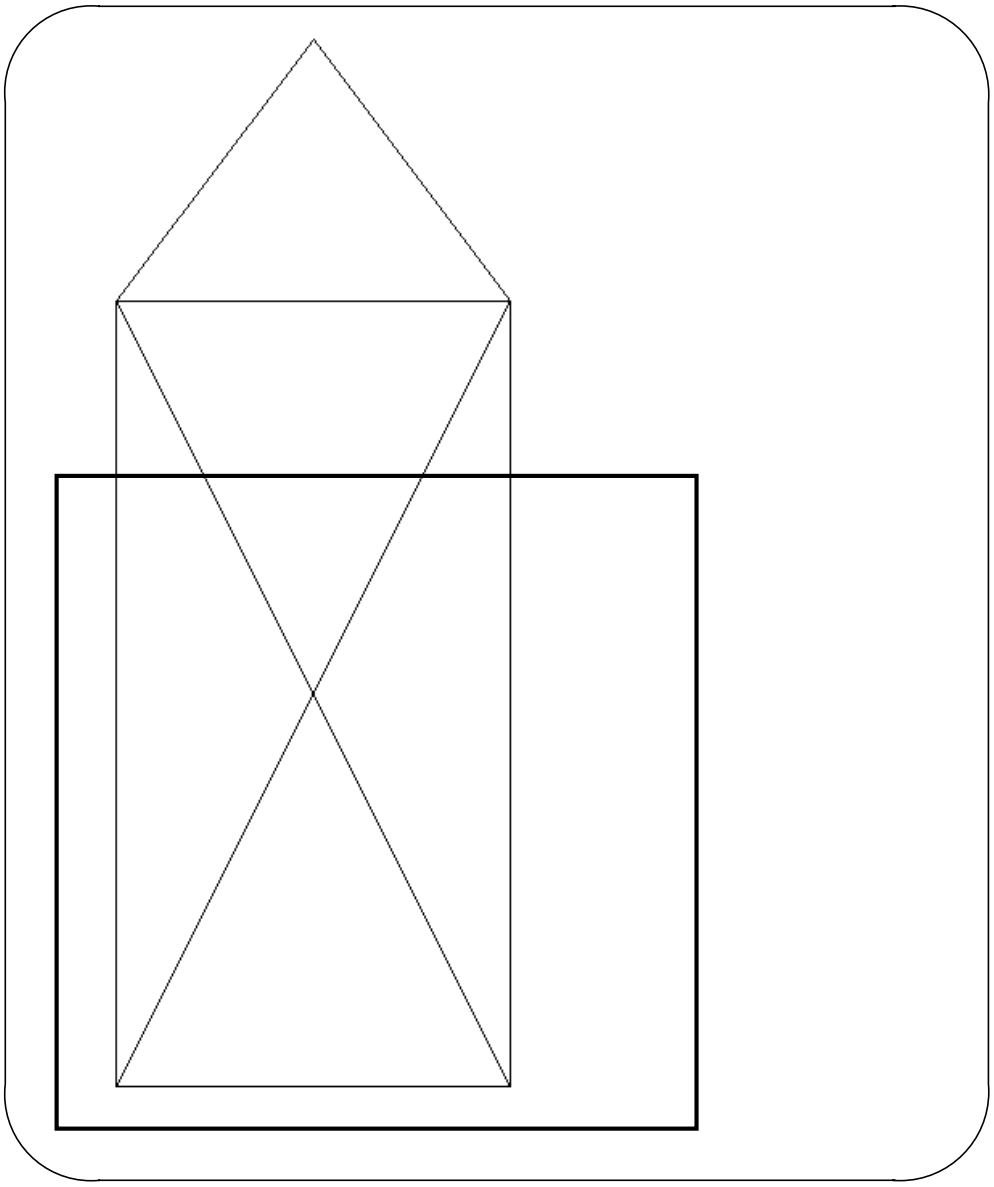


Figure 7–9 illustrates the house while clipping is disabled. The house overlaps the normalization window and viewport.

Figure 7–9 SET CLIPPING INDICATOR with Clipping Disabled



ZK–4028A–GE

Example 7–4 illustrates the use of the SET WORKSTATION VIEWPORT function.

Example 7–4 Establishing a Workstation Viewport

```
/*
 *  This program uses the default normalization transformations,
 *  generates a "tall, thin house," updates the screen, changes
 *  the workstation viewport to the lower left corner of the display
 *  surface, and generates the output again.
 *
 *  NOTE:  To keep the example concise, no error checking is performed.
 */

# include <stdio.h>
# include <gksdefs.h>

main ()
{

  int         default_conid = GKS$K_CONID_DEFAULT;
  int         device_num    = 1;
  float       device_x;
  float       device_y;
  int         error;
  int         house     = 1;
  int         in_class;
  float       max_x;
  float       max_y;
  int         meters;
  float       min_x;
  float       min_y;
  int         not_used;
  int         num_points;
  float       px[9];
  float       py[9];
  float       raster_x;
  float       raster_y;
  int         regen_flag     = GKS$K_PERFORM_FLAG;
  float       time_out       = 5.00;
  int         ws_id      = 1;
  int         ws_type        = GKS$K_WSTYPE_DEFAULT;
  int       ws_trans;

/*  Open GKS and the workstation environment. */

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &ws_type);
    gks$activate_ws (&ws_id);

/*
 *  Outlining the default world window results in outlining
 *  the NDC plane, the workstation window, and the workstation
 *  viewport, by default.
 */

    num_points = 5;
    px[0] = 0.0;    py[0] = 0.0;
    px[1] = 1.0;    py[1] = 0.0;
    px[2] = 1.0;    py[2] = 1.0;
    px[3] = 0.0;    py[3] = 1.0;
    px[4] = 0.0;    py[4] = 0.0;

    gks$polyline (&num_points, px, py);
```

(continued on next page)

Example 7–4 (Cont.) Establishing a Workstation Viewport

```
/*  Create and draw the house.  */

    num_points = 9;
    px[0] = 0.4;    py[0] = 0.1;
    px[1] = 0.1;    py[1] = 0.1;
    px[2] = 0.1;    py[2] = 0.7;
    px[3] = 0.4;    py[3] = 0.7;
    px[4] = 0.25;   py[4] = 0.9;
    px[5] = 0.1;    py[5] = 0.7;
    px[6] = 0.4;    py[6] = 0.1;
    px[7] = 0.4;    py[7] = 0.7;
    px[8] = 0.1;    py[8] = 0.1;

    gks$create_seg (&house);
    gks$polyline (&num_points, px, py);
    gks$close_seg ();


/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Inquire the display size. */

    gks$inq_max_ds_size (&ws_type, &error, &meters, &device_x,
       &device_y, &raster_x, &raster_y);

/*  Set the viewport with the return values. */

    min_x = 0.0;
    max_x = device_x/2.0;
    min_y = 0.0;
    max_y = device_y/2.0;

    gks$set_ws_viewport (&ws_id, &min_x, &max_x, &min_y, &max_y);


/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*
 *  Check whether the workstation viewport change required an implicit
 *  regeneration (IRG), thereby deleting all information not retained
 *  in a segment.
 */

    gks$inq_dyn_mod_ws_attb (&ws_type, &error, &not_used, &not_used,
       &not_used, &not_used, &not_used, &not_used, &ws_trans);

    if (ws_trans == GKS$K_IRG)
       {
       num_points = 5;
       px[0] = 0.0;    py[0] = 0.0;
       px[1] = 1.0;    py[1] = 0.0;
       px[2] = 1.0;    py[2] = 1.0;
       px[3] = 0.0;    py[3] = 1.0;
       px[4] = 0.0;    py[4] = 0.0;

       gks$polyline (&num_points, px, py);
       }

/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);
```

(continued on next page)

Example 7–4 (Cont.) Establishing a Workstation Viewport

```
/*  Deactivate and close the workstation environment and GKS. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();

}
```

Figure 7–10 illustrates how the house is displayed using the default normalization transformation.

Figure 7–10 Output Using Default Normalization Transformation

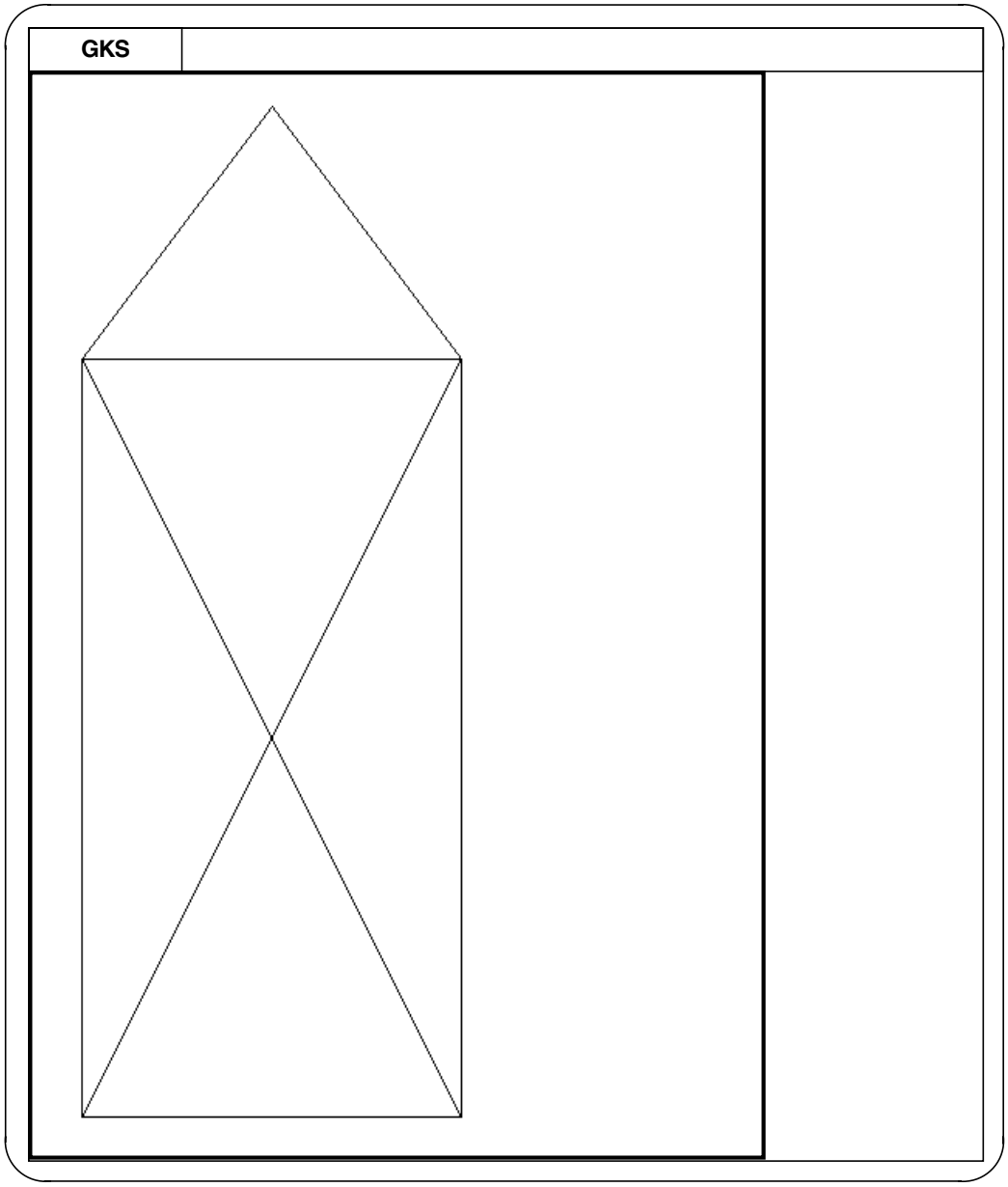
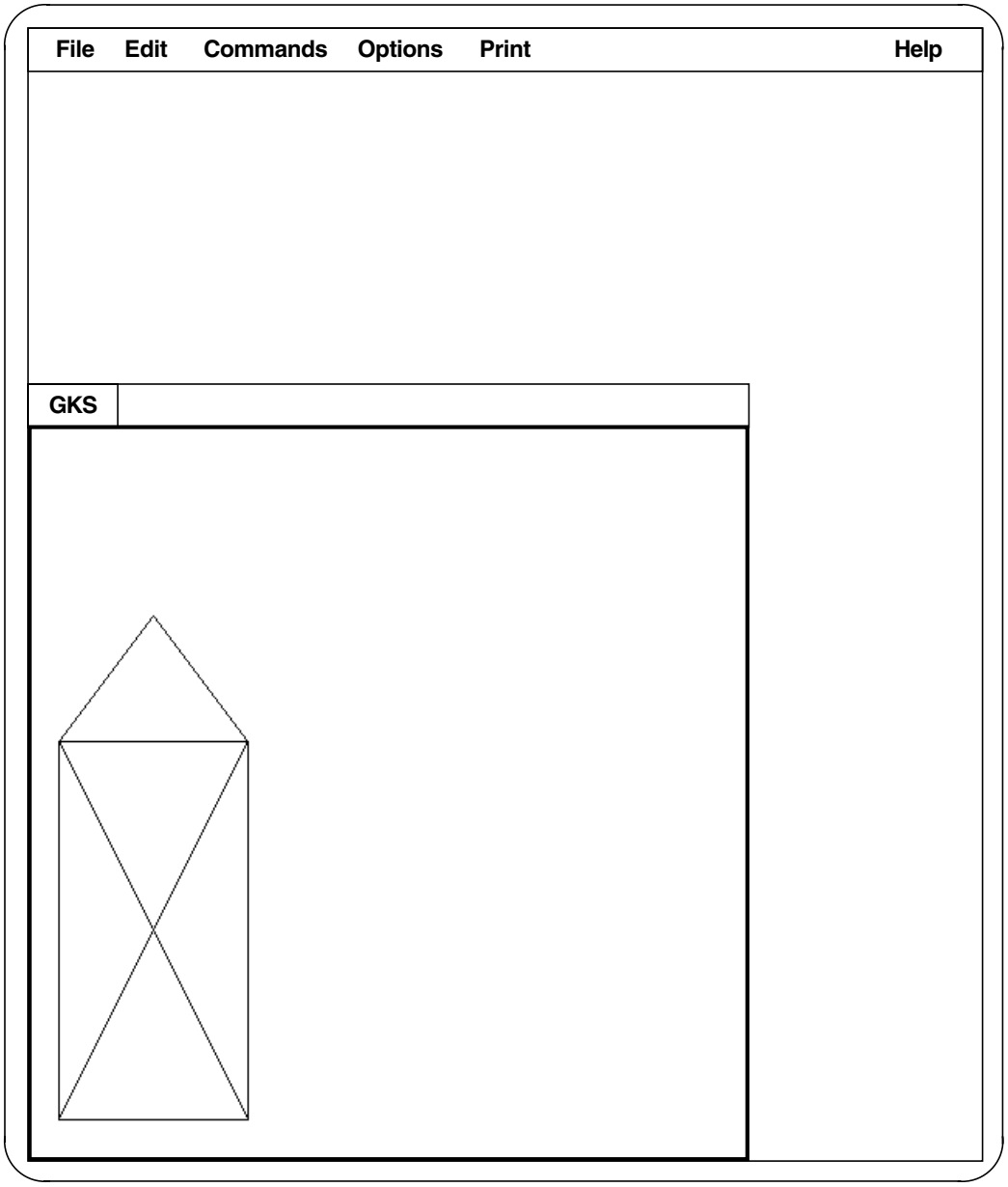


Figure 7–11 illustrates how the house is displayed with changes to the workstation viewport.

Figure 7–11 Output After Changes to the Workstation Viewport



Segment Functions

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8
Segment Functions

The DEC GKS segment functions create, manipulate, and delete stored groups of output primitives called **segments**.

When producing output, you may wish to reproduce a graphic image at different positions within a single picture, possibly across different devices, and possibly at different points during program execution. It is inefficient to call all the DEC GKS output and attribute functions every time you want to reproduce such an image. DEC GKS provides a method of storing groups of output primitives, output attributes, and clipping information in a segment.

8.1 Creating, Using, and Deleting Segments

To use segments, your workstation should be one of the categories OUTPUT, OUTIN, MO, or WISS (described in Section 8.2). When you create a segment, the segment is stored on all active workstations.

To create a segment, DEC GKS must be in the operating state WSAC (at least one workstation active). When DEC GKS is in this state, you can call CREATE SEGMENT, which creates a segment on all active workstations. The only argument passed to CREATE SEGMENT is the segment name. You use a segment name to identify a particular segment.

After you call CREATE SEGMENT, the DEC GKS operating state changes to SGOP (segment open). Subsequent calls to the DEC GKS output and attribute functions produce primitives stored in the segment on all active workstations. When you have created the desired image, call CLOSE SEGMENT. This call closes the segment, causing the DEC GKS operating state to change back to WSAC.

When you call CREATE SEGMENT, the DEC GKS operating state changes from WSAC to SGOP. SGOP signifies that a segment is open, or being created. Also, calling CREATE SEGMENT establishes the segment state list associated with the segment name, and DEC GKS records the segment name (in the GKS state list) as the name of the currently open segment.

Segments cannot contain other segments; in other words, segments cannot be nested. Therefore, if you call CREATE SEGMENT, you must call CLOSE SEGMENT before you attempt to call CREATE SEGMENT again. Until you call CLOSE SEGMENT, DEC GKS associates all generated output primitives with the name of the open segment. When you call CLOSE SEGMENT, the DEC GKS operating state changes from SGOP back to WSAC. After you close a segment, you cannot reopen the segment to add more output primitives.

If you need to, you can rename the segment using the function RENAME SEGMENT. If you are keeping an ordered list of segments, calls to this function may be useful.

There are three ways to delete segments. If you use the function DELETE SEGMENT FROM WORKSTATION, DEC GKS deletes the segment from the specified workstation. If you use DELETE SEGMENT, DEC GKS deletes the specified segment from all workstations storing the segment. If you call CLEAR WORKSTATION, and if the surface is cleared, you delete all segments stored on that workstation.

For more information concerning the DEC GKS operating states or the segment state list, see Chapter 4.

Note

If you store primitives in a segment, and want to be able to change the primitive's appearance elsewhere in the program, you must set the primitive's ASF to be GKS$K_ASF_BUNDLED before you generate the primitive. In this way, the primitive's ASF is stored in the segment with the primitive. If you want to change the primitive's appearance, you call the appropriate SET . . . REPRESENTATION function for the primitive's bundle index. If you store the primitive in a segment using individual attributes, the appearance of the primitive cannot be changed after primitive generation. For more information on aspect source flags, see Chapter 6.

8.1.1 Pick Identification

One of the DEC GKS logical input classes is the **pick** input class. Using the function REQUEST PICK, the user can choose a segment, and possibly a portion of the segment, as displayed on the surface of the workstation.

REQUEST PICK returns the segment name and the **pick identifier** of the segment or segment portion chosen by the user. The pick identifier is a numeric output attribute. Like other output attribute values (line type, line width, color, text alignment, and so on), the pick identifier is bound to an output primitive at the time of generation, and you cannot change its value. However, you can change the current pick identifier value before generating each output primitive. In doing so, DEC GKS associates a different numeric pick identifier value with each generated primitive.

During segment creation, you can use pick identifiers to establish a hierarchy within the segment. During pick input, DEC GKS returns the same segment name if the pick prompt touches the same segment, but may return different pick identifiers depending on which primitive *within the segment* the pick prompt touches.

To see how to use pick identifiers, see Example 9–2 for a program example that calls SET PICK IDENTIFIER.

8.2 Workstations and Segment Storage

When DEC GKS stores a segment on an active OUTPUT, OUTIN, or MO workstation, the method of storage is called workstation dependent segment storage (WDSS). On these workstations, you can control the segment attributes (see Section 8.4), move or alter the shape of the segment using the segment transformation functions (see Section 8.4.4.1), or delete the segment (either from a single workstation or from all workstations storing the segment).

If you are creating segments using the WDSS method of storage, you *cannot* copy a segment from one workstation to another. Also, you cannot recall a segment once it has been deleted from a workstation. You can only alter the segment's position within the picture by changing the segment transformation.

To copy a segment, or to reassociate a segment with a workstation after deletion from that particular workstation, you need to store the segment in workstation independent segment storage (WISS). Once a segment is stored in WISS, the segment is independent of any workstation and can be copied from WISS to other workstations.

By storing a segment on a WISS workstation, you can delete a segment from a non-WISS workstation and recall it again. Then, when you need to use the deleted segment later in the program, you can *associate* the segment stored on WISS with the other workstation, *copy* the segment to the other workstation, or *insert* the segment's primitives into the output stream of the other workstation.

If you associate a segment stored on a WISS workstation with another workstation, the other workstation stores an identical segment. If you copy a segment from a WISS workstation to another workstation, the segment's primitives are copied to the surface of the second workstation, but the second workstation does *not* store them in a segment. If you insert a segment into the output stream of another workstation, DEC GKS applies an INSERT SEGMENT transformation and then copies all the segment's primitives onto the surface of the other workstation, but the second workstation does *not* store them in a segment. If you are creating a segment, you can insert another segment's primitives into the newly created segment, but those primitives become part of the new segment and are no longer bound by the old segment name (see INSERT SEGMENT in this chapter for more information).

DEC GKS implements the WISS data structure as a workstation. To store a segment using WISS, open and then activate WISS specifying GKS$K_WSTYPE_WISS (value 5) as the workstation type. When you open WISS, you can specify GKS$K_CONID_DEFAULT as the connection identifier argument. (If you specify GKS$K_WSTYPE_WISS, DEC GKS ignores the connection identifier argument.)

Once you activate the WISS workstation and create segments, you can use the DEC GKS functions ASSOCIATE SEGMENT WITH WORKSTATION, COPY SEGMENT TO WORKSTATION, and INSERT SEGMENT. Example 8–1 shows the difference between ASSOCIATE SEGMENT WITH WORKSTATION and COPY SEGMENT TO WORKSTATION. See Example 8–2 for a program example using INSERT SEGMENT.

8.3 Segments and Surface Update

When you request changes to segment attributes (described in Section 8.4), the change may take place immediately (dynamically) or DEC GKS may need to update the surface to implement the change (an implicit regeneration), depending on the capabilities of your device. An implicit regeneration clears the screen and only redraws the primitives stored in segments. All primitives not stored in segments are lost. You can use the function INQUIRE DYNAMIC MODIFICATION OF SEGMENT ATTRIBUTES to determine if a request for a segment attribute change requires an implicit regeneration on your device.

There are two ways to determine whether your device requires an implicit regeneration to implement a change. If you are making only a few changes, you can call INQUIRE WORKSTATION DEFERRAL AND UPDATE STATES to determine if the *new frame necessary at update* entry is YES. If you are making many different changes, calling this function each time is inefficient.

You can call INQUIRE DYNAMIC MODIFICATION OF SEGMENT ATTRIBUTES once to determine for which changes your workstation requires an implicit regeneration. Then, you can set flags to force regenerations only when you make changes that require them. If you need to regenerate the picture on the workstation surface when changing segment attributes, call UPDATE WORKSTATION and pass GKS$K_PERFORM_FLAG as an argument.

Note

If you want to redraw all the segments on the workstation surface regardless of the current status of the new frame flag, call REDRAW ALL SEGMENTS ON WORKSTATION. A call to this function is equivalent to a call to UPDATE WORKSTATION while the new frame flag is set to YES, and while passing the argument GKS$K_PERFORM_FLAG.

Requests for changes to segments may require an implicit regeneration of the screen depending on the capabilities of your device (see Section 8.4 for a complete descriptions of the segment attributes). Table 8–1 describes surface regeneration resulting from changes to segments.

Table 8–1 Surface Regeneration from Changes to Segments

Change	Possible Effect
Segment priority	Calls to the following functions may create a situation in which two segments of different priorities overlap, or in which an overlapped segment must now be made completely visible, or in which visibility changes. • ASSOCIATE SEGMENT WITH WORKSTATION • DELETE SEGMENT • DELETE SEGMENT FROM WORKSTATION • SET SEGMENT PRIORITY • SET SEGMENT TRANSFORMATION • SET VISIBILITY In all cases, DEC GKS must take the segments' priorities into consideration before determining if the picture is out of date.
Segment transformation	Many workstations are unable to reposition segments dynamically, thus requiring an implicit regeneration.

(continued on next page)

Table 8–1 (Cont.) Surface Regeneration from Changes to Segments

Change	Possible Effect
Segment visibility	Some workstations may be able to make an invisible segment visible dynamically, but may need an implicit regeneration to make visible segments invisible, as visible-to-invisible changes require that the segments "beneath" the segment be redrawn. Some workstations may need an implicit regeneration to perform both, and some workstations may be able to make both changes dynamically.
Segment highlighting	Some workstations may need to implicitly regenerate the surface before they can highlight a segment.
Segment deletion	Segment deletion may require reproducing the segments "beneath" the deleted segment. Calling either DELETE SEGMENT or DELETE SEGMENT FROM WORKSTATION can require an implicit regeneration of the screen, depending on the capabilities of your workstation.

There are other conditions under which DEC GKS may require a surface regeneration, depending on the capabilities of your device. For example, if you attempt to alter the polyline representation (see Chapter 6), the workstation requires an implicit regeneration to affect this change.

If you are going to make certain output attribute changes or workstation transformation changes, you need to put all important output primitives into segments so they are not lost when you update the surface. For complete information as to changes that may require implicit regeneration on UPDATE WORKSTATION, or on REDRAW ALL SEGMENTS ON WORKSTATION, see Chapter 4.

8.4 Segment Attributes

As a workstation stores the output attributes of a primitive when it is a part of a segment, a workstation stores **segment attributes** that affect all the primitives stored within a segment. The segment attributes are as follows:

- Detectability
- Highlighting
- Priority
- Transformation
- Visibility

The following sections describe the segment attributes in detail.

8.4.1 Detectability

The detectability segment attribute determines whether or not the segment can be chosen during pick input. Pick input is only available on OUTIN workstations. By default, DEC GKS segments are undetectable (GKS$K_UNDETECTABLE).

To pick a segment, it must be both detectable and visible (GKS$K_VISIBLE). In many applications, if you do not want the user to be able to pick a segment, you should make the segment invisible as well as undetectable. Remember that

making a segment undetectable does not make the segment invisible; these are two separate segment attributes.

For more information concerning detectability, see SET DETECTABILITY in this chapter. For more information concerning pick input, see Chapter 9.

8.4.2 Highlighting

The highlighting segment attribute determines whether or not a workstation presents a highlighted segment on the workstation surface to draw the attention of the user to that segment. By default, DEC GKS segments are not highlighted (GKS$K_NORMAL).

Highlighting is device dependent and can be implemented in any of the following ways:

- Blinking all primitives in a segment
- Outlining the **segment extent rectangle**
- Reversing the foreground and background colors within the segment extent rectangle
- Outlining of all output primitives stored within the segment

The segment extent rectangle is the rectangle that outlines all the NDC points of the primitives stored in the segment. For more information concerning highlighting, see SET HIGHLIGHTING in this chapter.

8.4.3 Priority

The priority segment attribute determines which segment's primitives take priority when two segments overlap on the workstation surface. To assign a priority to a segment, you assign to the segment a real number greater than or equal to the value 0.0, and less than or equal to the value 1.0. Segments with the priority 0.0 have the lowest priority, and segments with the priority 1.0 have the highest priority. By default, DEC GKS segments have a priority value of 0.0.

Different devices implement segment priority differently. A device supports either an infinite number of priorities (theoretically), or a specific number of priorities. If the device supports an infinite number of priorities, the *maximum number of segment priorities supported* entry in the workstation description table is the value 0. Otherwise, the entry contains the number of priorities supported. (To access this table entry, call the function INQUIRE NUMBER OF SEGMENT PRIORITIES SUPPORTED.)

If the number of priorities supported is not 0, DEC GKS divides the 0.0 to 1.0 priority range into subranges according to the number of supported priorities. If you specify for two different segments, two different priority values that fall within the same subrange, those segments have the same priority. For example, if a workstation supports two segment priorities, all segments with the specified values between 0.0 and 0.5 inclusive have the same priority, and values between 0.51 and 1.0 have the same priority.

8.4.4 Transformation

When DEC GKS creates a picture containing segments, it places into effect the current normalization transformation, applies the current **segment transformation** to each segment, and if you have enabled clipping, clips the picture at the current normalization viewport. By default, DEC GKS applies the **identity segment transformation** to all segments. The identity transformation makes no changes to the size or position of the segment.

