HEWLETT PACKARD

GRAPHICS/1000-II Version 2.0

Device Handlers Manual Volume 1

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NOTICE

The information contained in this document is subject to change without notice.

Printing History

New editions of this manual will incorporate all material updated since the previous edition. Update packages may be issued between editions and contain replacement and additional pages to be merged into the manual by the user. Each updated page will be indicated by a revision date at the bottom of the page. A vertical bar in the margin indicates the changes on each page. Note that pages which are rearranged due to changes on a previous page are not considered revised.

The manual printing date and part number indicate its current edition. The printing date changes when a new edition is printed. (Minor corrections and updates which are incorporated at reprint do not cause the date to change.)

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Fourth Edition .... Dec 1992 Added PaintJet, DeskJet 500C, and HP-GL/2. Reordered the volumes.

Preface

Who should read this manual?

The *Graphics/1000 II Version 2.0 Device Handlers Manual* is intended for users of Hewlett-Packard's HP 1000 AGP/DGL software application packages. Application programmers can use this manual to determine how a particular package interacts with different devices.

What is the purpose of this manual?

This manual details the interaction between HP 1000 AGP/DGL software and the supported device. It discusses the effect that certain subroutines have on each of the devices, the dimensions of each device, and how some of the special capabilities of each device are accessed.

What does it assume?

This manual assumes that a programmer understands the features of at least one member of the AGP/DGL family of software packages. DGL programmers can refer to the *DGL Programmer's Reference Manual*, part number 97084-90000, for an explanation of the DGL package. Users of the AGP package can gain a thorough understanding of AGP by reading the *AGP User's Guide*, part number 97085-90010, and the *AGP Reference Manual*, part number 97085-90007.

How is it organized?

This manual is organized by the supported devices. The devices are grouped into Printers, CRTs, and Plotters. Each device is discussed in a separate section and identified by a divider reference tab. Printers (red tabs) and CRTs (dark gray tabs) are documented in Volume 1. Plotters (light gray tabs) are documented in Volume 2. Each section has a table of contents and a list of figures and tables (where applicable). Each section explains how the graphics systems interact with a particular device. Note that "I/O unit descriptor" is a generic term to reference a device. For the HP 1000, I/O unit descriptor is synonymous with Logical Unit (LU).

The sections are organized by functions. Within each section, the method in which functions are implemented by the graphics system is explained. The tables on the following pages define the HP supported devices for the HP 1000 Systems.

The devices covered in this manual are:

Volume 1

Dummy Devices
LaserJet
PaintJet and Color DeskJet
QuietJet
RuggedWriter
ThinkJet
HP 256x/2608
HP 256x with 26061A
HP 2686 LaserJet
HP 2932/2933/2934
Generic Terminals
HP 12065
HP 1350/1351
HP 2393
HP 2397
HP 2623
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HP 2647/2648
HP 9111
HP 9111 with 1350 and 1351
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Volume 2

HP-GL/2
ColorPro
DraftMaster
DraftPro
HP 7220
HP 7221
HP 7225
HP 7470
HP 7475
HP 7510
HP 7550
HP 7580/7585/7586
HP 9872

Device Configuration Matrix

Device	RTE-A		RTE-6/VM	
	Interface	Drivers	Interface	Drivers
Raster Terminals:				
RS-232 Muxes	12040A/B/C 12040D OBIO	IDM00 & DD*00 ID800 & DDC00 ID400 & DDC00	12972A/B/C 12972D	DVM00 DVC00
RS-232 ASIC	12005A	ID100 & DDC00 ID*00 & DDC00	12996A	DVR05
Vector Displays:				
HP-IB Interface	12009A	ID*37	59310B	DVA37
12065A Interface	12065A	ID*50	not supported	not supported
Tablets:				
HP-IB Interface	12009A	ID*37	59310B	DVA37
Plotters:				
RS-232 Muxes	12040A/B/C 12040D OBIO	IDM00 & DD*00 ID800 & DDC00 ID400 & DDC00	12972A/B/C 12972D	DVM00 DVC00
Eavesdrop on 264x with ASIC Card	not supported	not supported	264x/12966A Eavesdrop	DVR05
HP-IB Interface	12009A	ID*37	59310B	DVA37
Printers:				
RS-232 Muxes	12040A/B/C 12040D OBIO	IDM00 & DD*00 ID800 & DDC00 ID400 & DDC00	12972A/B/C 12972D	DVM00 DVC00
HP-IB Interface	12009A	ID*37 & DDC12 for 2608S & 256x; ID*37 & DD*12 for others	12821A	DVC12
2608A Parallel IF	not supported	not supported	26099A	DVB12

Device Handlers for Printers

Device	Graphics Display	Alpha-numeric Display	Button	Keyboard	Locator	Valuator	Pick
DeskJet, DeskJet Plus & 500	D0077	----	----	----	----	----	----
DeskJet 500C & 550C	D0078	----	----	----	----	----	----
LaserJet, LaserJet Plus, IIP, II, IID, 500 & 2000	D0077	----	----	----	----	----	----
LaserJet IIIP, IIII, IIID & IIISi	D0079	----	----	----	----	----	----
PaintJet & PaintJet XL	D0078	----	----	----	----	----	----
PaintJet XL with HP-GL/2 cartridge	D0079	----	----	----	----	----	----
PaintJet XL300	D0079	----	----	----	----	----	----
QuietJet	D0076	----	----	----	----	----	----
QuietJet Plus	D0075	----	----	----	----	----	----
RuggedWriter	D0074	----	----	----	----	----	----
ThinkJet	D0069	----	----	----	----	----	----
256x & 2608A/S with raster text	D0055	----	----	----	----	----	----
256x & 2608A/S with stroke text	D0045	----	----	----	----	----	----
256x with 26061A vector graphics option	D0026	----	----	----	----	----	----
2686A LaserJet & LaserJet Plus	D0058 or D0077	----	----	----	----	----	----
2932A/2933A/2934A with raster text	D0054	----	----	----	----	----	----
2932A/2933A/2934A with stroke text	D0053	----	----	----	----	----	----

Device Handlers for CRTs

Device	Graphics Display	Alpha-numeric Display	Button	Keyboard	Locator	Valuator	Pick
Terminals							
Generic Terminals	----	A0000	B0000	K0000	----	----	----
2393A	D0059	A0001	B0001	K0001	L0059	V0059	P0059
2397A	D0060	A0001	B0001	K0001	L0060	V0060	P0060
2623A	D0019	A0001	B0001	K0001	L0019	V0019	P0019
2625A & 2628A	D0020	A0001	B0001	K0001	L0019	V0019	P0019
2627A	D0036	A0001	B0001	K0001	L0019	V0019	P0019
2647A/2647F/2648A	D0001	A0001	B0001	K0001	L0001	V0001	P0001
Displays							
12065A Color Video IF	D0025	A0025	----	K0025	----	----	----
1350A/S & 1351A/S with 1310 Display	D0007	----	----	----	----	----	----
1350A/S & 1351A/S with 1311 Display	D0008	----	----	----	----	----	----
1350A/S & 1351A/S with 1317 Display	D0009	----	----	----	----	----	----
1350A/S & 1351A/S with 1321 Display	D0010	----	----	----	----	----	----
Tablets							
17623A Data Tablet	----	----	----	----	L0019	----	----
9111A	----	----	B0004	----	L0004	V0004	P0004
9111A with 1350S	----	----	B0004	----	L0005	V0004	P0005
9874A	----	A0017	B0017	K0017	L0017	V0017	P0017

