

Data Stream and Object Architectures

Graphics Object Content Architecture for Advanced Function Presentation Reference



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Note

Before using this information and the product it supports, be sure to read the general information in "Notices" on page 169.

Second Edition (October 2000)

This edition applies to the IBM Graphics Object Content Architecture for Advanced Function Presentation. It replaces and makes obsolete the previous edition, S544-5498-00. In AFP environments, this document makes obsolete the *IBM Graphics Object Content Architecture Reference*, SC31-6804. This edition remains current until a new edition or Technical Newsletter is published.

Technical changes are indicated by a vertical bar to the left of the change. Editorial changes that have no technical significance are not noted. For a detailed list of changes, see "Summary of Changes" on page 171.

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About This Book

This book describes the functions and services associated with the Graphics Object Content Architecture (GOCA) for Advanced Function Presentation (AFP). AFP GOCA defines a version of the GOCA architecture that is used in Advanced Function Presentation environments.

This book is a reference, not a tutorial. It complements individual product publications, but does not describe product implementations of the architecture.

Who Should Read This Book

This book is for systems programmers and other developers who develop or adapt products or programs to interoperate with other presentation products in an IBM mainframe or workstation environment.

How to Use This Book

This book is divided into nine chapters and four appendixes:

- Chapter 1, "A Presentation Architecture Perspective" introduces IBM Graphics Object Content Architecture for Advanced Function Presentation and positions it as a strategic Object Content Architecture.
- Chapter 2, "Introduction to GOCA and AFP GOCA" contains an introduction to the Graphics Object Content Architecture (GOCA) and to the version of GOCA used in Advanced Function Presentation environments.
- Chapter 3, "AFP GOCA Overview" includes the following concepts:
 - The graphics processor (GP)
 - The environment interface
 - The drawing processor
 - Graphics coordinate spaces
 - Color
 - Mix
 - Segments
 - Subsetting
 - Exception conditions
- Chapter 4, "Graphics Primitives and Attributes" describes the various primitive drawing operations and the attributes used to control them.
- Chapter 5, "Segments" describes the structuring of the object into independent pieces (segments) that can be chained together to form the picture.
- Chapter 6, "Environment Controls" describes how the environment communicates with the graphics processor to draw the graphics picture. It also describes the drawing process controls that can be set by the environment, and the control instructions used.

- Chapter 7, "Commands and Drawing Orders" provides a detailed listing of the commands and drawing orders, together with a description of their parameters and the exception conditions that can arise.
- Chapter 8, "Exception Conditions" provides a detailed listing of exception conditions.
- Chapter 9, "Compliance" defines the function sets currently supported in AFP GOCA.
- Appendix A, "Mixed Object Document Content Architecture (MO:DCA) Environment" describes how AFP GOCA fits into the Mixed Object Document Content Architecture (MO:DCA) environment.
- Appendix B, "Intelligent Printer Data Stream (IPDS) Environment" describes how AFP GOCA fits into the Intelligent Printer Data Stream (IPDS) environment.
- Appendix C, "Cross-References" provides tables of AFP GOCA commands, control instructions, and drawing orders sorted by identifier and by name.
- Appendix D, "Related Publications" lists other useful publications.

This publication also contains a glossary and index.

How to Read the Syntax Diagrams

Throughout this book, syntax is described using the structure defined below. The syntax includes six basic data types:

CODE	Architected constant
CHAR	Character string
BITS	Bit string
UBIN	Unsigned binary
SBIN	Signed binary
UNDF	Undefined type.

Syntax for Graphics Object Content Architecture (GOCA) is shown in tables.

Offset	Туре	Name	Range	Meaning
The field's offset	Data type, if applic- able	Name of field, if applicable	Range of valid values, if applicable	Meaning or purpose of the data element

Offset values specify the byte offset of the field in the table, or the bit offset within a field of BITS data type.

The bits are specified with bit 0 meaning the most significant bit.

Multi-byte fields of fixed length are shown as having two offsets, those of the first and last bytes of the field. For example, 4–7 indicates a field of length four bytes.

If a field is an array of varying length, then the offset of the last byte of the field is shown as n, for example, 2-n.

A blank entry in the range column indicates that there are no restrictions on the acceptable values.

Certain fields may be denoted as *reserved*. A reserved field is a parameter that has no functional definition at the current time, but may have at some time in the future. All bytes comprising a field, defined by the AFP GOCA architecture as a reserved field, should be given a value of zero by generating applications, and should be ignored by receiving applications.

The following example shows the syntax of the Begin Image at Given Position (GBIMG) Order.

Offset	Туре	Name	Range	Meaning
0	CODE		X'D1'	GBIMG order code
1	UBIN	LENGTH	X'0A'	Length of following data
2–3	SBIN	XPOS	X'8000'-X'7FFFF'	X _g coordinate of image origin (first image point of first image scan line)
4–5	SBIN	YPOS	X'8000'-X'7FFFF'	Y _g coordinate of image origin (first image point of first image scan line)
6	CODE	FORMAT	X'00'	Format of the image data:
				X'00' Each image point is mapped to a presentation device pel
7		RES	X'00'	Reserved; Only valid value
8–9	UBIN	WIDTH	X'0000'-X'FFFF'	Width of the image data, in image points
10–11	UBIN	HEIGHT	X'0000'-X'FFFF'	Height of the image data, in scan lines

Notation Used In Formulas

When formulas are used in this book, $\,\cdot\,$ is the notation for multiplication, and $\div\,$ the notation for division. For example:

a・b

indicates a multiplied by b.

a÷b

indicates a divided by b.

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Chapter 1. A Presentation Architecture Perspective

This chapter provides a brief overview of Presentation Architecture.

The Presentation Environment

Figure 1 shows today's presentation environment.



Figure 1. Presentation Environment. The environment is a coordinated set of services architected to meet the presentation needs of today's applications.

The ability to create, store, retrieve, view, and print data in presentation formats friendly to people is a key requirement in almost every application of computers and information processing. This requirement is becoming increasingly difficult to meet because of the number of applications, servers, and devices that must interoperate to satisfy today's presentation needs.

The solution is a presentation architecture base that is both robust and open ended and easily adapted to accommodate the growing needs of the open system environment. IBM® presentation architectures provide that base by defining interchange formats for data streams and objects that enable applications, services, and devices to communicate with one another to perform presentation functions. These presentation functions may be part of an integrated system solution or they may be totally separated from one another in time and space. IBM presentation architectures provide structures that support object-oriented models and client/server environments.

IBM presentation architectures define interchange formats that are system independent and are independent of any particular format used for physically transmitting or storing data. Where appropriate, IBM presentation architectures use

industry and international standards, such as the ITU-TSS (formerly known as CCITT) facsimile standards for compressed image data.

Architecture Components

IBM presentation architectures provide the means for representing documents in a data format that is independent of the methods used to capture or create them. Documents may contain combinations of text, image, graphics and bar code objects in device-independent and resolution-independent formats. Documents may contain fonts, overlays and other resource objects required at presentation time to present the data properly. Finally, documents may contain resource objects, such as a document index and tagging elements supporting the search and navigation of document data, for a variety of application purposes.

In IBM, the presentation architecture components are divided into two major categories: *data streams* and *objects*.

Data Streams

A *data stream* is a continuous ordered stream of data elements and objects conforming to a given format. Application programs can generate data streams destined for a presentation service, archive library, presentation device or another application program. The strategic presentation data stream architectures are:

- Mixed Object Document Content Architecture (MO:DCA[™])
- Intelligent Printer Data Stream[™] (IPDS[™]) Architecture

The MO:DCA architecture defines the data stream used by applications to describe documents and object envelopes for interchange with other applications and application services. Documents defined in the MO:DCA format may be archived in a database, then later retrieved, viewed, annotated and printed in local or distributed systems environments. Presentation fidelity is accommodated by including resource objects in the documents that reference them.

The IPDS architecture defines the data stream used by print server programs and device drivers to manage all-points-addressable page printing on a full spectrum of devices from low-end workstation and local area network-attached (LAN-attached) printers to high-speed, high-volume page printers for production jobs, shared printing, and mailroom applications. The same object content architectures carried in a MO:DCA data stream can be carried in an IPDS data stream to be interpreted and presented by microcode executing in printer hardware. The IPDS architecture defines bidirectional command protocols for query, resource management, and error recovery. The IPDS architecture also provides interfaces for document finishing operations provided by pre-processing and post-processing devices attached to IPDS printers.

Other IBM data streams which use many of the presentation objects and concepts introduced in this chapter are:

- The *3270 Data Stream*, used to transmit display data between applications and a nonprogrammable workstation
- The *Revisable-Form-Text Document Content Architecture (RFT:DCA)*, used to interchange revisable-form text and non-text objects between application programs in an office environment

Figure 2 on page 3 shows a system model relating MO:DCA and IPDS data streams to the presentation environment previously described. Also shown in the model are the object content architectures which apply to all levels of presentation processing in a system.



Figure 2. Presentation Model. This diagram shows the major components in a presentation system and their use of data stream and object architectures.

Objects

Documents can be made up of different kinds of data, such as text, graphics, image, and bar code. *Object content architectures* describe the structure and content of each type of data format that can exist in a document or appear in a data stream. Objects can be either *data objects* or *resource objects*.

A data object contains a single type of presentation data, that is, presentation text, vector graphics, raster image, or bar codes, and all of the controls required to present the data.

A resource object is a collection of presentation instructions and data. These objects are referenced by name in the presentation data stream and can be stored in system libraries so that multiple applications and the print server can use them.

All object content architectures (OCAs) are totally self-describing and independently defined. When multiple objects are composed on a page, they exist as peer

objects, which can be individually positioned and manipulated to meet the needs of the presentation application.

The object content architectures are:

- *Presentation Text Object Content Architecture (PTOCA)*. A data architecture for describing text objects that have been formatted for all-points-addressable presentations. Specifications of fonts, text color, and other visual attributes are included in the architecture definition.
- *Image Object Content Architecture (IOCA)*. A data architecture for describing resolution-independent image objects captured from a number of different sources. Specifications of recording formats, data compression, color and gray-scale encoding are included in the architecture definition.
- *Graphics Object Content Architecture (GOCA).* A data architecture for describing vector graphic picture objects and line art drawings for a variety of applications. Specification of drawing primitives, such as lines, arcs, areas, and their visual attributes, are included in the architecture definition.
- Graphics Object Content Architecture for Advanced Function Presentation[™] (AFP[™] GOCA). A version of GOCA that is used in Advanced Function Presentation (AFP) environments.
- Bar Code Object Content Architecture[™] (BCOCA[™]). A data architecture for describing bar code objects, using a number of different symbologies. Specification of the data to be encoded and the symbology attributes to be used are included in the architecture definition.
- Font Object Content Architecture (FOCA). A resource architecture for describing the structure and content of fonts referenced by presentation data objects in the document.

In addition to object content architectures, the MO:DCA architecture defines envelope architectures for objects of common value in the presentation environment. Examples of these are *Form Definition* resource objects for managing the production of pages on the physical media, *overlay* resource objects that accommodate electronic storage of forms data, and *index* resource objects that support indexing and tagging of pages in a document.

Figure 3 on page 5 shows an example of an all-points-addressable page composed of multiple presentation objects.

Letterhead can be an overlay resource containing text, image, and graphics objects



Figure 3. Presentation Page. This is an example of a mixed-object page that can be composed in a device-independent format, using MO:DCA format and printed on an IPDS printer.

Relationship to Systems Application Architecture®

Implementations of the data stream and object content architectures originally developed as part of Systems Application Architecture Common Communications Support (SAA® CCS) now extend to other major application platforms, such as AIX® and Microsoft® Windows®. This is part of a continuous movement toward providing greater interoperability between presentation components in client/server and open systems environments.

Application-Enabling Products

Some of the major application enabling products and application services using presentation interchange architectures are:

- Advanced Function Presentation (AFP). A set of licensed programs that use all-points-addressable concepts to present data on a wide variety of printer and display devices. The AFP programs include programs for creating, formatting, viewing, retrieving, printing, and distributing information.
- AFP Conversion and Indexing Facility (ACIF). An AFP program for converting a System/390[®] line-data print file into a MO:DCA document and for indexing the document for later retrieval, viewing and selective printing of pages.
- AFP Workbench. A platform for the integration of AFP workstation enabling applications and services. The Viewer application is a Workbench application that runs under OS/2[®], WIN-OS/2[™], and Microsoft Windows.

 AFP Toolbox. AFP Toolbox provides application programmers with ease of use in formatting printed output. Without requiring knowledge of the AFP data stream, the AFP Toolbox provides access to sophisticated AFP functions through a callable C, C++, or COBOL interface. It is available on OS/390[®], AIX, OS/2, and AS/400[®] platforms.

With IBM AFP Toolbox you can:

- Combine variable data with electronic forms, electronic signatures, and images
- Define variable length paragraphs
- Precisely position and align text anywhere on a page using a wide variety of fonts
- Draw fixed or variable depth and width boxes
- Generate barcode objects
- Draw horizontal and vertical fixed or variable length lines
- Include indexing tags for use in efficient viewing and archival/retrieval
- Accent printed output with color and shading
- Dynamically control fonts, including user-defined fonts
- Advanced Function Printing Utilities/400. An IBM licensed program that includes a group of utilities that work together to provide Advanced Function Printing on AS/400.
- *Graphical Data Display Manager (GDDM*®). An IBM licensed program containing utilities for creating, saving, editing, and displaying visual data such as page segments, charts, images, vector graphics, composites (text, graphics, image), and scanned data.
- OS/2 Presentation Manager® GPI. An extensive graphics programming interface (GPI) provided in OS/2 for creating, saving, editing and manipulating picture data composed of graphics primitives, such as lines, arcs, and areas with fill patterns. Metafiles created using the GPI can be archived for later retrieval in the MO:DCA interchange format.
- IBM SAA ImagePlus® Workstation Program/2. An IBM licensed program designed to capture, view, annotate, print and manipulate text and image documents on an OS/2 workstation platform. Documents are generated in the MO:DCA interchange format and can be transmitted to OS/390 and OS/400® hosts for folder management and archival storage by other ImagePlus components.
- IBM SAA MVS/ESA[™] ImagePlus System. A set of licensed programs that are designed to work in conjunction with the ImagePlus Workstation Program/2 to provide OS/390 host support for Folder Applications and WorkFlow Management. Documents are stored in the MO:DCA Interchange format and are distributed on request by an Object Distribution Manager.
- *IBM SAA AS/400 ImagePlus System*. A set of licensed programs that are designed to work in conjunction with the ImagePlus Workstation Program/2 to provide OS/400 host support for Electronic Filing Cabinets and WorkFolder applications. Documents are stored in the MO:DCA Interchange format and made available on request to workstation programs.
- IBM SAA ImagePlus/2 System. A comprehensive, user-configurable, OS/2 LAN-based implementation of ImagePlus document imaging. IBM SAA ImagePlus/2 consists of two components:
 - IBM SAA ImagePlus Services Facility/2

- IBM SAA ImagePlus Application Facility/2

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IBM SAA ImagePlus Services Facility/2 provides storage management, content class management, document, page and display management, image capture and presentation management. IBM SAA ImagePlus Application Facility/2 provides the application and end-user interface, document storage and retrieval, plus document, folder and case management. It also includes menu-driven workflow processing capabilities. Documents are stored in the MO:DCA Interchange format.

- *Print Services Facility*[™] (*PSF*). The IBM software product that drives IPDS printers. PSF is supported under OS/390, VSE, and VM and as a standard part of the operating system under OS/400. PSF manages printer resources such as fonts and electronic forms, and provides error recovery for print jobs. Multiple data streams are accepted by PSF and converted into an IPDS data stream for printing.
- Print Services Facility/2 (PSF/2). An OS/2-based print server that drives IPDS page printers and IBM PPDS and HP-PCL compatible printers. PSF/2 manages printer resources and provides error recovery for print jobs. PSF/2 supports distributed printing of MO:DCA print jobs from PSF for OS/390, PSF/VM, PSF/VSE, and OS/400. It also supports printing from a wide range of workstation applications, including Microsoft Windows and the OS/2 Presentation Manager.
- Infoprint® Manager for AIX, Windows NT®, and Windows 2000. A print server that drives IPDS page printers. In addition to managing printer resources and providing error recovery for print jobs, Infoprint Manager provides data stream conversions to MO:DCA format for interoperability with other AFP products on AIX and other system platforms.

For more information on these and other products, refer to the publications listed in Appendix D, "Related Publications" on page 165.

Presentation Architecture

Chapter 2. Introduction to GOCA and AFP GOCA

This chapter covers:

- · Background of Computer Graphics
- · Scope of GOCA
- Concepts of GOCA

Background

The generation of pictures by computer, called *computer graphics*, has been an application area for many years. However, computer graphics is no longer the specialized concern of large businesses using expensive hardware and consuming vast programming and computing resources. Applications using computer graphics are now readily available for small businesses and the home.

Scope of GOCA

In general, the term *computer graphics* refers to the definition and representation of graphics elements used to build pictures for presentation, either on hard-copy devices such as printers and plotters, or on soft-copy devices such as vector or raster displays. *Interactive computer graphics* refers to the creation and manipulation of these composed pictures using end-user input devices such as a tablet, joystick, or mouse.

GOCA is an object architecture used to represent pictures generated by computer.

This document defines the version of the GOCA architecture that is supported in Advanced Function Presentation (AFP) environments for printing and viewing.

Typically, pictures are built from many different kinds of *primitives*, such as:

- Lines or arcs
- · Characters or symbols
- · Shaded areas or point arrays

Each of these primitives has its own particular set of primitive attributes, such as:

- Line width or line style
- Orientation or direction
- Shading pattern or resolution

In addition, there is usually a set of controls, such as environment-defined defaults, that apply to all primitives.

GOCA is concerned with the creation and manipulation of pictures built by direct invocation of the above primitives and attributes. Thus, GOCA is restricted to the creation and modification of what is generally termed *vector*, or *line-drawn*, graphics. However, additional architectures can be built on top of GOCA for creating and manipulating more complex constructs such as graphs, histograms, and pie charts.

Concepts of GOCA

GOCA effectively defines a graphics subsystem that can exist in, or be invoked by, a number of environments. Each of these controlling environments can be specialized for a particular application area. AFP GOCA is the version of GOCA used to present and interchange graphics pictures in AFP environments. See Appendix A, "Mixed Object Document Content Architecture (MO:DCA) Environment" on page 147, and Appendix B, "Intelligent Printer Data Stream (IPDS) Environment" on page 157 for details of this environment.

Presentation of a graphics picture is facilitated by partitioning it into segments, which are effectively independent subpictures. The picture is defined by means of drawing orders that draw primitives, or set attributes and controls that determine the appearance of those primitives.

The picture is defined in a Graphics Presentation Space (GPS) that is independent of the environment. The mapping of this picture on to the presentation surface of a device is defined by a descriptor. The descriptor depends on the environment.

Chapter 3. AFP GOCA Overview

This chapter gives an overview of AFP GOCA, and describes:

- · The concept of the graphics processor
- The environment interface
- The drawing processor, including:
 - Primitives
 - Drawing orders
 - Attributes
- Graphics coordinate spaces
- Color
- Mix
- Segments
- Subsetting
- Exception Conditions

The Graphics Processor Model

GOCA is based on the concept of a graphics processor (GP). This processor is embedded into different controlling environments. Some typical controlling environments are:

- The Presentation Interface of the Systems Application Architecture Common Programming Interface (SAA CPI)
- Intelligent Printer Data Stream (IPDS) printers with graphics capability
- Mixed Object Document Content Architecture (MO:DCA) data streams for interchange

AFP GOCA deals with GOCA objects that are created, interchanged, archived, and presented within the latter two controlling environments.

The graphics processor contains the following processing components:

- Environment interface
- Drawing processor

Figure 4 on page 12 shows the components and connections of the graphics processor.



Figure 4. The Graphics Processor (GP) within the Controlling Environment

The Environment Interface

The environment interface performs the functions required to interface the graphics processor with the controlling environment and is responsible for examining the data passed to it from the controlling environment.

Three types of control structures are passed from the controlling environment to the graphics processor via the environment interface:

- Commands. The only command supported in AFP GOCA is the Begin Segment (X'70') command, which is used to define a segment.
- Control Instructions. The only control instruction supported in AFP GOCA is the Set Current Defaults (X'21') instruction, which sets the current default values of selected attributes.
- *Drawing Orders*. These orders comprise the segment data. They generate graphics primitives in the Graphics Presentation Space (GPS) and set their attributes.

Drawing Processor

The graphics picture is drawn in the GPS by the drawing processor, which executes a sequence of drawing orders. The drawing processor is started by the controlling environment, which in AFP GOCA is the MO:DCA and IPDS data stream.

Drawing orders whose execution affects the GPS are called primitive drawing orders. These orders cause the designated primitive to be mixed into the GPS. Additional drawing orders set drawing attributes. All drawing orders are sometimes simply referred to as orders.

Primitives

A primitive is the smallest portion of a picture that can be drawn. There are six types of primitive with their associated set of color and mix attributes:

- Line primitives
- Area primitives
- Character string primitives
- Marker primitives
- Pattern primitives
- Image primitives

A primitive is defined by:

- · The parameters of a primitive drawing order
- Modal parameters called attributes
- Control instructions that contain the Set Current Defaults instruction, such as the MO:DCA-P Graphics Data Descriptor (GDD) and the IPDS Write Graphics Control (WGC)

Modal parameters have values initialized by the environment and can be altered by attribute-setting drawing orders or by control instructions. Modal parameter values persist until they are explicitly altered, or until the end of the graphics object is encountered.

Drawing Orders

Drawing orders are defined for each of the following types of output primitive:

Line	Line primitives:		
	Line and Full Arc Fillet	Relative Line One or more straight lines connected together. A full circle or ellipse. A curved line drawn tangentially to a specified set of contiguous straight lines.	
Area	One or more closed figures, that can be filled. The closed figures can overlap.		
Character	String A series of characters drawn along a baseline starting at a specified point.		
Marker	A symbol positioned by its center, and drawn at one or more points.		
Pattern	A symbol that is repeated to fill an area.		
Image	A rectange points.	ular area containing a set of foreground and background	
A summary list of the Drawing Orders is given in "Summary List of Orders" on			

Attributes

Primitive attributes specify the characteristics of the output primitives that define the picture to be drawn.

The following types of attribute are defined:

- Drawing attributes
- · Line attributes

page 63.

- Character attributes
- Marker attributes
- · Pattern attributes

Drawing Attributes

- **Color** The color in which the foreground bits of the output primitive are to be drawn
- **Mix** Affects how the foreground of the output primitive that is being drawn is to be merged with the color information already in the GPS

Background Mix

Affects how the background of the output primitive that is being drawn is to be merged with the color information already in the GPS.

Sets of mix and color attributes are provided for each type of primitive.

Line Attributes

Line Type

The type of line to be drawn, for example solid or dashed.

Line Width

The width of line to be drawn, for example normal or wide.

Character Attributes

Character Precision

The requested appearance fidelity of a character string.

Character Shear

The amount of slope of a character string. This attribute is not supported in AFP GOCA.

Character Angle

The angle between the character baseline and the GPS X_g axis. Only values of 0°, 90°, 180° and 270° are supported in AFP GOCA.

Character Cell

The size of the cell in which a character is drawn.

Character Direction

The direction in which characters are drawn.

Character Set

The set of symbols from which characters are obtained.

Marker Attributes

Marker Precision

The requested appearance fidelity of a marker string.

Marker Cell

The size of the cell in which a marker is drawn.

Market Set

The set of symbols from which the marker is obtained.

Marker Symbol

The particular symbol that is to be used to draw markers.

Pattern Attributes

Pattern Set

The set of symbols from which the area fill pattern is obtained.

Pattern Symbol

The particular symbol that is to be used as a fill pattern when filling an area.

Graphics Coordinate Spaces

Two coordinate spaces or presentation spaces are used in AFP GOCA:

- Drawing Order Coordinate Space (DOCS)
- Graphics Presentation Space (GPS)

Drawing Order Coordinate Space (DOCS)

The DOCS is the coordinate space in which the drawing orders specify graphics primitives. Points are described in the drawing orders by specifying the x and y coordinates in the DOCS. Extents and offsets are described in the drawing orders by specifying the x and y extents and offsets in the DOCS. The DOCS is a standard, 2-dimensional Cartesian coordinate system. Units of measure for the DOCS are specified in the Graphics Data Descriptor. In AFP GOCA, there is a one-to-one mapping between the DOCS coordinate system and its units of measure and the GPS coordinate system and its units of measure. Therefore in AFP GOCA, DOCS and GPS are equivalent coordinate systems. All references to coordinate systems in AFP GOCA will be made with respect to GPS.

Graphics Presentation Space (GPS)

The GPS is the space in which the application user's view of the specified picture is generated. The GPS is a standard, 2-dimensional Cartesian coordinate system as shown in Figure 5. Coordinates in the GPS coordinate system are denoted by (X_g, Y_g) . Units of measure for the GPS are specified in the Graphics Data Descriptor.



Figure 5. Coordinate System used for the GPS

AFP GOCA uses 16-bit signed integers to specify GPS coordinates. A point outside GPS is characterized by a 2-byte arithmetic overflow. For a definition of the geometric parameter format used in AFP GOCA, see "Parameter Type" on page 56 and "Drawing Order Subset (Mandatory)" on page 149.

Usable Area (UA)

The usable area is a presentation space and coordinate system defined by the controlling environment. It is the space in which the implementation presents the picture to the end user, and merges the GPS with other presentation spaces in the device.

The controlling environment defines a GPS window on the GPS, and a graphics window mapping between the GPS window and the UA. In the AFP environment, the usable area is a MO:DCA-P or IPDS *object area*, which is merged with other object areas on a *logical page* presentation space.

Color

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The color values specified using the Set Color and Set Extended Color drawing orders generate an index into the standard color table defined in Table 1 on page 18. When a primitive is drawn, this color index is mixed with the color index of the GPS using the current mix and background mix attributes. The resulting color index of the GPS can be further modified by drawing another primitive at the same point in the GPS. When drawing is complete, the final color index is used to look up the current color value. The values in the color table control the physical process whereby colors are presented on the presentation surface.

The standard color table is accessed by two-byte color index values. These values are the valid color index values that can be specified in the Set Extended Color order and the Set Color order. The value specified in the Set Color order is prefixed with X'FF' to generate a two-byte color index value. The valid color attribute values and the colors that are drawn when the standard color table is selected are shown in Table 1 on page 18.

Table 1 on page 18 shows the meanings of the two-byte values. RGB values are also defined for each named color, assuming that the intensity range for each component is 0–255.

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Value	Color	Red (R)	Green (G)	Blue (B)
X'0000' or X'FF00'	Device default			
X'0001' or X'FF01'	Blue	0	0	255
X'0002' or X'FF02'	Red	255	0	0
X'0003' or X'FF03'	Pink/magenta	255	0	255
X'0004' or X'FF04'	Green	0	255	0
X'0005' or X'FF05'	Turquoise/cyan	0	255	255
X'0006' or X'FF06'	Yellow	255	255	0
X'0007'	White; see note	255	255	255
X'0008'	Black	0	0	0
X'0009'	Dark blue	0	0	170
X'000A'	Orange	255	128	0
X'000B'	Purple	170	0	170
X'000C'	Dark green	0	146	0
X'000D'	Dark turquoise	0	146	170
X'000E'	Mustard	196	160	32
X'000F'	Gray	131	131	131
X'0010'	Brown	144	48	0
X'FF07'	Device default	_	-	_
X'FF08'	Color of medium	_	-	_
All others	Reserved	-	_	_

The standard color table is equivalent to the Standard OCA Color Value Table defined in the MO:DCA controlling environment; see the *Mixed Object Document Content Architecture Reference*, SC31-6802, for the definition of this table.

Colors may also be specified using the Set Process Color drawing order. This order supports the specification of:

- · Process colors, using the RGB, CMYK, and CIELab color spaces
- · Spot colors, using the highlight color space
- Named colors, using the standard OCA color space. This is the color space that is supported by the Set Color and Set Extended Color drawing orders. For definitions of the color values used in this color space, see Table 1.

Note: When the standard OCA color space is selected with the Set Process Color drawing order, colors for foreground data are mixed into the GPS in the same manner as described for the Set Color and Set Extended Color orders. However, when any other color space is selected, colors for foreground data always overpaint the GPS.

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When the controlling environment provides a color table, it has complete choice of the color appearance of any entry in the color table. Colors are not actually mixed, but the color index values, which address the entries of the color table, are combined to address the new color entry of that color table.

If two output primitives drawn into the GPS have a common point, they are mixed at that point to produce a result that is held at that point. The output primitives exist independently in segments, but do *not* exist independently in the GPS. There is no concept of the GPS having layers with the output primitives underlying and overlying one another at points of the space.

Table 2. Foreground/Background in Graphics Presentation Space				
Data Type	Foreground	Background		
AFP GOCA Graphics	 Stroked area of arcs Stroked area of lines Stroked and filled portion of pattern symbols Stroked and filled portion of marker symbols Stroked and filled portion of graphic characters B'1' image points Entire area with solid fill 	Everything else		

Mixing applies only to those points of the GPS to which an output primitive is being drawn. The GPS always contains the result of the mixing of the output primitives currently drawn in the GPS. When a new output primitive is drawn into the GPS, each foreground or background point of the output primitive is combined with the corresponding point of the GPS to produce a new result in the GPS. Mixing is always an effect of a foreground or a background value of an output primitive on an existing GPS value.

Table 2 summarizes the definition of foreground and background in the GPS.

Implementation Note: If a color fill of an area is simulated with a pattern fill, the complete fill is considered foreground, not just the stroked and filled portion of the pattern symbols.

The attributes of mix and background mix specify the method by which the output-primitive color value is combined with the existing color value of each point of the GPS. These two mixing capabilities are not always the same mixing attribute value. For example, assume that the GPS contains a line on which the controlling environment wants to mix a character A, such that the background of that character does not interfere with the line. The application chooses Overpaint for the foreground-mix attribute of the character and Leave Alone for background-mix attribute of the character.

Every point of the GPS is background until points are drawn in GPS. The new color value of the current point of the GPS is obtained by applying the appropriate

Mix

mix attribute to the existing value for that point with the appropriate, foreground or background, color value for the corresponding point of the output primitive being applied.

The mix attributes are selected by use of the Set Mix or Set Background Mix Orders.

In the description that follows, the term *source* means the foreground, or background, of the primitive that is being drawn. The term *destination* means the area of the GPS on which the foreground or background of that primitive is being drawn.

The supported values of the foreground mix attributes are:

- X'00' Drawing default. This resets the mix attribute to its initial value.
- **X'02'** *Overpaint.* The color value of the source replaces the color value of the destination. This is also sometimes referred to as *opaque* mixing.

The supported values of the background mix attributes are:

- X'00' Drawing default. This resets the mix attribute to its initial value.
- **X'05'** *Leave Alone.* The color value of the destination is unchanged. This is also sometimes referred to as *transparent* mixing.

Segments

Segments are self-contained collections of drawing orders and attributes. They are the basic units from which a picture is constructed. A segment can be given a name defined as a four-byte unsigned integer; however, this name is ignored in AFP GOCA.

Facilities are provided to permit the chaining of segments during the process of describing a complete picture. Chaining is the unidirectional passing of control from one segment to another segment.

Every segment is either *chained* or *unchained*. A collection of one or more chained segments defines the picture to be drawn. Unchained segments are ignored in AFP GOCA. Chaining provides a known and architected initial state for the chained segments. Therefore, chained segments are completely independent pieces of the picture.

Subsetting

GOCA supports the functional requirements of a wide spectrum of graphics devices in a number of different environments. To efficiently support this range of capabilities, GOCA defines subsets of functionality. The subsets described in this manual for AFP GOCA are labeled as follows:

 Drawing Level 2 Version 0 (DR/2V0). DR/2V0 is supported in the MO:DCA-P and IPDS environments. See Chapter 9, "Compliance" on page 143 for details of this subset.

Exception Conditions

Exception conditions are defined by AFP GOCA for detectable errors in the syntax of GOCA constructs. They are reported to the controlling environment in an environment-dependent manner.

If the environment determines that processing can proceed, then for some of the exception conditions, AFP GOCA defines a standard action that is to be taken after the error is detected. For the other exception conditions, the environment must determine the continuation procedure.

Exception Conditions

Chapter 4. Graphics Primitives and Attributes

This chapter describes:

- · Output primitives in general
- Current position
- The symbols used to draw characters, markers, and shading patterns in areas
- The following output primitives and their associated attributes:
 - Lines
 - Areas
 - Character strings
 - Markers
 - Images
- Output primitive overflow

Output Primitives

Output primitives are the basic element from which graphics pictures are built. They are drawn by one or more drawing orders containing the parameters that define the primitive.

Primitives also use the modal parameters called *attributes* associated with them, as well as the general drawing process controls.

The architecture defines exception conditions for invalid values of parameters within drawing orders and assigns exception condition codes, EC-*xxxx*, to these for reporting purposes. See "Drawing Order Exceptions" on page 136 for details.

Current Position

Current position is a position in Graphics Presentation Space (GPS) remembered by the drawing processor. Current position is updated by the drawing processor as each output primitive value is executed. It is maintained as an (X_g, Y_g) coordinate value in GPS. With the drawing orders that are described in Chapter 7, "Commands and Drawing Orders" on page 57, this updating of current position can, in general, be implemented by replacing the old value of current position by an (X_g, Y_g) coordinate from the order being executed.

Two alternative forms of each output primitive drawing order are provided, each with a different order code:

- With the first form, all coordinates required to draw the output primitive are contained in the order itself.
- With the second form, the current position is used as the first pair of coordinate values of the output primitive.