If you desire, you can change the segment transformation that affects the following components of segment appearance:

Component	Description
Scaling	The first step in the segment transformation process is to scale the segment. Scaling determines the size of the segment extent rectangle, either enlarging or decreasing the total size of the segment.
Rotation	The second step in the segment transformation process is to rotate the segment. Rotation determines the positioning of the segment by establishing a fixed coordinate point in the segment, and then rotating the remaining segment points around the fixed point axis by a specified number of radians.
Translation	The last step in the segment transformation process is to translate the segment's coordinate points to new points according to vector coordinate values. Simply, it shifts the segment position in NDC space.

The first decision you must make when working with segment transformations is whether to specify your fixed point as a WC or NDC point. If you want to transform portions of the segment according to the *current* normalization transformation mapping, specify WC points. DEC GKS maps the specified WC point to the NDC plane and then performs the rotation or scaling.

If you want to transform the segment as stored on the NDC plane (regardless of the current normalization transformation), specify an NDC point as your fixed point.

Next, if you want to scale or to rotate the segment, you must decide which point in the segment to use as a **fixed point**. When DEC GKS scales the segment, the fixed point is the only point that maintains its position as the segment decreases or increases in size, either towards or away from the fixed point. When DEC GKS rotates the segment, it uses the fixed point as the point around which the other points in the segment rotate.

If you decide to shift the segment, you need to establish a **translation vector**. The translation vector is expressed by real number values that specify by how much the X and Y segment coordinate values change. When DEC GKS translates the segment, it adds the values specified in the translation vector to the segment's X and Y values, moving the segment within the specified coordinate system. If you do not wish to translate the segment's position, you can specify the value 0.0 for all components of the translation vector. The two-dimensional translation vector has X and Y components only.

If you decide to rotate the segment, you must decide on an **angle of rotation** in radians. A radian is a measure of an angle. A full circle, 360 degrees, equals 2*pi radians, one radian equaling 180/pi degrees. The value pi equals approximately 3.14. DEC GKS rotates the segment about the fixed point by the radian specified as the angle of rotation. Positive rotation values rotate counter

clockwise; negative rotation values rotate clockwise. If you do not wish to rotate the segment, you can specify 0.0 for the angle of rotation.

Finally, if you decide to scale the segment, you need to establish the **scale factors**. You express a scale factor as two real number values; DEC GKS multiplies the X and Y segment coordinate values by the scale factor components to determine the new size of the segment. If you do not want to scale the segment (keeping the segment the same size), specify the value 1.0 for all components of the scale factor. Values less than 1.0 decrease the segment size, and values greater than 1.0 increase the segment size. The two-dimensional scale factor has X and Y components.

Once you have decided how to scale, rotate, and translate a segment, you must construct a **transformation matrix**. A transformation matrix is an array of real values. The two-dimensional transformation matrix has six elements. To assist you in the creation of a transformation matrix, DEC GKS provides the utility functions EVALUATE TRANSFORMATION MATRIX and ACCUMULATE TRANSFORMATION MATRIX. The function EVALUATE TRANSFORMATION MATRIX has the following function syntax:

```
gks$eval_xform_matrix ( fix_pt_x, fix_pt_y, transl_vec_x, transl_vec_y,
rotation, scale_x, scale_y, coord_flag, trans_mat ) ;
```

After evaluating the first eight arguments, EVALUATE TRANSFORMATION MATRIX establishes the appropriate transformation matrix and writes the 6-element array of real numbers to the last argument *trans_mat*. For detailed information concerning this function, see the function description in Chapter 7.

The function ACCUMULATE TRANSFORMATION MATRIX is identical to EVALUATE TRANSFORMATION MATRIX, except that its first read-only argument is another 6-element transformation matrix, as follows:

```
gks$accum_xform_matrix ( old_xform_mat, fix_pt_x, fix_pt_y, transl_vec_x,
transl_vec_y, rotation, scale_x, scale_y,
coord_type, new_xform_mat ) ;
```

If you have a previously constructed transformation matrix to which you want to add translation, shifting, and scaling values, you call ACCUMULATE TRANSFORMATION MATRIX. DEC GKS creates a new transformation matrix using the first matrix and the specified scaling, rotation, and translation information, and then returns the resulting transformation matrix to the last argument. For detailed information concerning this function, see the function description in Chapter 7.

Once you have established the desired transformation matrix, either by accumulating matrixes or by evaluating a single matrix, you can set the segment transformation using SET SEGMENT TRANSFORMATION, which takes the name of a segment and the transformation matrix identifier as its arguments. DEC GKS applies the specified transformation to the stored segment on the NDC system. This current transformation remains in effect until you change it. Before copying a segment, or inserting a segment on a workstation, DEC GKS first checks the current segment transformation in the segment state list, and applies that transformation to the stored segment.

You may have to update the workstation surface to see the change in the segment transformation. See Section 8.3 for more information concerning surface update.

See Example 7–2 for a program example on the effects of a segment transformation.

In some applications, you may want to have more control over the order in which DEC GKS transforms segments. Simply, you may want to transform the segment in some order other than scaling, then rotating, and finally translation. You can accomplish this task by calling ACCUMULATE TRANSFORMATION MATRIX several times, performing one transformation at a time.

See Example 7–1 for a program example showing the cumulative effect of ACCUMULATE TRANSFORMATION MATRIX.

8.4.4.1 Normalization and Segment Transformations, and Clipping

When you generate an output primitive during segment creation, DEC GKS stores the primitive, the currently associated output attributes, the current clipping rectangle (the current normalization viewport), and the pick identifier value (see Section 8.1.1).

When DEC GKS generates one of the primitives in a given segment, the primitive is transformed by the current normalization transformation; then the primitive is transformed by the specified segment transformation; and finally, if clipping was enabled before you generated the segment primitive (the default clipping status), the primitive is clipped at the *stored* normalization viewport boundary, not necessarily the *current* normalization viewport boundary.

If clipping is *not* enabled at the time you generate an output primitive during segment creation, DEC GKS stores the default normalization viewport ([0,1] x [0,1]) as the clipping rectangle for the generated primitive.

Consequently, when you translate a segment's position, and if the segment crosses the viewport boundary, whether DEC GKS clips the primitives depends on the status of the clipping flag at the time of primitive generation.

During transformation, a segment's primitives may exceed the default normalization viewport, defined as ([0,1] x [0,1]) for two-dimensional transformations. DEC GKS can store segments that exceed the default normalization viewport in NDC space.

However, even though DEC GKS can store segments that exceed the default normalization viewport boundary, those portions cannot be displayed on the surface of the workstation. DEC GKS clips all pictures at least at that workstation window boundary during the workstation transformation. The maximum workstation window is ([0,1] x [0,1]) for two-dimensional transformations on the NDC plane.

See Example 7–3 for a program example on controlling clipping at the world viewport.

8.4.5 Visibility

The visibility segment attribute determines if the segment is visible on the workstation surface. By default, DEC GKS segments are visible (GKS$K_ VISIBLE).

Visibility can be used to hide a segment from a user until the segment is needed. For example, segment visibility is a useful way to control the displaying of messages and menus, although MESSAGE and REQUEST CHOICE can perform the same task.

By default, the visibility segment attribute is set to (GKS$K_VISIBLE). Keep in mind that a segment must be both visible and detectable to pick that segment during pick input (see Chapter 9).

8.5 Segment Inquiries

The following list presents the inquiry functions that you can use to obtain segment information when writing device-independent code:

INQUIRE CLIPPING
INQUIRE DYNAMIC MODIFICATION OF SEGMENT ATTRIBUTES
INQUIRE LEVEL OF GKS
INQUIRE NAME OF OPEN SEGMENT
INQUIRE OPERATING STATE VALUE
INQUIRE PICK DEVICE STATE
INQUIRE SEGMENT ATTRIBUTES
INQUIRE SET OF ACTIVE WORKSTATION
INQUIRE SET OF ASSOCIATED WORKSTATIONS
INQUIRE SET OF OPEN WORKSTATIONS
INQUIRE SET OF SEGMENT NAMES IN USE
INQUIRE SET OF SEGMENT NAMES ON WORKSTATION
INQUIRE WORKSTATION CATEGORY
INQUIRE WORKSTATION CONNECTION AND TYPE
INQUIRE WORKSTATION DEFERRAL AND UPDATE STATES
INQUIRE WORKSTATION MAXIMUM NUMBERS
INQUIRE WORKSTATION STATE

For more information concerning device-independent programming, see the *DEC GKS User's Guide*.

8.6 Function Descriptions

This section describes the DEC GKS segment functions in detail.

ASSOCIATE SEGMENT WITH WORKSTATION

Operating States

WSOP, WSAC

Syntax

gks$assoc_seg_with_ws (ws_id, seg_name)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier.
seg_name	Integer	Read	Reference	Segment name that identifies a segment that is stored on a WISS workstation.

Description

The ASSOCIATE SEGMENT WITH WORKSTATION function takes a segment stored in workstation-independent segment storage (WISS), and stores the segment on the specified workstation. If the segment is not stored in WISS, DEC GKS generates an error.

Clipping rectangles and clipping indicators are stored unchanged. This function cannot be invoked when a segment is open.

If the segment is already associated with the specified workstation, this function has no effect.

See Also

COPY SEGMENT TO WORKSTATION
INSERT SEGMENT
Example 8–1 for a program example using the ASSOCIATE SEGMENT WITH WORKSTATION function

CLOSE SEGMENT

Operating States

SGOP

Syntax

gks$close_seg ()

Description

The CLOSE SEGMENT function closes a segment.

After you call this function, you can no longer add output primitives to that segment. You cannot reopen a segment.

Calling this function changes the DEC GKS operating state from SGOP (segment open) to WSAC (at least one workstation active).

See Also

CREATE SEGMENT
Example 8–1 for a program example using the CLOSE SEGMENT function

COPY SEGMENT TO WORKSTATION

Operating States

WSOP, WSAC

Syntax

gks$copy_seg_to_ws (ws_id, seg_name)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier. The workstation must be of the type WISS.
seg_name	Integer	Read	Reference	Segment name. The segment must be stored on a WISS workstation.

Description

The COPY SEGMENT TO WORKSTATION function copies the output primitives from a segment stored on the WISS workstation to the specified workstation.

As part of the copy operation, the output primitives are transformed by the segment transformation stored with the segment, clipped by the clipping rectangle stored with the primitive, entered into the two-dimensional transformation pipeline before the normalization clipping step, and are finally transformed by the workstation transformation and output. See the *DEC GKS User's Guide* for more information.

Primitives are clipped by the clipping rectangle only when the clipping indicator stored with the primitive is set to CLIP.

See Also

ASSOCIATE SEGMENT WITH WORKSTATION
INSERT SEGMENT
Example 8–1 for a program example using the COPY SEGMENT TO WORKSTATION function

CREATE SEGMENT

Operating States

WSAC

Syntax

gks$create_seg (seg_name)

Argument	Data Type	Access	Passed by	Description
seg_name	Integer	Read	Reference	Segment name

Description

The CREATE SEGMENT function opens a segment on all active workstations.

When you call CREATE SEGMENT, the DEC GKS operating state is changed from at least one workstation active (WSAC) to segment open (SGOP).

For every active workstation, the name of the segment is added to the list of segments stored on that workstation.

The segment state list is set to the initial state of segment visible, undetectable, and not highlighted. The segment priority is set to 0, and the segment transformation is set to the identity transformation.

All subsequent output primitives will be added to the segment until the next CLOSE SEGMENT function is performed.

Only one segment can be open at a time.

See Also

CLOSE SEGMENT
DELETE SEGMENT
RENAME SEGMENT
Example 8–1 for a program example using the CREATE SEGMENT function

DELETE SEGMENT

Operating States

WSOP, WSAC, SGOP

Syntax

gks$delete_seg (seg_name)

Argument	Data Type	Access	Passed by	Description
seg_name	Integer	Read	Reference	Segment name

Description

The DELETE SEGMENT function deletes the specified segment from all workstations storing that segment. Using this function, you can delete any defined segment, but you cannot delete an open segment.

Calling this function deletes the specified segment's state list.

See Also

DELETE SEGMENT FROM WORKSTATION

DELETE SEGMENT FROM WORKSTATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$delete_seg_from_ws (ws_id, seg_name)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
seg_name	Integer	Read	Reference	Segment name

Description

The DELETE SEGMENT FROM WORKSTATION function deletes the segment from the specified workstation. Using this function, you can delete any defined segment, but you cannot delete an open segment.

If you delete the segment from the last workstation supporting a given segment, calling this function deletes the specified segment's state list, which has the same effect as calling the function DELETE SEGMENT.

See Also

DELETE SEGMENT

INSERT SEGMENT

Operating States

WSAC, SGOP

Syntax

gks$insert_seg (seg_name, ins_xform_mat)

Argument	Data Type	Access	Passed by	Description
seg_name	Integer	Read	Reference	Segment name
ins_xform_mat	Array of reals	Read	Reference	6-element insertion transformation matrix

Description

The INSERT SEGMENT function takes the specified segment stored in a WISS workstation and, for each active workstation, copies the primitives in the specified segment to either the open segment or into the stream of primitives outside segments. The primitives in the segment are transformed twice: once according to the segment's current transformation, and once according to the transformation matrix specified in the call to this function (the effect of the two transformations is cumulative).

For each active workstation, the primitives contained in the specified segment are copied to the workstation. The primitives are added to the open segment if the GKS state is SGOP (segment open). They are added to the stream of primitives outside of segments if the GKS state is WSAC (at least one workstation active).

All segments have a segment transformation attribute. The segment transformation is stored with the segment when the segment is created.

Output primitives stored in segments have a clipping rectangle and clipping indicator stored with the primitive when the primitive is created. The stored clipping rectangle and clipping indicator are taken from the GKS state list. The primitives contained in the specified segment are transformed first by the segment transformation of the specified segment. Then they are transformed by the specified insertion transformation matrix.

If a transformation has been specified for the segment to be inserted, DEC GKS calculates the accumulated effect of the segment transformation and then the insertion calculation, in that order. You can formulate an insertion transformation using either EVALUATE TRANSFORMATION MATRIX or ACCUMULATE TRANSFORMATION MATRIX.

The following equation shows the specified insertion transformation matrix. It also shows the effect of applying the specified insertion transformation matrix to a coordinate that already has been transformed by the segment transformation. The insert transformation and the segment transformation (conceptually) take place in NDC space.

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} M_{11} & M_{12} & M_{13} \\ M_{21} & M_{22} & M_{23} \end{bmatrix} \times \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

The original coordinates are (x, y) and the transformed coordinates are (x′, y′). Both of these coordinates are NDC points. The values M_{13} and M_{23} of the insertion transformation matrix are also specified in NDC units. All other matrix elements are unitless.

As part of the copy operation, all segment attributes (except the segment transformation attribute) are ignored. The ignored attributes are segment visibility, highlighting, detectability, and priority.

Also as part of the copy operation, the current settings of the attributes in the GKS state list replace all clipping indicators and clipping rectangles in the specified segment.

During the copy operation, all primitives in the specified segment retain the values of their corresponding primitive attributes that were assigned to them when they were created.

INSERT SEGMENT does not affect the current settings of the primitive attributes in the GKS state list.

See Also

ACCUMULATE TRANSFORMATION MATRIX
ASSOCIATE SEGMENT WITH WORKSTATION
COPY SEGMENT TO WORKSTATION
EVALUATE TRANSFORMATION MATRIX
SET SEGMENT TRANSFORMATION
Example 8–2 for a program example using the INSERT SEGMENT function

RENAME SEGMENT

Operating States

WSOP, WSAC, SGOP

Syntax

gks$rename_seg (old_name, new_name)

Argument	Data Type	Access	Passed by	Description
old_name	Integer	Read	Reference	Segment's old name
new_name	Integer	Read	Reference	Segment's new name

Description

The RENAME SEGMENT function changes the segment name from its current name to a new name. After you have renamed a segment using this function, you can reuse the old segment name.

SET DETECTABILITY

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_seg_detectability (seg_name, detect_flag)

Argument	Data Type	Access	Passed by	Description
seg_name	Integer	Read	Reference	Segment name
detect_flag	Integer (constant)	Read	Reference	Detectability flag

Constants

Defined Argument	Constant	Description
detect_flag	GKS$K_UNDETECTABLE	The segment cannot be picked. This is the default value.
	GKS$K_DETECTABLE	The segment is visible and can be picked.

Description

The SET DETECTABILITY function controls the segment attribute that determines whether the specified segment can be chosen during pick input. A segment must be both detectable and visible to be picked. The detectability segment attribute is described in more detail in Section 8.4.1.

See Also

SET VISIBILITY
Example 9–2 for a program example using the SET DETECTABILITY function

SET HIGHLIGHTING

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_seg_highlighting (seg_name, highl_flag)

Argument	Data Type	Access	Passed by	Description
seg_name	Integer	Read	Reference	Segment name
highl_flag	Integer (constant)	Read	Reference	Highlighting flag

Constants

Data Type	Constant	Description
highl_flag	GKS$K_NORMAL	DEC GKS does not highlight the segment. This is the default value.
	GKS$K_HIGHLIGHTED	DEC GKS highlights the segment, if visible.

Description

The SET HIGHLIGHTING function controls the segment attribute that determines whether the specified segment is highlighted.

If you use this function to highlight a segment on a VT241™ terminal, DEC GKS places the segment extent rectangle into an alternative foreground color to draw attention to the specified segment.

If you attempt to highlight an invisible segment, the highlighting does not take effect until you make the segment visible again. For more information on segment highlighting, see Section 8.4.2.

See Also

Example 8–3 for a program example using the SET HIGHLIGHTING function

SET SEGMENT PRIORITY

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_seg_priority (seg_name, priority)

Argument	Data Type	Access	Passed by	Description
seg_name	Integer	Read	Reference	Segment name.
priority	Real	Read	Reference	Segment priority, between 0.0 and 1.0. The default value is 0.0.

Description

The SET SEGMENT PRIORITY function sets the segment attribute that determines which segment takes precedence on the workstation surface, and which segment is chosen if the user chooses the overlapping area during pick input.

DEC GKS implements segment priority on a scale of real numbers from 0.0 to 1.0. Segments with the priority 0.0 have the lowest priority, and segments with the priority 1.0 have the highest priority.

Different devices implement segment priority differently. A device supports either an infinite number of priorities (theoretically) or a specific number of priorities. For more information on segment priority, see Section 8.4.3.

See Also

GET PICK
REQUEST PICK
SAMPLE PICK

SET SEGMENT TRANSFORMATION

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_seg_xform (seg_name, trans_matrix)

Argument	Data Type	Access	Passed by	Description
seg_name	Integer	Read	Reference	Segment name
trans_matrix	Array of reals	Read	Reference	6-element transformation matrix created earlier by a call to EVALUATE TRANSFORMATION MATRIX or ACCUMULATE TRANSFORMATION MATRIX

Description

The SET SEGMENT TRANSFORMATION function specifies the segment transformation that is stored with a specified segment.

All segments have a segment transformation attribute. The segment transformation is stored with the segment when the segment is created. At the time a segment is created, its segment transformation is set to the identity transformation.

SET SEGMENT TRANSFORMATION changes the segment transformation of the specified segment. When a segment is displayed, its primitives are transformed by the specified transformation matrix according to the following equation:

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \begin{bmatrix} M_{11} & M_{12} & M_{13} \\ M_{21} & M_{22} & M_{23} \end{bmatrix} \times \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

The original coordinates are (x, y); the transformed coordinates are (x′, y′). Both of these coordinates are NDC points. The values M_{13} and M_{23} of the segment transformation matrix are also specified in NDC units. All other matrix elements are unitless.

The functions EVALUATE TRANSFORMATION MATRIX and ACCUMULATE TRANSFORMATION MATRIX facilitate the construction of matrixes that can be specified as segment transformation matrixes.

The segment transformation can be reset by calling this function with the identity matrix. Segment transformations do not affect locator and stroke input coordinates. Segment transformation is described in more detail in Section 8.4.4.

See Also

ACCUMULATE TRANSFORMATION MATRIX
EVALUATE TRANSFORMATION MATRIX
Example 7–1 for a program example using the SET SEGMENT TRANSFORMATION function

SET VISIBILITY

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_seg_visibility (seg_name, vis_flag)

Argument	Data Type	Access	Passed by	Description
seg_name	Integer	Read	Reference	Segment name
vis_flag	Integer (constant)	Read	Reference	Segment visibility flag

Constants

Data Type	Constant	Description
vis_flag	GKS$K_INVISIBLE	DEC GKS does not show the segment on the workstation surface.
	GKS$K_VISIBLE	DEC GKS shows the segment on the workstation surface. This is the default.

Description

The SET VISIBILITY function sets the segment attribute that determines whether the specified segment is visible on the workstation surface. A segment must be both visible and detectable to be picked.

Depending on the capabilities of the device, and whether or not the specified segment overlaps other segments, you may need to call either UPDATE WORKSTATION or REDRAW ALL SEGMENTS ON WORKSTATION to update the picture on the surface of the workstation. For more information, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*. The visibility segment attribute is described in more detail in Section 8.4.5.

See Also

REDRAW ALL SEGMENTS ON WORKSTATION
SET DETECTABILITY
UPDATE WORKSTATION

8.7 Program Examples

Example 8–1 illustrates the use of the ASSOCIATE SEGMENT WITH WORKSTATION function.

Example 8–1 Comparing ASSOCIATE SEGMENT WITH WORKSTATION and COPY SEGMENT TO WORKSTATION

```
/*
 *  This program draws a house in the lower left corner of the
 *  screen and a line of text in the upper left corner. The program
 *  redraws the segments to show the ASSOCIATE SEGMENT WITH
 *  WORKSTATION and COPY SEGMENT TO WORKSTATION functions.
 *
 *  NOTE: To keep the example concise, no error checking is performed.
 */

# include <stdio.h>
# include <gksdescrip.h>     /* GKS descriptor file */
# include <gksdefs.h>        /* GKS definitions file */

main ()
{
    int         default_conid       = GKS$K_CONID_DEFAULT;
    int         device_num          = 1;
    struct      dsc$descriptor_s  text_dsc;
    int         house               =  1;
    int         in_class;
    float       larger              = 0.03;
    int         lower_left_corner   = 1;
    float       max_x               = 0.5;
    float       max_y               = 0.5;
    float       min_x               = 0.0;
    float       min_y               = 0.0;
    float       max_x_2             = 0.5;
    float       min_x_2             = 0.0;
    float       min_y_2             = 0.5;
    int         num_points          = 9;
    float       px[9];
    float       py[9];
    int         regen_flag          = GKS$K_POSTPONE_FLAG;
    char        *text_string        = "Associated segment.";
    float       time_out            = 5.00;
    int         title               = 2;
    int         upper_left_corner   = 2;
    int         wiss                = 2;
    float       world_x             = 0.1;
    float       world_y             = 0.5;
    int         ws_id               = 1;
    int         ws_type             = GKS$K_WSTYPE_DEFAULT;
    int         ws_type_wiss        = GKS$K_WSTYPE_WISS;

/*  Initialize the text descriptor. */

    text_dsc.dsc$a_pointer  = text_string;
    text_dsc.dsc$b_dtype    = DSC$K_DTYPE_T;
    text_dsc.dsc$b_class    = DSC$K_CLASS_S;
    text_dsc.dsc$w_length   = strlen (text_string);
```

(continued on next page)

Example 8–1 (Cont.) Comparing ASSOCIATE SEGMENT WITH WORKSTATION and COPY SEGMENT TO WORKSTATION

```
/*  Open GKS and the workstation environments. */

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &ws_type);
    gks$open_ws (&wiss, &default_conid, &ws_type_wiss);

/*
 *  By activating only the WISS workstation, GKS stores created
 *  segments only on the WISS workstation.  The screen remains clear.
 */

    gks$activate_ws (&wiss);

/*  Set the viewport limits for the specified normalization transformations. */

    gks$set_viewport (&lower_left_corner, &min_x, &max_x, &min_y, &max_y);
    gks$set_viewport (&upper_left_corner, &min_x_2, &max_x_2, &min_y_2,
       &max_y_2);

/*  Create two segments and store them on the WISS workstation. */

    gks$create_seg (&house);
    gks$select_xform (&lower_left_corner);

    px[0] = .4;          py[0] = .1;
    px[1] = .1;          py[1] = .1;
    px[2] = .1;          py[2] = .7;
    px[3] = .4;          py[3] = .7;
    px[4] = .25;         py[4] = .9;
    px[5] = .1;          py[5] = .7;
    px[6] = .4;          py[6] = .1;
    px[7] = .4;          py[7] = .7;
    px[8] = .1;          py[8] = .1;

    gks$polyline (&num_points, px, py);
    gks$close_seg ();

    gks$create_seg (&title);
    gks$select_xform (&upper_left_corner);
    gks$set_text_height (&larger);
    gks$text (&world_x, &world_y, &text_dsc);
    gks$close_seg ();

/*  Activate the WS_ID workstation. */

    gks$activate_ws (&ws_id);

/*
 *  By associating the segment containing text, the workstation stores
 *  the segment. By copying the segment containing the house, GKS draws
 *  the primitives to the display screen, but the workstation does not
 *  store the segment.
 */

    gks$assoc_seg_with_ws (&ws_id, &title);
    gks$copy_seg_to_ws (&ws_id, &house);

/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);
```

(continued on next page)

Example 8–1 (Cont.) Comparing ASSOCIATE SEGMENT WITH WORKSTATION and COPY SEGMENT TO WORKSTATION

```
/*
 *  When you redraw the segments, you force an update to the screen
 *  and eliminate primitives not contained in segments.  The house
 *  disappears and the text remains on the display screen because it
 *  was stored as a segment.
 */

    gks$redraw_seg_on_ws (&ws_id);

/*  Only the text is displayed.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/* Deactivate and close the workstation environments and GKS. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$deactivate_ws (&wiss);
    gks$close_ws (&wiss);
    gks$close_gks ();

}
```

Figure 8–1 shows the two segments (the house and the line of text) on the display surface.