Device Handlers for Plotters

Device	Graphics Display	Alpha-numeric Display	Button	Keyboard	Locator	Valuator	Pick
ColorPro 7440A (HB-IB)	D0061	----	----	----	L0061	----	----
ColorPro 7440A (RS-232)	D0063	----	----	----	L0063	----	----
DesignJet & DesignJet 600	D0079	----	----	----	----	----	----
DraftMaster I & II 7595A/7596A (HP-IB)	D0072	A0072	B0072	----	L0072	----	----
DraftMaster I & II 7595A/7596A (RS-232)	D0073	A0073	B0073	----	L0073	----	----
DraftMaster SX, RX & MX 7595B/C,7596B/C,7599B	D0079	----	----	----	----	----	----
DraftPro (HP-IB) 7570A/7575A /7576A	D0070	----	----	----	L0070	----	----
DraftPro (RS-232) 7570A/7575A/7576A	D0071	----	----	----	L0071	----	----
7220T with eight pens	D0018	----	----	----	L0018	----	----
7220C/T with eight pens and page advance	D0021	----	----	----	L0018	----	----
7221A/B/S/C/T	D0027	----	----	----	L0027	----	----
7221S/T with page advance	D0028	----	----	----	L0027	----	----
7221C/T with eight pens	D0029	----	----	----	L0027	----	----
7221T with eight pens and page advance	D0030	----	----	----	L0027	----	----
7225A/B	D0032	----	----	----	L0032	----	----
7470A Plotter (HP-IB)	D0031	----	----	----	L0031	----	----
7470A Plotter (RS-232)	D0067	----	----	----	L0067	----	----
7475A Plotter (HP-IB)	D0046	----	----	----	L0046	----	----
7475A Plotter (RS-232)	D0066	----	----	----	L0063	----	----
7510 Color Film Recorder	D0064	----	----	----	----	----	----
7550A Plotter (HP-IB)	D0047	----	----	----	L0046	----	----
7550A Plotter (RS-232)	D0065	----	----	----	L0063	----	----
7550B Plus	D0079	----	----	----	----	----	----
7580A/B and 7585A/B	D0006	----	----	----	L0006	----	P0006
7580B/7585B/7586B (HP-IB)	D0048	----	----	----	L0006	----	----
7580B/7585B/7586B (RS-232)	D0068	----	----	----	L0068	----	----
9872A/B/S/C/T	D0002	----	----	----	L0002	----	P0002
9872S with page advance	D0003	----	----	----	L0002	----	P0002
9872C with eight pens	D0015	----	----	----	L0002	----	P0002
9872T with eight pens and page advance	D0016	----	----	----	L0002	----	P0002

Supported Devices Matrix

Devices	RTE-A	RTE-6/VM
Printers:		
DeskJet	RS-232 Muxes	not supported
LaserJet	RS-232 Muxes	not supported
PaintJet	HP-IB, RS-232 Muxes	not supported
QuietJet	RS-232 Muxes	not supported
RuggedWriter	HP-IB, RS-232 Muxes	not supported
ThinkJet	RS-232 Muxes	RS-232 Muxes
2562C	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
256x	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes, parallel
2608A	not supported	parallel
2608S	not supported	HP-IB
2686A/+	RS-232 Muxes with 26054A	RS-232 Muxes
293xA	HP-IB, RS-232 Muxes	RS-232 Muxes
Terminals:		
2393A	RS-232	RS-232
2397A	RS-232	RS-232
2623A	RS-232	RS-232
2625A	RS-232	RS-232
2627A	RS-232	RS-232
2628A	RS-232	RS-232
264x	not supported	RS-232
Displays:		
12065A	A-Series Backplane	not supported
Tablets:		
9111	HP-IB	not supported
9874	not supported	HP-IB, RS-232
Plotters:		
ColorPro	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
DesignJet	HP-IB, RS-232 Muxes	not supported
DraftMaster	HP-IB, RS-232 Muxes	not supported
DraftPro	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
7220C/T	not supported	264x Eavesdrop on RS-232 Async
7221A/B/S/C/T	not supported	264x Eavesdrop on RS-232 Async
7470A	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
7475A	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
7510A	RS-232 Muxes	not supported
7550A	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
7550B	HP-IB, RS-232 Muxes	not supported
7580A/B	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
7585A/B	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
7586B	HP-IB, RS-232 Muxes	HP-IB, RS-232 Muxes
9872A/B/C/S/T	not supported	HP-IB, RS-232

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Configuration

Configuration

This chapter gives general device configuration for both RS-232 and HP-IB devices. Unless stated otherwise in the specific device handler section for your device, you may use the generation and configuration information given here.

RS-232 Devices

The following sections give sample generation records and configuration information for RS-232 Serial devices.

Generation

Using the D-MUX drivers, typical generation answer file entries for MUX port 0, at select code 23, and LU 4 are:

```
IFT,/RTE_A/ID800.REL,SC:23B

DVT,/RTE_A/DDC00.REL,MHP_PRINTER:0,LU:4
```

Configuration

Graphics LUs should not typically have timeouts. The timeout value should be set to zero to configure this.

The serial handlers use Xon/Xoff protocol. The MUX port must be configured for:

- Xon/Xoff
- Driver Type 0
- No Program Scheduling

Refer to your device manual for information on how to set your device for Xon/Xoff protocol.

Typical MUX configurations for Logical Unit 4 (LU 4) in RTE-A would be:

C-MUX	D-MUX
`CN,4,30B,142130B`	`CN,4,30B,130B`
`CN,4,33B,52500B`	`CN,4,34B,1`
`CN,4,34B,1`	`CN,4,21B`
`CN,4,21B`	

Typical MUX configurations for Logical Unit 4 (LU 4) in RTE-6/VM would be:

C-MUX	D-MUX
`CN,4,30B,142130B`	`CN,4,30B,130B`
`CN,4,33B,52501B`	`CN,4,34B,1`
`CN,4,34B,1`	`CN,4,21B`
`CN,4,21B`	

Note that the configurations above set the baud rate for the MUX to 9600 (indicated by the "`130B`" in the first `CN` command). Some devices may be able to use a higher baud rate. To configure the port for 19200 baud, for example, use "`140B`" in the first `CN` command. The last octal digit is the port number; in this example it is port 0.

For information on how a specific handler works for a specific device, refer to the section in this manual for that device.

HP-IB Devices

The following sections give sample generation records and configuration information for HP-IB devices.

Generation

Typical generation answer file entries for the following HP-IB devices are:

Plotters (at select code 26, LUs 3 and 4, and no timeout)

```
IFT,/RTE_A/%ID*37,SC:26B

DVT,,,LU:3,TO:0,DT:77B,DX:1,DP:1:0
DVT,,,LU:4,TO:0,DT:77B,DX:1,DP:1:1
```

HP 2608/256x Line Printers (at select code 26 and LU 5)

```
IFT,/RTE_A/%ID*37,SC:26B

DVT,/RTE_A/%DDC12,,LU:5,DP:1:5
```

Other Printers (at select code 26 and LU 6)

```
IFT,/RTE_A/%ID*37,SC:26B

DVT,/RTE_A/%DD*12,M2932A,LU:6,DT:12B,DP:1:6
```

Configuration

Graphics LUs should not typically have timeouts. The timeout value should be set to zero to configure this.

For specific HP-IB device configuration information, refer to the section in this manual for that device.

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Dummy Devices

Dummy Devices

General Information

The AGP/DGL Graphics Systems provide dummy device handlers that can be implictly linked with the application program. There is one dummy handler for each logical device supported. All of these dummy handlers are contained in the DIDD library. The device name for all of the dummy devices is "`DUMMY `". The dummy device handlers are supported on all system configurations supported by AGP or DGL.

Linking with AGP

When linking a Workstation Program (WSP) for AGP, the user only needs to explicitly link the device handlers that are needed for the workstation used by the AGP application. However, because the WSP must be able to access all logical devices supported by AGP, references are made to ALL of the logical devices. To satisfy references made to all logical devices by the WSP, dummy device handlers are implicitly linked when the DIDD library is searched for all device handlers not explicitly linked by the user. For example, if the user workstation does not contain a valuator device, the user does not need to explicitly link a valuator device handler. A dummy valuator handler will be implicitly linked when the DIDD library is searched.

Linking with DGL

When linking a DGL application program, the user typically loads all of the device handlers corresponding to the logical devices referenced by the DGL application program. If a device handler corresponding to a logical device referenced by the DGL application is not explicitly linked by the user, then a dummy device handler will be implicitly linked when DIDD is searched. For example, if a call is made to ZBUTN in the DGL program and the user does not explicitly link a button device handler (Bxxxx), then a dummy button handler will be implicitly linked.

