IPDS Technical Reference 1

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Manuals for the IPDS card

Refer to the manuals that are relevant to what you want to do with the IPDS card.

⭐ Important

- Adobe® Acrobat® Reader®/Adobe Reader must be installed in order to view the manuals as PDF files.

IPDS Supplement (IPDS.pdf)

Explains how to configure the IPDS card for the machine. It also explains about items selectable from the Web browser.

IPDS Printing Configuration Guide (IPDS_CONF.pdf) *English Only

Explains about the environment necessary for connecting the mainframe to the machine and performing IPDS printing.

IPDS Technical Reference 1 (IPDS_TEC1.pdf) *English Only

Explains about commands and functions for IPDS printing.

IPDS Technical Reference 2 (IPDS_TEC2.pdf)*English Only

Explains about IPDS commands.

🔽 Note

- For details about the necessary environment and how to install the IPDS card and machine, consult your sales or service representative. For details about the necessary environments and operation of the mainframe, contact IBM.

Notice

Important

Contents of this manual are subject to change without prior notice.

In no event will the company be liable for direct, indirect, special, incidental, or consequential damages as a result of handling or operating the machine.

How to Read This Manual

Symbols

This manual uses the following symbols:

⭐ **Important**

Indicates points to pay attention to when using the machine, and explanations of likely causes of paper misfeeds, damage to originals, or loss of data. Be sure to read these explanations.

⬇ **Note**

Indicates supplementary explanations of the machine's functions, and instructions on resolving user errors.

[ ]

Indicates the names of keys on the machine's display or control panels.

About This Book

This book provides technical reference information about how printers support the IPDS data stream.

Audience

This publication is intended for the system programmers, application programmers, and systems engineers who are familiar with data streams and are writing or modifying programs to operate your printer with the IPDS data stream.

Terminology

Paper Input and Output Receptacles

Input receptacles are called trays. Output receptacles are called stackers or bins.

Related Publications

This book refers to the following:

- PostScript Language Reference Manual, second edition, by Adobe Systems, Inc.

- PCL 5 Printer Language Technical Reference Manual by Hewlett-Packard Company

- PCL 5 Comparison Guide by Hewlett-Packard Company

- Printer Job Language Technical Reference Manual by Hewlett-Packard Company

🔽 Note

- For details on the IPDS Architecture, see the Intelligent Printer Data Stream Reference, S544-3417.

About IPDS

This chapter introduces the Intelligent Printer Data Stream (IPDS) and describes some of the capabilities of IPDS.

IPDS lets you print pages containing an unlimited mix of different types of data: high-quality text, images, vector graphics, and bar codes.

You can send IPDS data to printers attached to the IBM Application System/400 (AS/400) intelligent work stations, local area networks, IBM 3270-family controllers, Ethernet, and spooled systems. In some of these environments, you can create applications to directly control IPDS printers such as this printer. For more information about IPDS as a component of printing subsystems, refer to Intelligent Printer Data Stream Reference.

IBM provides a variety of host software products with components that generate IPDS commands for this printer or other IPDS printers. These software products vary in their use of IPDS functions. Some of the software products available are:

- OS/400 Version 5.4 or later
- Graphical Data Display Manager (GDDM) Version 2.3 or later
- Print Service Facility (PSF for z/OS) Version 4.1.0 or later
- Print Service Facility (PSF for i5/OS and OS/400) Version 5.4 or later
- InfoPrint Manager for AIX Version 4.2 or later
- InfoPrint Manager for Windows Version 2.2 or later
- InfoPrint Process Director for Linux Version 1.3.1 or later
- InfoPrint Process Director for AIX Version 1.3.1 or later

🔽 Note

- The capabilities of the printer depend on the host software and the IPDS functions that the software enables.

Capabilities of IPDS

A printer controlled by IPDS has a number of advantages over conventional printers. With IPDS you can:

- Use the printer's all-points-addressable printing to print text, graphics, images, or bar codes at any point on a page or that is within the printers printable area.
- Print text in a variety of type styles and switch fonts within a printed page.
- Use both images and vector graphics (explained later in this chapter) to print line drawings, pie charts, bar charts, graphics, logos, tables, and signatures.
- Combine text with images and graphics on the same page (creating what is known as a composite document).
- Electronically store and later print forms and letterheads that are always printed in the same predetermined type style.
- Electronically store and later print text where the type style printed is the same as that used in the rest of the text.
- Print any of 16 different kinds of bar codes in many sizes and with a number of variations.
- Print either portrait (upright, letter orientation) or landscape (printing "on the side", with the page wider than it is tall).
- Print on either one side or both sides of the paper (with duplex option).

Printing a Letter

IPDS lets you print a letter in just one step. In conventional printing, you must load letterhead paper into your printer, print the text of your letter, and then manually sign the letter.
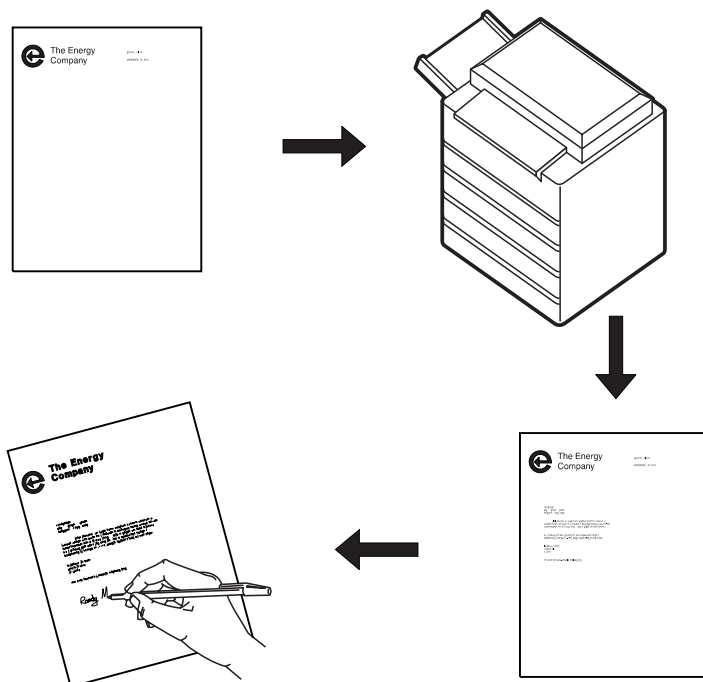
Using IPDS, you can temporarily store your letterhead and signature in the printer's memory and then merge the letterhead, text, and signature with additional data to form a complete letter. You can also include graphics, such as a line chart or bar chart, in your letter, creating a composite document.
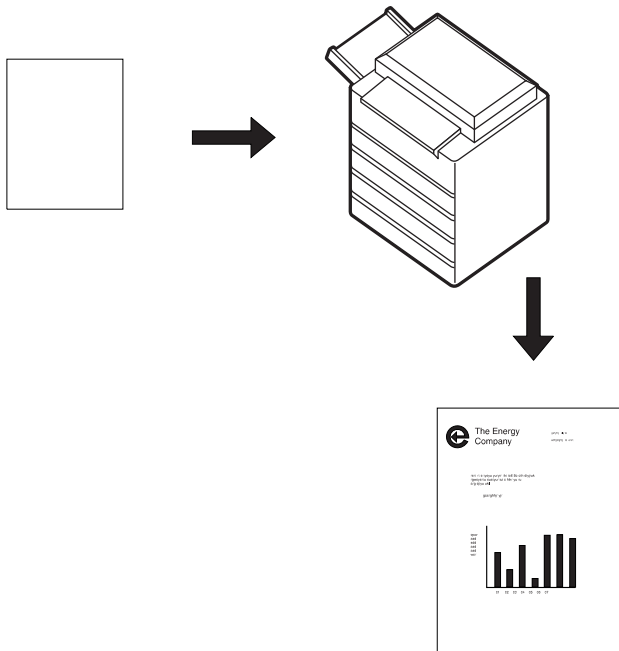
An IPDS-driven printer offers flexibility. For example, you can highlight a list of items by printing the list in a different type style from the rest of the text; or you can print your letterhead in one font and your text in another font.

You can electronically store your letterhead so it is always printed in the same type style. This printing concept is discussed in p.12 "Using Overlays".

You can store your printed signature block so it is printed in the type style used in the rest of the letter or memo. That way the signature block's type style matches the letter in which it appears, no matter how many different fonts you use for different kinds of letters. This printing concept is discussed in p.13 "Using Page Segments".

You can include bar charts or line graphs in your letter. Such graphic material can be generated through either the Image function or the Graphics function. See p.14 "Using Images and Graphics".

Using Overlays

Overlays are stored constructs (text, graphics, images, and bar codes), often in complex configurations, with all the instructions needed to print. An overlay always prints in the type style used when it was stored and can be positioned anywhere on the page.

Overlays are useful for letterheads and for forms, as shown below.

Electronically Stored Form Overlay

Variable Page Data

Merge

Finished Product

Using Page Segments

Page segments are similar to overlays, except that the construct is stored without specific instructions for type styles and position on the page. Page segments are printed in the type style in use at print time. You can place a page segment anywhere on the page.

One way to use a page segment is as text under a signature, as shown below.

Variable Page Data

MEMO ONE

TO: J.D. SWIFT
SALES DEPARTMENT

I AM IMPRESSED WITH YOUR
STEADY INCREASE IN SALES

LET'S GET TOGETHER AND
DISCUSS SOME STRATEGY.

CALL MY SECRETARY FOR
AN APPOINTMENT.

Fred Jones

FRED JONES
PRESIDENT

Stored Page Segment

Fred Jones

FRED JONES
PRESIDENT

MEMO TWO

From:

Fred Jones

FRED JONES
PRESIDENT

To: All Employees

Beginning this Friday
our work week will end
at 3 pm. Enjoy this
extra leisure time.

Using Images and Graphics

Graphic material - charts, engineering drawings, and line drawings - can be sent to the printer as IM Images, IO Images, or Graphics. In all-points-addressable printing by the printer, a page can consist of 300 points per inch, 7.8 million printable points, each one of which is individually addressable. These addressable points are called picture elements or pixels.

IM and IO Images

Images are figures on the page created by explicitly specifying each pixel in the figure. There is one bit of image data per pixel, so a large quantity of data is needed to create an image.

IM images are uncompressed raster data images. A raster pattern is composed of a series of pixels arranged in scan lines.

IO images are compressed or uncompressed raster data images. Compression generally reduces the amount of data sent to the printer and should significantly save transmission time. IO images may be arbitrarily scaled and corrected for resolution differences between the scanner and the printer.

Graphics
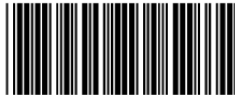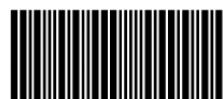
Graphics are line drawings created from separate lines, arcs, and markers. With vector graphics, only control information such as the end points of a line are sent to the printer. This process lets you create complex figures with a minimum of data.

For details on graphics commands, see IBM Data Stream and Object Architectures Graphics Object Content Architecture (GOCA) Reference, SC31-6804. For details on IO image commands, see IBM Data Stream and Object Architectures Image Object Content Architecture (IOCA) Reference, SC31-6805.

Using Bar Codes

Bar code data is encoded information that is recognized by optical scanning devices.

The printer can print the bar code types as shown below in many sizes and variations, such as with or without the human-readable characters.

123456 — 3 of 9 Alphanumeric	A - 0 0 - 2 9 - D — USS Codabar	1234567 — EAN-8
123456789012 — EAN-13	123456789 — Interleaved 2 of 5	12345 — Industrial 2 of 5

1234567890 — Matrix 2 of 5	1234567890 — MSI

1 12345678901 2 — UPC Version A See Note.	02345600005 — UPC Version E See Note.

Note: Also can have 2-digit and 5-digit supplemental the same as EAN 13 below.

3 4 5 6 7 / 12345678901234567 — EAN-13 with 5-Digit Supplemental	3 4 / 12345678901234 — EAN-13 with 2-Digit Supplemental

POSTNET	012 — CODE 128

Printing in Duplex Mode

The printer can print on one or both sides of the paper. All of the printer's IPDS capabilities are provided in either mode.

Duplex printing is controlled through the IPDS Load Copy Control (LCC) command.

1. IPDS Overview

About the IPDS Feature

The Intelligent Printer Data Stream (IPDS) is a structured field data stream designed to manage and control All Points Addressable (APA) printers. APA is a printing concept that allows users to position text, images, graphics, and overlays at any defined point on a printed page.

IPDS allows both data and commands to be streamed to the printer via channels, controllers or any type of networking link which supports the transparent transmission of data to print processes that are resident in the device.

Commands within the data stream also allow the "Host" process to control the media handling capabilities of the device, select source drawers, jog output and other operations dealing with paper. In addition, the commands provide the means for managing the downloading of fonts and other stored resources such as overlays and page segments that are required at presentation time to construct the printed page. Finally, the commands provide the means for returning error information and performing recovery actions. The source IPDS architecture document is the Intelligent Printer Data Stream Reference.

The machine supports the following IPDS Architecture command sets.

- Device Control (DC1)
- Text (TX1 with PTOCA PT1, PT2 and PT3)
- IM Image (IM1 with IMD1)
- IO Image (IO1 with IOCA FS10 + 8-bit Grayscale via halftoning), FS11, FS40, FS42 and FS45)
- Graphics (GR1 with GOCA DR/2V0)
- Page Segments (PS1)
- Object Container (OC1)
- Overlay (OL1)
- Loaded Font (LF1 and LF3)
- Bar Code (BC1 with BCD1)

IPDS Operating States

If the host sends a command inappropriate for the printer state, the printer returns an error code identifying the error and follows Exception Handling Control processing.

Home State

The following actions can force the printer to home state, regardless of the current state of the printer:

1. The Set Home State (SHS) command

2. The Execute Order Anystate--Discard Buffered Data (XOA/DBD) command

3. The printer's transmission of a NACK to the host

4. The Arctic link-level Clear command

5. Any non-IPDS print order in NDS (New Display System)

6. An NDS Reset order

7. An NDS System Status Available No Mode order

All these actions will also force the printer to an IPDS command boundary if it is not already on one. To interpret SHS or XOA/DBD, the printer and the host must already be in agreement as to where the IPDS command boundaries are.

Deactivation of fonts with the DF command occurs in Home State.

Overlay State

Overlays can be nested to a depth of 6 as indicated in the STM Overlay Command-Set Vector, see "Overlay Command Set", IPDS Technical Reference 2.

Font State

An operating state for downloading single-byte Coded Font patterns, Font Character Sets, and Code Pages.

IPDS Command Format

All IPDS commands are encoded in the following patterns:

Offset	Range	Meaning	Error Code
0-1	X'0005' X'7FFF'	LENGTH	X'0202..02'
2-3		COMMAND	X'8001..00'
	X'D601'	Manage IPDS Dialog	
	X'D603'	No Operation	
	X'D60F'	Load Font Index	
	X'D619'	Load Font Character Set Control	
	X'D61A'	Load Code Page Control	
	X'D61B'	Load Code Page	
	X'D61D'	Load Equivalence	
	X'D61F'	Load Font Control	
	X'D62D'	Write Text	
	X'D62E'	Activate Resource	
	X'D62F'	Load Font	
	X'D633'	Execute Order Anystate	
	X'D634'	Presentation Fidelity Control	
	X'D63C'	Write Object Container Control	

Offset	Range	Meaning	Error Code
2-3	X'D63D'	Write Image Control	
	X'D63E'	Write Image Control 2	
	X'D63F'	Load Font Equivalence	
	X'D64C'	Write Object Container	
	X'D64D'	Write Image	
	X'D64E'	Write Image 2	
	X'D64F'	Deactivate Font	
	X'D65B'	Deactivate Data-Object-Font Component	
	X'D65C'	Deactivate Data Object Resource	
	X'D65D'	End	
	X'D65F'	Begin Page Segment	
	X'D66C'	Data Object Resource Equivalence	
	X'D66D'	Logical Page Position	
	X'D66F'	Deactivate Page Segment	
	X'D67C'	Include Data Object	
	X'D67D'	Include Overlay	
	X'D67F'	Include Page Segment	
	X'D680'	Write Bar Code Control	

Offset	Range	Meaning	Error Code
2-3	X'D681'	Write Bar Code	
	X'D684'	Write Graphics Control	
	X'D685'	Write Graphics	
	X'D68F'	Execute Order Homestate	
	X'D697'	Set Home State	
	X'D69F'	Load Copy Control	
	X'D6AF'	Begin Page	
	X'D6BF'	End Page	
	X'D6CF'	Logical Page Descriptor	
	X'D6DF'	Begin Overlay	
	X'D6E4'	Sense Type and Model	
	X'D6EF'	Deactivate Overlay	
4		FLAGS (Active when Bit value = 1)	X'0204..02'
	Bit 0 0/1	Acknowledgement Required (ARQ)	
	Bit 1 0/1	Correlation Number Present	
	Bit 2 0/1	Acknowledgement Continuation	
	Bit 3-6 000	Reserved	
	Bit 7 0/1	Persistent NACK (DSC non-SNA ONLY, otherwise Reserved)	
5-6	X'0000'-X'FFFF'	CORRELATION ID	

1

1

Offset	Range	Meaning	Error Code
7		DATA - The specific operands, parameters and/or data fields as appropriate for the given command.	

Reserved Bytes

Throughout the command descriptions in the following chapters, some data fields, bytes, and bits are specified as reserved.