Figure 8–1 Output with Two Segments

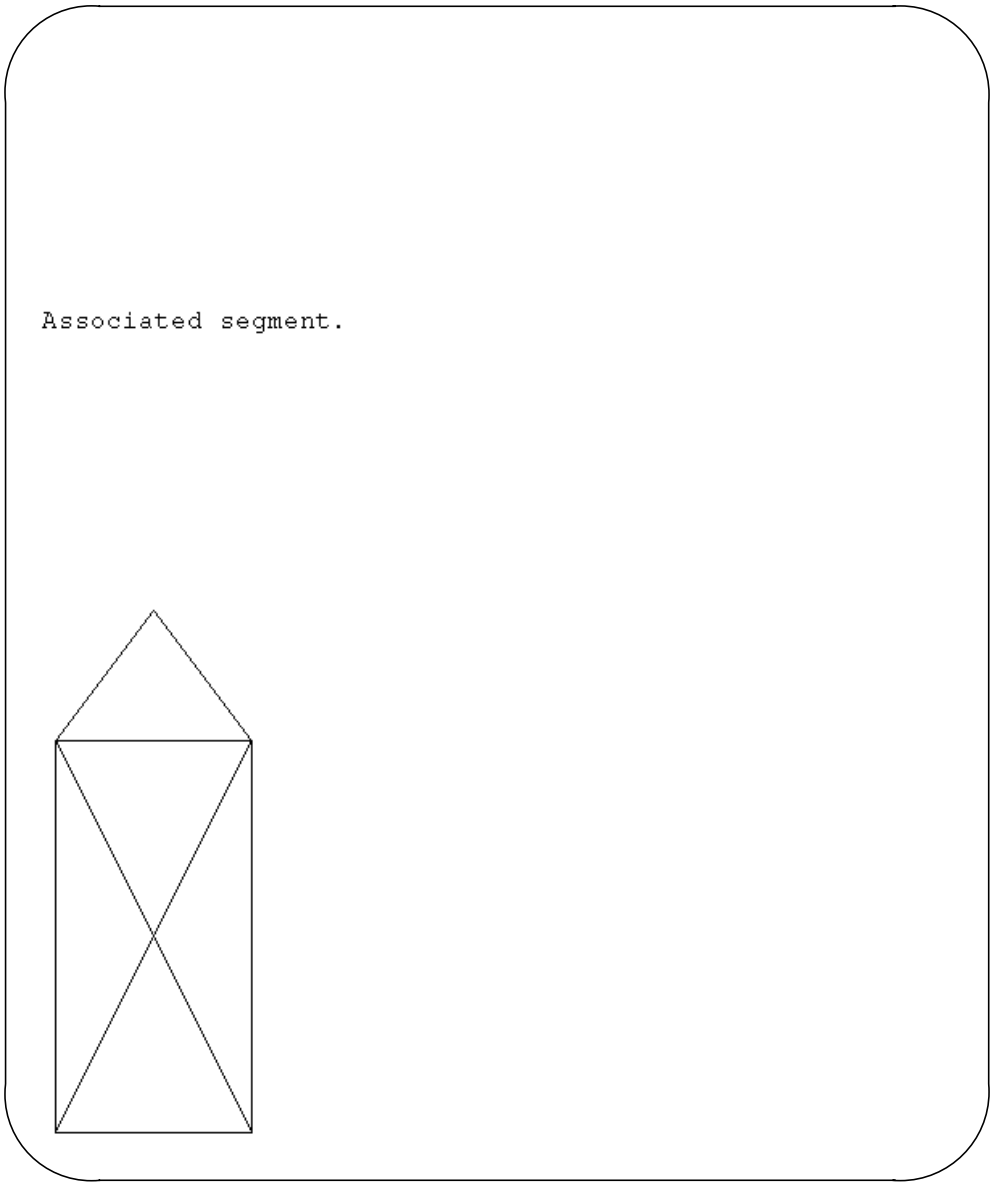

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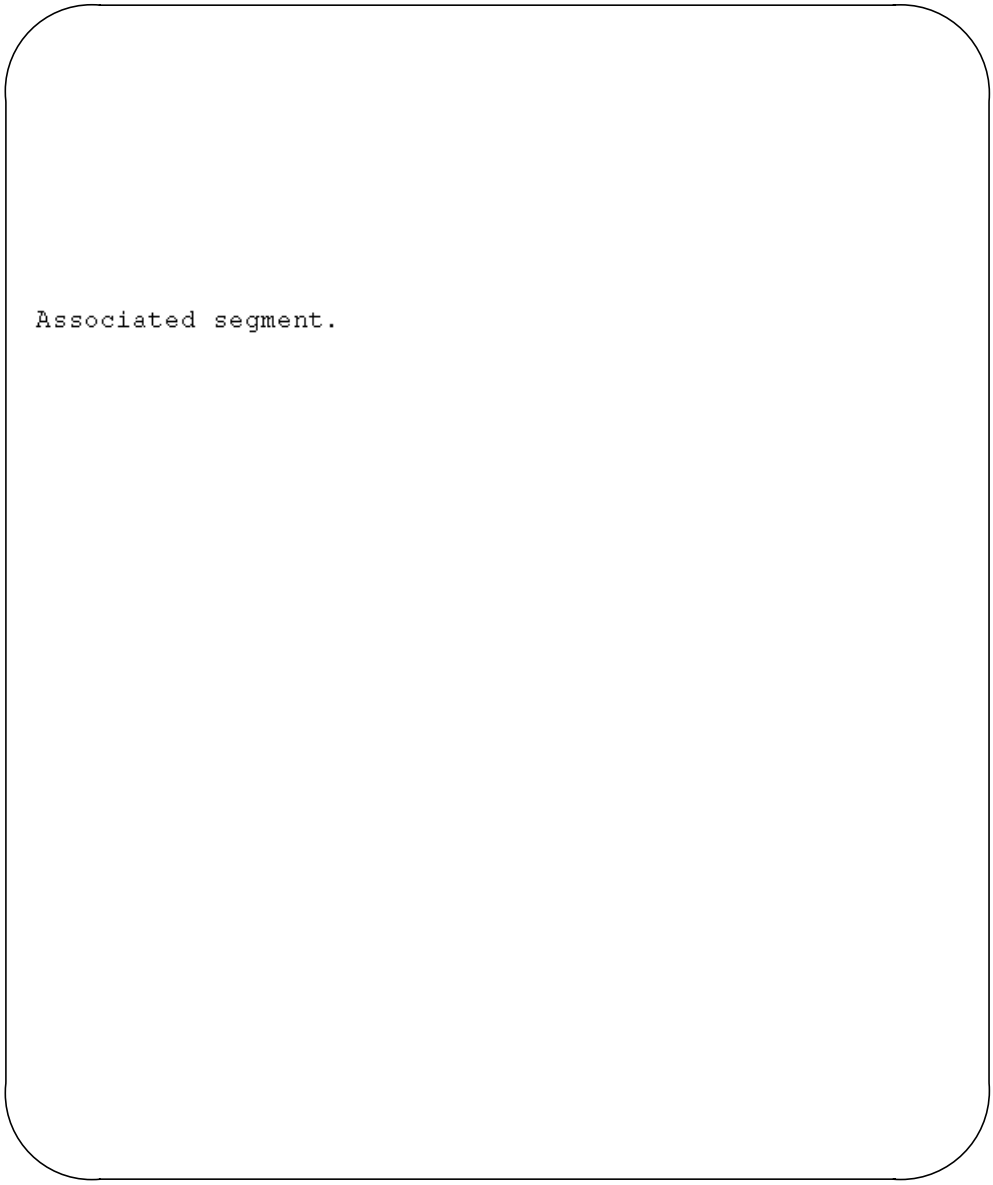
Figure 8–2 shows only the text because the text was stored as a segment.

Figure 8–2 Output with Associated Segment



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Example 8–2 illustrates the use of the INSERT SEGMENT function.

Example 8–2 Inserting a Segment's Primitives into Another Segment

```
/*
 *  This program illustrates the use of the function INSERT SEGMENT.
 *  It draws a house in the lower left corner of the screen and then
 *  inserts that house into other segments.
 *
 *  NOTE:  To keep the example concise, no error checking is performed.
 */

# include <stdio.h>
# include <gksdefs.h>

main ()
{
    int         clip_indicator      = GKS$K_NOCLIP;
    int         coord_flag          = GKS$K_COORDINATES_NDC;
    int         default_conid       = GKS$K_CONID_DEFAULT;
    int         device_num          = 1;
    int         house_1             = 1;
    int         house_2             = 2;
    int         in_class;
    int         lower_left_corner   = 1;
    int         lower_right_corner  = 2;
    float       max_x               = 0.5;
    float       max_y               = 0.5;
    float       min_x               = 0.0;
    float       min_y               = 0.0;
    float       no_change           = 1.0;
    float       null                = 0.0;
    int         num_points          = 9;
    float       px[9];
    float       py[9];
    int         regen_flag_1        = GKS$K_POSTPONE_FLAG;
    float       right               = 0.5;
    float       time_out            = 5.00;
    float       up                  = 0.5;
    int         wiss                = 2;
    int         ws_id               = 1;
    int         ws_type             = GKS$K_WSTYPE_DEFAULT;
    int         ws_type_wiss        = GKS$K_WSTYPE_WISS;
    float       xform_matrix[6];

/*  Open and activate GKS and the workstation environments. */

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &ws_type);
    gks$open_ws (&wiss, &default_conid, &ws_type_wiss);
    gks$activate_ws (&ws_id);
    gks$activate_ws (&wiss);

/*
 *  Set the viewport limits for the normalization transformation.
 *  The normalization window is established to be the lower left
 *  corner of NDC space.
 */

    gks$set_viewport (&lower_left_corner, &min_x, &max_x, &min_y, &max_y);
```

(continued on next page)

Example 8–2 (Cont.) Inserting a Segment's Primitives into Another Segment

```
/*  Create a segment in the lower left corner of the surface.  */

    gks$create_seg (&house_1);

    gks$select_xform (&lower_left_corner);

    px[0] = 0.4;    py[0] = 0.1;
    px[1] = 0.1;    py[1] = 0.1;
    px[2] = 0.1;    py[2] = 0.7;
    px[3] = 0.4;    py[3] = 0.7;
    px[4] = 0.25;   py[4] = 0.9;
    px[5] = 0.1;    py[5] = 0.7;
    px[6] = 0.4;    py[6] = 0.1;
    px[7] = 0.4;    py[7] = 0.7;
    px[8] = 0.1;    py[8] = 0.1;

    gks$polyline (&num_points, px, py);
    gks$close_seg ();

/*  Deactivate WISS so no other segments are stored there. */

    gks$deactivate_ws (&wiss);

/*  Turn off the clipping so the transformed houses are visible. */

    gks$set_clipping (&clip_indicator);

/*  Change the matrix value. */

    gks$eval_xform_matrix (&null, &null, &right, &null, &null,
       &no_change, &no_change, &coord_flag, xform_matrix);

/*
 *  Create a segment in the lower right corner by inserting
 *  the primitives for house_1 into house_2.
 */

    gks$create_seg (&house_2);
    gks$insert_seg (&house_1, xform_matrix);
    gks$close_seg ();

/*
 *  Using EVALUATE TRANSFORMATION MATRIX, you can create the transformation
 *  matrix that you need to pass to INSERT SEGMENT as an argument.  This
 *  matrix specifies a position translation of 0.5 NDC points to the right.
 *  When this matrix is passed to INSERT SEGMENT while a segment is open,
 *  the house's primitives are transformed and made a part of the open
 *  segment.
 */

    gks$eval_xform_matrix (&null, &null, &null, &up, &null,
       &no_change, &no_change, &coord_flag, xform_matrix);

/*
 *  Insert the primitives in the upper left corner using INSERT SEGMENT.
 *  Inserting segments when the GKS operating state is GKS$K_WSAC causes
 *  the output primitives to be written to the workstation surface, but
 *  the primitives are not stored in a segment.  These segment primitives
 *  are translated 0.5 NDC points in an upwards direction.
 */

    gks$insert_seg (&house_1, xform_matrix);

/*  Change the matrix value. */

    gks$eval_xform_matrix (&null, &null, &right, &up, &null,
       &no_change, &no_change, &coord_flag, xform_matrix);
```

(continued on next page)

Example 8–2 (Cont.) Inserting a Segment's Primitives into Another Segment

```
/*  Insert the primitives in the upper right corner using INSERT SEGMENT. */

    gks$insert_seg (&house_1, xform_matrix);

/*  Release the deferred output. Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag_1);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*
 *  The call to REDRAW ALL SEGMENTS ON WORKSTATION redraws all segments
 *  and deletes all primitives outside of segments.  Wait 5 seconds.
 */

    gks$redraw_seg_on_ws (&ws_id);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Deactivate and close the workstation environments and GKS. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_ws (&wiss);
    gks$close_gks ();

}
```

Figure 8–3 shows the original segment, drawn in the lower left corner, inserted into the upper right and left corners of the display surface.

Figure 8–3 Output of the Original and Inserted Segments

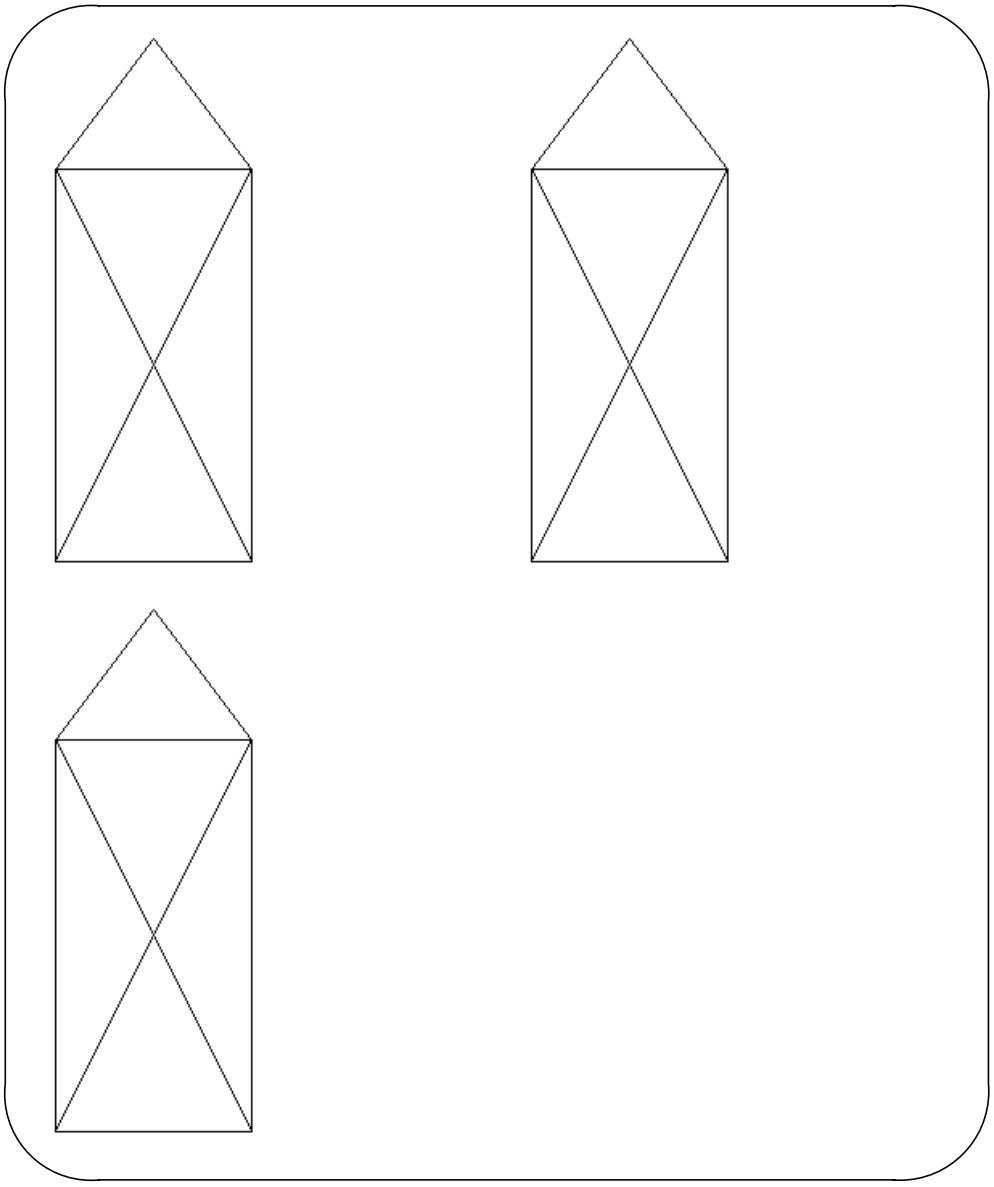

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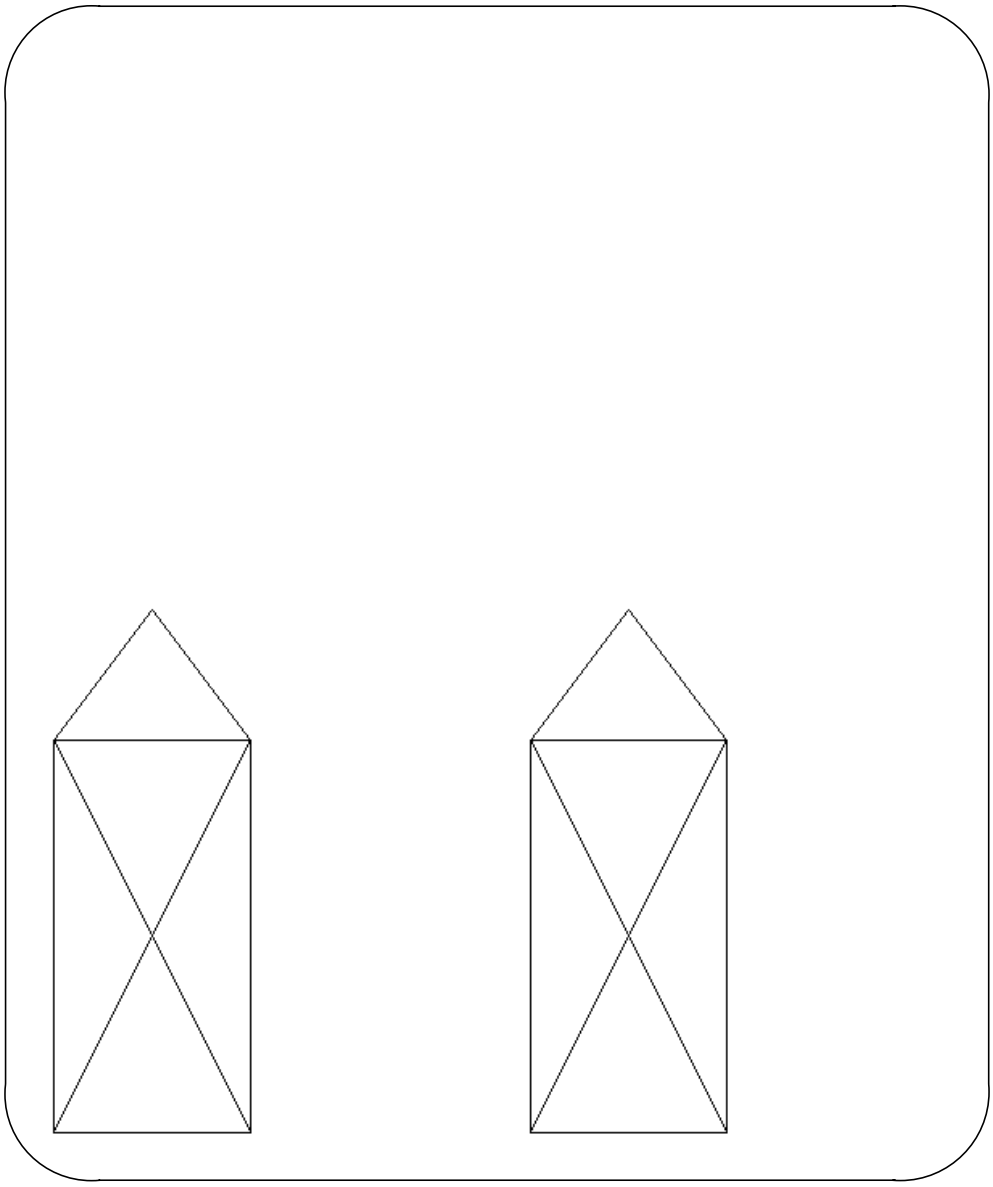
Figure 8–4 shows the redrawn segments. The houses not stored in segments have been deleted.

Figure 8–4 Output of the Redrawn Segments



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Example 8–3 illustrates the use of the SET HIGHLIGHTING function.

Example 8–3 Highlighting a Segment

```
/*
 *  This program illustrates the SET HIGHLIGHTING function.
 *  It draws a house in the lower left corner of the screen and
 *  a highlighted house in the upper right corner.
 *
 *  NOTE:  To keep the example concise, no error checking is performed.
 */
```

(continued on next page)

Example 8–3 (Cont.) Highlighting a Segment

```
# include <stdio.h>
# include <gksdefs.h>

main ()
{
    int         default_conid       = GKS$K_CONID_DEFAULT;
    int         device_num          = 1;
    int         highlight_flag      = GKS$K_HIGHLIGHTED;
    int         house_1             = 1;
    int         house_2             = 2;
    int         in_class;
    int         lower_left_corner   = 1;
    float       max_x               = 0.5;
    float       max_y               = 0.5;
    float       max_x_2             = 1.0;
    float       max_y_2             = 1.0;
    float       min_x               = 0.0;
    float       min_y               = 0.0;
    float       min_x_2             = 0.5;
    float       min_y_2             = 0.5;
    int         num_points          = 9;
    float       px[9];
    float       py[9];
    int         regen_flag          = GKS$K_PERFORM_FLAG;
    float       time_out            = 5.00;
    int         upper_right_corner  = 2;
    int         ws_id               = 1;
    int         ws_type             = GKS$K_WSTYPE_DEFAULT;

/*  Open and activate GKS and the workstation environment. */

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &ws_type);
    gks$activate_ws (&ws_id);

/*  Set the viewport limits for the normalization transformations. */

    gks$set_viewport (&lower_left_corner, &min_x, &max_x, &min_y, &max_y);
    gks$set_viewport (&upper_right_corner, &min_x_2, &max_x_2, &min_y_2,
       &max_y_2);

/*  Create a segment in the lower left corner of the surface. */

    gks$create_seg (&house_1);
    gks$select_xform (&lower_left_corner);

    px[0] = .4;
    py[0] = .1;

    px[1] = .1;
    py[1] = .1;

    px[2] = .1;
    py[2] = .7;

    px[3] = .4;
    py[3] = .7;

    px[4] = .25;
    py[4] = .9;

    px[5] = .1;
    py[5] = .7;

    px[6] = .4;
    py[6] = .1;
```

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Example 8–3 (Cont.) Highlighting a Segment

```
    px[7] = .4;
    py[7] = .7;

    px[8] = .1;
    py[8] = .1;

    gks$polyline (&num_points, px, py);
    gks$close_seg ();

/*  Create a second segment in the upper right corner of the surface. */

    gks$create_seg (&house_2);
    gks$select_xform (&upper_right_corner);
    gks$polyline (&num_points, px, py);
    gks$close_seg ();

/*  Release the deferred output.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Highlight house_2. */

    gks$set_seg_highlighting (&house_2, &highlight_flag);

/*  Update the surface to initiate the change.  Wait 5 seconds. */

    gks$update_ws (&ws_id, &regen_flag);
    gks$await_event (&time_out, &ws_id, &in_class, &device_num);

/*  Deactivate and close the workstation environment and GKS. */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();

}
```

Figure 8–5 illustrates the houses before highlighting occurs.

Figure 8–5 Output Prior to Highlighting

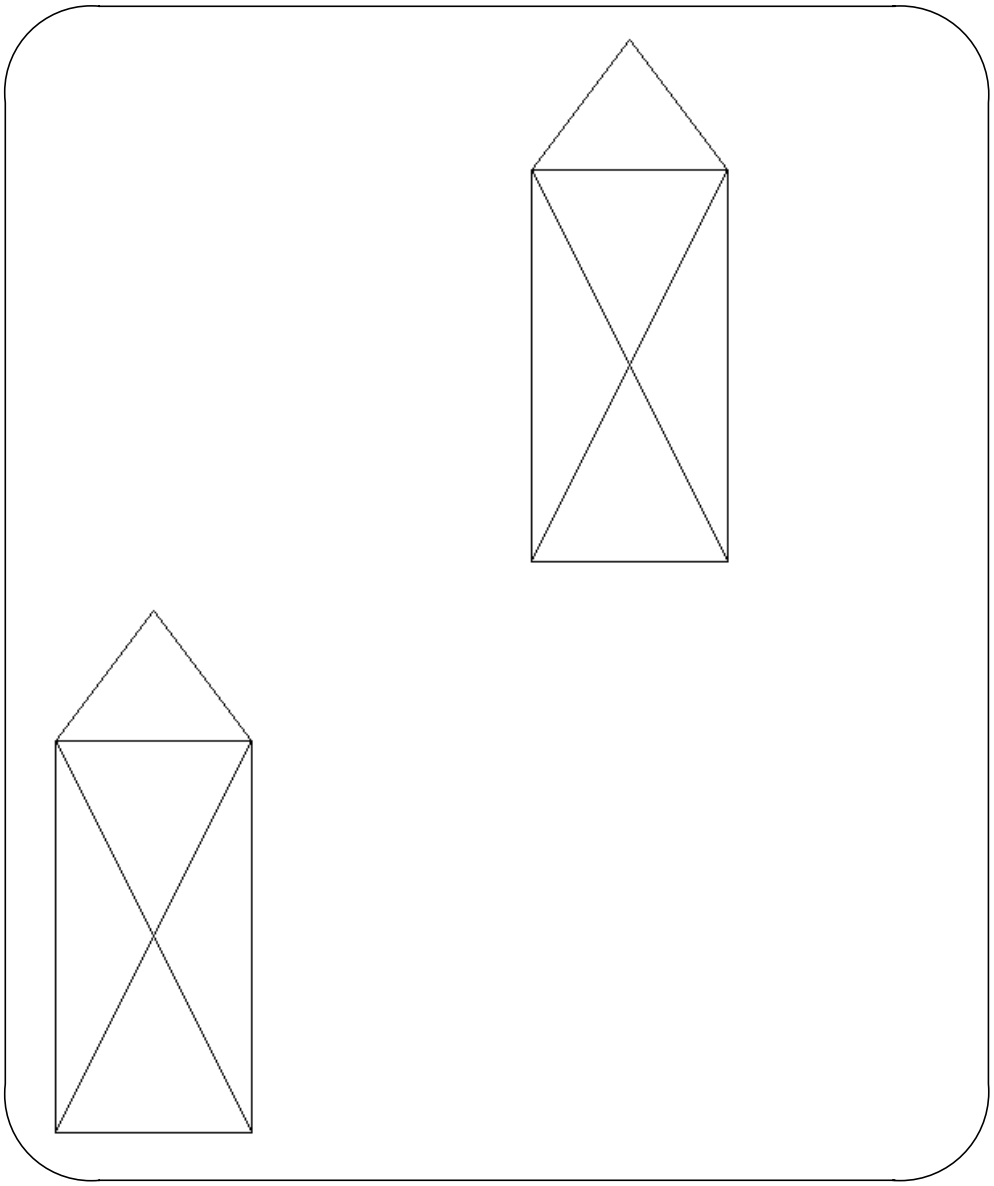
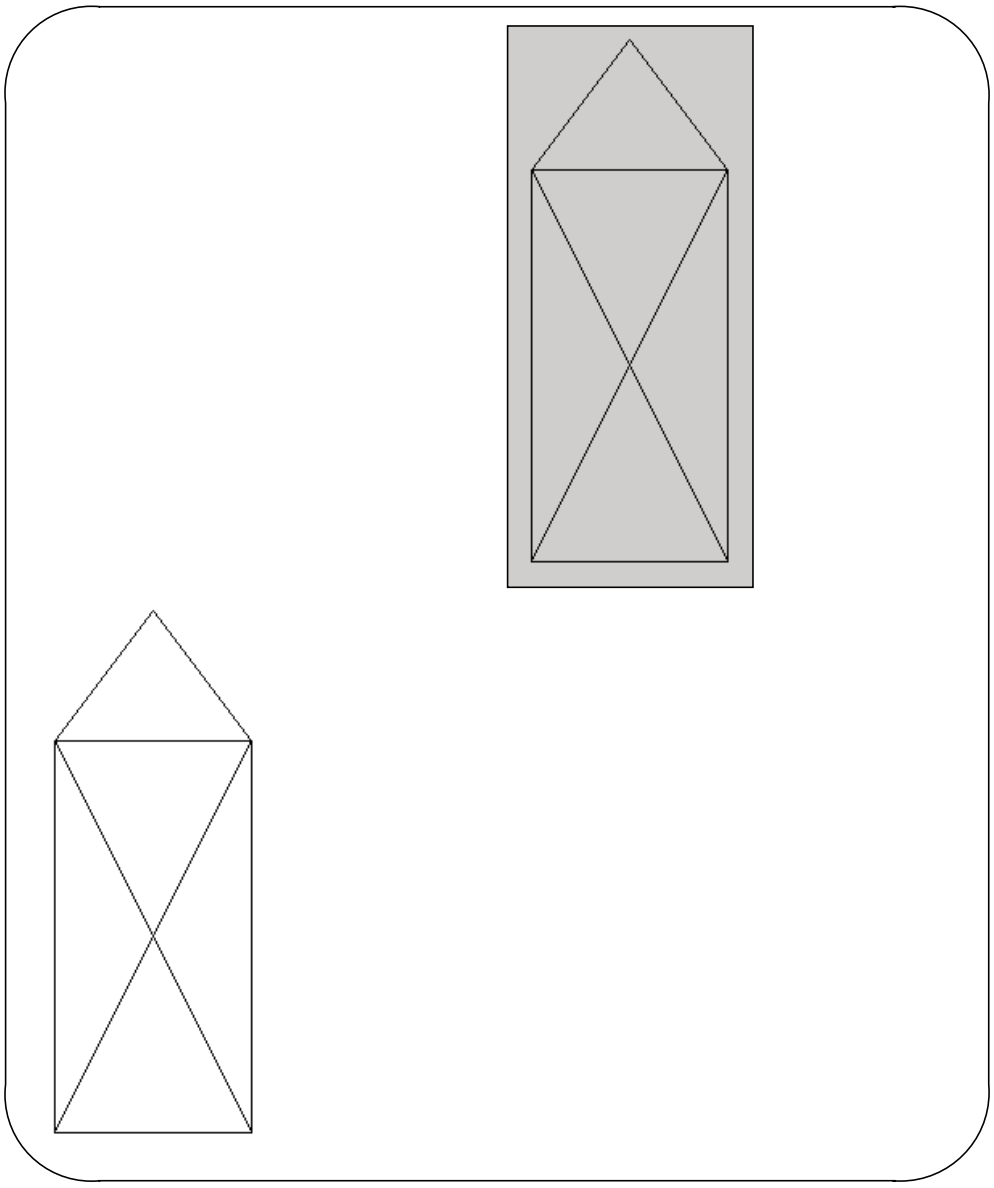


Figure 8–6 shows the house in the upper right corner being highlighted.