The second form of drawing order is shorter than the first form. The second form is used when the initial coordinate of an order is the Current Position as established by the previous order, and effectively connects the primitives together.

The drawing order Set Current Position is provided to manipulate Current Position.

Current Position is set to the origin of GPS, that is, $(X_g=0, Y_g=0)$, at the beginning of each new segment.

Symbols

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Symbols are used to draw:

- Characters
- Markers
- Shading patterns in areas

A particular symbol can be used as a character, as a marker, and as a pattern.

The controlling environment provides access to sets of symbols by resolving the local identifier of the character set, marker set, or pattern set.

When drawing symbols, the minimum degree of accuracy required for the appearance of the symbols is determined by the value of the appropriate precision attribute. Two precision attributes, character precision and marker precision, control the appearance of characters and markers respectively.

The method of defining a symbol does not limit the operations that can be applied to that symbol. Therefore, the method of symbol definition does not tie that symbol to a particular level of precision. An implementation can choose to support only certain precisions for particular types of symbol definition. Subsets may define what precision is required to be supported.

Precision and the method by which symbols are defined are independent of each other.

To draw a symbol, it is necessary to specify an x,y position, a symbol set, and a code point.

If the requested symbol set does not exist, the appropriate exception condition is raised. The standard action for this exception is to use the appropriate standard default set.

If the code point identifies a symbol that is not valid or not defined, the appropriate exception condition is raised. The standard action for this exception is to use the appropriate standard default symbol.

Markers, patterns, and characters are all examples of symbols. The loading mechanism and handling facilities are common to all types of symbols.

Table 3 on page 25 summarizes how attributes are set when symbols are used for characters, markers, and patterns.

Table 3. Setting Attributes for Character, Marker, and Pattern Symbols				
	Symbols			
Attribute	Character	Marker	Pattern	
Color	Set Color orders	Set Color orders	Set Color orders	
(Foreground) Mix	Set Mix order	Set Mix order	Set Mix order	
Background Mix	Set Background Mix order	Set Background Mix order	Set Background Mix order	
Precision	Set Character Precision order	Set Marker Precision order	Reserved	
Shear	Set Character Shear order	Reserved	Reserved	
Angle	Set Character Angle order	Reserved	Reserved	
Cell Size	Set Character Cell order	Set Marker Cell order	Reserved	
Direction	Set Character Direction order	Not applicable	Not applicable	
Set	Set Character Set order	Set Marker Set order	Set Pattern Set order	
Code Point	Character String order	Set Marker Symbol order	Set Pattern Symbol order	
Reference Position	Character String order	Marker order	Device default	

In raster symbol definitions and in fully described and outline fonts, the foreground color of the symbol is always the current character color attribute value.

Line Primitives

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There are two types of line primitives:

- Straight Lines
- Curved Lines

Straight Lines

The following orders can be used to draw straight lines:

- The Line order draws one or more contiguous straight lines by providing the endpoints of each line.
- The Relative Line order draws one or more contiguous straight lines by using offset values.

Line Order

The Line order has two forms:

- Line at a Given Position (GLINE) order
- · Line at Current Position (GCLINE) order

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Straight lines are drawn through the set of points specified as parameters of the order. In general, any number of points can be specified, provided the maximum length count on the order is not exceeded.

The current values of the line attributes are taken into account when the lines are drawn. Current position is set to the last point specified in the order.

Relative Line Order

The Relative Line order has two forms:

- Relative Line at a Given Position (GRLINE) order
- Relative Line at Current Position (GCRLINE) order

The parameters of the order include an initial position, (X_0, Y_0) and a set of offset values, $\{d_1, e_1\}, ... \{d_n, e_n\}$. The offsets are one-byte values that give the end point of a line relative to the start of that same line; that is, the differences in the x,y coordinate values of the start and end points of the line. Negative values for these offsets are permitted.

Straight lines are drawn between the points (x_0, y_0) , $(x_0 + d_1, y_0 + e_1)$, $(x_0 + d_1 + d_2, y_0 + e_1 + e_2)$,..., $(x_0 + d_1 + ... + d_n, y_0 + e_1 + ... + e_n)$.

The current values of the line attributes are taken into account when the relative lines are drawn. Current position is set to the last point calculated.

Note that the straight lines are drawn so that the line width is centered on the specified points.

Curved Lines

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Curved lines can be drawn using the following orders:

- Full Arc
- Partial Arc
- Fillet





Figure 6. Arc Parameters

Full Arc



Figure 7. Full Arc

Full Arc orders use the current value of arc parameters to define the primitive. The arc parameters specify the required *shape* and *size* of an ellipse, which can be a circle. The Set Arc Parameters order sets the current value of the arc parameters. Arc parameters are shown in Figure 6 on page 27.

The parameters in the Set Arc Parameters order, P, Q, R, and S, define a transformation that maps the counterclockwise unit circle to the required ellipse, placed at the origin (0,0):

 $X' = P \cdot X + R \cdot Y$ $Y' = S \cdot X + Q \cdot Y$

where X and Y are the coordinates of the points on the unit circle, and X' and Y' are the coordinates of the points on the defined ellipse. Note that the unit circle has a radius of 1 GPS units.

If $P \cdot R + S \cdot Q = 0$, the transform is termed orthogonal and the line from the origin (0,0) to the point (P,S) is either a radius of the circle, or half the major/minor axis of the ellipse. The line from the origin to the point (R,Q) is either the radius of the circle, or half the minor/major axis of the ellipse.

If $P \cdot Q = R \cdot S$, the ellipse degenerates to a straight line or a point. If P = Q = r and R = S = 0, the ellipse degenerates to a circle with radius r.

The parameters in the Set Arc Parameters order, P,Q,R, and S, may also be viewed as specifying the coordinates of the major/minor axis endpoints for an ellipse or circle whose center is positioned at the origin ($X_g=0$, $Y_g=0$) of GPS, as follows:

- $P = X_g$ coordinate of major axis endpoint
- $Q = Y_g^{"}$ coordinate of minor axis endpoint
- $R = X_q$ coordinate of minor axis endpoint
- $S = Y_q^{\circ}$ coordinate of major axis endpoint

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The Full Arc order draws one complete circle, or a complete ellipse. The parameters of this order are the center point, and a multiplier that specifies by how much the ellipse or circle defined by the Set Arc Parameters order is to be scaled, before being drawn. In AFP GOCA, the ellipse or circle is drawn in a counterclockwise direction. Figure 7 on page 28 shows the generation of an ellipse. The small ellipse at the origin is defined by the Set Arc Parameters order with minor axis 2b. The Full Arc drawing order transforms this ellipse into an ellipse with center at current position or a specified point, and with a multiplier such that the new minor axis $2B = Multiplier \cdot 2b$. The major axis is scaled in the same manner.

The current values of the line attributes are taken into account when each full arc is drawn.

In AFP environments, the standard default for the arc parameters is:

P=Q=1 R=S=0

Note that the parameter values are specified in GPS L-units.

CP or Given Point Center Sweep angle Start angle Unit Circle

Figure 8. Partial Arc

The Partial Arc primitive draws a line from a specified point or current position to the start of an arc, and then draws the arc.

The arc is part of the full arc defined by the current arc parameters and the multiplier M. The center of the arc is at a point specified within the Partial Arc drawing order. The part of the arc that is drawn is defined by the start-angle and sweep-angle parameters. The partial arc is drawn in a counterclockwise direction.

Partial Arc

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The start angle is the angle between the X axis of the unit circle space and the radius drawn from the center of the arc to the start point of the arc. The sweep angle is the angle subtended at the center of the arc by the two radii drawn from the center of the unit circle to the start and end points of the arc; see Figure 8.

Both angles are specified in the unit-circle space, and hence are transformed by an amount defined by the current arc parameters in the same way that the unit circle is transformed. If the partial arc is part of a circle, the angles following the transform will be the same as the angles on the unit circle. If the partial arc is part of an ellipse, the angles following the transform will, in general, be different than the angles on the unit circle.

The current values of the line attributes are taken into account when the partial arc is drawn. Current position is set to the end-point of the arc.



Fillet



This primitive is drawn using the Fillet order. The parameters of the order are the (X_{a}, Y_{a}) coordinates for a set of points, $P_0 P_1, ..., P_n$.

The points specified in the order are joined by conceptual straight lines, to which a curve is fitted. The curve is tangential to the first line at its start point, and to the last line at its end point. If there are more than two lines, the curve is tangential to the intermediate lines at their center points. If only two points are supplied, a straight line is drawn between the points.

- **Architecture Note:** The Fillet drawing order does not support specification of a *sharpness* parameter. In Figure 9, this parameter would determine how close the drawn curve comes to the points P_1 , P_2 , and P_3 . If a quarter circle or quarter ellipse is used to fit the points, the sharpness parameter is not required since the circle or ellipse is completely defined by completing the parallelogram. If a quarter arc is not used, a sharpness parameter can be used and is defined, in reference to Figure 9, as follows:
 - 1. Generate the virtual line P_0M_1
 - 2. Find the midpoint of this line, V_0
 - 3. Generate V₀P₁
 - 4. Call the point where V_0P_1 intersects the arc D_1
 - 5. The sharpness parameter is defined to be the ratio of $V_0D_1 \div D_1P_1$.

The recommended value for the sharpness parameter, when used in AFP GOCA, is .7.

The current values of the line attributes are taken into account when the fillet is drawn. Current position is set to the last point specified.

The curve that is drawn is computed as follows (see Figure 9 on page 30).

- 1. Let the points specified in the order be known as P_0 , P_1 , ... P_n .
- 2. Conceptual lines are drawn between the points P₀ to P₁, P₁ to P₂, P₂ to P₃, and so on.
- The midpoints of the lines from P₁ to P₂, P₂ to P₃, P_{n-2} to P_{n-1} are computed; call these M₁, M₂, ... M_{n-2}.
- 4. The points P₀, P₁, M₁, P₂, M₂, P₃, ... M_{n-2}, P_{n-1}, P_n are then considered three at a time, starting with P₀, P₁, M₁. A quadrant of a circle is scaled, and can be distorted to become a part of an ellipse, in order that the curve be tangential to the line P₀-P₁ at the point P₀, and tangential to the line P₁-M₁ at the point M₁.

The center point of the ellipse is the point obtained by completing the parallelogram defined by the sides $P_0 - P_1$ and $P_1 - M_1$.

- The next three points are considered, that is M₁, P₂, M₂ and a quadrant of a circle is transformed into part of an ellipse that is tangential to the line M₁-P₂ at M₁, and tangential to the line P₂-M₂ at M₂.
- This process continues, with part of an ellipse being fitted to three points in turn, until the last three points M_{n-2}, P_{n-1}, P_n, have been incorporated; see Figure 9 on page 30.

Note: If all the points P_0 through P_n are within the GPS, the actual fillet does not go outside the GPS.

Line Attributes

Table 4 shows the attributes controlling the drawing of line primitives, that is, straight lines and curved lines.

Table 4. Attributes Controlling Line Primitives				
Attribute	Standard Default	Length (in bytes)	Meaning	
LINE TYPE	Solid (X'07')	1	Specification of type of line	
LINE WIDTH	Normal (X ' 0100 ')	2	Specification of line width as fractional multiplier of normal width	
LINE COLOR	Device dependent	2–4	Color value set into GPS for foreground	
LINE MIX	Overpaint (X'02')	1	Specification of Mix mode in GPS for foreground	

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Line Type

The Line Type attribute controls the type of line used to draw straight and curved lines.

The line type is defined as a series of dots and dashes. As lines are drawn into the GPS, the line type is used repetitively to determine which parts of the line are drawn into the GPS:

- The dots and dashes are drawn.
- The spaces between the dots and dashes are not drawn and have no effect on the GPS.

The sequence of line type dots and dashes is not reset, except by a Move Type order, which is an order that causes current position to be updated to a new value specified in the order before anything is drawn. Move Type orders are defined in Table 5.

Table 5. Move Type Orders	
Description	Orders
Any straight or curved line order that explicitly specifies the starting point of the line that is to be drawn	 Box at a Given Position. Fillet at Given Position (GFLT) Full Arc at Given Position (GFARC) Line at Given Position (GLINE) Partial Arc at Given Position (GPARC) Relative Line at Given Position (GRLINE)
Orders that explicitly or implicitly set current position	Set Current Position (GSCP)
Other orders that specify an initial position	 Begin Image at a Given Position (GBIMG) Character String at a Given Position (GCHST) Marker at a Given Position (GMRK)

The line types are defined as follows:

Attribute Meaning

- X'00' Drawing Default
- X'01' Dotted Line
- X'02' Short Dashed Line
- X'03' Dash-dot Line
- X'04' Double Dotted Line
- X'05' Long Dashed Line
- X'06' Dash Double-dot Line
- X'07' Solid Line
- X'08' Invisible Line

When the line type attribute is set to invisible, current position is updated, but nothing is drawn into the GPS.

The exact appearance of the standard line types is implementation-dependent. An implementation is permitted to proportion this appearance with line width. For consistent appearance of the standard line types, the following guideline should be used. The guideline defines the line types in terms of drawing the dashes and dots

and moving over the spaces between them. The lengths are expressed in units of line width. The first number is the length of the first dash or dot in the sequence, and the second is the length of the move that follows. Further pairs of numbers, defining the dash, dot, and move lengths, are defined for the more complex line types. Note that the size of a dot is implementation-dependent and is generally less than a line-width. Therefore, its length is shown as zero.

The guidelines for generating the line types are as follows:

Attribute Sequence

V 01	0, 2
X'02'	3, 3
X'03'	6, 4, 0, 4
X'04'	0, 3, 0, 7
X'05'	8, 3
X'06'	6, 3, 0, 3, 0, 3

value.

Line Width

The current line width attribute controls the width of line used to draw straight or curved lines.

The line width attribute consists of an integral and fractional part. When only the integral part is set by a Set Line Width order, the fractional part is reset to zero.

The value of the Line Width attribute specifies a multiplier of the normal line width:

Attribute	Meaning
X'0000'	Drawing Default. The value of the attribute when the graphics processor was invoked. This value was set either by the Set Current Defaults instruction in the Graphics Data Descriptor or by the controlling environment.
X'0100'	Normal line width (multiplier of 1). The actual width of the line on the output medium is implementation defined. For consistent appearance, the normal line width should be chosen to approximate .01 inches.
X'nnnn'	Multiplier. The high-order byte is an integral multiplier of the normal width, and the low-order byte is a fractional multiplier. An implementation does the multiplication on its implementation-defined normal width in output-medium pels, then selects the nearest supported

In particular, if the value specified exceeds the maximum supported by the device, that maximum is used.

Architecture Note: The line width should be scaled when the controlling environment specifies a scaling mapping of the GPS window into the usable area (object area).

Areas

Areas are two-dimensional, composite primitives defined within a Begin Area/End Area bracket. An area is defined by its boundary, which is filled with a shading pattern.

An area definition may start in one segment and be completed in an appended segment.

The boundary of an area is defined as one or more *closed figures* that are either constructed or complete; see Figure 10 on page 34. An example of a complete figure is one defined by the Full Arc order. Each constructed figure consists of a set of straight and curved lines connected together. These lines can be drawn if required.



Figure 10. Closed and Open Figures

The following description refers to a *Move Type* order. This term refers to the type of order that causes current position to be updated to a new value specified in the order before anything is drawn. See "Line Type" on page 32 for a list of Move Type orders.

The first constructed figure in an area is defined as starting at the Begin Area order. It is delimited either by an End Area order, or by any Move Type order that is valid in an area definition, which implies the start of a new closed figure. See "Valid Area Definitions" on page 36 for a list of orders that are valid in an area definition.

Implementations can choose to allow complete figures, such as Full Arc at current position, within a constructed figure.

Each figure in an area must be properly closed, that is, its start and end points must be identical. If the points are not identical, the figure is closed arbitrarily with a straight line connecting the start and end points. The current position is set to the start point of the figure.

Application Note: If the Begin Area order specifies that the boundary is to be drawn, the generated line to close the figure may or may not be drawn; this is presentation device-dependent. If the Begin Area order specifies that the boundary is not to be drawn, the generated line to close the figure is not drawn.

The figures formed in this way jointly define the area boundary. The interior of the area is shaded using the values of the pattern attributes that were current when the Begin Area order was executed.

The interior of the area is determined as follows (see Figure 11 on page 35). Whether any point is within the area interior is determined by drawing a conceptual line from that point to infinity, without crossing any vertices. If this line crosses the area boundary an *odd* number of times, the point is in the area interior and the region containing that point is shaded. When counting line crossings, coincident

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boundary lines are all counted. Regions with an *even* number of line crossings from infinity are not shaded.

This is called the *alternate* mode for determining the interior of an area.

Architecture Note: The alternate mode for determining the interior of an area is also called the *odd-parity* rule; see J. Foley, A. van Dam, S. Feiner, and J. Hughes, *Computer Graphics Principles and Practice*, Second Edition, Addison-Wesley, 1990.



Figure 11. Determining the Interior of an Area

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The area is filled with the pattern specified by the pattern set and pattern symbol attributes that were current when the Begin Area order was executed. If no such set is available, exception condition EC-6803 is raised, the standard action for which is to use the standard default pattern set. If the code point is undefined in the specified pattern set, exception condition EC-6804 is raised, the standard action for which is to use the standard default pattern symbol. In AFP environments, this is X'10'—Solid fill.

Logically, an area is constructed as follows:

- 1. When an End Area order is executed, the closed figures within the area are filled. The values of the pattern set, pattern symbol, pattern color, pattern mix, and pattern background mix that were current when the Begin Area order was executed are used in generating the fill pattern. After the End Area order is executed, the current pattern color, pattern mix, and pattern background mix attributes are upated to reflect any change in the color, mix, and background mix attributes that may have been specified inside the area definition.
- If indicated by the Begin Area order, the area boundary is drawn in the GPS in the sequence that the drawing orders that define the boundary are executed. The boundary lines are drawn using the values of the Line attributes that are current at the time the orders defining the boundary are executed.

If no boundary lines are drawn, or the line type specified is invisible, the boundary acts as if it were drawn as a zero-width line.

If two areas are defined that are adjacent to each other, that is, they have at least one boundary line in common, the fill patterns used in the two areas can overlap at the boundary. It is also permissible to overlap the boundary with the fill pattern. T

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Drawing boundaries with solid lines and a mix of overpaint ensures consistent results.

The value of the current position is not changed by the Begin Area order itself, but is changed by those orders that are used to define the area boundary.

Valid Area Definitions

An exception condition, EC-6801, occurs if the Begin Area and End Area orders delimiting an area definition are not both in the same segment. Note that an appended segment is part of the segment that it appends. Area orders cannot be nested.

Only the following orders are allowed between the Begin Area order and its corresponding End Area order:

- Box
- Comment
- Fillet
- Full Arc
- Line
- No-op
- Partial Arc
- Relative Line
- Set Arc Parameters
- Set Background Mix
- Set Color
- Set Current Position
- Set Extended Color
- Set Fractional Line Width
- Set Line Type
- Set Line Width
- Set Mix
- Set Process Color

Supported orders other than those listed above raise exception condition EC-6802.

Note: The Marker and Character String orders are not permitted as part of an area definition.

Patterns

A pattern is used to fill the interior of an area and is created by selecting a symbol using the pattern set and pattern symbol attributes. This symbol is repeated, both in the horizontal and vertical directions, to fill the interior of an area. Figure 12 on page 37 shows representative patterns corresponding to attribute values X'01' (1) to X'10' (16) in the default pattern set.

Note that a Pattern Symbol attribute value of X'00' selects the drawing default symbol. If no drawing default symbol is specified in the graphics data descriptor, the presentation default in AFP GOCA is solid fill. Note also that an attribute value of X'40' (blank) is treated the same as an attribute value of X'0F' (no fill).



Figure 12. Default Pattern Set

Chapter 4. Graphics Primitives and Attributes 37

Area (Pattern) Attributes

Table 6 shows the attributes controlling the drawing of Area primitives.

Table 6. Attributes Controlling Area Primitives				
Attribute	Standard Default	Length (in bytes)	Meaning	
PATTERN SET	Default pattern set	1	Specification of pattern set local identifier	
SYMBOL	Solid shading (X'10')	1	Specification of pattern symbol code point	
COLOR	Device dependent	2–4	Color value set into GPS for foreground	
MIX	Overpaint (X'02')	1	Specification of mix mode in GPS for foreground	
BACKGROUND MIX	Leave alone (X'05')	1	Specification of mix mode in GPS for background	

Character Strings

Two orders are supported for drawing character strings:

- The Character String order draws a character string starting at a given point (X₀, Y₀), and sets the current position to (X₀, Y₀). See "Character String (GCHST, GCCHST) Orders" on page 74 for details.
- The Character String at Current Position order draws a character string starting at the current position, and does not change the current position.

The coded font from which the character definitions are to be obtained is given by the value of the Character Set attribute.

The color of all characters in the string is given by the value of the Color attribute.

The way in which characters in the string are merged with any output primitives that have already been drawn is controlled by the values of the character mix and character background mix attributes.

The current values of the line type, line width, pattern set, and pattern symbol attributes have no effect on the appearance of the characters in the string.

A character string can be defined in which some of its characters need to be drawn outside the boundaries of the GPS. The result of executing a Character String order where this occurs is implementation dependent.

The appearance and relative positions of the characters in the string are dependent on the values of:

- Code points in the order
- Character Attributes (see "Character Attributes" on page 43)

A character string is drawn based upon the specified character precision:

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 Precision 1

 Device-specific (string) precision

 Precision 2

 Device-specific (character) precision

 Precision 3

 Stroke precision (not supported in AFP GOCA)

Figure 13 shows two different methods used in AFP environments for positioning GOCA character strings.

Font Positioning Method



R = Reference point for Left to Right, escapement point for Right to Left

 $T=\mbox{Reference}$ point for Top to Bottom, escapement point for Bottom to Top

B = Reference point for Bottom to Top, escapement point for Top to Bottom

E = Reference point for Right to Left, escapement point for Left to Right



Figure 13. Methods for Positioning Character Strings

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Device-Specific (Character) Precision

Character precision has been implemented differently on different devices; it is not consistent among implementations. The intent of this precision is that characters are positioned and drawn as follows. Note that the character reference point is not always placed at the current position. Scale and rotation are not necessarily applied when drawing the symbol.

- The position of the first character is determined by the Character Direction attribute. Each device uses one of the two methods of locating the points R,E,T,B shown in Figure 13 on page 39; refer to your device documentation for specific implementation information.
 - When the character direction is left to right, point R for the first character is positioned at the current or given position from the Character String order.
 - When the character direction is right to left, point E for the first character is positioned at the current or given position from the Character String order.
 - When the character direction is top to bottom, point T for the first character is positioned at the current or given position from the Character String order.
 - When the character direction is bottom to top, point B for the first character is positioned at the current or given position from the Character String order.
- 2. The character is then drawn taking the following character attributes into account:
 - For devices that scale GOCA characters, the symbol is scaled using the Character Cellsize attribute. This scaling is independent in the X-axis and Y-axis.

Note that for some devices, if the character cell size is specified as negative values, a mirror image of the character is generated. That is, if the cell width is negative, the character is mirrored about the Y-axis, and if the cell height is negative, the character is mirrored about the X-axis.

- The character cell is rotated by the angle given in the character angle attribute.
- For some devices, the character is rotated within the cell based on the selected coded font rotation.
- 3. The next character in the string is positioned.
 - When the character direction is left to right, a vector is generated from the left edge of the character box to the right edge, and successive characters are placed in the direction of this vector.
 - When the character direction is top to bottom, a vector is generated from the top edge of the character box to the bottom edge, and successive characters are placed in the direction of this vector.
 - When the character direction is right to left, a vector is generated from the right edge of the character box to the left edge, and successive characters are placed in the direction of this vector.
 - When the character direction is bottom to top, a vector is generated from the bottom edge of the character box to the top edge, and successive characters are placed in the direction of this vector.

4. Subsequent characters in the string are positioned and drawn in the same manner.Figure 14 on page 41 shows the effect of the Character Direction and Character Angle attributes when the device uses the font positioning method. Figure 15 on page 42 shows the effect of the Character Direction and Character Angle attributes when the device uses the cell positioning method.

Character	Character Angle				
Direction	0 °	90 °	$180~^{\circ}$	$270~^\circ$	Rotation
Left to Right	ABC	ABC	→ → ▼BC	ABC_	0 °
Top to Bottom	Å B C ↓		C ₩ ¥	- ∩₩ >•	$270~^{\circ}$
Right to Left	CBA,	CBA.	← CBV	_CBA,	180 °
Bottom to Top	C B A A	₩₽-₹+ 	¥ B C	>₩ <u></u>	90 °

— Character baseline

- Current graphics position = Character reference point of first character
- → Inline direction

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The character rotation, which is specified in a font mapping in the controlling environment, is selected to match the specified Character Direction. For example in the MO:DCA environment, the character rotation is specified in a Map Coded Font structured field. In the IPDS environment, character rotation is determined by the specified Font Inline Sequence. The relationship between these two parameters is as follows:

0 degree character rotation $=$	0 degree font inline sequence
90 degree character rotation $=$	270 degree font inline sequence
180 degree character rotation $=$	180 degree font inline sequence
270 degree character rotation $=$	90 degree font inline sequence

| Figure 14. Font Positioning Method

Character Direction	0 °	Character Angle0 °90 °180 °270 °				
Left to Right	ABC	ABC		ABC	0 °	
Top to Bottom	ABC ↓		A Data Strain S		270 °	
Right to Left	CBA,	CBA	CBV	CBA	180 °	
Bottom to Top			↓ C		90 °	

Character baseline

- Current graphics position = Character reference point of first character
- → Inline direction

The character rotation, which is specified in a font mapping in the controlling environment, is selected to match the specified Character Direction. For example in the MO:DCA environment, the character rotation is specified in a Map Coded Font structured field. In the IPDS environment, character rotation is determined by the specified Font Inline Sequence. The relationship between these two parameters is as follows:

0 degree character rotation = 0 degree font inline sequence 90 degree character rotation = 270 degree font inline sequence 180 degree character rotation = 180 degree font inline sequence 270 degree character rotation = 90 degree font inline sequence

| Figure 15. Cell Positioning Method

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Device-Specific (String) Precision

String precision has been implemented differently on different devices; it is not consistent among implementations. String precision differs from character precision in the following respects:

- The Character Angle attribute can be ignored.
- The positioning of the first character can be approximate.
- Drawing of the symbol need take no account of scale or rotation.
- The positioning of further characters in the string need not be scaled according to the Cellsize attribute.

Character Attributes

Table 7 shows the attributes controlling the appearance of character strings.

Table 7. Attributes Controlling Character String Primitives					
Attribute	Standard Default	Length (in bytes)	Meaning		
ANGLE X,Y	No rotation	4	Character rotation x and y values		
CELLSIZE	Device dependent	4	Specification of character cell width and height		
CELLSIZEF	Device dependent	4	Specification of fractional extension of character cell width and height		
DIRECTION	Left to right (X'01')	1	Specification of character direction		
PRECISION	Device dependent (X ' 02 ')	1	Specification of character precision		
CHARACTER SET	Device dependent	1	Specification of character set local identifier		
SHEAR X,Y	No shear	4	Shear x and y values; not supported in AFP GOCA		
SYMBOL	Device dependent	1	Specification of default character code point		
COLOR	Device dependent	2–4	Color value set into GPS for foreground		
MIX	Overpaint (X'02')	1	Specification of mix mode in GPS for foreground		
BACKGROUND MIX	Leave alone (X'05')	1	Specification of mix mode in GPS for background		

Markers

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A marker is a symbol that is used to indicate a position. It is similar to a character drawn at a specified (X_g, Y_g) position. When a marker is used, however, the center of the cell in which the marker is drawn is placed at the specified position.

Two orders are provided for drawing markers:

- The Marker order draws a marker at one or more points.
- The Marker at Current Position order draws a marker at the current position and at one or more further points.

The particular symbol that is drawn is the one identified by the current marker symbol from the current marker set. This symbol is drawn at all the positions specified in the one order. The only marker set supported in AFP GOCA is the default marker set, shown in Figure 16 on page 44. The size of the marker symbols in this set is device-dependent.

X '0 0 '	The	d e fa u lt;	s a m	e a	A S	X '0 1 '
X '0 1 '	Х					
X '0 2 '	+					
X '0 3 '	\diamond					
X '0 4 '						
X '0 5 '	*					
X '0 6 '	\ast					
X '0 7 '	•					
X '0 8 '						
X '0 9 '	•					
X 'O A '	0					
X'40'	(bla	nk)				

Figure 16. Default Marker Set

The color of all markers drawn by an order is given by the value of current marker color. The way in which markers are merged with any output primitives that have already been drawn is controlled by the values of the marker mix and marker background mix attributes.

The current values of the line type, line width, pattern set, and pattern symbol attributes have no effect on the appearance of the markers. These attributes are set to the standard default values on invocation of the marker symbols.

A marker symbol whose position is inside the GPS, but is placed such that part of the marker lies outside the GPS, is not an error. The appearance of that marker in the GPS is implementation-dependent.

The position and appearance of a marker are dependent on the values of the marker precision and marker cellsize attributes, as follows:

Precision 1

String Precision. In AFP GOCA, the size of the marker symbols in the default marker set are device-dependent. The marker is positioned at a specified point, or at the current position.

Precision 2

Character Precision. In AFP GOCA, this is the same as Precision 1—String Precision.

Marker Attributes

Table 8 shows the attributes controlling the appearance of markers.

Table 8. Attributes Controlling Marker Primitives					
Attribute	Standard Default	Length (in bytes)	Meaning		
CELLSIZE	Device dependent	4	Specification of marker cell width and height		
PRECISION	String (X'01')	1	Specification of marker precision		
MARKER SET	Device dependent	1	Specification of marker set local identifier		
SYMBOL	Cross (X'01')	1	Specification of marker symbol code point		
COLOR	Device dependent	2–4	Color value set into GPS for foreground		
MIX	Overpaint (X'02')	1	Specification of mix mode in GPS for foreground		
BACKGROUND MIX	Leave alone (X'05')	1	Specification of mix mode in GPS for background		

Images

Images are rectangular arrays of points that are included directly in the graphics picture definition. An image is represented by a sequence of orders. The first order is a Begin Image order, which is followed by one or more Image Data orders. The sequence *must* end with an End Image order.

Note: The only other orders permitted within the Begin Image/End Image order bracket are the No-Operation and Comment orders.

Only one format of image data is defined: FORMAT=X'00'. With this format, each Image Data order contains the data for one row of the image.

Image points are mapped to presentation-device pels. The size of the image is given by the WIDTH and HEIGHT parameters in the Begin Image order. There must be as many Image Data orders as the HEIGHT parameter, and each Image Data order must contain the number of bits specified by the WIDTH parameter, plus padding to a byte boundary.

The position of the image in GPS is specified in GPS L-units.

The current values of the image attributes are taken into account when drawing the image. An image must be completely defined in one segment. However, it may start in one segment and be completed in an appended segment.

Image Attributes

Table 9 shows the attributes controlling the appearance of an image.

Table 9. Attributes Controlling Image Primitives					
Attribute	Standard Default	Length (in bytes)	Meaning		
COLOR	Device dependent	2–4	Color value set into GPS for foreground		
MIX	Overpaint (X'02')	1	Specification of mix mode in GPS for foreground		
BACKGROUND MIX	Leave alone (X'05')	1	Specification of mix mode in GPS for background		

Output Primitive Overflow

It is possible to define an output primitive such that it starts inside the GPS, but some part of it lies outside the GPS.

If a primitive, such as the Full Arc, Partial Arc, or Box primitive, starts inside the GPS, ends inside the GPS, leaves the current position in the GPS, but goes outside the GPS for some part of its path, exception EC-000D is raised. The standard action for exception EC-000D is to draw the primitive in an implementation-dependent manner. For presentation devices that cannot maintain a position outside the GPS, such as devices that are limited to 2-byte arithmetic, this exception is mandatory. For devices that can maintain a position outside the GPS, it is optional.

An error is also generated when a primitive, such as the Relative Line or Partial Arc primitive, is specified that causes the current position to fall outside the GPS. In that case a drawing process check is generated and there is no standard action. For the Relative Line primitive, the exception is EC-E100. For the Partial Arc primitive it is EC-E300. For presentation devices that cannot maintain a position outside the GPS, these exceptions are mandatory. For devices that can maintain a position outside the GPS, they are optional.

A coordinate point that is outside the GPS is characterized by an arithmetic overflow in its X_g or Y_g coordinate. Because AFP GOCA uses 16-bit signed integers to specify GPS coordinates, a point outside the GPS is characterized by a 2-byte arithmetic overflow. Note that this does not mean that AFP GOCA processors are limited to 2-byte arithmetic. It simply means that they need to be able to detect 2-byte arithmetic overflows. For a definition of the geometric parameter format used in AFP GOCA, see "Parameter Type" on page 56 and "Drawing Order Subset (Mandatory)" on page 149.

Chapter 5. Segments

Segments are self-contained collections of drawing orders. This chapter describes:

- Segment types
- Segment processing sequence
- Segment properties
- Segment prolog

Segment Types

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Segments of the following types can be created, as determined by the CHAIN parameter in the Begin Segment command:

- Chained
- Unchained

In AFP GOCA, all segments are processed in *immediate mode*. In this mode, chained segments define the picture. They are processed by the drawing processor as they are received from the environment interface, and are *not* stored. Unchained segments are ignored.

Segments are transmitted by the controlling environment to the drawing processor with Begin Segment Commands and the drawing orders that follow these commands. The Begin Segment (chained) command invokes the drawing processor to draw the segment.

In the MO:DCA and IPDS environments, a graphics object can contain multiple chained segments. All chained segments within the object are processed independently in the sequence in which they arrive; together they generate the graphics picture. A segment cannot be split across multiple graphics objects.