When the description for a reserved field, byte, or bit specifies "should be zero," the printer does not check the contents of the bytes or bits. The reserved data should be set to zero, because they could be defined in future changes to the printer. However, non zero values do not cause an error and are ignored by the printer.

When the description for a reserved field, byte, or bit specifies it "must be zero," the printer checks the contents of the bytes or bits and will return error status to the host if the field contains a non zero value.

Flag Byte

Bit 7 is the Persistent NACK bit for 3270 Non-SNA DSC (Data Stream Compatibility) Mode NACKs. This bit has no meaning in other attachment environments.

Valid values for the Acknowledge Reply Flag byte are described in the Intelligent Printer Data Stream Reference.

Correlation ID (CID)

The correlation ID (CID) is an identifier of a specific instance of an IPDS command.

It is used to correlate errors with the command that generated them.

It is not possible to correlate all errors with particular IPDS commands. Mechanism errors (for example, out of paper position checks and unpopulated character positions in resident fonts) are never correlated.

Therefore, it is possible for some NACKs to be returned without correlation numbers even if all downstream commands had correlation numbers.

Error Processing

The machine supports Page Continuation Action error processing. See Intelligent Printer Data Stream Reference for details.

The printer stops if there is a probability that it is not parsing commands correctly.

This means that, regardless of the setting of the Exception Handling Control (EHC) the printer will stop processing, send a NACK, and enter home state immediately if one of the following conditions occurs:

1. The command length is less than 5 (No correlation number present).

2. The command length is less than 7 (Correlation number present).

3. The command length is greater than 32767.

4. The command does not have X'D6' as the first byte of the command code.

5. The command does have X'D6' as the first byte but is otherwise unrecognized.

6. A resource download is interrupted, resulting in a purge of the partial resource object.

The maximum numbers of queued asynchronous and synchronous errors are as followed.

- One for ARCTIC and NDS DSC mode

- Seven for NDS LU1 mode

- Seven for TCP/IP mode

Intervention required and equipment check exception types will be reported for NDS and TCP/IP interface type.

Exception Highlight Support

If a position exception occurs and the "position-check highlight" flag (XOAEHC byte 2, bit 6) is on (B'1'), or if a Page Continuation Action (PCA) is taken for a position check, the approximate location of each unique occurrence of the position check will be highlighted with a Print-Error-Marker (PEM). Other exceptions detected in page state, or a derivative of page state, or when printing a medium overlay, which have a PCA defined, are also indicated by a PEM when the PCA is taken.

A PEM is a distinguishing mark which is placed in close proximity to the area on the page where the exception has occurred.

- The PEM for Position Check processing is a solid rectangular mark, placed in close proximity to the area on the page where the exception occurred. For the exception detected, the associated code (08C100) will be located at the top of the logical page, starting in the left hand corner.

- The PEM for PCA processing is a hollow rectangular mark enclosing a +, placed in close proximity to the area on the page where the exception has occurred, if the location can be accurately specified. For the exception detected, the associated code (040B00) will be located at the top of the logical page, starting in the left hand corner.

- Multiple exception code highlighting is limited to only the codes that will fit across the top of the logical page (10).
- PEM Size: 600 Pixel (80 by 80)

If error exception handling is set to allow printing of an undefined character, the undefined character will appear as:

- A Space if it is unprintable.
- The Character itself if printable.

Page and Copy Counters

Page and Copy Counter information is reported using the 18-byte counter format described in Intelligent Printer Data Stream Reference, section "Acknowledge Reply". The following counters are supported:

- Received Page
- Committed Page
- Committed Copy
- Operator Viewing Page
- Operator Viewing Copy
- Jam Recovery Page
- Jam Recovery Copy
- Stacked Page
- Stacked Copy

For Action Code 22, counters are adjusted as follows:

- Received Page - Actual Received Count
- Committed Page - Mapped to Stacked Page
- Committed Copy - Mapped to Stacked Copy
- Operator Viewing Page Counter - Mapped to Stacked Page Counter
- Operator Viewing Copy Counter - Mapped to Stacked Copy Counter
- Jam Recovery Page Counter - Mapped to Stacked Page Counter
- Jam Recovery Copy Counter - Mapped to Stacked Copy Counter
- Stacked Page Counter - Last value
- Stacked Copy Counter - Last Value

Data Types

The machine supports four different types of data that may be used to create an output page. These are: text, graphics, images, and bar codes. The printed page can include any combination of these data types.

Blocks of graphics, bar code or image data are presented as a single unit to the printer. The printer enters the appropriate "Block" State (graphics block, image block, bar code block) to create the entire data group for that block of data.

Page segments and Overlays are any combinations of text, graphics, bar codes and images. The printer can store these segments and overlays for later use as the page is created.

Text

Presentation Text is the data type used to present lines of character information on a logical page.

The information to be presented is represented as a string of graphic character IDs and X'2B' control sequences that are sent to the printer in the Write Text command (See "Write Text", IPDS Technical Reference 2). The initial conditions governing the presentation of the data are established via control parameters that are sent to the printer in the Logical Page Description command (See "Logical Page Descriptor", IPDS Technical Reference 2).

The source architecture document for Text is Presentation Text Object Content Architecture Reference.

Image

Image is the data type used to present rectangular arrays of raster data in an Image block area on a page.

This data may have been created originally by a scanning process or generated by a computer program. The machine supports the IM Image Function Set (See "IM Image Command Set", IPDS Technical Reference 2). and the IO Image Function Set (See "IO Image Command Set", IPDS Technical Reference 2).

The IM Image Function Set has a syntax and functional content that is based on AFPDS image arrays and cells. The IO Image Function Set has a syntax and functional content based on the IOCA architecture for image data (See Image Object Content Architecture Reference).

The raster data to be presented is represented as a sequence of scan lines 'm' lines deep by 'n' picture elements (pixels) wide. In IO image data, there may be more than one bit per pixel if the image data is grayscale encoded. The format of the data and the recording algorithms used to encode the image array are sent to the printer as control parameters of the Write Image Control 2 command that prepares the printer for processing image data. The data itself is sent in the Write Image 2 command.

Graphics

Graphics is the data type used to present line art picture drawings in a graphics block area on a page.

The information to be presented is represented by a sequence of primitive drawing orders that are used by the device to construct arcs, lines, fillets, character strings, markers and other elements that define the drawing. These primitive orders, in turn, are grouped into one or more drawing segments that are executed to present the picture.

The Write Graphics Control command (See "Graphics Command Set", IPDS Technical Reference 2) is sent to the printer to establish the clipping window control parameters and initial drawing conditions to be used in presenting the picture data. The picture segments are sent to the printer as data in zero or more Write Graphics commands of the architecture.

The graphics drawing orders are summarized in "Drawing Orders", IPDS Technical Reference 2. The source architecture document for graphics data is the Graphics Object Content Architecture Reference.

Bar Code

Bar Code is the data type used to present machine-scannable bar code symbols in a bar code block area on a page.

The Write Bar Code Control command (See "Bar Code Command Set", IPDS Technical Reference 2) is sent to the printer to establish the bar code pattern parameters to be used in presentation. Data for the bar code symbols is sent to the printer in zero or more Write Bar Code commands.

Coordinate System

Xm, Ym Coordinate System (Medium Presentation Space)

1

The Xm, Ym coordinate system is the medium presentation space coordinate system. The origin of this system (Xm=0, Ym=0) can be set by the IPDS XOH Set Media Origin command to any of the four corners of the media. If this command is not sent to the printer the origin is the top-left corner (viewed from the center). In this case, positive Xm values begin at the origin and increase along the top edge from left to right. Positive Ym values begin at the origin and increase along the left side from top to bottom. Top is defined as the short edge which leads into the printer. See Intelligent Printer Data Stream Reference for a description of the Xm, Ym Coordinate System and default media origin for envelopes.

Xp, Yp Coordinate System (Logical Page Presentation Space)

Identifying the Size of the Logical Page or Overlay

The size of the logical page or overlay presentation space is set during a printer initialization using the "IPDS Initialization Defaults" or by the host program when it sends a Logical Page Descriptor command.

Overlays are logical pages and are handled as such by the printer with the following special considerations:

1. Overlays are positioned in relationship to the logical page presentation space origin (Xp=0, Yp=0) when they are merged with the Include Overlay command.

2. Overlays are positioned in relationship to the origin of the medium presentation space (Xm=0, Ym=0) when they are merged with the Merge Overlay keyword in a copy control record.

🅔 Reference

I, B Coordinates System (Text)

The +I and +B directions for the logical page or overlay are specified in degrees of rotation in relationship to the +Xp direction on the logical page.

The printer sets the +I and +B directions during the initialization through the "IPDS Initialization Defaults". The host program can change the +I and +B directions through the Logical Page Descriptor command (See Intelligent Printer Data Stream Reference).

The host program can also change the +I and +B directions as it builds a page or overlay through text controls in the print data sent by a Write Text command (See "Write Text", IPDS Technical Reference 2).

🔻Note

- Setting the orientations of the +I and +B axes also implicitly sets their origins as one of the four corners of the logical page or overlay.

📑Reference

- For details about the "IPDS Initialization Defaults", see p.39 "IPDS Initialization Defaults".

Other Text Positioning Terms

Some other terms that relate to text positioning and fonts include:

Text Orientation

The combination of the inline sequence direction (the direction which characters are added to a line) and the baseline sequence direction (the direction which lines are added to a page or overlay) identify the text orientation for a page. The inline sequence direction can be 0, 90, 180 or 270 degrees. The machine supports baseline sequence directions that are always rotated plus or minus 90 degrees from the inline sequence direction. Therefore, there are eight text orientations for printing pages or overlays.

Printing Baseline

An imaginary line that extends across the page or overlay in the positive inline sequence direction (+I), between pixels, and beginning from the baseline sequence printing coordinate (Bc). (Sometimes shown as baseline as in the font terms baseline offset and baseline extent.)

In languages with a right to left or left to right reading order (for example, English), the printing baseline is the imaginary line on which the main body of the character appears to rest. Descenders (the "tails" of lower case g, j, p, q, and y characters) usually extend below the printing baseline.

In languages with a top to bottom reading order (for example, Kanji), the printing baseline is an imaginary vertical line that passes through the center of the character.

Each font index record contains a Font Inline Sequence field. The field value specifies a relationship between the inline sequence direction and the font rotation (the character pattern rotation for the font). The printer uses the font index record to identify how to place characters on the printing baseline for a page or overlay. The characters are placed in the combination of the inline sequence direction (the printing direction) and the font rotation.

The Baseline Offset value is another field in the font index record. This value locates the printing baseline relationship to a specified character box reference edge.

Notation Conventions

Some field values (or ranges of values) are specified assuming a unit of measure of 14400 L-units per 10 inches (5670 L-units per 10 centimeters). To determine supported values for a unit of measure of 2400 L-units per 10 inches (945 L-units per 10 centimeters) use the following steps.

1. Convert the specified value from hex (2's complement) to decimal.

2. Divide the + or - decimal number by 6.

3. Round to the nearest integer.

4. Convert the + or - decimal value back to hex (2's complement).

For example, if the specified value is X'8000' the following steps would be performed.

1. 8000(H) = -32768(D)

2. -32768/6 = -5461.333

3. -5461(D) = EAAB(H)

Color Simulation

This printer provides "limited color simulation" by either simulating with generated grayscales or substituting "black" in special cases.

- Data objects whose colors are simulated with "grayscale":
    - PTOCA (characters, underscores, overscores, text rules)
    - GOCA (characters, lines, arcs, image, solid-area fill, pattern fill)
    - IM1/IOCA (bi-level image)
    - Object Areas (Pages, Overlays, BCOCA and IOCA)
- Data objects whose colors are simulated with "black":
    - GOCA Markers
    - BCOCA Bar Code Symbols and HRI
- Full Color Image is not supported on this printer since the transformation to grayscale would be very costly from a performance perspective. Host utilities are available to convert full color images to bi-level images for printing on monochrome printers.
- Grayscale Image (8 bits/pixel) is supported on this printer, however for very large images unacceptable performance degradation may result, due to the dithering process to produce bi-level image.

Simulation Modes Supported

There are two color simulation modes that may be supported:

- Legacy Mode (Substituting "black" or Pattern Creation)
- Fidelity Mode (Simulation with Grayscale)

The machine supports both the Legacy Mode and the Fidelity Mode of color simulation.

The Legacy Mode is provided to support customer legacy applications where simulation with grayscale would produce unacceptable results. There are console configuration menus to allow customers to select what level of color simulation best meets their needs. There are also console configuration menus to allow customers to select whether or not Color PTOCA (text) Objects should be simulated with grayscale or rendered with black. Rendering all PTOCA objects with black may be desirable, especially when small fonts are utilized.

Color Simulation Processes and Algorithms

To allow printing of documents containing color specifications, the specified colors in the document should be simulated in a consistent and predictable manner.

Color simulation occurs independently at the object level.

- Named Colors

    Convert Named Color to RGB Process Color using the following table.

This table defines the valid color values used to specify named colors in PTOCA, GOCA, BCOCA, IOCA and IM objects. The table also specifies the RGB values for each named color, assuming that each component is specified with 8 bits and that the component intensity range 0 to 1 is mapped to the binary value range 0 to 255. For a definition of the supported colors for individual objects refer to the appropriate OCA specifications, since some objects only support a subset of the colors.

Range	Named Color	Red (R)	Green (G)	Blue (B)
X'0000' or X'FF00'	Printer Default (Black)	0	0	0
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	
X'0005' or X'FF05'	Turquoise (cyan)	0	255	255
X'0006' or X'FF06'	Yellow	255	255	0
X'0007'	White	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	147	170
X'000E'	Mustard	196	160	32

Range	Named Color	Red (R)	Green (G)	Blue (B)
X'000F'	Gray	131	131	131
X'0010'	Brown	144	48	0
X'FF07'	Printer Default (Black)	0	0	0
X'FF08'	Color of Medium (Reset)			

– Simulate RGB Process Color with Grayscale

- Full-process Colors. To maintain output consistency across different printer families, process colors to be simulated are converted to grayscale intensities based on color "luminance" (Y). A luminance of 0 is defined to be black and a luminance of 1 is defined to be white. CIE luminance (Y) is derived using the following "architected" equations:

  RGB Color Space:

  Where Y=0 is black, Y=1 is white

  $Y = 0.212(R) + 0.701(G) + 0.087(B)$

  assuming 0 R,G,B 1

  Where R, G and B represent the non-gamma-corrected (linear) red, green and blue components.

  CIELab Color Space:

  CIELab space is the exception where the current implementation directly utilizes Lightness (L).

  $L = L$

  assuming 0 L 100

  CMYK Color Space:

  Where Y=0 is black, Y=1 is white

  $Y = 1 - min(1,(0.212C+0.701M+0.087Y+K))$

  assuming 0 C,M,Y,K 1

  Where the function min (a,b) selects the smaller of (a,b).

- Highlight Colors

  Color Mapping Tables (CMT) are not supported, therefore mapping to process color is not provided.

- Highlight colors are mapped to black with the % coverage applied to produce a gray level.

Logical Page and Object Area Coloring

Color Specification

The Color Specification triplet is used to specify the foreground color of the logical page or object area before any object data is placed on the logical page or object area.

Offset	Range	Meaning	Error Code
0	X'0E'-X'10'	TRIPLET LENGTH	X'020E..01'
1	X'4E'	COLOR SPECIFICATION TRIPLET	
2	X'00'	RESERVED	
3		COLOR SPACE (Note 1)	X'020E..02'
	X'01'	RGB - Limited Simulated Color Support	
	X'04'	CMYK - Limited Simulated Color Support	
	X'06'	Highlight - Limited Simulated Color Support	
	X'08'	CIELAB - Limited Simulated Color Support	
	X'40'	Standard OCA - Limited Simulated Color Support	
4-7	X'00000000'	RESERVED	

Offset	Range	Meaning	Error Code
8		1ST COLOR COMPONENT BITS	X'020E..05'
	X'01' - X'08'	(RGB, CMYK, CIELAB)	
	X'10'	(Standard OCA, Highlight)	
9		2ND COLOR COMPONENT BITS	X'020E..05'
	X'00' - X'08'	(RGB, CMYK, Highlight, CIELAB)	
10		3RD COLOR COMPONENT BITS	X'020E..05'
	X'00' - X'08'	(RGB, CMYK, CIELAB)	
11		4TH COLOR COMPONENT BITS	X'020E..05'
	X'00' - X'08'	(CMYK)	

Offset	Range	Meaning	Error Code
12-15		COLOR VALUE	X'020E..03'
		RGB Color Space	X'020E..04'
	X'nn'	Red Intensity	
	X'nn'	Green Intensity	
	X'nn'	Blue Intensity	
		CMYK Color Space	
	X'nn'	Cyan Intensity	
	X'nn'	Magenta Intensity	
	X'nn'	Yellow Intensity	
	X'nn'	Black Intensity	
		Highlight Color Space	
	X'nnnn'	Highlight Color Number	
	X'nn'	Percent Coverage	
	X'nn'	Percent Shading	
		CIELAB Color Space	
	X'nn'	Luminance (L)	
	X'nn'	Chrominance Difference (a)	

Offset	Range	Meaning	Error Code
12-15	X'nn'	Chrominance Difference (b)	
		Standard OCA Color Space	
	X'0000' or X'FF00'	Printer Default (Black)	
	X'0001' or X'FF01'	Blue	
	X'0002' or X'FF02'	Red	
	X'0003' or X'FF03'	Pink	
	X'0004' or X'FF04'	Green	
	X'0005' or X'FF05'	Turquoise	
	X'0006' or X'FF06'	Yellow	
	X'0007'	White - Color of Medium (Reset)	
	X'0008'	Black	
	X'0009'	Dark Blue	
	X'000A'	Orange	
	X'000B'	Purple	
	X'000C'	Dark Green	
	X'000D'	Dark Turquoise	
	X'000E'	Mustard	
	X'000F'	Gray	
	X'0010'	Brown	
	X'FF07'	Printer Default (Black)	
	X'FF08'	Color of Medium (Reset)	

Presentation Space Reset Mixing

The Presentation Space Reset Mixing triplet is used to specify whether or not a logical page or object area is reset to the color of medium before any object data is placed on the logical page or object area.