Figure 8–6 Effects of SET HIGHLIGHTING



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Input Functions

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9
Input Functions

The DEC GKS input functions let an application accept input from a user. This chapter provides information about physical and logical input devices, prompt and echo types, and general information about input functions. Then it describes each DEC GKS input function.

9.1 Physical Input Devices

A **physical input device** provides input to an application. A keyboard, tablet, and mouse are examples of physical devices. A single application can use input from many physical input devices.

9.2 Logical Input Devices

Because many kinds of physical input devices exist, DEC GKS maintains device independence by using **logical input devices**. A logical input device acts as an intermediary between a physical input device and the application. That is, the user inputs data from the physical input device to the application via the logical input device. GKS lets a single open workstation have zero or more logical input devices active at the same time.

9.2.1 Identifying a Logical Input Device

A logical input device is identified by a workstation identifier, an input class, and a device number. The **workstation identifier** identifies an open workstation that belongs to the category INPUT or OUTIN. The logical input device is part of the workstation. How DEC GKS implements the logical input device depends on what physical input devices the workstation is using.

The **input class** determines the type of logical input value the logical input device returns to the application. A logical input device belongs to one of six input classes. For example, a locator-class logical input device returns cursor location values. You determine the input class when you activate the logical input device. (See Section 9.2.3 for information about activating a logical input device and Section 9.2.6 for a detailed description of input classes.)

The **device number** distinguishes one logical input device from another of the same input class on the same workstation. It lets you use more than one logical input device of the same class on a single workstation. For example, you can use a display menu as one choice-class logical input device and a keyboard as another choice-class logical input device.

The device number determines what mechanism triggers the logical input device. (See Section 9.2.5 for information about triggering a logical input device.) DEC GKS defines at least four device numbers for each input class. For example, a choice 1 device number requires the user to press mouse button 1 to trigger the logical input device. (Without a mouse, the user must press Return.) A choice

2 device number requires the user to press the arrow keys or the keys on the numeric keypad.

The device number also determines the format in which DEC GKS returns data. For example, a string 1 device number returns a Digital multinational text string, while a string 3 device number returns an ASCII value.

9.2.2 Controlling the Appearance of the Logical Input Device

The **prompt and echo type** controls what the logical input device looks like on the screen. Each input class has its own set of prompt and echo types. For example, locator-class prompt and echo type 2 marks the current location with cross hairs, while locator-class prompt and echo type 3 marks it with a tracking cross. But valuator-class prompt and echo type 2 displays the current value with a dial or a pointer, while valuator-class prompt and echo type 3 displays a digital representation of the value. (See Section 9.3 for detailed information about prompts and echo types.)

DEC GKS displays the prompt and echo type in the echo area. The echo area cannot be larger than the workstation, but can be smaller than the workstation. The prompt and echo type cursor is active only within the input echo area.

The echo flag controls the visibility of an active logical input device.

9.2.3 Activating and Deactivating a Logical Input Device

You must activate a logical input device before you use it. To activate the logical input device, you must place it in one of three operating modes:

- Request
- Sample
- Event

Request mode is the default operating mode. DEC GKS places the logical input device in request mode when a workstation opens. To activate a logical input device in request mode, call a REQUEST function. DEC GKS activates the logical input device and displays the input prompt (if echoing is enabled) when you call a REQUEST function. For example, to activate a locator-class logical input device in request mode, you would call REQUEST LOCATOR and supply the appropriate values to the arguments. DEC GKS deactivates the logical input device when the REQUEST function completes.

To place a logical input device in request mode, sample mode, or event mode, you must call a SET MODE function and supply the values for the following arguments:

- Workstation identifier
- Device number
- Operating mode (request, sample, or event)
- Echo flag (GKS$K_ECHO or GKS$K_NOECHO)

For example, to place a locator-class logical input device in sample mode, you must call SET LOCATOR MODE and specify SAMPLE as the operating mode.

When DEC GKS places a logical input device in sample mode, it activates the logical input device and displays the input prompt (if echoing is enabled). To have the logical input device return a value to the application, you must call a SAMPLE function. For example, to have a locator-class logical input device in

sample mode return a value, you would call SAMPLE LOCATOR and specify the workstation identifier and the device number.

When DEC GKS places a logical input device in event mode, it activates the logical input device and displays the input prompt (if echoing is enabled). To have the logical input device return a value to the application, you must call the AWAIT EVENT and the GET functions. For example, to have a locator-class logical input device in event mode return a value, you would call AWAIT EVENT. Check the event input class to make sure it is locator, then call GET LOCATOR.

To deactivate a logical input device in sample or event mode, you must place the device back into request mode by calling a SET MODE function and specifying REQUEST as the value for the *op_mode* argument. For example, to deactivate a locator-class logical input device in sample mode, you would call SET LOCATOR MODE and specify REQUEST as the operating mode.

9.2.4 Initializing a Logical Input Device

Each workstation has its own default values that a logical input device can use. However, you also can set your own values for the logical input device. To set your own values, you must initialize the logical input device using the INITIALIZE function. The logical input device must be in request mode to be initialized. For example, to initialize a locator-class logical input device, you would put it in request mode by calling SET LOCATOR MODE. Then you would call INITIALIZE LOCATOR and supply the values you want. (See Section 9.4 for detailed information about initializing a logical input device.)

If you do not initialize the logical input device, it uses the default values.

9.2.5 Obtaining Measures from a Logical Input Device

A logical input device returns a value to the application. The value it returns is called the **measure** of the device. Two operating classes, request and event, require the user to perform an action on a physical input device to return the measure. The action is called the **input trigger**. When the user performs the action, the user **triggers** the logical input device, which then returns its measure. The input class and device number determine what kind of action the user must perform to trigger the logical input device. For example, when using a keyboard, the user triggers the logical input device by pressing a key on the keyboard. When using a mouse, the user triggers the logical input device by clicking a mouse button.

Sample mode does not require the user to trigger a logical input device. For example, SAMPLE LOCATOR gets the current value of a locator-class logical input device without any input from the user.

9.2.6 The Input Class

The input class determines the type of input the logical input device returns to the application. You determine the input class when you activate the logical input device. DEC GKS uses six input classes:

- Locator
- Stroke
- Valuator
- Choice

- String
- Pick

A locator-class logical input device first displays a prompt on the workstation surface. The user can then move the prompt and, if the application is using an appropriate input mode, trigger the input device. The locator input class returns two real numbers that represent world coordinate (WC) values. DEC GKS transforms the input point from a device coordinate point to a normalized device coordinate (NDC) point. Then it transforms the NDC point to a corresponding WC point.

A stroke-class logical input device also displays a prompt on the workstation surface. The user can then move the prompt, which causes device coordinate points to be input until the user presses Return. The stroke input class returns a sequence of real numbers that are the corresponding WC values of the stroke. DEC GKS transforms the input points from device coordinate points to NDC points. Then it transforms the NDC points to corresponding WC points.

For more information about the DEC GKS coordinate systems, see Chapter 7, Transformation Functions.

A valuator-class logical input device displays a picture on the workstation surface that represents a series of real numbers. You specify the lowest and highest values in the application. For several workstations, the picture may look like a slide bar with a pointer to a current value. The user moves the cursor up and down the scale to the desired position. The valuator input class returns the real number representing the position of the pointer on the scale.

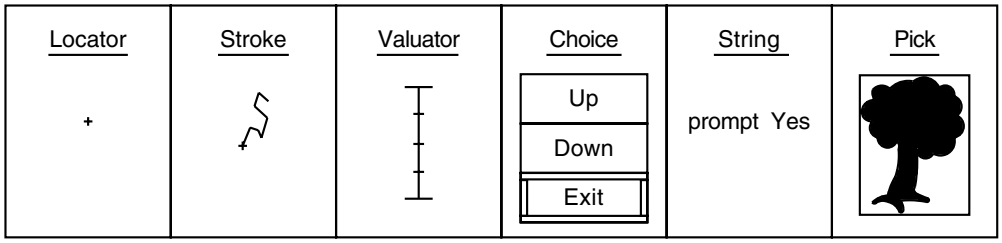
A choice-class logical input device creates a picture on the workstation surface that lists a series of choices. The choices are represented internally by integer values. You can label the choices with text in your application. For several workstations, the choices can look like a menu, with the currently selected choice highlighted. The user moves the choice input prompt through the choices, highlights a choice, and then triggers the device. When the user triggers the choice logical input device, the choice input class returns the integer representing the choice the user selected.

A string-class logical input device displays a prompt on the workstation surface where the user can enter a character string. In the application, you can provide an initial string for the prompt. DEC GKS appends the input string to the initial string. The user can enter a string as large as the defined input buffer. On many workstations, pressing Return triggers the string-class logical input device. The string input class returns a character string.

A pick-class logical input device positions a prompt on the workstation surface. The user moves the prompt among the segments on the workstation surface. If the application is using an appropriate input mode, the user can trigger the pick device. The pick input class returns integers that represent the name of the picked segment and the **pick identifier** associated with parts of a segment. (For detailed information about pick identifiers, see Chapter 8, Segment Functions.)

Figure 9–1 shows possible visual interfaces for the logical input classes.

Figure 9–1 Visual Interfaces for Logical Input Classes



Significant differences may exist in how workstations implement input classes. For example, using a stroke-class logical input device on a DECwindows workstation, you can specify X and Y device coordinate change vectors to tell the input device when to add another device coordinate point to the stroke. When the user moves the cursor to a point whose distance from the last entered point exceeds both the specified X and Y vectors, the input device accepts the point as the next point in the stroke. This affects the smoothness of the line, allowing you to create relatively curved shapes instead of jagged lines. If you specify a relatively short X and Y difference, DEC GKS accepts many of the input points as you move the cursor.

In contrast, on the VT340™ terminal, you must move the arrow keys and signal each time you have reached a point you want to be a part of the stroke. For information on input classes for specific devices, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

9.3 Prompt and Echo Types

A single workstation can prompt the user and echo the input in different ways when using the same logical input device. Some differences may be subtle. For example, a workstation may use either a plus sign or a set of cross hairs as a prompt for a single locator device, both triggered by pressing MB1. One logical input device can have a number of prompt and echo types. The prompt and echo types provide different visual interfaces for the logical input device. The GKS standard defines some prompt and echo types, while others are implementation dependent.

For example, DEC GKS supports the following prompt types for its locator-class logical input devices:

- A tracking plus sign (+)
- A cross hair
- A tracking cross (X)
- A line from the initial locator position to the current locator position (rubber-band line)
- A rectangle whose diagonal connects the initial and current positions (rubber-band box)
- A numeric representation of the current locator position

The first prompt is implementation dependent. The last five are defined by the GKS standard.

The input devices use DEC GKS primitives such as lines, markers, and fill areas to construct input prompts. However, the input devices may also use additional information that determines the physical appearance of the prompt and input echoed on the surface. For example, an input device may use a polyline output attribute that affects the physical appearance of cross hairs displayed on the surface. The information depends on the needs of the different prompt and echo types on different physical devices. It is provided to the input device through input data records.

9.3.1 DEC GKS Prompt and Echo Types

The following sections describe the prompt and echo types supported by DEC GKS for each class of logical input devices.

Not all prompt and echo types are available for every logical input device with every workstation type. To see which ones are available for a particular workstation type, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

9.3.1.1 Choice-Class Prompt and Echo Types

DEC GKS supports the following choice-class prompt and echo types:

Prompt and Echo Type	Description
–1	Highlights the current choice using a hollow rectangle.
1	Displays the list of choice strings within the echo area.
2	Displays the list of choice strings within the echo area.
3	Displays the list of choice strings within the echo area.

9.3.1.2 Locator-Class Prompt and Echo Types

DEC GKS supports the following locator-class prompt and echo types:

Prompt and Echo Type	Description
–13	Marks the current location using a segment. The segment is drawn relative to the current location. The current location is also marked by a tracking plus sign.
–12	Marks the current location using a rubber-band ellipse centered at the initial point and the current location at the corner of the bounding rectangle.
–11	Marks the current location with the world coordinate translation of the device coordinate position.
–10	Marks the current location using a circle centered at the midpoint of the initial location and the current location.
–9	Marks the current location using a circle centered at the initial position, with the current location on the circumference.
–8	Marks the current location using an open-type arc defined by the current location and two points supplied in the data record.
–7	Marks the current location using a pie-type arc defined by the current location and two points supplied in the data record.

Prompt and Echo Type	Description
–6	Marks the current location using a chord-type arc defined by the current location and two points supplied in the data record.
–5	Marks the current location using a horizontal line drawn from the initial position to the current location.
–4	Marks the current location using a vertical line drawn from the initial position to the current location.
–3	Marks the current location using two lines connected to two fixed points supplied by the data record.
–2	Marks the current location using a rectangle that is centered at the initial points and has a corner at the current location.
–1	Marks the current location with a rectangular box.
1	Marks the current location with a tracking plus sign.
2	Marks the current location by using a vertical and a horizontal line as cross hairs.
3	Marks the current location using a tracking cross.
4	Marks the current location using a line connecting the current location to the initial location (rubber band line).
5	Marks the current location using a rectangle whose diagonal is the line between the current location and the initial location (rubber band box).
6	Marks the current location by displaying a digital representation of the location.

9.3.1.3 Pick-Class Prompt and Echo Types

DEC GKS supports the following pick-class prompt and echo types:

Prompt and Echo Type	Description
1	Highlights the extent rectangle of the picked output primitive.
2	Highlights the extent rectangle of all the output primitives that share the pick identifier of the picked primitive.
3	Highlights the extent rectangle of the picked segment.

9.3.1.4 String-Class Prompt and Echo Type

DEC GKS supports the following string-class prompt and echo types:

Prompt and Echo Type	Description
1	Displays the current string value in the echo area.

9.3.1.5 Stroke-Class Prompt and Echo Types

DEC GKS supports the following stroke-class prompt and echo types:

Prompt and Echo Type	Description
1	Displays a line joining successive points of the current stroke.

Prompt and Echo Type	Description
3	Displays a polymarker at each successive point of the current stroke.
4	Displays a line joining successive points of the current stroke.

9.3.1.6 Valuator-Class Prompt and Echo Types

DEC GKS supports the following valuator-class prompt and echo types:

Prompt and Echo Type	Description
–4	Displays the range as floating values (for use only with the hardware dials).
–3	Displays the range of values in a circular dial (for use only with the VWS workstations).
–2	Displays the range of values on a horizontal sliding scale.
–1	Displays the range of values on a vertical sliding scale.
1	Displays a graphical representation of the current value (such as a dial or a pointer).
2	Displays a graphical representation of the current value (such as a dial or a pointer).
3	Displays a digital representation of the current value.

9.3.2 Input Data Records

If you call one of the INITIALIZE input functions, you must use an **input data record** to pass information about a specific prompt and echo type on a given logical input device. The input data record contains information about the input prompt interface. For example, the input data record for a locator-class logical input device may specify output attributes that affect the thickness or color of cross hairs on the workstation surface. You can use the default input data record or an application-specified input data record. The application-specified input data record is an argument to the INITIALIZE input functions. DEC GKS also uses an input data record to return information to the application with the INQUIRE . . . DEVICE STATE and INQUIRE DEFAULT . . . DEVICE DATA functions. (See the GKS International Standard (ISO 8805(E) 1988) for a detailed description of input data records.)

The GKS standard describes input data records as having required components and optional components. If a component is required, all input devices use that component of the data record. If a component is optional, the input device must be able to accept that component, but may or may not use it when generating the input prompt and echo. For example, suppose a polyline color is an optional part of the data record. The GKS implementation cannot generate an error if it encounters the component and does not have to change the color of the prompt on the workstation surface.

The following sections list all the input data record information for the GKS$ binding. The tables within these sections include the prompt and echo type, the input data record information, and whether the workstation uses (U) or ignores (I) the input data record. NA means the information is not applicable.

Use the tables to determine which data record information to supply to the workstation for a particular prompt and echo type associated with an input device. Then consult the appropriate language-independent header file for the data type and the exact structure of the data record you need to pass the information to the workstation. If you are working on a VMS system, use the header files GKS$DEFS.*. On an ULTRIX system, use the header files gksdefs.*. The data type names representing the input data records are easy to recognize because they correspond to the device type and the prompt and echo type numbers.

You can use either a language-defined operator or a language-defined function as the size of the input data record for the INITIALIZE function argument *rec_size*. You also can use the SIZEOF function to calculate the size of the input data record in bytes.

9.3.2.1 Choice Class

This section lists the input data record information required for choice-class prompt and echo types.

Prompt and Echo Type	Input Data Record Information	Used or Ignored
–1, 1	Number of choice alternatives	U
	Address of array of choice string lengths	U
	Address of array of choice string addresses	U
	Title string	U
	Title string length	U
2	Number of choice alternatives	U
	Address of array of prompts turned off (GKS$K_CHOICE_PROMPT_OFF) or on (GKS$K_CHOICE_PROMPT_ON)	U
3	Number of choice alternatives	U
	Address of array of choice string addresses	U
	Title string	U
	Title string length	U

9.3.2.2 Locator Class

This section lists the input data record information required for locator-class prompt and echo types.

Prompt and Echo Type	Input Data Record Information	Used or Ignored
–1	X dimension of the box in WC values.	U
	Y dimension of the box in WC values.	U

Prompt and Echo Type	Input Data Record Information	Used or Ignored
–11, 1, 2, 3	These prompt and echo types require no input data record information. Use a dummy data record.	NA
6	Title string	U
	Title string length	U
–12, –10, –9, –5, –4, 4	Attribute control flag tells the workstation to use either the current output attribute (GKS$K_ACF_CURRENT) or the newly specified attributes provided in the data record (GKS$K_ACF_SPECIFIED).	U
	Line type ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Line width scale factor ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Polyline color index ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Polyline index.	I
	Line type index.	U[1]
	Line width scale factor.	U[1]
	Polyline color index.	I
–2, 5	Polyline-fill-area control flag tells the workstation to use either a polyline (GKS$K_ACF_POLYLINE) or a fill area (GKS$K_ACF_FILL_AREA) to draw the rectangle. Use GKS$K_ACF_POLYLINE because the fill area rectangle is not currently available.	I[2]
	Attribute control flag tells the workstation to use either the current output attribute (GKS$K_ACF_CURRENT) or the newly specified attributes provided in the data record (GKS$K_ACF_SPECIFIED).	U
	Line type ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Line width scale factor ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Polyline color index ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I

[1]If the attribute control flag is GKS$K_ACF_SPECIFIED, the workstation uses the information. If the attribute control flag is GKS$K_ACF_CURRENT, the workstation ignores the information.

[2]The workstation ignores this information because DEC GKS supports only the polyline rectangle. The workstation expects the flag to be GKS$K_ACF_POLYLINE.

Prompt and Echo Type	Input Data Record Information	Used or Ignored
	Polyline index.	I
	Line type index.	U[1]
	Line width scale factor.	U[1]
	Polyline color index.	I
	Fill area interior style ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Fill area style index ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Fill area color index ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Fill area index ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Fill area interior style (GKS$K_INTSTYLE_HOLLOW, GKS$K_INTSTYLE_SOLID, GKS$K_INTSTYLE_PATTERN, or GKS$K_INTSTYLE_HATCH).	I
	Fill area style index.	I
	Fill area color index.	I
–8, –7, –6, –3	Attribute control flag tells the workstation to use either the current output attribute (GKS$K_ACF_CURRENT) or the newly specified attributes provided in the data record (GKS$K_ACF_SPECIFIED).	U
	X component of the first WC point.	U
	Y component of the first WC point.	U
	X component of the second WC point.	U
	Y component of the second WC point.	U
	Line type ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Line width scale factor ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Polyline color ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL).	I
	Line type index.	U[1]
	Line width scale factor.	U[1]
	Polyline color index.	I
13	Segment identifier of the segment used for the cursor segment.	U

[1]If the attribute control flag is GKS$K_ACF_SPECIFIED, the workstation uses the information. If the attribute control flag is GKS$K_ACF_CURRENT, the workstation ignores the information.

9.3.2.3 Pick Class

This section lists the input data record information required for pick-class prompt and echo types.

Prompt and Echo Type	Input Data Record Information	Used or Ignored
1, 2, 3	Size of the pick aperture (prompt) in device coordinates	U

9.3.2.4 String Class

This section lists the input data record information required for string-class prompt and echo types.

Prompt and Echo Type	Input Data Record Information	Used or Ignored
1	Number of characters in the input buffer	U
	Initial cursor position within the string, 1 <= position <= string_length	I
	Title string	U
	Title string length	U

9.3.2.5 Stroke Class

This section lists the input data record information required for stroke-class prompt and echo types.

Prompt and Echo Type	Input Data Record Information	Used or Ignored
1	Number of stroke points in the input buffer	U
	Editing position expressed as a stroke point	I
	X component of the WC change vector	U
	Y component of the WC change vector	U
	Time interval, in seconds	I
3	Number of stroke points in the input buffer	U
	Editing position expressed as a stroke point	I
	X component of the WC change vector	U
	Y component of the WC change vector	U
	Time interval, in seconds	I
	Attribute control flag tells the workstation to use either the current output attribute (GKS$K_ACF_CURRENT) or the newly specified attributes provided in the data record (GKS$K_ACF_SPECIFIED)	U
	Polymarker type ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL)	I

Prompt and Echo Type	Input Data Record Information	Used or Ignored
	Polymarker size factor ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL)	I
	Polymarker color ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL)	I
	Polymarker bundle index	I
	Polymarker type index	U[1]
	Polymarker scale factor	U[1]
	Polymarker color index	I
4	Number of stroke points in the input buffer	U
	Editing position expressed as a stroke point	I
	X component of the WC change vector	U
	Y component of the WC change vector	U
	Time interval, in seconds	I
	Attribute control flag tells the workstation to use either the current output attribute (GKS$K_ACF_CURRENT) or the newly specified attributes provided in the data record (GKS$K_ACF_SPECIFIED)	U
	Line type ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL)	I
	Line width scale factor ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL)	I
	Polyline color index ASF (GKS$K_ASF_BUNDLED or GKS$K_ASF_INDIVIDUAL)	I
	Polyline index	I
	Line type index	U[1]
	Line width scale factor	U[1]
	Polyline color index	I

[1]If the attribute control flag is GKS$K_ACF_SPECIFIED, the workstation uses the information. If the attribute control flag is GKS$K_ACF_CURRENT, the workstation ignores the information.

9.3.2.6 Valuator Class

This section lists the input data record information required for valuator-class prompt and echo types.

Prompt and Echo Type	Input Data Record Information	Used or Ignored
–3, –2, –1, 1, 2, 3	Low value of the numeric range	U
	High value of the numeric range	U

Prompt and Echo Type	Input Data Record Information	Used or Ignored
	Title string	U
	Title string length	U

9.4 Initializing Input

INITIALIZE functions let you specify attributes of the logical input devices. To initialize a logical input device, you must place the device in request mode. Request mode is the DEC GKS default input mode.

After you put the logical input device into request mode, you can either use its default attributes or specify your own. To use the default attributes, activate a logical input device without first calling one of the INITIALIZE functions. To specify your own attributes, call one of the INITIALIZE functions before you activate the logical input device.

INITIALIZE functions include:

- INITIALIZE CHOICE
- INITIALIZE LOCATOR
- INITIALIZE PICK
- INITIALIZE STRING
- INITIALIZE STROKE
- INITIALIZE VALUATOR

9.5 Input Operating Modes

DEC GKS supports three input operating modes: request, sample, and event. You can use any of the six types of logical input devices in any of the three input operating modes.

Some applications must work synchronously with the input process. That is, the application must pause to wait for the user to complete the input action. You can use the request mode to have an application work synchronously.

Some applications must work asynchronously with the input process. That is, the application must run while the user enters input. You can use sample mode or event mode to have an application work asynchronously. In sample mode, the application takes the current measure of an input device without the user having to trigger it. In event mode, the device handler places triggered input values in a time-ordered queue that the application accesses when it needs to process input.

To change the input operating mode for a given device, you call one of the SET MODE functions. Besides changing operating modes, these functions also enable and disable echoing of the input prompt and the input values. Disabling echoing is useful when the DEC GKS echo types are inadequate and you must echo the input in an application-specific manner.

By default, all input prompts are active at once. For example, if you press the arrow keys, you change all input prompts on the workstation surface whose devices use the arrow keys. Device handlers can provide ways for the user to deactivate all but one input prompt, for each logical input device. In this way, the user can **cycle** through the devices, changing only one measure at a time,

in some device-specific order. ReGIS™ and some Tektronix® workstations let you cycle through logical input devices. For more information, see the section on cycling logical input devices in the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

Note

You cannot cycle past a device whose echoing is disabled. (Normally, DEC GKS notifies you of the logical input device's turn in the cycle by displaying the logical input device's prompt.) Using the corresponding physical device will always change the measure of a nonechoing device. For example, if you use pick-class logical input device 1 on the VT340 terminal while disabling its echoing, pressing the arrow keys always changes the measure of this logical input device no matter how you cycle through the remaining prompting devices.

The following sections describe each of the input operating modes.

9.5.1 Request Mode

In request mode, the application program pauses and DEC GKS waits for the user either to trigger the end of input or to cancel input. You can use a logical input device in request mode without calling the SET MODE functions if you have not previously set the logical input device to another mode. Request mode is the DEC GKS default input operating mode.

To initialize a logical input device, you must make sure the logical input device's input prompt does not currently appear on the workstation surface. The logical input device must be in request mode to be initialized.

Although you can place any or all the supported logical input devices in request mode at any one time, you can only request input from one logical input device at a time. To request input, you must specify a logical input device number and a workstation identifier and call one of the REQUEST functions. REQUEST functions include the following:

- REQUEST CHOICE
- REQUEST LOCATOR
- REQUEST PICK
- REQUEST STRING
- REQUEST STROKE
- REQUEST VALUATOR

After the application requests input by calling one of the REQUEST functions, DEC GKS displays the input prompt (if echoing is enabled).

In request mode, the user can trigger or break a request for input in several ways. If the user triggers the logical input device, DEC GKS writes the value GKS$K_STATUS_OK to the request function *input_status* argument. (See Section 9.2.5 for information about triggering a logical input device.) If the user performs a break requesting input, DEC GKS writes the value GKS$K_STATUS_NONE to the request function *input_status* argument. (Different workstations may require different actions for the user to perform a break.)

Choice-class and pick-class logical input devices allow the user another option besides returning data or breaking input. They let the user end the input process without choosing or picking. If the user triggers the logical input device without moving the input prompt, DEC GKS returns one of the appropriate values, GKS$K_STATUS_NOCHOICE or GKS$K_STATUS_NOPICK, to the *input_status* argument. (DEC GKS also returns GKS$K_STATUS_NOPICK if the user is not currently positioning the aperture on a segment.)

9.5.2 Sample Mode

In sample mode, the application and the input process operate asynchronously. The user changes the input measure of a given logical input device by changing the position of the input prompt, but cannot trigger the logical input device. The application determines when to sample (take) the current measure of the logical input device. The user specifies input values, but the application controls when it actually accepts the values. The application ends the input session when conditions within the program are met.

To place a logical input device in sample mode, you must specify sample mode to one of the SET MODE functions. As soon as you do, DEC GKS displays the input prompt (if echoing is enabled). At this point, the user can enter input, but cannot trigger the logical input device or cancel input.

To sample input, you must specify a logical input device number and a workstation identifier and call one of the SAMPLE functions. SAMPLE functions include:

- SAMPLE CHOICE
- SAMPLE LOCATOR
- SAMPLE PICK
- SAMPLE STRING
- SAMPLE STROKE
- SAMPLE VALUATOR

After you place the device in sample mode, you cannot reinitialize the device (by calling one of the INITIALIZE functions). If you want to reinitialize the device, you must remove the input prompt from the workstation surface. To remove it, place the device in request mode, reinitialize the device, and then place the device back into sample mode.

You can place any or all the supported logical input devices in sample mode at one time. However, you can sample from only one device at a time. The program can call a SAMPLE function from any point in the application. The device handler returns the current measure from the specified workstation and the specified logical input device. When the program reaches some application-defined condition, the application can remove the input prompt from the workstation surface by changing the input mode from sample mode to request mode.