The Append option indicates that the segment is a continuation of the preceding segment. Unfinished drawing orders, areas, images, and prologs may be completed in appended segment data. See "Begin Segment Command" on page 58 for further details of the functions of the Append option.

Immediately-processed segments terminate, and, if temporarily stored, are deleted, when the drawing processor is stopped. When the drawing processor stops as the result of the normal completion of an invocation, a Draw Complete indication is returned to the originator. When the drawing processor stops because a draw process check has been detected, an error indication is returned to the originator. The processor cannot be interrupted during the processing of an invocation. An invocation while the drawing processor is processing a previous invocation causes a busy indication to be returned to the originator.

Segment Processing Sequence

Segment processing starts at the first segment in the segment chain. The processing of a segment always starts at its first order and proceeds in sequence, order by order, until the last order is processed, at which time the segment is terminated.

When the invocation operates on a single segment, it is complete when the segment is terminated.

When the invocation operates on a chain of segments, the graphics processor sequentially processes and terminates each segment in the chain. When the last specified chained segment is terminated, the invocation is complete.

Segment Properties

Associated with each segment is a set of properties. These properties are specified in the Begin Segment command, see "Begin Segment Command" on page 58. The function of these properties is to provide control information relevant to the processing of the segment.

The properties and their functions are as follows:

Property	Function
Name	4-byte identifier. In AFP GOCA, this property is ignored.
Length	2-byte length of segment data.
Chain	Indicates whether or not the segment is to be chained.
Prolog	Indicates that the segment has a prolog section at the beginning of the data. See "Segment Prolog" for details of prolog processing.
New/Appe	end Indicates whether this is a new segment or a segment to be appended

to the previous segment.

These properties are unique to the segment. They are not inherited between segments. They are defined when a segment is created.

Segment Prolog

Segment prologs provide a defined position where initial attributes and drawing process controls are set. A prolog is optional; its presence is indicated by the prolog bit in the Begin Segment command.

If present, the prolog is always at the beginning of the segment, and is ended by an End Prolog Order within the same segment. Note that for a segment that is spread over multiple appended segments with multiple Begin Segment commands, the End Prolog drawing order may be specified in any of the appended segments.

The end of a prolog in a segment must be indicated by an End Prolog Order. Exception condition EC-000C is raised, if the end of the segment is reached while still in the prolog.

Note: Exception condition EC-3E00 is raised if an End Prolog Order is found when not in a prolog.

Within the prolog, only the following orders are valid:

- Comment
- No Operation
- Segment Characteristics
- Set Arc Parameters

- Set Background Mix
- Set Character Angle
- Set Character Cell
- Set Character Direction
- Set Character Precision
- Set Character Set
- Set Character Shear
- Set Color
- Set Current Position
- Set Extended Color
- Set Fractional Line Width
- Set Line Type
- Set Line Width
- Set Marker Cell
- Set Marker Precision
- Set Marker Set
- Set Marker Symbol
- Set Mix
- Set Pattern Set
- Set Pattern Symbol
- Set Process Color

Implementation Note: Some AFP printers also accept the Set Pick Identifier order in a prolog, and process this order as a NoOp.

The other supported orders, when specified in the prolog, cause exception condition EC-000C to be raised.

Segment Prolog Semantics

The semantics of the segment prolog for chained segments processed in immediate mode are as follows.

The segment data is processed by the graphics processor following processing of a Begin Segment command. For a segment that is specified with the APPEND parameter, the segment data that follows the Begin Segment command is part of the segment, not the whole segment.

For an Immediate mode chained segment that is spread over multiple appended segments with multiple Begin Segment commands, only the PROLOG flag bit in the Begin Segment that is marked as *New* determines whether the segment has a prolog or not. The PROLOG bits in subsequent Begin Segment commands that are marked as APPEND are ignored.

For a segment that is spread over multiple appended segments with multiple Begin Segment commands, it is necessary for the graphics processor to check the segment data in all the Begin Segment commands for the segment before it can determine whether the segment is valid or not, that is, whether or not the segment contains an End Prolog Order to match the setting of the segment prolog property.

For example, with a segment whose data is spread over three appended segments with three Begin Segment commands, the first command could indicate that the segment has a prolog, but the End Prolog Order could well be in data in the third segment. The PROLOG flag in the first Begin Segment command of a multi-part

Segment Prolog

segment does not indicate that an End Prolog Order is necessarily contained within the segment data that follows the Begin Segment command.

Chapter 6. Environment Controls

This chapter describes:

- Control instructions
- Drawing processor facilities, including

 Current attributes
 - Drawing process controls

Control Instructions

The controlling environment communicates with the graphics processor by means of control instructions and drawing process controls. Control instructions are embedded in environment-dependent carriers in AFP GOCA as follows:

- When the graphics object is carried in a MO:DCA-P data stream, the carrier is a Graphics Data Descriptor (GDD) structured field; for more information see Appendix A, "Mixed Object Document Content Architecture (MO:DCA) Environment" on page 147.
- When the graphics object is carried in an IPDS data stream, the carrier is a Graphics Data Descriptor self-defining field in the Write Graphics Control (WGC) command; for more information see Appendix B, "Intelligent Printer Data Stream (IPDS) Environment" on page 157.

Both the GDD and WGC contain the Set Current Defaults control instruction, defined in "Set Current Defaults Instruction."

Note: If the drawing defaults contain any invalid bits, the processor raises exception condition EC-000A.

Set Current Defaults Instruction

This control instruction sets the current default values of the selected attributes and drawing process controls. When the graphics object is carried in a MO:DCA-P data stream, this control instruction is contained in the Graphics Data Descriptor (GDD) structured field. When the graphics object is carried in an IPDS data stream, this control instruction is contained in the Graphics Data Descriptor (GDD) self-defining field of the Write Graphics Control (WGC) command.

Offset	Туре	Name	Range	Meaning	
0	CODE		X'21'	Set Current Defaults Instruction	
1	UBIN	LENGTH	4–n	Length of following data	
2		SET	X'00'	Drawing a	ttributes
			X'01'	Line Attrib	outes
			X'02'	Character	attributes
			X'03'	Marker att	tributes
			X'04'	Pattern at	tributes
			X'0B'	Arc param	neters
			All others	Reserved	
3–4	CODE	MASK	X'0000'-X'FFFF'	Set Mask	
5	BITS	FLAGS			
Bit 0		DEFAULT	B'0', B'1'	B'0' B'1'	Set all indicated items to their standard default values Set the indicated items to the values contained in the source data
Bits 1–3		RES	B'000'	Reserved;	; only valid value
Bits 4–7		RES	B'1111'	Reserved; only valid value	
6– <i>n</i>	DATA		Default values. Bytes 6 onward are not present if DEFAULT=B'0'.		

Syntax

This instruction permits the setting of a variable number of values, under control of the MASK parameter in bytes 3–4, into the attribute set selected by the value of the SET parameter in byte 2. When a MASK bit equals 0, the default does not change and data bytes are not present for that attribute. A B'1' in any bit of MASK indicates that the corresponding item is to be set. If the DEFAULT bit is B'0', these items are set to the standard defaults; if it is B'1', these items are set to the values 6–*n* of the instruction.

If the value of an attribute specifies the drawing default in an attribute setting order, for example the X'00' value of the MODE parameter used in the Set Mix Order, it causes the current default to be set to the standard default value.

Bits 0–15 in MASK correspond to items within the selected attribute set, as shown in the following tables. The number of bytes required is set into the item corresponding to each 1 bit in Mask, in ascending numerical order of the MASK bit (0–15). Setting is terminated when all the items requested have been loaded.

Notes:

- 1. When the integral part of the line width attribute is set, the fractional part is reset to zero. See "Line Attributes" on page 31 for a description of the Line Width attribute.
- 2. The format of the DATA field is the same as the corresponding data in the attribute setting drawing orders.

Drawing Attributes (SET=X'00')

Mask bit	Item name	Length (bytes)
0	Color	2
1	Reserved; must be zero	N/A
2	Foreground mix	1
3	Background mix	1
4–15	Reserved; must be zero	N/A

Note: Setting any of the above attributes to a value is a shorthand way of setting all color, or mix, attributes to the same value.

Line Attributes (SET=X'01')

Mask bit	Item name	Length (bytes)
0	Line type	1
1	Line width	1
2–15	Reserved; must be zero	N/A

Character Attributes (SET=X'02')

Mask bit	Item name	Length (bytes)
0	Angle X,Y	4
1	Cellsize CW,CH	4
2	Direction	1
3	Precision	1
4	Character Set	1
5	Shear, X,Y	4
6–15	Reserved; must be zero	N/A

Note: The character symbol default attribute is not settable by this instruction.

Marker Attributes (SET=X'03')

Mask bit	Item name	Length (bytes)
0–2	Reserved; must be zero	N/A
3	Precision	1
4	Marker set	1
5–6	Reserved; must be zero	N/A
7	Marker symbol	1
8–15	Reserved; must be zeros	N/A

Pattern Attributes (SET=X'04')

Mask bit	Item name	Length (bytes)
0–3	Reserved; must be zeros	N/A
4	Pattern Set	1
5–6	Reserved; must be zeros	N/A
7	Pattern Symbol	1
8–15	Reserved; must be zeros	N/A

Arc Parameters (SET=X'0B')

Mask bit	Item name	Length (bytes)
0	P value	2
1	Q value	2
2	R value	2
3	S value	2
4–15	Reserved; must be zeros	N/A

Instruction Process Checks: A check condition is set under the following conditions:

- IPC-0002
 - If the SET parameter (byte 2) is invalid or unsupported
 - If the FLAGS parameter (byte 5) bits 1–3 are not B'000' or bits 4–7 are not B'111'
 - If an unallocated item is referenced in the MASK parameter (bytes 3-4)
- IPC-0003
 - If the FLAGS parameter (byte 5) bit 0 is X'0' and LENGTH is not X'04'
 - If the FLAGS parameter (byte 5) bit 0 is X'1' and the length of the immediate data (byte 6 onward) does not exactly match the length implied by MASK
- IPC-0021
 - If any values in the data are invalid or unsupported

Drawing Processor Facilities

The following facilities are available to the drawing processor while it is processing segments:

- Current attributes
- Drawing process controls

Current Attributes

As the orders in a segment are processed, the drawing processor maintains the current values of all primitive attribute types in the current attributes. These values are used by the graphics processor to draw output primitives in the GPS.

Figure 17 shows how the controlling environment uses pre-defined standard defaults and the Set Current Defaults control instruction in the GDD and WGC to establish drawing defaults before the drawing processor is invoked to process a segment. At the start of processing of the segment, the drawing default values are set into the current attributes.



Figure 17. Attributes and Drawing Process Control

Drawing Process Controls

The following controls manage various aspects of the drawing process:

Parameter type

The format of the parameters in the drawing orders. These controls are described in "Parameter Type" on page 56

Arc parameters

Values used as parameters when drawing circles or ellipses. These controls are described in "Set Arc Parameters (GSAP) Order" on page 96.

Drawing defaults exist for each drawing process control. The defaults are maintained by the processor, and they are set to the standard defaults, or to the current defaults provided by the environment, whenever the processor is invoked.

Parameter Type

The parameter type specifies the format of the parameters within drawing orders, and has two parts:

- · Coordinate type
- · Geometric parameter format

The format of this control is:

Mnemonic	Standard default	Length (in bytes)	Meaning
COORD	X'00'	1	Coordinate type
GEOM	X'00'	1	Geometric parameter format

The following value of the coordinate type parameter is specified by the DR/2V0 subset and supported in AFP GOCA environments:

Value Meaning

X'00' 2-D coordinates

The following value of the geometric parameter format is specified by the DR/2V0 subset and is supported in AFP GOCA environments:

Value Meaning

X'00' 16-bit signed integer "high byte first" format

Chapter 7. Commands and Drawing Orders

This chapter describes:

- The Begin Segment command
- Order formats
- Order alignment
- Current position in drawing orders
- Coordinate data
- · Offset data
- · Default values for drawing orders and attributes
- The following drawing orders:
 - Begin Area
 - Begin Image
 - Box at Given Position
 - Box at Current Position
 - Character String at Given Position
 - Character String at Current Position
 - Comment
 - End Area
 - End Image
 - End Prolog
 - Fillet at Given Position
 - Fillet at Current Position
 - Full Arc at Given Position
 - Full Arc at Current Position
 - Image Data
 - Line at Given Position
 - Line at Current Position
 - Marker at Given Position
 - Marker at Current Position
 - No-Operation
 - Partial Arc at Given Position
 - Partial Arc at Current Position
 - Relative Line at Given Position
 - Relative Line at Current Position
 - Segment Characteristics
 - Set Arc Parameters
 - Set Background Mix
 - Set Character Angle
 - Set Character Cell
 - Set Character Direction
 - Set Character Precision
 - Set Character Set
 - Set Character Shear
 - Set Color
 - Set Current Position
 - Set Extended Color
 - Set Fractional Line Width
 - Set Line Type
 - Set Line Width
 - Set Marker Cell
 - Set Marker Precision

- Set Marker Set
- Set Marker Symbol
- Set Mix
- Set Pattern Set
- Set Pattern Symbol
- Set Process Color

Begin Segment Command

This command defines or modifies a segment, its properties, or both. It can be transmitted as part of the picture chain or as an unchained segment. If the segment is transmitted as part of the chain it is executed as received, then discarded. If a segment is transmitted as unchained, it is ignored.

Note: There is no formal End Segment command, and none is needed. However, the reserved fixed two-byte drawing order with order code X'71' is used as an End Segment drawing order by some applications. This order is treated as a No-Op in AFP GOCA.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'70'	Begin Segment command.
1	UBIN	LENGTH	X'0C'	Length of following parameters
2–5	UBIN	NAME	Any value	Name of segment to be created; ignored
6	BITS	FLAG1	Any value	Ignored
7	BITS	FLAG2		Segment Properties 2
Bit 0		CHAIN	B'0', B'1'	B'0'ChainedB'1'Unchained
Bits 1–2		CHPOS	Any value	Ignored
Bit 3		PROLOG	B'0', B'1'	B'0'No PrologB'1'Prolog
Bit 4			Any value	Ignored
Bits 5–6		APP	B'00', B'01', B'10', or B'11'	B'00'New segmentB'01'ReservedB'10'ReservedB'11'Append the specified data to the end of the existing segment
Bit 7		DATAFL	Any value	Ignored
8–9	UBIN	SEGL	X'0000'-X'FFFF'	Segment data length
10–13	CHAR	P/SNAME	Any value	Predecessor/successor name; ignored

The segment data in the form of drawing orders follows immediately in the following format:

Offset	Туре	Name	Range	Meaning
0— <i>n</i>		SEGDATA		Segment data. The number of bytes is equal to the number defined by SEGL.

Semantics

This command defines a segment for immediate execution. It consists of a command code, a command length, and a parameters section. The command is followed by a data section that contains the drawing orders for the segment. Bytes 0–13 of this command are often referred to as the *Begin Segment Introducer (BSI)*.

- Byte 0 The command code is X'70' for a Begin Segment command.
- **LENGTH** Specifies the length of the parameter section, that is, it does not include the length of the command code or its own length. This length must be X'OC'.

Note: The parameter section consists of a name parameter, a flag parameter, and a data length parameter.

- **NAME** A 32-bit unsigned integer that specifies the name of the segment. This name is ignored in AFP GOCA.
- **FLAG2** Contains the CHAIN, PROLOG, and APP flags, which are used to set various segment properties for the specified segment.
 - **CHAIN** Indicates whether this segment is chained or not. Chained segments define the picture, unchained segments are ignored in AFP GOCA.
 - **PROLOG** Indicates whether the segment has a prolog section at the beginning of the segment data.
 - **APP** Provides the following functions:
 - Value Description
 - **B'00'** New Segment. In chained immediate mode, if the segment is the first within the graphics object, the prolog segment property is saved, and the segment data is processed with the drawing defaults.
 - **B'01'** *Reserved.* The command is rejected.
 - **B'10'** *Reserved.* The command is rejected.
 - B'11' Append data to segment. In chained immediate mode, if the segment is the first in a graphics object, the command can be rejected; if accepted, it is treated as a *new* segment. In chained immediate mode, if the segment is not the first in a graphics object, the segment data is considered to be a continuation of the data that followed the Begin Segment command immediately prior to the current Begin Segment command. This data is invoked with the *current* values of the drawing attributes, not with the drawing defaults, and uses the value of the prolog property that was saved in a previous New Segment command. This means that a prolog that is started in a new segment may be terminated with an End Prolog order in one of the appended segments.

The appended segment data may possibly complete any unfinished drawing order, area, image definition, or prolog.

SEGL Specifies the length of the data section. A zero length for the data section is invalid when creating a *new* segment, but this does not cause an exception in AFP GOCA.

SEGDATA

The data section for the segment. This parameter contains the drawing orders.

Exception Conditions

The actual mechanism by which these Communication Process Checks are reported is environment-dependent.

CPC-0001

Explanation: Invalid command code specified.

CPC-7001

Explanation: APP has the value B'10'.

CPC-7082

Explanation: APP has the value B'01'.

CPC-70C1

Explanation: Invalid parameter length specified.

CPC-70C5

Explanation: Insufficient data. Segment data is less than length specified by SEGL.

Order Formats

Drawing orders are represented in one of four formats, depending on the length of the operand data:

- Fixed 1-byte format is used for orders that have no operand data.
- Fixed 2-byte format is used for orders that have a single byte of operand data.
- Long format is used for orders with up to 255 bytes of operand data.
- Extended format is used for orders with up to 65535 bytes of operand data. This format is not used in AFP GOCA.

The format of an order is determined by its order code:

- One fixed 1-byte order has an order code of X'00'.
- For fixed 2-byte orders, bit 0 is set to 0, and bit 4 is set to 1, that is, the first digit of the order code is less than 8, and the second digit is greater than, or equal to, 8.
- Apart from the special orders, that is, the fixed 1-byte and the extended format orders, orders that are not fixed 2-byte orders are *long* format orders.

 Extended orders have an order code of X'FE', which introduces the extended format.

Fixed 1-Byte Format

The fixed 1-byte order format has a 1-byte order code only. One order has this format: the No-Operation (GNOP1) order.

Order code	
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Figure 18. Fixed 1-Byte Order Format

Fixed 2-Byte Format

The fixed 2-byte format has a 1-byte order code and one byte of data:

Order code	Operand
· · · · · · · · · · · · · · · · · · ·	



Long Format

The long format has a 1-byte order code and a 1-byte length field followed by the number of data bytes specified by the length field. The value of the length field is the length of the operand data in bytes, that is, the length does not include the order code or length field.

Order code	Length
Operar	nd data

Figure 20. Long Order Format

Extended Format

The extended format has a 1-byte order code, X'FE', and a 1-byte qualifier field, followed by a 2-byte length field, followed by the number of data bytes specified by the length field. The value of the length field is the length of the operand data, in bytes; that is, the length does not include the order code, qualifier, or length fields.

Order code	Qualifier			
Ler	ngth			
Operand data				

Figure 21. Extended Order Format

Order Alignment

Orders can be followed by any number of No-Operation (GNOP1) or Comment (GCOMT) orders, to align the next order on any convenient byte boundary. Orders can be aligned on any byte boundary, although, depending on the implementation, a performance benefit can be obtained if orders are aligned on even-byte boundaries. Note that a drawing order may start in one segment and be completed in an appended segment.

Current Position in Drawing Orders

Some orders have two forms. One form uses the current position as one of its coordinate values; the other form does not. See "Current Position" on page 23 for more details.

Coordinate Data

Coordinate data is used in orders to specify points in GPS, each point being specified by a set of two parameters, X_g and Y_g . The sequence of parameters in coordinate data is (X_g, Y_g) ; the format of the parameters is 16-bit twos-complement signed binary integers (SBIN). The drawing processor interprets coordinate data and raises an exception condition if the length of the data is not consistent with complete specification of points.

Offset Data

Offset data is used in orders to specify a point in GPS by specifying its offset from a given point. Each point is specified by a set of two parameters. The sequence of parameters in offset data is x,y; the format of the parameters is 8-bit twos-complement signed binary integers (SBIN).

Default Values

The defaulting mechanism used is as follows. See also Figure 17 on page 55.

• All current attributes and drawing process controls are set to their default values when the environment containing the graphics processor is initialized. These default values are referred to as the *standard defaults*.

The standard defaults are either:

- Environment-dependent values
- Architected values, that is, one of the values that can be selected with a nonzero attribute value has been architected as the default.
- The standard defaults are copied into another set of defaults, referred to as the *current defaults,* when the graphics processor is initialized.
- The current defaults can be changed by the Set Current Defaults control instruction.
- When a drawing process is initiated, the current defaults are copied into a set of defaults called the *drawing defaults*. These are the defaults that are assumed during the execution of the drawing process.

The drawing defaults apply during the whole of the drawing process. They cannot be changed by a control instruction while the drawing process is being executed.

- The current values of the primitive attributes are either set or propagated at the start of a segment. "Current Attributes" on page 55 describes how the initial values are determined.
- The current values of the drawing process controls are either set or propagated at the start of a segment. "Drawing Process Controls" on page 55 describes how the initial values are determined.

Summary List of Orders

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Length	Hex	Order	Meaning
1-byte	00	GNOP1	No Operation
Long	01	GCOMT	Comment
Long	04	GSGCH	Segment Characteristics
2-byte	08	GSPS	Set Pattern Set
2-byte	0A	GSCOL	Set Color
2-byte	0C	GSMX	Set Mix
2-byte	0D	GSBMX	Set Background Mix
Long	11	GSFLW	Set Fractional Line Width
2-byte	18	GSLT	Set Line type
2-byte	19	GSLW	Set Line width
Long	21	GSCP	Set Current Position
Long	22	GSAP	Set Arc Parameters
Long	25	GSBCOL	Set Background Color
Long	26	GSECOL	Set Extended Color
2-byte	28	GSPT	Set Pattern Symbol
2-byte	29	GSMT	Set Marker Symbol
Long	33	GSCC	Set Character Cell
Long	34	GSCA	Set Character Angle
Long	35	GSCH	Set Character Shear
Long	37	GSMC	Set Marker Cell
2-byte	38	GSCS	Set Character Set
2-byte	39	GSCR	Set Character Precision
2-byte	ЗA	GSCD	Set Character Direction
2-byte	3B	GSMP	Set Marker Precision
2-byte	3C	GSMS	Set Marker Set
2-byte	3E	GEPROL	End Prolog
Long	60	GEAR	End Area
2-byte	68	GBAR	Begin Area
Long	80	GCBOX	Box at CP

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Length	Hex	Order	Meaning
Long	81	GCLINE	Line at CP
Long	82	GCMARK	Marker at CP
Long	83	GCCHST	Character String at CP
Long	85	GCFLT	Fillet at CP
Long	87	GCFARC	Full Arc at CP
Long	91	GCBIMG	Begin Image at CP
Long	92	GIMD	Image Data
Long	93	GEIMG	End Image
Long	A1	GCRLINE	Relative Line at CP
Long	A3	GCPARC	Partial Arc at CP
Long	B2	GSPCOL	Set Process Color
Long	C0	GBOX	Box
Long	C1	GLINE	Line
Long	C2	GMRK	Marker
Long	C3	GCHST	Character String
Long	C5	GFLT	Fillet
Long	C7	GFARC	Full Arc
Long	D1	GBIMG	Begin Image
Long	E1	GRLINE	Relative Line
Long	E3	GPARC	Partial Arc

Architecture Note: Some AFP printers accept the following drawing orders and process them as No-Ops:

- Set Pick Identifier (GSPIK, X'43'). This drawing order is in long format.
- End Segment drawing order (X'71'). This drawing order is in fixed 2-byte format, where the second byte is reserved and should be set to X'00'.

Begin Area (GBAR) Order

This order indicates the start of a set of primitives that define an area boundary.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'68'	GBAR order code
1	BITS	FLAGS		Internal flags
Bit 0		RES1	B'1'	Reserved for migration; only valid value
Bit 1		BOUNDARY	B'0', B'1'	Boundary-line draw indicator:
				B'0'Do not draw boundary linesB'1'Draw boundary lines
Bit 2		INSIDE	B'0'	Mode to determine inside:
				B'0' Alternate mode
Bits 3–7		RES2	B'00000'	Reserved; only valid value

Semantics

The Begin Area order starts the definition of a filled area. The area definition *must* be terminated by an End Area order. See "Areas" on page 33 for details of the area definition.

The BOUNDARY bit determines whether or not the boundary of the area is drawn. The INSIDE bit determines the method of filling the interior. Alternate mode is the only mode supported in AFP GOCA.

The pattern set, pattern symbol, pattern color, pattern mix, and pattern background mix attributes that *are current when the Begin Area order is executed* are used to fill the area. The line attributes that are current at the time the orders defining the boundary are executed are used to draw the boundary.

The value of the current position is not changed by the Begin Area order itself, but is changed by those orders used to define the area boundary, including any implicit figure-closing orders that are required.

Area orders must *not* be nested and an area *must* be defined completely within a single segment.

For an area within an immediate-mode segment, temporary storage can be required. An exception condition, EC-6805, is set if this storage overflows.

RES1 is set to B'1' for compatibility with old implementations. Generators must set this value, but receivers can ignore this bit.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0002

Explanation: A reserved byte, or bit, in the order is not set to zero.

Bits 2-7 of FLAGS are not all zero.

EC-6800

Explanation: A Begin Area order has been executed after another Begin Area order, without an intervening End Area order being executed.

EC-6801

Explanation: A Begin Area order has been executed in a segment, and the end of the segment is reached without an End Area order having been executed.

Note: This exception condition is raised when the end of the segment is reached.

EC-6802

Explanation: A supported order that is invalid within an area is detected.

Note: This exception condition is raised when the order that is invalid is detected.

The following exception conditions cause a standard action to be taken:

EC-6803

Explanation: The coded font identified by the current pattern set is not available.

Standard Action: The standard default pattern set is used.

EC-6804

Explanation: The current pattern symbol identifies an undefined symbol in the current pattern symbol set.

Standard Action: The standard default pattern symbol is used. In AFP environments this is X'10'—Solid fill.

EC-6805

Explanation: Temporary storage overflow while drawing an area in an immediate segment.

Standard Action: Drawing of the area is completed in an implementation-defined manner.

Begin Image (GBIMG, GCBIMG) Orders

These orders identify the start of an image definition at a given position or at the current position.

Syntax

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Offset	Туре	Name	Range	Meaning
0	CODE		X'D1'	GBIMG order code
1	UBIN	LENGTH	X'0A'	Length of following data
2–3	SBIN	XPOS	X'8000'-X'7FFF'	X _g coordinate of image origin (first image point of first image scan line)
4–5	SBIN	YPOS	X'8000'-X'7FFF'	Y _g coordinate of image origin (first image point of first image scan line)
6	CODE	FORMAT	X'00'	Format of the image data:
				X'00' Each image point is mapped to a presentation device pel
7		RES	X'00'	Reserved; only valid value
8–9	UBIN	WIDTH	X'0000'-X'FFFF'	Width of the image data, in image points
10–11	UBIN	HEIGHT	X'0000'-X'FFFF'	Height of the image data, in scan lines

Begin Image at Given Position (GBIMG) Order

Begin Image at Current Position (GCBIMG) Order

Offset	Туре	Name	Range	Meaning
0	CODE		X'91'	GCBIMG order code
1	UBIN	LENGTH	X'06'	Length of following data
2	CODE	FORMAT	X'00'	Format of the image data:
				X'00' Each image point is mapped to a presentation device pel
3		RES	X'00'	Reserved; only valid value
4–5	UBIN	WIDTH	X'0000'-X'FFFF'	Width of the image data, in image points.
6–7	UBIN	HEIGHT	X'0000'-X'FFFF'	Height of the image data, in scan lines.

Semantics

The Begin Image at Given Position (GBIMG) Order defines an image at the specified position. The Begin Image at Current Position (GCBIMG) order defines an image at the current position.

An image consists of a rectangular region of points and is defined by a sequence of orders, starting with a Begin Image order and ending with an End Image order. Between these two orders are one or more Image Data, Comment, or No-Operation orders, and these are the only orders permitted.

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The XPOS and YPOS parameters define the position of the image origin, that is the first point of the first scan line, which is at the top-left corner of the image. This origin is defined in GPS.

If a particular bit in the image data is B'1', it defines a foreground pel, and the point is drawn using the current values of the image mix and color attributes. If the bit is B'0', it defines a background pel, and the point is drawn using the current value of the image background mix attribute.

There is an Image Data order for every row of the image. That is, for an image n rows high there *must* be n Image Data orders between the Begin Image and End Image orders. Each Image Data order contains sufficient integral bytes of data for the width of the image. If the width of the image is *not* an integral number of bytes, the padding bits at the right hand end of the last byte in the Image Data order are ignored.

Each image point is mapped to a presentation device pel, unless the image resolution is explicitly specified in the Graphics Data Descriptor; see "Window Specification (Mandatory)" on page 150. If the image resolution is explicitly specified, the mapping may include resolution correction so that the image is presented at its original size.

Implementation Note: In the absence of any other image resolution information, AFP printers map image points to device pels as follows:

- Printers that have a fixed resolution map point-to-pel at that resolution.
- Printers that have an *acceptance mode* for a fixed resolution map point-to-pel at the acceptance-mode resolution and then scale to the printhead resolution.
- Printers that have a fixed resolution but scale transparently to a different printhead resolution map point-to-pel at the fixed resolution and then scale to the printhead resolution.
- Printers that support multiple raster source resolutions map point-to-pel to the single (maximum) printhead resolution reported in the IPDS XOH-OPC Image and Coded Font Resolution self-defining field. Such printers normally also provide acceptance modes at lower resolutions, so that if the GOCA image size is too small at the printhead resolution, the customer can switch to a lower-resolution acceptance mode.
- The image is not scaled when a scale-to-fit or scale-to-fill mapping to the object area is specified for the graphics object.

The image is drawn in HEIGHT scan lines of length by WIDTH image points. Each row is drawn by taking sequential bits from the corresponding Image Data order, and drawing them in sequential points left-to-right in the horizontal direction. The first row, first Image Data order, starts at the image origin point. Each subsequent row (HEIGHT—1 successive Image Data orders) starts at a point adjacent to the first point of the previous row, in the top-to-bottom direction. The first scan line of the image is oriented parallel to the GPS X_g axis, and subsequent scan lines are generated in the negative Y_g direction.

Architecture Notes:

- 1. The practical limit for the WIDTH parameter range is 2040, which is the maximum number of bits in the Image Data order.
- Some presentation devices support a smaller range than X'0000'-X'FFFF' for the HEIGHT parameter.

Current position is set to the image origin. The current values of the color, mix, and background mix attributes are taken into account when drawing the image.

An image definition must be completely within one segment, that is, the Begin Image, Image Data, and End Image orders that define a particular image *must* all be in one segment. Note that a segment may consist of a new segment followed by one or more appended segments. Together they are treated as one segment, therefore, an image definition may start in a new or appended segment and finish in an appended segment.

Exception Conditions

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The following exception conditions raise a drawing process check:

EC-0002

Explanation: A reserved byte, or bit, in the order is not set to zero.

EC-0003

Explanation: The order has an incorrect length.

EC-D100

Explanation: A Begin Image order has been executed in a segment, and the end of the segment is reached without an End Image order having been executed.

Note: This exception condition is raised when the end of the segment is reached.

EC-D101

Explanation: A Begin Image order has been executed in a segment, and a supported order other than a Comment, No-Operation, Image Data, or End Image order is executed.

Note: This exception condition is raised when the order that is invalid is detected.

EC-D102

Explanation: The value specified for the FORMAT parameter is not supported.

The following exception conditions cause a standard action to be taken:

EC-D103

Explanation: The value specified for the WIDTH parameter is too large to allow the environment to completely present the image.

Standard Action: The width of the image is truncated to allow presentation of the smaller image.

EC-D104

Explanation: The value specified for the HEIGHT parameter is too large to allow the environment to completely present the image.

Standard Action: The height of the image is truncated to allow presentation of the smaller image.

Box (GBOX, GCBOX) Orders

These orders define a box with square or round corners, drawn with its first corner at a given position or at the current position.

| Syntax

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Box at Given Position (GBOX) Order

Offset	Туре	Name	Range	Meaning
0	CODE		X'C0'	GBOX order code.
1	UBIN	LENGTH	10, 12, 14	Length of following data
2	BITS	CONTROL		Draw control flags
Bit 0		RES1	B'0'	Reserved; only valid value
Bit 1		FILL	B'0'	Reserved; only valid value
Bit 2		BOUNDARY	B'1'	Reserved; only valid value
Bits 3–7	-	RES2	B'00000'	Reserved; only valid value
3	3		X'00'	Reserved; only valid value
4–5	SBIN	XPOS0	X'8000'-X'7FFF'	X _g coordinate of first corner
6–7	SBIN	YPOS0	X'8000'-X'7FFF'	Y _g coordinate of first corner
8–9	SBIN	XPOS1	X'8000'-X'7FFF'	X _g coordinate of diagonal corner
10–11	SBIN	YPOS1	X'8000'-X'7FFF'	Y _g coordinate of diagonal corner
The following	The following parameters are optional:			
12–13	UBIN	HAXIS	0–32767	Full length of x-direction axis of ellipse for rounded corner
14–15	UBIN	VAXIS	0–32767	Full length of y-direction axis of ellipse for rounded corner

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Offset	Туре	Name	Range	Meaning	
0	CODE		X'80'	GCBOX order code	
1	UBIN	LENGTH	6, 8, 10	Length of following data	
2	BITS	CONTROL		Draw control flags	
Bit 0		RES1	B'0'	Reserved; only valid value	
Bit 1		FILL	B'0'	Reserved; only valid value	
Bit 2		BOUNDARY	B'1'	Reserved; only valid value	
Bits 3–7		RES2	B'00000'	Reserved; only valid value	
3		RES3	X'00'	Reserved; only valid value	
4–5	SBIN	XPOS1	X'8000'-X'7FFF'	X _g coordinate of diagonal corner	
6–7	SBIN	YPOS1	X'8000'-X'7FFF'	Y _g coordinate of diagonal corner	
The following parameters are optional:					
8–9	UBIN	HAXIS	0–32767	Full length of x-direction axis of ellipse for rounded corner	
10–11	UBIN	VAXIS	0–32767	Full length of y-direction axis of ellipse for rounded corner	

Box at Current Position (GCBOX) Order

Semantics

The Box at Given Position (GBOX) Order defines a rectangular box with square or rounded corners with its first corner specified by the first coordinate pair, and the diagonally-opposite corner specified by the second coordinate pair. The Box at Current Position (GCBOX) Order defines a rectangular box with square or rounded corners with its first corner at the current position, and the diagonally-opposite corner specified by the first coordinate pair. The box is drawn in a counterclockwise direction in GPS. The sides of the rectangle are drawn parallel to the GPS X_a , Y_a axes.