Offset	Range	Meaning	Error Code
0	X'03'	TRIPLET LENGTH	X'020E..01'
1	X'70'	PRESENTATION SPACE RESET MIXING TRIPLET	
2	Bit 0 0	MIXING FLAGS Do not reset to color of the logical page to color of medium.	
	Bit 0 1	Reset to color of the logical page to color of medium.	
	Bits 1-7 0000000	Reserved	

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2. Summary of IPDS Commands

IPDS Initialization Defaults

This chapter lists the IPDS commands that can be used with the printer. For more information about how to use these commands, see the Intelligent Printer Data Stream Reference.

Printer commands listed on the following pages are the valid values as identified in Intelligent Printer Data Stream Reference unless otherwise noted. Where the IPDS architecture allows choices, those choices are indicated.

When you set the printer power switch to the On (|) position, various IPDS data stream parameters are set to their initialization default values. These values are used for control parameters when:

- The command stream specifies that the printer default should be used,

- No explicit values are specified in the command stream sent to the printer, or

- Previously transmitted values are lost and initial machine settings are reestablished at POR time.

These values remain in effect until overridden by specific data stream commands from the host application program. The following list of values remain in effect until explicitly overridden by the following IPDS commands:

- Load Copy Control

- Load Font Equivalence

- Logical Page Descriptor

- Logical Page Position

- XOA Exception Handling Control

- XOH Select Input Media Source

- XOH Set Media Origin

- XOH Set Media Size

- Text Control Sequences (STO, SIM, SIA, SBI, SCFL, STC, DIR, and DBR)

Meaning	Default Value
L-Units Base Value	X'00' (10 inches)
L-Units per Base	X'3840' (14400 per 10 inches)
Input Media Source	Determined by the printer's control panel, Forms Device Setting
Media Origin	X'00' (top-left)

Meaning	Default Value
Width of the Physical Page	Derived from X-Extent of Medium Presentation Space
Length of the Physical Page	Derived from Y-Extent of Medium Presentation Space
Width of the Logical Page in L-Units (X p-Extent)	Derived from X-Extent of Medium Presentation Space
Length of the Logical Page in L-Units (Y p-Extent)	Derived from Y-Extent of Medium Presentation Space
Ordered Data Flags	X'00' (Unordered page, block, and text flags)
Inline Sequence	X'0000' (0 degrees)
Baseline Sequence	X'2D00' (90 degrees)
Initial I Print Coordinate	X'0000'
Initial B Print Coordinate	X'00C0' (192 L-Units below the logical page origin) Text printing on the first line requires the Current B Text Position to be large enough to accommodate the height of the current font.
Xm-Coordinate page origin	X'000000' Logical page X-displacement from the physical page origin (0 in)
Ym-Coordinate page origin	X'000000' Logical page Y-displacement from the physical page origin (0 in)
Initial Inline Margin in L-Units	X'0000'
Inter-character Adjustment	X'0000'
Baseline Increment	X'00F0' (240 L-Units)
Text Color	Black
Code Page ID	From configuration settings

Meaning	Default Value
Font Type	Font selection from configuration settings. The default font may be changed to another font which supports the selected Code Page. For printer generated bar codes with human readable information (HRI), the default font is OCR-B (UPC and EAN bar code types) or OCR-A (other bar code types with HRI).
Exception Handling Control	X'C10101' Report undefined characters, position checks, and all other exceptions. Do not take Alternate Exception Action. Terminate, print page, and go to home state. No highlighting of position checks.
Number of Copy Groups	X'01'
X-Extent of Medium Presentation Space	Determined by Configuration
Y-Extent of Medium Presentation Space	Determined by Configuration
X Coordinate (logical page origin)	X'0000'
Y Coordinate (logical page origin)	X'0000'
Xp-Extent of Logical Page	Derived from X-Extent of Medium Presentation Space
Yp-Extent of Logical Page	Derived from Y-Extent of Medium Presentation Space
Code Page Global ID (CPGID)	Determined by Configuration
Font Global ID (FGID)	Determined by Configuration
Font Width (FW)	Determined by Configuration
Copy Group Definition Length	X'04' (The default copy group definition is four bytes long.)
Number of Identical Copies	X'01' (The printer prints one copy of each page.)
Keyword Entry	X'C100' (The printer prints simplex, no text suppression, no overlays.)

Page Printer Initialization Sequence

Before printing begins, the host may determine characteristics of the printer and its resources and may specify certain parameters related to subsequent printing.

Following is a typical sequence of initialization commands.

- Sense Type and Model (STM) with ARQ
- XOH Obtain Printer Characteristics (OPC) with ARQ
- Set Home State (SHS)
- Logical Page Descriptor (LPD)
- Logical Page Position (LPP)
- Load Copy Control (LCC)
- Load Font Equivalence (LFE) with ARQ

3. IPDS Command Set

About IPDS Command Set

For details about following IPDS command sets, see IPDS Technical Reference 2.

- Device Control Command Set
- Presentation Text Command Set
- IM Image Command Set
- IO Image Command Set
- Graphics Command Set
- Bar Code Command Set
- Overlay Command Set
- Page Segment Command Set
- Object Container Command Set
- Loaded Font Command Set

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4. Exception Reporting, Sense Data, and Recovery

About Exception Reporting, Sense Data, and Recovery

This chapter supplies information about Acknowledge Reply, which the IPDS uses for exception reporting.

The chapter begins with general information followed by tables of the exception reporting codes for the printer. The tables contain details about the specific exceptions. The chapter concludes with a section on printer counter adjustments.

🔽Note

- When you have questions about codes from the printer, use this chapter instead of the exception-reporting chapter in the Intelligent Printer Data Stream Reference. Although the two chapters are similar, this chapter contains only those exception codes that the printer returns.

General Reply Rules

IPDS uses the Acknowledge Reply command to return both positive and negative replies to the host.

Positive messages are Acknowledge Replies. The negative messages (exception messages) are NACKs and are sent as sense-byte information in the special data area. For more information about Acknowledge Replies, see "Device Control Command Set", IPDS Technical Reference 2.

The following general rules apply to printer replies:

- The printer reports a data-stream exception with a NACK. Only one exception can be returned in each NACK.

- The printer sends an ACK or a NACK in response to an Acknowledgement Required (ARQ) flag. If there is an exception, the printer sends a NACK without receiving an ARQ.

- If the printer receives a command requesting an acknowledgement, it expects the host to wait for the acknowledgement before sending more commands.

- Any data received after an exception is reported is discarded until all queued NACKs have been either sent to the host or cleared by an appropriate linklevel command. An exception on a command can be reported before receiving the entire command data. When an Alternate Exception Action (AEA) or Page Continuation Action (PCA) is not to be taken, the next data received should be part of a new command. Otherwise, an 8001..00 exception may result. The printer might not discard the remaining bytes in a command with an error when reported. Therefore, the next data received should be the start of a new command. As a result, begin the host

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data re-transmission only after a synchronizing command (such as XOH Print Buffered Data or XOA Discard Buffered Data) is successfully acknowledged. A terminating condition causes the first NACK to be reported. The next NACK is reported when the next five bytes of data are received. This is usually an IPDS command header. Reporting a NACK discards all data currently received. The process of receiving five bytes and sending a NACK repeats until the NACK queue is exhausted or cleared by the appropriate link-level command.

- An ACK indicates that the data stream was checked and that commands were transformed into the printer's internal command language, with the following exceptions: – Asynchronous-position exceptions and undefined character exceptions are not detected until print time. – The data stream is not checked when IPDS is being saved for future use, as in overlays and page segments, and when more than one copy group is specified in a Load Copy Control (LCC) command. An exception in an overlay or page segment is reported synchronously with the End Page (EP) command on the page it is used. An exception in a saved copy group is reported synchronously after the EP command; that is, in the next command after the EP.

- The XOA Exception-Handling Control (EHC) order tells the printer how to handle exceptions. More information about the EHC order follows.

Exception-Handling Control (EHC)

The EHC order lets you control the three exception-handling functions listed below. Brief descriptions of the functions follow this listing.

- Exception Reporting. You can record three types of exception conditions and related exception information and have them reported at specified times using NACKs.

- Alternate Exception Actions (AEA). You can specify whether the printer is to take Alternate Exception Actions (AEAs), which prescribe actions to take when the printer is given an IPDS command or parameters it does not support.

- Exception-Presentation Processing. The exception-presentation processing function has two parts:

  - Page Continuation Actions (PCA). You can specify whether to end or continue processing a page that has an exception.

  - Exception Page Print. You can specify whether the printer is to print or discard a page that was terminated.

Exception Reporting

Use the exception-reporting bits in the Exception-Handling Control (EHC) record to control the recording and reporting of three classes of exceptions:

- Undefined characters

- Position exceptions

- All other exceptions that have AEAs.

When you instruct the printer to record a given class of exception, it always records exceptions that fit in that class. If you instruct the printer not to record a given class of exception, the printer still records such exceptions if the printer was told not to take the AEA.

Classes of Data Stream Exceptions

All printer data stream exceptions are returned in 24 bytes of detailed sense information in the special data area of the NACK. The exception-code identifier consists of three bytes: 0, 1, and 19. Byte 0 specifies the exception class; bytes 1 and 19 identify the particular exception.

The six classes of data-stream exceptions are:

- Command Reject
- Intervention Required
- Equipment Check
- Data Check
- Specification Check
- IO Images
- Bar Codes
- Graphics
- General
- Conditions Requiring Host Notification.

For details, see p.51 "Exception-Reporting Codes".

Sense Byte Information

The following list gives details of the information in each sense byte.

Byte(s)	Meaning
0	Defines the exception class for the specific exception. It is the first byte of each 3-byte exception ID.
1	Together with sense byte 19, byte 1 defines the specific exception within an exception class. It is the second byte of each 3-byte exception ID.
2	Contains exception-recovery action codes that specify the required actions for the exception conditions. For details, see p.48 "Action Codes in Sense Byte 2".

Byte(s)	Meaning
3	Reserved
4 through 18	Describe the specific cause in three separate formats: • Format 0 Provides details about all data stream exceptions other than data check positioning exceptions. • Format 2 Provides details about device exceptions, including intervention-required exceptions, equipment-check exceptions, and conditions requiring host notification. • Format 7 Provides details about data check positioning exceptions. For details about formats, see p.49 "Formats 0, 1, and 2 for Sense Bytes 4-18 and 20-23".
19	Together with sense byte 1, byte 19 defines the specific exception within an exception class. It is the third byte of each 3-byte exception ID.
20 through 23	Contain additional information about the state of the printer when it senses an exception.

Action Codes in Sense Byte 2

The action codes in sense byte 2 classify the exception to assist host-exception recovery and allow printing to continue. The action codes listed are the only ones returned by the printer.

Action Code (in hex)	Exception-Recovery Action
01 Data Stream Exception	A syntax error exists in the IPDS data stream. The specific recovery actions depend on the specific exception (sense bytes 0, 1, and 19 in the tables of printer exception codes) and host support requirements. Data stream exceptions occur on the page or resource just before the received page counter.
08 Paper Jam	The printer detects a paper jam. Retransmit all pages and associated resources (overlays, page segments, and fonts) that have not passed the printer-defined jam recovery point.

Action Code (in hex)	Exception-Recovery Action
09 Data-Related Print Exception	A sheet cannot be printed because of something within the data stream. The data might be too complex, too dense, or the media source selected might be incompatible with the media destination selected. The printer has discarded all buffered pages and modified the page and copy counters.
0C Resource Storage Exception	The printer cannot accept a page or resource (overlay, page segment, or font) because the storage area is full. Delete all resources not necessary to continue printing and retransmit the page in progress. If this action fails, the recovery action depends on host support requirements.
15 Cancel	The printer operator requests that the current job be canceled. Cancel the job containing the page at the host-defined canceling point.
1A Re-drive Buffered Pages	The printer may not be in Ready State, may need paper or toner, or may have a full exit tray. Take the appropriate recovery action for the exception code and retransmit all pages and associated resources that have not been committed for printing.
1D Printer Characteristics Changed	At least one of the printer characteristics that is reported in the reply to an XOH OPC command has changed. The host should issue an XOH OPC command to obtain the new printer characteristics.
1E Asynchronous Out-of-Storage Exception	A resource or a page that is not currently being received at the Received Page ID caused an out-of-storage exception. The printer has discarded all buffered pages and reset the page and copy counters.

The page on which this exception was discovered will not print.

The host must issue an XOH PBD to ensure that the page and copy counters are accurately adjusted. After the XOH PBD has returned an ACK, the page in error is the page just before the Committed Page Counter. Cancel the printed data containing the page just before the Committed Page ID. |
| 22 Printer Communications Inoperative | A printer condition exists from which the printer cannot recover without operator intervention. End the communication and the session. |

Formats 0, 1, and 2 for Sense Bytes 4-18 and 20-23

Sense bytes 4 through 18 and 20 through 23 describe the cause of each exception condition. (Sense byte 19 is byte 3 of the exception code.) These descriptions are presented in three separate formats, which are explained below.

Format 0

Format 0 provides detailed information for all data stream exceptions except data check positioning exceptions. This format applies to all data check, specification-check, and command-reject exceptions, except for exceptions X'08C1..00', X'020A..05', and X'0411..00'.

Byte(s)	Meaning
4	Data exception, X'DE'
5	Format Identifier, X'00'
6,7	Count of occurrences of the exception (the printer provides an approximate count of occurrences of some exceptions)
8,9	ID of overlay that has an exception
10,11	ID of page segment that has an exception
12,13	Command in process when exception found
14,15	Object Identifier (other than overlay or page segment that has an exception, such as a font exception)
16,17	Identifies a part within an object that has the exception, such as " font"
18	Reserved
20-23	Page Identifier for the page that has the exception

Format 1

Format 1 provides detailed information for both data check positioning exceptions. This format applies only to data check exceptions X'08C1..00', X'020A..05', and X'0411..00'.

Byte(s)	Meaning
4	Data exception, X'DE'
5	Format Identifier, X'01'
6, 7	Count of occurrences of the exception (the printer provides an approximate count of occurrences of some exceptions)
8, 18	Reserved
20-23	Page Identifier for the page that has the exception

Format 2

Format 2 provides detailed information for all device exceptions. This format applies to all intervention-required and equipment-check exceptions and for conditions requiring host notification.

Byte(s)	Meaning
4	System Reference Code, X'BF'
5	Format Identifier, X'02'
6-23	Format Identifier, X'02'

Exception-Reporting Codes

The following tables describe all printer exception codes that are returned to the host in the special data area of a NACK.

Each exception code is identified by three bytes: byte 0, byte 1, and byte 19. The first table lists the names of the exception classes which are returned in byte 0. The subsequent tables give detailed information about each of the groups listed in the first table.

⬇Note

- The printer provides an approximate count of occurrences of some exceptions.

Exception Classes

Sense Byte 0	Exception Class and Description
X'80'	Command Reject—the printer cannot recognize a received command.
X'50'	Equipment Check with Intervention Required—the printer detects a condition caused by hardware failure or hardware limitations, and manual intervention at the printer is required.
X'40'	Intervention Required—the printer detects a condition that requires manual intervention, such as "out of paper".
X'20'	Reserved
X'10'	Equipment Check—the printer detects an equipment malfunction or hardware error.

Sense Byte 0	Exception Class and Description
X'08'	Data Check—the printer detects a position exception or an undefined character exception.
X'05'	Specification Check - IO Images—the printer detects an invalid or unsupported data value in an IO image command.
X'04'	Specification Check - Bar Codes—the printer detects an invalid or unsupported data value in a bar code command.
X'03'	Specification Check - Graphics—the printer detects an invalid or unsupported data value in a graphics command.
X'02'	Specification Check - General—the printer detects an invalid or unsupported data value in a received command.
X'01'	Conditions Requiring Host Notification—the printer detects a condition that requires action by the host.

Tables of Printer Exception Codes

The following tables list specific exception classes and are arranged in three columns. The first column lists the 3-byte ID given in sense bytes 0, 1, and 19. The second column gives a description of each exception. The third column lists the action code given in sense byte 2.

Typically, when an exception has a defined AEA, the PCA is the AEA. Also, no PCA is taken when the command is received in Home state or Font state.

In each table, the exceptions are listed in ascending numeric order.

Note

- The term architecturally valid refers to the range of values permitted by the IPDS architecture. An "invalid" value denotes one outside the range defined by the architecture. "Supported" values are those that the printer accepts. Therefore, "unsupported" values may be valid by architecture but not in the printer implementation.

    - The machine supports 24 Byte Sense data (See "Sense Type and Model", IPDS Technical Reference 2).

    - The machine supports AEA and PCA error processing. See Intelligent Printer Data Stream Reference for details on Sense byte information and error processing.

- The maximum number of queued asynchronous and synchronous errors is 1 for Twinax and Coax DSC mode and 7 for Coax LU1 mode and TCP/IP mode.