When sampling choice and pick logical input devices, you can obtain an additional input status. The additional input status can have one of two values: GKS$K_STATUS_NOCHOICE or GKS$K_STATUS_NOPICK. You can obtain the value GKS$K_STATUS_NOCHOICE if the user did not alter the device's measure since it was activated. You can obtain the value GKS$K_STATUS_NOPICK if the user did not move the aperture or is not currently positioning the aperture on a segment. Under the specified conditions, DEC GKS writes one of these values to the *input_status* argument.

9.5.3 Event Mode

EVENT functions remove, read, and flush input reports from the event queue. In event mode, the application and the input process operate asynchronously. Event mode differs from sample mode because the user must trigger input values that DEC GKS then places in a time-ordered queue. Each set of input values is a **report**. The application chooses when to remove the reports from the queue, beginning with the first input value the user entered.

To place a logical input device in event mode, you must specify event mode to one of the SET functions. As soon as you do, DEC GKS displays the input prompt (if echoing is enabled). At this point, the user can generate events that the device handler places in the event input queue.

EVENT functions include:

- AWAIT EVENT
- FLUSH DEVICE EVENTS
- GET CHOICE
- GET LOCATOR
- GET PICK
- GET STRING
- GET STROKE
- GET VALUATOR

After you place the device in event mode, you cannot reinitialize the device (by calling one of the INITIALIZE functions) until you remove the input prompt from the workstation surface. To remove it, place the device in request mode, reinitialize the device, and then place the device back into event mode.

You can process reports the user generates. To remove a report from the event input queue, call the AWAIT EVENT function. AWAIT EVENT checks the event queue for a length of time up to the amount specified in the *time_out* argument. If the event queue contains at least one report, AWAIT EVENT removes the oldest report, places it in the *current event report* entry in the GKS state list, and lets the application resume. If the queue remains empty for the entire timeout period, AWAIT EVENT writes GKS$K_INPUT_CLASS_NONE to its *input_class* argument and lets the application resume.

Each input report contains the following information that corresponds to the generated event:

- The workstation identifier
- The input class of the device
- The device number
- The input value or values

To process the information in the current event report, you must check the value written to the *input_class* argument of AWAIT EVENT. Once you determine the class of the device that generated the event, you call one of the GET functions.

The GET functions obtain information from the current event report. Therefore, repeated calls to one of the GET functions will write the same values to the output arguments. The current event report does not change unless you call AWAIT EVENT to fetch another report from the queue. After you fetch another report, a subsequent call to one of the GET functions obtains new input values.

If you decide you have enough information from a particular logical input device, you can stop generating events by placing the logical input device back in request mode. Then you can flush all the events the logical input device generated that remain in the event input queue by calling FLUSH DEVICE EVENTS.

Example 9–1 shows a sample program using a locator-class logical input device in event mode.

9.5.3.1 Event Input Queue Overflow

Because the user can generate events as soon as you call a GET function, the user may fill the event input queue before the application can remove any of the event reports. The input event queue could overflow.

If you try to call either AWAIT EVENT or FLUSH DEVICE EVENTS, DEC GKS logs an initial event input queue overflow error (ERROR_147—Input queue has overflowed). If you continue calling either AWAIT EVENT or FLUSH DEVICE EVENTS, the functions still perform their task. However, the logical input devices cannot accept additional input until you clear the input queue. You can generate ERROR_147 many times while trying to clear the queue. DEC GKS, however, logs the error only once, the first time it occurs.

To test for input queue overflow, you can call INQUIRE INPUT QUEUE OVERFLOW immediately after calling AWAIT EVENT. If the *error_status* argument to INQUIRE INPUT QUEUE OVERFLOW equals 0, the following is true:

- The event input queue has overflowed.
- Information about the overflow is available.
- INQUIRE INPUT QUEUE OVERFLOW writes to its output arguments the workstation identifier, the input class, and the device number of the logical input device that last accepted input.

If *error_status* does not equal 0, the information needed to write to the output arguments is not available. In this case, *error_status* can equal one of the following values:

- ERROR_7—GKS not in proper state.
- ERROR_148—Input queue has not overflowed since GKS was opened or since the last invocation of INQUIRE INPUT QUEUE OVERFLOW.
- ERROR_149—Input queue has overflowed, but the associated workstation has been closed.

If the event input queue overflows, you can call FLUSH DEVICE EVENTS to clear the events from the queue. FLUSH DEVICE EVENTS clears the buffer and lets the user enter input again. Because FLUSH DEVICE EVENTS clears individual logical input devices, you must call it for each logical input device the application is using. If you know the input class that caused the overflow, you can call FLUSH DEVICE EVENTS for only that input class. If you do not know which input class caused the overflow, you must call FLUSH DEVICE EVENTS for all the logical input devices and for all the input classes the application was using.

A second way to clear the events from the overflowed queue is to continue calling AWAIT EVENT, removing the reports one by one until a call returns GKS$K_ INPUT_CLASS_NONE.

Using FLUSH DEVICE EVENTS is the preferred way to clear events from an overflowed queue. If you use AWAIT EVENT, the user may continue generating input faster than AWAIT EVENT can remove events from the queue.

9.6 Overlapping Viewports

This section assumes you know something about the DEC GKS coordinate systems. You may want to review Chapter 7, Transformation Functions, before reading further.

When defining normalization viewports, you may cause them to overlap on the NDC plane. The overlap can affect the application during input requests. To prevent overlap, the application should use a viewport priority list during input.

To illustrate using a viewport priority list, consider two normalization viewports. The first is the default viewport ([0,1] x [0,1]) of the unity transformation. The second belongs to normalization transformation number 1 and has the range ([0.5, 1] x [0.5, 1]) in NDC values. The viewport of normalization transformation number 1 overlaps the right half of the default viewport.

During stroke and locator input, the user positions the cursor on the device surface and returns one point or a series of points in device coordinates. DEC GKS translates the device coordinates to NDC points. Then it uses the viewport input priority to determine which normalization transformation to use when translating the points to WC points.

DEC GKS maintains a priority list that it uses to decide which normalization viewport has a higher input priority. By default, DEC GKS assigns the highest priority to the unity transformation (0). The viewports of all remaining transformations decrease in priority as their transformation numbers increase. For example, viewport 0 is higher than viewport 1; 1 is higher than 2; 2 is higher than 3, and so on.

When using a locator-class input device, DEC GKS uses the normalization transformation of the highest input priority that contains the input point. When using stroke input, DEC GKS uses the normalization transformation of the highest priority that contains all the points in the stroke. A locator or stroke input device cannot return device coordinate points that can fall outside the default normalization viewport ([0,1] x [0,1]). Therefore, you can always use the unity transformation to transform stroke input data.

For more information about transformations and viewport priority, see Chapter 7, Transformation Functions.

9.7 Input Inquiries

When using the DEC GKS input functions, you may need to inquire from the workstation description table or from the workstation state list. If you need default values, you inquire from the description table. If you need the currently set values, you inquire from the state list.

The following sections describe programming techniques for inquiry functions.

9.7.1 Default and Current Input Values

Your application can set all the input values individually before it calls one of the INITIALIZE functions. If you do not want the application to set all the input values, you can have it pass the input values returned by one of two sets of inquiry functions. The first set obtains default input values. The second set obtains current input values.

The following inquiry functions obtain default input values:

- INQUIRE DEFAULT CHOICE DEVICE DATA
- INQUIRE DEFAULT LOCATOR DEVICE DATA
- INQUIRE DEFAULT PICK DEVICE DATA
- INQUIRE DEFAULT STRING DEVICE DATA
- INQUIRE DEFAULT STROKE DEVICE DATA
- INQUIRE DEFAULT VALUATOR DEVICE DATA

The following inquiry functions obtain current input values:

- INQUIRE CHOICE DEVICE STATE
- INQUIRE LOCATOR DEVICE STATE
- INQUIRE PICK DEVICE STATE
- INQUIRE STRING DEVICE STATE
- INQUIRE STROKE DEVICE STATE
- INQUIRE VALUATOR DEVICE STATE

Be careful when passing the argument containing the data record buffer size to the inquiry functions. The buffer size is a modifiable variable (read/write). When passed to the inquiry function, the argument must contain the size of the buffer. If it does not, the inquiry function will not return the contents of the data record properly.

After the function call, DEC GKS writes the amount of the buffer actually used. You can compare this value to the data record buffer size to see if DEC GKS had to truncate the data record when writing it to the buffer. If DEC GKS truncated the data record, you must decide whether to continue execution or change the buffer size so the entire data record fits.

9.7.2 Device-Independent Programming

You can use the INQUIRE functions when writing device-independent applications. Depending on the type of input you use, you may need to call many INQUIRE functions. For example, your application may need to check the following information:

- The level of GKS, which determines the supported input operating modes. This information is important for applications that need to be transported to other systems. (DEC GKS is a level 2c implementation.)
- The category of the workstation.
- The number of input devices of a given class the workstation supports.
- The prompt and echo types a given workstation supports.

- The maximum possible echo area available on a given workstation.
- The data record information for a given workstation using a specified prompt and echo type (see Section 9.7.1).

Use the following INQUIRE functions to obtain input information when writing a device-independent application:

INQUIRE CHOICE DEVICE STATE
INQUIRE CURRENT NORMALIZATION TRANSFORMATION NUMBER
INQUIRE DEFAULT CHOICE DEVICE DATA
INQUIRE DEFAULT LOCATOR DEVICE DATA
INQUIRE DEFAULT PICK DEVICE DATA
INQUIRE DEFAULT STRING DEVICE DATA
INQUIRE DEFAULT STROKE DEVICE DATA
INQUIRE DEFAULT VALUATOR DEVICE DATA
INQUIRE DISPLAY SPACE SIZE
INQUIRE INPUT QUEUE OVERFLOW
INQUIRE LEVEL OF GKS
INQUIRE LOCATOR DEVICE STATE
INQUIRE NORMALIZATION TRANSFORMATION
INQUIRE PICK DEVICE STATE
INQUIRE SET OF OPEN WORKSTATIONS
INQUIRE STRING DEVICE STATE
INQUIRE STROKE DEVICE STATE
INQUIRE VALUATOR DEVICE STATE
INQUIRE WORKSTATION CATEGORY
INQUIRE WORKSTATION TRANSFORMATION

For information about device-independent programming, see the *DEC GKS User's Guide*.

9.8 Function Descriptions

This section describes the DEC GKS input functions in detail.

AWAIT EVENT

Operating States

WSOP, WSAC, SGOP

Syntax

gks$await_event (time_out, ws_id, input_class, dev_num)

Argument	Data Type	Access	Passed by	Description
time_out	Real	Read	Reference	Time-out value in seconds
ws_id	Integer	Write	Reference	Workstation identifier
input_class	Integer (constant)	Write	Reference	Input class
dev_num	Integer	Write	Reference	Logical input device number

Constants

Defined Argument	Constant	Description
input_class	GKS$K_INPUT_CLASS_NONE	Input queue is empty
	GKS$K_INPUT_CLASS_LOCATOR	Event from a locator device
	GKS$K_INPUT_CLASS_STROKE	Event from a stroke device
	GKS$K_INPUT_CLASS_ VALUATOR	Event from a valuator device
	GKS$K_INPUT_CLASS_CHOICE	Event from a choice device
	GKS$K_INPUT_CLASS_PICK	Event from a pick device
	GKS$K_INPUT_CLASS_STRING	Event from a string device
	GKS$K_INPUT_CLASS_ VIEWPORT	Event from a viewport device

Description

The AWAIT EVENT function examines the input queue for all input devices.

DEC GKS searches the input queue for an event and, if the input queue is empty, suspends the application program until either of the following happens:

- An event appears on the input queue.
- The timeout period specified in the timeout argument expires.

The timeout argument is specified in the format *ss.hh*, where *ss* is seconds and *hh* is hundredths of a second. This argument cannot be negative and cannot be larger than 356,400 seconds (99 hours).

If this argument is 0.0, this function allows application execution to continue. It either removes the oldest event or, if there are no events in the queue, returns the value GKS$K_INPUT_CLASS_NONE to the input class argument.

When AWAIT EVENT checks the event input queue, its subsequent action depends on the state of the queue. If the queue contains reports, this function performs the following tasks:

- Removes the oldest event report from the queue
- Writes information to the current event report entry in the GKS state list
- Writes the event's workstation identifier, input class, and logical device number to its corresponding output arguments

If the timeout period has expired, and if this function finds the queue to be empty, this function writes input class value GKS$K_INPUT_CLASS_NONE to its output argument.

If you generate the queue overflow error, this function still performs its task.

See Also

Example 9–1 for a program example using the AWAIT EVENT function

FLUSH DEVICE EVENTS

Operating States

WSOP, WSAC, SGOP

Syntax

gks$flush_device_events (ws_id, input_class, dev_num)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
input_class	Integer (constant)	Read	Reference	Input class
dev_num	Integer	Read	Reference	Logical input device number

Constants

Defined Argument	Constant	Description
input_class	GKS$K_INPUT_CLASS_NONE	Input queue is empty
	GKS$K_INPUT_CLASS_LOCATOR	Event from a locator device
	GKS$K_INPUT_CLASS_STROKE	Event from a stroke device
	GKS$K_INPUT_CLASS_ VALUATOR	Event from a valuator device
	GKS$K_INPUT_CLASS_CHOICE	Event from a choice device
	GKS$K_INPUT_CLASS_PICK	Event from a pick device
	GKS$K_INPUT_CLASS_STRING	Event from a string device
	GKS$K_INPUT_CLASS_ VIEWPORT	Event from a viewport device

Description

The FLUSH DEVICE EVENTS function removes all events generated by the specified logical input device from the input queue. This function performs its task even if it generates the queue overflow error message.

For information about the viewport input class, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*, under the escapes Set Viewport Event and Inquire Viewport Data.

GET CHOICE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$get_choice (input_status, choice_value)

Argument	Data Type	Access	Passed by	Description
input_status	Integer (constant)	Write	Reference	Input status flag
choice_value	Integer	Write	Reference	Choice selected

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_OK	Input obtained
	GKS$K_STATUS_NOCHOICE	Triggered without choosing

Description

The GET CHOICE function obtains information from the *current event report* entry in the GKS state list and writes the choice status and choice value to the output arguments.

If the report contains input generated by anything other than a choice-class logical input device, a call to this function generates an error. (See the AWAIT EVENT function in this chapter for more information concerning device class and the *current event report* entry.)

After a successful call to GET CHOICE, the input status parameter contains either the value GKS$K_STATUS_OK or GKS$K_STATUS_NOCHOICE.

See Also

AWAIT EVENT
FLUSH DEVICE EVENTS
SET CHOICE MODE

GET LOCATOR

Operating States

WSOP, WSAC, SGOP

Syntax

gks$get_locator (trans_num, world_x, world_y)

Argument	Data Type	Access	Passed by	Description
trans_num	Integer	Write	Reference	Normalization transformation used
world_x	Real	Write	Reference	X WC position of locator
world_y	Real	Write	Reference	Y WC position of locator

Description

The GET LOCATOR function obtains information from the *current event report* entry in the GKS state list, and writes the normalization transformation number, and the X and Y WC point values to the output arguments.

If the current event report contains input generated by anything other than a locator-class logical input device, a call to this function generates an error. (See the AWAIT EVENT function in this chapter for more information concerning device class and the *current event report* entry.)

See Also

AWAIT EVENT
FLUSH DEVICE EVENTS
SET LOCATOR MODE
Example 9–1 for a program example using the GET LOCATOR function

GET PICK

Operating States

WSOP, WSAC, SGOP

Syntax

gks$get_pick (input_status, seg_name, pick_id)

Argument	Data Type	Access	Passed by	Description
input_status	Integer (constant)	Write	Reference	Input status flag
seg_name	Integer	Write	Reference	Picked segment
pick_id	Integer	Write	Reference	Chosen pick identifier

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_OK	Input obtained
	GKS$K_STATUS_NOPICK	Triggered without picking

Description

The GET PICK function obtains information from the *current event report* entry in the GKS state list and writes the input status, segment name, and pick identifier to the output arguments.

If the current event report contains input generated by anything other than a pick-class logical input device, a call to this function generates an error. (See the AWAIT EVENT function in this chapter for more information concerning device class and the *current event report* entry.)

See Also

AWAIT EVENT
FLUSH DEVICE EVENTS
SET PICK MODE

GET STRING

Operating States

WSOP, WSAC, SGOP

Syntax

gks$get_string (string_buf, string_size, rep_str_size)

Argument	Data Type	Access	Passed by	Description
string_buf	Character string	Write	Descriptor	Application's buffer for input character string
string_size	Integer	Write	Reference	Number of bytes in returned string
rep_str_size	Integer	Write	Reference	Total size, in bytes, of string found in current event report

Description

The GET STRING function obtains information from the *current event report* entry in the GKS state list and writes the string, the string size, and the number of characters written to the string output argument.

When activating string input, the following two buffers exist:

- The application's string buffer, whose size you specify when you pass the buffer argument by descriptor to this function
- The logical input device's string buffer, whose size you can specify in the call to the INITIALIZE STRING function

When reading a string from the current event report using the GET STRING function, DEC GKS removes characters up to the number that fits into the application's buffer. If the size of the string in the current event report is larger than the application's buffer, you need to call GET STRING again, using a larger application buffer, to obtain the entire string contained in the report. (Remember that the string contained in the current report does not change until you call the AWAIT EVENT function to replace the current report.)

If the current event report contains input generated by anything other than a string-class logical input device, a call to this function generates an error. (See the AWAIT EVENT function in this chapter for more information concerning device class and the *current event report* entry.)

Note

The initial string appears only in the first generated string event report. Subsequent string reports do not contain the initial string.

See Also

AWAIT EVENT
FLUSH DEVICE EVENTS
SET STRING MODE

GET STROKE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$get_stroke (trans_num, num_ent_points, stroke_buf_x, stroke_buf_y, stroke_size_x, stroke_size_y)

Argument	Data Type	Access	Passed by	Description
trans_num	Integer	Write	Reference	Normalization transformation used
num_ent_ points	Integer	Write	Reference	Number of points in current event report
stroke_buf_x	Array of reals	Write	Descriptor	X WC coordinates of the stroke points
stroke_buf_y	Array of reals	Write	Descriptor	Y WC coordinates of the stroke points
stroke_size_x	Integer	Write	Reference	Number of X coordinates returned
stroke_size_y	Integer	Write	Reference	Number of Y coordinates returned

Description

The GET STROKE function obtains information from the *current event report* entry in the GKS state list and writes the normalization transformation number, the number of entered points, the stroke point values, and the number of accepted stroke point values to the output arguments.

When activating stroke input, the following two buffers exist:

- The application's stroke buffer, whose size you specify when you pass the buffer argument by descriptor to this function
- The logical input device's stroke buffer, whose size you can specify in the call to the INITIALIZE STROKE function

When reading stroke points from the current event report using the GET STROKE function, DEC GKS removes points up to the number that fits into the application's buffer. If the size of the stroke in the current event report is larger than the application's buffer, you need to call GET STROKE again, using a larger application buffer, to obtain the entire stroke contained in the report. (Remember that the stroke contained in the current report does not change until you call the AWAIT EVENT function to replace the current report.)

If the current event report contains input generated by anything other than a stroke-class logical input device, a call to this function generates an error. (See the AWAIT EVENT function in this chapter for more information concerning device class and the *current event report* entry.)

Note

The initial stroke appears only in the first generated stroke event report. Subsequent stroke reports do not contain the initial stroke.

See Also

AWAIT EVENT
FLUSH DEVICE EVENTS
SET STROKE MODE

GET VALUATOR

Operating States

WSOP, WSAC, SGOP

Syntax

gks$get_valuator (valuator)

Argument	Data Type	Access	Passed by	Description
valuator	Real	Write	Reference	Current measure of the valuator device

Description

The GET VALUATOR function obtains the valuator input value from the *current event report* entry in the GKS state list and writes the real value to the output argument.

If the current event report contains input generated by anything other than a valuator-class logical input device, a call to this function generates an error. (See the AWAIT EVENT function in this chapter for more information concerning device class and the *current event report* entry.)

See Also

AWAIT EVENT
FLUSH DEVICE EVENTS
SET VALUATOR MODE

INITIALIZE CHOICE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$init_choice (ws_id, dev_num, init_status, init_choice, pr_echo_type, echo_area, data_rec, rec_size)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier.
dev_num	Integer	Read	Reference	Choice device number.
init_status	Integer (constant)	Read	Reference	Initial input status.
init_choice	Integer	Read	Reference	Initial choice number.
pr_echo_type	Integer	Read	Reference	Prompt and echo type.
echo_area	Array of four reals	Read	Reference	Echo area in device coordinates (XMIN, XMAX, YMIN, YMAX).
data_rec	Record	Read	Reference	Choice input data record. See the appropriate language-dependent header file (gks*defs.*) for the specific data type and data record structure.
rec_size	Integer	Read	Reference	Size of data record, in bytes.

Constants

Defined Argument	Constant	Description
init_status	GKS$K_STATUS_OK	Input obtained
	GKS$K_STATUS_NOCHOICE	No choice input

Description

The INITIALIZE CHOICE function establishes the initial values of a choice-class logical input device only if the device's prompt is not currently present on the workstation surface. (The device must be in request mode.)

The initial values include the initial choice value, the prompt and echo type, the echo area, and the data record. Subsequent requests for choice input use the values you specify.

The data record size and contents are dependent on the PET specified in the argument *pr_echo_type* and the workstation requirements. See the introduction to Chapter 9 for a description of the required data record information for each of the PETs for the choice device. See the language-dependent header file (gks*defs.*) for the specific data type and structure associated with a particular PET number. Use either a language-dependent operator or function, or the

function SIZEOF to determine the size of the data record before calling this function.

If you do not call INITIALIZE CHOICE before you request input from a choice-class logical input device, DEC GKS uses the default input values. For more information concerning the default input values, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET CHOICE MODE
SIZEOF
Example 9–3 for a program example using an INITIALIZE . . . function

INITIALIZE LOCATOR

Operating States

WSOP, WSAC, SGOP

Syntax

gks$init_locator (ws_id, dev_num, init_x, init_y, trans_num, pr_echo_type, echo_area, data_rec, rec_size)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier.
dev_num	Integer	Read	Reference	Locator device number.
init_x	Real	Read	Reference	Initial X position in WC points.
init_y	Real	Read	Reference	Initial Y position in WC points.
trans_num	Integer	Read	Reference	Translation normalization transformation number.
pr_echo_type	Integer	Read	Reference	Prompt and echo type.
echo_area	Array of four reals	Read	Reference	Echo area in device coordinates (XMIN, XMAX, YMIN, YMAX).
data_rec	Record	Read	Reference	Locator input data record. See the appropriate language-dependent header file (gks*defs.*) for the specific data type and data record structure.
rec_size	Integer	Read	Reference	Size of data record, in bytes.

Description

The INITIALIZE LOCATOR function establishes the initial values of a locator-class logical input device only if the device's prompt is not currently present on the workstation surface. (The device must be in request mode.)

The initial values include the WC position of the initial locator, the normalization transformation used to transform the initial locator point, the prompt and echo type, the echo area, and the data record. Subsequent requests for locator input use the values you specify.

The data record size and contents are dependent on the PET specified in the argument *pr_echo_type* and the workstation requirements. See the introduction to Chapter 9 for a description of the required data record information for each of the PETs for the locator device. See the language-dependent header file (gks*defs.*) for the specific data type and structure associated with a particular PET number. Use either a language-dependent operator or function, or the function SIZEOF to determine the size of the data record before calling this function.

If you do not call INITIALIZE LOCATOR before you request input from a locator-class logical input device, DEC GKS uses the default input values. For more information concerning the default input values, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET LOCATOR MODE
SET VIEWPORT INPUT PRIORITY
SIZEOF
Example 9–1 for a program example using the INITIALIZE LOCATOR function

INITIALIZE PICK

Operating States

WSOP, WSAC, SGOP

Syntax

gks$init_pick (ws_id, dev_num, init_status, init_seg, init_pick_id, pr_echo_type, echo_area, data_rec, rec_size)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier.
dev_num	Integer	Read	Reference	Pick device number.
init_status	Integer (constant)	Read	Reference	Initial pick status.
init_seg	Integer	Read	Reference	Initially picked segment.
init_pick_id	Integer	Read	Reference	Pick identifier specifying where to locate prompt initially.
pr_echo_type	Integer	Read	Reference	Prompt and echo type.
echo_area	Array of four reals	Read	Reference	Echo area in device coordinates (XMIN, XMAX, YMIN, YMAX).
data_rec	Record	Read	Reference	Pick input data record. See the appropriate language-dependent header file (gks*defs.*) for the specific data type and data record structure.
rec_size	Integer	Read	Reference	Size of data record, in bytes.

Constants

Defined Argument	Constant	Description
init_status	GKS$K_STATUS_OK	Input obtained
	GKS$K_STATUS_NOPICK	No pick hit detected

Description

The INITIALIZE PICK function establishes the initial values of a pick-class logical input device only if the device's prompt is not currently present on the workstation surface. (The device must be in request mode.)

The initial values include the initial status value, the initial segment, the prompt and echo type, the echo area, the data record, and the initial pick identifier. A pick identifier is an integer that represents a portion of a segment, allowing you to pick subsets of a segment instead of picking the entire segment. Subsequent requests for pick input use the values you specify.

The data record size and contents are dependent on the PET specified in the argument *pr_echo_type* and the workstation requirements. See the introduction to Chapter 9 for a description of the required data record information for each of the PETs for the pick device. See the language-dependent header file (gks*defs.*) for the specific data type and structure associated with a particular PET number. Use either a language-dependent operator or function, or the function SIZEOF to determine the size of the data record before calling this function.

If you do not call INITIALIZE PICK before you request input from a pick-class logical input device, DEC GKS uses the default input values. For more information concerning the default input values, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET PICK MODE
SIZEOF
Example 9–2 for a program example using the INITIALIZE PICK function

INITIALIZE STRING

Operating States

WSOP, WSAC, SGOP

Syntax

gks$init_string (ws_id, dev_num, init_string, pr_echo_type, echo_area, data_rec, rec_size)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier.
dev_num	Integer	Read	Reference	String device number.
init_string	Character string	Read	Descriptor	Initially displayed string.
pr_echo_type	Integer	Read	Reference	Prompt and echo type.
echo_area	Array of four reals	Read	Reference	Echo area in device coordinates (XMIN, XMAX, YMIN, YMAX).
data_rec	Record	Read	Reference	String input data record. See the appropriate language-dependent header file (gks*defs.*) for the specific data type and data record structure.
rec_size	Integer	Read	Reference	Size of data record, in bytes.

Description

The INITIALIZE STRING function establishes the initial values of a string-class logical input device only if the device's prompt is not currently present on the workstation surface. (The device must be in request mode.)

The initial values include the initial string value, the prompt and echo type, the echo area, and the data record. Subsequent requests for string input use the values you specify.

The data record size and contents are dependent on the PET specified in the argument *pr_echo_type* and the workstation requirements. See the introduction to Chapter 9 for a description of the required data record information for each of the PETs for the string device. See the language-dependent header file (gks*defs.*) for the specific data type and structure associated with a particular PET number. Use either a language-dependent operator or function, or the function SIZEOF to determine the size of the data record before calling this function.

If you do not call INITIALIZE STRING before you request input from the string-class logical input device, DEC GKS uses the default input values.

See Also

SET STRING MODE
SIZEOF
Example 9–3 for a program example using the INITIALIZE STRING function

INITIALIZE STROKE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$init_stroke (ws_id, dev_num, init_num_points, init_stroke_x, init_stroke_y, trans_num, pr_echo_type, echo_area, data_rec, rec_size)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier.
dev_num	Integer	Read	Reference	Stroke device number.
init_num_ points	Integer	Read	Reference	Number of points in initial stroke.
init_stroke_x	Array of reals	Read	Reference	X WC values in initial stroke.
init_stroke_y	Array of reals	Read	Reference	Y WC values in initial stroke.
trans_num	Integer	Read	Reference	Initial normalization transformation number.
pr_echo_type	Integer	Read	Reference	Prompt and echo type.
echo_area	Array of four reals	Read	Reference	Echo area in device coordinates (XMIN, XMAX, YMIN, YMAX).
data_rec	Record	Read	Reference	Stroke input data record. See the appropriate language-dependent header file (gks*defs.*) for the specific data type and data record structure.
rec_size	Integer	Read	Reference	Size of data record, in bytes.

Description

The INITIALIZE STROKE function establishes the initial values of a stroke-class logical input device only if the device's prompt is not currently present on the workstation surface. (The device must be in request mode.)