Alphanumeric Device Handler

Description

When JIWS/ZIWS is called with the opcode specified, the following information is always returned:

Opcode	Information	Returned
7050	Device name	ILIST(1) = "DU" ILIST(2) = "MM" ILIST(3) = "Y "
	Status	ILIST(4) = −1
	Alphanumeric device I/O unit descriptor (that is, logical unit)	ILIST(5) = 0
	Maximum number of lines displayable	ILIST(6) = 0
	Number of characters per line	ILIST(7) = 0

Subroutine Calls to Dummy Devices

AGP

When attempting to enable a dummy alphanumeric device (JEDEV), error 5 is generated and the alphanumeric device is not enabled. Therefore, any subsequent alphanumeric calls generate errors because the device is not enabled.

DGL

When attempting to enable a dummy button device (ZBINT), IERR is set to 1 and any subsequent alphanumeric calls are ignored.

Button Device Handler

Description

When JIWS/ZIWS is called with the opcode specified, the following information is always returned:

Opcode	Information	Returned
6051	Device name	ILIST(1) = "DU" ILIST(2) = "MM" ILIST(3) = "Y "
	Status	ILIST(4) = −1
	Button device I/O unit descriptor	ILIST(5) = 0
	Number of buttons supported	ILIST(6) = 0

Subroutine Calls to Dummy Devices

AGP

When attempting to enable a dummy button device (JEDEV), error 5 is generated and the button device is not enabled. Therefore, any subsequent button calls generate errors because the device is not enabled.

DGL

When attempting to enable a dummy button device (ZBINT), IERR is set to 1 and any subsequent button calls are ignored.

Keyboard Device Handler

Description

When JIWS/ZIWS is called with the opcode specified, the following information is always returned:

Opcode	Information	Returned
5051	Device name	ILIST(1) = "DU" ILIST(2) = "MM" ILIST(3) = "Y "
	Status	ILIST(4) = −1
	Keyboard device I/O unit descriptor	ILIST(5) = 0

Subroutine Calls to Dummy Devices

AGP

When attempting to enable a dummy keyboard device (JEDEV), error 5 is generated and the keyboard device is not enabled. Therefore, any subsequent keyboard calls generate errors because the device is not enabled.

DGL

When attempting to enable a dummy keyboard device (ZKINT), IERR is set to 1 and any subsequent keyboard calls are ignored.

Locator Device Handler

Description

When JIWS/ZIWS is called with the opcode specified, the following information is always returned:

Opcode	Information	Returned
255	Resolution of locator	RLIST(1) = 0.0 RLIST(2) = 0.0
256	Maximum size of locator	RLIST(1) = 1.0 RLIST(2) = 1.0
6050	Device name	ILIST(1) = "DU" ILIST(2) = "MM" ILIST(3) = "Y "
	Status	ILIST(4) = −1
	Locator device I/O unit descriptor	ILIST(5) = 0
	Number of locator buttons	ILIST(1) = 0

Subroutine Calls to Dummy Devices

AGP

When attempting to enable a dummy locator (JEDEV), error 5 is generated and the locator is not enabled. Therefore, any subsequent locator calls generate errors because the device is not enabled.

DGL

When attempting to enable a dummy locator device (ZLINT), IERR is set to 1 and any subsequent locator calls are ignored.

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LaserJet Device Handler

List of Illustrations

Tables

LaserJet Device Handler

Introduction

This handler chapter differs from earlier Graphics/1000-II Version 2.0 manual chapters in that the normally separate DGL and AGP sections are combined into one section. In general, AGP routines are prefixed with a J as in JOESC, while DGL routines are prefixed with a Z as in ZOESC. Unless otherwise specified in a heading prefix, all references apply to both AGP and DGL.

You should be familiar with the operation of the specific printer. If necessary, refer to one of the following manuals for the appropriate operating instructions.

LaserJet 2000 Operator's Manual, part number 02684-90901.

LaserJet Operator's Reference Manual, part number 02686-90914.

LaserJet II Operator's Manual, part number 33440-90901.

This handler is supported on RTE-A computer systems using the "new" serial drivers ID400 and ID800. Due to the size of the data contained in a 300 dpi full size print, it is recommended that XON XOFF be used with a baud rate of 19200. Even at this rate, data transfer times in excess of five minutes are not uncommon. Connect the printer using an HP 40242M (straight through) cable to the MUX port. Typical generation answer file entries for MUX port 0, at select code 23B, LU 4, using ID800 and DDC00 are as follows:

```
IFT,/GEN/SOURCE/ID800.REL,SC:23B

DVT,GEN/SOURCE/DDC00.REL,MHP_PRINTER:0,LU:4
```

Typical initialization sequences for MUX port 0 are as follows:

```
CN 4 30B 140B

CN 4 34B 1
```

Supported Logical Devices

The following logical devices are supported by the AGP/DGL graphics systems when using the D0077 handler:

Logical Device	Device Handler Name	Physical Device
Display	D0077	DeskJet Plus, DeskJet 500, LaserJet, LaserJet Plus, IIP, II, IID, 500, 2000 HP 2686A LaserJet and LaserJet Plus

The LaserJet family printers do not respond to inquires. This handler checks for the correct device driver and assumes the device at the logical unit (LU) is a LaserJet family printer.

The handler assumes that sufficient memory (for full letter size page graphics prints at the highest density supported) is present and does not clear printer memory as the D0058 handlers do. If the handler is used on a device without sufficient memory, Error 21 will probably occur.

The four printer density levels supported are:

- 75 dots per inch
- 100 dots per inch
- 150 dots per inch
- 300 dots per inch

The density used by the handler is based upon the control word sent with a JDINT or ZDINT call.

This handler's architecture uses uses a raster image in EMA and VMA. The raster image size is 462 pages. All primitives are written into the raster image (or frame buffer) until a new-frame-action occurs. When the new-frame-action occurs, the raster image is sent to the printer. This handler does not allow direct graphics access of printer hardware capabilities, such as fonts or shading, because everything is done in software. This architecture was chosen because the printer supports alphanumeric characters and raster graphics using escape sequences, but not vector graphics.

Interleaved Text and Graphics

It is possible to interleave text and graphics provided that the application supplies the text and uses the AGP/DGL package in a way such that conflict does not occur. The display device can be opened with appropriate control words and closed in such a manner such that new-frame-actions do not occur. This is not meant to imply that merged text and graphics is a function of AGP/DGL, nor that it is particularly easy to do, merely that it can be done. This capability was not available with the D0058 AGP/DGL handlers. For further details, refer to the sections on JDINT/ZDINT, New-Frame-Action, and termination sections later in this chapter.

Graphics Display Device Handler

Plotting Area

Table 1. Letter Size Plotting Area

Print Density	Plotting Area			
75 dots/inch	Width:	266.70 mm	Height:	200.49 mm
100 dots/inch	Width:	266.70 mm	Height:	203.20 mm
150 dots/inch	Width:	266.70 mm	Height:	203.20 mm
300 dots/inch	Width:	266.70 mm	Height:	203.20 mm

Plotting Capacity

Table 2. Letter Size Plotting Capacity

Print Density	Plotting Area			
75 dots/inch	Width:	592 points	Height:	787 points
100 dots/inch	Width:	800 points	Height:	1050 points
150 dots/inch	Width:	1200 points	Height:	1575 points
300 dots/inch	Width:	2400 points	Height:	3150 points

Plotting Resolution

Table 3. Letter Size Resolution

Print Density	Plotting Area	
75 dots/inch	2.9528	points/mm in X and Y directions
100 dots/inch	3.9370	points/mm in X and Y directions
150 dots/inch	5.9055	points/mm in X and Y directions
300 dots/inch	11.8110	points/mm in X and Y directions

Aspect Ratio of Maximum Area

0.76

Initialization

(JDINT/ZDINT). The physical origin is the upper left corner of the paper.

Density

Bits 10 and 11 are used to specify density as follows:

Table 4. Density

Bit 10	Bit 11	Resulting Density
0	0	75 dots per inch
1	0	100 dots per inch
0	1	150 dots per inch
1	1	300 dots per inch

Limits

(JDLIM/ZDLIM). The default logical display limits are specified relative to the upper left corner of the paper when bit 8 is clear (not set). When bit 8 is set, the logical display limits are specified in a rotated format. The origin in the Y-direction (non-rotated) or the origin in the X-direction (rotated) is column 1 of the printer.