- The cause of the exception and the Alternate Exception Action (AEA) are the same as specified in Intelligent Printer Data Stream Reference unless otherwise noted.

TCP/IP Sense Data

Intervention Required Sense Data

Exception ID	Meaning	Action Code
X'4000..00'	Printer not ready	3
X'4001..00'	Out of paper	3
X'4002..00'	Output bin full	3
X'4004..00'	Out of toner	3
X'4031..00'	Paper Length Check	3
X'4033..00'	Paper Width Check	3
X'407C..00'	Out of Staples	3
X'407C..01'	Staple jam	3
X'407C..03'	Punch waste bin full	3
X'40E6..00'	Cover open	3

IPDS Exceptions Reported

Command Reject Exceptions

Exception ID	Meaning	Action Code
X'8001..00'	Invalid IPDS command code	01
X'8002..00'	Invalid IPDS command sequence	01
X'8004..00'	Data received after ARQ	01
X'80E0..00'	Invalid IPDS command length	01

Equipment Check with Intervention Required

Exception ID	Meaning	Action Code
50F8..00	Media Source X'nn' is not available (has been disabled).	01

Intervention Required Exceptions

Exception ID	Meaning	Action Code
X'4000..00'	Printer is not ready: • The printer is in a not-ready state. • Alternate Exception Action: none. • Page Continuation Action: none.	1A
X'4001..00'	Printer is out of paper: • The printer is out of paper, and paper was not added within specified amount of time. • Alternate Exception Action: none. • Page Continuation Action: none.	1A
X'4002..00'	The printer's exit tray is full: • The printer's exit tray is full and it was not emptied within a specified amount of time. • Alternate Exception Action: none. • Page Continuation Action: none.	1A

Exception ID	Meaning	Action Code
X'4004..00'	Printer is out of toner: • The printer is out of toner, and toner was not added within a specified amount of time. • Alternate Exception Action: none. • Page Continuation Action: none.	1A
X'4031..00'	Paper Length Check • The printer has detected a paper-length check, and it has not been corrected by the operator after a specified amount of time. • Alternate Exception Action: none. • Page Continuation Action: none.	1A
X'4033..00'	Paper Width Check • The printer has detected a paper-width check, and it has not been corrected by the operator after a specified amount of time. • Alternate Exception Action: none. • Page Continuation Action: none.	1A
X'407C..00'	Out of Staples	1A
X'407C..01'	Staple jam	08
X'407C..03'	Punch waste bin full	1A

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Exception ID	Meaning	Action Code
X'40E5..00'	Paper jam recovery needed: • A paper jam has occurred and has not been cleared within a specified amount of time. Any lost pages must be resent. • Alternate Exception Action: none. • Page Continuation Action: none.	08
X'40E6..00'	Cover open	03
X'40E8..nn'	Supported but not installed media source ID	1A

Equipment Check Exceptions

Exception ID	Meaning	Action Code
X'10F1..00'	Permanent hardware exception: • A permanent hardware failure exists. • The microcode detected either a logic exception from which the printer could not recover or a condition that should not have occurred. • Alternate Exception Action: none. • Page Continuation Action: none.	22

Data Check Exceptions

Exception ID	Meaning	Action Code
X'0821..00'	Undefined character	01
X'0860..00'	Numeric representation precision check	01
X'08C1..00'	Numeric representation precision check	01

IO-Image Specification Exceptions

Exception ID	Meaning	Action Code
X'0500..01'	Invalid or unsupported IO Image SDF code	01
X'0500..03'	Invalid or unsupported IO Image SDF	01
X'0500..04'	Invalid IO Image SDF value	01
X'0570..0F'	IO Image Begin Segment out of sequence	01
X'0571..0F'	IO Image End Segment out of sequence	01
X'0591..0F'	IO Image Begin Image Content out of sequence	01
X'0592..0F'	IO Image Data SDF out of sequence	01
X'0593..0F'	IO Image End Image Content out of sequence	01
X'0594..01'	Inconsistent Image Size Parameter value and Image data	01
X'0594..0F'	IO Image Size Parameter missing or out of sequence	01

Exception ID	Meaning	Action Code
X'0594..11'	IO Image Size cannot be determined	01
X'0595..0F'	IO Image Encoding Parameter out of sequence	01
X'0595..10'	IO Image Encoding Parameter unsupported Value	01
X'0595..11'	IO Image Decompression error	01
X'0596..0F'	IO Image Data Element Size Parameter out of Sequence	01
X'0596..10'	IO Image Data Element Size Parameter unsupported value	01
X'0596..11'	IO Image Data Element Size Parameter and Image Encoding Parameter inconsistent	01
X'0597..0F'	IO Image Look Up Table ID Parameter out of sequence	01
X'0597..10'	IO Image Look Up Table ID Parameter unsupported Value	01
X'05A9..02'	IO Image data outside the Image Presentation Space	01

Bar Code Specification Exceptions

Exception ID	Meaning	Action Code
X'0403..00'	Invalid or unsupported bar code type	01
X'0404..00'	Unsupported local-font ID or font not available	01
X'0405..00'	Invalid or unsupported bar code color	01

Exception ID	Meaning	Action Code
X'0406..00'	Invalid or unsupported module width	01
X'0407..00'	Invalid or unsupported element height	01
X'0408..00'	Invalid or unsupported height multiplier	01
X'0409..00'	Invalid or unsupported wide-to-narrow ratio	01
X'040A..00'	Invalid or unsupported symbol origin	01
X'040B..00'	Invalid or unsupported bar code modifier	01
X'040C..00'	Invalid or unsupported bar code data length	01
X'040E..00'	Check-digit calculation exception	01
X'040F..00'	Unsupported 2D bar code size	01
X'040F..01'	Invalid structured append sequence indicator	01
X'040F..02'	Structured append sequence indicator too large	01
X'040F..03'	Mismatched structured append information	01
X'040F..04'	Invalid number of structured append symbols	01
X'040F..05'	Invalid symbol mode value	01
X'040F..06'	Invalid data symbol characters per row value	01
X'040F..07'	Invalid desired number of row values	01

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Exception ID	Meaning	Action Code
X'040F..08'	Too much data for a PDF417 bar code	01
X'040F..09'	Invalid security level value	01
X'040F..0A'	Incompatible combination of Data Matrix parameters	01
X'040F..0B'	Invalid structured append file identification value	01
X'040F..0C'	Invalid Macro PDF417 Control Block length value	01
X'040F..0D'	Invalid Macro PDF417 Control Block data	01
X'040F..0E'	Invalid QR Code EBCDIC Code Page value	01
X'040F..0F'	Invalid QR Code Version value	01
X'040F..10'	Invalid QR Code Error Correction-level value	01
X'040F..11'	Incompatible combination of QR Code Special-function flags	01
X'0410..00'	Invalid or unsupported human-readable interpretation location	01
X'0411..00'	Attempt to print portion of symbol outside block or VPA	01

Graphics Specification Exceptions

Exception ID	Meaning	Action Code
X'0300..01'	Unallocated or unsupported graphics order or command code	01
X'0300..02'	Reserved byte exception or invalid attribute set	01

Exception ID	Meaning	Action Code
X'0300..03'	Incorrect drawing order length	01
X'0300..04'	Invalid attribute value	01
X'0300..08'	Truncated order exception	01
X'0300..0C'	Segment prolog exception	01
X'0300..0E'	Unsupported attribute value	01
X'0300..21'	Invalid or unsupported default	01
X'0334..00'	Character angle value not supported	01
X'033E..00'	Invalid End Prolog	01
X'0360..00'	Area bracket exception	01
X'0368..00'	Begin Area received incorrectly	01
X'0368..01'	Area truncated exception	01
X'0368..02'	Supported order invalid in area	01
X'0368..03'	Pattern Symbol Set not supported	01
X'0368..04'	Undefined pattern symbol	01
X'0370..01'	Unsupported Begin Segment Introducer segment flag	01
X'0370..82'	Invalid Begin Segment Introducer segment flag	01
X'0370..C1'	Invalid Begin Segment Introducer length	01
X'0370..C5'	Insufficient Segment Data	01
X'0392..00'	Graphics image order sequence exception	01
X'0392..01'	Image data discrepancy	01

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Exception ID	Meaning	Action Code
X'0393..00'	Graphics image bracket exception	01
X'0393..01'	Incorrect number of Image Data drawing orders	01
X'03C2..00'	Marker Symbol Set not supported	01
X'03C2..01'	Undefined marker code	01
X'03C3..00'	Font not available	01
X'03C3..01'	Undefined graphics character code	01
X'03C6..01'	Arc drawing check	01
X'03D1..00'	Truncated graphics image exception	01
X'03D1..01'	Invalid order in graphics image	01
X'03D1..02'	Graphics image format not supported	01
X'03D1..03'	Image width greater than maximum supported	01
X'03D1..04'	Image height greater than maximum supported	01
X'03E1..00'	Relative line outside coordinate space	01

General Specification Exceptions

Exception ID	Meaning	Action Code
X'0200..01'	Embedded Control Sequence Code Exception	01
X'0202..01'	End Suppression (ESU) text-control exception	01

Exception ID	Meaning	Action Code
X'0202..02'	Invalid or unsupported IPDS command length	01
X'0202..05'	Invalid data self-defining-field length	01
X'0203..02'	IPDS Command Header Length too small	01
X'0203..05'	Invalid or unsupported block orientation	01
X'0204..01'	EP command encountered	01
X'0204..02'	Invalid use of Acknowledgement Continuation Bit	01
X'0204..05'	Invalid or unsupported area-position reference system	01
X'0205..01'	Invalid spanning sequence	01
X'0205..05'	Invalid or unsupported self-defining-field unit base	01
X'0206..01'	Invalid Begin Suppression (BSU)	01
X'0206..05'	Invalid or unsupported self-defining field L-units	01
X'0207..05'	Invalid or unsupported self-defining-field extents or Graphic Window values inconsistent	01
X'0208..05'	Invalid or unsupported mapping option	01
X'0209..05'	Invalid or unsupported axis offsets	01
X'020B..05'	Invalid self-defining-field identifier	01

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Exception ID	Meaning	Action Code
X'020E..02'	Invalid or unsupported Color Space	01
X'020E..03'	Invalid or unsupported Color value	01
X'020E..05'	Invalid or unsupported number of bits for a color component	01
X'020F..01'	Invalid or unsupported Set Text Orientation (STO)	01
X'0210..01'	Invalid or unsupported Set Inline Margin (SIM)	01
X'0211..01'	Invalid or unsupported Set Baseline increment (SBI)	01
X'0212..01'	Invalid or unsupported inter-character adjustment	01
X'0213..01'	Invalid or unsupported Absolute Move Baseline (AMB)	01
X'0214..01'	Invalid or unsupported Absolute Move Inline (AMI)	01
X'0214..02'	The font resource to be deactivated is not found	01
X'0215..01'	Invalid or unsupported Relative Move Inline (RMI)	01
X'0215..02'	Invalid or unsupported DF command font or font-section ID	01
X'0216..01'	Invalid or unsupported Relative Move Baseline (RMB)	01
X'0217..01'	Invalid or unsupported Set Variable-Space Increment (SVI)	01
X'0217..02'	Invalid or unsupported DF command deletion type	01

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Exception ID	Meaning	Action Code
X'0218..02'	Invalid, unsupported, or unavailable font ID	01
X'0219..01'	Invalid or Unsupported value for Repeat String (RPS) repeat length	01
X'0219..02'	Multiple occurrences of the same LFE font-equivalence number	01
X'021A..01'	Repeat String (RPS) or Transparent Data (TRN) exception	01
X'021B..01'	Repeat String (RPS) target-string length exception	01
X'021B..02'	Invalid or unsupported Load Font Control unit base for L-units	01
X'021C..01'	Invalid escape sequence	01
X'021C..02'	Invalid LFC command byte-count value	01
X'021D..02'	Invalid or unsupported the Load Font Equivalence global font ID	01
X'021E..01'	Invalid WT text-control length	01
X'021F..01'	Repeat String (RPS) length exception	01
X'021F..02'	Mismatch of LFE command font Host-Assigned IDs	01
X'0220..02'	Invalid Load Font Control (Byte 36 value)	01
X'0221..02'	Invalid or unsupported Load Font Control font-index format	01
X'0222..02'	Invalid or unsupported Load Font Control data pattern format	01

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Exception ID	Meaning	Action Code
X'0223..02'	Invalid or unsupported Load Font Control font-type bits	01
X'0226..02'	Invalid or unsupported LSS or LFC X-box size	01
X'0227..02'	Invalid or unsupported LSS or LFC Y-box size	01
X'022A..02'	Invalid or unsupported Load Font Control L-Units per unit base in the X-direction	01
X'022B..02'	Invalid or unsupported Load Font Control L-Units per unit base in the Y-direction	01
X'022D..02'	Invalid or unsupported Load Font Control character-data alignment	01
X'022E..02'	Insufficient font data received	01
X'0231..01'	Invalid or unsupported Load Copy Control number of copies	01
X'0232..01'	Invalid or unsupported Load Copy Control Keyword in copy-group entry	01
X'0232..02'	Excess font data received	01
X'0234..01'	Invalid or unsupported Load Copy Control entry-byte count	01
X'0236..01'	Invalid or unsupported Load Copy Control simplex/duplex parameter	01
X'0237..01'	Invalid or Unsupported LCC N-up Parameter	01
X'0237..03'	Invalid or Unsupported LCC Media Destination Parameter	01

Exception ID	Meaning	Action Code
X'0237..04'	Incompatible Media Source and Media Destination	01
X'0237..05'	Mixture of Media Source or Destination IDs in a duplex copy-subgroup pair	01
X'0238..01'	Maximum supported number of Overlays per LCC copy-group exceeded	01
X'0239..01'	Maximum supported number of Suppressions per LCC copy-group exceeded	01
X'0239..02'	Load Font Control font Host-Assigned ID already assigned	01
X'023A..02'	Maximum number of Fonts allowed by printer exceeded	01
X'023C..02'	Invalid or unsupported value within Load Font Index command	01
X'023E..02'	Invalid Load Font Control character-pattern address	01
X'023F..02'	STO-SCFL-LFE mismatch	01
X'0240..02'	Invalid or unsupported value for Font Inline Sequence	01
X'0242..01'	WIC pixel count is less than the minimum required	01
X'0243..01'	WIC command pixel count is greater than the maximum supported value	01
X'0243..02'	Invalid double-byte font-section identifier	01
X'0244..01'	WIC command scan count is less than the minimum required	01

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Exception ID	Meaning	Action Code
X'0245..01'	WIC command scan count is greater than the maximum supported value	01
X'0246..01'	Invalid WIC source image format	01
X'0246..02'	Invalid parameter for the Load Font Index command	01
X'0247..01'	Invalid or unsupported Write Image Control magnification factor	01
X'0247..02'	Invalid or unsupported Load Font Equivalence font-inline sequence	01
X'0248..01'	Invalid or unsupported Write Image Control scan-line direction	01
X'0249..01'	Invalid scan-line-sequence direction in the WIC command	01
X'024A..01'	Invalid or unsupported Write Image Control image block location	01
X'0253..01'	Invalid or unsupported Write Image Control image color	01
X'0254..41'	Invalid Finishing Fidelity Triplet Length	01
X'0254..42'	Invalid Finishing Fidelity Triplet Continue value	01
X'0254..43'	Invalid Finishing Fidelity Triplet Report value	01
X'0254..51'	Invalid Text Fidelity Triplet Length	01

Exception ID	Meaning	Action Code
X'0254..52'	Invalid Text Fidelity Triplet Continue value	01
X'0254..53'	Invalid Text Fidelity Triplet Report value	01
X'0258..03'	Invalid or unsupported text color	01
X'0260..02'	Invalid or unsupported Load Page Descriptor Xp and I L-units per unit base	01
X'0261..02'	Invalid L-Units (Yp) Value in the LPD command	01
X'0262..02'	Invalid or unsupported Load Page Descriptor Xp-extent	01
X'0263..02'	Invalid or unsupported Load Page Descriptor Yp-extent	01
X'0264..02'	Invalid or unsupported Load Page Descriptor unit base	01
X'0268..02'	Invalid or unsupported Load page Descriptor	01
X'0269..02'	Invalid baseline-sequence direction in the LPD command	01
X'026A..01'	Insufficient source image data	01
X'026A..02'	Invalid or unsupported LPD initial I print coordinate	01
X'026B..01'	Excess source image data received	01
X'026B..02'	Invalid or unsupported LPD initial B print coordinate	01
X'026F..02'	Invalid XOH-SMO Media Origin	01

Exception ID	Meaning	Action Code
X'0270..02'	Invalid or unsupported XOH Set Media Size L-units per unit base	01
X'0272..02'	Invalid or unsupported XOH Set Media Size Xm-extent	01
X'0273..02'	Invalid or unsupported XOH Set Media Size Ym-extent	01
X'0274..02'	Invalid or unsupported XOH Set Media Size unit base	01
X'0277..01'	Group Termination Exception	01
X'027A..01'	Invalid triplet length value in a group triplet	01
X'027B..01'	Incorrect number of triplet data bytes in a group triplet	01
X'027C..01'	Incompatible finishing operations	01
X'027C..02'	Too many or too few sheets for a finishing operation	01
X'027C..03'	Invalid or unsupported finishing operation type	01
X'027C..04'	Invalid or unsupported finishing operation reference corner and edge	01
X'027C..05'	Unsupported finishing operation count	01
X'027C..06'	Invalid or unsupported finishing operation axis offset	01
X'027C..07'	Invalid or unsupported number of finishing positions	01
X'027C..09'	Finishing operation incompatible with physical media or media destination	06