The initial values include the number of points in the initial stroke, the WC points in the initial stroke, the normalization transformation number used to translate WC points of the initial stroke to NDC points, the prompt and echo type, the echo area, and the data record. Subsequent requests for stroke input use the values you specify.

The data record size and contents are dependent on the PET specified in the argument *pr_echo_type* and the workstation requirements. See the introduction to Chapter 9 for a description of the required data record information for each of the PETs for the stroke device. See the language-dependent header file (gks*defs.*) for the specific data type and structure associated with a particular PET number. Use either a language-dependent operator or function, or the function SIZEOF to determine the size of the data record before calling this function.

If you do not call INITIALIZE STROKE before you request input from a stroke-class logical input device, DEC GKS uses the default input values. For more information concerning the default input values, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET STROKE MODE
SET VIEWPORT INPUT PRIORITY
SIZEOF
Example 9–3 for a program example using an INITIALIZE . . . function

INITIALIZE VALUATOR

Operating States

WSOP, WSAC, SGOP

Syntax

gks$init_valuator (ws_id, dev_num, init_value, pr_echo_type, echo_area, data_rec, rec_size)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier.
dev_num	Integer	Read	Reference	Valuator device number.
init_value	Real	Read	Reference	Initial value.
pr_echo_type	Integer	Read	Reference	Prompt and echo type.
echo_area	Array of four reals	Read	Reference	Echo area in device coordinates (XMIN, XMAX, YMIN, YMAX).
data_rec	Record	Read	Reference	Valuator input data record. See the appropriate language-dependent header file (gks*defs.*) for the specific data type and data record structure.
rec_size	Integer	Read	Reference	Size of data record, in bytes.

Description

The INITIALIZE VALUATOR function establishes the initial values of a valuator-class logical input device only if the device's prompt is not currently present on the workstation surface. (The device must be in request mode.)

The initial values include the initial valuator value, the prompt and echo type, the echo area, and the data record. Subsequent requests for valuator input use the values you specify.

The data record size and contents are dependent on the PET specified in the argument *pr_echo_type* and the workstation requirements. See the introduction to Chapter 9 for a description of the required data record information for each of the PETs for the valuator device. See the language-dependent header file (gks*defs.*) for the specific data type and structure associated with a particular PET number. Use either a language-dependent operator or function, or the function SIZEOF to determine the size of the data record before calling this function.

If you do not call INITIALIZE VALUATOR before you request input from a valuator-class logical input device, DEC GKS uses the default input values. For more information concerning the default input values, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

SET VALUATOR MODE
SIZEOF
Example 9–4 for a program example using the INITIALIZE VALUATOR function

REQUEST CHOICE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$request_choice (ws_id, dev_num, input_status, choice_value)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
input_status	Integer (constant)	Write	Reference	Input status flag
choice_value	Integer	Write	Reference	Choice value selected

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_NONE	No input obtained
	GKS$K_STATUS_OK	Input obtained
	GKS$K_STATUS_NOCHOICE	Triggered without choosing

Description

The REQUEST CHOICE function prompts the user for input according to the specifications passed to the INITIALIZE CHOICE and SET CHOICE MODE functions, and returns the status and measure of the response.

If the user enters input, the function writes OK to the status argument, and the positive integer representing the user's choice to the input argument.

If the user invokes a break action, the function returns NONE to the status argument, and the value 0 to the input argument. For choice-class logical input devices, the value 0 indicates a break; the status OK indicates input; and the status NOCHOICE indicates that the user did not make a choice (input was triggered without the cursor being moved).

See Also

INITIALIZE CHOICE
SET CHOICE MODE
Example 9–3 for a program example using a REQUEST . . . function

REQUEST LOCATOR

Operating States

WSOP, WSAC, SGOP

Syntax

gks$request_locator (ws_id, dev_num, input_status, trans_num, world_x, world_y)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
input_status	Integer (constant)	Write	Reference	Input status flag
trans_num	Integer	Write	Reference	Normalization transformation used
world_x	Real	Write	Reference	X WC position of locator
world_y	Real	Write	Reference	Y WC position of locator

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_NONE	No input obtained
	GKS$K_STATUS_OK	Input obtained

Description

The REQUEST LOCATOR function prompts the user for input according to the specifications passed to the INITIALIZE LOCATOR and SET LOCATOR MODE functions, and returns the status and measure of the response.

If the user enters input, the function writes OK to the status argument and writes the locator information to the output arguments. This information includes the transformation number used to transform the device coordinate to a WC point, and the corresponding WC point.

If the user invokes a break action, the function writes NONE to the status argument and the input values are not valid.

For more information about the locator position and PETs, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

See Also

INITIALIZE LOCATOR
SET LOCATOR MODE
Example 9–3 for a program example using a REQUEST . . . function

REQUEST PICK

Operating States

WSOP, WSAC, SGOP

Syntax

gks$request_pick (ws_id, dev_num, input_status, seg_name, pick_id)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
input_status	Integer (constant)	Write	Reference	Input status flag
seg_name	Integer	Write	Reference	Picked segment
pick_id	Integer	Write	Reference	Chosen pick identifier

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_NONE	Break during input
	GKS$K_STATUS_OK	Input obtained
	GKS$K_STATUS_NOPICK	Triggered without picking

Description

The REQUEST PICK function prompts the user for input according to the specifications passed to the INITIALIZE PICK and SET PICK MODE functions, and returns the status and measure of the response.

If the user enters the input, the function writes OK to the status argument, and writes the integers representing the name of the chosen segment and the chosen pick identifier (see the SET PICK IDENTIFIER function) to the output arguments.

If the user invokes a break action, the function returns NONE to the status argument, and the input values are not valid. If the user triggered the input measure before moving the prompt, or if the user triggers input while the cursor is not positioned on a segment, this function writes NOPICK to the status argument.

See Also

INITIALIZE PICK
SET PICK IDENTIFIER
SET PICK MODE
Example 9–3 for a program example using a REQUEST . . . function

REQUEST STRING

Operating States

WSOP, WSAC, SGOP

Syntax

gks$request_string (ws_id, dev_num, input_status, string_buf, string_size)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
input_status	Integer (constant)	Write	Reference	Input status flag
string_buf	Character string	Write	Descriptor	Application's string buffer
string_size	Integer	Write	Reference	Size of string in bytes

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_NONE	No input obtained
	GKS$K_STATUS_OK	Input obtained

Description

The REQUEST STRING function prompts the user for input according to the specifications passed to the INITIALIZE STRING and SET STRING MODE functions, and returns the status and measure of the response.

When you call this function, the following two buffers exist:

- The application's string buffer, whose size you specify when you pass the buffer argument by descriptor to this function
- The logical input device's string buffer, whose size you can specify in the call to the INITIALIZE STRING function

If the user enters input, the function writes OK to the status argument, the character string to the application's buffer, and the length of the character string to the last argument. If the entered string is larger than the application's buffer, then you lose all additional data. You must make sure that your application's buffer is as large as the device's string buffer.

If the user invokes a break action, the function returns NONE to the status argument, and the input arguments are not valid.

See Also

INITIALIZE STRING
SET STRING MODE
Example 9–3 for a program example using the REQUEST STRING function

REQUEST STROKE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$request_stroke (ws_id, dev_num, input_status, trans_num, num_ent_points, stroke_buf_x, stroke_buf_y, stroke_size_x, stroke_size_y)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
input_status	Integer (constant)	Write	Reference	Input status flag
trans_num	Integer	Write	Reference	Normalization transformation number
num_ent_ points	Integer	Write	Reference	Number of points entered by user
stroke_buf_x	Array of reals	Write	Descriptor	X WC values of accepted stroke
stroke_buf_y	Array of reals	Write	Descriptor	Y WC values of accepted stroke
stroke_size_x	Integer	Write	Reference	Number of X coordinates returned
stroke_size_y	Integer	Write	Reference	Number of Y coordinates returned

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_NONE	No input obtained
	GKS$K_STATUS_OK	Input obtained

Description

The REQUEST STROKE function prompts the user for input according to the specifications passed to the INITIALIZE STROKE and SET STROKE MODE functions, and returns the status and measure of the response.

If the user enters input, the function writes OK to the status argument, and writes the normalization transformation number used to translate the device coordinate points to WC points, the returned stroke points, the total number of entered points, and the number of returned points as output arguments.

When you call this function, the following two buffers exist:

- The application's stroke buffer, whose size you specify when you pass the buffer argument by descriptor to this function

- The logical input device's stroke buffer, whose size you can specify in the call to the INITIALIZE STROKE function

DEC GKS can return points up to the size of the application's X and Y coordinate buffers. If the size of the entered stroke is larger than the number of points placed in the application's buffer, you lose all additional data. You must make sure that your application's buffer is as large as the device's stroke buffer.

If the user invokes a break action, the function returns NONE to the status argument, and the input values are not valid.

See Also

INITIALIZE STROKE
SET STROKE MODE
Example 9–3 for a program example using a REQUEST . . . function

REQUEST VALUATOR

Operating States

WSOP, WSAC, SGOP

Syntax

gks$request_valuator (ws_id, dev_num, input_status, real_value)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
input_status	Integer (constant)	Write	Reference	Input status flag
real_value	Real	Write	Reference	Real number chosen by user

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_NONE	No input obtained
	GKS$K_STATUS_OK	Input obtained

Description

The REQUEST VALUATOR function prompts the user for input according to the specifications passed to the INITIALIZE VALUATOR and SET VALUATOR MODE functions, and returns the status and measure of the response.

If the user accepts the input, the function writes OK to the status argument, and the selected real number to the valuator data.

If the user invokes a break action, the function returns NONE to the status argument, and the input value is not valid.

See Also

INITIALIZE VALUATOR
SET VALUATOR MODE
Example 9–3 for a program example using a REQUEST . . . function

SAMPLE CHOICE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$sample_choice (ws_id, dev_num, input_status, choice_value)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
input_status	Integer (constant)	Write	Reference	Input status flag
choice_value	Integer	Write	Reference	Choice value selected

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_OK	Input obtained
	GKS$K_STATUS_NOCHOICE	No choice input obtained

Description

The SAMPLE CHOICE function writes the current measure of the specified choice-class logical input device to the corresponding output argument.

If the input is valid, the function writes OK to the status argument and writes the positive integer representing the user's choice to the input argument.

If the initial choice status is NOCHOICE, and if the user did not move the prompt from its initial position, this function writes NOCHOICE to the status argument. This indicates that the user has not yet made a choice.

See Also

SET CHOICE MODE

SAMPLE LOCATOR

Operating States

WSOP, WSAC, SGOP

Syntax

GKS$SAMPLE_LOCATOR (ws_id, dev_num, trans_num, world_x, world_y)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
trans_num	Integer	Write	Reference	Normalization transformation used
world_x	Real	Write	Reference	X WC position of locator
world_y	Real	Write	Reference	Y WC position of locator

Description

The SAMPLE LOCATOR function writes the current measure of the specified locator-class logical input device and the corresponding normalization transformation number to the appropriate output arguments.

See Also

SET LOCATOR MODE

SAMPLE PICK

Operating States

WSOP, WSAC, SGOP

Syntax

gks$sample_pick (ws_id, dev_num, input_status, seg_name, pick_id)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
input_status	Integer (constant)	Write	Reference	Input status flag
seg_name	Integer	Write	Reference	Picked segment
pick_id	Integer	Write	Reference	Pick identifier associated with the chosen picked primitive

Constants

Defined Argument	Constant	Description
input_status	GKS$K_STATUS_OK	Input obtained
	GKS$K_STATUS_NOPICK	No pick hit detected

Description

The SAMPLE PICK function writes the current measure of the specified pick-class logical input device to the corresponding output argument. This function writes OK to the status argument and writes the positive integers representing the picked segment and the pick identifier to the output arguments if the input is valid.

If the initial choice status is NOPICK, and if the user did not move the prompt, this function writes NOPICK to the status argument. This indicates that the user did not pick a segment yet. The logical input device also returns NOPICK if the user moved the prompt but the aperture is not touching a segment at the time of the sample.

See Also

SET PICK MODE
Example 9–2 for a program example using the SAMPLE PICK function

SAMPLE STRING

Operating States

WSOP, WSAC, SGOP

Syntax

gks$sample_string (ws_id, dev_num, string_buf, string_size, tot_string_size)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
string_buf	Character string	Write	Descriptor	Application's input character string buffer
string_size	Integer	Write	Reference	Number of bytes returned in *string_buf* and removed from device's buffer
tot_string_size	Integer	Write	Reference	Total number of characters in the device's buffer, in bytes

Description

The SAMPLE STRING function writes the current measure of the specified string-class logical input device to the appropriate output arguments.

When you call this function, the following two buffers exist:

- The application's string buffer, whose size you specify when you pass the buffer argument by descriptor to this function
- The logical input device's string buffer, whose size you can specify in the call to the INITIALIZE STRING function

When sampling a string, DEC GKS takes the first characters in the entered text string, including any initial prompt, up to the number of characters specified by the size of the application's buffer. If the size of the entered string is larger than the number of characters placed in the application's buffer, DEC GKS performs the following tasks:

- Removes the sampled string (the size of the application's buffer) from the device's buffer.
- Places the sampled string in the application's buffer.
- Leaves any remaining characters in the device's buffer. You need to call this function again to access the remaining characters.

See Also

INITIALIZE STRING
SET STRING MODE

SAMPLE STROKE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$sample_stroke (ws_id, dev_num, trans_num, num_ent_points, stroke_buf_x, stroke_buf_y, stroke_size_x, stroke_size_y)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
trans_num	Integer	Write	Reference	Normalization transformation used
num_ent_ points	Integer	Write	Reference	Number of points in stroke entered by user
stroke_buf_x	Array of reals	Write	Descriptor	Array containing X WC stroke values
stroke_buf_y	Array of reals	Write	Descriptor	Array containing Y WC stroke values
stroke_size_x	Integer	Write	Reference	Number of X coordinates for stroke points returned in buffer *stroke_buf_x* and removed from device's buffer
stroke_size_y	Integer	Write	Reference	Number of Y coordinates for stroke points returned in buffer *stroke_buf_y* and removed from device's buffer

Description

The SAMPLE STROKE function writes the current measure of the specified stroke-class logical input device to the corresponding output arguments.

When you call this function, the following two buffers exist:

- The application's stroke buffer, whose size you specify when you pass the buffer argument by descriptor to this function
- The logical input device's stroke buffer, whose size you can specify in the call to the INITIALIZE STROKE function

When sampling stroke input, DEC GKS accepts any initial stroke points and translates them according to the current normalization transformation. DEC GKS can accept points up to the number specified by the size of the application's buffer. If the size of the entered stroke is larger than the number of stroke points placed in the application's buffer, DEC GKS performs the following tasks:

- Removes the sampled stroke (the size of the application's buffer) from the device's buffer.
- Places the sampled stroke in the application's buffer.
- Leaves any remaining points in the device's buffer. You need to call this function again to access the remaining stroke points.

SAMPLE STROKE

See Also

INITIALIZE STROKE
SET STROKE MODE

SAMPLE VALUATOR

Operating States

WSOP, WSAC, SGOP

Syntax

gks$sample_valuator (ws_id, dev_num, real_value)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
real_value	Real	Write	Reference	Current measure of the valuator device

Description

The SAMPLE VALUATOR function writes the current measure of the specified valuator-class logical input device to the corresponding output argument.

See Also

SET VALUATOR MODE
Example 9–4 for a program example using the SAMPLE VALUATOR function

SET CHOICE MODE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_choice_mode (ws_id, dev_num, op_mode, echo_flag)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
op_mode	Integer (constant)	Read	Reference	Input operating mode
echo_flag	Integer (constant)	Read	Reference	Echo flag

Constants

Defined Argument	Constant	Description
op_mode	GKS$K_INPUT_MODE_REQUEST	Request mode. This is the default value.
	GKS$K_INPUT_MODE_SAMPLE	Sample mode.
	GKS$K_INPUT_MODE_EVENT	Event mode.
echo_flag	GKS$K_NOECHO	Echo disabled. This is the default value.
	GKS$K_ECHO	Echo enabled.

Description

The SET CHOICE MODE function sets the specified choice device to the specified operating mode and sets the echo state of the device as specified. Depending on the input operating mode, an interaction with the device may begin or end.

The input device state defined by the operating mode and the echo switch are stored in the workstation state list for the specified choice device.

See Also

INITIALIZE CHOICE
Example 9–1 for a program example using a SET . . . MODE function

SET LOCATOR MODE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_locator_mode (ws_id, dev_num, op_mode, echo_flag)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
op_mode	Integer (constant)	Read	Reference	Input operating mode
echo_flag	Integer (constant)	Read	Reference	Echo flag

Constants

Defined Argument	Constant	Description
op_mode	GKS$K_INPUT_MODE_REQUEST	Request mode. This is the default value.
	GKS$K_INPUT_MODE_SAMPLE	Sample mode.
	GKS$K_INPUT_MODE_EVENT	Event mode.
echo_flag	GKS$K_NOECHO	Echo disabled.
	GKS$K_ECHO	Echo enabled. This is the default value.

Description

The SET LOCATOR MODE function sets the specified locator device to the specified operating mode and sets the echo state of the device as specified. Depending on the input operating mode, an interaction with the device may begin or end.

The input device state defined by the operating mode and the echo switch are stored in the workstation state list for the specified locator device.

See Also

INITIALIZE LOCATOR
Example 9–1 for a program example using the SET LOCATOR MODE function

SET PICK MODE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_pick_mode (ws_id, dev_num, op_mode, echo_flag)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
op_mode	Integer (constant)	Read	Reference	Input operating mode
echo_flag	Integer (constant)	Read	Reference	Echo flag

Constants

Defined Argument	Constant	Description
op_mode	GKS$K_INPUT_MODE_REQUEST	Request mode. This is the default value.
	GKS$K_INPUT_MODE_SAMPLE	Sample mode.
	GKS$K_INPUT_MODE_EVENT	Event mode.
echo_flag	GKS$K_NOECHO	Echo disabled.
	GKS$K_ECHO	Echo enabled. This is the default value.

Description

The SET PICK MODE function sets the specified pick device to the specified operating mode and sets the echo state of the device as specified. Depending on the input operating mode, an interaction with the device may begin or end.

The input device state defined by the operating mode and the echo switch are stored in the workstation state list for the specified pick device.

See Also

INITIALIZE PICK
Example 9–2 for a program example using the SET PICK MODE function

SET STRING MODE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_string_mode (ws_id, dev_num, op_mode, echo_flag)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
op_mode	Integer (constant)	Read	Reference	Input operating mode
echo_flag	Integer (constant)	Read	Reference	Echo flag

Constants

Defined Argument	Constant	Description
op_mode	GKS$K_INPUT_MODE_REQUEST	Request mode. This is the default value.
	GKS$K_INPUT_MODE_SAMPLE	Sample mode.
	GKS$K_INPUT_MODE_EVENT	Event mode.
echo_flag	GKS$K_NOECHO	Echo disabled.
	GKS$K_ECHO	Echo enabled. This is the default value.

Description

The SET STRING MODE function sets the specified string device to the specified operating mode and sets the echo state of the device as specified. Depending on the input operating mode, an interaction with the device may begin or end.

The input device state defined by the operating mode and the echo switch are stored in the workstation state list for the specified string device.

See Also

INITIALIZE STRING
Example 9–1 for a program example using a SET . . . MODE function

SET STROKE MODE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_stroke_mode (ws_id, dev_num, op_mode, echo_flag)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
op_mode	Integer (constant)	Read	Reference	Input operating mode
echo_flag	Integer (constant)	Read	Reference	Echo flag

Constants

Defined Argument	Constant	Description
op_mode	GKS$K_INPUT_MODE_REQUEST	Request mode. This is the default value.
	GKS$K_INPUT_MODE_SAMPLE	Sample mode.
	GKS$K_INPUT_MODE_EVENT	Event mode.
echo_flag	GKS$K_NOECHO	Echo disabled.
	GKS$K_ECHO	Echo enabled. This is the default value.

Description

The SET STROKE MODE function sets the specified stroke device to the specified operating mode and sets the echo state of the device as specified. Depending on the input operating mode, an interaction with the device may begin or end.

The input device state defined by the operating mode and the echo switch are stored in the workstation state list for the specified stroke device.

See Also

INITIALIZE STROKE
Example 9–1 for a program example using a SET . . . MODE function

SET VALUATOR MODE

Operating States

WSOP, WSAC, SGOP

Syntax

gks$set_valuator_mode (ws_id, dev_num, op_mode, echo_flag)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
dev_num	Integer	Read	Reference	Device number
op_mode	Integer (constant)	Read	Reference	Input operating mode
echo_flag	Integer (constant)	Read	Reference	Echo flag

Constants

Defined Argument	Constant	Description
op_mode	GKS$K_INPUT_MODE_REQUEST	Request mode. This is the default value.
	GKS$K_INPUT_MODE_SAMPLE	Sample mode.
	GKS$K_INPUT_MODE_EVENT	Event mode.
echo_flag	GKS$K_NOECHO	Echo disabled.
	GKS$K_ECHO	Echo enabled. This is the default value.

Description

The SET VALUATOR MODE function sets the specified valuator device to the specified operating mode and sets the echo state of the device as specified. Depending on the input operating mode, an interaction with the device may begin or end.

The input device state defined by the operating mode and the echo switch are stored in the workstation state list for the specified valuator device.

See Also

INITIALIZE VALUATOR
Example 9–4 for a program example using the SET VALUATOR MODE function

SIZEOF

Operating States

GKCL, GKOP, WSOP, WSAC, SGOP

Syntax

gks$sizeof (data_type_id, size)

Argument	Data Type	Access	Passed by	Description
data_type_id	Integer (constant)	Read	Reference	Data type identifier
size	Integer	Write	Reference	Data type size in bytes

Constants

Defined Argument	Constant	Description
data_type_id	GKS$K_TYP_INTEGER	Integer
	GKS$K_TYP_CHOICE_REC	Choice input data record
	GKS$K_TYP_LOC_REC	Locator input data record
	GKS$K_TYP_PICK_REC	Pick input data record
	GKS$K_TYP_STRING_REC	String input data record
	GKS$K_TYP_STROKE_REC	Stroke input data record
	GKS$K_TYP_VAL_REC	Valuator input data record
	GKS$K_TYP_ESCAPE_REC	Escape data record
	GKS$K_TYP_GDP_REC	GDP data record
	GKS$K_TYP_REAL	Real
	GKS$K_TYP_ADDRESS	Address

Description

The SIZEOF function calculates the size, in bytes, of the data type defined by the argument *data_type_id* and returns the size in the output argument *size*. Use this function to calculate the size of the input, escape, and GDP data records required in the INITIALIZE . . . , INQUIRE DEFAULT . . . DEVICE DATA, INQUIRE . . . DEVICE STATE, ESCAPE, and GENERALIZED DRAWING PRIMITIVE functions.

9.9 Program Examples

Example 9–1 shows a sample program using a locator-class logical input device in event mode. The program places a tracking plus sign (+) on the screen.

Example 9–1 Using a Locator Class Logical Input Device in Event Mode

```
/*
 *  This program initializes and generates locator events.  Some of
 *  the calls it uses include:  INQUIRE LOCATOR STATE,
 *  SET LOCATOR MODE, and INITIALIZE LOCATOR.
 *
 */

# include <stdio.h>

# include <gksdescrip.h>       /* GKS descriptor file */
# include <gksdefs.h>          /* GKS GKS$ binding constants */

# define DEV_NUM_1   1
# define TEXT_HEIGHT 0.03
# define TIME        0.0

main ()
{

/*
 *  data_record is a dummy argument.  The device handler ignores
 *  the data record for all supported locator prompt and echo types.
 *
 *  echo_area is an array of real numbers that represent the
 *  rectangular echo area, in device coordinates.  The echo area
 *  defines the workstation surface from which GKS accepts input
 *  from the input prompt.
 */

  int   class;
  int   data_record[1];
  int   default_conid;
  int   default_wstype;
  int   device_num;
  float echo_area[4];
  int   echo_flag;
  char  *error_message      = "Error status is not 0.";
  char  *error_name         = "SYS$ERROR";
  int   error_status;
  int   input_mode;
  int   input_status;
  float larger;
  float position_05          = 0.05;
  float position_70          = 0.70;
  float position_75          = 0.75;
  float position_80          = 0.80;
  float position_85          = 0.85;
  float position_90          = 0.90;
  float position_95          = 0.95;
  int   prompt_echo_type;
  int   record_buffer_length;
  int   record_size;
```

(continued on next page)

Example 9–1 (Cont.) Using a Locator Class Logical Input Device in Event Mode

```
  char  *text1_msg          = "Move the input prompt upwards.";
  char  *text2_msg          = "Trigger until I say to stop.";
  char  *text3_msg          = "You are still far away.";
  char  *text4_msg          = "You are getting closer.";
  char  *text5_msg          = "You are getting REALLY close.";
  char  *text6_msg          = "YOU MADE IT!!!";
  float timeout;
  int   value_type;
  float world_x;
  float world_y;
  int   ws_id;
  int   xform;

  struct dsc$descriptor_s error_dsc;
  struct dsc$descriptor_s message_dsc;
  struct dsc$descriptor_s text1_dsc;
  struct dsc$descriptor_s text2_dsc;
  struct dsc$descriptor_s text3_dsc;
  struct dsc$descriptor_s text4_dsc;
  struct dsc$descriptor_s text5_dsc;
  struct dsc$descriptor_s text6_dsc;

/*
 *  Open the graphics environment:  open GKS, open the workstation,
 *  and activate the workstation.
 */

/*  Create the string descriptor for OPEN GKS. */

    error_dsc.dsc$a_pointer = error_name;
    error_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    error_dsc.dsc$b_class   = DSC$K_CLASS_S;
    error_dsc.dsc$w_length  = strlen (error_name);

    ws_id             = 1;
    default_conid     = GKS$K_CONID_DEFAULT;
    default_wstype    = GKS$K_WSTYPE_DEFAULT;

    gks$open_gks (&error_dsc);
    gks$open_ws (&ws_id, &default_conid, &default_wstype);
    gks$activate_ws (&ws_id);

/*
 *  Use INQUIRE LOCATOR DEVICE STATE to initialize the variables
 *  you need to pass to the input functions.
 *
 *  GKS$K_VALUE_REALIZED tells the graphics handler to return the
 *  input values as they are implemented.  (Use GKS$K_VALUES_SET
 *  to return the values the way the application set them.)
 *
 *  After the function call, record_buffer_length contains the
 *  amount of the buffer filled with the written data record.  If
 *  record_size is larger than record_buffer_length, GKS truncated
 *  the data record to fit into the declared buffer.
 */

    value_type = GKS$K_VALUE_REALIZED;
    device_num = DEV_NUM_1;
```

(continued on next page)

Example 9–1 (Cont.) Using a Locator Class Logical Input Device in Event Mode

```
    gks$inq_locator_state (&ws_id, &device_num, &value_type,
       &error_status, &input_mode, &echo_flag, &xform, &world_x, &world_y,
       &prompt_echo_type, echo_area, data_record, &record_buffer_length,
       &record_size);

/*
 *  Create the string descriptor for the error message.  Check to see if the
 *  error status equals 0.
 */

    message_dsc.dsc$a_pointer = error_message;
    message_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    message_dsc.dsc$b_class   = DSC$K_CLASS_S;
    message_dsc.dsc$w_length  = strlen (error_message);

    if (error_status != 0)
       {
       gks$message (&ws_id, &message_dsc);
       goto PROGRAM_END;
       }

/*  Set the initial position of the input prompt. */

    world_x = 0.9;
    world_y = 0.0;

/*  Initialize the logical input device. */

    gks$init_locator (&ws_id, &device_num, &world_x, &world_y,
       &xform, &prompt_echo_type, echo_area, data_record,
       &record_buffer_length);

/*  Activate the logical input device by placing it in event mode. */

    echo_flag  = GKS$K_ECHO;
    input_mode = GKS$K_INPUT_MODE_EVENT;

    gks$set_locator_mode (&ws_id, &device_num, &input_mode, &echo_flag);

/*  Create the string descriptors for the screen messages. */

    text1_dsc.dsc$a_pointer = text1_msg;
    text1_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text1_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text1_dsc.dsc$w_length  = strlen (text1_msg);

    text2_dsc.dsc$a_pointer = text2_msg;
    text2_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text2_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text2_dsc.dsc$w_length  = strlen (text2_msg);

/*  Instruct the user. */

    larger = 0.03;

    gks$set_text_height (&larger);
    gks$text (&position_05, &position_95, &text1_dsc);
    gks$text (&position_05, &position_90, &text2_dsc);

/*
 *  Do until the user moves the input prompt closest to the top
 *  of the device surface.
 */
```