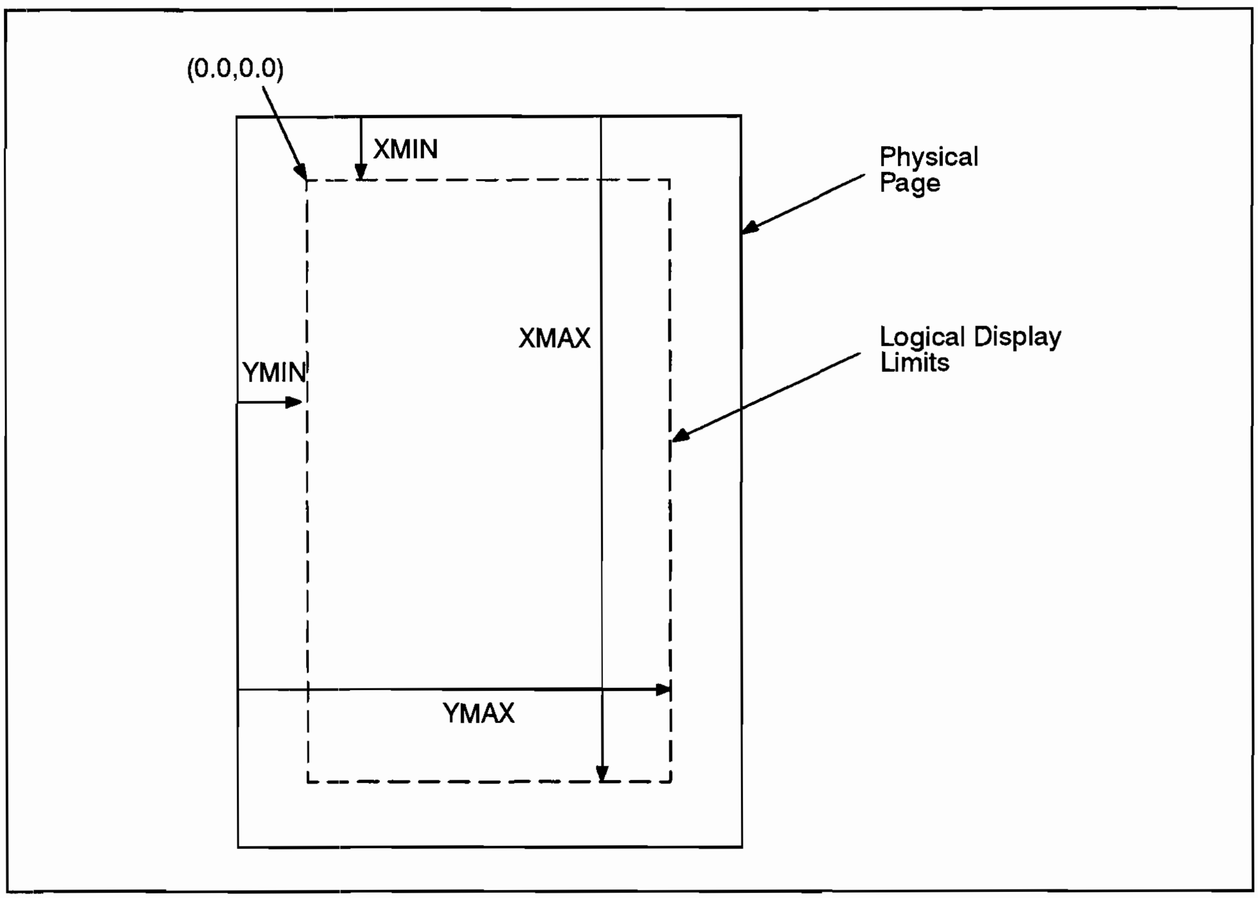

Figure 3. Paper Positioning and Limitations (non-rotated)

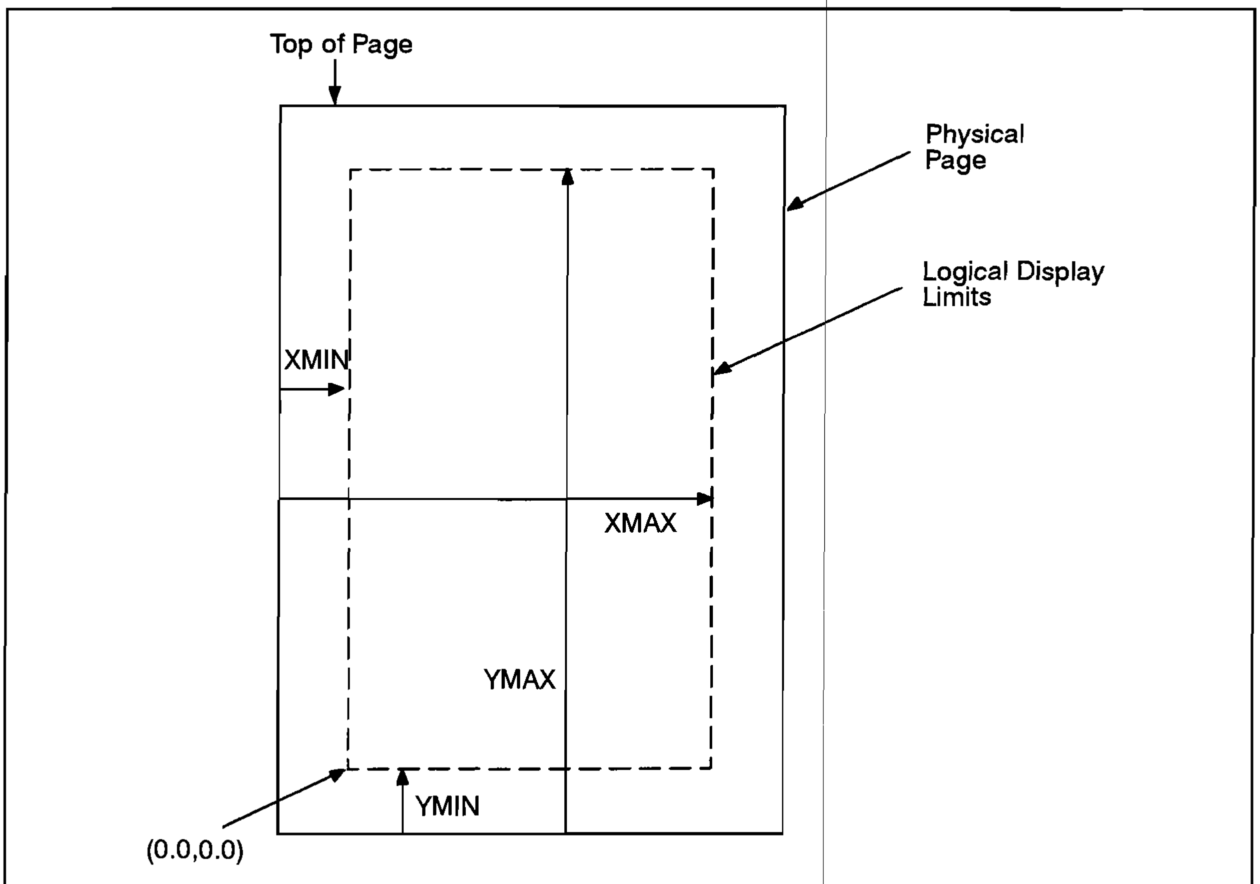

Figure 4. Paper Positioning and Limitations (rotated)

Supported Primitive Attributes

Color

(JCOLR/ZCOLR). The D0077 display handler provides a software color table of two colors. The size of the color table cannot be changed. The color table is initialized when JDINT/ZDINT is called. The color selected corresponds to the color defined in the color table.

Table 5. Color Table

Color Table Entry	Color
0	Color set to white (background color)
1	Color set to black

Redefining and Inquiring Color

(JDCOL/ZDCOL)(JICOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Output Primitives

Clipping

The device handler supports vector and text clipping which is set to the view surface limits. Parts of graphics items that exceed the view surface limits are clipped.

If AGP window clipping is disabled and parts of the image are outside of the view surface limits, then unpredictable results may occur.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG/ZPGDD). This device does not have hardware area fill. A polygon specified by ZPGDD is always represented as described in the *DGL Programmer's Reference Manual.*

Markers

(J2MRK/J3MRK/JR2MK/JR3MK/ZMARK). Nineteen standard markers are supported. A character size of 1.69 mm by 2.26 mm is used to generate markers. Markers are affected by the color attribute.