Exception ID	Meaning	Action Code
X'027C..0A'	Incompatible media destination change in a group to be finished	06
X'0280..02'	Invalid or unsupported rule width	06
X'0282..02'	Invalid or unsupported rule length	01
X'0285..01'	Invalid or unsupported Delete Overlay command overlay ID	01
X'0287..02'	Invalid or unsupported Load Font Control unit base for Pixel-units	01
X'0288..02'	Invalid or unsupported Load Font Control Pixel-units per unit base in the X-direction	01
X'0289..02'	Invalid or unsupported Load Font Control Pixel-units per unit base in the Y-direction	01
X'028A..01'	Invalid or unsupported Delete Page Segment command page segment Host-Assigned ID	01
X'028A..02'	Invalid or unsupported Load Font Control Relative-Metric Multiplying Factor	01
X'028F..01'	Invalid or unsupported AR command parameter values	01
X'028F..02'	AR activation command failed	01
X'028F..03'	Invalid Resource ID triplet length	01
X'028F..04'	Invalid or unsupported resolution or metric-technology value	01

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Exception ID	Meaning	Action Code
X'028F..10'	Invalid or unsupported value in a Metric Adjustment triplet	01
X'028F..11'	Baseline adjustment value too large or too small	01
X'0290..01'	Invalid or unsupported Overlay ID	01
X'0291..01'	BO overlay ID already loaded	01
X'0291..02'	Invalid or unsupported XOA Request Resource list entry	01
X'0292..01'	Overlay ID not loaded	01
X'0293..01'	Recursive overlay invocation	01
X'0294..01'	Invalid or unsupported page segment Host-Assigned ID	01
X'0295..01'	Page segment Host-Assigned ID already loaded	01
X'0295..02'	Invalid or unsupported XOH Page Counters Control page-counter update	01
X'0296..01'	Page segment Host-Assigned ID not loaded	01
X'0297..01'	Overlay nesting limit exceeded	01
X'0298..01'	Invalid or unsupported suppression number	01
X'0298..03'	Invalid or unsupported Temporary Baseline Move text control	01
X'029A..01'	Invalid overstrike character increment	01
X'02A4..01'	Page boundary in the X-direction cannot be presented by the printer	01

Exception ID	Meaning	Action Code
X'02A5..01'	Page boundary in the Y-direction cannot be presented by the printer	01
X'02AC..01'	Insufficient Main Storage to print the Sheet	09
X'02AD..01'	Invalid or unsupported Load Page Position command	01
X'02AE..01'	Invalid or unsupported parameter in an IO command	01
X'02AF..01'	Insufficient storage to print the sheet	0C
X'02AF..01'	Asynchronous Insufficient storage to print the sheet	1E
X'02B0..00'	LCPC Code Page HAID already in use	01
X'02B0..01'	Invalid LCPC Code Page HAID	01
X'02B0..02'	Invalid or Unsupported LCPC Encoding Scheme	01
X'02B0..04'	Too much or too little code page data	01
X'02B0..05'	Invalid or Unsupported LCPC Byte count	01
X'02B0..07'	Code points out of order in LCP command	01
X'02B0..0A'	LFCSC HAID already assigned	01
X'02B0..0B'	Invalid LFCSC HAID	01
X'02B0..0C'	Invalid or Unsupported LFCSC pattern technology ID	01
X'02B0..0E'	Invalid or Unsupported LFCSC Byte count	01

Exception ID	Meaning	Action Code
X'02B0..0F'	Invalid or Unsupported LFCSC Map size	01
X'02B1..01'	Invalid or Unsupported LF Character ID format	01
X'02B1..02'	Invalid LF technology specific ID offset	01
X'02B1..03'	Invalid LF technology specific ID length	01
X'02B1..04'	GCGIDs out of order in a Font Character Set	01
X'02B1..08'	Invalid LF technology specific object length	01
X'02B1..09'	LF checksum mismatch	01
X'02B1..0A'	Invalid Name Length in LF3 technology specific object	01
X'02B1..0B'	Invalid data within a LF3 technology specific object	01
X'02B2..01'	Parent character set not activated	01
X'02B2..02'	Font character set extension not valid with pattern technology	01
X'02B2..03'	Mismatched character ID format in a LF command	01
X'02B2..04'	Mismatched MICR printing flag in a LFCSC command	01
X'02C0..01'	Mixture of Xm-axis duplex and Ym-axis duplex copy groups	01
X'02C0..02'	Mixture of N-up copy subgroups in a LCC command	01
X'02C0..03'	More than one N-up keyword specified in a copy subgroup	01

Exception ID	Meaning	Action Code
X'02C0..04'	Duplexing and N-up not supported together	01
X'02C0..05'	N-up partitioning not supported with envelope media	01
X'02C1..01'	Maximum number of simplex or duplex keywords in an LCC command	01
X'02C1..02'	Internal value not unique in an LE command	01
X'02C2..01'	Odd number of duplex copy groups in an LCC command	01
X'02C2..02'	More than one Media Source or Destination Keyword specified in a copy subgroup	01
X'02C3..01'	Mixture of simplex and duplex parameters in an LCC command	01
X'02C4..01'	Unequal copy counts in an LCC command	01
X'02C5..01	Unable to delete resource (needed on duplex side)	01
X'02C5..02'	Physical media not compatible with duplex printing	01
X'02C6..01'	Unable to deactivate a component of an activated coded font	01
X'02C6..02'	Invalid mapping type in an LE command	01
X'02C8..01'	An unsupported Input Media Source ID was specified	01
X'02C8..02'	Invalid or unsupported internal value or external value in an Load Equivalence command	01

Exception ID	Meaning	Action Code
X'02FF..02'	Exceptions detected but not queued	01

Host Notification Exceptions

Exception ID	Meaning	Action Code
X'0100..00'	Normal Printer Restart (Printer IMLed or IPDS Dialog Resources Deleted)	0D
X'0101..00'	Media Size or Input Media Source ID Changed	1D
X'0180..00'	Request to end IPDS Dialog	05
X'018F..00'	Error Printer Restart (Printer IMLed)	0D
X'01E4..00'	Cancel Key Pressed	15

Page Counter Adjustments

To identify which page or pages to send to the printer after an exception occurs, the host program must determine the position of the sheets in the paper path.

Count fields in the ACK command identify the state of a virtual paper path that includes a count of the number of pages received, the number of pages past the jam-recovery point, and the number of pages stacked.

The printer tracks the following:

- Received Page Counter
- Committed Page Counter
- Committed Copy Counter
- Stacked Page Counter
- Stacked Copy Counter

All other counters are mapped to the Stacked Page Counter (for pages) and the Stacked Copy Counter (for copies).

The following rules define how the counters are updated:

- After power is switched on, all counter values equal X'0000'.

- When a counter containing X'FFFF' increments, the counter wraps to X'0000'.

- The counters are updated as shown in the following table as each condition is detected.

- The Copy Counters are incremented when more than one copy of a page is printed. When all copies have passed a station, the Copy Counter is then reset to zero and the Page Counter is incremented.

The Copy Counters are not reset to zero during exception recovery.

Condition (in hex)	Counters	Counter Adjustments
Action Codes 08 22	Received Page Counter	Set to Jam Recovery Page Counter
	Committed Page Counter	Set to Jam Recovery Page Counter
	Committed Copy Counter	Set to Jam Recovery Page Counter
	Operator Viewing Page Counter	Set to Jam Recovery Page Counter
	Operator Viewing Copy Counter	Set to Jam Recovery Page Counter
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	Set to Jam Recovery Page Counter
	Stacked Copy Counter	Set to Jam Recovery Copy Counter
Action Codes 15 1A 1D	Received Page Counter	Set to Committed Page Counter
	Committed Page Counter	No change
	Committed Copy Counter	No change
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change

Condition (in hex)	Counters	Counter Adjustments
Action Code 0C	Received Page Counter	No change
	Committed Page Counter	No change
	Committed Copy Counter	No change
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change
Action Code 01	Received Page Counter	No change
	Committed Page Counter	No change
	Committed Copy Counter	No change
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change

Condition (in hex)	Counters	Counter Adjustments
Action Code 1E	Received Page Counter	Set to Committed Page Counter
	Committed Page Counter	No change
	Committed Copy Counter	No change
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change
All other action codes	Received Page Counter	No change
	Committed Page Counter	No change
	Committed Copy Counter	No change
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change

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Condition (in hex)	Counters	Counter Adjustments
Command XOA - Discard Buffered Data	Received Page Counter	Set to Committed Page Counter
	Committed Page Counter	No change
	Committed Copy Counter	No change
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change
Normal Counter Wrap (on a Per-Counter Basis)	Received Page Counter	Reset to 0
	Committed Page Counter	Reset to 0
	Committed Copy Counter	Reset to 0
	Operator Viewing Page Counter	Reset to 0
	Operator Viewing Copy Counter	Reset to 0
	Jam Recovery Page Counter	Reset to 0
	Jam Recovery Copy Counter	Reset to 0
	Stacked Page Counter	Reset to 0
	Stacked Copy Counter	Reset to 0

Condition (in hex)	Counters	Counter Adjustments
Command XOH - Page Counters Control	Received Page Counter	For details about XOH PCC command, see "Device Control Command Set", IPDS Technical Reference 2.
	Committed Page Counter	
	Committed Copy Counter	
	Operator Viewing Page Counter	
	Operator Viewing Copy Counter	
	Jam Recovery Page Counter	
	Jam Recovery Copy Counter	
	Stacked Page Counter	
	Stacked Copy Counter	

Note

- Should not be incremented for page in error (that is, any partial page is discarded).

- The Received Page Counter should be incremented if a partial or complete page is printed.

- For Action Code X'1E', the host should issue an XOH Print Buffered Data command with the ARQ bit on and a unique correlation ID (to ensure that the Acknowledge Reply matches the Print Buffer Data [PBD] command) to cause the Committed Page/Copy Counter to reflect the page in error.

Page and Copy Counter Adjustments for Data-Stream Exceptions

The following are counter adjustments for simplex copy groups.

Condition (in hex)	Counters	Counter Adjustments
Action Code 01 and the page is printed	Received Page Counter	Does not reflect the page in which the error occurs.
	Committed Page Counter	No change
	Committed Copy Counter	Reflects any committed copies resulting from prior error-free copy groups.
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change
Action Code 01 and the page is not printed	Received Page Counter	Reflects the page in which the error occurs, only if the error occurred on the last copy group.
	Committed Page Counter	No change
	Committed Copy Counter	Reflects any committed copies resulting from prior error-free copy groups or from the copy group in error.
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change

The following are counter adjustments for duplex copy groups.

Condition (in hex)	Counters	Counter Adjustments
Action Code 01 on the front side and the page is printed	Received Page Counter	Reflects the page in which the error occurs (the front side) only if the error occurred on the other in a copy group other than the first copy group.
	Committed Page Counter	No change
	Committed Copy Counter	Reflects any committed copies resulting from prior error-free copy group pairs.
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change
Action Code 01 on back side and the page is not printed	Received Page Counter	Does not reflect the page in the error occurs (the back side) it does reflect the front side.
	Committed Page Counter	No change
	Committed Copy Counter	Reflects any committed copies resulting from prior error-free copy group pairs.
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change

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Condition (in hex)	Counters	Counter Adjustments
Action Code 01 on the front side and the page is not printed	Received Page Counter	Reflects the page in which the error occurs (front side).
	Committed Page Counter	No change
	Committed Copy Counter	Reflects any committed copies resulting from prior error-free copy group pairs.
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change
Action Code 01 on the back side and the page is printed	Received Page Counter	Reflects the page in which the error occurs (back side) only if the error occurred on the last copy group. Reflects front side.
	Committed Page Counter	No change
	Committed Copy Counter	Reflects any committed copies resulting from prior error-free copy group pairs or from the copy group in error.
	Operator Viewing Page Counter	No change
	Operator Viewing Copy Counter	No change
	Jam Recovery Page Counter	No change
	Jam Recovery Copy Counter	No change
	Stacked Page Counter	No change
	Stacked Copy Counter	No change

5. Code Page and Font Identification

About Code Page and Font Identification

The machine supports both raster and outline technology fonts: Single and Double byte. The resident single-byte LF1 "raster" fonts are generated using outline font technology (IBM AFP Font Collection): the IBM Core Interchange Font Set, the IBM Coordinated Font Set and the 4028 Compatibility Font Set.

The valid combinations of GCSGID/CPGID, GCSGID/FGID/FW, or GCSGID/ CPGID/FGID/FW are too numerous to list here. They can be obtained by the host using the Any state command "XOA Request Resource List", IPDS Technical Reference 2 with the appropriate Resource Type and RIDF.

They can also be determined by using the information under p.95 "Resident IPDS Fonts" with the criteria described in the following sections:

🔽Note

- The machine supports Download and Capture of Font Resources. There is Date/Time stamp information to help identify versions of font resources. p.89 "Coded Font" includes the Date/Time stamps for the resident fonts.

- The machine will report DBCS raster font (and any captured raster fonts) using the RRL command when the IPDS Resolution (op panel) setting is Independence Mode. If the IPDS Resolution (op panel) setting is an Acceptance Mode, only those raster fonts with resolutions that match the current Acceptance mode resolution setting (240 or 300 or 600 DPI), will be reported via RRL.

RRL RT'06' Code Page (CPGID)

Values are listed in p.93 "Font Terms", p.95 "Resident IPDS Fonts", and p.97 "XOA-RRL Replies for Font Character Sets", and will be reported via XOA-RRL RT 06 RIDF 03.

RRL RT'12' Specific Code Pages (GCSGID/CPGID)

Valid combinations are listed in p.93 "Font Terms", p.97 "XOA-RRL Replies for Font Character Sets", and p.97 "XOA-RRL Replies for Font Character Sets", and will be reported via XOA-RRL RT 12 RIDF 03.

RRL RT'11' Graphic Character Sets (GCSGID SUB/SUPERSETS)

Valid combinations are listed in p.97 "XOA-RRL Replies for Font Character Sets" (GCSGID Subsets for the Strategic Font Set 2) and will be reported via XOA-RRL RT 11 RIDF 03.

RRL RT'07' Font Character Sets (GCSGID/FGID/FW)

- Valid combinations for the IBM Core Interchange Set are listed inp.90 "Code Page" (IBM Core Interchange Resident Scalable Font Set), and will be reported via XOARRL RT 07 RIDF 03.

  - Scalable Font Width (FW) will be reported as 0 to the host PSF. This indicates that any width/scale-factor is valid.

  - p.92 "Operating System/400 Terms" (GCSGID Subsets for IBM Core Interchange Fonts) shows the subset GCSGIDs for each of the listed superset GCSGIDs in p.90 "Code Page" (IBM Core Interchange Resident Scalable Font Set). These subset GCSGIDs are valid combinations for the associated superset GCSGIDs in the GCSGID/ FGID/FW, but will not be added to the RRL 0703 response unless required by the host PSF's.

- Valid combinations for the IBM Coordinated Set are listed in p.97 "XOA-RRL Replies for Font Character Sets" (Resident PSC Strategic Scalable Font Set 2) and will be reported via XOA-RRL RT 07 RIDF 03.

  - Scalable Font Width (FW) will be reported as 0 to the host PSF. This indicates that any width/scale-factor is valid.

  - p.97 "XOA-RRL Replies for Font Character Sets" (GCSGID Subsets for the Strategic Font Set 2) shows the subset GCSGIDs for each of the listed superset GCSGIDs in p.96 "IBM Core Interchange Resident Scalable Font Set (IPDS only)" (Resident PSC Strategic Scalable Font Set 2). These subset GCSGIDs are valid combination entries for the associated superset GCSGIDs in the GCSGID/FGID/FW, but will not be added to the RRL 0703 response unless required by the host PSF's.

- Valid combinations for the 4028 Compatibility Set require p.94 "Font and Code Page Selection" (FGID/FW) and p.95 "Resident IPDS Fonts" (GCSGID), and will be reported via XOA-RRL RT 07 RIDF 03.

  - The FW's for these fonts are non-zero, because they represent fixed-width fonts.

  - The Alternate FGIDs are valid values for GCSGID/FGID/FW combinations.

  - Native Mode - These fonts (which are representing 4028 raster fonts) don't have a GCSGID of their own, so the GCSGID used is from the associated Code Pages (CPGIDs).The GCSGIDs are obtained by finding the Code Page(s) in p.95 "Resident IPDS Fonts" that matches the Code Page(s) listed for a given FGID/FW entry in p.94 "Font and Code Page Selection". The GCSGID for each of the Code Pages listed with an FGID is a valid combination entry. Since these fonts don't have a superset GCSGID, there is no subset condition. So each of these unique GCSGID/FGID/FW combinations will be added to the XOA-RRL 0703 report to the host PSF.

  - 4028 Emulation Mode - These fonts (which are representing 4028 raster fonts) don't have a GCSGID of their own, so the GCSGID used is 0.

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RRL RT'01'/'03'/'10' RIDF'03' (GCSGID/CPGID/FGID/FW = GRID)

- Valid combinations for the IBM Core Interchange Set require p.90 "Code Page" (IBM Core Interchange Resident Scalable Font Set) (superset GCSGID/FGID/FW), p.92 "Operating System/400 Terms" (GCSGID Subsets for IBM Core Interchange Fonts) (GCSGID subsets) and p. 93 "Font Terms" (GCSGID/ CPGID), and will be reported via XOA-RRL RT 01 RIDF 03 (also RT 10 RIDF 03). In all GRIDs, the GCSGID chosen will belong to the Code Page, as this is almost always the subset of the outline font GCSGID.