(continued on next page)

Example 9–1 (Cont.) Using a Locator Class Logical Input Device in Event Mode

```
/*  Create the string descriptors for the screen messages. */

    text3_dsc.dsc$a_pointer = text3_msg;
    text3_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text3_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text3_dsc.dsc$w_length  = strlen (text3_msg);

    text4_dsc.dsc$a_pointer = text4_msg;
    text4_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text4_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text4_dsc.dsc$w_length  = strlen (text4_msg);

    text5_dsc.dsc$a_pointer = text5_msg;
    text5_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text5_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text5_dsc.dsc$w_length  = strlen (text5_msg);

    text6_dsc.dsc$a_pointer = text6_msg;
    text6_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text6_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text6_dsc.dsc$w_length  = strlen (text6_msg);

/*
 *  In the while loop, the call to AWAIT EVENT immediately checks
 *  the input queue (as specified by the timeout argument of 0.0).
 *  If the user has not yet entered an event or if the application
 *  has removed all reports generated so far, AWAIT EVENT returns
 *  GKS$K_INPUT_CLASS_NONE to its class argument.
 *
 *  This program uses only the locator input class to generate
 *  events.  The if statement keeps calling GET LOCATOR as long as
 *  the class argument is GKS$K_INPUT_CLASS_LOCATOR.  The program
 *  stops calling GET LOCATOR when the class argument becomes
 *  GKS$K_INPUT_CLASS_NONE.
 */

    timeout = TIME;

    while (world_y < 0.9)
       {

       /* Check the event queue. */

          gks$await_event (&timeout, &ws_id, &class, &device_num);

          if (class != GKS$K_INPUT_CLASS_NONE)
             gks$get_locator (&xform, &world_x, &world_y);

       /* Tease the user as the prompt gets closer. */

          if ((world_y > 0.1) && (world_y < 0.5))
             gks$text (&position_05, &position_85, &text3_dsc);

          if ((world_y > 0.5) && (world_y < 0.7))
             gks$text (&position_05, &position_80, &text4_dsc);

          if ((world_y > 0.7) && (world_y < 0.9))
             gks$text (&position_05, &position_75, &text5_dsc);
       }

  gks$text (&position_05, &position_70, &text6_dsc);
```

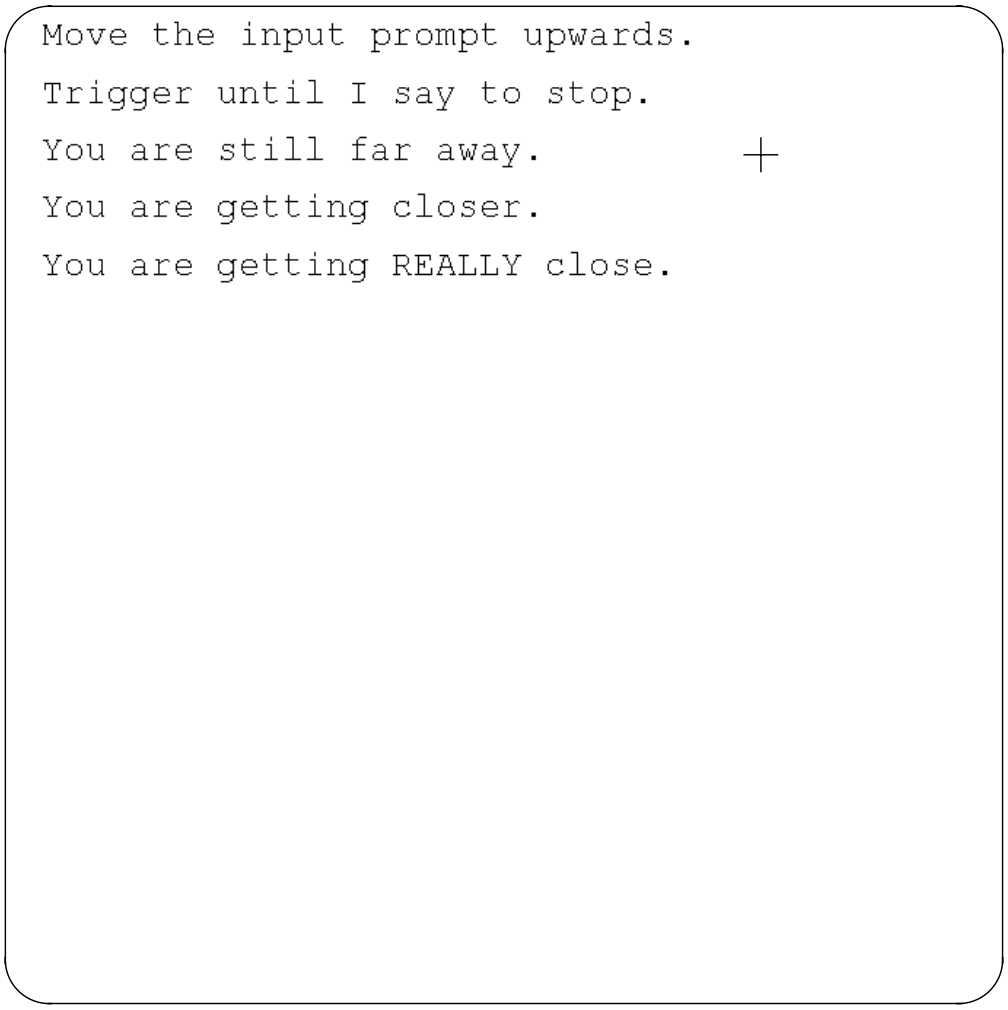
(continued on next page)

Example 9–1 (Cont.) Using a Locator Class Logical Input Device in Event Mode

```
/*
 *  Deactivate the logical input device by placing it in request mode.
 *  (You only have to return to request mode, though, if you are going
 *  to use a different type of input mode besides event later in
 *  the program.
 */

    echo_flag  = GKS$K_ECHO;
    input_mode = GKS$K_INPUT_MODE_REQUEST;

    gks$set_locator_mode (&ws_id, &device_num, &input_mode, &echo_flag);

    PROGRAM_END:

/*
 *  Deactivate the workstation, close the workstation, and
 *  close GKS.
 */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();
}
```

Figure 9–2 shows a workstation screen after the user has moved the input prompt near the top of the screen.

Figure 9–2 Input Prompt Near the Top of the Screen



Example 9–2 illustrates the use of the SAMPLE PICK function.

Example 9–2 Using a Pick-Class Logical Input Device in Sample Mode

```
/*
 *  This program initializes and samples pick input.  Some of the
 *  calls include:  SET FILL INTERIOR STYLE, SET PICK ID,
 *  SET FILL AREA COLOUR INDEX, FILL AREA, CREATE SEGMENT, CLOSE SEGMENT,
 *  SET TEXT HEIGHT, TEXT, INQUIRE PICK DEVICE STATE, INITIALIZE PICK,
 *  SET PICK MODE, SET DETECTABILITY, and SAMPLE PICK.
 *
 *  NOTE: To keep the example concise, no error checking is performed.
 */

# include <stdio.h>
```

(continued on next page)

Example 9–2 (Cont.) Using a Pick-Class Logical Input Device in Sample Mode

```
# include <gksdescrip.h>        /* GKS descriptor file */
# include <gksdefs.h>           /* GKS GKS$ binding constants */

#define DEV_NUM_1     1
#define TEXT_HEIGHT   0.03

main ()
{

/*
 *  echo_area is an array of real numbers that represents the
 *  rectangular echo area, in device coordinates.  The echo area
 *  defines the workstation surface from which GKS accepts input
 *  from the input prompt.
 */

    int    box_1;
    int    box_2;
    int    color_index;
    int    default_conid;
    int    default_wstype;
    float  data_record[1];
    int    detectability;
    int    device_num;
    float  echo_area[4];
    int    echo_flag;
    char   *error_message       = "Error status is not SUCCESS.";
    int    error_status;
    int    fill_style;
    int    initial_status;
    int    input_mode;
    int    input_status;
    float  larger;
    char   *number_one          = "1";
    char   *number_two          = "2";
    int    num_points           = 4;
    int    pick_id;
    float  position_20          = 0.20;
    float  position_30          = 0.30;
    float  position_45          = 0.45;
    float  position_05          = 0.05;
    float  position_70          = 0.70;
    float  position_75          = 0.75;
    float  position_80          = 0.80;
    float  position_85          = 0.85;
    float  position_90          = 0.90;
    float  position_95          = 0.95;
    int    prompt_echo_type;
    int    record_buffer_length = 4;
```

(continued on next page)

Example 9–2 (Cont.) Using a Pick-Class Logical Input Device in Sample Mode

```
    int    record_size;
    int    segment;
    char   *text_string1        = "Move the cursor to a triangle.";
    char   *text_string2        = "I will say if it is correct." ;
    char   *text_string3        = "You are pretty far away.";
    char   *text_string4        = "You are getting closer.";
    char   *text_string5        = "You are REALLY close.";
    char   *text_string6        = "YOU MADE IT!!!";
    int    triangle_1;
    int    triangle_2;
    int    value_type;
    int    ws_id;
    float  x_values[4];
    float  y_values[4];

    struct dsc$descriptor_s message_dsc;
    struct dsc$descriptor_s number_one_dsc;
    struct dsc$descriptor_s number_two_dsc;
    struct dsc$descriptor_s text_string1_dsc;
    struct dsc$descriptor_s text_string2_dsc;
    struct dsc$descriptor_s text_string3_dsc;
    struct dsc$descriptor_s text_string4_dsc;
    struct dsc$descriptor_s text_string5_dsc;
    struct dsc$descriptor_s text_string6_dsc;

/*
 *  Open the graphics environment:  open GKS, open the workstation,
 *  and activate the workstation.
 */

    default_conid     = GKS$K_CONID_DEFAULT;
    default_wstype    = GKS$K_WSTYPE_DEFAULT;
    ws_id             = 1;

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &default_wstype);
    gks$activate_ws (&ws_id);

/*  Create the divided boxes. */

    fill_style = GKS$K_INTSTYLE_SOLID;

    gks$set_fill_int_style (&fill_style);

/*  Establish the position of the first box. */

/*
 *  Create the box on the left side of the workstation surface
 *  and place it in a segment.  Divide the box diagonally and
 *  set pick identifiers for each of the created triangles.
 */

    x_values[0] = 0.1;
    y_values[0] = 0.3;

    x_values[1] = 0.4;
    y_values[1] = 0.6;

    x_values[2] = 0.1;
    y_values[2] = 0.6;

    x_values[3] = 0.1;
    y_values[3] = 0.3;
```

(continued on next page)

Example 9–2 (Cont.) Using a Pick-Class Logical Input Device in Sample Mode

```
    box_1 = 1;
    color_index = 2;
    triangle_1 = 1;
    triangle_2 = 2;

    gks$create_seg (&box_1);
    gks$set_pick_id (&triangle_1);
    gks$set_fill_color_index (&color_index);
    gks$fill_area (&num_points, x_values, y_values);

    x_values[2] = 0.4;
    y_values[2] = 0.3;

    color_index = 3;

    gks$set_pick_id (&triangle_2);
    gks$set_fill_color_index (&color_index);
    gks$fill_area (&num_points, x_values, y_values);
    gks$close_seg ();

/*
 *  Reset the X and Y world coordinate values to change the
 *  position of the box.
 */

    x_values[0] = 0.6;
    x_values[1] = 0.9;
    x_values[2] = 0.6;
    x_values[3] = 0.6;
    y_values[2] = 0.6;

/*
 *  Create the box on the right side of the workstation surface
 *  and place it in a segment.  Divide the box diagonally and
 *  set pick identifiers for each of the created triangles.
 */

    gks$set_pick_id (&triangle_1);

    box_2 = 2;
    color_index = 2;

    gks$create_seg (&box_2);
    gks$set_fill_color_index (&color_index);
    gks$fill_area (&num_points, x_values, y_values);

    x_values[2] = 0.9;
    y_values[2] = 0.3;

    color_index = 3;

    gks$set_pick_id (&triangle_2);
    gks$set_fill_color_index (&color_index);
    gks$fill_area (&num_points, x_values, y_values);
    gks$close_seg ();

    detectability = GKS$K_DETECTABLE;

    gks$set_seg_detectability (&box_1, &detectability);
    gks$set_seg_detectability (&box_2, &detectability);
```

(continued on next page)

Example 9–2 (Cont.) Using a Pick-Class Logical Input Device in Sample Mode

```
/*  Create the descriptor strings for the numbers. */

    number_one_dsc.dsc$a_pointer = number_one;
    number_one_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    number_one_dsc.dsc$b_class   = DSC$K_CLASS_S;
    number_one_dsc.dsc$w_length  = strlen (number_one);

    number_two_dsc.dsc$a_pointer = number_two;
    number_two_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    number_two_dsc.dsc$b_class   = DSC$K_CLASS_S;
    number_two_dsc.dsc$w_length  = strlen (number_two);

/*  Label the triangles by their pick identifiers. */

    larger = TEXT_HEIGHT;

    gks$set_text_height (&larger);
    gks$text (&position_20, &position_45, &number_one_dsc);
    gks$text (&position_30, &position_45, &number_two_dsc);
    gks$text (&position_70, &position_45, &number_one_dsc);
    gks$text (&position_80, &position_45, &number_two_dsc);

/*
 *  Declare a data length of one long word which will hold the
 *  size of the pick prompt.
 */

    record_buffer_length = sizeof (data_record);

/*
 *  Use INQUIRE PICK DEVICE STATE to initialize the variables
 *  you need to pass to the input function.  GKS$K_VALUE_REALIZED
 *  tells the graphics handler to pass the input values as they
 *  are implemented.  (Use GKS$K_VALUE_SET to tell the application
 *  to pass the input values the way the application set them.)
 *
 *  After the function call, record_buffer_length contains the
 *  amount of the buffer filled with the written data record.  If
 *  record_size is larger than record_buffer_length, you know GKS
 *  truncated the data record to fit into your declared buffer.
 */

    device_num = DEV_NUM_1;
    value_type = GKS$K_VALUE_REALIZED;

    gks$inq_pick_state (&ws_id, &device_num, &value_type,
       &error_status, &input_mode, &echo_flag, &initial_status, &segment,
       &pick_id, &prompt_echo_type, echo_area, data_record,
       &record_buffer_length, &record_size);


/*  Set up the string descriptor for the error message. */

    message_dsc.dsc$a_pointer = error_message;
    message_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    message_dsc.dsc$b_class   = DSC$K_CLASS_S;
    message_dsc.dsc$w_length  = strlen (error_message);

/*  Check to see if the error status equals 0. */
```

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Example 9–2 (Cont.) Using a Pick-Class Logical Input Device in Sample Mode

```
    if (error_status != 0)
       {
       gks$message (&ws_id, &message_dsc);
       goto PROGRAM_END;
       }

/*
 *  Use INITIALIZE PICK to initialize the logical input device. Assign new
 *  values to the input variables.
 */

    initial_status = GKS$K_STATUS_OK;
    pick_id = triangle_1;
    segment = box_1;

    gks$init_pick (&ws_id, &device_num, &initial_status, &segment, &pick_id,
       &prompt_echo_type, echo_area, data_record, &record_buffer_length);

/*
 *  Activate the logical input device by placing it in sample mode.
 *  The input prompt now appears on the workstation surface and the
 *  user can change the measure of the device.
 */

    echo_flag  = GKS$K_ECHO;
    input_mode = GKS$K_INPUT_MODE_SAMPLE;

    gks$set_pick_mode (&ws_id, &device_num, &input_mode, &echo_flag);


/*  Set up the string descriptors for the screen messages. */

    text_string1_dsc.dsc$a_pointer = text_string1;
    text_string1_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text_string1_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text_string1_dsc.dsc$w_length  = strlen (text_string1);

    text_string2_dsc.dsc$a_pointer = text_string2;
    text_string2_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text_string2_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text_string2_dsc.dsc$w_length  = strlen (text_string2);

    text_string3_dsc.dsc$a_pointer = text_string3;
    text_string3_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text_string3_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text_string3_dsc.dsc$w_length  = strlen (text_string3);

    text_string4_dsc.dsc$a_pointer = text_string4;
    text_string4_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text_string4_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text_string4_dsc.dsc$w_length  = strlen (text_string4);

    text_string5_dsc.dsc$a_pointer = text_string5;
    text_string5_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text_string5_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text_string5_dsc.dsc$w_length  = strlen (text_string5);

    text_string6_dsc.dsc$a_pointer = text_string6;
    text_string6_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    text_string6_dsc.dsc$b_class   = DSC$K_CLASS_S;
    text_string6_dsc.dsc$w_length  = strlen (text_string6);
```

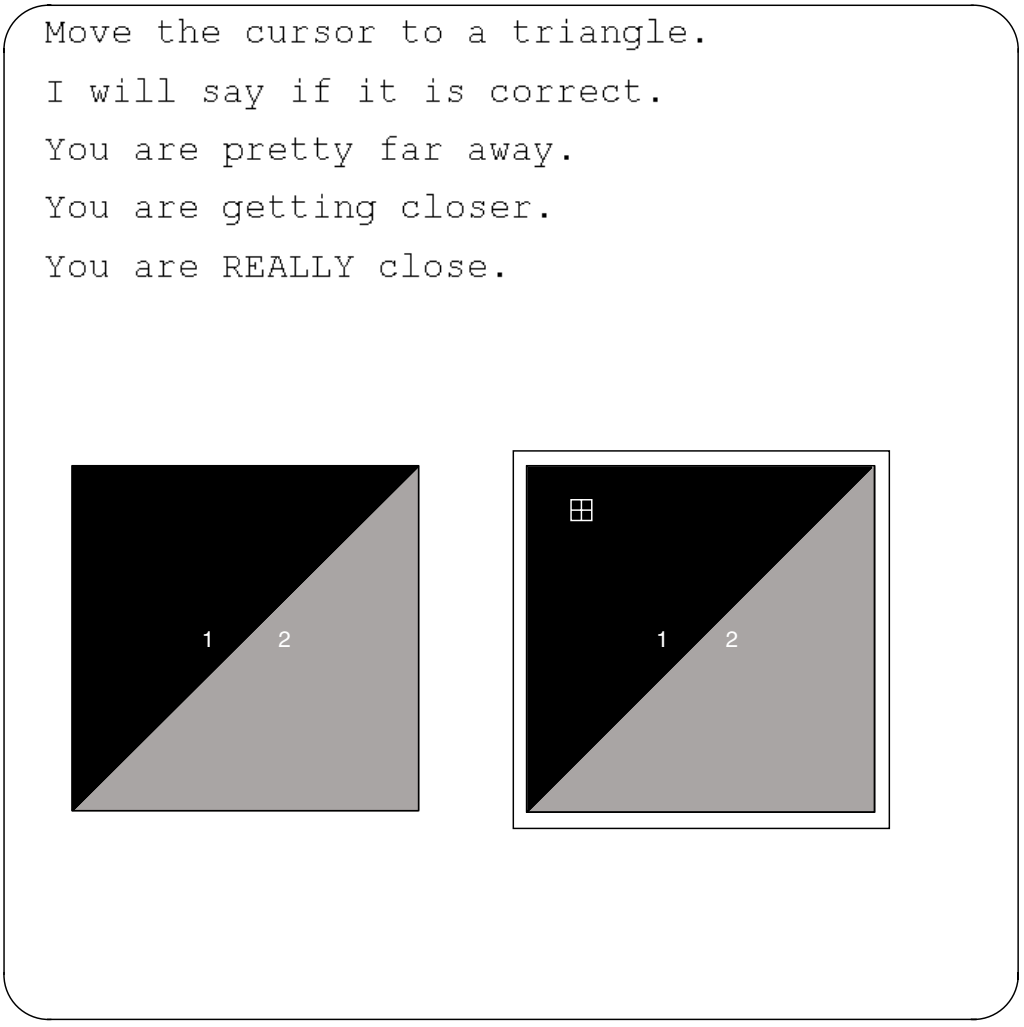
(continued on next page)

Example 9–2 (Cont.) Using a Pick-Class Logical Input Device in Sample Mode

```
/*  Tell the user the task. */

    larger = TEXT_HEIGHT;

    gks$set_text_height (&larger);
    gks$text (&position_05, &position_95, &text_string1_dsc);
    gks$text (&position_05, &position_90, &text_string2_dsc);

/*
 *  Retrieve the current input value without the user having to
 *  trigger the device by using SAMPLE PICK.  The while loop ends
 *  when the user picks the second triangle in the second box.
 */

    while ((segment != 2) || (pick_id != 2))
       {
       gks$sample_pick (&ws_id, &device_num, &input_status,
          &segment, &pick_id);

       /*
        *  Tease the user by saying how close the aperture is to
        *  segment 2, pick identifier 2.
        */

           if ((segment == 1) && (pick_id == 1))
              gks$text (&position_05, &position_85, &text_string3_dsc);

           else if ((segment == 1) && (pick_id == 2))
              gks$text (&position_05, &position_80, &text_string4_dsc);

           else if ((segment == 2) && (pick_id == 1))
              gks$text (&position_05, &position_75, &text_string5_dsc);
       }

    gks$text (&position_05, &position_70, &text_string6_dsc);

/*
 *  Deactivate the logical input device by placing it in request mode.
 *  The device handler removes the input prompt from the workstation
 *  surface and the user can no longer enter input.
 */

    echo_flag  = GKS$K_ECHO;
    input_mode = GKS$K_INPUT_MODE_REQUEST;

    gks$set_pick_mode (&ws_id, &device_num, &input_mode, &echo_flag);

    PROGRAM_END:

/*
 *  Deactivate the workstation, close the workstation, and
 *  close GKS.
 */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();
}
```

Figure 9–3 shows the workstation surface when the user picks the correct triangle.

Figure 9–3 Picking the Correct Triangle



Example 9–3 illustrates the use of the INITIALIZE STRING function.

Example 9–3 Using a String-Class Logical Input Device in Request Mode

```
/*
 *  This program initializes and requests string input. Some of the
 *  calls it uses include:  INQUIRE STRING STATE, INITIALIZE STRING,
 *  and REQUEST STRING.
 */

# include <stdio.h>

# include <gksdescrip.h>     /* GKS descriptor file */
# include <gksdefs.h>        /* GKS GKS$ binding constants */
```

(continued on next page)

Example 9–3 (Cont.) Using a String-Class Logical Input Device in Request Mode

```
# define BUFFER_LENGTH  4
# define DEV_NUM_1      1
# define STRING_PET     1
# define STRING_SIZE    80

main ()
{

/*
 *  data record contains the buffer length and the initial editing
 *  position for all logical input prompt and echo types.  The buffer
 *  can be only as long as the maximum size the workstation supports.
 *  To obtain the maximum buffer size, call INQUIRE DEFAULT STRING
 *  DEVICE DATA.
 *
 *  echo_area is an array of real numbers that represent the
 *  rectangular echo area, in device coordinates.  The echo area
 *  defines the workstation surface from which GKS accepts input
 *  from the input prompt.
 *
 *  The defined string variables contain a string that is the length of
 *  the terminal screen.  You can change the maximum size of the input
 *  string every time you initialize the string logical input device by
 *  changing the value associated with the buffer length.
 */

    int       buffer_length;
    int       cursor_pos;
    int       data_record[BUFFER_LENGTH];
    int       default_conid;
    int       default_wstype;
    char      default_string[STRING_SIZE+1];
    int       device_num;
    float     echo_area[4];
    int       echo_flag;
    char      *error_message  = "Error status is not SUCCESS.";
    int       error_status;
    int       input_mode;
    int       input_status;
    char      input_string[STRING_SIZE+1];
    int       prompt_echo_type;
    char      *prompt_string  = "GKS>";
    int       record_buffer_length;
    int       record_size;
    int       string_return_size;
    int       string_size;
    int       ws_id;

    struct dsc$descriptor_s default_string_dsc;
    struct dsc$descriptor_s input_string_dsc;
    struct dsc$descriptor_s message_dsc;
    struct dsc$descriptor_s prompt_string_dsc;

/*
 *  Open the graphics environment:  open GKS, open the workstation,
 *  and activate the workstation.
 */

    default_conid     = GKS$K_CONID_DEFAULT;
    default_wstype    = GKS$K_WSTYPE_DEFAULT;
    ws_id             = 1;
```

(continued on next page)

Example 9–3 (Cont.) Using a String-Class Logical Input Device in Request Mode

```
    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &default_wstype);
    gks$activate_ws (&ws_id);

/*
 *  Use INQUIRE STRING DEVICE STATE to initialize the variables
 *  you need to pass to the input functions.
 *
 *  After the function call, record_buffer_length contains the size
 *  of the buffer filled with the written data record.  If record_size
 *  is larger than record_buffer_length, you know GKS truncated the
 *  data record to fit into the declared buffer.
 */

    data_record[0]        = (int) &buffer_length;
    data_record[1]        = (int) &cursor_pos;
    device_num            = DEV_NUM_1;
    record_buffer_length  = sizeof (data_record);

    default_string_dsc.dsc$w_length  = STRING_SIZE;
    default_string_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    default_string_dsc.dsc$b_class   = DSC$K_CLASS_S;
    default_string_dsc.dsc$a_pointer = default_string;

    gks$inq_string_state (&ws_id, &device_num, &error_status,
       &input_mode, &echo_flag, &default_string_dsc, &string_return_size,
       &prompt_echo_type, echo_area, data_record, &record_buffer_length,
       &record_size);


/*
 *  Set up the string descriptor for the error message.  Check to see if the
 *  error status equals 0.
 */

    message_dsc.dsc$a_pointer = error_message;
    message_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    message_dsc.dsc$b_class   = DSC$K_CLASS_S;
    message_dsc.dsc$w_length  = strlen (error_message);

    if (error_status != 0)
       {
       gks$message (&ws_id, &message_dsc);
       goto PROGRAM_END;
       }

/*  Assign new values to the input variables. */

    buffer_length     = 15;
    prompt_echo_type  = STRING_PET;


/*  Create the string descriptor for the prompt. */

    prompt_string_dsc.dsc$w_length  = strlen (prompt_string);
    prompt_string_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    prompt_string_dsc.dsc$b_class   = DSC$K_CLASS_S;
    prompt_string_dsc.dsc$a_pointer = prompt_string;

/*  Initialize the logical input device. */

    gks$init_string (&ws_id, &device_num, &prompt_string_dsc,
       &prompt_echo_type, echo_area, data_record, &record_buffer_length);
```

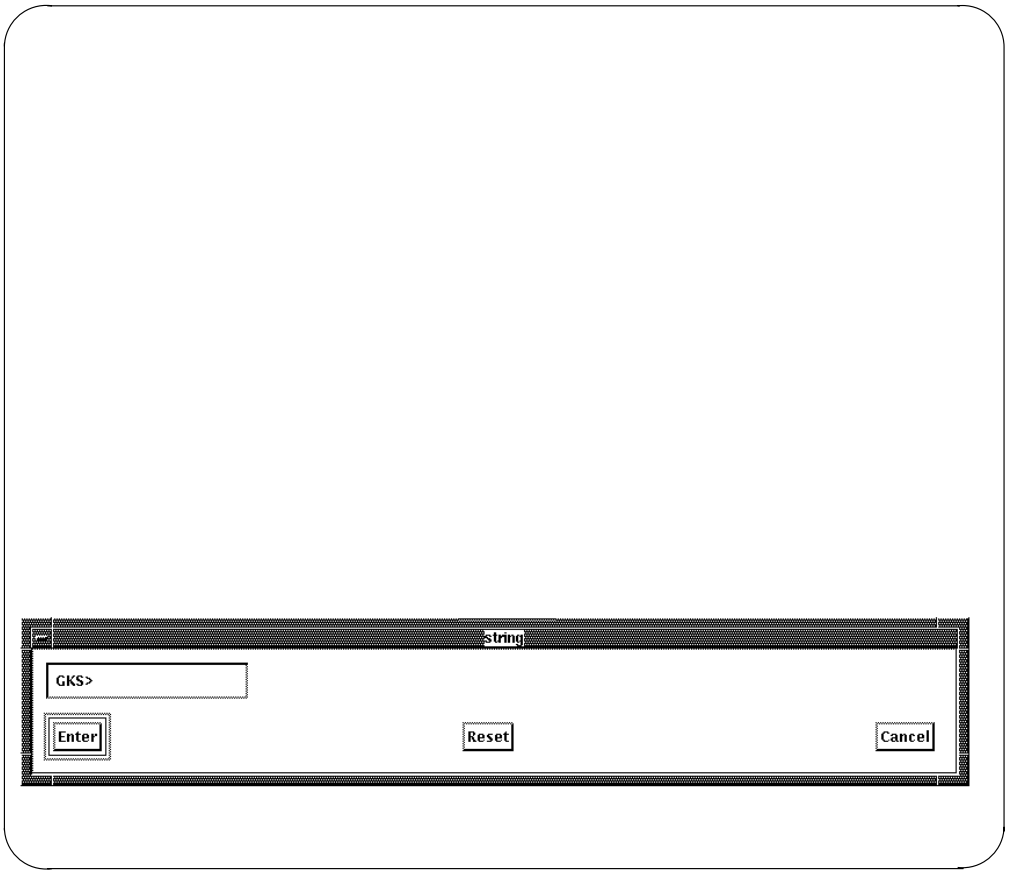
(continued on next page)

Example 9–3 (Cont.) Using a String-Class Logical Input Device in Request Mode

```
/*
 *  Activate the logical input device by calling REQUEST STRING.
 *  GKS writes the string to the next-to-last argument.  The last
 *  argument contains the size of the input string.
 */

    input_string_dsc.dsc$w_length  = STRING_SIZE;
    input_string_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    input_string_dsc.dsc$b_class   = DSC$K_CLASS_S;
    input_string_dsc.dsc$a_pointer = input_string;

    gks$request_string (&ws_id, &device_num, &input_status,
       &input_string_dsc, &string_size);

    PROGRAM_END:

/*
 *  Deactivate the workstation, close the workstation, and
 *  close GKS.
 */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();

/*  Output the input string and its size. */

    input_string[string_size] = 0;
    printf ("string %s , size %d, status %d \n", input_string_dsc.dsc$a_pointer,
             string_size, input_status);

}
```

Figure 9–4 shows a workstation screen at the request for input.