Medium- and Low-Quality Text (AGP)

(JTEXL, JTEXM). For text that is not clipped by AGP, only parts of characters extending beyond the current hardware clipping limits or the paper limits are clipped. Refer to ZTEXT for further information about AGP medium- and low-quality text, which is the same as DGL text.

Text (DGL)

(ZTEXT). The only character set available is the standard 96-character ASCII set.

After a ZTEXT call, the starting position is set so that consecutive calls to ZTEXT have the effect of concatenation. In addition to the viewable characters, text strings can also include the control characters listed in Table 6. Any other control characters are ignored.

Table 6. Text Control Characters

Octal Control	Code	Function
Back Space	10B	Move starting position one character-cell width back
Line Feed	12B	Move starting position one character-cell height down
Vertical Tab	13B	Move starting position one character-cell height up
Carriage Return	14B	Move starting position back to the beginning of the text string

```
abcdefghijklm
nopqrstuvwxyz
ABCDEFGHIJKLM
NOPQRSTUVWXYZ
! "#$%&' () *+, -
. /0123456789:
; <=>?@ [\] ^_` {
| } ~
```

Figure 7. Supported Vector Character Set

New-Frame-Action (AGP)

(JNEWF/JPURG/JSVIX/JSHI/JVSAL/JDLIM/JCLR). The action taken when a new-frame-action is given is dependent on two bits in the JDINT control word: bit 9 and the simulated raster-erase bit. Bit 9 determines if a new-frame-action is necessary for a given circumstance. If bit 9 is not set, a new-frame-action is always a necessary new-frame-action. Note that when bit 9 is not set, blank pages may be generated. If bit 9 of the control word is set, a new-frame-action causes the picture to be output and a page advance performed. The following sections describe the effect of the simulated raster erase bit on new-frame-actions.

Simulated Raster Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates, causes a page eject and all visible segments to be redrawn (if the new-frame-action is necessary). When the new-frame-action is given with the display not enabled, it does not alter the printer.

Simulated Raster Erase Set

The implementation of the printer handler has the ability to erase images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call, and to remove graphics elements without doing a page eject. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is like redrawing the image in white (that is, the background color); therefore, black lines crossing the image to be purged may also have parts of them erased, leaving holes.

An explicit JNEWF call always causes a page eject and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates (if the new-frame-action is necessary). This provides a means of generating a clean surface (one without holes). The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations because the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside of a batch-of-updates always results in a page eject and visible segments being redrawn when the JUPDT call is given (if the new-frame-action is necessary).

New-Frame-Action (DGL)

(ZNEWF). The action taken when a new-frame-action is given is dependent on bit 9 of the ZDINT control word. If bit 9 of the control word is set, a new-frame-action is performed only if the picture contains some output. When bit 9 is not set, blank pages may be generated. A necessary new-frame-action causes the picture to be made current, the picture to be output, and a page advance to be performed.

Input Escape Functions

(JIESC/ZIESC). Inquiry escape functions are not supported by AGP/DGL.

Output Escape Functions

(JOESC/ZOESC). The following output escape function is supported

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.

Locator Echoes on the Graphics Display

(JWLOC/ZWLOC). Locator echoing is not supported.

Termination

(JWOFF/ZDEND). If bit 12 of the JDINT/ZDINT control word is set, termination causes a new-frame-action to occur. If bit 12 of the JDINT/ZDINT control word is clear, termination does not cause a new-frame-action. When the new-frame-action occurs, the printer is reset to default values.

The device name is set to "0077 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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PaintJet and Color DeskJet Device Handler

Introduction

In this chapter the AGP and DGL information is combined into one section for each device handler. Unless otherwise specified, all references apply to both AGP and DGL. In general, AGP routines are prefixed with a J as in JOESC, while DGL routines are prefixed with a Z as in ZOESC.

You should be familiar with the operation of your PaintJet or Color DeskJet printer. If necessary, refer to the appropriate manual listed below for operating instructions:

HP PaintJet Color Graphics Printer User's Guide, part number 03630-90001.

HP PaintJet XL Color Graphics Printer User's Guide, part number C1602-90001.

HP PaintJet XL Color Graphics Printer Computer Information, part number C1602-90002.

DeskJet 500C Setup Guide, part number C2114-90010.

DeskJet 500C User's Guide, part number C2114-90020.

Supported Logical Devices

The following logical devices are supported by the AGP/DGL Graphics Systems:

Logical Device	Device Handler Name	Physical Device
Graphics Printer (Display)	D0078	HP 3630A (PaintJet), HP C1602A (PaintJet XL), HP C2114A (DeskJet 500C), HP C2121A (DeskJet 550C)

This handler does not inquire the device identifier from the printer; it only checks for the correct driver type and assumes the device at the Logical Unit (LU) is a printer supported by this handler.

The following two densities are supported when this handler is used with a PaintJet or PaintJet XL:

- 90 dots/inch
- 180 dots/inch

The following two densities are supported when used with a Color DeskJet:

- 150 dots/inch
- 300 dots/inch

The density used by the handler is based on the control word sent with a JDINT or ZDINT call.

This device handler uses EMA/VMA. Please refer to the EMA/VMA Device Handlers section in your AGP or DGL Reference Manual.

This handler's architecture uses a raster image in EMA/VMA. All primitives are written into the raster image (or frame buffer) until a new-frame-action occurs. When the new-frame-action occurs, the raster image is sent to the printer. This architecture does not allow access to printer hardware capabilities, such as fonts or shading, because everything is done in software. This architecture was chosen because the printers support alphanumeric characters and raster graphics, but not vector graphics.

The EMA/VMA requirements of this handler are larger than comparable monochrome printers because of the requirement to store the color information. The following table lists the number of pages of EMA/VMA required when this handler is used at the supported densities:

Printer	Density	Pages of EMA/VMA
PaintJet and PaintJet XL	90 dpi	130
	180 dpi	517
Color DeskJet	150 dpi	359
	300 dpi	1434 (Must use VMA)

The maximum number of EMA pages is 1022. This handler uses a maximum of 1434 pages, which is greater than the maximum number of EMA pages. Therefore, you must use VMA (not EMA) if you are using a Color DeskJet at 300 dpi. For other configurations, the handler may be linked to use EMA. LINK will allocate 1022 pages of EMA in this case. If you desire to have the speed of EMA but do not want to use 1022 pages of memory when you only need 130, 517, or 359 pages, you should link your program to use VMA and specify the required number of pages as the working set size.

Device Configuration

For the DeskJet 500C, the color cartridge must be installed.

The paper size for all printers supported by this handler must be set to U. S. Letter Size (8 1/2 x 11 inches).

Graphics Display Device Handler

Plotting Area

Printer	Plotting Area	
PaintJet, PaintJet XL, and Color DeskJet	Width: 259.08 mm	Height: 203.2 mm

Plotting Capacity

Printer	Print Density	Plotting Area	
PaintJet and PaintJet XL	90 dots/inch	Width: 918 points	Height: 720 points
	180 dots/inch	Width: 1836 points	Height: 1440 points
Color DeskJet	150 dots/inch	Width: 1530 points	Height: 1200 points
	300 dots/inch	Width: 3060 points	Height: 2400 points

Resolution

Printer	Print Density	Resolution
PaintJet and PaintJet XL	90 dots/inch	3.5433 points/mm in the X-direction. 3.5433 points/mm in the Y-direction.
	180 dots/inch	7.0866 points/mm in the X-direction. 7.0866 points/mm in the Y-direction.
Color DeskJet	150 dots/inch	5.9055 points/mm in the X-direction. 5.9055 points/mm in the Y-direction.
	300 dots/inch	11.8110 points/mm in the X-direction. 11.8110 points/mm in the Y-direction.

Aspect Ratio of Maximum Area

Printer	Ratio
PaintJet/DeskJet	0.7843

Initialization

(JDINT/ZDINT). When initialized, the following operations are performed:

Device name:	Set to "PJET " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Starting position:	Set to (0.0,0.0).
Physical origin:	Upper-left corner of the paper.
Logical display surface:	Set to the default limits. See the section Logical Display Surface.
View surface:	Always justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the maximum (physical) device limits.
Page advance:	If bit 7 in the control word is set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary. If bit 7 is not set, the paper is always advanced to the next page boundary.
Color table:	Initialized to default values.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.
Density:	Bits 10 and 11 specify printer density as described in the Density section in this chapter.
Limits (JDLIM/ZDLIM):	The default logical display limits are specified relative to the upper left corner of the paper.