If this drawing order is in an area definition, the box is treated as a closed figure and filled using the pattern set, pattern symbol, pattern color, pattern mix, and pattern background mix attributes that are active for the area. The BOUNDARY parameter in the Begin Area order determines whether the boundary of the box is drawn.

If HAXIS and VAXIS are omitted, or either HAXIS or VAXIS is zero, a rectangular box with square corners is drawn with its first corner at the current position (GCBOX), or at (XPOS0,YPOS0) (GBOX). The diagonally opposite corner is at (XPOS1,YPOS1). If the values of HAXIS and VAXIS are nonzero, and HAXIS is not equal to VAXIS, a similar rectangle is drawn, except that the corners are replaced by quarter ellipses whose *full* axes are HAXIS and VAXIS. IF HAXIS = VAXIS, the corners are quadrants of a circle whose diameter is HAXIS. If VAXIS is omitted, it is assumed to be equal to HAXIS.

Note: HAXIS cannot be omitted without omitting VAXIS as well.

The current values of the line attributes are taken into account when drawing the boundary of the box.

I	Current position is set to (XPOS0, YPOS0) (GBOX) or is unchanged (GCBOX).
Exception	Conditions
I	The following exception conditions raise a drawing process check:
	EC-0003
I	Explanation: The order has an incorrect length.
I	The following exception condition causes a standard action to be taken:
I	EC-C000
	Explanation: The HAXIS or VAXIS parameter is too large to fit the indicated corner into the size of the box.
I	Standard Action: Corners with the largest axis that fit the box are drawn.
I	EC-C001
I	Explanation: Either the HAXIS or VAXIS parameter is outside the range.
I	Standard Action: A box with square corners is drawn.

Character String (GCHST, GCCHST) Orders

These orders draw a character string at a given position or at the current position.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'C3'	GCHST order code
1	UBIN	LENGTH	4–255	Length of following data
2–3	SBIN	XPOS	X'8000'-X'7FFF'	X _g coordinate of character string origin
4–5	SBIN	YPOS	X'8000'-X'7FFF'	Y _g coordinate of character string origin
6— <i>n</i>	CHAR	СР		Code points of each character in the string

Character String at Given Position (GCHST) Order

Character String at Current Position (GCCHST) Order

Offset	Туре	Name	Range	Meaning
0	CODE		X'83'	GCCHST order code
1	UBIN	LENGTH	0–255	Length of following data
2–n	CHAR	СР		Code points of each character in the string

Semantics

The Character String at Given Position (GCHST) order draws a character string that starts at the specified position. The Character String at Current Position (GCCHST) order draws a character string that starts at the current position.

Note: The current position is changed to (XPOS,YPOS) (GCHST), or is unchanged (GCCHST).

If a fully described coded font is being used, the coded font from which the character definitions are to be obtained is given by the value of the current character set attribute. If the coded font identified by the value in the current character set attribute is not available, EC-C300 is raised. The standard action for EC-C300 is to use the standard default character set.

The particular character definitions identified by the current character set are determined by the code points in the Character String order. The length of the code points is determined by the coded font.

All code points in the Character String order must refer to valid graphic characters. If they do not, EC-C301 is raised. The standard action for EC-C301 is to use the standard default character symbol.

The color of the foreground of all characters in the string is given by the current value of the character color attribute.

The way in which characters in the string are merged with any output primitives that have already been drawn is controlled by the values of the character mix and background mix attributes.

The current values of the line type, line width, pattern set, and pattern symbol attributes have no effect on the appearance of the characters in the string. These attributes are set to the standard default values on invocation of the symbols. The current values are remembered and restored at the end of the invocation.

A GCHST order with an initial position (XPOS,YPOS), but with no string of code points, is permitted. This serves only to move the current position.

The Set Character Precision, Set Character Set, Set Character Cell, Set Character Angle, and Set Character Direction drawing orders determine the character size, character rotation, and character direction. For more information, see "Character Strings" on page 38.

Exception Conditions

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The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

The following exception conditions cause a standard action to be taken:

EC-C300

Explanation: The coded font identified by the value in the current character set attribute is not available.

Standard Action: The standard default character set is used. In AFP environments, this is the presentation device default font.

EC-C301

Explanation: A code point in the order does not refer to a valid graphic character.

Standard Action: The standard default character symbol is used.

EC-C302

Explanation: The current character set attribute value identifies a character set definition that cannot support the functions implied by the current character precision attribute.

Standard Action: The character set identified by the current character set is used with the highest value of precision that the character set can support.

Comment (GCOMT) Order

This order enables data to be stored within a segment.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'01'	GCOMT order code
1	UBIN	LENGTH	0–255	Length of following data
2–n	UNDF	DATA	Any value	Comment data

Semantics

This order is treated as a No-Operation. It has no effect on the GPS or on any current attribute or control. The data within the order can be any value and is ignored. The order can appear anywhere within a segment.

Exception Conditions

This order does not raise any exception conditions.

End Area (GEAR) Order

This order indicates the end of a set of primitives that define an area boundary.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'60'	GEAR order code
1	UBIN	LENGTH	0–255	Length of following data
2–n		DATA	X'00'	Reserved; only valid value

Semantics

The End Area order identifies the end of an area.

The bytes of data on this order must all be X'00'. LENGTH is the number of bytes of zeros, and can be zero.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0002

Explanation: A reserved byte, or bit, in the order is not set to zero.

EC-6000

Explanation: An End Area order has been executed without an unmatched Begin Area order having previously been executed.

End Image (GEIMG) Order

This order identifies the end of an image definition.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'93'	GEIMG order code
1	UBIN	LENGTH	0–255	Length of following data
2–n		DATA	X'00'	Reserved; only valid value

Semantics

The End Image order identifies the end of an image. The bytes of data on this order must all be X'00'. LENGTH is the number of bytes of zeros, and can be zero.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0002

Explanation: A reserved byte, or bit, in the order is not set to zero.

EC-9300

Explanation: An End Image order is executed without an unmatched Begin Image order having been executed previously.

EC-9301

Explanation: The number of Image Data orders between the Begin Image and End Image orders is not equal to the number of rows in the image, as given by the value of HEIGHT in the Begin Image order.

End Prolog (GEPROL) Order

This order indicates the end of the prolog of a segment.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'3E'	GEPROL order code
1		RES	X'00'	Reserved; only valid value

Semantics

The End Prolog order indicates the end of the prolog section of a segment.

See "Segment Prolog" on page 48 for details of the processing of segment prologs.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0002

Explanation: A reserved byte, or bit, in the order is not set to zero.

EC-000C

Explanation: One of the following conditions has occurred within the prolog section of a segment:

- · A supported order that is not valid within a prolog is specified
- The end of the segment has been reached without an End Prolog order.

EC-3E00

Explanation: An End Prolog order has occurred outside the prolog section of a segment.

Fillet (GFLT, GCFLT) Orders

These orders draw a curved line tangential to a specified set of straight lines, at the given position or at the current position.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'C5'	GFLT order code
1	UBIN	LENGTH	4–n	Length of following data. <i>n</i> must be non-zero, less than 255 and a multiple of 4.
2–3	SBIN	XPOS0	X'8000'-X'7FFF'	X _g coordinate of first line start point
4–5	SBIN	YPOS0	X'8000'-X'7FFF'	Y _g coordinate of first line start point
6–7	SBIN	XPOS1	X'8000'-X'7FFF'	X _g coordinate of first line endpoint
8–9	SBIN	YPOS1	X'8000'-X'7FFF'	Y _g coordinate of first line endpoint
10–11	SBIN	XPOS2	X'8000'-X'7FFF'	X _g coordinate of second line endpoint
12–13	SBIN	YPOS2	X'8000'-X'7FFF'	Y _g coordinate of second line endpoint
:		:		Coordinate data of further line endpoints
	SBIN	XPOSF	X'8000'-X'7FFF'	X _g coordinate of final line endpoint
	SBIN	YPOSF	X'8000'-X'7FFF'	Y _g coordinate of final line endpoint

Fillet at Given Position (GFLT) Order

Fillet at Current Position (GCFLT) Order

Offset	Туре	Name	Range	Meaning
0	CODE		X'85'	GCFLT order code
1	UBIN	LENGTH	0– <i>n</i>	Length of following data. <i>n</i> must be less than 255 and a multiple of 4.
2–3	SBIN	XPOS1	X'8000'-X'7FFF'	X _g coordinate of first line endpoint
4–5	SBIN	YPOS1	X'8000'-X'7FFF'	Y _g coordinate of first line endpoint
6–7	SBIN	XPOS2	X'8000'-X'7FFF'	X _g coordinate of second line endpoint
8–9	SBIN	YPOS2	X'8000'-X'7FFF'	Y _g coordinate of second line endpoint
:		:		Coordinate data of further line endpoints
	SBIN	XPOSF	X'8000'-X'7FFF'	X _g coordinate of final line endpoint
	SBIN	YPOSF	X'8000'-X'7FFF'	Y _g coordinate of final line endpoint

Semantics

The Fillet at Given Position (GFLT) order generates a single curve that starts at a specified position. The Fillet at Current Position (GCFLT) order generates a single curve that starts at the current position. Additional points can be added to form a polycurve.

The points specified in the order are joined by imaginary straight lines and a curve is then fitted to the lines. The curve is tangential to the first line at its start point and to the last line at its end point. If there are intermediate lines, the curve is tangential to these lines at their center points. See "Fillet" on page 30 for the definition of the curves drawn.

A Fillet at Given Position (GFLT) order with only an initial position is permitted. This serves only to move the current position.

When only two points are supplied, a straight line results.

The current values of the line attribute are taken into account when drawing the fillet; and the current position is set to the last point specified.

Exception Conditions

The following exception condition raises a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

Full Arc (GFARC, GCFARC) Orders

These orders construct a full circle or an ellipse with the center at a specified point or at the current position.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'C7'	GFARC order code
1	UBIN	LENGTH	6	Length of following data
2–3	SBIN	XPOS	X'8000'-X'7FFF'	$\rm X_g$ coordinate of the center of the circle or ellipse
4–5	SBIN	YPOS	X'8000'-X'7FFF'	${\rm Y}_{\rm g}$ coordinate of the center of the circle or ellipse
6	UBIN	МН	X'00'-X'FF'	Integer Portion of Multiplier
7	UBIN	MFR	X'00'-X'FF'	Fractional Portion of Multiplier

Full Arc at Given Position (GFARC) Order

Full Arc at Current Position (GCFARC) Order

Offset	Туре	Name	Range	Meaning
0	CODE		X'87'	GCFARC order code
1	UBIN	LENGTH	2	Length of following data
2	UBIN	MH	X'00'-X'FF'	Integer Portion of Multiplier
3	UBIN	MFR	X'00'-X'FF'	Fractional Portion of Multiplier

Semantics

The Full Arc at Given Position (GFARC) order constructs a circle or an ellipse with its center at the specified position. The Full Arc at Current Position (GCFARC) order constructs a circle or an ellipse with its center at the current position. A previous Set Arc Parameters drawing order determines the shape and orientation of the arc. If no Set Arc Parameters drawing order has been received, the presentation process draws an arc using the default values of the arc parameters. The arc is drawn in a counterclockwise direction in GPS. See "Full Arc" on page 28 for the definition of the curve drawn.

Note: The current position is set to (XPOS,YPOS) (GFARC), or is unchanged (GCFARC).

The current values of the line attributes are taken into account when drawing the full arc.

If this drawing order is in an area definition, the arc is treated as a closed figure and filled using the pattern set, pattern symbol, pattern color, and pattern mix attributes that are active for the area. The BOUNDARY parameter in the Begin Area order determines whether the boundary of the arc is drawn. MH specifies the integer portion of a scale factor; MFR specifies the fractional portion of the scale factor. A decimal point is implied between MH and MFR. The fractional portion of the scale factor is calculated by dividing MFR by 256. For example, if MFR=X'40', its decimal value is 64, which, divided by 256 results in a fractional component for the scale factor of 1/4.

For a circle, the radius is $(MH \cdot R + MFR \cdot R)$ where R is the radius of the circle defined by the current arc parameters.

For an ellipse, the major and minor axes are $(MH \cdot MAJ + MFR \cdot MAJ)$ and $(MH \cdot MIN + MFR \cdot MIN)$, where MAJ and MIN are the major and minor axes of the ellipse defined by the current arc parameters.

Exception Conditions

The following exception condition raises a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

The following exception condition causes a standard action to be taken:

EC-C601

Explanation: The drawing processor has detected an exceptional condition that can prevent the drawing of the arc within the normal limits of pel accuracy.

Standard Action: The arc is drawn as accurately as the implementation can define. This action might produce straight lines.

Image Data (GIMD) Order

This order specifies the raster data for one scan line or row of an image.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'92'	GIMD order code
1	UBIN	LENGTH	0–255	Length of following data
2–n	BITS	DATA	Any value	Image Data

Semantics

The Image Data order contains the data for one scan line or row of an image. Each Image Data order can contain any number of bytes of data, from zero, up to a maximum of 255 bytes.

The current position is not changed by the order.

If the LENGTH parameter is not equal to the rounded-up quotient of image WIDTH divided by 8, there are too few or too many data bytes, and exception EC-9201 exists.

See "Begin Image (GBIMG, GCBIMG) Orders" on page 67 for details of the image construct.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-9200

Explanation: A Begin Image order was not executed before the Image Data order in this segment.

EC-9201

Explanation: There are insufficient, or too many, bytes of data in the Image Data order.

EC-9301

Explanation: The number of Image Data orders between the Begin Image and End Image orders is not equal to the number of rows in the image, as specified by the HEIGHT parameter in the Begin Image Order.

Line (GLINE, GCLINE) Orders

These orders define one or more connected straight lines, drawn from the given position or from the current position.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'C1'	GLINE order code
1	UBIN	LENGTH	4-n	Length of following data. <i>n</i> must be non-zero, less than 255, and a multiple of 4.
2–3	SBIN	XPOS0	X'8000'-X'7FFF'	X _g coordinate of first line start point
4–5	SBIN	YPOS0	X'8000'-X'7FFF'	Y _g coordinate of first line start point
6–7	SBIN	XPOS1	X'8000'-X'7FFF'	X _g coordinate of first line endpoint
8–9	SBIN	YPOS1	X'8000'-X'7FFF'	Y _g coordinate of first line endpoint
10–11	SBIN	XPOS2	X'8000'-X'7FFF'	X _g coordinate of second line endpoint
12–13	SBIN	YPOS2	X'8000'-X'7FFF'	Y _g coordinate of second line endpoint
:		:		Coordinate data of further line endpoints
	SBIN	XPOSF	X'8000'-X'7FFF'	X _g coordinate of final line endpoint
	SBIN	YPOSF	X'8000'-X'7FFF'	Y _g coordinate of final line endpoint

Line at Given Position (GLINE) Order

Line at Current Position (GCLINE) Order

Offset	Туре	Name	Range	Meaning
0	CODE		X'81'	GCLINE order code.
1	UBIN	LENGTH	0– <i>n</i>	Length of following data. <i>n</i> must be less than 255 and a multiple of 4.
2–3	SBIN	XPOS1	X'8000'-X'7FFF'	X _g coordinate of first line endpoint
4–5	SBIN	YPOS1	X'8000'-X'7FFF'	Y _g coordinate of first line endpoint
6–7	SBIN	XPOS2	X'8000'-X'7FFF'	X _g coordinate of second line endpoint
8–9	SBIN	YPOS2	X'8000'-X'7FFF'	Y _g coordinate of second line endpoint
		:		Coordinate data of further line endpoints
	SBIN	XPOSF	X'8000'-X'7FFF'	X _g coordinate of final line endpoint
	SBIN	YPOSF	X'8000'-X'7FFF'	Y _g coordinate of final line endpoint

Semantics

The Line at Given Position (GLINE) order draws a line from the point specified by the first pair of coordinates to the point specified by the second pair of coordinates. If additional coordinate pairs are specified, the presentation process draws a line from the previous end point to the next coordinate pair. The Line at Current Position (GCLINE) order draws a line from the current position to the point specified

by the first coordinate pair. If additional coordinate pairs are specified, the presentation process draws a line from the previous end point to the next coordinate pair. Consecutive points in the orders are joined by straight lines.

The current values of the color, mix, line type and line width attributes are taken into account when drawing the line.

The current position is set to the last point specified.

A Line at Given Position (GLINE) order with only an initial position is permitted. This form of GLINE moves the current position.

Exception Conditions

The following exception condition raises a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

Marker (GMRK,GCMRK) Orders

These orders draw the current marker symbol at one or more positions starting from the given position or from the current position.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'C2'	GMRK order code
1	UBIN	LENGTH	4–n	Length of following data. <i>n</i> must be non-zero, less than 255, and a multiple of 4.
2–3	SBIN	XPOS0	X'8000'-X'7FFF'	X _g coordinate of first marker
4–5	SBIN	YPOS0	X'8000'-X'7FFF'	Y _g coordinate of first marker
6–7	SBIN	XPOS1	X'8000'-X'7FFF'	X _g coordinate of second marker
8–9	SBIN	YPOS1	X'8000'-X'7FFF'	Yg coordinate of second marker
:		:		Coordinate data of further markers
	SBIN	XPOSF	X'8000'-X'7FFF'	X _g coordinate of final marker
	SBIN	YPOSF	X'8000'-X'7FFF'	Yg coordinate of final marker

Marker at Given Position (GMRK) Order

Marker at Current Position (GCMRK) Order

Offset	Туре	Name	Range	Meaning
0	CODE		X'82'	GCMRK order code
1	UBIN	LENGTH	0– <i>n</i>	Length of following data. <i>n</i> must be less than 255 and a multiple of 4.
2–3	SBIN	XPOS1	X'8000'-X'7FFF'	X _g coordinate of second marker
4–5	SBIN	YPOS1	X'8000'-X'7FFF'	Y _g coordinate of second marker
÷		:		Coordinate data of further markers
	SBIN	XPOSF	X'8000'-X'7FFF'	X _g coordinate of final marker
	SBIN	YPOSF	X'8000'-X'7FFF'	Y _g coordinate of final marker

Semantics

The Marker at Given Position (GMRK) order draws an initial marker symbol at the point specified by the first coordinate pair, and draws additional marker symbols at all the points specified by the remaining coordinate pairs. The Marker at Current Position (GCMRK) order draws an initial marker symbol at the current position and draws additional marker symbols at all the points specified by the remaining coordinate pairs.

Markers are positioned in GPS. The specified points define the position of the center of the marker. The current position is set to the last coordinate specified. If no coordinate has been specified, the current position remains unchanged.

A Marker at Current Position (GCMRK) order with no coordinate values specified, that is, the value of LENGTH is zero, draws a marker at the current position.

The marker set from which the marker symbol is obtained is given by the value of the marker set attribute. If this marker set is not available, EC-C200 is raised, the standard action for which is to use the standard default marker set. In AFP environments, this is the default marker set.

The particular marker symbol that is drawn is given by the value of the current marker symbol attribute. If the code point is undefined in the marker set identified by the current marker set attribute, EC-C201 is raised, the standard action for which is to use the the standard default marker symbol. In AFP environments this is X'01'—Cross.

The color of the markers is given by the value of the current marker color. The way in which the markers are merged with any output primitives that have already been drawn is controlled by the values of the marker mix and background mix attributes.

Note: It is not an error if a marker symbol is placed inside the GPS, such that part of the marker lies outside the GPS. However, the appearance of such a marker in the GPS is implementation-defined.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

The following exception conditions cause a standard action to be taken:

EC-C200

Explanation: The marker set identified by the value in the current marker set attribute is not available.

Standard Action: The standard default marker set is used. In AFP environments, this is the default marker set.

EC-C201

Explanation: The code point in the current marker symbol attribute is not defined in the current marker set.

Standard Action: The standard default marker symbol is used. In AFP environments this is X'01'—Cross.

EC-C202

Explanation: The current marker set attribute value identifies a symbol set definition that cannot support the functions implied by the current marker precision attribute.

Standard Action: The symbol set identified by the current Marker Set attribute value is used with the lowest value of precision that the symbol set can support.

No-Operation (GNOP1) Order

This order is a No-Operation.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'00'	GNOP1 order code

Semantics

The No-Operation order is a null operation. It has no effect on the GPS, or any current attribute or control.

Exception Conditions

This order does not raise any exception conditions.

Partial Arc (GPARC, GCPARC) Orders

These orders draw a line from the given position or the current position to the start of an arc, and then construct a partial arc. The start point of the arc is specified by the start angle; and the length of the arc is specified by the sweep angle.

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Partial Arc at Given Position (GPARC) Order

Offset	Туре	Name	Range	Meaning
0	CODE		X'E3'	GPARC order code
1	UBIN	LENGTH	18	Length of following data
2–3	SBIN	XPOS	X'8000'-X'7FFF'	X _g coordinate of line start point
4–5	SBIN	YPOS	X'8000'-X'7FFF'	Y _g coordinate of line start point
6–7	SBIN	XCENT	X'8000'-X'7FFF'	X_g coordinate of the center of the arc
8–9	SBIN	YCENT	X'8000'-X'7FFF'	Y_g coordinate of the center of the arc
10	UBIN	МН	X'00'-X'FF'	Integer Portion of Multiplier
11	UBIN	MFR	X'00'-X'FF'	Fractional Portion of Multiplier
12–15	SBIN	STRTANG	X'00000000'- X'7FFFFFF'	Start angle of arc, modulo 360
16–19	SBIN	SWPANG	X'00000000'- X'7FFFFFF'	Sweep angle of arc, modulo 360

Partial Arc at Current Position (GCPARC) Order

Ι	Offset	Туре	Name	Range	Meaning
I	0	CODE		X'A3'	GCPARC order code
Ι	1	UBIN	LENGTH	14	Length of following data
Ι	2–3	SBIN	XCENT	X'8000'-X'7FFF'	X_g coordinate of the center of the arc
I	4–5	SBIN	YCENT	X'8000'-X'7FFF'	${\rm Y_g}$ coordinate of the center of the arc
I	6	UBIN	МН	X'00'-X'FF'	Integer Portion of Multiplier
Ι	7	UBIN	MFR	X'00'-X'FF'	Fractional Portion of Multiplier
 	8–11	SBIN	STRTANG	X'00000000'- X'7FFFFFF'	Start angle of arc, modulo 360
 	12–15	SBIN	SWPANG	X'0000000'- X'7FFFFFF'	Sweep angle of arc, modulo 360
Semantics

The Partial Arc at Given Position (GPARC) Order draws a line from point (XPOS,YPOS) to the start of an arc, then draws the arc with its center at point (XCENT,YCENT). The Partial Arc at Current Position (GCPARC) Order draws a line from the current position to the start of an arc, then draws the arc with its center at point (XCENT,YCENT). The arc is part of the full arc defined by the current arc parameters and the multiplier M. The part of the arc that is drawn is defined by the starting angle, START, and the sweep angle, SWEEP. Both angles are defined on the unit circle space and are transformed by an amount defined by the current arc parameters in the same way that the unit circle is transformed. See "Partial Arc" on page 29 for details.

A previous Set Arc Parameters drawing order determines the shape and orientation of the arc. If no Set Arc Parameters drawing order has been received, the presentation process draws an arc using the standard default values of the arc parameters.

MH specifies the integer portion of a scale factor; MFR specifies the fractional portion of the scale factor. A decimal point is implied between MH and MFR. The fractional portion of the scale factor is calculated by dividing MFR by 256. For example, if MFR=X'40', its decimal value is 64, which, divided by 256 results in a fractional component for the scale factor of 1/4.

For a circle, the radius is $(MH \cdot R + MFR \cdot R)$ where R is the radius of the circle defined by the current arc parameters.

For an ellipse, the major and minor axes are $(MH \cdot MAJ + MFR \cdot MAJ)$ and $(MH \cdot MIN + MFR \cdot MIN)$, where MAJ and MIN are the major and minor axes of the ellipse defined by the current arc parameters.

The START and SWEEP parameters are defined as signed 32-bit integers, whose range is restricted to positive values, that is, X'0000000' to X'7FFFFFFF'. The START and SWEEP angles are the numbers, in degrees, that result from dividing the integers by 65536 (2¹⁶) and interpreting the result as a modulo 360 number. The effective range of the angles is therefore greater than or equal to 0° and less than 360°. For example, if the sweep angle is specified to be X'00007FFF', its value is 32767÷65536 modulo 360 = .5°.

The current values of the line attributes are taken into account when drawing the partial arc.

The current position is moved to the end-point of the arc.

Exception Conditions

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| | The following exception condition raises a drawing process check:

EC-0003

Explanation: The order has incorrect length.

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EC-E300

Explanation: The partial arc started inside GPS but then finished outside. Therefore, the calculated new current position is outside GPS.

EC-E302

Explanation: A negative value is specified for the SWEEP angle.

EC-E303

Explanation: A negative value is specified for the START angle.

The following exception conditions cause a standard action to be taken:

EC-000D

Explanation: The start and end points of a partial arc are inside GPS, but a portion of the arc is outside GPS.

Standard Action: All drawing outside the GPS is suppressed. The portion of the arc that is inside the GPS is drawn.

EC-C601

Explanation: The drawing processor has detected an exceptional condition that can prevent the drawing of the arc within the normal limits of pel accuracy.

Standard Action: The arc is drawn as accurately as the implementation can define. This action might produce straight lines.

Relative Line (GRLINE, GCRLINE) Orders

These orders define one or more connected straight lines, at the given position or at the current position. For these drawing orders, the endpoint of each line is specified as an offset from the previous endpoint rather than as an absolute value.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'E1'	GRLINE order code	
1	UBIN	LENGTH	4–n	Length of following data. <i>n</i> must be less than 255 and a multiple of 2.	
2–3	SBIN	XPOS0	X'8000'-X'7FFF'	X _g coordinate of line start point	
4–5	SBIN	YPOS0	X'8000'-X'7FFF'	Y _g coordinate of line start point	
6	SBIN	XOFFS0	X'80'-X'7F'	Offset in X _g direction for first endpoint	
7	SBIN	YOFFS0	X'80'-X'7F'	Offset in Y _g direction for first endpoint	
8	SBIN	XOFFS1	X'80'-X'7F'	Offset in X _g direction for second endpoint	
9	SBIN	YOFFS1	X'80'-X'7F'	Offset in Y_g direction for second endpoint	
:		:		Offset data for further points	
	SBIN	XOFFSF	X'80'-X'7F'	Offset in X _g direction for final endpoint	
	SBIN	YOFFSF	X'80'–X'7F'	Offset in Y _g direction for final endpoint	

Relative Line at Given Position (GRLINE) Order

Relative Line at Current Position (GCRLINE) Order

Offset	Туре	Name	Range	Meaning	
0	CODE		X'A1'	GCRLINE order code	
1	UBIN	LENGTH	0– <i>n</i>	Length of following data. <i>n</i> must be less than 255 and a multiple of 2.	
2	SBIN	XOFFS0	X'80'-X'7F'	Offset in X _g direction for first endpoint	
3	SBIN	YOFFS0	X'80'-X'7F'	Offset in Y_g direction for first endpoint	
4	SBIN	XOFFS1	X'80'-X'7F'	Offset in X_g direction for second endpoint	
5	SBIN	YOFFS1	X'80'-X'7F'	Offset in Y_g direction for second endpoint	
÷		:		Offset data for further points	
	SBIN	XOFFSF	X'80'-X'7F'	Offset in X _g direction for final endpoint	
	SBIN	YOFFSF	X'80'-X'7F'	Offset in Y _g direction for final endpoint	

Semantics

The Relative Line at Given Position (GRLINE) order adds the offset of each line endpoint cumulatively to the line start point (specified by XPOS, YPOS) to generate a sequence of points P_1 , P_2 , ... P_f , where P_f is the final endpoint specified. The Relative Line at Current Position (GCRLINE) order adds to the offset of each line endpoint cumulatively to the current position to generate a sequence of points P_1 , P_2 , ... P_f , where P_f is the final endpoint P_1 , P_2 , ... P_f , where P_f is the final endpoint cumulatively to the current position to generate a sequence of points P_1 , P_2 , ... P_f , where P_f is the final endpoint specified.

Straight lines are drawn connecting the points in sequence, that is, from the starting point to P_1 , from P_1 to P_2 , ..., and from $P_{(f-1)}$ to P_f .

Any number of offsets can be included within the limits of the length specifications.

A Relative Line at Given Position (GRLINE) order with only an initial position is permitted. This serves only to move the current position, which is set to the specified point.

A relative line that starts inside GPS, but has values of offset specified that accumulate to be outside GPS, is an error.

The current values of color, mix, line type, and line width are taken into account when drawing the relative lines.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

EC-E100

Explanation: A relative line starts inside GPS, but goes outside.

Segment Characteristics (GSGCH) Order

This order is processed as a No-Op in AFP GOCA. It is valid only in the prolog of a segment.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'04'	GSGCH order code	
1	UBIN	LENGTH	0–255	Length of following data	
2	CODE	CHID	X'00'	Identification code for characteristics	
3–n	UNDF	PARMS		Parameters of characteristics	

Semantics

Not applicable in AFP GOCA.

Exception Conditions

The following exception condition may optionally raise a drawing process check:

EC-0400

Explanation: The Segment Characteristics order is detected outside the prolog section of a segment.

Set Arc Parameters (GSAP) Order

This order sets the values of the current arc parameters.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'22'	GSAP order code	
1	UBIN	LENGTH	8	Length of following data	
2–3	SBIN	XMAJ	X'8000'-X'7FFF'	X _g coordinate of major axis end point	
4–5	SBIN	YMIN	X'8000'-X'7FFF'	Y _g coordinate of minor axis end point	
6–7	SBIN	XMIN	X'8000'-X'7FFF'	X _g coordinate of minor axis end point	
8–9	SBIN	YMAJ	X'8000'-X'7FFF'	Y _g coordinate of major axis end point	

Semantics

The Set Arc Parameters order specifies the shape and orientation of a circle or an ellipse. Subsequent Full Arc orders specify the size and location of the circle or ellipse. For details, see "Full Arc" on page 28.

The parameters XMAJ, YMAJ, XMIN, YMIN define a transformation that maps the unit circle at the GPS origin ($X_g=0,Y_g=0$) to the required circle or ellipse, also at the GPS origin, such that:

 $X' = XMAJ \cdot X + XMIN \cdot Y$ $Y' = YMAJ \cdot X + YMIN \cdot Y$

where X and Y are the coordinates of points on the unit circle, and X'and Y' are the coordinates of points on the arc. The arc is drawn in a counterclockwise direction.

More simply, the parameters XMAJ, YMAJ, XMIN, and YMIN specify the coordinates of the endpoints of the major and minor axes, respectively, of the ellipse.

For a circle of radius *r* the parameters are:

XMAJ=r YMIN=r XMIN=0 YMAJ=0

For an ellipse with major axis 2a and minor axis 2b the parameters are:

XMAJ=a YMIN=b XMIN=0 YMAJ=0

For the same ellipse, but rotated A degrees counterclockwise with respect to the X_g axis the parameters are:

 $XMAJ=a \cdot \cos(A)$ $YMIN=b \cdot \cos(A)$ $XMIN=-b \cdot \sin(A)$ $YMAJ=a \cdot \sin(A)$

This drawing order does not change the current graphics position.

Exception Conditions

The following exception conditions raise a drawing process check:

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EC-0003
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Explanation: The order has an incorrect length.

Set Background Mix (GSBMX) Order

The Background Mix order provides a shorthand way of setting the following background mix attributes to the same value:

- Character background mix
- Image background mix
- Marker background mix
- · Pattern background mix

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'0D'	GSBMX order code	
1	CODE	MODE	X'00'-X'05'	Mix-mode value:	
				X'00' Drawing default X'01'-X'04' Not supported in AFP GOCA X'05' Leave Alone All other values Reserved	

Semantics

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The Set Background Mix order sets the current value of all four background mix attributes to the value specified in the order.

The standard default in AFP environments is X'05'—Leave alone.

Background mix attributes control the way in which the color of the background of a primitive is combined with the color of the GPS.

With MODE set to X'05', the background pels are transparent and do not affect the color of underlying pels in the GPS. Since this is the only background mix mode supported in AFP GOCA, selecting the drawing default (MODE X'00') will also default to MODE X'05'.

For a description of the meaning of the various mix modes, see "Mix" on page 19.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'05'—Leave alone.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'05'—Leave alone.