    - Scalable Font Width (FW) will be reported as 0 to the host PSF. This indicates that any width/scale-factor is valid.

    - CPGIDs and GCSGIDs are listed in p.93 "Font Terms". For each pair, determine which FGIDs in p.90 "Code Page" (IBM Core Interchange Resident Scalable Font Set) which contains the p.93 "Font Terms" GCSGID as a subset. An example is that there would be 51 GRID combinations for the Times New Roman Medium font...FGID is always 2308, FW is always 0, and there are 51 unique CPGID/GCSGID pairs in Table p.93 "Font Terms" which are subsets of the superset GCSGID 1269.

- Valid combinations for the IBM Coordinated Set require p.119 "IBM Coordinated Font Set (IPDS)" (Resident PSC Strategic Scalable Font Set 2) (superset GCSGID/FGID/FW), p.121 "IBM Coordinated Font Set Code Page Set" (GCSGID Subsets for the Strategic Font Set 2) (GCSGID subsets) and p.106 "IBM Core Interchange Resident Code Page Set" and p.121 "IBM Coordinated Font Set Code Page Set" (GCSGID/CPGID), and will be reported via XOA-RRL RT 01 RIDF 03 (also RT 10 RIDF 03). In all GRIDs, the GCSGID chosen will belong to the Code Page, as this is almost always the subset of the outline font GCSGID.

    - Scalable Font Width (FW) will be reported as 0 to the host PSF. This indicates that any width/scale-factor is valid.

    - CPGIDs and GCSGIDs are listed in p.93 "Font Terms" and p.97 "XOA-RRL Replies for Font Character Sets". For each pair, determine which FGIDs in p.96 "IBM Core Interchange Resident Scalable Font Set (IPDS only)" (Resident PSC Strategic Scalable Font Set 2) can combine with them. This is done by finding the superset GCSGID in p.97 "XOA-RRL Replies for Font Character Sets" (GCSGID Subsets for the Strategic Font Set 2) which contains the p. 93 "Font Terms" GCSGID as a subset. An example is that there would be 41 GRID combinations for the Letter Gothic font...FGID is always 400, FW is always 0, and there are 41 unique CPGID/GCSGID pairs in p.93 "Font Terms" and p.97 "XOA-RRL Replies for Font Character Sets". which are subsets of the superset GCSGID 2039.

- Valid combinations for the 4028 Compatibility Set require p.94 "Font and Code Page Selection" (FGID/FW) and p.95 "Resident IPDS Fonts" (GCSGID/CPGID), and will be reported via XOA-RRL RT 01 RIDF 03. In all GRIDs, the GCSGID chosen will belong to the Code Page, as this is almost always the subset of the outline font GCSGID.

    - The FW's for these fonts are non-zero, because they represent fixed-width fonts.

    - The Alternate FGIDs are valid values for FGID/FW combinations.

- The GCSGID/CPGID pairs for each font are obtained by finding the Code Page(s) in p.95 "Resident IPDS Fonts" that match the Code Page(s) listed for a given FGID/FW pair in p.94 "Font and Code Page Selection".

6. Fonts

IBM Font Structure

In IBM AFP terminology, a font has three components. They are:

- Coded font

- Character set

- Code page

```
                    ┌─────────────────────────┐
                    │       Coded Font        │
                    └─────────────────────────┘
                         │               │
    ┌────────────────────────┐    ┌────────────────────────┐
    │ Character Set          │    │ Code Page              │
    │  • Characters          │    │  • Characters IDs      │
    │  • Character properties│    │  • Code points         │
    │  • Printing attributes │    │                        │
    └────────────────────────┘    └────────────────────────┘
```
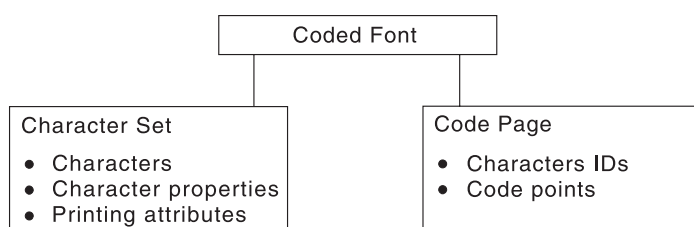
⭳ **Note**

- These terms have different meanings in Operating System/400 (OS/400). See p.92 "Operating System/400 Terms" for what these terms mean in OS/400.

Coded Font

In IBM font structure, a coded font translates your request for type (for example, text you previously entered at a computer terminal) into characters for printing.

A coded font consists of two parts:

- References to specific character sets

- References to specific code pages

A character must be included in the specified character set and listed on the specified code page before it can be printed.

A coded font associates a specific code page with a specific character set. A coded font contains one code-page and one character-set pair.

Character Set

In IBM font structure, a character set corresponds to the definition of a font; it contains the characters of a single type family, typeface, and type size. In addition, a character set specifies character properties and printing attributes.

```
                        ┌─────────────────────┐
                        │    Character Set     │
                        └─────────────────────┘
           ┌───────────────────┼───────────────────┐
┌─────────────────┐  ┌─────────────────────┐  ┌─────────────────────┐
│ Characters      │  │ Character Properties │  │ Printing Attributes │
│                 │  │  • Baseline          │  │  • Character rotation│
│                 │  │  • Position          │  │  • Maximum ascender  │
│                 │  │  • Character ID      │  │  • Point size        │
└─────────────────┘  └─────────────────────┘  └─────────────────────┘
```
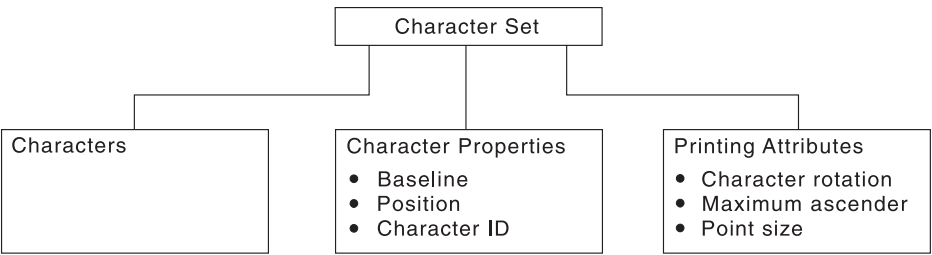
Characters

Characters are the letters, numerals, punctuation marks, or other symbols of a font.

Character properties

Character properties detail how a character is positioned relative to the characters around it. Some character properties include the following:

- The baseline of a character, showing its general alignment

- The dimensions of space in which the character is printed

- The position of the character within that space

- The identifier of the character (the character ID)

One of the character properties is the character ID (or graphic character ID). Each character is assigned a character ID; for example, the character A (uppercase A) is assigned the character ID LA020000.

The purpose of a character ID is to distinguish the character from similar characters. For example, the following characters look similar; however, they are different and are assigned different character IDs:

Minus sign (-): Character ID SA000000

Hyphen (-): Character ID SP100000

Em dash (—): Character ID SM900000

For a list of character IDs and the graphic character each represents, refer to "ABOUT TYPE: IBM's Technical Reference for Core Interchange Digitized Type".

Printing attributes

The printing attributes define how the character set will be printed. Some printing attributes include rotation of characters, maximum ascender, and point size.
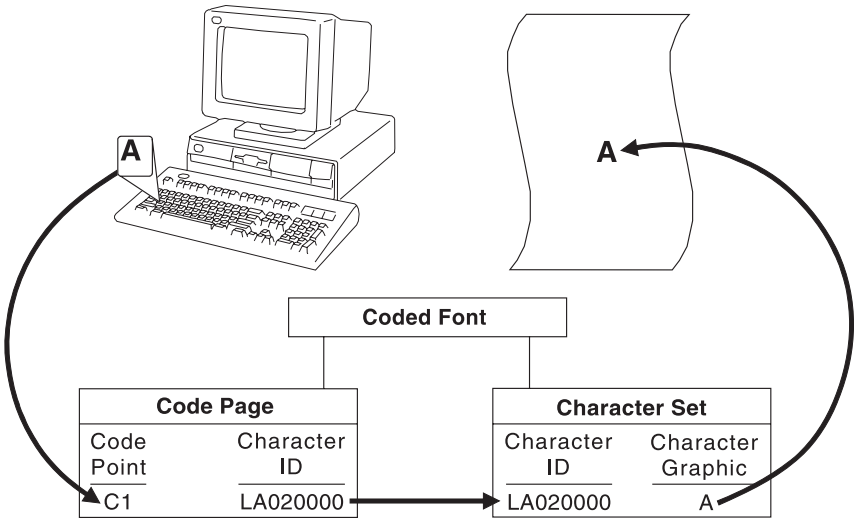
Code Page

A code page is a set of symbols that can be printed by your printer. These symbols can be letters, numbers, or graphic elements such as lines or patterns. The symbols may be grouped to be specific to a country, language, or special symbol set. By supporting different code pages, the printer can support different language requirements.

No particular typeface is assumed for any particular code page. The typeface is defined as a font by the assignment of size, weight, and posture.

Character IDs and Code Points

In IBM font structure, a code page maps each character of text to the characters in a character set. The following figure shows how a code page maps text to the characters in a character set. As you enter your text at a computer terminal, each keyboard character is translated into a code point. When the text is printed, each code point is matched to a character ID on the code page you specified. The character ID then is matched to the image (raster pattern) of the character in the character set you specified. The image in the character set is the image that is printed in your text. To be a valid code page for a particular character set, all character IDs in the code page must be included in that character set.

Every code page has 256 positions, or code points, that represent potential characters. Each of the code points is normally identified by its bit configuration in hexadecimal, with two hex characters per byte. The range of values is hex 00 through hex FF, or 256 values. The code page determines which character prints for each of the printable code points.

A character ID is an 8-byte standard identifier for a character regardless of its type family. For example, all uppercase "A" have the same character ID (LA020000). Character IDs also are called graphic character identifiers (GCIDs).

Binary: 11000001

Decimal: 193

Hexadecimal: C1

The following figure shows an example of a part of a code page. When the printer receives hexadecimal code point C1 for the code page shown (code page 00037 Version 1), it prints an uppercase A (character ID LA020000). Baselines for each character on the example code page show the general alignment of characters.

CPGID: 37
GCSGID: 697

Hex Codes 1st → 2nd ↓	4-	5-	6-	7-	8-	9-	A-	B-	C-	D-	E-	F-
-0	SP010000	& SM030000	- SP100000	ø LO610000	Ø LO620000	° SM190000	µ SM170000	^ SD110000	{ SM110000	} SM140000	\ SM970000	0 ND100000
-1	SP300000	é LE150000	/ SP120000	É LE120000	a LA010000	j LJ010000	~ SD190000	£ SC070000	A LA020000	J LJ020000	÷ SA060000	1 ND010000
-2	â LA150000	ê LE350000	Â LA160000	Ê LE360000	b LB010000	k LK010000	s LS010000	¥ SC050000	B LB020000	K LK020000	S LS250000	2 ND020000
-3	ä LA170000	ë LE170000	Ä LA180000	Ë LE180000	c LC010000	l LL010000	t LT010000	· SD630000	C LC020000	L LL020000	T LT020000	3 ND030000
-4	à LA130000	è LE130000	À LA140000	È LE140000	d LD010000	m LM010000	u LU310000	© SM520000	D LD020000	M LM020030	U LU020000	4 ND040000
-5	á LA110000	í LI110000	Á LA120000	f LI120000	e LE010000	n LN010000	v LV010000	§ SM240000	E LE020000	N LN220000	V LV030006	5 ND050000
-6	â LA190000	î LI150000	Ã LA200000	Î LI160000	f LF010000	o LO010000	w LW010000	¶ SM250000	F LF020000	O LO020000	W LW020000	6 ND060000
-7	å LA270000	ï LI170000	Å LA280000	Ï LI180000	g LG010300	p LP010000	x LX010000	½ NF040000	G LG020000	P LP020000	X LX020000	7 ND070000
-8	ç LC410000	ì LI130000	Ç LC420000	ì LI140000	h LH010000	q LQ010000	y LY010000	⅓ NF010000	H LH020000	Q LQ020000	Y LY020000	8 ND080000

Different Code Pages

Code pages accommodate various national languages by using characters and special symbols appropriate to the language. Code pages can have identical character IDs assigned to different code points.

For example, the character é (lowercase e accent acute, character ID LE110000) has the following code point assignment in two different code pages:

- Hexadecimal code point 51 in code page 00037 Version 1
- Hexadecimal code point 5A in code page 00280 Version 1

Operating System/400 Terms

Table 158 lists the IBM AFP font terminology and describes how it is used with the OS/400 printing interfaces.

AFP Term	OS/400 AFP Implementation	OS/400 Print File Term
Coded font	*FNTRSC object with CDEFNT attribute	Coded font
Character set	*FNTRSC object with FNTCHRSET attribute	Font
Code page	*FNTRSC object with CDEPAG attribute	Character ID (CHRID)

⬇ Note

- This is not the character ID that identifies individual characters within an AFP character set. This is a control object that identifies a code page by two numbers representing a character set ID and a code page ID.

Font Terms

A font is a complete set of characters in a particular typeface, type size, and code page.

The following terms help define a font:

Character Set

A set of numeric, alphabetic, or graphic characters with their assigned code points.

Code Page

A table of alphanumeric characters and graphic characters each of which is assigned a 1-byte value (a code point). These values define which characters will print.

Code Page Global ID (CPGID)

Identifies a specific set of code points assigned to a specific list of graphic character IDs.

Font Global ID (FGID)

Specifies a value for selecting a font. IBM fonts have a preassigned FGID value.

Graphic Character Set Global ID (GCSGID)

Identifies the list of graphic character IDs included in the code page.

Spacing

Also called font width or escapement. Spacing is the distance from the start of a character to the start of the next character. Font spacing can be defined by spacing type:

- Fixed-pitch fonts – All characters in a fixed-pitch font have the same spacing, which is specified as the number of characters per inch.

- Typographic fonts – Typographic fonts are identified as Typo.

Most documents are easier to read if the widths of the characters vary, that is, if a W is printed wider than an I. Typographic fonts have this variability. These fonts are sized by height, not width.

Seventy-two points equals approximately one inch. Therefore, a 10-point font is 10/72 inch high.

Type height includes some white space above and below the printed character for adequate minimum spacing between the lines of type.

Text is most readable when character spacing ranges from 8 to 12 points. For example, the text in this document is 10 point.

🔽 Note

- For typographic fonts, it is recommended that the first and last print positions on each line be left blank.

  - Proportionally spaced machine (PSM) fonts – Proportionally spaced machine fonts are identified by PSM or PS. PSM fonts are a compromise between the variability of typographic sizes and the simple uniformity of fixed pitch. With PSM fonts, the widths of the characters vary. For example, a lowercase "i" has a different width than an uppercase W. However, a specific character in one font will be the same width in another font. For example, a W in one

PSM font is the same width as the W in every other PSM font. Therefore, it is possible to have only one character-width table that applies to every PSM font.

Posture

Refers to a character's incline, or tilt. Roman posture is upright. Italic posture is inclined to the right.

Type Size

Also called point size. Specifies the overall height of the font, measured in printer's points. A point is 1/72 inch. For example, a 12-point font is 1/6 inch high.

Typeface

Also called type style. Specifies the shape and design of each letter of the alphabet. A complete alphabet of letter designs makes up one typeface.

Weight

Refers to the thickness of the strokes that make up the characters of a font, as in a bold font weight.

Font and Code Page Selection

Printers with an IPDS feature receive IPDS commands to specify fonts. The IPDS command set can select any font or code page supported by the printer. See the printer User's Guide for a list of the IPDS fonts supported. However, host software may restrict the actual fonts or code pages that can be selected. This includes typographic and nontypographic fonts in all pitches, point sizes, and widths. The information provided to the printer to select a font is called a GRID (Global Resource Identifier). The GRID consists of the following (See p.93 "Font Terms" for a description of these terms):

- FGID (Font Global Identifier)
- GCSGID (Graphic Character Set Global Identifier)
- CPGID (Code Page Global Identifier)
- Font Width

For typographic fonts with the same FGID, specify the FONT WIDTH parameter to the printer. The printer needs the font width parameter to identify the font in order to specify the point size. The FONT WIDTH parameter is described in detail in the IPDS section.

You can select the code page and code page version from a configuration setting. Refer to your printer's User's Guide for instructions on changing code page and code page version configuration settings. Some system software does not allow you to change code pages by software and uses the printer default code page for printing. The printer factory default character set is 0697 and the code page is 00037 version 1.

This may require you to change the printer code page to match the system software.

Note

- When using an application that does not allow selection of font width, use the alternate FGID when available to access typographic fonts.

Resident IPDS Fonts

Printer will support outline fonts from both the IBM Core Interchange Font Set and the IBM Coordinated Font Set as resident fonts. In addition, selections of these fonts are grouped into the 4028 Compatibility Font set. This set is used to represent the 4028 base internal raster fonts for limited compatibility. The font technologies used in the printer are:

```
IBM Core Interchange - Type 1 Outlines
IBM Coordinated - Type 1 Outlines
4028 Compatibility - Type 1 Outlines
3820 ROM Font Compatibility - Raster
```

Resident Font Activation Methods

Fonts resident within the Printer may be activated using the following IPDS commands. Note that some fonts have restrictions on allowable font activation methods.