Control Word Summary

The following are the defined bits for the control word:

Bits 10 and 11	(6000B)	density; see Density section in this chapter
Bit 9	(1000B)	conditional new-frame-action
Bit 8	(400B)	rotate
Bit 7	(200B)	ZDINT page advance
Bit 0	(1B)	spool

Logical Display Surface

The logical display surface is set to the default value with bit 8 clear (not set). If bit 8 is set, the logical display surface is rotated.

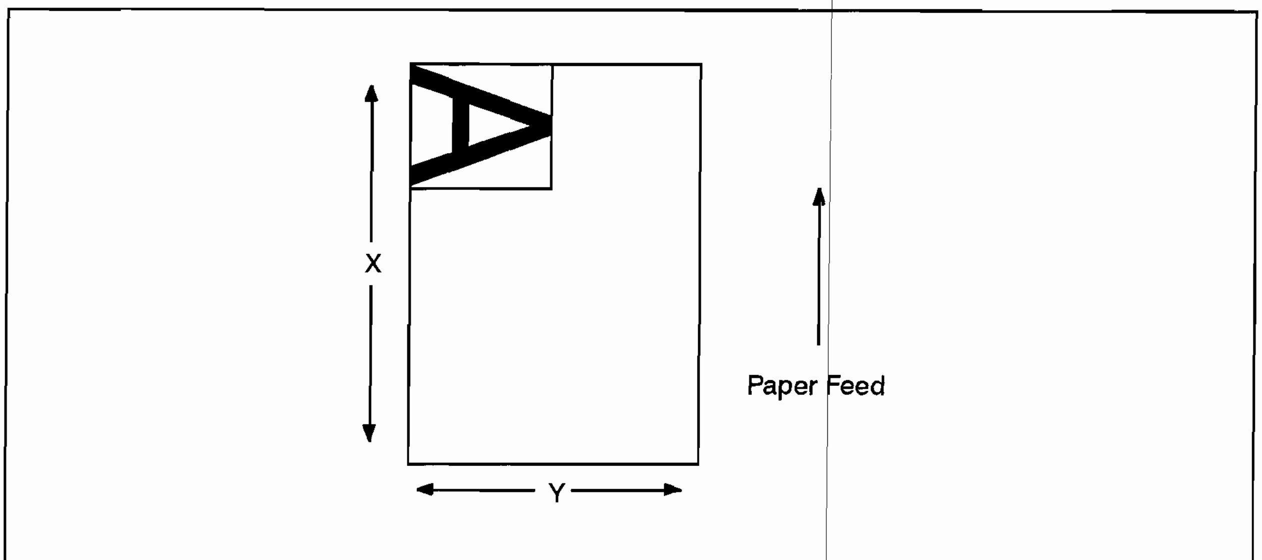

Figure 1. Default Orientation on the Physical Page - Bit 8 Clear

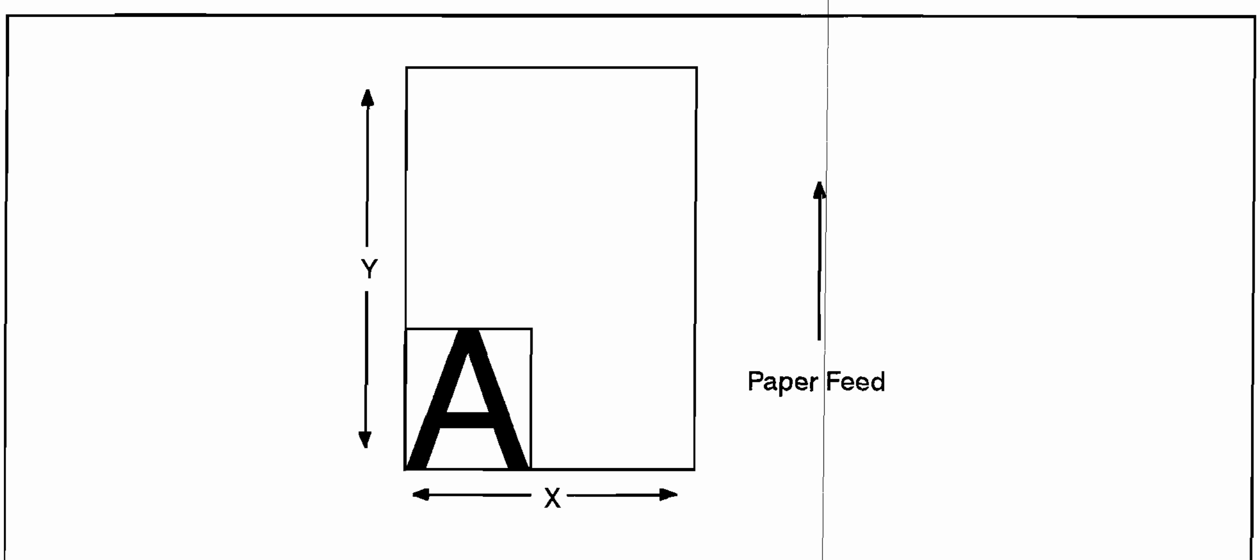

Figure 2. Rotated Orientation on the Physical Page - Bit 8 Set

Table 1. Color Table

Color Table Entry	Color	Red	Green	Blue
0	White	1.0	1.0	1.0
1	Black	0.0	0.0	0.0
2	Red	1.0	0.0	0.0
3	Green	0.0	1.0	0.0
4	Yellow	1.0	1.0	0.0
5	Blue	0.0	0.0	1.0
6	Magenta	1.0	0.0	1.0
7	Cyan	0.0	1.0	1.0

Redefining and Inquiring Color

(JDCOL/ZDCOL)(JICOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(JPICL/ZPICL). Refer to JCOLR/ZCOLR for information regarding color.

Polygon Style

(JDPST/ZDPST). Using JDPST/ZDPST does not cause polygons already displayed to change style.

Highlighting

(JSHI/JGHI/ZHIGH). Highlighting is not supported.

Line Style

(JLSTL/ZLSTL). Thirteen predefined line styles are supported. Line styles 1 through 7 may be classified as *continuous*. Line styles 8 through 13 are the same patterns as styles 2 through 7 drawn in the vector adjusted format. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, or the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete description of continuous and start adjusted line styles.

Polygon Interior Line Style

(JPILS/ZPILS). Refer to JLSTL and ZLSTL for information regarding line style.

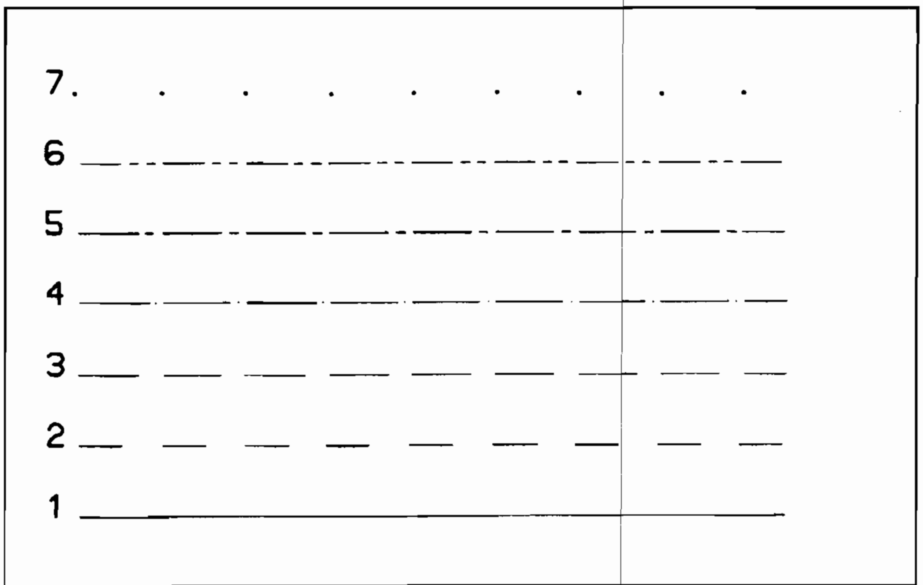

Figure 5. Supported Line Styles

Line Width

(JLWID/ZLWID). Four line widths are supported:

Line Width Index	Line
1	Primitives drawn with a line width one pixel wide
2	Primitives drawn with a line width three pixels wide
3	Primitives drawn with a line width five pixels wide
4	Primitives drawn with a line width seven pixels wide

Character Sizes

(JCSIZ/ZCSIZ). Medium- and low-quality text is generated in software using a vector character set. A vector character set is defined as a series of moves and draws and is affected by the viewing transformation, line style, and line width. Both handlers support all character cell sizes that have a width and height not less than 0.85 millimeters and not greater than 250 millimeters.