Figure 9–4 Requesting Input from a String-Class Logical Input Device in Request Mode



Example 9–4 illustrates the use of the SAMPLE VALUATOR function.

Example 9–4 Using a Valuator-Class Logical Input Device in Sample Mode

```
/*
 *  This program initializes and samples valuator input.  Some of
 *  the calls include:  INQUIRE VALUATOR STATE, INITIALIZE VALUATOR,
 *  SET VALUATOR MODE, and SAMPLE VALUATOR, EVALUATE TRANSFORMATION
 *  MATRIX, and SET SEGMENT TRANSFORMATION.
 *
 *  To keep the example concise NO error checking is performed.
 */

# include <stdio.h>

# include <gksdescrip.h>       /* GKS descriptor file */
# include <gksdefs.h>          /* GKS GKS$ binding constants */
```

(continued on next page)

Example 9–4 (Cont.) Using a Valuator-Class Logical Input Device in Sample Mode

```
#define DEV_NUM_1     1
#define BUFFER_LENGTH 2
#define TEXT_HEIGHT   0.03

main ()
{

/*
 *  echo_area is an array of real numbers that represents the
 *  rectangular echo area, in device coordinates.  The echo area
 *  defines the workstation surface from which GKS accepts input
 *  from the input prompt.
 *
 *  The graphics handler uses two parts of the valuator input data
 *  record for prompt and echo type 1:  the real value representing
 *  an upper limit and another real value representing a lower limit.
 *
 *  Your terminal might support one of three valuator prompt and echo
 *  types represented by the integers 1, 2, and 3.  Types 1 and 2
 *  prompt the user with a rectangle and a horizontal scale.  To use
 *  the first two types, the user uses the arrow keys or the mouse to
 *  move an arrow along the scale between the upper and lower limits.
 *  With type 3, GKS changes a single digital representation of the real
 *  values between the upper and lower limits.  The user controls the change
 *  of numbers with the arrow keys or the mouse.
 */

    float     angle;
    int       box;
    float     box_x[5];
    float     box_y[5];
    int       coordinate_flag;
    float     data_record[BUFFER_LENGTH];
    int       default_conid;
    int       default_wstype;
    int       device_num;
    float     echo_area[4];
    int       echo_flag;
    char      *error_message  = "Error status is not SUCCESS.";
    int       error_status;
    int       fill_int_style;
    float     fixed_point_x;
    float     fixed_point_y;
    float     high_value;
    float     init_value;
    int       input_mode;
    int       input_status;
    char      *instruction_1  = "Change the box's size.";
    char      *instruction_2  = "To stop, set the value to 2.0.";
```

(continued on next page)

Example 9–4 (Cont.) Using a Valuator-Class Logical Input Device in Sample Mode

```
    float     larger;
    float     low_value;
    int       points;
    float     position_05     = 0.05;
    float     position_90     = 0.90;
    float     position_95     = 0.95;
    int       prompt_echo_type;
    int       record_buffer_length;
    int       record_size;
    float     rotation;
    float     sampled_value;
    float     scale_x;
    float     scale_y;
    float     xform_matrix[6];
    float     vector_x;
    float     vector_y;
    int       ws_flag;
    int       ws_id;

    struct dsc$descriptor_s inst1_dsc;
    struct dsc$descriptor_s inst2_dsc;
    struct dsc$descriptor_s message_dsc;

/*
 *  Open the graphics environment:  open GKS, open the workstation,
 *  and activate the workstation.
 */

    default_conid     = GKS$K_CONID_DEFAULT;
    default_wstype    = GKS$K_WSTYPE_DEFAULT;
    ws_id             = 1;

    gks$open_gks (0, 0);
    gks$open_ws (&ws_id, &default_conid, &default_wstype);
    gks$activate_ws (&ws_id);

/*
 *  Use INQUIRE VALUATOR DEVICE STATE to initialize the variables you
 *  need to pass to the input functions.
 *
 *  After the function call, record_buffer_length contains the
 *  amount of the buffer filled with the written data record.  If
 *  record_size is larger than record_buffer_length, GKS truncated
 *  the data record to fit into the declared buffer.
 */

    device_num           = DEV_NUM_1;
    record_buffer_length = sizeof (data_record);

    gks$inq_valuator_state (&ws_id, &device_num, &error_status,
       &input_mode, &echo_flag, &init_value, &prompt_echo_type, echo_area,
       data_record, &record_buffer_length, &record_size);

/*  Set up the string descriptor for the error message. */

    message_dsc.dsc$a_pointer = error_message;
    message_dsc.dsc$b_dtype   = DSC$K_DTYPE_T;
    message_dsc.dsc$b_class   = DSC$K_CLASS_S;
    message_dsc.dsc$w_length  = strlen (error_message);

/*  Check to see if the error status equals 0. */
```

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Example 9–4 (Cont.) Using a Valuator-Class Logical Input Device in Sample Mode

```
    if (error_status != 0)
       {
       gks$message (&ws_id, &message_dsc);
       goto PROGRAM_END;
       }

/*  Assign new values to the input variables. */

    data_record[0]   = 0.001;  /* Low value of valuator */
    data_record[1]   = 2.0;    /* High value of valuator */
    init_value       = 1.0;
    prompt_echo_type = 1;

/*  Initialize the logical input device. */

    gks$init_valuator (&ws_id, &device_num, &init_value,
       &prompt_echo_type, echo_area, data_record, &record_size);

/*
 *  Activate the logical input device by placing it in sample mode.
 *  The input prompt now appears on the workstation surface and
 *  the user can change the measure of the device.
 */

    echo_flag  = GKS$K_ECHO;
    input_mode = GKS$K_INPUT_MODE_SAMPLE;

    gks$set_valuator_mode (&ws_id, &device_num, &input_mode, &echo_flag);

/*
 *  Create a box.  (The program will scale the box according to
 *  the sample values of the logical input device.)
 */

    box            = 1;
    fill_int_style = GKS$K_INTSTYLE_SOLID;
    larger         = TEXT_HEIGHT;
    points         = 5;

    gks$set_fill_int_style (&fill_int_style);
    gks$set_text_height (&larger);

    box_x[0] = 0.4;
    box_y[0] = 0.4;

    box_x[1] = 0.6;
    box_y[1] = 0.4;

    box_x[2] = 0.6;
    box_y[2] = 0.6;

    box_x[3] = 0.4;
    box_y[3] = 0.6;

    box_x[4] = 0.4;
    box_y[4] = 0.4;
```

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Example 9–4 (Cont.) Using a Valuator-Class Logical Input Device in Sample Mode

```
    gks$create_seg (&box);
    gks$fill_area (&points, box_x, box_y);
    gks$close_seg ();

/*  Set up the string descriptors for the messages. */

    inst1_dsc.dsc$a_pointer    = instruction_1;
    inst1_dsc.dsc$b_dtype      = DSC$K_DTYPE_T;
    inst1_dsc.dsc$b_class      = DSC$K_CLASS_S;
    inst1_dsc.dsc$w_length     = strlen (instruction_1);

    inst2_dsc.dsc$a_pointer    = instruction_2;
    inst2_dsc.dsc$b_dtype      = DSC$K_DTYPE_T;
    inst2_dsc.dsc$b_class      = DSC$K_CLASS_S;
    inst2_dsc.dsc$w_length     = strlen (instruction_2);

/*  Display instructions to the user. */

    gks$text (&position_05, &position_95, &inst1_dsc);
    gks$text (&position_05, &position_90, &inst2_dsc);


/*  Sample the user input by using SAMPLE VALUATOR
 *
 *  The call to SAMPLE VALUATOR retrieves the current input value
 *  (without the user having to trigger the logical input device).
 *  The while loop ends when the user moves the input prompt to 2.0.
 */

    sampled_value = 1.0;

    while (sampled_value != 2.0)
       {
       gks$sample_valuator (&ws_id, &device_num, &sampled_value);

       /*  Scale the segment using EVALUATE TRANSFORMATION MATRIX. */

           angle           = 0.0;
           coordinate_flag = GKS$K_COORDINATES_WC;
           fixed_point_x   = 0.5;
           fixed_point_y   = 0.5;
           scale_x         = sampled_value;
           scale_y         = sampled_value;
           vector_x        = 0.0;
           vector_y        = 0.0;

           gks$eval_xform_matrix (&fixed_point_x, &fixed_point_y,
              &vector_x, &vector_y, &angle, &scale_x, &scale_y,
              &coordinate_flag, xform_matrix);

           if (sampled_value != 1.0)
              {
              ws_flag = GKS$K_PERFORM_FLAG;

              gks$set_seg_xform (&box, xform_matrix);
              gks$update_ws (&ws_id, &ws_flag);
              }
       }
```

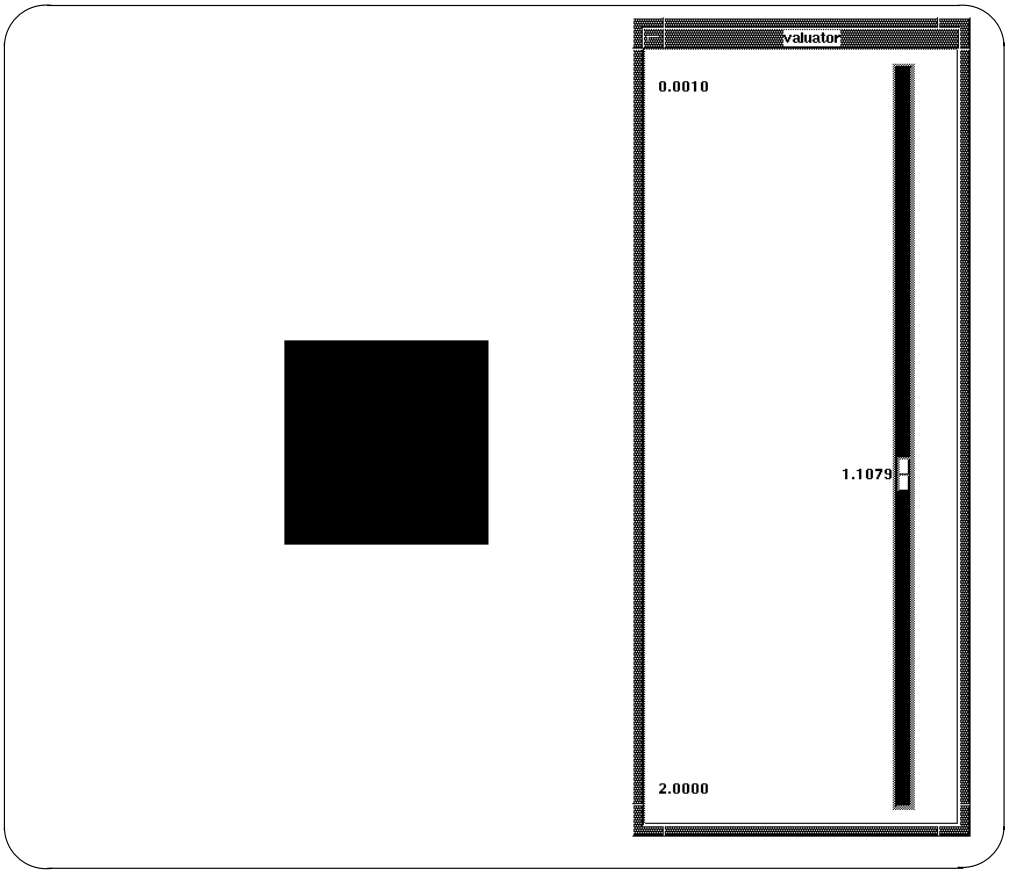
(continued on next page)

Example 9–4 (Cont.) Using a Valuator-Class Logical Input Device in Sample Mode

```
/*  Deactivate the logical input device by placing it in request mode. */

    echo_flag  = GKS$K_ECHO;
    input_mode = GKS$K_INPUT_MODE_REQUEST;

    gks$set_valuator_mode (&ws_id, &device_num, &input_mode, &echo_flag);

    PROGRAM_END:

/*
 *  Deactivate the workstation, close the workstation, and
 *  close GKS.
 */

    gks$deactivate_ws (&ws_id);
    gks$close_ws (&ws_id);
    gks$close_gks ();

/*  Display the sampled value. */

    printf ("%f\n",sampled_value);
}
```

Figure 9–5 shows the workstation surface after DEC GKS activates the valuator-class logical input device in sample mode.

Figure 9–5 Workstation Surface after Activating a Valuator-Class Logical Input Device in Sample Mode



Metafile Functions

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10
Metafile Functions

The DEC GKS **metafile** functions provide a mechanism for long-term storage, communication, and reproduction of a graphic image. Metafiles created by an application can be used by other applications on other computer systems to reproduce a picture. When you store picture information in a metafile, you store specific information concerning the output primitives contained in the picture, the corresponding output attributes, and other information that may be needed to reproduce the picture.

When DEC GKS creates a metafile, it uses one of two formats to store the information about the generated picture. DEC GKS can create either GKS Metafiles (GKSM or GKS3) or Computer Graphics Metafiles (CGM). GKSM metafiles are two-dimensional metafiles and GKS3 metafiles are three-dimensional metafiles.

The GKSM format is defined by the GKS standard; the GKS3 format is defined by the GKS–3D standard. When using the GKSM or GKS3 format, DEC GKS stores an audit of the generation of DEC GKS primitives. For more information concerning GKSM and GKS3 format, see Section 10.1 and the metafile appendix in the *DEC GKS User's Guide*.

The CGM format is defined by the CGM ANSI X3.122-1986 standard. This metafile format consists of a set of elements that can be used to describe a single graphic picture. CGM format is designed for use with many types of graphics applications, including DEC GKS applications. If you need to create a CGM for use with other applications, possibly on other systems, you can use DEC GKS to create the file. However, DEC GKS cannot read CGM format. For more information concerning CGM, see Section 10.2.

A short-term method of storing output primitives is to store them in segments. For more information concerning segments, see Chapter 8, Segment Functions.

10.1 Creating a GKSM or GKS3 Metafile

To create a GKSM or GKS3, you open and then activate a metafile workstation using the constant GKS$K_GKSM_OUTPUT (numeric value 2) as a workstation type for category GKS$K_WSCAT_MO workstations. As the device connection, name the file that is to contain the metafile information. DEC GKS uses the file name exactly as specified, without using a default file extension. You can open and activate as many GKS$K_GKSM_OUTPUT workstations as determined by the maximum allowable open and active workstations, sending output to the active GKS$K_GKSM_OUTPUT workstation. Specify the file type values, GKSM or GKS3, with the appropriate environment option to indicate a two- or three-dimensional GKS metafile. For more information on these environment options, see Chapter 2 and Chapter 3.

Once the GKS$K_GKSM_OUTPUT type workstation is active, DEC GKS records information about the current state of the picture, such as output attribute information. Then, as you call DEC GKS functions, pertinent information about the function call is recorded in a metafile record. Category metafile output workstations record the following information:

- The control functions that affect the appearance of the picture on the workstation surface.
- Output primitives, if the GKS$K_GKSM_OUTPUT workstation is active at the time of the function call. The primitives are stored in a form equivalent to NDC points.
- Output attribute settings that are current at the time of primitive generation.
- Segments, if the GKS$K_GKSM_OUTPUT workstation is active at the time of the call to CREATE SEGMENT.
- Geometric attribute data (such as character height, character-up vector, and so on) affecting stored text primitives, in a form equivalent to NDC points.
- Normalization transformation information such as the clipping rectangle. DEC GKS does not record workstation transformations.
- Data specific to the application, or information that DEC GKS metafiles cannot store through standard calls to DEC GKS functions (stored using the function WRITE ITEM TO GKSM).

If a call to a DEC GKS function is not applicable to the graphical picture, such as calls to certain control or inquiry functions, DEC GKS does not store the function call information in the metafile. Because metafiles record information pertinent to output only, DEC GKS metafiles do not record information about input function calls.

When you create a GKSM or GKS3 metafile, DEC GKS produces a **metafile header**, and for each function call necessary to reproduce the current environment, DEC GKS writes a series of **items** to the metafile. The metafile header contains information such as the author of the metafile, the date, the version number, and the length of the different fields in the data record. The items generated by a function call roughly correspond to the actual function call or to the state of the picture when the call was made.

For each item, DEC GKS produces an **item header** and an **item data record**. The DEC GKS standard specifies this general format for data storage within a GKSM or GKS3 (metafile header followed by an item header followed by an item data record, and so on), but the individual item data record format is implementation specific. For example, some implementations may store all item data as a string of characters, whereas other implementations may store some information as binary-encoded integer values and some information in character strings.

An **item type** is an integer value that corresponds to a DEC GKS function. For example, an item of type 3 corresponds to a call to UPDATE WORKSTATION. The item type is contained in the item header. For a list of the integer values, see the appendix on metafiles in *DEC GKS User's Guide*.

When creating a GKSM or GKS3 metafile, you do not need to know the information contained in the item header or the item data record. Once you activate a type GKS$K_GKSM_OUTPUT workstation and call output functions, DEC GKS formats the graphic output information within the metafile for you.

When you close the GKS$K_GKSM_OUTPUT workstation, DEC GKS writes an item of type 0 to the metafile to specify that it is the last item in the metafile.

10.2 Creating a CGM

To create a CGM, you open and then activate a workstation using the constant GKS$K_CGM_OUTPUT (numeric value 7) as a workstation type for category GKS$K_WSCAT_MO workstations. As the device connection, name the file that is to contain the metafile information. DEC GKS uses the file name exactly as specified, without using a default file extension. You can open and activate as many type GKS$K_CGM_OUTPUT workstations as determined by the maximum allowable open and active workstations, sending appropriate output to the appropriate active type GKS$K_CGM_OUTPUT workstation.

Once the GKS$K_CGM_OUTPUT workstation is active, DEC GKS places the graphic information into **elements**, by category. The element categories are as follows:

Category	Description
Delimiter elements	Separate structures within the metafile.
Metafile descriptor elements	Describe the functional content and unique characteristics of the CGM.
Picture descriptor elements	Define the limits of the virtual device coordinates (VDC) and the parameter modes for the attribute elements.
Control elements	Specify size and precision of VDC points, and format descriptions of the CGM elements.
Graphic primitive elements	Describe the geometric objects in the picture.
Attribute elements	Describe the various appearances of the graphic elements.
Escape elements	Describe device- and system-specific functionality.
External elements	Pass information not needed for the creation of a picture (for example, a message sent to the user of the metafile).

The elements may have associated data. For example, the graphic primitive elements may specify VDC points. (The DEC GKS NDC points correspond to the CGM VDC points.) DEC GKS determines the element data from your DEC GKS function calls.

All the CGM elements are grouped into structures similar in appearance to an application program. DEC GKS creates a metafile description at the top of the file. Other structures include the metafile default structure and the metafile picture structure. Each structure begins and ends with the appropriate delimiter elements.

Unlike GKSM or GKS3 items, CGM elements have a certain format, or **encoding**. DEC GKS can create CGM elements in one of the following encodings:

Encoding	Description
Character	This encoding requires that the CGM elements and their parameters be stored in a character-coded format as specified by the CGM standard. With this encoding, your metafiles use a minimum amount of physical storage.
Binary	This encoding requires that the CGM elements and their parameters be stored in binary code. Using this encoding, many of the applications and machines can store and read a CGM with greater ease.
Clear text	This encoding requires that the CGM elements and their parameters be stored in text. Using this encoding, you can type, print, or edit the CGM so you can review its contents before reading the file.

You can use bit mask constant values within your program to specify an encoding. An example of such a GKS$ binding call (in C) is as follows:

```
# define CGM_NAME "cgm_file.txt"

wstype = GKS$K_CGM_OUTPUT | GKS$M_CHARACTER_ENCODING;
filedesc.dsc$w_length = sizeof(CGM_NAME) - 1;
filedesc.dsc$b_dtype = DSC$K_DTYPE_T;
filedesc.dsc$b_class = DSC$K_CLASS_S;
filedesc.dsc$a_pointer = CGM_NAME;

gks$open_ws (&wsid, &filedesc, &wstype);
```

All the available constant values are listed in the language-dependent header files. The *Device Specifics Reference Manual for DEC GKS and DEC PHIGS* contains extended information concerning bitmasks.

When you create a CGM, you do not need to know the information contained in the individual elements. Once you activate a type GKS$K_CGM_OUTPUT workstation and call output functions, DEC GKS formats the graphic output information within the metafile for you.

For detailed information concerning the CGM format for the supported encodings, see the *Device Specifics Reference Manual for DEC GKS and DEC PHIGS*.

10.3 Reading a GKSM or GKS3 Metafile

To reproduce a graphic image from a GKSM or GKS3, you must open a metafile input (GKS$K_WSCAT_MI) workstation. DEC GKS defines the constant GKS$K_GKSM_INPUT (numeric value 3) as the workstation type for category GKS$K_WSCAT_MI workstations. Also, when you open the type GKS$K_GKSM_INPUT workstation, specify the name of the file containing the recorded data items as the connection identifier argument. DEC GKS uses the file name exactly as specified, without using a default file extension. You can open only one type GKS$K_GKSM_INPUT workstation for every corresponding physical file. DEC GKS distinguishes between GKSM and GKS3 files directly from the contents of the files.

When you open a type GKS$K_GKSM_INPUT workstation, the first item written to the metafile becomes the **current item**. The current item is the item processed when you call the function GET ITEM TYPE FROM GKSM. You can open as many type GKS$K_GKSM_INPUT workstations as DEC GKS permits in total workstations, interpreting items from the appropriate metafile on the appropriate active workstations.

To reproduce the graphic image stored in the metafile, you must call the following functions for all the applicable items in the metafile, until you reach the item type 0 (signifying the last item):

- GET ITEM TYPE FROM GKSM—Returns the item type and the length of the data record of the current item.
- READ ITEM FROM GKSM—Returns the item data record and causes the next item in the metafile to become the current item.
- INTERPRET ITEM—Reads information about an item and reproduces the desired action on all active workstations of categories GKS$K_WSCAT_OUTPUT and GKS$K_WSCAT_OUTIN.

In most applications, you call INTERPRET ITEM for all items in a metafile. However, there are cases when you may not wish to do this.

For example, if the creator of the metafile called the function WRITE ITEM TO GKSM to pass user-defined data to the metafile, you need to handle this information in a special manner. For example, if the user-defined data is a text string containing information for the application programmer, then instead of passing the record to INTERPRET ITEM, you should store or write the text string as desired. You can identify user-defined data by checking the item type; all item types greater than 100 are GKSM user-defined items. Item types less than 0 are GKS3 user-defined items. DEC GKS metafiles reserve item data numbers 0 to 100. If you are not using a DEC GKS GKSM or GKS3, the reserved item numbers may differ.

As another example, if you checked the item type and found it to be 3 (which is a call to the function UPDATE WORKSTATION), you may not want to interpret that item if it would delete important output primitives already on the workstation surface. For more information concerning the effects of a call to UPDATE WORKSTATION, see Chapter 4, Control Functions.

If after calling GET ITEM TYPE FROM GKSM, you decide that you do not want to interpret the item, pass the value 0 as the data length argument to READ ITEM FROM GKSM. This skips the current item, causing the next item in the file to become the current item.

10.4 Metafile Inquiries

The following list presents the inquiry functions that you can use to obtain information when writing device-independent code:

INQUIRE LEVEL OF GKS
INQUIRE LIST OF AVAILABLE WORKSTATION TYPES
INQUIRE OPERATING STATE VALUE
INQUIRE SET OF OPEN WORKSTATIONS
INQUIRE WORKSTATION STATE

For more information concerning device-independent programming, see the *DEC GKS User's Guide*.

10.5 Function Descriptions

This section describes the DEC GKS metafile functions in detail.

GET ITEM TYPE FROM GKSM

Operating States

WSOP, WSAC, SGOP

Syntax

gks$get_item (ws_id, item_type, item_data_len)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
item_type	Integer	Write	Reference	Item type
item_data_len	Integer	Write	Reference	Length of the data record, in bytes

Description

The GET ITEM TYPE FROM GKSM function returns the item type and the length of the item data record from the current item in a metafile to the last argument.

See Also

OPEN WORKSTATION
READ ITEM FROM GKSM
WRITE ITEM TO GKSM

INTERPRET ITEM

Operating States

WSOP, WSAC, SGOP

Syntax

gks$interpret_item (item_type, item_data_len, item_data_rec)

Argument	Data Type	Access	Passed by	Description
item_type	Integer	Read	Reference	Item type
item_data_len	Integer	Read	Reference	Total length of the data record, in bytes
item_data_rec	Record	Read	Reference	Item data record

Description

The INTERPRET ITEM function interprets an item data record obtained by a call to READ ITEM FROM GKSM.

If the item type corresponds to a call to a function that affects graphic representation, this function makes appropriate changes to the GKS state list, and generates the specified graphic output on all active workstations of categories OUTPUT and OUTIN.

If the item type identifies user-defined data, this function generates an error indicating that it cannot interpret the item.

See Also

GET ITEM TYPE FROM GKSM
READ ITEM FROM GKSM

READ ITEM FROM GKSM

Operating States

WSOP, WSAC, SGOP

Syntax

gks$read_item (ws_id, max_rec_len, item_data_rec)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
max_rec_len	Integer	Read	Reference	Maximum length of declared variable to hold item's data record, in bytes
item_data_rec	Record	Write	Reference	Item's data record

Description

The READ ITEM FROM GKSM function reads the data record of the current metafile item and then writes the record to its last argument.

You should compare the maximum length for the data record (as passed to this function) with the actual length of the data record (as GET ITEM TYPE FROM GKSM writes to one of its arguments). If the actual size of the record is larger than the maximum allocated space, DEC GKS truncates the record, causing loss of information. To skip an item, specify the value 0 as the maximum record length.

After returning the data record to the application program, this function makes the next item in the metafile the current item.

See Also

GET ITEM TYPE FROM GKSM
INTERPRET ITEM

WRITE ITEM TO GKSM

Operating States

WSAC, SGOP

Syntax

gks$write_item (ws_id, item_type, item_data_len, item_data_rec)

Argument	Data Type	Access	Passed by	Description
ws_id	Integer	Read	Reference	Workstation identifier
item_type	Integer	Read	Reference	Item type
item_data_len	Integer	Read	Reference	Total length of the data record, in bytes
item_data_rec	Record	Read	Reference	Item data record

Description

The WRITE ITEM TO GKSM function writes a user-defined data item record to a metafile.

You can precede each call to an output function by writing a character string to the metafile, describing the component of the picture generated by the subsequent function call. You can establish a specific item type value greater than 100 to specify such a description for a GKSM file. The application program can treat any item type value greater than 100 as such a description. In a GKS3 file, values less than 0 indicate a user-defined item.

If you use a metafile structure that is different from the structure of a GKSM or GKS3, you may have to specify different item data record values to this function.

See Also

ACTIVATE WORKSTATION
OPEN WORKSTATION

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