Load Font Equivalence

The Load Font Equivalence (LFE) command maps font local identifiers, specified within text, graphics or bar code data, to font Host Assigned IDs (HAIDs) and Global Resource IDs (GRIDs).

If the GRID specified in the LFE command matches a GRID contained in the printer, the font is activated.

Activate Resource (Load Resource Equivalence)

The Activate Resource (AR) command (previously known as Load Resource Equivalence) maps Host Assigned IDs to global names of another format. The format for the global name is identified by a resource type and resource ID combination.

If the Printer has a resource that matches the global name in the AR command, that resource is activated.

The following combinations of Resource Type and Resource ID Format are supported by the Printer.

Resource Type	RT Hex	Resource ID Format	RIDF Hex
Single Byte Coded Raster Font	X'01'	IBM GRID	X'03'
Single Byte Coded Raster Font	X'01'	MVS Host Unalterable	X'06'
Double Byte Coded Font Section	X'03'	IBM GRID	X'03'
Double Byte Coded Font Section	X'03'	MVS Host Unalterable	X'06'

Resource Type	RT Hex	Resource ID Format	RIDF Hex
Code Page	X'06'	IBM GRID	X'03'
Font Character Set	X'07'	IBM GRID	X'03'
Single Byte Coded Font Index	X'08'	IBM GRID	X'03'
Single Byte Coded Font Index	X'08'	MVS Host Unalterable	X'06'
Double Byte Coded Font Index	X'09'	IBM GRID	X'03'
Double Byte Coded Font Index	X'09'	MVS Host Unalterable	X'06'
Coded Font	X'10'	IBM GRID	X'03'
Coded Font	X'10'	Coded Font Format	X'07'

IBM Core Interchange Resident Scalable Font Set (IPDS only)

The IBM Core Interchange fonts as shown in Table 159 will be supported as resident fonts in the following language groups:

- Latin 1/2/3/4/5
- Symbols
- Arabic
- Cyrillic Greek
- Hebrew
- Thai
- Lao
- Katakana

p.97 "XOA-RRL Replies for Font Character Sets" (IBM Core Interchange Resident Scalable Font Set) lists the typefaces resident in the Printer and includes the valid FGID and code pages for each font. The Date Stamp on the character sets with GCSGIDs of 1269, 1275, 1300, 1264, and 1265 is 94350, and the Time Stamp used is 00:00:00.00. The Date Stamp on the character sets with a GCSGID of 1355 is 98152 and the Time Stamp used is 00:00:00.00. The Date Stamp used on the remaining character sets is 02185, and the Time Stamp used is 00:00:01.00.

p.105 "GCSGID Subsets" provides a mapping of the valid subsets of the GCSGIDs listed for the IBM Core Interchange fonts.

XOA-RRL Replies for Font Character Sets

The resident set as shown in Table 159 will support a font character set of any valid font width when queried as an individual font character set.

When queried for a list of font character sets, the resident character sets will be reported with a font width of zero. A font width of zero indicates that the font is scalable.

Valid combinations of the CPGIDs, GCSGIDs, FGIDs and Font Widths for the resident fonts are defined in p.85 "About Code Page and Font Identification".

IBM Core Interchange Resident Scalable Font Set

Typeface	FGID	GCSGID	Font Width	Code Pages
Latin 1/2/3/4/5 with Euro and Vietnamese				
Times New Roman Medium	2308	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Times New Roman Bold	2309	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Times New Roman Italic Medium	2310	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Times New Roman Italic Bold	2311	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Roman Medium	2304	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Roman Bold	2305	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Italic Medium	2306	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Italic Bold	2307	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".

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Typeface	FGID	GCSGID	Font Width	Code Pages
Courier Roman Medium	416	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Roman Bold	420	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Italic Medium	424	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Italic Bold	428	1503	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Symbols with Euro				
Times New Roman Medium	2308	1191	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Times New Roman Bold	2309	1191	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Roman Medium	2304	1191	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Roman Bold	2305	1191	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Roman Medium	416	1191	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Roman Bold	420	1191	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
APL2				
APL2	307	1364	Scalable	293, 310, 910

Typeface	FGID	GCSGID	Font Width	Code Pages
APL2 Bold	322	1364	Scalable	293, 310, 910
Cyrillic Greek with Euro				
Times New Roman Medium	2308	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Times New Roman Bold	2309	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Times New Roman Italic Medium	2310	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Times New Roman Italic Bold	2311	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Roman Medium	2304	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Roman Bold	2305	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Italic Medium	2306	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Helvetica Italic Bold	2307	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Roman Medium	416	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Roman Bold	420	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".

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Typeface	FGID	GCSGID	Font Width	Code Pages
Courier Italic Medium	424	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Italic Bold	428	1504	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Arabic with Euro				
ITC Boutros Setting Medium	2308	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
ITC Boutros Setting Bold	2309	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
ITC Boutros Setting Italic Medium	2310	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
ITC Boutros Setting Italic Bold	2311	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
ITC Boutros Modern Rokaa Medium	2304	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
ITC Boutros Modern Rokaa Bold	2305	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
ITC Boutros Modern Rokaa Italic Medium	2306	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
ITC Boutros Modern Rokaa Italic Bold	2307	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".

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Typeface	FGID	GCSGID	Font Width	Code Pages
Boutros Typing Medium	416	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Boutros Typing Bold	420	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Boutros Typing Italic Medium	424	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Boutros Typing Italic Bold	428	1506	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Hebrew with Euro				
Narkissim Medium	2308	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Narkissim Bold	2309	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Narkissim Italic Medium	2310	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Narkissim Italic Bold	2311	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Narkiss Tam Medium	2304	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Narkiss Tam Bold	2305	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".

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Typeface	FGID	GCSGID	Font Width	Code Pages
Narkiss Tam Italic Medium	2306	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Narkiss Tam Italic Bold	2307	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Shalom Medium	416	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Shalom Bold	420	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Shalom Italic Medium	424	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Shalom Italic Bold	428	1362	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Thai				
Burirum Medium	2308	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Burirum Bold	2309	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Burirum Italic Medium	2310	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Burirum Italic Bold	2311	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".

Typeface	FGID	GCSGID	Font Width	Code Pages
Thonburi Medium	2304	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Thonburi Bold	2305	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Thonburi Italic Medium	2306	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Thonburi Italic Bold	2307	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Thai Medium	416	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Thai Bold	420	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Thai Italic Medium	424	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Thai Italic Bold	428	1505	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Lao				
Kaewfah Medium	2308	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Kaewfah Bold	2309	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".

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Typeface	FGID	GCSGID	Font Width	Code Pages
Kaewfah Italic Medium	2310	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Kaewfah Italic Bold	2311	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Pusuwan Medium	2304	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Pusuwan Bold	2305	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Pusuwan Italic Medium	2306	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Pusuwan Italic Bold	2307	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Lao Medium	416	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Lao Bold	420	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Lao Italic Medium	424	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Courier Lao Italic Bold	428	1341	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Katakana				
Katakana Gothic	304	1306	Scalable	290, 897, 1027, 1041, 1139

GCSGID Subsets

The following table provides a mapping of the valid subsets of the GCSGIDs listed for the IBM Core Interchange fonts.

GCSGID Subsets for IBM Core Interchange Fonts

GCSGID	Valid GCSGID Subsets
1269	0101, 0103, 0119, 0251, 0265, 0269, 0273, 0277, 0281, 0285, 0288, 0289, 0293, 0297, 0301, 0305, 0309, 0313, 0317, 0321, 0325, 0329, 0337, 0341, 0611, 0697, 0919, 0959, 0965, 0980, 0982, 0983, 0987, 0990, 0991, 0993, 0995, 1111, 1132, 1133, 1145, 1146, 1149, 1152, 1166, 1167, 1174, 1188, 1189, 1198, 1220, 1232, 1233, 1237, 1256, 1258, 1259, 1260, 1261, 1268, 1286, 1301, 1302, 2039
1355	1269, 2041
2041	0695, 0988, 1243, 1353, 1412, 2039
1275	0340, 0630, 0909, 1191, 1257
1264	0235, 0994, 1154, 1162, 1177, 1244
1265	0941, 0687, 0986, 0992, 1147, 1199, 1217, 1218
1300	0218, 0925, 0960, 0981, 0985, 0996, 0998, 1150, 1190, 1231, 1235, 1249, 1251, 1276, 1401
1279	1102, 1395, 1396
1304	380, 963, 1113
1306	332, 1122, 1164, 1172, 1187
1364	1304, 1330, 1340
1362	1265, 1356, 1357, 1358, 1360
1502	969
1503	1305, 1336, 1346, 1347, 1355, 1375, 1377, 1378, 1380, 1391, 1392, 1393, 1394, 1397, 1410, 1414, 1418, 1421
1504	1300, 1331, 1338, 1371, 1373, 1381, 1383, 1385, 1387, 1388, 1390, 1411, 1413, 1441

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GCSGID	Valid GCSGID Subsets
1505	1279
1506	1264, 1461, 1463, 1464, 1465

IBM Core Interchange Resident Code Page Set

The following lists the code pages used with the IBM Core Interchange Resident Fonts. Not all code Pages apply to each font; this is determined by the character set. Please correlate the GCSGIDs found in the following lists with the correct IBM Core Interchange Font GCSGID superset in p.105 "GCSGID Subsets" to determine which code pages apply to a particular font family.

IBM Core Interchange Resident Code Page Set

Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
Latin 1 Country Extended Code Pages		
37	697	US English, Canadian English, Canadian French, Dutch, Brazilian Portuguese, Portuguese
273	697	Austrian, German
274	697	Belgian
275	697	Brazilian
277	697	Danish, Norwegian
278	697	Finnish, Swedish
280	697	Italian
281	697	Japanese
282	697	Portuguese
284	697	Castilian Spanish, Latin American, Spanish
285	697	UK English
297	697	French, Catalan

Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
500	697	Multinational, Belgium French, Belgium, Dutch, Swiss French, Swiss, German, Swiss Italian
871	697	Icelandic
1140	695	US English, Canadian English, Canadian French, Dutch, Brazilian Portuguese, Portuguese ECECP
1141	695	Austrian, German ECECP
1142	695	Danish, Norwegian ECECP
1143	695	Finnish, Swedish ECECP
1144	695	Italian ECECP
1145	695	Castilian Spanish, Latin American, Spanish ECECP
1146	695	UK English ECECP
1147	695	French, Catalan ECECP
1148	695	Multinational ECECP, Belgium, French, Belgium Dutch, Swiss, French, Swiss German, Swiss Italian
1149	695	Icelandic ECECP
Latin 1 EBCDIC Publishing Code Pages		
361	1145	Multinational, Belgium French, Belgium, Dutch, Swiss French, Swiss, German, Swiss Italian
382	1145	German
383	1145	Belgian
384	1145	Brazilian Portuguese
385	1145	Canadian French
386	1145	Danish, Norwegian

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Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
387	1145	Finnish, Swedish
388	1145	French, Catalan
389	1145	Italian
390	1145	Japanese
391	1145	Portuguese
392	1145	Castilian Spanish
393	1145	Latin American Spanish
394	1145	UK English
395	1145	US English, Canadian English
Latin 1 ASCII Code Pages		
437	919	Multinational, US English, UK English, Dutch, German, Finnish, French, Italian, Spanish, Swedish
850	980	Multinational PC
858	988	Multinational PC with Euro
860	990	Portuguese (Primary = 850)
861	991	Icelandic (Primary = 850)
863	993	Canadian French (Primary = 850)
865	995	Nordic (Primary = 850)
1004	1146	IBM PC Desktop Publishing
819	697	ISO Latin 1
1252	1412	Windows Latin 1
1112	1305	Baltic, Multi EBCDIC
1257	1421	Windows, Baltic Rim
Latin 2/3/4/5 EBCDIC and ASCII Code Pages		

Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
852	982	Croatian, Czech, East German, Hungarian, Polish, Romanian, Slovak, Slovenian
852	1377	Croatian, Czech, East German, Hungarian, Polish, Romanian, Slovak, Slovenian with Euro
870	959	Latin 2 Multilingual
912	959	Latin 2 ISO/ ANSI 8 Bit
1153	1375	Latin 2 Multilingual with Euro
1250	1410	Windows Latin 2
853	983	Latin 3 Multilingual PC
905	1286	Latin 3 Multilingual
913	1286	Latin 3 Multilingual
1069	1256	Latin 4 EBCDIC
914	1256	Latin 4 ISO/ASCII
857	987	Latin 5 Turkey PC
857	1380	Latin 5 Turkey PC with Euro
1155	1378	EBCDIC Turkey with Euro
857	987	Latin 5 PC
920	1152	Latin 5 ISO/ANSI 8 Bit
1026	1152	Latin 5
1254	1414	Windows, Turkish
1157	1391	EBCDIC Estonia with Euro
922	1347	Estonia, PC
902	1392	8-bit Estonia with Euro
1156	1393	EBCDIC Baltic Multilingual with Euro

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Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
921	1346	PC Baltic Multilingual
901	1394	PC Baltic Multilingual with Euro
Latin 9 EBCDIC and ASCII Code Pages		
923	1353	Latin 9
924	1353	Latin 9 EBCDIC
Vietnamese		
1130	1336	Vietnamese EBCDIC
1164	1397	Vietnamese EBCDIC with Euro
1129	1336	Vietnamese ISO-8
1163	1397	Vietnamese ISO-8 with Euro
1258	1418	Windows Vietnamese
Thailand		
838	1279	Thailand
889	1102	Thailand
874	1279	Thailand, PC
1160	1395	Thailand, EBCDIC with Euro
1161	1395	Thailand, PC with Euro
1162	1396	Windows Thailand
Lao		
1132	1341	Lao EBCDIC
1133	1341	Lao ISO-8
Latin EBCDIC DCF Code Pages		
1002	1132	DCF Release 2 Compatibility
1003	1133	US Text Subset

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Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
1068	1259	Text with Numeric Spacing
1039	1258	GML List Symbols
Cyrillic and Greek EBCDIC and ASCII Code Pages		
880	960	Cyrillic Multilingual (Primary = 1025)
915	1150	Cyrillic ISO/ASCII 8 Bit
855	985	Cyrillic PC
866	996	Cyrillic #2 PC
1025	1150	Cyrillic Multilingual
1251	1411	Windows, Cyrillic
423	218	Greek 183 (Primary = 875)
813	925	Greek ISO/ASCII 8 Bit
813	1371	Greek ISO/ASCII 8 Bit with Euro
851	981	Greek PC (Primary = 869)
869	998	Greek PC
869	1373	Greek PC with Euro
875	925	Greek
875	1371	Greek with Euro
1039	1258	GML List Symbols
1253	1413	Windows, Greek
1253	1381	EBCDIC Cyrillic Multi. with Euro
808	1385	PC, Cyrillic, Russian with Euro
1131	1338	PC, Cyrillic, Belo Russian
849	1387	PC, Cyrillic, Belo Russian with Euro

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Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
808	1385	PC, Cyrillic, Russian with Euro
1158	1388	EBCDIC Cyrillic, Ukraine with Euro
1125	1331	PC, Cyrillic, Ukrainian
848	1390	PC, Cyrillic, Ukrainian with Euro
872	1383	Cyrillic PC with Euro
1166	1441	EBCDIC Cyrillic Multi. with Euro
Arabic EBCDIC and ASCII Code Pages		
420	235	Arabic Bilingual
420	1461	Arabic Bilingual with Euro
864	994	Arabic PC
864	1463	Arabic PC with Euro
1008	1162	Arabic ISO/ASCII 8 Bit
1008	1464	Arabic ISO/ASCII 8 Bit with Euro
1029	1154	Arabic Extended ISO/ASCII 8 Bit
1046	1177	Arabic Extended ISO/ASCII 8 Bit
1046	1465	Arabic Extended ISO/ASCII 8 Bit with Euro
1039	1258	GML List Symbols
Hebrew EBCDIC and ASCII Code Pages		
916	941	Hebrew ISO/ASCII 8 Bit
1028	941	Hebrew Publishing
424	941	Hebrew
424	1356	Hebrew with Euro
803	1147	Hebrew Character Set A (Primary = 424)

Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
803	1357	Hebrew Character Set A (Primary = 424) with Euro
856	986	Hebrew PC (Primary = 862)
856	1358	Hebrew PC (Primary = 862) with Euro
862	992	Hebrew PC
867	1360	Israel with Euro
1039	1258	GML List Symbols
Symbols		
259	340	Symbols, Set 7
899	340	Symbols, Set 7 ASCII
1087	1257	Symbols, Adobe
1038	1257	Symbols, Adobe ASCII
1091	1191	Symbols, Modified Set 7
1092	1191	Symbols, Modified Set 7 ASCII
363	630	Symbols, Set 8
829	909	Math Symbols
1039	1258	GML List Symbols
Katakana		
1027	1172	Japanese Latin Extended
290	332	Japan Katakana
290	1172	Host/PC Japanese Katakana Extended
897	1164	Japan PC #1
1041	1187	Japanese Extended PC

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Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)	Language Supported
1139	1122	Japan Alphanumeric Katakana
APL2		
293	1340	APL USA
310	963	Graphic Escape APL/TN
910	1330	APL ASCII

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4028 Compatibility Resident Font Set

The following lists the typefaces resident in the Printer and includes the valid FGID and code pages for each font. The Date Stamp on most of these character sets is 94350, and the Time Stamp used is 00000000.