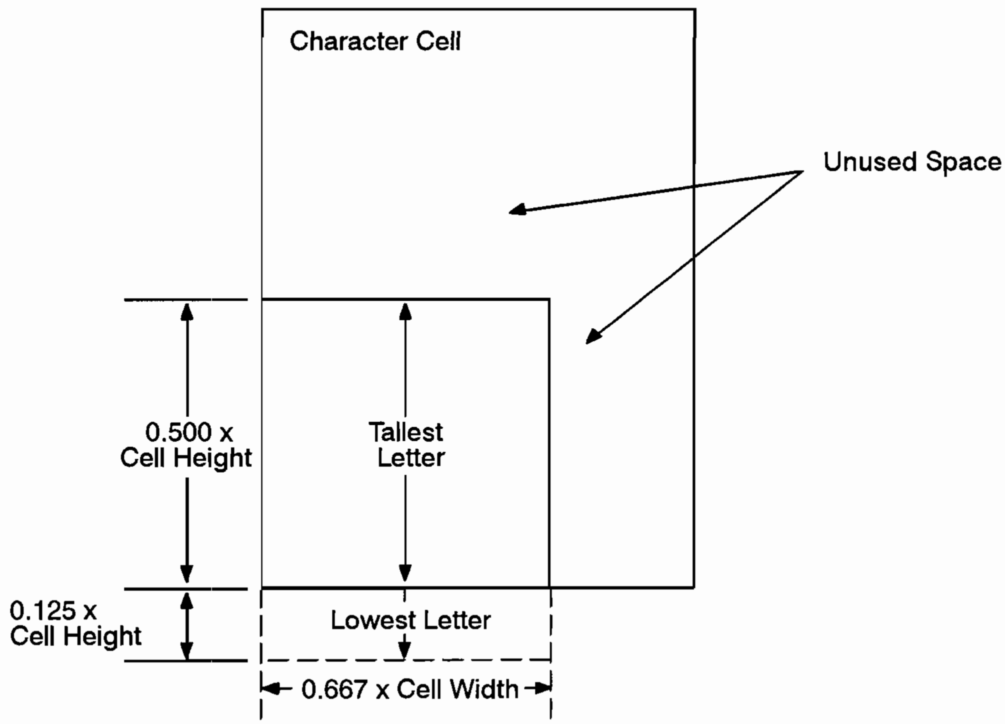

Figure 6. Placement of Character in Character Cell

Output Primitives

Clipping

These device handlers support vector and text clipping that is set to the view surface limits. Parts of graphics items that exceed the view surface limits are clipped.

If AGP window clipping is disabled and parts of the image are outside the view surface limits, unpredictable results may occur.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG/ZPGDD). The printers supported by this handler do not have hardware area fill. A polygon specified by ZPGDD is always represented as described in the *DGL Programmer's Reference Manual.*

Markers

(J2MRK/J3MRK/JR2MK/JR3MK/ZMARK). Nineteen standard markers are supported. A character size of 1.69 millimeters by 2.26 millimeters is used to generate markers. Markers are affected by the color attribute.

Medium- and Low-Quality Text (AGP)

(JTEXL/JTEXM). For text that is not clipped by AGP, only parts of characters extending beyond the current hardware clipping limits or the paper limits are clipped. Refer to ZTEXT for further information about DGL text that is the same as AGP medium- and low-quality text.

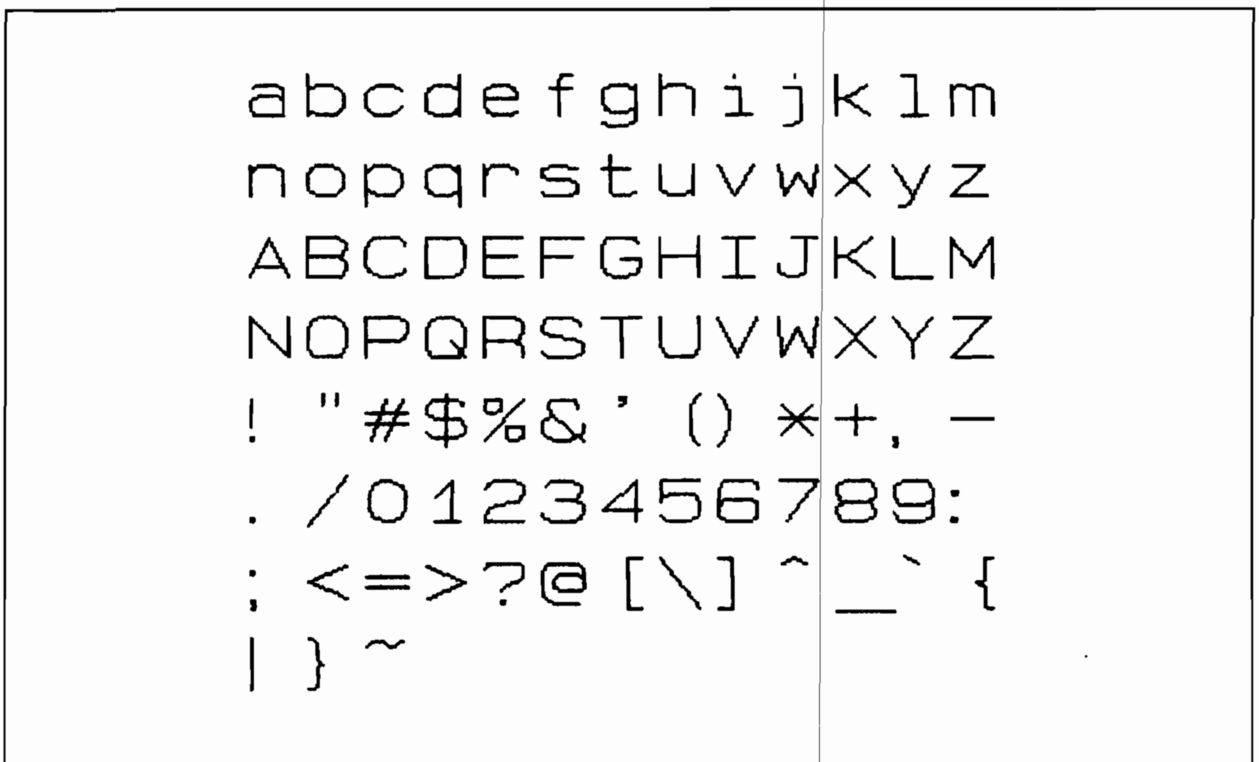

Figure 7. Supported Vector Character Set

Text (DGL)

(ZTEXT). The only character set available is the standard 96-character ASCII set.

After a ZTEXT call, the starting position is set so that consecutive calls to ZTEXT have the effect of concatenation. In addition to the viewable characters, text strings can also include the control characters listed in Table 2. Any other control characters are ignored.

Table 2. Text Control Characters

Octal Control	Code	Function
Backspace	10B	Move the starting position one character-cell width back.
Line Feed	12B	Move the starting position one character-cell height down.
Vertical Tab	13B	Move the starting position one character-cell height up.
Carriage Return	14B	Move the starting position back to the beginning of the text string.

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QuietJet Device Handlers

Introduction

This chapter combines the DGL and AGP information into one section. Unless otherwise specified, all references apply to both AGP and DGL. In general, AGP routines are prefixed with a J as in JOESC, while DGL routines are prefixed with a Z as in ZOESC.

You should be familiar with the operation of the HP 2227A or HP 2228A printer. If necessary, refer to the manual listed below for operating instructions:

QuietJet Series Owners Manual, part number 02227-90019.