Set Character Angle (GSCA) Order

This order sets the value of the current character angle attribute.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'34'	GSCA order code	
1	UBIN	LENGTH	4	Length of following data	
2–3	SBIN	XPOS	X'8000'-X'7FFF'	X _g coordinate of point	
4–5	SBIN	YPOS	X'8000'-X'7FFF'	Y _g coordinate of point	

Semantics

The Set Character Angle order sets the value of the current character angle attribute to the value specified in the order.

The character angle attribute controls the angle of the character baseline with respect to the GPS X_g axis for subsequent character strings. This angle is specified using the values XPOS, YPOS, where the character baseline is a line parallel to the line that passes through the points (X_g =0, Y_g =0) and (X_g =XPOS, Y_g =YPOS). The angle of the baseline relative to the X_g -axis of GPS is then the angle whose tangent is YPOS/XPOS. The values of YPOS and XPOS are not required to be the sine and cosine of the angle.

- If YPOS is zero, and XPOS is positive, the character angle is 0°.
- If XPOS is zero, and YPOS is positive, the character angle is 90°.
- If YPOS is zero, and XPOS is negative, the character angle is 180°.
- If XPOS is zero, and YPOS is negative, the character angle is 270°.

In AFP GOCA, the only supported values for character angle are 0°, 90°, 180°, and 270°. If XPOS is zero and YPOS is zero, the character angle is set to the drawing default. If none is specified, it is set to the standard default, which in AFP environments is 0°.

The application of this attribute is dependent on the value of the character precision attribute; see "Character Strings" on page 38 for details. This drawing order does not change the attributes of any other drawing order.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

The following exception condition causes a standard action to be taken:

EC-3400

Explanation: The specific character angle requested is not supported.

Standard Action: The closest character angle supported is used.

Set Character Cell (GSCC) Order

This order sets the value of the current character cell-size attribute.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'33'	GSCC order code	
1	UBIN	LENGTH	4, 8	Length of following data	
2–3	SBIN	CELLWI	X'8000'-X'7FFF'	Width of character cell, integer part	
4–5	SBIN	CELLHI	X'8000'-X'7FFF'	Height of character cell, integer part	
The following parameters are optional:					
6–7	UBIN	CELLWFR	X'0000'-X'FFFF'	Width of character cell, fractional part	
8–9	UBIN	CELLHFR	X'0000'-X'FFFF'	Height of character cell, fractional part	

Semantics

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The Set Character Cell order sets the value of the current character cell-size attribute to the value specified in the order. Depending on the device implementation of the specified precision, this attribute is used to scale characters specified in subsequent character-string drawing orders. Devices that use the font positioning method ignore the character cell.

The application of this attribute is dependent on the value of the character precision attribute. See "Character Strings" on page 38 for details.

Two formats exist for this drawing order:

- Four-byte format
 - CELLWI specifies the width of the character cell in drawing units.
 - CELLHI specifies the height of the character cell in drawing units.
- Eight-byte format

In this format, both integer and fractional values are specified for the character cell width and height. The width and width-fraction fields form a 4-byte signed value, and the height and height-fraction fields form a 4-byte signed value. A decimal point is implied between the integer part and the fractional part of each parameter.

- CELLWI specifies the width of the character cell in drawing units.
- CELLWFR specifies the fractional part of the width of the character cell in drawing units.
- CELLHI specifies the height of the character cell in drawing units.
- CELLHFR specifies the fractional part of the height of the character cell in drawing units.

The fractional parts do not exist in the drawing defaults and are set to zero when the drawing default is set into the current attribute. This drawing order does not change the current graphics position. Note that, for precisions 1 and 2 for some implementations, if the character cell size is specified as negative values, a mirror image of the character is generated. That is, if the cell width is negative, the character is mirrored about the Y-axis, and if the cell height is negative, the character is mirrored about the X-axis. Refer to "Character Strings" on page 38 for a description of how the character cell is used on various AFP devices.

Exception Conditions

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The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

Set Character Direction (GSCD) Order

This order sets the value of the current character direction attribute.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'3A'	GSCD order code	
1	CODE	DIRECTION	X'00'-X'04'	Value for character direction:	
				X'00'Drawing defaultX'01'Left to rightX'02'Top to bottomX'03'Right to leftX'04'Bottom to topAll other values Reserved	

Semantics

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The Set Character Direction order sets the value of the current character direction attribute to the value specified in the order.

The character direction attribute controls the placement of the first character in the string and each succeeding character relative to the previous character.

Value Description

- **X'00'** *Drawing Default.* The standard default in AFP environments is left to right (X'01').
- X'01' Left to right. Characters are positioned so that, at a 0° character angle, the character reference point, which is point R in Figure 13 on page 39, is coincident with the current graphics position. A vector is then drawn from the left edge of the character box to the right edge, and successive characters are placed in the direction of this vector.
- **X'02'** *Top to bottom.* Characters are positioned so that, at a 0° character angle, the character reference point, which is point T in Figure 13 on page 39, is coincident with the current graphics position. A vector is then drawn from the top edge of the character box to the bottom edge, and successive characters are placed in the direction of this vector.
- X'03' *Right to left.* Characters are positioned so that, at a 0° character angle, the character reference point, which is point E in Figure 13 on page 39, is coincident with the current graphics position. A vector is then drawn from the right edge of the character box to the left edge, and successive characters are placed in the direction of this vector.
- X'04' Bottom to top. Characters are positioned so that, at a 0° character angle, the character reference point, which is point B in Figure 13 on page 39, is coincident with the current graphics position. A vector is then drawn from the bottom edge of the character box to the top edge, and successive characters are placed in the direction of this vector.

Architecture Note: This graphics drawing order defines a function that is analogous to part of the text orientation function in presentation text, which defines an *inline* direction and the development of characters along this direction.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'01'—Left to right.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'01'—Left to right.

Set Character Precision (GSCR) Order

This order sets the value of the current character precision attribute.

Syntax

ODE				
		X'39'	GSCR order code	
ODE F	PREC	X'00'-X'03'	Value for character-precision attribute:	
			X'00'Drawing defaultX'01'String precisionX'02'Character precisionX'03'Stroke precision (not supported in AFP GOCA)All other values	
:0	'DE	DE PREC	DE PREC X'00'-X'03'	

Semantics

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The Set Character Precision order sets the value of the current character precision attribute to the value specified in the order. The character precision attribute controls the type of character that is to be used for drawing character strings. Refer to "Character Strings" on page 38 for a description of how character precision is defined.

Value Description

- X'00' Drawing Default. This value sets the current character precision attribute to the value of the drawing default. The standard default in AFP environments is precision X'02'.
- X'01' Precision 1—Device-Specific (String) Precision. This precision has been implemented differently on different devices; it is not consistent among implementations. The characters are drawn using the quickest, simplest mode possible for the implementation. In this mode, the only parameters that *must* be considered when the characters are drawn are the character code point, character set, and character direction parameters. The character angle and character cell-size parameters are not guaranteed to have any effect on the appearance of characters in the string.
- X'02' Precision 2—Device-Specific (Character) Precision. This precision has been implemented differently on different devices; it is not consistent among implementations. The character string is drawn taking into account all the attributes to determine the positioning of the characters. The character attributes are not guaranteed to affect the appearance of the characters in the string.
- X'03' *Precision 3—Stroke Precision.* This value is not supported in AFP GOCA. If it is specified, exception EC-000E exists.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'02'—character precision.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'02'—character precision.

Set Character Set (GSCS) Order

This order sets the value of the current character-set attribute.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'38'	GSCS order code	
1	CODE	LCID	X'00'-X'FF'	Local identifier (LCID) for the character set:	
				X'00' Drawing default X'01'-X'FE'	
				Local identifier for the character set X'FF' Special character set	

Semantics

The Set Character Set order sets the value of the current character set attribute to the value specified in the order.

When the current character set attribute is X'00', it identifies the drawing default, that is, the default from the GDD, or if not specified, the standard default character set. In AFP environments, this is the presentation device default font.

When the current character set attribute is X'01' to X'FE', it identifies the character set that is to be used to draw characters in subsequent Character String orders. The controlling environment maps the LCID to a specific font.

When the current character set attribute is X'FF', it identifies the special character set, which is implementation-defined.

Architecture Note: In AFP environments, the special character set is the presentation device default font.

Character definitions from the character set identified by the current character set attribute are modified under control of the current character precision attribute before being drawn.

Architecture Note: In MO:DCA and IPDS environments, the MO:DCA character rotation (IPDS font inline sequence) associated with the font is ignored when determining character direction and angle. However, when the font positioning method is used, the selected character direction should match the selected character rotation (font inline sequence) so that appropriate font metrics, such as character increment and A-space, are available. If a font with the required character rotation is not available to the presentation device, the spacing and positioning of characters is unpredictable.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-C300

Explanation: The coded font identified by the value in the current character set attribute is not available.

Standard Action: The standard default character set is used. In AFP environments, this is the presentation device default font.

Set Character Shear (GSCH) Order

This order sets the value of the current character shear attribute. This order is processed as a No-Op in AFP GOCA.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'35'	GSCH order code	
1	UBIN	LENGTH	4	Length of following data	
2–3	SBIN	НХ	X'8000'-X'7FFF'	Dividend of shear ratio	
4–5	SBIN	HY	X'8000'-X'7FFF'	Divisor of shear ratio	

Semantics

Not applicable in AFP GOCA.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

Set Color (GSCOL) Order

The Set Color order provides a shorthand way of setting the following foreground color attributes to the same value:

- Character color
- Image color
- Line color
- Marker color
- Pattern color

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'0A'	GSCOL	order code
1	CODE	COL	X'00'-X'08'	Value for	color attribute:
				X'00' X'01' X'02' X'03' X'04' X'05' X'06'	Drawing default Blue Red Magenta (Pink) Green Cyan (Turquoise) Yellow
				X'07'Presentation-process defaultX'08'Color of mediumAll other values	
					Not valid

Semantics

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The Set Color order sets the current value of all five color attributes to the value specified in the order. Color attributes control the color of the foreground of the output primitives as they are drawn.

The standard default in AFP environments is the presentation device default color.

The color value specified by this order is prefixed with X'FF' to generate a two-byte color index value into the standard color table. See "Color" on page 17.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The action is environment-dependent.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The action is environment-dependent.

Architecture Note: If colors are simulated in AFP environments, color exceptions need not be generated.

Set Current Position (GSCP) Order

This order sets the value of the current position in the Graphics Presentation Space (GPS).

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'21'	GSCP order code
1	UBIN	LENGTH	4	Length of following data
2–3	SBIN	XPOS	X'8000'-X'7FFF'	X _g coordinate of point
4–5	SBIN	YPOS	X'8000'-X'7FFF'	Y _g coordinate of point

Semantics

The Set Current Position order sets the value of current position to the value specified in the order.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

Set Extended Color (GSECOL) Order

The Set Extended Color order provides a shorthand way of setting the following foreground color attributes to the same value:

- Character color
- Image color
- Line color
- Marker color
- Pattern color.

Syntax

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Offset	Туре	Name	Range	Meaning
0	CODE		X'26'	GSCECOL order code
1	UBIN	LENGTH	2	Length of following data
2–3	CODE	COLOR	See Table 10 on page 115.	Value for color attribute

Semantics

The Set Extended Color order sets the current value of all five color attributes to the value specified in the order. Color attributes control the color of the foreground bits of the output primitives as they are drawn.

The color value specified by this order is used as a two-byte color index value into the standard color table, see "Color" on page 17. The color values supported by this order are the same as the values defined in the standard color table, and they are also the same as the values defined in the Standard OCA Color Value Table defined in the MO:DCA controlling environment, see the *Mixed Object Document Content Architecture Reference*, SC31-6802.

The standard default in AFP environments is the presentation device default color.

The two-byte values have the following meaning. RGB values are also defined for each named color, assuming that the intensity range for each component is 0–255.

Value	Color	Red (R)	Green (G)	Blue (B)
X'0000' or X'FF00'	Device default			
X'0001' or X'FF01'	Blue	0	0	255
X'0002' or X'FF02'	Red	255	0	0
X'0003' or X'FF03'	Pink/magenta	255	0	255
X'0004' or X'FF04'	Green	0	255	0
X'0005' or X'FF05'	Turquoise/cyan	0	255	255
X'0006' or X'FF06'	Yellow	255	255	0
X'0007'	White; see note	255	255	255
X'0008'	Black	0	0	0
X'0009'	Dark blue	0	0	170
X'000A'	Orange	255	128	0
X'000B'	Purple	170	0	170
X'000C'	Dark green	0	146	0
X'000D'	Dark turquoise	0	146	170
X'000E'	Mustard	196	160	32
X'000F'	Gray	131	131	131
X'0010'	Brown	144	48	0
X'FF07'	Device default	_	-	_
X'FF08'	Color of medium	_	-	-
All others	Reserved	_	_	_

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

The following exception conditions cause a standard action to be taken:

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The action is environment-dependent.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The action is environment-dependent.

Architecture Note: If colors are simulated in AFP environments, color exceptions need not be generated.

Set Fractional Line Width (GSFLW) Order

This order sets the value of the current line-width attribute.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'11'	GSFLW order code
1	UBIN	LENGTH	2	Length of following data
2	UBIN	МН	X'00'-X'FF'	Integral multiplier of normal line width
3	UBIN	MFR	X'00'-X'FF'	Fractional multiplier of normal line width

Semantics

The Set Fractional Line Width order sets the value of the current line-width attribute to the value specified in the order. The current line-width attribute controls the width of line used to draw line primitives.

MH specifies the integer portion of the normal line width multiplier; MFR specifies the fractional portion of the normal line width multiplier. A combined value of X'0000' specifies the drawing default. A combined value of X'0100' represents a unity multiplier, that is, normal line width, which should approximate .01 inches. A decimal point is implied between MH and MFR. The fractional portion of the multiplier is calculated by dividing MFR by 256. For example, if MFR=X'40', its decimal value is 64, which, divided by 256 results in a fractional component for the multiplier of 1/4. Note that the normal line width is presentation device dependent.

See "Line Width" on page 33 for more information on the line width attribute.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

The following exception condition causes a standard action to be taken:

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is a multiplier of X'0100', that is, normal line width.

Set Line Type (GSLT) Order

This order sets the value of the current line-type attribute.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'18'	GSLT order code	
1	CODE	LINETYPE	X'00'-X'08'	Value for line-type	e attribute:
				X'00' Drawir specifi X'01' Dotted X'02' Short of X'03' Dash-o X'04' Double X'05' Long of X'06' Dash-o X'06' Dash-o X'07' Solid II X'08' Invisib All other values Reserv	ng default; solid if none led I line dashed line dot line e dotted line dashed line double-dot line ine le line

Semantics

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The Set Line Type order sets the value of the current line-type attribute to the value specified in the order. The current line-type attribute controls the type of line used to draw line primitives.

The standard default in AFP environments is X'07'-Solid line.

See "Line Type" on page 32 for more information on the line-type attribute and for guidelines on how the sequence of dashes, dots, and spaces should be generated.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'07'—Solid line.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'07'—Solid line.

Set Line Width (GSLW) Order

This order sets the value of the current line-width attribute to the value specified in the order.

Syntax

Offset	Туре	Name	Range	Meaning	
0	CODE		X'19'	GSLW order code	
1	UBIN	МН	X'00'-X'FF'	Value for line-width attribute:	
				X'00' Drawing default X'01'-X'FF' Integral multiplier of normal line width	

Semantics

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The Set Line Width order sets the value of the current line-width attribute to the value specified in the order. This order also resets the fractional part of the line-width attribute to zero. The current line-width attribute controls the width of line used to draw line primitives.

MH specifies an integer multiplier of the normal line width. A value of X'01' represents a unity multiplier, that is, normal line width, which should approximate .01 inches.

The standard default in AFP environments is a multiplier of X'01'—normal line width.

See "Line Width" on page 33 for more information on the line width attribute.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is a multiplier of X'01', that is, normal line width.

Set Marker Cell (GSMC) Order

This order sets the value of the current marker cell-size attribute. This order is processed as a No-Op in AFP GOCA.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'37'	GSMC order code
1	UBIN	LENGTH	4	Length of following data
2–3	SBIN	CELLWI	X'8000'-X'7FFF'	Width of marker cell
4–5	SBIN	CELLHI	X'8000'-X'7FFF'	Height of marker cell

Semantics

Not applicable in AFP GOCA.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

Set Marker Precision (GSMP) Order

This order sets the value of the current marker-precision attribute.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'3B'	GSMP order code
1	CODE	PREC	X'00'-X'03'	Value for marker-precision attribute:
				X'00'Drawing defaultX'01'String precisionX'02'Character precisionX'03'Stroke precision (not supported in AFP GOCA)All other values Reserved

Semantics

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The Set Marker Precision order sets the value of the current marker-precision attribute to the value specified in the order.

Value	Description
X'00'	<i>Drawing Default.</i> This value sets the current marker precision attribute to the value of the drawing default.
	The standard default in AFP environments is X'02'—Character precision.
X'01'	<i>Precision 1—String Precision.</i> The markers are drawn using the quickest, simplest mode possible in the device. In this mode, the only parameters that must, as a minimum, be considered when the markers are drawn are the marker symbol and the marker symbol set. The positioning of the marker can be approximate.
X'02'	<i>Precision 2—Character Precision.</i> In AFP GOCA, this is treated the same as precision 1.
X'03'	Precision 3—Stroke Precision. This value is not supported in AFP

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-0004

GOCA.

Explanation: The attribute value specified in the order is not valid.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'02'—Character precision.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'02'—Character precision.

Set Marker Set (GSMS) Order

This order sets the value of the current marker symbol-set attribute.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'3C'	GSMS order code
1	CODE	LCID	X'00'-X'FF'	Local identifier (LCID) for the marker set:
				X'00' Default marker set X'01'-X'FE' Local identifier for marker set (not supported in AFP GOCA) X'FF' Default marker set (not supported in AFP GOCA)

Semantics

The Set Marker Set order sets the value of the current marker-set attribute to the value specified in the order.

When the value of the marker-set attribute is X'00', the marker is drawn from the default marker set. See "Markers" on page 43 for diagrams of the marker symbols in the default marker set.

Values X'01' to X'FF' are not supported in AFP GOCA.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-C200

Explanation: The marker set identified by the value in the current marker set attribute is not available.

Standard Action: The standard default marker set is used. In AFP environments, this is the default marker set.

Set Marker Symbol (GSMT) Order

This order sets the value of the current marker-symbol attribute.

Syntax

Onool	- 71	Nume	Nange	weaning
0	CODE		X'29'	GSMT order code
1	CODE	MCPT	X'00', X'01'–X'0A',	Value of marker symbol code point:
			X'40'	X'00' Drawing default; cross if not specified
				When the default marker set is selected (Marker Set = X '00'):
				X'01'CrossX'02'PlusX'03'DiamondX'04'SquareX'05'6-point starX'06'8-point starX'06'8-point starX'07'Filled diamondX'08'Filled squareX'09'DotX'0A'Small circleX'40'BlankAll other values

Semantics

The Set Marker Symbol order sets the value of the current marker-symbol attribute to the value in the order.

See "Markers" on page 43 for diagrams of the marker symbols corresponding to attribute values X'01'-X'0A' in the default marker set.

The standard default in AFP environments is X'01'-Cross.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-C201

Explanation: The code point identified by the value in the current marker symbol attribute is not defined in the current marker set.

Standard Action: The standard default marker symbol is used. In AFP environments, this is X'01'—Cross.

Set Mix (GSMX) Order

The Set Mix order provides a shorthand way of setting the following foreground mix attributes to the same value:

- Character foreground mix
- Image foreground mix
- Line foreground mix
- Marker foreground mix
- Pattern foreground mix

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'0C'	GSMX order code
1	CODE	MODE	X'00'-X'05'	Mix-mode value:
				X'00' Drawing default X'01' Not supported in AFP GOCA X'02' Overpaint X'03'-X'05' Not supported in AFP GOCA All other values Reserved

Semantics

The Set Mix order sets the current value of all five mix attributes to the value specified in the order. Mix attributes control the way in which the color of the foreground of a primitive is combined with the color of the presentation space.

With MODE set to X'02', the foreground pels are opaque and their color replaces the color of underlying pels in the GPS. Since this is the only foreground mix mode supported in AFP GOCA, selecting the drawing default (MODE X'00') will also default to MODE X'02'.

For a description of the meaning of the various mix modes see "Mix" on page 19.

Exception Conditions

The following exception conditions cause a standard action to be taken:

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'02'—Overpaint.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used. In AFP environments, this is X'02'—Overpaint.

Set Pattern Set (GSPS) Order

This order sets the value of the current pattern set attribute.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'08'	GSPS order code
1	CODE	LCID	X'00'-X'FF'	Local identifier (LCID) for the pattern set:
				X'00' Default pattern set X'01'-X'FE' Local identifier for the pattern set (not supported in AFP GOCA) X'FF' Default pattern set (not supported in AFP GOCA)

Semantics

The Set Pattern Set order sets the value of the current pattern-set attribute to the value specified in the order.

When the value of the pattern-set attribute is X'00', the pattern is drawn from the default pattern set. See Figure 12 on page 37 for diagrams of the patterns in the default pattern set.

Values X'01' to X'FF' are not supported in AFP GOCA.

Exception Conditions

No exceptions are generated until the pattern set is used for area fill. See "Begin Area (GBAR) Order" on page 65.
Set Pattern Symbol (GSPT) Order

This order sets the value of the current pattern-symbol attribute.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'28'	GSPT order code
1	CODE	PATT	X'00'–X'10', X'40'	Value of pattern-symbol code point:
				X'00' Drawing default
				When the default pattern set is selected: (Pattern Set = X'00'):
				X'01'-X'08'
				Dotted patterns of decreasing density
				X'09' Vertical lines
				X'0A' Horizontal lines
				X'0B' Diagonal lines 1 (bottom-left to top-right)
				X'0C' Diagonal lines 2 (bottom-left to top-right)
				X'0D' Diagonal lines 1 (top-left to
				X'0E' Diagonal lines 2 (top-left to bottom-right)
				X'0F' No fill
				X'10' Solid fill
				X'40' Blank (processed the same as
				X'0F', no fill)
				All other values
				Reserved

Semantics

The Set Pattern Symbol order sets the value of the current pattern-symbol attribute to the value specified in the order. The value of the pattern-symbol attribute determines which particular pattern from the current pattern set is used to fill the interior of subsequent areas.

See Figure 12 on page 37 for diagrams of the patterns corresponding to the attribute values X'01'-X'10' in the default pattern set.

The standard default in AFP environments is X'10'-Solid fill.

Exception Conditions

No exceptions are generated until the pattern symbol is used for area fill. See "Begin Area (GBAR) Order" on page 65.

Set Process Color (GSPCOL) Order

The Set Process Color (GSPCOL) drawing order specifies a process color, highlight color, or named color that sets the following color attributes to the same value:

- · Character color
- Image color
- Line color
- Marker color
- Pattern color

Architecture Note: To fill an area with the color specified by this drawing order, select the drawing default with the Set Pattern Set order, and either the drawing default or solid shading with the Set Pattern Symbol order.

Syntax

Offset	Туре	Name	Range	Meaning
0	CODE		X'B2'	GSPCOL order code
1	UBIN	LENGTH	12–14	Length of following data
2				Reserved; must be zero
3	CODE	COLSPCE	X'01', X'04', X'06',	Color space:
			X'08', X'40'	X'01'RGBX'04'CMYKX'06'Highlight color spaceX'08'CIELABX'40'Standard OCA color space
4–7				Reserved; must be zero
8	UBIN	COLSIZE1	X'01'–X'08', X'10'	Number of bits in component 1. See color space definitions.
9	UBIN	COLSIZE2	X'00'-X'08'	Number of bits in component 2. See color space definitions.
10	UBIN	COLSIZE3	X'00'-X'08'	Number of bits in component 3. See color space definitions.
11	UBIN	COLSIZE4	X'00'-X'08'	Number of bits in component 4. See color space definitions.
12– <i>n</i>		COLVALUE	See "Semantics" for details.	Color specification

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Semantics

COLSPCE is a code that defines the color space and the encoding for the color specification. If the color space is invalid, exception condition EC-0004 exists. The standard action is to use the device default color. If the color space is unsupported, exception condition EC-000E exists. The standard action is to use the device default color. A more specific and preferred exception for an invalid or unsupported color space is EC-0E02. The standard action is to use the device default color.

Value Description

X'01' RGB color space. The color value is specified with three components. Components 1, 2, and 3 are unsigned binary numbers that specify the red, green, and blue intensity values, in that order. COLSIZE1, COLSIZE2, and COLSIZE3 are non-zero and define the number of bits used to specify each component. COLSIZE4 is reserved and should be set to zero. The intensity range for the R,G,B components is 0 to 1, which is mapped to the binary value range 0 to (2^{ColSizeN} – 1), where N=1,2,3.

Architecture Note: The reference white point and the chromaticity coordinates for RGB are defined in SMPTE RP 145-1987 entitled *Color Monitor Colorimetry* and RP 37-1969 entitled *Color Temperature for Color Television Studio Monitors*, respectively. The reference white point is commonly known as *Illuminant D*₆₅₀₀ or simply *D65*. The recommended gamma is 2.2.

- X'04' CMYK color space. The color value is specified with four components. Components 1, 2, 3, and 4 are unsigned binary numbers that specify the cyan, magenta, yellow, and black intensity values, in that order. COLSIZE1, COLSIZE2, COLSIZE3, and COLSIZE4 are non-zero and define the number of bits used to specify each component. The intensity range for the C,M,Y,K components is 0 to 1, which is mapped to the binary value range 0 to (2^{ColSizeN} – 1), where N=1,2,3,4. This is a device-dependent color space.
- **X'06'** Highlight color space. This color space defines a request for the presentation device to generate a highlight color. The color value is specified with one to three components.

Component 1 is a two-byte unsigned binary number that specifies the highlight color number. The first highlight color is assigned X'0001', the second highlight color is assigned X'0002', and so on. The value X'0000' specifies the presentation device default color. COLSIZE1 = X'10' and defines the number of bits used to specify component 1.

Component 2 is an optional one-byte unsigned binary number that specifies a percent coverage for the specified color. Percent coverage can be any value from 0% to 100% (X'00'-X'64'). The number of distinct values supported is device-dependent. If the coverage is less than 100%, the remaining coverage is achieved with color of medium. COLSIZE2 = X'00' or X'08' and defines the number of bits used to specify component 2. A value of X'00' indicates that component 2 is not specified in the color value, in which case the architected default for percent coverage is 100%. A value of X'08' indicates that component 2 is specified in the color value.

Component 3 is an optional one-byte unsigned binary number that specifies a percent shading, which is a percentage of black that is to be added to the specified color. Percent shading can be any value from 0% to 100% (X'00'-X'64'). The number of distinct values supported is device-dependent. If percent coverage and percent shading are specified, the effective range for percent shading is 0% to (100-coverage)%. If the sum of percent coverage plus percent shading is less than 100%, the remaining coverage is achieved with color of medium. COLSIZE3 = X'00' or X'08' and defines the number of bits

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used to specify component 3. A value of X'00' indicates that component 3 is not specified in the color value, in which case the architected default for percent shading is 0%. A value of X'08'indicates that component 3 is specified in the color value.

If the percent value for component 2 or component 3 is invalid, exception condition EC-0E04 exists. The standard action is to use the maximum valid percent value.

COLSIZE4 is reserved and should be set to zero. This is a device-dependent color space.

Architecture Notes:

- The color that is rendered when a highlight color is specified is device dependent. For presentation devices that support colors other than black, highlight color values in the range X'0001' to X'FFFF' may be mapped to any color. For bi-level devices, the color may be simulated with a graphic pattern. In addition, presentation devices may not support the % coverage and % shading parameters for highlight colors. In that case, these parameters are simulated with 100% coverage and 0% shading, respectively.
- If the specified highlight color is "presentation device default," devices whose default color is black use the percent coverage parameter, which is specified in component 2, to render a percent shading.
- 3. On printing devices, the color of medium is normally white, in which case a coverage of *n*% results in adding (100–*n*)% white to the specified color, or *tinting* the color with (100–*n*)% white. Display devices may assume the color of medium to always be white and use this algorithm to render the specified coverage.
- 4. The highlight color space can also specify indexed colors when used in conjunction with a Color Mapping Table (CMT). In that case, component 1 specifies a two-byte value that is an index into the CMT, and components 2 and 3 are not specified in the color value. For a description of the Color Mapping Table in MO:DCA-P environments, see the *Mixed Object Document Content Architecture Reference*, SC31-6802.
- **X'08'** CIELAB color space. The color value is specified with three components. Components 1, 2, and 3 are binary numbers that specify the L, a, b values, in that order, where L is the luminance and a and b are the chrominance differences. Component 1 specifies the L value as an unsigned binary number; components 2 and 3 specify the a and b values as signed binary numbers. COLSIZE1, COLSIZE2, and COLSIZE3 are non-zero and define the number of bits used to specify each component. COLSIZE4 is reserved and should be set to zero. The range for the L component is 0 to 100, which is mapped to the binary value range 0 to $(2^{ColSize1} 1)$. The range for the a and b components is -127 to +127, which is mapped to the binary range $-(2^{ColSizeN-1} 1)$ to $+(2^{ColSizeN-1} 1)$.

For color fidelity, 8-bit encoding should be used for each component, that is, ColSize1, ColSize2, and ColSize3 are set to X'08'. When the recommended 8-bit encoding is used for the a and b components, the

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range is extended to include -128, which is mapped to the value X'80'. If the encoding is less than 8 bits, treatment of the most negative binary endpoint for the a and b components is device-dependent, and tends to be insignificant due to the quantization error.

Architecture Note: The reference white point for CIELAB is known as *D50* and is defined in CIE publication 15-2 entitled *Colorimetry*.

X'40' Standard OCA color space. The color value is specified with one component. Component 1 is an unsigned binary number that specifies a named color, using a two-byte value from the standard OCA color value table. For a complete description of the standard OCA Color value table, see the *Mixed Object Document Content Architecture Reference*, SC31-6802. COLSIZE1 = X'10' and defines the number of bits used to specify component 1. COLSIZE2, COLSIZE3, COLSIZE4 are reserved and should be set to zero. This is a device-dependent color space.

The two-byte values have the meanings shown in Table 11. RGB values are also defined for each named color, assuming that the intensity range for each component is 0–255.

Table 11. Color-Value Table						
Value	Color	Red (R)	Green (G)	Blue (B)		
X'0000' or X'FF00'	Device default	-	_	_		
X'0001' or X'FF01'	Blue	0	0	255		
X'0002' or X'FF02'	Red	255	0	0		
X'0003' or X'FF03'	Pink/magenta	255	0	255		
X'0004' or X'FF04'	Green	0	255	0		
X'0005' or X'FF05'	Turquoise/cyan	0	255	255		
X'0006' or X'FF06'	Yellow	255	255	0		
X'0007'	White; see note	255	255	255		
X'0008'	Black	0	0	0		
X'0009'	Dark blue	0	0	170		
X'000A'	Orange	255	128	0		
X'000B'	Purple	170	0	170		
X'000C'	Dark green	0	146	0		
X'000D'	Dark turquoise	0	146	170		
X'000E'	Mustard	196	160	32		
X'000F'	Gray	131	131	131		
X'0010'	Brown	144	48	0		
X'FF07'	Device default	-	-	_		
X'FF08'	Color of medium	-	-	_		
All others	Reserved	_	_	_		
Note: The color rendered on presentation devices that do not support white is device-dependent. For example, some printers simulate white with the color of the medium, which results in white if a white medium is used.						

All others

Reserved

COLSIZE1 defines the number of bits used to specify the first color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary. For example, if COLSIZE1 = X'06', the first color component has two padding bits.

COLSIZE2 defines the number of bits used to specify the second color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

COLSIZE3 defines the number of bits used to specify the third color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

COLSIZE4 defines the number of bits used to specify the fourth color component. The color component is right-aligned and padded with zeros on the left to the nearest byte boundary.

For COLSIZE1–COLSIZE4, if the specified value is invalid, exception condition EC-0004 exists. The standard action is to use the device default color. If the specified value is unsupported, exception condition EC-000E exists. The standard action is to use the device default color. A more specific and preferred exception for an invalid or unsupported number of bits in a color component is EC-0E05. The standard action is to use the device default color.

COLVALUE specifies the color value in the defined format and encoding. If the color value is invalid, exception condition EC-0004 exists. The standard action is to use the device default color. If the color value is unsupported, exception condition EC-000E exists. The standard action is to use the device default color. A more specific and preferred exception for an invalid or unsupported color value is EC-0E03. The standard action is to use the device default color. Note that the number of bytes specified for this parameter depends on the color space. For example, when there are 8 bits per component, an RGB color value is specified with 3 bytes, while a CMYK color value is specified with 4 bytes. If extra bytes are specified, they are ignored as long as the drawing order length is valid.

Exception Conditions

The following exception conditions raise a drawing process check:

EC-0003

Explanation: The order has an incorrect length.

The following exception conditions cause a standard action to be taken:

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The device default color is used.

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I	Explanation: The attribute value specified in the order is not supported.
I	Standard Action: The device default color is used.
I	EC-0E02
1	Explanation: The color space specified in the order is invalid or unsupported.
I	Standard Action: The device default color is used.
I	EC-0E03
1	Explanation: The color value specified in the order is invalid or unsupported.
I	Standard Action: The device default color is used.
I	EC-0E04
I	Explanation: The highlight color percent value specified in the order is invalid.
I	Standard Action: The maximum valid percent value is used.
I	EC-0E05
1	Explanation: The number of bits for a color component specified in the order is invalid or unsupported.
I	Standard Action: The device default color is used.
	Architecture Notes:
 	 AFP printers should generate the specific and preferred exceptions defined for this drawing order. For example, if the color value is invalid or unsupported, AFP printers should generate EC-0E03.
	If colors are simulated in AFP environments, color exceptions need not be generated.
	3. When a color space other than the standard OCA color space is selected with this drawing order, the concept of mixing color index values in the GPS does not apply. The use of mixing rules other than "overpaint" or "leave alone" is not possible.
	 For a description of color spaces and their relationships, see R. Hunt, <i>The</i> <i>Reproduction of Colour in Photography, Printing, and Television</i>, Fifth Edition, Fountain Press, 1995.