The Date Stamp on FGIDs 76 and 159(20224) is 96036. The Date Stamp on FGID 164 is 96039 with a Time Stamp 08225100 for all GCSGIDs except 695, where the Data Stamp is 98124 and the Time Stamp is 13491500. The Date Stamp on FGID 701 is 96309 with a Time Stamp of 08230800 for all GCSGIDs except 695, where the Date Stamp is 98124 and the Time Stamp is 13492000. Fonts listed with an "Alt FGID", are used as a substitute for the requested "Alt FGID".

The Printer will substitute Times New Roman (from the IBM Core Interchange Set) for the Times Roman fonts listed in Table 162. The Courier fonts will also come from the IBM Core Interchange Set. All the remaining listed fonts will be from the IBM Coordinated Font Set (See p.119 "IBM Coordinated Font Set (IPDS)" (Resident PSC Strategic Scalable Font Set 2)).

See p.117 "4028 Compatibility Resident Code Page Set" for an explanation of the groups used in the "Code Pages" column.

⬇️Note

- Prestige fonts used with code pages with a CPGID of 259 are mapped to the Courier Roman Medium Symbols font (FGID 416 GCSGID 1275) as shown in Table 159. When the printer is in Box-Draw mode, any font which does not indicate CPGID 259 support will print with the Roman Medium Symbols font in a point size of 10 (12 pitch) when used with Code Page 259. This emulates 4028 behavior.

- Courier FGIDs 11 and 85 and Prestige FGIDs 12 and 86 now support Code Page 259 (when Box-Draw mode is on) to the extent these were supported in the 4028. In this mode, CPGID 1091 is substituted for CPGID 259 in order to print box-draw characters that line up with each other. The registered CPGID 259 does not have such characters, and is used when not in Box-Draw mode.

- To match the 4028 and 3116 printed font sizes, the FGIDs 254, 256, 281, and 290 are scaled anamorphically (internal to the Printer) as follows:

FGID	Vertical ✕ Horizontal Scale Factors (points)
254	7.8 vpt ✕ 7.0 hpt
256	7.8 vpt ✕ 7.0 hpt
281	7.0 vpt ✕ 6.0 hpt
290	5.0 vpt ✕ 4.5 hpt

4028 Compatibility Resident Font Set

Typeface	FGID	Alt FGID	Pitch	Point Size	Font width	Code Pages
Boldface	159		Proportional	12	120	A, B
Prestige PSM Roman Medium	164		Proportional	12	120	A, B
Courier	11		10	12	144	259, A, B
Courier	85		12	10	120	259, A, B
Courier	223		15	8	96	A, B
Courier.17ss	254		17.1	7.8	84	A, B
Courier Bold	46		10	12	144	A, B
Courier Bold	108		12	10	120	A, B
Courier Italic	92		12	10	120	A, B
Letter Gothic	281		20	7	72	A, B
OCR A	19		10	12	144	892
OCR B	3		10	12	144	893
Prestige Pica	12		10	12	144	259, A, B
Prestige Elite	86		12	10	120	259, A, B
Prestige	221		15	7.8	96	A, B
Prestige	256		17.1	8.5	84	A, B
Prestige PSM	164		Proportional	12	120	A, B
Prestige Elite Bold	111		12	10	120	A, B
Prestige Elite Italic	112		12	10	120	A, B
Times Roman	5687	760	Typo	6	40	A
Times Roman	5687	751	Typo	8	53	A

Typeface	FGID	Alt FGID	Pitch	Point Size	Font width	Code Pages
Times Roman	5687	1051	Typo	10	67	A
Times Roman	5687	1351	Typo	12	80	A
Times Roman Bold	5707	1053	Typo	10	67	A
Times Roman Bold	5707	761	Typo	12	80	A
Times Roman Bold	5707	762	Typo	14	93	A
Times Roman Bold	5707	1803	Typo	18	120	A
Times Roman Bold	5707	2103	Typo	24	160	A
Times Roman Italic	5815	1056	Typo	10	67	A
Times Roman Italic	5815	763	Typo	12	80	A
Times Roman Bold Italic	5835	764	Typo	10	67	A
Times Roman Bold Italic	5835	765	Typo	12	80	A
Gothic Text (311x)	203		13.3	9	108	A, B
Gothic Text (311x)	283		20	6	72	A, B
Gothic Text (311x)	290		26.7	5	54	A, B

4028 Compatibility Resident Code Page Set

The following lists provides an explanation of the groups as used in the Code Pages column of p.115 "4028 Compatibility Resident Font Set".

4028 Compatibility Resident Code Page Set

Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)
Group A	
037, 273, 274, 277, 278, 280, 281, 284, 285, 297, 500, 871	697

Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)
1140, 1141, 1142, 1143, 1144, 1145, 1146, 1147, 1148, 1149	695
038, 367	103
260	341
276	277
286	317
287	321
288	325
1002	1132
437	919
850	980
858	988
1003 (Addition to 4028 font support. Not supported by 4028.)	1133
Group B	
256 (Replaced by 500)	337
289 (Replaced by 500, but missing obsolete "Peseta" character)	329
Miscellaneous	
310	963
259	340
892	968
893	969
1303 (Used internally for resident Code 128 barcode font and postal bar code font support)	n/a

IBM Coordinated Font Set (IPDS)

"Resident PSC Strategic Scalable Font Set 2" lists the scalable IBM Coordinated font set typefaces resident in the Printer and includes the valid FGID and code pages for each font.

Where the IBM Core Interchange code pages are referenced in p.106 "IBM Core Interchange Resident Code Page Set", only the Latin 1 Country Extended, Latin 1 EBCDIC Publishing, Latin 1 ASCII and Latin EBCDIC DCF code pages are supported.

GCSGID Subsets

The following lists provides an a mapping of the valid subsets of the GCSGIDs listed for the PSC Strategic Font Set 2.

Resident PSC Strategic Scalable Font Set 2

Typeface	FGID	GCSGID	Font Width	Code Pages
APL	307	1304	Scalable	293, 310, 910
APL Bold	322	1304	Scalable	293, 310, 910
Boldface	20224	2039	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Boldface (Euro)	20224	2041	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Gothic Text	304	2039	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Gothic Text (Euro)	304	2041	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Letter Gothic	400	2039	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Letter Gothic (Euro)	400	2041	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".

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Typeface	FGID	GCSGID	Font Width	Code Pages
Letter Gothic Bold	404	2039	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Letter Gothic Bold (Euro)	404	2041	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
OCR A	305	968	Scalable	876, 892
OCR B	306	969	Scalable	877, 893
OCR B (Euro)	306	1502	Scalable	877, 893
Prestige	432	2039	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Prestige (Euro)	432	2041	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Prestige Bold	318	2039	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Prestige Bold (Euro)	318	2041	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Prestige Italic	319	2039	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Prestige Italic (Euro)	319	2041	Scalable	See p.106 "IBM Core Interchange Resident Code Page Set".
Katakana Gothic	304	1306	Scalable	290, 897, 1027, 1041

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IBM Coordinated Font Set Code Page Set

The following lists provides the GCSGIDs and CPGIDs for the individual Code Pages listed in the Code Pages column of p.119 "IBM Coordinated Font Set (IPDS)" (Resident PSC Strategic Scalable Font Set 2).

IBM Coordinated Font Set Code Page Set

Code Page Global ID (CPGID)	Graphic Character Set ID (GCSGID)
293	380
310	963
910	1113
876, 892	968
877, 893	969
877, 893	1502
290, 1027	1172
897	1164
1041	1187

GCSGID Subsets for the Strategic Font Set 2

GCSGID	Valid GCSGID Subsets
1304	0380, 0963, 1113
2039	0101, 0103, 0119, 0251, 0265, 0269, 0273, 0277, 0281, 0285, 0288, 0289, 0293, 0297, 0301, 0305, 0309, 0313, 0317, 0321, 0325, 0329, 0337, 0341, 0611, 0697, 0919, 0980, 0990, 0991, 0993, 0995, 1132, 1133, 1145, 1146, 1149, 1198, 1220, 1258, 1259, 1260
1306	0332, 1164, 1172, 1187
2041	0695, 0988, 1243, 1353, 1412, 2039

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IPDS Default Font

Factory Setting

The factory setting for the default font is Courier Roman Medium 10 pitch (12 point) using code page 037, version 1. The GRID for the default font is: FGID=416, GCSGID=697, CPGID=037, FontWidth=144 (CPI setting is 10.0). The default font may be changed by the operator using the printer's control panel. It will reset to the Factory Setting upon each IML. It can be reset to the Factory Setting by doing a Cold Reset to the printer.

The default font can be set for Single Byte fonts. It does not contain Double Byte Font Character Sets or Code Pages.

Selectable IPDS Default Font

To change the default font requires the use of the printer's control panel. The printer's control panel will present menu choices for selecting the various parts of the font.

The operator may select the default font using any or all of the Code Page (CPGID), Font (FGID), and Characters Per Inch (CPI) parameters. The available parameters will be listed in Groups to help identify valid/invalid combinations. An invalid combination will be resolved inside the printer because the printer must have a valid default font. However, the parameter adjustment will not be visible at the printer's control panel display. Detailed information listing the valid combinations and how to select them will be available with the printer.

The selection is based upon a hierarchy: Code Page is highest, Font is next, and Font Width (CPI) is the lowest. Should an invalid combination be selected, the Code Page will override Font and CPI, and Font will override CPI.

There are 5 Groups, A-E, into which all the fonts, code pages, and widths fall. All combinations defined within a Group are valid. When internal modification is necessary, the following rules apply:

- An invalid/unsupported CPGID becomes Code Page 037 (Group A).
- An invalid/unsupported Font Width (CPI) becomes 10.0 CPI (which will translate to 12 points).
- For a Group A CPGID, an invalid/unsupported FGID becomes 416 Courier Roman Medium.
- For a Group B CPGID, the FGID is automatically 304 Gothic Katakana.
- For a Group C CPGID, the FGID is automatically 305 OCR A. Font Width is 10.0 CPI.
- For a Group D CPGID, the FGID is automatically 306 OCR B. Font Width is 10.0 CPI.
- For a Group E CPGID, an invalid/unsupported FGID becomes 416 Courier Roman Medium.

🔽Note

- The 4028 compatibility fonts are a new addition to the printer's control panel selection. This is necessary because some of these FGIDs are anamorphically scaled, and therefore cannot be correctly reproduced with just an AFP FGID and a CPI value.

These fonts are handled specially in that all of these FGIDs (except 5687, 5707, 5815, 5835) ignore the printer's control panel CPI value, because the FGID fully describes the font. In the case of the 4 typographic FGIDs, there are valid discreet sizes associated with them. If the correct CPI values are not used, the printer will default to the nearest discrete size value. Tie goes to the smaller value.

Selectable Code Pages

The following code pages are selectable by the operator:

Code-Page/Group	Code Page Description
500 A	Belgium, Switzerland / International

Code-Page/Group	Code Page Description
037 A	US, Canada, Netherlands, Portugal
038 A	US English ASCII
260 A	Canadian French
273 A	Austrian / German
274 A	Belgium
276 A	Canadian French (94 character set)
277 A	Danish / Norwegian
278 A	Finnish / Swedish
280 A	Italian
281 A	Japanese
284 A	Spanish
285 A	UK English
286 A	Austrian / German (Alternate)
287 A	Danish / Norwegian (Alternate)
288 A	Finnish / Swedish (Alternate)
297 A	French
871 A	Icelandic
1140 A	US, Canada, Netherlands, Portugal (Euro)
1141 A	Austrian, German (Euro)
1142 A	Danish Norwegian (Euro)
1143 A	Finnish, Swedish (Euro)
1144 A	Italian (Euro)
1145 A	Spanish (Euro)
1146 A	UK English (Euro)
1147 A	Catalan French (Euro)

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Code-Page/Group	Code Page Description
1148 A	Multinational (Euro)
1149 A	Icelandic (Euro)
290 B	Japanese / Katakana
892 C	OCR - A
893 D	OCR - B
420 E	Arabic
423 E	Greek
424 E	Hebrew
870 E	Latin 2 Multilingual
875 E	Greek
880 E	Cyrillic
905 E	Turkish
1025 E	Cyrillic (primary)
1026 E	Turkish (primary)

Selectable Fonts

The following fonts (FGID) are selectable by the operator:

FGID/Group	FGID Description
2304 A, E	Helvetica Roman/ITC Boutros Modern Rokaa/Narkiss Tam - Medium
2305 A, E	Helvetica Roman/ITC Boutros Modern Rokaa/Narkiss Tam - Bold
2306 A, E	Helvetica Roman/ITC Boutros Modern Rokaa/Narkiss Tam - Italic Medium
2307 A, E	Helvetica Roman/ITC Boutros Modern Rokaa/Narkiss Tam - Italic Bold

FGID/Group	FGID Description
2308 A, E	Times New Roman/ITC Boutros Setting Rokaa/Narkissim - Medium
2309 A, E	Times New Roman/ITC Boutros Setting Rokaa/Narkissim - Bold
2310 A, E	Times New Roman/ITC Boutros Setting Rokaa/Narkissim - Italic Medium
2311 A, E	Times New Roman/ITC Boutros Setting Rokaa/Narkissim - Italic Bold
416 A, E	Courier Roman/Boutros Typing/Shalom - Medium
420 A, E	Courier Roman/Boutros Typing/Shalom - Bold
424 A, E	Courier Roman/Boutros Typing/Shalom - Italic Medium
428 A, E	Courier Roman/Boutros Typing/Shalom - Italic Bold
20224 A	Boldface
304 A	Gothic Text
400 A	Letter Gothic
404 A	Letter Gothic Bold
432 A	Prestige
318 A	Prestige Bold
319 A	Prestige Italic
304 B	Katakana Gothic
305 C	OCR A
306 D	OCR B

4028 Selectable Fonts

The following 4028 fonts (FGID) are also selectable by the operator:

FGID/Group	FGID Description
159 A	Boldface (Proportional Space 12 pt., based on 10 CPI)

FGID/Group	FGID Description
11 A	Courier 10.0 CPI
85 A	Courier 12.0 CPI
223 A	Courier 15.0 CPI
254 A	Courier 17.1 CPI
46 A	Courier Bold 10.0 CPI
18 A	Courier Italic 10.0 CPI
92 A	Courier Italic 12.0 CPI
203 A	Gothic Text 13.3 CPI
283 A	Gothic Text 20.0 CPI
290 A	Gothic Text 26.7 CPI
281 A	Letter Gothic 20 CPI
19 C	OCR A
03 D	OCR B
12 A	Prestige Pica 10.0 CPI
86 A	Prestige Elite 12.0 CPI
221 A	Prestige Elite 15.0 CPI
256 A	Prestige Elite 17.1 CPI
111 A	Prestige Elite Bold 12.0 CPI
112 A	Prestige Elite Italic 12.0 CPI
5687 A	Times Roman Typographic 6, 8, 10, 12 pt
5707 A	Times Roman Typographic Bold 10, 12, 14, 18, 24 pt
5815 A	Times Roman Typographic Italic 10, 12 pt
5835 A	Times Roman Typographic Bold Italic 10, 12 pt

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Selectable Font Widths

The following Font Widths (CPI) are selectable by the operator:

Group	Range in characters per inch
A, B, E	5.0 CPI - 30.0 CPI, in increments of 0.1 CPI.
C, D	10.0 CPI.

4028 Fixed Width	Ignored. Handled internally because the FGID defines the size.
5687 6 pt	20.0 CPI
5687 8 pt	15.1 CPI
5687 10 pt	11.9 CPI
5687 12 pt	10.0 CPI
5707 10 pt	11.9 CPI
5707 12 pt	10.0 CPI
5707 14 pt	8.6 CPI
5707 18 pt	6.7 CPI
5707 24 pt	5.0 CPI
5815 10 pt	11.9 CPI
5815 12 pt	10.0 CPI
5835 10 pt	11.9 CPI
5835 12 pt	10.0 CPI

Normally, IPDS Font Width is in terms of 1440ths of an inch (for example, 144, 120). However, printer's control panel Font Width selection is more easily understood (and more universally used) as Characters Per Inch. So the values will range from 5.0 cpi (Font Width 288) to 30.0 cpi (Font Width 48) in increments of 0.1 cpi.

The resulting cpi will be translated internally to the nearest integer font width value. Since CPI is inherently a reciprocal, 0.1 cpi increments will be a non-linear font width progression. This should not prove a serious problem since default fonts for IPDS are not the primary selection path.

An extra note is that font widths for fixed width fonts are calculated differently than for typographic fonts.

The vertical point size is the real common ground. So to get a 12 point size, a fixed width font will use a font width of 144; 10 cpi. A typographic font will use a font width of 80. To keep compatible sizes this is also translated from 10 cpi. The FGID defines which range to use. For further details, refer to the LFE and/or AR command sections of the IPDS architecture spec.

IPDS Bar Code Printing

To support the BCOCA tower for printing of bar codes, the OCR-A and OCR-B fonts and their corresponding code pages (892 and 893) must be resident in the printer. These are supported as shown in p.115 "4028 Compatibility Resident Font Set".

Code page 1303 is also resident to be used for printing code 128 bar codes.

IPDS Font Bolding

The Printer will accept the IPDS Load Font Equivalence command and support the bold and double strike bits for both resident Type 1 and loaded raster fonts. No other bits within the LFE flags byte are supported.

The bold/double strike attributes are handled the same way within the printer. The function is provided by printing a text block multiple times, each time shifted an appropriate amount. Since the attributes are tied to the font LID and not the font resource, the font resource is not affected.

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7. Appendix

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