Set Process Color

Chapter 8. Exception Conditions

Exception conditions are detected in the graphics processor by the environment interface when interpreting instructions and commands, and by the drawing processor when interpreting commands and orders. The detection of exception conditions is mandatory unless noted otherwise.

Set Current Defaults Instruction Exceptions

The following are the exceptions, called instruction process checks, detected when interpreting Set Current Defaults control instructions:

IPC-0002

Explanation: This instruction process check is detected:

- If SET parameter (byte 2) is X'10' to X'FF'
- If FLAGS parameter (byte 5) bits 1–3 are not zero, or bits 4–7 are not one
- If an unallocated item is referenced in the MASK parameter (bytes 3-4)

IPC-00003

Explanation: This instruction process check is detected:

- If FLAGS parameter bit 0 is X'0' and LENGTH is not X'04'
- If FLAGS parameter bit 0 is X'1' and the length of the immediate data (byte 6 onward) does not exactly match the length implied by the MASK parameter

IPC-0021

Explanation: This instruction process check is detected if any values in the data are invalid.

Begin Segment Command Exceptions

The following are the exceptions, called command process checks, detected when interpreting Begin Segment commands:

CPC-0001

Explanation: Invalid command code specified.

CPC-7001

Explanation: Begin Segment APP parameter has the value B'10'.

CPC-7082

Explanation: Begin Segment APP parameter has the value B'01'.

CPC-70C1

Explanation: Invalid parameter length specified.

CPC-70C5

Explanation: Insufficient data. The segment data is less than the length specified by SEGL parameter.

Drawing Order Exceptions

A drawing process *exception condition (EC)* exists whenever the drawing processor detects an invalid or unsupported order or an invalid or unsupported parameter value on an order. Each exception condition identified by the architecture has been assigned a unique code of the form EC-*xxxx*.

The architecture provides control over the way in which an exception condition is to be handled, as follows:

- For each exception condition, the AFP GOCA architecture defines the action that is to be taken when the condition arises. This action is one of the following:
 - Report a drawing process check (DPC). The identifier of the DPC is the same as that of the exception condition; that is, exception condition EC-xxxx raises DPC-xxxx.
 - Perform some architecture- or implementation-defined Standard action. For example, for EC-C301 on the Character String order, which is the condition where a code point in the order does not refer to a valid graphic character, the architected standard action is to draw the standard default character symbol.
- The environment, for example, the IPDS environment, optionally can provide an
 exception handling control that causes the drawing processor to raise a
 drawing process check for each and every exception condition, rather than
 execute the standard action, if any, defined for the exception condition. This
 exception handling control, if provided, can specify what is to happen after the
 drawing process check has been raised; for example, terminate the draw
 function or skip to the next drawing order.

The exception conditions associated with each drawing order are listed with each order.

There are two types of exception condition detected when interpreting drawing orders:

- Those for which no architected standard action is defined
- Those that have a standard action defined

Exception Conditions without Standard Actions

This section lists those exception conditions that raise a drawing process check and that do not have a standard action defined:

EC-0002

Explanation: A reserved byte or bit in the order is not set to zero. This is an optional exception.

EC-0003

Explanation: Incorrect length specification. The length in the order is not a valid value for the order.

EC-0008

Explanation: Truncated order. The order about to be executed is not a complete order.

This error can occur when the last order in a segment is being executed. This order meets one of the following conditions:

- The order is a fixed, two-byte order; and the second byte is not in the segment.
- The order is a long order; and the length byte is not in the segment.
- The order is a long order; and the number of bytes from the end of the length field to the end of the segment is less than the value of the length count.
- The order is an extended order; and the number of bytes from the end of the length field to the end of the segment is less than the value of the length count.

EC-000A

Explanation: Invalid descriptor. This condition occurs when the Graphics Data Descriptor (GDD), passed in the invocation sent to the drawing processor, contains invalid bits. A drawing process check is raised. This exception may optionally be generated in MO:DCA-P environments.

EC-000C

Explanation: One of the following conditions has occurred within the prolog section of a segment:

- · An order that is not valid in the prolog has been detected.
- The end of the segment has been reached without an End Prolog order.

EC-0400

Explanation: The Segment Characteristics order was detected outside the prolog section of a segment.

EC-3E00

Explanation: An End Prolog order has occurred outside the prolog section of a segment.

EC-6000

Explanation: An End Area order has been executed without a Begin Area order having previously been executed.

EC-6800

Explanation: A Begin Area order has been executed after another Begin Area order, without an intervening End Area order being executed.

EC-6801

Explanation: A Begin Area order has been executed in a segment; and the end of the segment is reached without an End Area order having been executed.

EC-6802

Explanation: A supported order that is not valid within an area is detected.

EC-9200

Explanation: A Begin Image order was not executed before the Image Data order in this segment.

EC-9201

Explanation: There are insufficient, or too many, bytes of data in the Image Data order.

EC-9300

Explanation: An End Image order is executed without a Begin Image order having been executed previously.

EC-9301

Explanation: The number of Image Data orders between the Begin Image and End Image orders is not equal to the number of rows in the image (as given by the value of the HEIGHT parameter in the Begin Image order).

EC-D100

Explanation: A Begin Image order has been executed in a segment; and the end of the segment is reached without an End Image order having been executed.

EC-D101

Explanation: A Begin Image order has been executed in a segment; and a supported order other than a Comment, No-Operation, Image Data, or End Image order is executed.

EC-D102

Explanation: The value specified for the FORMAT parameter in a Begin Image order is not supported.

EC-E100

Explanation: A relative line starts inside GPS, but then goes outside GPS.

EC-E300

Explanation: A partial arc started inside GPS, but then finished outside. Therefore, the calculated new current position is outside GPS.

EC-E302

Explanation: A negative value is specified for the SWEEP angle in a Partial Arc order.

EC-E303

Explanation: A negative value is specified for the START angle in a Partial Arc order.

Exception Conditions with Standard Actions

This section lists those exception conditions that raise a drawing process check and that do have standard actions defined.

EC-0001

Explanation: Unallocated order codes. All unallocated order codes are reserved for future use. If an attempt is made to execute one of these unallocated order codes, this exception condition occurs. This exception condition is also raised when a device tries to execute an order that it does not support.

EC-0001 takes priority over all other exception conditions when multiple exception conditions occur; for example, an unsupported order that is invalid in the current context.

Standard Action: Skip over the order.

Note: In the IPDS environment, this standard action is not used. See the *Intelligent Printer Data Stream Reference*, S544-3417.

EC-0004

Explanation: The attribute value specified in the order is not valid.

Standard Action: The standard default value of the attribute is used, except for color where the action is implementation-dependent.

EC-000D

Explanation: Graphic presentation space overflow. This condition occurs when an order is executed that tries to draw something outside the Graphic Presentation space.

Standard Action: The action is implementation-dependent.

EC-000E

Explanation: The attribute value specified in the order is not supported.

Standard Action: The standard default value of the attribute is used, except for color where the action is implementation-dependent.

EC-0E02

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Explanation: Invalid or unsupported color space in Set Process Color order.

Standard Action: The device default color is used.

EC-0E03

Explanation: Invalid or unsupported color value in Set Process Color order.

Standard Action: The device default color is used.

EC-0E04

Explanation: Invalid percent value in Set Process Color order.

Standard Action: The maximum valid percent value is used.

EC-0E05

Explanation: Invalid or unsupported number of bits for a color component in Set Process Color order.

Standard Action: The device default color is used.

EC-3400

Explanation: The specific character angle requested is not supported.

Standard Action: The closest character angle supported is used.

EC-6803

Explanation: The pattern set identified by the current pattern set is not available.

Standard Action: The standard default pattern set is used. In AFP environments, this is the default pattern set.

EC-6804

Explanation: The current pattern symbol identifies an undefined symbol in the current pattern set.

Standard Action: The standard default pattern symbol is used. In AFP environments, this is X'10'—Solid fill.

EC-6805

Explanation: Temporary storage overflow while drawing an area in an immediate segment.

Standard Action: Drawing of the area is completed in an implementation-defined manner.

EC-C000

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Explanation: The HAXIS or VAXIS parameter in a Box order is too large to fit the indicated corner into the size of the box.

Standard Action: Corners with the largest axis that fit the box are drawn.

EC-C001

Explanation: The HAXIS or VAXIS parameter in a Box order is outside the range.

Standard Action: A box with square corners is drawn.

EC-C200

Explanation: The marker set identified by the value in the current marker-set attribute is not available.

Standard Action: The standard default marker set is used. In AFP environments, this is the default marker set.

EC-C201

Explanation: The code point in the current marker-symbol attribute is not defined in the current marker set.

Standard Action: The standard default marker symbol is used. In AFP environments this is X'01'—Cross.

EC-C202

Explanation: The current marker-set attribute value identifies a marker set definition that cannot support the functions implied by the current marker-precision attribute.

Standard Action: The marker set identified by the current marker-set attribute value is used, with the highest value of precision that the marker set can support.

EC-C300

Explanation: The coded font identified by the value in the current character-set attribute is not available.

Standard Action: The standard default character set is used. In AFP environments, this is the presentation device default font.

EC-C301

Explanation: A code point in the order does not refer to a valid graphic character.

Standard Action: The standard default character symbol is used.

EC-C302

Explanation: The current character-set attribute value identifies a character set definition that cannot support the functions implied by the current character-precision attribute.

Standard Action: The character set identified by the current character-attribute value is used, with the highest value of precision that the character set can support.

EC-C601

Explanation: The drawing processor has detected an exceptional condition that might prevent the drawing of the arc within the normal limits of pel accuracy.

Standard Action: The arc is drawn as accurately as the implementation can define. This action might produce straight lines.

EC-D103

Explanation: The value specified for the WIDTH parameter in a Begin Image order is too large to allow the environment to completely present the image.

Standard Action: The width of the image is truncated to allow presentation of the smaller image.

EC-D104

Explanation: The value specified for the HEIGHT parameter in a Begin Image order is too large to allow the environment to completely present the image.

Standard Action: The height of the image is truncated to allow presentation of the smaller image.

Drawing Order Exceptions

Chapter 9. Compliance

This chapter describes the GOCA subsets that are supported in the AFP GOCA architecture.

Base (Mandatory) Level (Version 0)

This level represents the base set of functions defined within Version 0 of GOCA. It is the minimum set of functions required to be supported in any environment. It consists of the following minimum general communication capabilities:

- · Recognition of commands and modes
- · Interpretation and validation of the commands within the mode
- Rejection of those commands and modes that are not supported, and return of error data, within the supported subset levels
- Reporting, on request of the environment, the supported features of the drawing process
- · Reporting error conditions to the environment

The following commands are supported:

· Begin Segment (chained) in immediate mode

Drawing Order Level 2, Version 0 (DR/2V0)

This is a GOCA subset supported by printers and viewers in AFP environments.

Immediate segments are a prerequisite to DR/2V0.

The following segment properties *must* be supported:

- Length
- Name (ignored in AFP GOCA)
- Chain
- Prolog
- New/Append

The coordinate type value is X'00'—2-D coordinates.

The geometric parameter format is X'00'—16-bit signed integer, high-order byte first.

The functions include straight and curved lines, areas, images, character strings, patterns, and markers. The following drawing orders must be supported:

- Begin Area (GBAR) order. The required support for INSIDE flag is Alternate Mode.
- Begin Image (GBIMG, GCBIMG) orders (format X'0000' only)
- Character String (GCHST, GCCHST) orders
- Comment (GCOMT) order
- End Area (GEAR) order

- End Image (GEIMG) order
- End Prolog (GEPROL) order
- Fillet (GFLT, GCFLT) orders
- Full Arc (GFARC, GCFARC) orders
- Image Data (GIMD) order
- Line (GLINE, GCLINE) orders
- Marker (GMRK, GCMRK) orders
- No-Operation (GNOP1) order
- Relative Line (GRLINE, GCRLINE) orders
- Segment Characteristics (GSGCH) order. A check that this order is in the prolog state is optionally performed.
- Set Arc Parameters (GSAP) order
- Set Background Mix (GSBMX) order. The required support is X'00' and X'05'—Leave Alone.
- Set Character Angle (GSCA) order. The required support is 90-degree angles when applied to precision 2 symbols.
- Set Character Cell (GSCC) order
- Set Character Direction (GSCD) order
- Set Character Precision (GSCR) order. The required support is drawing default and precisions 1 and 2.
- Set Character Set (GSCS) order
- Set Character Shear (GSCH) order. The required support is drawing default and "no shear." Other values can be treated as "no shear," but generators should not produce these values.
- Set Color (GSCOL) order
- Set Current Position (GSCP) order
- Set Extended Color (GSECOL) order
- Set Line Type (GSLT) order
- Set Line Width (GSLW) order. The required support is normal line width, plus a further line width selectable by a multiplier of two.
- Set Marker Cell (GSMC) order. The required support is drawing default.
- Set Marker Precision (GSMP) order. The required support is drawing default and precisions 1 and 2.
- Set Marker Set (GSMS) order. The required support is drawing default (default marker set).

Note: Because the required support for marker set is drawing default, the *only* marker set available in the AFP environment is the default marker set.

- Set Marker Symbol (GSMT) order
- Set Mix (GSMX) order. The required support is X'00' and X'02'-Overpaint.
- Set Pattern Set (GSPS) order. The required support is drawing default (default pattern set).

Note: Because the required support for pattern set is drawing default, the *only* pattern set available in the AFP environment is the default pattern set.

• Set Pattern Symbol (GSPT) order

Architecture Notes:

- 1. Some AFP printers accept the Set Fractional Line Width (SFLW) order.
- 2. Some AFP printers accept the following drawing orders and process them as No-Ops:
 - Set Pick Identifier (GSPIK, X'43'). This drawing order is in long format.
 - End Segment drawing order (X'71'). This drawing order is in fixed 2-byte format, where the second byte is reserved and should be set to X'00'.

Compliance

Appendix A. Mixed Object Document Content Architecture (MO:DCA) Environment

This appendix describes how graphics objects may be included within a Mixed Object Document Content Architecture—Presentation (MO:DCA-P) document for the purpose of interchanging the graphics objects between a generating node and one or more receiving nodes. See the *Mixed Object Document Content Architecture Reference*, SC31-6802, for a full description of the MO:DCA architecture.

A MO:DCA-P document is a final form (presentation) document suitable for presentation on output devices, for archiving, and for document interchange. The Graphics Data Descriptor and Graphics Data structured fields used to carry graphics objects in MO:DCA-P documents are defined in "Graphics Structured Fields in MO:DCA-P" on page 148.

To guarantee interchange, a MO:DCA-P document carrying a graphics object must include all information related to the object. The MO:DCA document must therefore contain not only the definition of the graphics object, but it must also provide linkage to the resources that the object references.

The discussion of MO:DCA structured fields is included in this appendix solely for setting the context of their use by graphics.

Compliance with MO:DCA Interchange Sets

When graphics objects are interchanged with the purpose of outputting the objects on a display, printer or other output device, it is very important that visual fidelity be maintained as far as is possible. In an attempt to satisfy this objective, the GOCA architecture defines the following for the MO:DCA-P environments:

- A set of rules that must be followed by all generators when constructing graphics objects
- A set of graphics processing capabilities that are guaranteed to be supported by all receivers

In order to comply with a particular MO:DCA-P Interchange Set, products that generate graphics objects must only generate objects that contain graphics items and values defined in that interchange set. Including items or values not in the interchange set can result in processing exceptions being raised by the receiving processor, and exception actions being taken. However, a generator must not rely on a receiver taking these actions.

In order to conform to a particular MO:DCA-P Interchange Set, products that receive graphics objects and convert them using a processor for output to some device, are required to support all the graphics facilities defined in that interchange set.

It is optional for the processor in the receiving node to check each graphics object for compliance with the relevant interchange set. A receiver may optionally raise warnings, in the form of errors, if a non-compliant graphics object is detected.

Graphics Structured Fields in MO:DCA-P

This section describes the syntax of the Graphics Data Descriptor (GDD) and Graphics Data (GAD) structured fields in a MO:DCA-P document.

Graphics Data Descriptor (GDD) in MO:DCA-P

The GDD is a mandatory structured field in the Object Environment Group of a MO:DCA-P graphics object. The GDD contains GOCA control instructions that define the following:

- The drawing order subset that needs to be supported by the receiver for proper interpretation of the graphics data
- The GPS measurement units; note that these are also the DOCS measurement units
- The size and position of the GPS window that will be mapped to the MO:DCA-P object area
- The graphics drawing defaults, specified by the Set Current Defaults instruction, that must be set up by the receiver

In this environment, only the following attributes can have their default values set using the Set Current Defaults instruction:

- Drawing Attributes
- Line Attributes
- Character Attributes
- Marker Attributes
- Pattern Attributes
- Arc Parameters

Note: This is the same set of defaults as are supported by the Intelligent Printer Data Stream (IPDS) architecture.

	Structured Field			
SF Length	X'D3A6BB'	Flags	Reserved	Self-Identifying Parameters

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GDD Self-Identifying	Parameters
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Offset	Туре	Name	Range	Meaning
0	CODE		X'F7'	Drawing Order Subset
1	UBIN	LENGTH	7	Length of following data
2	CODE		X'B0'	Drawing order subset
3–4		RES	X'0000'	Reserved; must be zero
5	CODE	SUBLEV	X'02'	Drawing order subset level 2.0
6	CODE	VERSION	X'00'	Version 0
7	UBIN	LENGTH	X'01'	Length of following field
8	CODE	GEOM	X'00'	Coordinate formats in data:
				X'00' 16-bit, high-byte first, signed integer

Drawing Order Subset (Mandatory)

If invalid bits are specified in this self-identifying parameter, EC-000A may optionally be detected.

Architecture Note: The obsolete *AFP Data Stream Reference*, S544-3202, allowed the Drawing Order Subset Parameter to be optional. If this parameter was not provided, the default was defined to be Drawing Order Subset level 2, version 0 (DR/2V0). AFP GOCA receivers may continue to treat this as an optional parameter with the same default for migration, but new AFP GOCA generators should always generate this parameter.

Window Specification (Mandatory)

	Offset	Туре	Name	Range	Meaning
	0	CODE		X'F6'	Window Specification
	1	UBIN	LENGTH	18	Length of following data
	2	BITS	FLAGS		
	Bit 0	-	PPS	B'0'	Picture Presentation Space:
					B'0' 2-D
	Bit 1		ABS	B'1'	Picture Dimensions:
					B'1' Absolute; picture is designed for presentation in L-units (see bytes 5–9)
1	Bit 2	-	RES	B'0'	Reserved; must be zero
1	Bit 3		IMGRES	B'0', B'1'	Image Resolution:
					 B'0' Resolution not defined or non-symmetric image B'1' X and Y resolutions are equal and are defined by IMXYRES (see bytes 10–11)
1	Bit 4		IMGNS	B'0', B'1'	Non-symmetric image; ignored if bit 3 = B'1'
 					 B'0' Resolution not defined or symmetric image B'1' Image resolution is 120 × 144 points per inch
1	Bits 5-7		RES	B'000'	Reserved; must be zero
	3		RES	X'00'	Reserved; must be zero
	4	CODE	CFORMAT	X'00'	Picture frame size coordinate format:
					X'00' 16-bit high-byte first signed integer
	5	CODE	UBASE	X'00'	Unit Base for GPS:
					X'00' Ten inches
 	6–7	CODE	XRESOL	X'0960', X'3840'	Number of X _g units/UBASE; must be the same as YRESOL
					X'0960' 2400 X'3840' 14400
	8–9	CODE	YRESOL	X'0960', X'3840'	Number of Y _g units/UBASE; must be the same as XRESOL
					X'0960' 2400 X'3840' 14400
 	10–11		IMXYRES	X'0000'-X'7FFF'	X'0000' Not specified X'0001'-X'7FFF' Number of image points per UBASE (ten inches) in X and Y directions
	12–13	SBIN	XLWIND	X'8000'-X'7FFF', see note	X_g coordinate for left edge of GPS window

Offset	Туре	Name	Range	Meaning
14–15	SBIN	XRWIND	X'8000'-X'7FFF', see note	X_g coordinate for right edge of GPS window
16–17	SBIN	YBWIND	X'8000'-X'7FFF', see note	Y _g coordinate for bottom edge of GPS window
18–19	SBIN	YTWIND	X'8000'-X'7FFF', see note	$\rm Y_g$ coordinate for top edge of GPS window
Note: The complete range is valid, and assumes a measurement unit of $1/1440$ inch. That is, the measurement base is ten inches, and the X _a , Y _a units per unit base are 14400.				

If invalid bits are specified in this self-identifying parameter, EC-000A may optionally be detected.

If a measurement unit other than 1/1440 inch is used, then the range values for XLWIND, XRWIND, YBWIND, and YTWIND can be determined by using the following steps.

- 1. Calculate the number of actual supported units per inch (X) as follows:
 - If the measurement base is ten inches, divide the number of supported units per ten inches by 10.
 - If the measurement base is ten centimeters, multiply the number of supported units per ten centimeters by 0.254.
- 2. Calculate the ratio of actual supported units per inch (X) to the assumed 1440 units per inch. To do this, divide (X) by 1440, yielding the ratio (Y).
- 3. Calculate the new range value in the supported measurement units as follows:
 - a. Convert the old range value to base ten; then multiply it by the ratio (Y).
 - b. Round to the nearest integer.

For example, suppose that the specified range is X'8000'-X'7FFF' when using 14400 units per 10 inches. The equivalent range at a unit of measure of 1/240 of an inch is calculated as follows:

1. Supported units per inch:

 $2400 \div 10 = 240$

2. Ratio of supported units per inch to 1440 units per inch:

 $240 \div 1440 = 1/6$

3. Range at 2400 units per 10 inches:

X'8000' = -32768 (converted to base 10) -32768 · 1/6 = -5461.3333 X'7FFF' = 32767 (converted to base 10) 32767 · 1/6 = 5461.1667

Therefore, the equivalent range at 2400 units per 10 inches is –5461 to 5461, which in hexadecimal is X'EAAB' to X'1555'.

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Architecture Notes:

- 1. The obsolete AFP Data Stream Reference (S544-3202) allowed 4 additional reserved bytes following the YTWIND parameter. These bytes are supported by AFP GOCA receivers for migration, but new AFP GOCA generators should not generate these bytes.
- 2. The image resolution value specified by the IMGRES, IMGNS, and IMXYRES parameters allows a presentation device to maintain the size of GOCA images when scaling or resolution-correcting the GOCA object. In the absence of this information and any other externally-provided information on the resolution of GOCA image, the image is mapped point-to-pel in the presentation device. In that case the resulting image size varies with the resolution of the device.

Set Current Defaults (Optional)

Defaults can be set by the appropriate Set Current Defaults instructions. For a complete description of this instruction, see "Set Current Defaults Instruction" on page 51. The following tables show the *maximum* set of attributes allowed. Subsets of these are also allowed, using the MASK bits as selectors for attributes in the particular attribute set. The format of the attribute sets is described in "Set Current Defaults Instruction" on page 51.

Offset	Туре	Name	Range	Meaning
0	CODE		X'21'	Set Current Defaults instruction
1	UBIN	LENGTH	8	Length of following data
2	CODE	SET	X'00'	Drawing Attributes
3–4	BITS	MASK	X'B000'	Set Mask
5	CODE	FLAG	X'0F', X'8F'	X'0F'Use standard defaultX'8F'Use value in bytes 6-n
6–7	CODE	COLOR	See Table 1 on page 18.	Color value
8	CODE	FORMIX	X'00', X'02'	Foreground mix value
9	CODE	BACKMIX	X'00', X'05'	Background mix value

Set Current Defaults—Drawing Attributes

Set Current Defaults—Line Attributes

Offset	Туре	Name	Range	Meaning
0	CODE		X'21'	Set Current Defaults instruction
1	UBIN	LENGTH	6	Length of following data
2	CODE	SET	X'01'	Line Attributes
3–4	BITS	MASK	X'C000'	Set Mask
5	CODE	FLAG	X'0F', X'8F'	X'0F'Use standard defaultX'8F'Use value in bytes 6-n
6	CODE	LINETYPE	X'00'-X'08'	Line-type value
7	UBIN	LINEWID	X'00'-X'FF'	Line-width value

Offset	Туре	Name	Range	Meaning
0	CODE		X'21'	Set Current Defaults instruction
1	UBIN	LENGTH	19	Length of following data
2	CODE	SET	X'02'	Character Attributes
3–4	BITS	MASK	X'FC00'	Set Mask
5	CODE	FLAG	X'0F', X'8F'	X'0F'Use standard defaultX'8F'Use value in bytes 6-n
6–9	SBIN	ANGLE	X'8000'-X'7FFFF'	Character Angle X,Y
10–13	SBIN	CELLSIZE	X'8000'-X'7FFFF'	Character cell size CW,CH
14	CODE	DIRN	X'00'-X'04'	Character direction
15	CODE	PREC	X'00'-X'02'	Character precision
16	CODE	SET	X'00'-X'FF'	Character set
17–20	SBIN	SHEAR	X'8000'-X'7FFFF'	Character shear X,Y

Set Current Defaults—Character Attributes

Set Current Defaults—Marker Attributes

Offset	Туре	Name	Range	Meaning	
0	CODE		X'21'	Set Current Defaults instruction	
1	UBIN	LENGTH	7	Length of following data	
2	CODE	SET	X'03'	Marker Attributes	
3–4	BITS	MASK	X'1900'	Set Mask	
5	CODE	FLAG	X'0F', X'8F'	X'0F'Use standard defaultX'8F'Use value in bytes 6-n	
6	CODE	PREC	X'00'-X'02'	Marker precision	
7	CODE	SET	X'00'	Marker set	
8	CODE	SYMBOL	X'00'-X'0A', X'40'	Marker symbol	

Set Current Defaults—Pattern Attributes

Offset	Туре	Name	Range	Meaning	
0	CODE		X'21'	Set Current Defaults instruction	
1	UBIN	LENGTH	6	Length of following data	
2	CODE	SET	X'04'	Pattern Attributes	
3–4	BITS	MASK	X'0900'	Set Mask	
5	CODE	FLAG	X'0F', X'8F'	X'0F'Use standard defaultX'8F'Use value in bytes 6-n	
6	CODE	SET	X'00'	Pattern set	
7	CODE	SYMBOL	X'00'-X'10', X'40'	Pattern symbol	

Offset	Туре	Name	Range	Meaning	
0	CODE		X'21'	Set Current Defaults instruction	
1	UBIN	LENGTH	12	Length of following data	
2	CODE	SET	X'0B'	Arc parameters	
3–4	BITS	MASK	X'F000'	Set Mask	
5	CODE	FLAG	X'0F', X'8F'	X'0F'Use standard defaultX'8F'Use value in bytes 6-n	
6–7	SBIN	XMAJ	X'8000'-X'7FFF'	X coordinate, major axis end	
8–9	SBIN	YMIN	X'8000'-X'7FFF'	Y coordinate, minor axis end	
10–11	SBIN	XMIN	X'8000'-X'7FFF'	X coordinate, minor axis end	
12–13	SBIN	YMAJ	X'8000'-X'7FFF'	Y coordinate, major axis end	

Set Current Defaults—Arc Parameters

Graphics Data (GAD) in MO:DCA-P

The graphics segments for a graphics object are contained within one or more GAD structured fields. Receipt of the first segment starts the drawing process. No restrictions exist on how much or how little graphics data is specified in a single GAD, except for the length limit of the structured field. A GAD, for example, can carry partial segments, full segments, multiple segments, or any combination of these. The only requirement is that the data itself is ordered in the sequence that is expected for immediate processing and that the last GAD completes the last segment.

Because this environment does not support the calling of segments, all segments should be chained segments. Any unchained segments in the data are ignored.

The GAD structured field is optional in a MO:DCA-P graphics object and may be repeated multiple times.

Structured Field Introducer				
SF Length	X'D3EEBB'	Flags	Reserved	Begin Segment commands followed by segment data in the form of drawing orders

Syntax and semantics for the Begin Segment command are described in "Begin Segment Command" on page 58.

GOCA Subset for MO:DCA-P

GOCA objects in MO:DCA-P documents must comply with drawing subset DR/2V0, as described in Chapter 9, "Compliance" on page 143. Compliance in this context means that the object must contain only those drawing orders that are in subset DR/2V0 with the parameter values defined for these orders in that subset.

An exception to this is any of the color attribute-setting orders, where there are no colors that are required to be supported. These color orders can specify any of the values allowed by the architecture. If a receiver does not support the requested

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value, an exception condition is optionally raised and the standard action is performed; that is, a device-dependent color is used.

All receiving products that claim to support MO:DCA-P must support all the orders in GOCA subset DR/2V0.

GOCA Subset for MO:DCA-P

Appendix B. Intelligent Printer Data Stream (IPDS) Environment

The Intelligent Printer Data Stream (IPDS) architecture is the strategic IBM data stream for controlling advanced function printer devices. It supports the *all-points-addressable* printing function that allows text and individual image, graphics and barcode objects to be positioned and presented at any point on the printed page.

All IPDS printer commands are defined in self-defining field formats that are described in the *Intelligent Printer Data Stream Reference*, S544-3417. The reader is referred to this document for a definitive description of the architecture.

Graphics in the IPDS Environment

The Write Graphics Control command is sent to the printer to establish the control parameters and initial drawing conditions to be used in presenting the picture data. The picture segments themselves are sent to the printer as data in one or more Write Graphics commands.

The subset of the graphics architecture supported by the IPDS architecture is DR/2V0, as described in Chapter 9, "Compliance" on page 143.

IPDS Graphics Command Set

The IPDS Graphics Command Set consists of the following commands:

- Write Graphics Control (X'D684')
- Write Graphics (X'D685')

Write Graphics Control Command

The Write Graphics Control command is sent to the printer to indicate that the command sequence that follows is directed to a graphics object on the current page, overlay, or page segment that is being constructed by the device. The parameters of this command define the size, placement, and orientation of the graphics object area and establish the initial conditions for interpreting the graphics data.

Upon receiving this command the printer enters the appropriate graphics state and initializes control for processing graphics picture segments that are sent in subsequent Write Graphics commands. The End command received in graphics state terminates the processing of graphics data.

The drawing processor can be invoked in any one of three IPDS printer states, as follows:

- Page state
- Overlay state
- Page Segment state

When the drawing processor is invoked in Overlay or Page Segment state, the picture data sent to the printer is saved as part of the Overlay or Page Segment

definition for later inclusion on pages via the Load Copy Control, Include Overlay or Include Page Segment commands.

Positive acknowledgement of graphics commands in Overlay state or Page Segment state means that general syntax and validity checks have been made and that the command, or command sequence, has been accepted for processing. Additional exceptions that are detected when the data is included on the page are reported at that time, assuming that exception reporting is enabled.

Output Control Definitions

Graphics Object Areas

Pictures are presented in rectangular output areas called object areas. Object areas can be positioned at any addressable point on a page or in any Overlay or Page Segment definition and can be defined in any one of four orientations (0°, 90°, 180°, and 270°) relative to the axis of the reference system. Object areas correspond to the Usable Area (UA) defined in "Usable Area (UA)" on page 16.

The size, position, and orientation of object areas are defined to the printer by parameters that are specified in the Write Graphics Control command.

GPS Window

The GPS window is a rectangular area within the GPS specified in GPS coordinates. This is the part of the picture that is mapped to the object area. The graphics data within this window is always trimmed by the printer, before the data is mapped to the object area.

The GPS window parameters are specified to the printer in the Write Graphics Control command.

Mapping Control Options

The data within the GPS Window can be mapped to the object area as specified by the Mapping Control Option parameter of the Write Graphics Control command. These options are:

Center and Trim

Map the center of the GPS Window to the center of the object area and present to scale. Excess picture data, if any, is trimmed at object area boundaries.

Scale to Fit

Map the center of the window to the center of the object area and scale to fit. The scaling is symmetric and the aspect ratio is preserved. All picture data within the window is always presented when this option is specified.

Position and Trim

Map the upper left-hand corner of the window to an offset point within the object area and present to scale. Excess picture data, if any, is trimmed at object area boundaries.

Mapping Defaults

If this parameter is omitted, Position and Trim is used. Excess picture data, if any, is trimmed at page boundaries and the offset position is defined to be the origin of the object area.

Write Graphics Control Data

The Write Graphics Control data is made up of three consecutive self-defining fields, as follows:

- Graphics Area Position (GAP)
- Graphics Output Control (GOC)
- Graphics Data Descriptor (GDD)

Graphics Area Position

This self-defining field defines the position and orientation of the Graphics object area relative to a reference coordinate system. It is a mandatory field in the Write Graphics Control command.

Graphics Output Control

This self-defining field specifies the size of the graphics object area and the mapping option for the graphics object. It is an optional data field in the Write Graphics Control command. If this field is omitted, the size of the graphics object area is made equal to the size of the GPS window, as specified in the Graphics Data Descriptor, and the Position and Trim option applies, where the offset origin position is defined to be the same as the object area origin.

It is an exception if there is an attempt to present data outside the boundary of the logical page.

Graphics Data Descriptor

This is a mandatory self-defining field in the Write Graphics Control command. It specifies the parameters that define the input picture boundaries in GPS and sets the drawing default conditions.

Write Graphics Command

The Write Graphics command transmits graphics data to the printer. The data that is carried in this command consists of picture segments that in turn contain the drawing orders that define the picture in GPS.

The segments that are sent to the printer are of two types:

- Chained
- Unchained

The type is indicated by the flag specified in the Begin Segment header.

The chained segments are the picture. The unchained segments are ignored, since calling of segments is not supported in DR/2V0.

All segments sent to the printer are executed in *intermediate mode*. That is, the drawing orders, except for unchained segments, are executed as they are received and are *not retained or stored* as named segments. The receipt of the first "chained segment" is an implicit command to the printer to start the drawing process.

There are no restrictions on how much, or how little, data is sent to the printer in a single IPDS Write Graphics command, except for the 32K length limit of the command. A Write Graphics command, for example, can transmit partial segments, full segments, multiple segments, or any combination of these. The only requirement is that the data itself is ordered in the sequence that is expected for immediate execution.

The Begin Segment command supported by IPDS printers is shown in "Begin Segment Command" on page 58.

Additional Related Commands

The following commands are used for query and resource management functions. Only an overview of these commands is presented in this document. They are described in detail in the *Intelligent Printer Data Stream Reference*, S544-3417.

Sense Type and Model (STM)

Requests information from the printer that identifies the type and model of the device and the command sets supported. The information requested is returned in the Special Data Area of the Acknowledge Reply to the STM command. The command sets and data levels supported are also returned as part of the acknowledgement data.

Execute Order Homestate—Obtain Printer Characteristics (XOH OPC)

Requests information from the printer that identifies various characteristics of the device. The characteristics include information about the printable area currently available, symbol-set support, image and coded font resolution, and other device characteristics.

Execute Order Anystate—Request Resource List (XOA RRL)

Requests the printer to return a specified list of available resources, that is fonts, overlays, and page segments, in the Acknowledge Replay to this command. This information can be used by host programs to perform a variety of resource management functions.

Load Font Equivalence (LFE)

This command is sent to the printer to map Local Identifiers referenced in graphics to a specified coded font in the printer.

The correlation function provided by this command is independent of any specific font technology implemented by the printing device. That is, the device can resolve this mapping to stored font patterns downloaded from the host, or from permanently resident patterns.

The same font resource can be used for text, graphics and bar code data.

Font Commands

The host can use commands defined in the IPDS Loaded Font command set and Device Control command set to download and manage coded fonts in the printer. The following commands are provided:

- Activate Resource
- Deactivate Font
- Load Code Page
- Load Code Page Control
- Load Font
- Load Font Character Set Control
- Load Font Control
- Load Font Index
- · Load Symbol Set

Appendix C. Cross-References

This appendix provides tables that list:

- · AFP GOCA commands sorted by identifier
- · AFP GOCA commands sorted by acronymr
- AFP GOCA control instructions sorted by identifier
- AFP GOCA control instructions sorted by acronym
- AFP GOCA drawing orders sorted by identifier
- · AFP GOCA drawing orders sorted by acronym

AFP GOCA Commands Sorted by Identifier

Table 12. Commands Sorted by ID			
Identifier	Command Name	Acronym	Page
X'70'	Begin Segment	BSI	58

AFP GOCA Commands Sorted by Acronym

Table 13. Commands Sorted by Acronym				
Acronym	Identifier	Command Name	Page	
BSI	X'70'	Begin Segment	58	

AFP GOCA Control Instructions Sorted by Identifier

Table 14. Control Instructions Sorted by ID			
Identifier	Instruction Name	Acronym	Page
X'21'	Set Current Defaults	SCD	51

AFP GOCA Control Instructions Sorted by Acronym

Table 15. Control Instructions Sorted by Acronym				
Acronym	Identifier	Instruction Name	Page	
SCD	X'21'	Set Current Defaults	51	

AFP GOCA Drawing Orders Sorted by Identifier

Table 16 (Page 1 of 3). Drawing Orders Sorted by ID			
Identifier	Drawing Order Name	Acronym	Page
X'00'	No Operation	GNOP1	89
X'01'	Comment	GCOMT	76
X'04'	Segment Characteristics	GSGCH	95
X'08'	Set Pattern Set	GSPS	126

Table 16 (Page 2 of 3). Drawing Orders Sorted by ID			
Identifier	Drawing Order Name	Acronym	Page
X'0A'	Set Color	GSCOL	111
X'0C'	Set Mix	GSMX	125
X'0D'	Set Background Mix	GSBMX	98
X'11'	Set Fractional Line Width	GSFLW	117
X'18'	Set Line Type	GSLT	118
X'19'	Set Line Width	GSLW	119
X'21'	Set Current Position	GSCP	113
X'22'	Set Arc Parameters	GSAP	96
X'26'	Set Extended Color	GSECOL	114
X'28'	Set Pattern Symbol	GSPT	127
X'29'	Set Marker Symbol	GSMT	124
X'33'	Set Character Cell	GSCC	102
X'34'	Set Character Angle	GSCA	100
X'35'	Set Character Shear	GSCH	110
X'37'	Set Marker Cell	GSMC	120
X'38'	Set Character Set	GSCS	108
X'39'	Set Character Precision	GSCR	106
X'3A'	Set Character Direction	GSCD	104
X'3B'	Set Marker Precision	GSMP	121
X'3C'	Set Marker Set	GSMS	123
X'3E'	End Prolog	GEPROL	79
X'43'	Set Pick Identifier	GSPIK	Note 1
X'60'	End Area	GEAR	77
X'68'	Begin Area	GBAR	65
X'71'	End Segment		Note 2
X'80'	Box at CP	GCBOX	72
X'81'	Line at CP	GCLINE	85
X'82'	Marker at CP	GCMRK	87
X'83'	Character String at CP	GCCHST	74
X'85'	Fillet at CP	GCFLT	80
X'87'	Full Arc at CP	GCFARC	82
X'91'	Begin Image at CP	GCBIMG	67
X'92'	Image Data	GIMD	84
X'93'	End Image	GEIMG	78
X'A1'	Relative Line at CP	GCRLINE	93
X'A3'	Partial Arc at CP	GCPARC	90
X'B2'	Set Process Color	GSPCOL	128
X'C0'	Box	GBOX	71

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Table 16 (Page 3 of 3). Drawing Orders Sorted by ID			
Identifier	Drawing Order Name	Acronym	Page
X'C1'	Line	GLINE	85
X'C2'	Marker	GMRK	87
X'C3'	Character String	GCHST	74
X'C5'	Fillet	GFLT	80
X'C7'	Full Arc	GFARC	82
X'D1'	Begin Image	GBIMG	67
X'E1'	Relative Line	GRLINE	93
X'E3'	Partial Arc	GPARC	90

Notes:

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- 1. The Set Pick Identifier (X'43') long-format drawing order is not formally part of AFP GOCA, but is accepted by some AFP printers and treated as a No-Op.
- The End Segment (X'71') fixed two-byte drawing order is not formally part of AFP GOCA, but is accepted by some AFP printers and treated as a No-Op.

AFP GOCA Drawing Orders Sorted by Acronym

Table 17 (Page 1 of 2). Drawing Orders Sorted by Acronym			
Acronym	Identifier	Drawing Order Name	Page
GBAR	X'68'	Begin Area	65
GBIMG	X'D1'	Begin Image	67
GBOX	X'C0'	Box	71
GCBIMG	X'91'	Begin Image at CP	67
GCBOX	X'80'	Box at CP	72
GCCHST	X'83'	Character String at CP	74
GCFARC	X'87'	Full Arc at CP	82
GCFLT	X'85'	Fillet at CP	80
GCHST	X'C3'	Character String	74
GCLINE	X'81'	Line at CP	85
GCMRK	X'82'	Marker at CP	87
GCOMT	X'01'	Comment	76
GCPARC	X'A3'	Partial Arc at CP	90
GCRLINE	X'A1'	Relative Line at CP	93
GEAR	X'60'	End Area	77
GEIMG	X'93'	End Image	78
GEPROL	X'3E'	End Prolog	79
GFARC	X'C7'	Full Arc	82
GFLT	X'C5'	Fillet	80
GIMD	X'92'	Image Data	84
GLINE	X'C1'	Line	85

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Table 17 (Page 2 of 2). Drawing Orders Sorted by Acronym			
Acronym	Identifier	Drawing Order Name	Page
GMRK	X'C2'	Marker	87
GNOP1	X'00'	No Operation	89
GPARC	X'E3'	Partial Arc	90
GRLINE	X'E1'	Relative Line	93
GSAP	X'22'	Set Arc Parameters	96
GSBMX	X'0D'	Set Background Mix	98
GSCA	X'34'	Set Character Angle	100
GSCC	X'33'	Set Character Cell	102
GSCD	X'3A'	Set Character Direction	104
GSCH	X'35'	Set Character Shear	110
GSCOL	X'0A'	Set Color	111
GSCP	X'21'	Set Current Position	113
GSCR	X'39'	Set Character Precision	106
GSCS	X'38'	Set Character Set	108
GSECOL	X'26'	Set Extended Color	114
GSFLW	X'11'	Set Fractional Line Width	117
GSGCH	X'04'	Segment Characteristics	95
GSLT	X'18'	Set Line Type	118
GSLW	X'19'	Set Line Width	119
GSMC	X'37'	Set Marker Cell	120
GSMP	X'3B'	Set Marker Precision	121
GSMS	X'3C'	Set Marker Set	123
GSMT	X'29'	Set Marker Symbol	124
GSMX	X'0C'	Set Mix	125
GSPCOL	X'B2'	Set Process Color	128
GSPIK	X'43'	Set Pick Identifier	Note 1
GSPS	X'08'	Set Pattern Set	126
GSPT	X'28'	Set Pattern Symbol	127
	X'71'	End Segment	Note 2
Notes:			

- 1. The Set Pick Identifier (X'43') long-format drawing order is not formally part of AFP GOCA, but is accepted by some AFP printers and treated as a No-Op.
- 2. The End Segment (X'71') fixed two-byte drawing order is not formally part of AFP GOCA, but is accepted by some AFP printers and treated as a No-Op.

Appendix D. Related Publications

Several other publications may help you understand the licensed programs used with the data streams described in this book.

IBM Architecture Publications

You can order any of these architecture publications separately, or order the first seven publications using SBOF-6179.

Title	Order Number
Bar Code Object Content Architecture Reference	S544-3766
Font Object Content Architecture Reference	S544-3285
Image Object Content Architecture Reference	SC31-6805
Intelligent Printer Data Stream Reference	S544-3417
Graphics Object Content Architecture Reference	SC31-6804
Mixed Object Document Content Architecture Reference	SC31-6802
Presentation Text Object Content Architecture Reference	SC31-6803
Graphics Object Content Architecture for Advanced Function Presentation Reference	S544-5498
Character Data Representation Architecture Reference	SC09-2190

IBM Advanced Function Presentation Publications

Title	Order Number
<i>Guide to Advanced Function Presentation</i> . Contains a comprehensive overview of AFP and AFP concepts.	G544-3876
Advanced Function Presentation: Programming Guide and Line Data Reference	S544-3884
Advanced Function Presentation: Printer Information. Contains detailed information about IBM's page printers.	G544-3290
Technical Reference for IBM Expanded Core Fonts	S544-5228
Technical Reference for Code Pages	S544-3802
Font Summary for AFP Font Collection	S544-5633
IBM Advanced Function Presentation Fonts: Font Summary	G544-3810
Overlay Generation Language/370: User's Guide and Reference. Contains information about the OGL product, which is used to create AFP overlays.	S544-3702
Page Printer Formatting Aid User's Guide and Reference. Contains information about the PPFA product, which is used to create AFP page definitions and form definitions.	G544-3181

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Title	Order Number
Advanced Function Presentation Workbench for Windows: Using the Viewer Application. Contains information about using the APF Workbench Viewer with the AFP Application Programming Interface.	G544-3813
Advanced Function Presentation Conversion and Indexing Facility: Application Programming Guide. Contains information about using ACIF.	G544-3824
Advanced Function Presentation: Toolbox for Multiple Operating Systems User's Guide.	G544-5292
AFP API Programming Guide and Reference. Contains information for using the AFP Application Programming Interface.	S544-3872
Printing and Publishing Collection Kit. Contains the online, softcopy version of most of the books referred to in this book.	SK2T-2921

IBM ImagePlus Publications

Title	Order Number
IBM SAA ImagePlus Online Library CD-ROM	SK2T-2131
ImagePlus MVS/ESA General Information Manual	GC31-7537
AS/400 ImagePlus General Information Manual	GC38-2027
SAA ImagePlus/2 General Information Manual	GC28-8173

IBM Graphics and Image Publications

Title	Order Number
GDDM General Information Manual. Provides an introduction to the GDDM series of licensed programs.	GC33-0866
<i>Introducing GDQF</i> . Contains a comprehensive overview of Graphical Display and Query Facility for complex manufacturing graphics, image, and publishing products.	GH52-0249
<i>OS/2 Presentation Manager GPI</i> . Contains a description of the Presentation Manager Graphic Programming Interface.	G362-0005

Print Services Facility Publications

Title	Order Number
Print Services Facility/MVS®: Application Programming Guide	S544-3673
Print Services Facility/VM: Application Programming Guide	S544-3677
Print Services Facility/VSE: Application Programming Guide	S544-3666
Print Services Facility/2: Getting Started	G544-3767

Title	Order Number
IBM AIX Print Services Facility/6000: Print Services Facility for AIX Users	G544-3814
AS/400 Information Directory	GC21-9678

Infoprint Manager Publications

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Title	Order Number
Infoprint Manager for AIX Publications (CD-ROM)	SK2T-9266
Infoprint Manager for Windows NT and Windows 2000 Publications (CD-ROM)	SK2T-9288

Related Publications

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Summary of Changes

This second edition of the *Graphics Object Content Architecture for Advanced Function Presentation Reference* contains the following significant architecture extensions:

• Two new drawing orders:

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- Box drawing order, for generating a box with rounded corners
- Partial Arc drawing order, for generating a portion of a circular or elliptic arc
- A method to specify the resolution for AFP GOCA image using an extension to the Graphics Data Descriptor
- Clarifications to character string processing
- Miscellaneous clarifications

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Glossary

Some of the terms and definitions that appear in this glossary have been taken from other source documents.

If you do not find the term that you are looking for, please refer to the *IBM Dictionary of Computing*, document number SC20-1699.

The following definitions are provided as supporting information only, and are not intended to be used as a substitute for the semantics described in the body of this reference.

Α

absolute coordinate. One of the coordinates that identify the location of an addressable point with respect to the origin of a specified coordinate system. Contrast with *relative coordinate*.

absolute move. A method used to designate a new presentation position by specifying the distance from the designated axes to the new presentation position. The reference for locating the new presentation position is a fixed position as opposed to the current presentation position.

absolute positioning. The establishment of a position within a coordinate system as an offset from the coordinate system origin. Contrast with *relative positioning*.

addressable position. A position in a presentation space or on a physical medium that can be identified by a coordinate from the coordinate system of the presentation space or physical medium. See also *picture element.* Synonymous with *position.*

Advanced Function Presentation (AFP). The IBM strategic environment for presentation.

AEA. See alternate exception action.

AFP. See Advanced Function Presentation.

AFP data stream. A presentation data stream that is processed in AFP environments. MO:DCA-P is the strategic AFP interchange data stream. IPDS is the strategic AFP printer data stream.

AFPDS. A term formerly used to identify the composed-page MO:DCA-based data stream interchanged in AFP environments. See also *MO:DCA* and *AFP data stream*.

AFP GOCA. The version of the GOCA architecture that is defined for and supported in AFP environments.

all points addressable (APA). The capability to address, reference, and position data elements at any addressable position in a presentation space or on a physical medium. Contrast with character cell addressing, in which the presentation space is divided into a fixed number of character-size rectangles in which characters can appear. Only the cells are addressable. An example of all points addressability is the positioning of text, graphics, and images at any addressable point on the physical medium. See also *picture element*.

alternate exception action (AEA). In the IPDS architecture, a defined action that a printer can take when a clearly defined, but unsupported, request is received. Control over alternate exception actions is specified by an Execute Order Anystate Exception-Handling Control command.

American National Standards Institute (ANSI). An organization consisting of producers, consumers, and general interest groups. ANSI establishes the procedures by which accredited organizations create and maintain voluntary industry standards in the United States. It is the United States constituent body of the International Organization for Standardization (ISO).

anamorphic scaling. Scaling an object differently in the vertical and horizontal directions. See also *scaling*, *horizontal font size*, and *vertical font size*.

ANSI. See American National Standards Institute.

APA. See all points addressable.

application. The use to which an information system is put.

application program. A program written for or by a user that applies to the user's work.

arc. A continuous portion of the curved line of a circle or ellipse. See also *full arc*.

architected. Identifies data that is defined and controlled by an architecture. Contrast with *unarchitected*.

arc parameters. Variables that specify the curvature of an arc.

area. In GOCA, a set of closed figures that can be filled with a pattern or a color.

area filling. A method used to fill an area with a pattern or a color.

aspect ratio. (1) The ratio of the horizontal size of a picture to the vertical size of the picture. (2) In a bar code symbol, the ratio of bar height to symbol length.

attribute. A property or characteristic of one or more constructs. See also *character attribute*, *color attribute*, *current drawing attributes*, *default drawing attributes*, *line attributes*, *marker attributes*, and *pattern attributes*.

В

background. (1) The part of a presentation space that is not occupied with object data. (2) In GOCA, that portion of a graphics primitive that is mixed into the presentation space under the control of the current value of the background mix attribute. Contrast with *foreground*. (3) In GOCA, that portion of a character cell that does not represent a character. (4) In bar codes, the spaces, quiet zones, and area surrounding a printed bar code symbol.

background color. The color of a background. Contrast with *foreground color*.

background mix. (1) An attribute that determines how the color of the background of a graphics primitive is combined with the existing color of the graphics presentation space. (2) An attribute that determines how the points in overlapping presentation space backgrounds are combined. Contrast with *foreground mix*.

base-and-towers concept. A conceptual illustration of an architecture that shows the architecture as a base with optional tower(s). The base and the towers represent different degrees of function achieved by the architecture.

base support level. Within the base-and-towers concept, the smallest portion of architected function that is allowed to be implemented. This is represented by a base with no towers. Synonymous with *mandatory support level*.

BCOCA. See Bar Code Object Content Architecture.

between-the-pels. The concept of pel positioning that establishes the location of a pel's reference point at the edge of the pel nearest to the preceding pel rather than through the center of the pel.

BITS. A data type for architecture syntax, indicating one or more bytes to be interpreted as bit string information.

bounded character box. A conceptual rectangular box, with two sides parallel to the character baseline,

that circumscribes a character and is just large enough to contain the character, that is, just touching the shape on all four sides.

BSI. See Begin Segment Introducer.

С

CCS. See Common Communications Support.

CCSID. See Coded Character Set Identifier.

CGCSGID. See Coded Graphic Character Set Global Identifier.

CHAR. A data type for architecture syntax, indicating one or more bytes to be interpreted as character information.

character. A member of a set of elements used for the organization, control, or representation of data. A character can be either a graphic character or a control character. See also *graphic character* and *control character*.

character angle. The angle that is between the baseline of a character string and the horizontal axis of a presentation space or physical medium.

character attribute. A characteristic that controls the appearance of a character or character string.

character baseline. A conceptual reference line that is coincident with the X axis of the character coordinate system.

character box. A conceptual rectangular box with two sides parallel to the character baseline. A character's shape is formed within a character box by a presentation process, and the character box is then positioned in a presentation space or on a physical medium. The character box can be rotated before it is positioned.

character cell size. The size of a rectangle in a drawing space used to scale font symbols into the drawing space.

character code. An element of a code page or a cell in a code table to which a character can be assigned. The element is associated with a binary value. The assignment of a character to an element of a code page determines the binary value that will be used to represent each occurrence of the character in a character string.

character coordinate system. An orthogonal coordinate system that defines font and character measurement distances. The origin is the character

reference point. The X axis coincides with the character baseline.

character direction. In GOCA, an attribute controlling the direction in which successive characters appear. Values are: left-to-right, right-to-left, top-to-bottom, and bottom-to-top. Synonymous with *direction*.

character escapement point. The point where the next character reference point is usually positioned. See also *character increment* and *presentation position*.

character identifier. The unique name for a graphic character.

character increment. The distance from a character reference point to a character escapement point. For each character, the increment is the sum of a character's A-space, B-space, and C-space. A character's character increment is the distance the inline coordinate is incremented when that character is placed in a presentation space or on a physical medium. Character increment is a property of each graphic character in a font and of the font's character rotation.

character metrics. Measurement information that defines individual character values such as height, width, and space. Character metrics can be expressed in specific fixed units, such as pels, or in relative units that are independent of both the resolution and the size of the font. Often included as part of the more general term "font metrics". See also *character set metrics* and *font metrics*.

character pattern. The scan pattern for a graphic character of a particular size, style, and weight.

character positioning. A method used to determine where a character is to appear in a presentation space or on a physical medium.

character precision. The acceptable amount of variation in the appearance of a character on a physical medium from a specified ideal appearance, including no acceptable variation. Examples of appearance characteristics that can vary for a character are shape and position.

character reference point. The origin of a character coordinate system. The X axis is the character baseline.

character rotation. The alignment of a character with respect to its character baseline, measured in degrees in a clockwise direction. Examples are 0°, 90°, 180°, and 270°. Zero-degree character rotation exists when a character is in its customary alignment with the baseline. Contrast with *rotation*.

character set. A finite set of different graphic or control characters that is complete for a given purpose.

For example, the character set in ISO Standard 646, 7-bit Coded Character Set for Information Processing Interchange.

character set attribute. An attribute used to specify a coded font.

character set metrics. The measurements used in a font. Examples are height, width, and character increment for each character of the font. See also *character metrics* and *font metrics*.

character shape. The visual representation of a graphic character.

character shear. The angle of slant of a character cell that is not perpendicular to a baseline. Synonymous with *shear*.

character string. A sequence of characters.

clipping. Eliminating those parts of a picture that are outside of a clipping boundary such as a viewing window or presentation space. Synonymous with *trimming*.

CODE. A data type for architecture syntax that indicates an architected constant to be interpreted as defined by the architecture.

Coded Character Set Identifier (CCSID). A 16-bit number identifying a specific set consisting of an encoding scheme identifier, character set identifiers, code page identifiers, and other relevant information that uniquely identifies the coded graphic character representation used.

coded font. (1) A resource containing elements of a code page and a font character set, used for presenting text, graphics character strings, and bar code HRI. See also *code page* and *font character set.* (2) In FOCA, a resource containing the resource names of a valid pair of font character set and code page resources. The graphic character set of the font character set must match the graphic character set of the code page for the code font resource pair to be valid.

coded font local identifier. A binary identifier that is mapped by the environment to a named resource to identify a coded font. See also *local identifier*.

coded graphic character. A graphic character that has been assigned one or more code points within a code page.

coded graphic character set. A set of graphic characters with their assigned code points.

Coded Graphic Character Set Global Identifier (CGCSGID). A four-byte binary or a ten-digit decimal identifier consisting of the concatenation of a GCSGID and a CPGID. The CGCSGID identifies the code point assignments in the code page for a specific graphic character set, from among all the graphic characters that are assigned in the code page.

code page. (1) A resource object containing descriptive information, graphic character identifiers, and code points corresponding to a coded graphic character set. (2) A set of assignments, each of which assigns a code point to a character. Each code page has a unique name or identifier. Within a given code page, a code point is assigned to one character. More than one character set can be assigned code points from the same code page. See also *code point* and *section*.

Code Page Global Identifier (CPGID). A unique code page identifier that can be expressed as either a two-byte binary or a five-digit decimal value.

code point. A unique bit pattern that can serve as an element of a code page or a site in a code table, to which a character can be assigned. The element is associated with a binary value. The assignment of a character to an element of a code page determines the binary value that will be used to represent each occurrence of the character in a character string. Code points are one or more bytes long. See also *code table* and *section*.

code table. A table showing the character allocated to each code point in a code. See also *code page* and *code point*.

color attribute. An attribute that affects the color values provided in a graphics primitive, a text control sequence, or an IPDS command. Examples of color attributes are foreground color and background color.

color image. Images whose image data elements are represented by multiple bits or whose image data element values are mapped to color values. Constructs that map image-data-element values to color values are look-up tables and image-data-element structure parameters. Examples of color values are screen color values for displays and color toner values for printers.

color model. See color space.

color of medium. The color of a presentation space before any data is added to it. Synonymous with *reset color*.

color space. The method by which a color is specified. For example, the RGB color space specifies color in terms of three intensities for red (R), green (G), and blue (B).

color table. A collection of color element sets. The table can also specify the method used to combine the

intensity levels of each element in an element set to produce a specific color. Examples of methods used to combine intensity levels are the additive method and the subtractive method. See also *color space*.

command. (1) In GOCA, a data-stream construct used to communicate from the controlling environment to the drawing process. The command introducer is environment-dependent. (2) A request for system action.

CPI. See Common Programming Interface.

Common Programming Interface (CPI). Definitions of those application development languages and services that have (or are intended to have) implementations on and a high degree of commonality across the SAA environments. One of the three SAA architectural areas (the other two being Common Communications Support and Common User Access).

Common User Access (CUA). Guidelines for the dialog between a person and the workstation or terminal. One of the three SAA architectural areas (the other two being Common Programming Interface and Common Communications Support).

construct. An architected set of data such as a structured field or a triplet.

continuous-form media. Connected sheets. An example of connected sheets is sheets of paper connected by a perforated tear strip. Contrast with *cut-sheet media*.

control character. (1) A character that denotes the start, modification, or end of a control function. A control character can be recorded for use in a subsequent action, and it can have a graphic representation. See also *character*. (2) A control function the coded representation of which consists of a single code point.

control instruction. A data construct transmitted from the controlling environment and interpreted by the environment interface to control the operation of the graphics processor.

controlling environment. The environment in which an object is embedded, for example, the IPDS and MO:DCA data streams.

coordinate system. A Cartesian coordinate system. An example is the image coordinate system that uses the fourth quadrant with positive values for the Y axis. The origin is the upper left-hand corner of the fourth quadrant. A pair of (x,y) values corresponds to one image point. Each image point is described by an image data element. See also *character coordinate system*. **coordinates**. A pair of values that specify a position in a coordinate space. See also *absolute coordinate* and *relative coordinate*.

CPGID. See Code Page Global Identifier.

CUA. See Common User Access.

current drawing attributes. The set of attributes used at the present time to direct a drawing process. Contrast with *default drawing attributes*.

current inline coordinate. The inline presentation position at the present time. This inline presentation position is the summation of the increments of all inline controls since the inline coordinate was established in the presentation space. An inline presentation position is established in a presentation space either as part of the initialization procedures for processing an object or by an Absolute Move Inline control sequence. Synonymous with *current inline presentation coordinate*.

current position. The position identified by the current presentation space coordinates. For example, the coordinate position reached after the execution of a drawing order. Contrast with *given position*.

cut-sheet media. Unconnected sheets. Contrast with *continuous-form media*.

D

data stream. A continuous stream of data that has a defined format. An example of a defined format is a structured field.

DBCS. See double-byte character set.

default. A value, attribute, or option that is assumed when none has been specified and one is needed to continue processing. See also *default drawing attributes* and *default drawing controls*.

default drawing attributes. Synonymous with *drawing defaults*.

default indicator. A field whose bits are all B'1', indicating that a hierarchical default value is to be used. The value can be specified by an external parameter. See also *external parameter*.

device dependent. Dependent upon one or more device characteristics. An example of device dependency is a font whose characteristics are specified in terms of addressable positions of specific devices.

digital half-toning. A method used to simulate gray levels on a bilevel device.

digital image. An image whose image data was sampled at regular intervals to produce a digital representation of the image. The digital representation is usually restricted to a specified set of values.

direction. In GOCA, an attribute that controls the direction in which successive characters appear. Values are: left-to-right, right-to-left, top-to-bottom, and bottom-to-top. Synonymous with *character direction*.

DOCS. See drawing order coordinate space.

document. (1) A machine-readable collection of one or more objects that represents a composition, a work, or a collection of data. (2) A publication or other written material.

document content architecture. A family of architectures that define the syntax and semantics of the document component.

document element. A self-identifying, variable-length, bounded record, that can have a content portion that provides control information, data, or both. An application or device does not have to understand control information or data to parse a data stream when all the records in the data stream are document elements. See also *structured field*.

document fidelity. The degree to which a document presentation preserves the creator's intent.

document formatting. A method used to determine where information is positioned in presentation spaces or on physical media.

document presentation. A method used to produce a visible copy of formatted information on physical media.

double-byte character set (DBCS). A character set that can contain up to 65536 characters.

double-byte coded font. A coded font in which the code points are two bytes long.

drawing process control. A control used by the graphics processor that determines how a picture is drawn. Examples of drawing process controls are arc parameters.

drawing defaults. In GOCA, the set of attributes adopted at the start of each segment that is processed. These attributes are set either from standard defaults defined by the controlling environment or from the Set Current Defaults instruction that is contained in the Graphics Data Descriptor. Synonymous with *default drawing attributes*. Contrast with *current drawing attributes*.

drawing order. In GOCA, a graphics construct that the controlling environment builds to instruct a drawing

processor about what to draw and how to draw it. The order can specify, for example, that a graphics primitive be drawn, or a change to drawing attributes or drawing controls be effected. One or more graphics primitives can be used to draw a picture. Drawing orders can be included in a structured field. Synonymous with *order*.

drawing order coordinate space (DOCS). A two-dimensional conceptual space in which graphics primitives are drawn, using drawing orders, to create pictures.

drawing processor. A graphics processor component that executes segments to draw a picture in a presentation space. See also *segment* and *graphics presentation space*.

drawing units. Units of measurement used within a graphics presentation space to specify absolute and relative positions.

duplex printing. A method used to print data on both sides of a sheet. Normal-duplex printing occurs when the sheet is turned over the Y_m axis. Tumble-duplex printing occurs when the sheet is turned over the X_m axis. Contrast with *simplex printing*.

Ε

EBCDIC. See *Extended Binary-Coded Decimal Interchange Code*.

Em. In printing, a unit of linear measure referring to the baseline-to-baseline distance of a font, in the absence of any external leading.

Em square. A square layout space used for designing each of the characters of a font.

encoding scheme. A set of specific definitions that describe the philosophy used to represent character data. The number of bits, the number of bytes, the allowable ranges of bytes, the maximum number of characters, and the meanings assigned to some generic and specific bit patterns, are some examples of specifications to be found in such a definition.

Encoding Scheme Identifier (ESID). A 16-bit number assigned to uniquely identify a particular encoding scheme specification. See also *encoding scheme*.

environment interface. The part of the graphics processor that interprets commands and instructions from the controlling environment.

escapement direction. In FOCA, the direction from a character reference point to the character escapement point, that is, the font designer's intended direction for successive character shapes. See also *character direction*.

ESID. See Encoding Scheme Identifier.

exception. An invalid or unsupported data-stream construct.

exception action. Action taken when an exception is detected.

exception condition. The condition that exists when a product finds an invalid or unsupported construct.

exchange. The predictable interpretation of shared information by a family of system processes in an environment where the characteristics of each process must be known to all other processes. Contrast with *interchange*.

Extended Binary-Coded Decimal Interchange Code (**EBCDIC**). A coded character set that consists of eight-bit coded characters.

external parameter. A parameter for which the current value can be provided by the controlling environment, for example, the data stream, or by the application itself. Contrast with *internal parameter*.

F

factoring. The movement of a parameter value from one state to a higher-level state. This permits the parameter value to apply to all of the lower-level states unless specifically overridden at the lower level.

FGID. See Font Typeface Global Identifier.

fillet. A curved line drawn tangential to a specified set of straight lines. An example of a fillet is the concave junction formed where two lines meet.

final form data. Data that has been formatted for presentation.

FOCA. See Font Object Content Architecture.

font. A set of graphic characters that have a characteristic design, or a font designer's concept of how the graphic characters should appear. The characteristic design specifies the characteristics of its graphic characters. Examples of characteristics are shape, graphic pattern, style, size, weight, and increment. Examples of fonts are fully-described fonts, symbol sets, and their internal printer representations. See also *coded font* and *symbol set*.

font character set. A FOCA resource containing descriptive information, font metrics, and the digital representation of character shapes for a specified graphic character set.

Font Typeface Global Identifier (FGID). A unique font identifier that can be expressed as either a two-byte binary or a five-digit decimal value. The FGID is used to identify a type style and the following characteristics: posture, weight, and width.

font height (FH). (1) A characteristic value, perpendicular to the character baseline, that represents the size of all graphic characters in a font. Synonymous with vertical font size. (2) In a font character set, nominal font height is a font-designer defined value corresponding to the nominal distance between adjacent baselines when character rotation is zero degrees and no external leading is used. This distance represents the baseline-to-baseline increment that includes the font's maximum baseline extent and the designer's recommendation for internal leading. The font designer can also define a minimum and a maximum vertical font size to represent the limits of scaling. (3) In font referencing, the specified font height is the desired size of the font when the characters are presented. If this size is different from the nominal vertical font size specified in a font character set, the character shapes and character metrics might need to be scaled prior to presentation.

font metrics. Measurement information that defines individual character values such as height, width, and space, as well as overall font values such as averages and maximums. Font metrics can be expressed in specific fixed units, such as pels, or in relative units that are independent of both the resolution and the size of the font. See also *character metrics* and *character set metrics*.

font object. A resource object that contains some or all of the description of a font.

Font Object Content Architecture (FOCA). An architected collection of constructs used to describe fonts and to interchange those font descriptions.

font referencing. A method used to identify or characterize a font. Examples of processes that use font referencing are document editing, formatting, and presentation.

font width (FW). (1) A characteristic value, parallel to the character baseline, that represents the size of all graphic characters in a font. Synonymous with *horizontal font size*. (2) In a font character set, nominal font width is a font-designer defined value corresponding to the nominal character increment for a font character set. The value is generally the width of the space character and is defined differently for fonts with different spacing characteristics.

• For fixed-pitch, uniform character increment fonts: the fixed character increment, which is also the space character increment

- · For PSM fonts: the width of the space character
- For typographic, proportionally-spaced fonts: one-third of the vertical font size, which is also the default size of the space character.

The font designer can also define a minimum and a maximum horizontal font size to represent the limits of scaling. (3) In font referencing, the specified font width is the desired size of the font when the characters are presented. If this size is different from the nominal horizontal font size specified in a font character set, the character shapes and character metrics might need to be scaled prior to presentation.

foreground. (1) The part of a presentation space that is occupied with object data. (2) In the IPDS architecture, the pels of a text rule. Also, the B'1' pels of the following:

- · Text, graphics, or bar code characters
- Images
- Graphics lines or arcs
- Filled areas
- · Bar code symbols.

(3) In GOCA, the portion of a drawing primitive that is mixed into the presentation space under the control of the current value of the mix and color attributes. See also *pel.* Contrast with *background*.

foreground color. A color attribute used to specify the color of the foreground of a primitive. Contrast with *background color*.

foreground mix. An attribute used to determine how the foreground color of data is combined with the existing color of a graphics presentation space. An example of data is a graphics primitive. Contrast with background mix.

form. A physical entity on which information is printed. An example of a form is one piece of paper. Synonymous with *sheet*.

format. The arrangement or layout of data on a physical medium or in a presentation space.

formatter. A process used to prepare a document for presentation.

full arc. A complete circle or ellipse. See also arc.

fully-described font. In the IPDS architecture, an LF1-type raster-font resource containing font metrics, descriptive information, and the raster representation of character shapes, for a specific graphic character set. A fully-described font can be downloaded to a printer using the Load Font Control and Load Font commands. An LF1-type coded font or coded-font section is the combination of one fully-described font and one font index. See also *font index*.

function set. A collection of architecture constructs and associated values. Function sets can be defined across or within subsets.

FW. See font width.

G

GCGID. See Graphic Character Global Identifier.

GCSGID. See Graphic Character Set Global Identifier.

GID. See global identifier.

given position. The coordinate position at which drawing is to begin. A given position is specified in a drawing order. Contrast with *current position*.

Global Identifier (GID). One of the following:

- Code Page Global ID (CPGID)
- Graphic Character Global Identifier (GCGID)
- Font Typeface Global Identifier (FGID)
- Graphic Character Set Global Identifier (GCSGID)
- In MO:DCA, an encoded graphic character string that, when qualified by the associated CGCSGID, provides a reference name for a document element.

global resource identifier (GRID). An eight-byte identifier that identifies a coded font resource. A GRID contains the following fields in the order shown:

- 1. GCSGID of a minimum set of graphic characters required for presentation. It can be a character set that is associated with the code page, or with the font character set, or with both.
- 2. CPGID of the associated code page
- 3. FGID of the associated font character set
- 4. Font width in 1440ths of an inch.

glyph. A member of a set of symbols that represent data. Glyphs can be letters, digits, punctuation marks, or other symbols. Synonymous with *graphic character*. See also *character*.

GOCA. See Graphics Object Content Architecture.

GPS. See Graphics Presentation Space.

graphic character. A member of a set of symbols that represent data. Graphic characters can be letters, digits, punctuation marks, or other symbols. Synonymous with *glyph*. See also *character*.

Graphic Character Global Identifier (GCGID). An alphanumeric character string used to identify a specific graphic character. A GCGID can be from four bytes to eight bytes long.

graphic character identifier. The unique name for a graphic character in a font or in a graphic character set. See also *character identifier*.

Graphic Character Set Global Identifier (GCSGID). A unique graphic character set identifier that can be expressed as either a two-byte binary or a five-digit decimal value.

graphics command set. In the IPDS architecture, a collection of commands used to present GOCA data in a page, page segment, or overlay.

graphics data. Data containing lines, arcs, markers, and other constructs that describe a picture.

graphics object. An object that contains graphics data. See also *object*.

Graphics Object Content Architecture (GOCA). An architected collection of constructs used to interchange and present graphics data.

graphics object area. A rectangular area on a logical page into which a graphics presentation space window is mapped.

graphics presentation space (GPS). A two-dimensional conceptual space in which the application user's view of the specified picture is generated. The picture can then be mapped onto an

output medium.

graphics presentation space window. The portion of a graphics presentation space that can be mapped to an object area on a logical page.

graphics primitive. A basic construct used by an output device to draw a picture. Examples of graphics primitives are arc, line, fillet, character string, and marker.

graphics processor. The processing capability required to interpret a GOCA object, that is, to present the picture represented by the object. It includes the environment interface, which interprets commands and instructions, and the drawing processor, which interprets the drawing orders.

graphics segment. A picture or sub-picture that consists of a Begin Segment command followed by drawing orders. See also *segment*.

grayscale image. Images whose image data elements are represented by multiple bits and whose image data element values are mapped to more than one level of brightness through an image data element structure parameter or a look-up table.

GRID. See global resource identifier.

Η

hexadecimal. A number system with a base of sixteen. The decimal digits 0 through 9 and characters A through F are used to represent hexadecimal digits. The hexadecimal digits A through F correspond to the decimal numbers 10 through 15, respectively. An example of a hexadecimal number is X'1B', which is equal to the decimal number 27.

highlight color. A spot color that is used to accentuate or contrast monochromatic areas. See also *spot color*.

highlighting. The emphasis of displayed or printed information. Examples are increased intensity of selected characters on a display screen and exception highlighting on an IPDS printer.

hollow font. A font design in which the graphic character shapes include only the outer edges of the strokes.

horizontal font size. (1) A characteristic value, parallel to the character baseline, that represents the size of all graphic characters in a font. Synonymous with *font width*. (2) In a font character set, nominal horizontal font size is a font-designer defined value corresponding to the nominal character increment for a font character set. The value is generally the width of the space character and is defined differently for fonts with different spacing characteristics.

- For fixed-pitch, uniform character increment fonts: the fixed character increment, which is also the space character increment
- For PSM fonts: the width of the space character
- For typographic, proportionally-spaced fonts: one-third of the vertical font size, which is also the default size of the space character.

The font designer can also define a minimum and a maximum horizontal font size to represent the limits of scaling. (3) In font referencing, the specified horizontal font size is the desired size of the font when the characters are presented. If this size is different from the nominal horizontal font size specified in a font character set, the character shapes and character metrics might need to be scaled prior to presentation.

horizontal scale factor. In outline-font referencing, the specified horizontal adjustment of the Em square. The horizontal scale factor is specified in 1440ths of an inch. When the horizontal and vertical scale factors are different, anamorphic scaling occurs. See also *vertical scale factor*.

host. (1) In the IPDS architecture, a computer that drives a printer. (2) In IOCA, the host is the controlling environment.

I

ID. Identifier. See also *Host-Assigned ID (HAID)*, *correlation ID, font control record*, and *overlay ID*.

IEEE. Institute of Electrical and Electronics Engineers.

I-direction. In PTOCA, the direction in which successive characters appear in a line of text.

image. An electronic representation of a picture produced by means of sensing light, sound, electron radiation, or other emanations coming from the picture or reflected by the picture. An image can also be generated directly by software without reference to an existing picture.

image content. Image data and its associated image data parameters.

image coordinate system. An X,Y Cartesian coordinate system using only the fourth quadrant with positive values for the Y axis. The origin of an image coordinate system is its upper left hand corner. An X,Y coordinate specifies a presentation position that corresponds to one and only one image data element in the image content.

image data. Rectangular arrays of raster information that define an image.

Image Object Content Architecture (IOCA). An architected collection of constructs used to interchange and present images.

image segment. Image content bracketed by Begin Segment and End Segment self-defining fields. See also *segment*.

IM image. A migration image object that is resolution dependent, bilevel, and cannot be compressed or scaled. Contrast with *IO image*.

immediate mode. In GOCA, the mode in which segments are executed as they are received and then discarded.

inline direction (I). In PTOCA, the direction in which successive characters appear in a line of text. Synonymous with *I-direction*.

Intelligent Printer Data Stream (IPDS). An architected host-to-printer data stream that contains both data and controls defining how the data is to be presented.

interchange. The predictable interpretation of shared information in an environment where the characteristics

of each process need not be known to all other processes. Contrast with *exchange*.

internal parameter. In PTOCA, a parameter whose current value is contained within the object. Contrast with *external parameter*.

International Organization for Standardization (ISO). An organization of national standards bodies from various countries established to promote development of standards to facilitate international exchange of goods and services, and develop cooperation in intellectual, scientific, technological, and economic activity.

interoperability. The capability to communicate, execute programs, or transfer data among various functional units in a way that requires the user to have little or no knowledge of the unique characteristics of those units.

IOCA. See Image Object Content Architecture.

IO image. An image object containing IOCA constructs. Contrast with *IM image*.

IPDS. See Intelligent Printer Data Stream.

ISO. See International Organization for Standardization.

italics. A typeface with characters that slant upward to the right. In FOCA, italics is the common name for the defined inclined typeface posture attribute or parameter.

Κ

Kanji. A graphic character set for symbols used in Japanese ideographic alphabets.

kerning. The design of graphic characters so that their character boxes overlap, resulting in the reduction of space between characters. This allows characters to be designed for cursive languages, ligatures, and proportionally-spaced fonts. An example of kerning is the printing of adjacent graphic characters so they overlap on the left or right side.

keyword. A two-part self-defining parameter consisting of a one-byte identifier and a one-byte value.

L

LAN. See local area network.

landscape. A presentation orientation in which the X_m axis is parallel to the long sides of a rectangular physical medium. Contrast with *portrait*.

language. A set of symbols, conventions, and rules that is used for conveying information. See also *pragmatics*, *semantics*, and *syntax*.

LCID. See Local Character Set Identifier.

leading. A printer's term for the amount of space between lines of a printed page. Leading refers to the lead slug placed between lines of type in traditional typesetting. See also *internal leading* and *external leading*.

LID. See local identifier.

ligature. A single glyph representing two or more characters. Examples of characters that can be presented as ligatures are *ff* and *ffi*.

line attributes. Those attributes that pertain to straight and curved lines. Examples of line attributes are line type and line width.

line type. A line attribute that controls the appearance of a line. Examples of line types are dashed, dotted, and solid. Contrast with *line width*.

line width. A line attribute that controls the appearance of a line. Examples of line width are normal and thick. Contrast with *line type*.

local area network (LAN). A data network located on a user's premises in which serial transmission is used for direct data communication among data stations.

Local Character Set Identifier (LCID). A local identifier used as a character, marker, or pattern set attribute.

local identifier (LID). An identifier that is mapped by the environment to a named resource.

location. A site within a data stream. A location is specified in terms of an offset in the number of structured fields from the beginning of a data stream, or in the number of bytes from another location within the data stream.

logical page. A presentation space. One or more object areas or data blocks can be mapped to a logical page. A logical page has specifiable characteristics, such as size, shape, orientation, and offset. The shape of a logical page is the shape of a rectangle. Orientation and offset are specified relative to a medium coordinate system.

logical unit. A unit of linear measurement expressed with a unit base and units per unit-base value. For example, in MO:DCA and IPDS architectures, the following logical units are used:

- 1 logical unit = 1/1440 inch (unit base = 10 inches, units per unit base = 14400)
- 1 logical unit = 1/240 inch (unit base = 10 inches, units per unit base = 2400)

Synonymous with L-unit.

look-up table (LUT). A logical list of colors or intensities. The list has a name and can be referenced to select a color or intensity. See also *color table*.

lowercase. Pertaining to small letters as distinguished from capital letters. Examples of small letters are *a*, *b*, and *g*. Contrast with *uppercase*.

L-unit. See logical unit.

LUT. See look-up table.

Μ

mandatory support level. Within the base-and-towers concept, the smallest portion of architected function that is allowed to be implemented. This is represented by a base with no towers. Synonymous with *base support level*.

marker. A symbol with a recognizable appearance that is used to identify a particular location. An example of a marker is a symbol that is positioned by the center point of its cell.

marker attributes. The characteristics that control the appearance of a marker. Examples of marker attributes are size and color.

marker cell. A conceptual rectangular box that can include a marker symbol and the space surrounding that symbol.

marker precision. A method used to specify the degree of influence that marker attributes have on the appearance of a marker.

marker set. In GOCA, a set of graphic symbols used to indicate a position.

marker symbol. A graphic symbol that is used for a marker.

meaning. A table heading for architecture syntax. The entries under this heading convey the meaning or purpose of a construct. A meaning entry can be a long name, a description, or a brief statement of function.

measurement base. A base unit of measure from which other units of measure are derived.

media. Plural of medium. See also medium.

medium. A two-dimensional conceptual space with a base coordinate system from which all other coordinate systems are either directly or indirectly derived. A medium is mapped onto a physical medium in a device-dependent manner. Synonymous with *medium presentation space*. See also *logical page*, *physical medium*, and *presentation space*.

medium presentation space. A two-dimensional conceptual space with a base coordinate system from which all other coordinate systems are either directly or indirectly derived. A medium presentation space is mapped onto a physical medium in a device-dependent manner. Synonymous with *medium*. See also *logical page, physical medium*, and *presentation space*.

mil. 1/1000 inch.

mix. A method used to determine how the color of a graphics primitive is combined with the existing color of a graphics presentation space. See also *foreground mix* and *background mix*.

Mixed Object Document Content Architecture (MO:DCA). An architected, device-independent data stream for interchanging documents.

MO:DCA. See *Mixed Object Document Content Architecture*.

monospaced font. A font with graphic characters having a uniform character increment. The distance between reference points of adjacent graphic characters is constant in the escapement direction. The blank space between the graphic characters can vary. Synonymous with *uniformly spaced font*. Contrast with *proportionally spaced font* and *typographic font*.

move order. A drawing order that specifies or implies movement from the current position to a given position. See also *current position* and *given position*.

Ν

name. A table heading for architecture syntax. The entries under this heading are short names that give a general indication of the contents of the construct.

named color. A color that is specified with a descriptive name. An example of a named color is "green."

neutral white. A color attribute that gives a device-dependent default color, typically white on a screen and black on a printer.

no operation (NOP). A construct whose execution causes a product to proceed to the next instruction to be processed without taking any other action.

NOP. See no operation.

N-up. The presentation of a fixed number of pages on a side of a physical medium. For example, 4-up is the presentation of four pages on a side.

0

object. (1) A collection of structured fields. The first structured field provides a begin-object function, and the last structured field provides an end-object function. The object can contain one or more other structured fields whose content consists of one or more data elements of a particular data type. An object can be assigned a name, which can be used to reference the object. Examples of objects are text, font, graphics and image objects. (2) Something that a user works with to perform a task.

object area. In the MO:DCA and IPDS architectures, a rectangular area in a presentation space into which a data object is mapped. The presentation space can be for a page or an overlay. Examples are a graphics object area, an image object area, and a bar code object area.

object data. A collection of related data elements bundled together. Examples of object data include graphic characters, image data elements, and drawing orders.

offset. A table heading for architecture syntax. The entries under this heading indicate the numeric displacement into a construct. The offset is measured in bytes and starts with byte zero. Individual bits can be expressed as displacements within bytes.

online. A device state in which the device is under the direct control of a host. Contrast with *offline*.

order. Synonymous with drawing order.

orientation. The angular distance a presentation space or object area is rotated in a specified coordinate system, expressed in degrees and minutes. For example, the orientation of printing on a physical medium, relative to the X_m axis of the X_m , Y_m coordinate system. See also *text orientation*.

origin. The point in a coordinate system where the axes intersect. Examples of origins are the addressable position in an X_m, Y_m coordinate system where both coordinate values are zero and the character reference point in a character coordinate system.

orthogonal. Intersecting at right angles. An example of orthogonal is the positional relationship between the axes of a Cartesian coordinate system.

outline font. A shape technology in which the graphic character shapes are represented in digital form by a series of mathematical expressions that define the outer edges of the strokes. The resultant graphic character shapes can be either solid or hollow.

overlay. (1) A resource object that can contain text, image, graphics, and bar code data. Overlays define their own environment and are often used as electronic forms. (2) The final representation of such an object on a physical medium. Contrast with *page segment*.

overscore. A line parallel to the baseline and placed above the character.

overstrike. In PTOCA, the presentation of a designated character as a string of characters in a specified text field. The intended effect is to make the resulting presentation appear as though the text field, whether filled with characters or blanks, has been marked out with the overstriking character.

overstriking. The method used to merge two or more graphic characters at the same addressable position in a presentation space or on a physical medium.

Ρ

page. (1) A data stream object delimited by a Begin Page structured field and an End Page structured field. A page can contain text, image, graphics, and bar code data. In the IPDS architecture, a page can be copied a specified number of times with or without modification.
(2) The final representation of such an object on a physical medium.

page segment. (1) In the IPDS architecture, a resource object that can contain text, image, graphics, and bar code data. Page segments do not define their own environment, but are processed in the existing environment. (2) In MO:DCA, a resource object that can contain any mixture of bar code objects, graphics objects, and IOCA image objects. A page segment does not contain an active environment group. The environment for a page segment is defined by the active environment group of the including page or overlay. (3) The final representation of such an object on a physical medium. Contrast with *overlay*.

parameter. (1) A variable that is given a constant value for a specified application. (2) A variable used in conjunction with a command to affect its result.

pattern. A graphic symbol used repeatedly to fill an area.

pattern attributes. The characteristics that specify the appearance of a pattern.

pattern set. In GOCA, a set of graphic symbols used to fill the interior of an area.

pattern symbol. A graphic symbol that is used for a pattern.

pel. The smallest printable or displayable unit on a physical medium. In computer graphics, the smallest element of a physical medium that can be independently assigned color and intensity. Pels per inch is often used as a measurement of presentation granularity. Synonymous with *picture element* and *pixel*.

physical medium. A physical entity on which information is presented. Examples of a physical medium are a sheet of paper and a display screen. See also *medium* and *medium presentation space*.

physical printable area. A bounded area defined on the physical medium within which printing can take place. The physical printable area is an attribute of sheet size and printer capabilities, and cannot be altered by the host. The physical printable area is mapped to the medium presentation space, and is used in user printable area and valid printable area calculations. Contrast with *user printable area* and *valid printable area*.

picture element. Synonymous with pel.

pixel. Synonymous with pel.

point. (1) A unit of measure used mainly for measuring typographical material. There are seventy-two points to an inch. (2) In GOCA, a parameter that specifies the position within the drawing order coordinate space. See also *drawing order coordinate space*.

portrait. A presentation orientation in which the X_m axis is parallel to the short sides of a rectangular physical medium. Contrast with *landscape*.

position. A position in a presentation space or on a physical medium that can be identified by a coordinate from the coordinate system of the presentation space or physical medium. See also *picture element*. Synonymous with *addressable position*.

posture. Inclination of a letter with respect to a vertical axis. Examples of inclination are upright and inclined. An example of upright is Roman. An example of inclined is italics.

pragmatics. Information related to the usage of a construct. See also *semantics* and *syntax*.

presentation device. A device that produces character shapes, graphics pictures, images, or bar

code symbols on a physical medium. Examples of a physical medium are a display screen and a sheet of paper.

presentation position. An addressable position that is coincident with a character reference point. See also *addressable position* and *character reference point*.

presentation services. In printing, a software component that communicates with a printer using a printer data stream, such as the IPDS data stream, to print pages, download and manage print resources, and handle exceptions.

presentation space. A conceptual address space with a specified coordinate system and a set of addressable positions. The coordinate system and addressable positions can coincide with those of a physical medium. Examples of presentation spaces are medium, logical page, and object area. See also *graphics presentation space*, *logical page*, and *medium presentation space*.

presentation text object. An object that contains presentation text data. See also *object*.

Presentation Text Object Content Architecture (**PTOCA**). An architected collection of constructs used to interchange and present presentation text data.

process color. A color that is specified as a combination of the components, or primaries, of a color space. A process color is rendered by mixing the specified amounts of the primaries. An example of a process color is C=.1, M=.8, Y=.2, K=.1 in the cyan/magenta/yellow/black (CMYK) color space. Contrast with *spot color*.

prolog. The first portion of a segment's data. Prologs are optional. They contain attribute settings and drawing controls. Synonymous with *segment prolog*.

Proportional Spacing Machine font (PSM font). A font originating with the electric typewriter and having character increment values that are integer multiples of the narrowest character width.

proportionally spaced font. A font with graphic characters that have varying character increments. Proportional spacing can be used to provide the appearance of even spacing between presented characters and to eliminate excess blank space around narrow characters. An example of a narrow character is the letter *i*. Synonymous with *typographic font*. Contrast with *monospaced font* and *uniformly spaced font*.

PSM font. See Proportional Spacing Machine font.

PTOCA. See Presentation Text Object Content Architecture.

R

range. A table heading for architecture syntax. The entries under this heading give numeric ranges applicable to a construct. The ranges can be expressed in binary, decimal, or hexadecimal. The range can consist of a single value.

raster pattern. A rectangular array of pels arranged in rows called scan lines.

relative coordinate. One of the coordinates that identify the location of an addressable point by means of a displacement from some other addressable point. Contrast with *absolute coordinate*.

relative line. A straight line developed from a specified point by a given displacement.

relative metrics. Graphic character measurements expressed as fractions of a square, called the *Em-square*, whose sides correspond to the vertical size of the font. Because the measurements are relative to the size of the Em square, the same metrics can be used for different point sizes and different raster pattern resolutions. Relative metrics require defining the unit of measure for the Em square, the point size of the font, and, if applicable, the resolution of the raster pattern.

relative positioning. The establishment of a position within a coordinate system as an offset from the current position. Contrast with *absolute positioning*.

repeating group. A group of parameter specifications that can be repeated.

reserved. Having no assigned meaning and put aside for future use. The content of reserved fields is not used by receivers, and should be set by generators to a specified value, if given, or to binary zeros. A reserved field or value can be assigned a meaning by an architecture at any time.

reset color. The color of a presentation space before any data is added to it. Synonymous with *color of medium*.

resolution. (1) A measure of the sharpness of an input or output device capability, as given by some measure relative to the distance between two points or lines that can just be distinguished. (2) The number of addressable pels per unit of length.

resolution correction. A method used to present an image on a printer without changing the physical size or proportions of the image when the resolutions of the printer and the image are different.

resource. An object that is referenced by a data stream or by another object to provide data or

information. Resource objects can be stored in libraries. In MO:DCA, resource objects can be contained within a resource group. Examples of resources are fonts, overlays, and page segments.

retired. Set aside for a particular purpose, and not available for any other purpose. Retired fields and values are specified for compatibility with existing products and identify one of the following:

- Fields or values that have been used by a product in a manner not compliant with the architected definition
- Fields or values that have been removed from an architecture.

rotating. In computer graphics, turning all or part of a picture about an axis perpendicular to the presentation space.

rotation. The orientation of a presentation space with respect to the coordinate system of a containing presentation space. Rotation is measured in degrees in a clockwise direction. Zero-degree rotation exists when the angle between a presentation space's positive X axis and the containing presentation space's positive X axis is zero degrees. Contrast with *character rotation*.

row. A subarray that consists of all elements that have an identical position within the high dimension of a regular two-dimensional array.

rule. A solid line of any line width.

S

SAA. See Systems Application Architecture.

SAA environments. Those environments in which IBM intends to provide full implementation of applicable SAA architectural elements.

SBCS. See single-byte character set.

SBIN. A data type for architecture syntax, that indicates that one or more bytes be interpreted as a signed binary number, with the sign bit in the high-order position of the leftmost byte. Positive numbers are represented in true binary notation with the sign bit set to B'0'. Negative numbers are represented in twos-complement binary notation with a B'1' in the sign-bit position.

scaling. Making all or part of a picture smaller or larger by multiplying the coordinate values of the picture by a constant amount. If the same multiplier is applied along both dimensions, the scaling is uniform, and the proportions of the picture are unaffected. Otherwise, the scaling is anamorphic, and the proportions of the picture are changed. See also *anamorphic scaling*.

scaling ratio. The ratio of an image-block size to an image-presentation-space size.

scan line. A series of picture elements. Scan lines in raster patterns form images. See also *picture element* and *raster pattern*.

section. A portion of a double-byte code page that consists of 256 consecutive entries. The first byte of a two-byte code point is the section identifier. See also *code page* and *code point*.

section identifier. A value that identifies a section. Synonymous with *section number*.

section number. A value that identifies a section. Synonymous with *section identifier*.

segment. (1) In GOCA, a picture or sub-picture that consists of a Begin Segment command followed by drawing orders. See also *graphics segment*. (2) In IOCA, image content bracketed by Begin Segment and End Segment self-defining fields. See also *image segment*.

segment chain. A string of segments that defines a picture. Synonymous with *picture chain*.

segment exception condition. An

architecture-provided classification of the errors that can occur in a segment. Segment exception conditions are raised when a segment error is detected. Examples of segment errors are segment format, parameter content, and sequence errors.

segment offset. A position within a segment, measured in bytes from the beginning of the segment. The beginning of a segment is always at offset zero.

segment prolog. The first portion of a segment's data. Prologs are optional. They contain attribute settings and drawing controls. Synonymous with *prolog*.

segment properties. The segment characteristics used by a drawing process. Examples of segment properties are segment name, segment length, and segment prolog.

semantics. The meaning of the parameters of a construct. See also *pragmatics* and *syntax*.

shear. The angle of slant of a character cell that is not perpendicular to a baseline. Synonymous with *character shear*.

sheet. A physical entity on which information is printed. An example of a sheet is one piece of paper. Synonymous with *form*.

side. A physical surface of a sheet. A sheet has a front side and a back side. See also *sheet*.

simplex printing. A method used to print data on one side of a sheet; the other side is left blank. Contrast with *duplex printing*.

single-byte character set (SBCS). A character set that can contain up to 256 characters.

single-byte coded font. A coded font in which the code points are one byte long.

slope. The posture, or incline, of the main strokes in the graphic characters of a font. Slope is specified in degrees by a font designer.

spot color. A color that is specified with a unique identifier such as a number. A spot color is normally rendered with a custom colorant instead of with a combination of process color primaries. See also *highlight color*. Contrast with *process color*.

standard action. The architecture-defined action to be taken on detecting an exception condition, when the environment specifies that processing should continue.

stroke. A straight or curved line used to create the shape of a letter.

structured field. A self-identifying, variable-length, bounded record, which can have a content portion that provides control information, data, or both. See also *document element*.

structured field introducer. In MO:DCA, the header component of a structured field that provides information that is common for all structured fields. Examples of information that is common for all structured fields are length, function type, and category type. Examples of structured field function types are begin, end, data, and descriptor. Examples of structured field category types are presentation text, image, graphics, and page.

subset. Within the base-and-towers concept, a portion of architecture represented by a particular level in a tower or by a base. See also *subsetting tower*.

subsetting tower. Within the base-and-towers concept, a tower representing an aspect of function achieved by an architecture. A tower is independent of any other towers. A tower can be subdivided into subsets. A subset contains all the function of any subsets below it in the tower. See also *subset*.

symbol. (1) A visual representation of something by reason of relationship, association, or convention.
(2) In GOCA, the subpicture referenced as a character definition within a font character set and used as a character, marker, or fill pattern. A bitmap can also be referenced as a symbol for use as a fill pattern.

symbol set. A coded font that is usually simpler in structure than a fully-described font. Symbol sets are used where typographic quality is not required. Examples of devices that might not provide typographic quality are dot-matrix printers and displays. See also *character set, marker set, and pattern set.*

syntax. The rules governing the structure of a construct. See also *pragmatics* and *semantics*.

Systems Application Architecture (SAA). A set of IBM software interfaces, conventions, and protocols that provide a framework for designing and developing applications that are consistent across systems.

Т

text. A graphic representation of information. Text can consist of alphanumeric characters and symbols arranged in paragraphs, tables, columns, and other shapes. An example of text is the data sent in an IPDS Write Text command.

text orientation. A description of the appearance of text as a combination of inline direction and baseline direction. See also *baseline direction*, *inline direction*, and *orientation*.

text presentation. The transformation of document graphic character content and its associated font information into a visible form. An example of a visible form of text is character shapes on a physical medium.

toned. Containing marking agents such as toner or ink. Contrast with *untoned*.

trimming. Eliminating those parts of a picture that are outside of a clipping boundary such as a viewing window or presentation space. Synonymous with *clipping*.

triplet. A three-part self-defining variable-length parameter consisting of a length byte, an identifier byte, and one or more parameter-value bytes.

triplet identifier. A one-byte type identifier for a triplet.

truncation. Planned or unplanned end of a presentation space or data presentation. This can occur when the presentation space extends beyond one or more boundaries of its containing presentation space or when there is more data than can be contained in the presentation space.

type. A table heading for architecture syntax. The entries under this heading indicate the types of data present in a construct. Examples include: BITS, CHAR, CODE, SBIN, UBIN, UNDF.

typeface. All characters of a single type family or style, weight class, width class, and posture, regardless of size. For example, Sonoran Serif, Bold, Normal, Italics, in any point size.

type family. All characters of a single design, regardless of attributes such as width, weight, posture, and size. Examples are Courier and Gothic.

type structure. Attributes of characters other than type family or typeface. Examples are solid shape, hollow shape, and overstruck.

type style. The form of characters within the same font, for example, Courier or Gothic.

type weight. A parameter indicating the degree of boldness of a typeface. A character's stroke thickness determines its type weight. Examples are light, medium, and bold. Synonymous with *weight class*.

type width. A parameter indicating a relative change from the font's normal width-to-height ratio. Examples are normal, condensed, and expanded. Synonymous with *width class*.

typographic font. A font with graphic characters that have varying character increments. Proportional spacing can be used to provide the appearance of even spacing between presented characters and to eliminate excess blank space around narrow characters. An example of a narrow character is the letter *i*. Synonymous with *proportionally spaced font*. Contrast with *monospaced font* and *uniformly spaced font*.

U

UBIN. A data type for architecture syntax, indicating one or more bytes to be interpreted as an unsigned binary number.

unarchitected. Identifies data that is neither defined nor controlled by an architecture. Contrast with *architected*.

underscore. A method used to create an underline beneath the characters in a specified text field. An example of underscore is the line presented under one or more characters. Also a special graphic character used to implement the underscoring function.

UNDF. A data type for architecture syntax, indicating one or more bytes that are undefined by the architecture.

uniformly spaced font. A font with graphic characters having a uniform character increment. The distance between reference points of adjacent graphic characters is constant in the escapement direction. The blank space between the graphic characters can vary.

Synonymous with *monospaced font*. Contrast with *proportionally spaced font* and *typographic font*.

unit base. A one-byte code that represents the length of the measurement base. For example, X'00' might specify that the measurement base is ten inches.

untoned. Unmarked portion of a physical medium. Contrast with *toned*.

uppercase. Pertaining to capital letters. Examples of capital letters are *A*, *B*, and *C*. Contrast with *lowercase*.

user printable area (UPA). The portion of the physical printable area to which user-generated data is restricted. See also *logical page*, *physical printable area*, and *valid printable area*.

V

valid printable area (VPA). The intersection of a logical page with the area of the medium presentation space in which printing is allowed. If the logical page is a secure overlay, the area in which printing is allowed is the physical printable area. If the logical page is not a secure overlay and if a user printable area is defined, the area in which printing is allowed is the intersection of the physical printable area with the user printable area. If a user printable area is not defined, the area in which printing is allowed is the physical printable area. See also *logical page, physical printable area*.

vertical font size. (1) A characteristic value, perpendicular to the character baseline, that represents the size of all graphic characters in a font. Synonymous with font height. (2) In a font character set, nominal vertical font size is a font-designer defined value corresponding to the nominal distance between adjacent baselines when character rotation is zero degrees and no external leading is used. This distance represents the baseline-to-baseline increment that includes the font's maximum baseline extent and the designer's recommendation for internal leading. The font designer can also define a minimum and a maximum vertical font size to represent the limits of scaling. (3) In font referencing, the specified vertical font size is the desired size of the font when the characters are presented. If this size is different from

the nominal vertical font size specified in a font character set, the character shapes and character metrics might need to be scaled prior to presentation.

vertical scale factor. In outline-font referencing, the specified vertical adjustment of the Em square. The vertical scale factor is specified in 1440ths of an inch. When the horizontal and vertical scale factors are different, anamorphic scaling occurs. See also *horizontal scale factor*.

VPA. See valid printable area.

W

weight class. A parameter indicating the degree of boldness of a typeface. A character's stroke thickness determines its weight class. Examples are light, medium, and bold. Synonymous with *type weight*.

width class. A parameter indicating a relative change from the font's normal width-to-height ratio. Examples are normal, condensed, and expanded. Synonymous with *type width*.

window. A predefined part of a graphics presentation space. See also *graphics presentation space window*.

Χ

 $\mathbf{X}_{g}, \mathbf{Y}_{g}$ coordinate system. The graphics presentation space (GPS) coordinate system.

 $\mathbf{X}_{m}, \mathbf{Y}_{m}$ coordinate system. (1) In the IPDS architecture, the medium presentation space coordinate system. (2) In MO:DCA, the medium coordinate system.

 $\mathbf{X}_{oa}, \mathbf{Y}_{oa}$ coordinate system. The object area coordinate system.

 $\mathbf{X}_{\text{ol}}, \mathbf{Y}_{\text{ol}}$ coordinate system. The overlay coordinate system.

 X_{pg}, Y_{pg} coordinate system. The coordinate system of a page presentation space. This coordinate system describes the size, position, and orientation of a page presentation space. Orientation of an X_{pg}, Y_{pg} coordinate system is relative to an environment specified coordinate system, for example, an X_m, Y_m coordinate system.

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