Supported Logical Devices

The following logical devices are supported by the AGP/DGL Graphics Systems:

Logical Device	Device Handler Name	Physical Device
Graphics Printer (Display)	D0075	HP 2227A QuietJet Plus
Graphics Printer (Display)	D0076	HP 2228A QuietJet

The HP 2227A and HP 2228A printers, do not respond to inquire procedures. This handler checks for the correct device handler and assumes the device at the Logical Unit (LU) is an HP 2227A or HP 2228A printer.

Two densities are supported:

- 96 dots/inch
- 192 dots/inch

The density used by the handler is based on the control word sent with a JDINT or ZDINT call.

This device handler uses EMA/VMA. Please refer to the EMA/VMA Device Handlers section in the AGP or DGL Reference Manual.

This handler's architecture uses a raster image in EMA. All primitives are written into the raster image (or frame buffer) until a new-frame-action occurs. When the new-frame-action occurs, the raster image is sent to the printer. This architecture does not allow access to printer hardware capabilities, such as fonts or shading, because everything is done in software. This architecture was chosen because the printers support alphanumeric characters and raster graphics, but not vector graphics.

Graphics Display Device Handler

Plotting Area

Printer	Plotting Area	
HP 2227A	Width: 266.70 mm	Height: 334.43 mm
HP 2228A	Width: 266.70 mm	Height: 203.2 mm

Plotting Capacity

Printer	Print Density	Plotting Area	
HP 2227A	96 dots/inch	Width: 1008 points	Height: 1264 points
HP 2228A	96 dots/inch	Width: 1008 points	Height: 768 points
HP 2227A	192 dots/inch	Width: 2016 points	Height: 2528 points
HP 2228A	192 dots/inch	Width: 2016 points	Height: 1536 points

Resolution

Printer	Print Density	Resolution
HP 2227A and HP 2228A	96 dots/inch	3.7796 points/mm in the X-direction. 3.7796 points/mm in the Y-direction.
HP 2227A and HP 2228A	192 dots/inch	7.5591 points/mm in the X-direction. 7.5591 points/mm in the Y-direction.

Aspect Ratio of Maximum Area

Plotter	Ratio
HP 2227A	0.80
HP 2228A	0.76

Initialization

(JDINT/ZDINT). Care should be used when loading paper. Make sure to align the top of the page with the first printing scan line.

When initialized, the following operations are performed:

Device name:	Set to "2227A " or "2228A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Starting position:	Set to (0.0,0.0).
Physical origin:	Upper-left corner of the paper.
Logical display surface:	Set to the default limits. See the section "Logical Display Surface."
View surface:	Always justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the maximum (physical) device limits.
Page advance:	If bit 7 in the control word is set, the paper is not advanced. If bit 7 is not set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized to default values.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.
Density:	If bit 10 in the control word is set, 192 dots/inch density is used. If bit 10 is not set, 96 dots/inch density is used.
Limits (JDLIM/ZDLIM):	The default logical display limits are specified relative to the upper left corner of the paper

Logical Display Surface

The logical display surface is set to the default value with bit 8 clear (not set). If bit 8 is set, the logical display surface is rotated.

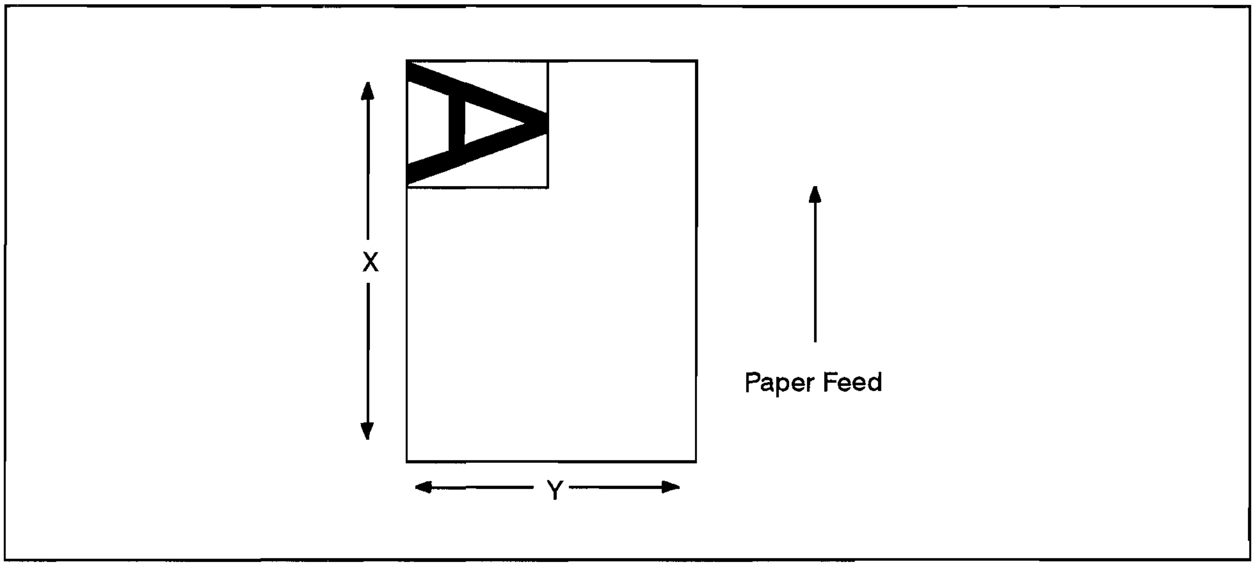

Figure 1. Default Orientation on the Physical Page - Bit 8 Clear

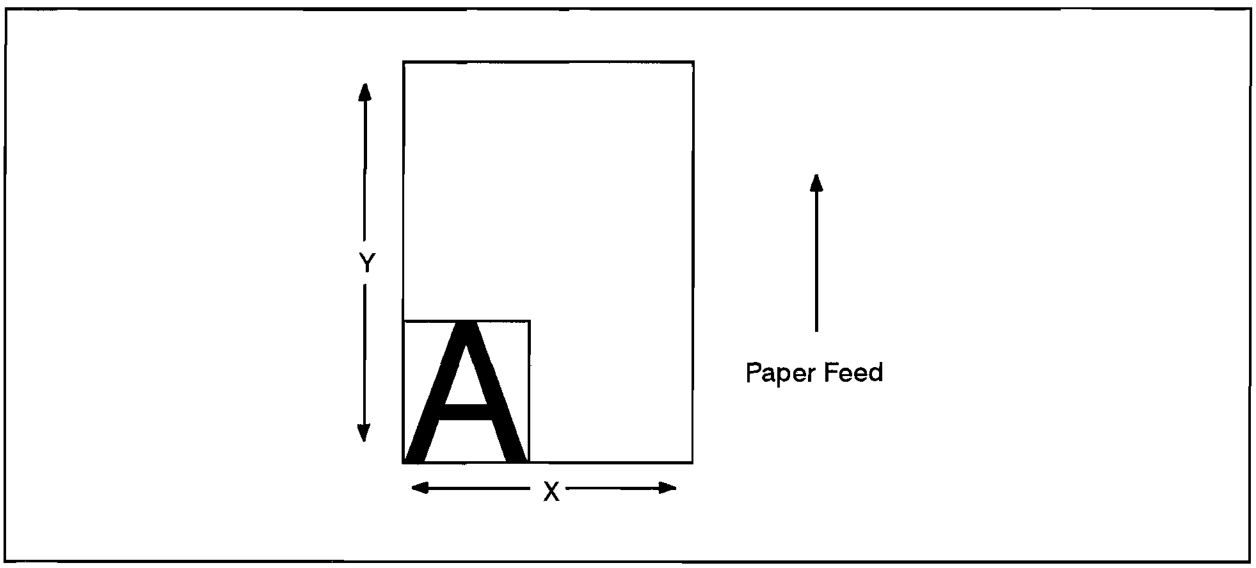

Figure 2. Rotated Orientation on the Physical Page - Bit 8 Set

Density

Bit 10 of the control word sent with the JDINT or ZDINT call is used to specify density in dots/inch as follows:

Bit 10	Resulting Density
0	96 dots/inch
1	92 dots/inch

Limits

(JDLIM/ZDLIM). The default logical display limits are specified relative to the upper left corner of the paper when bit 8 of the control word sent with the JDINT or ZDINT call is clear (not set). When bit 8 is set, the logical display limits are specified in a rotated format. The origin in the Y-direction (non-rotated) or the origin in the X-direction (rotated) is column 1 of the printer.

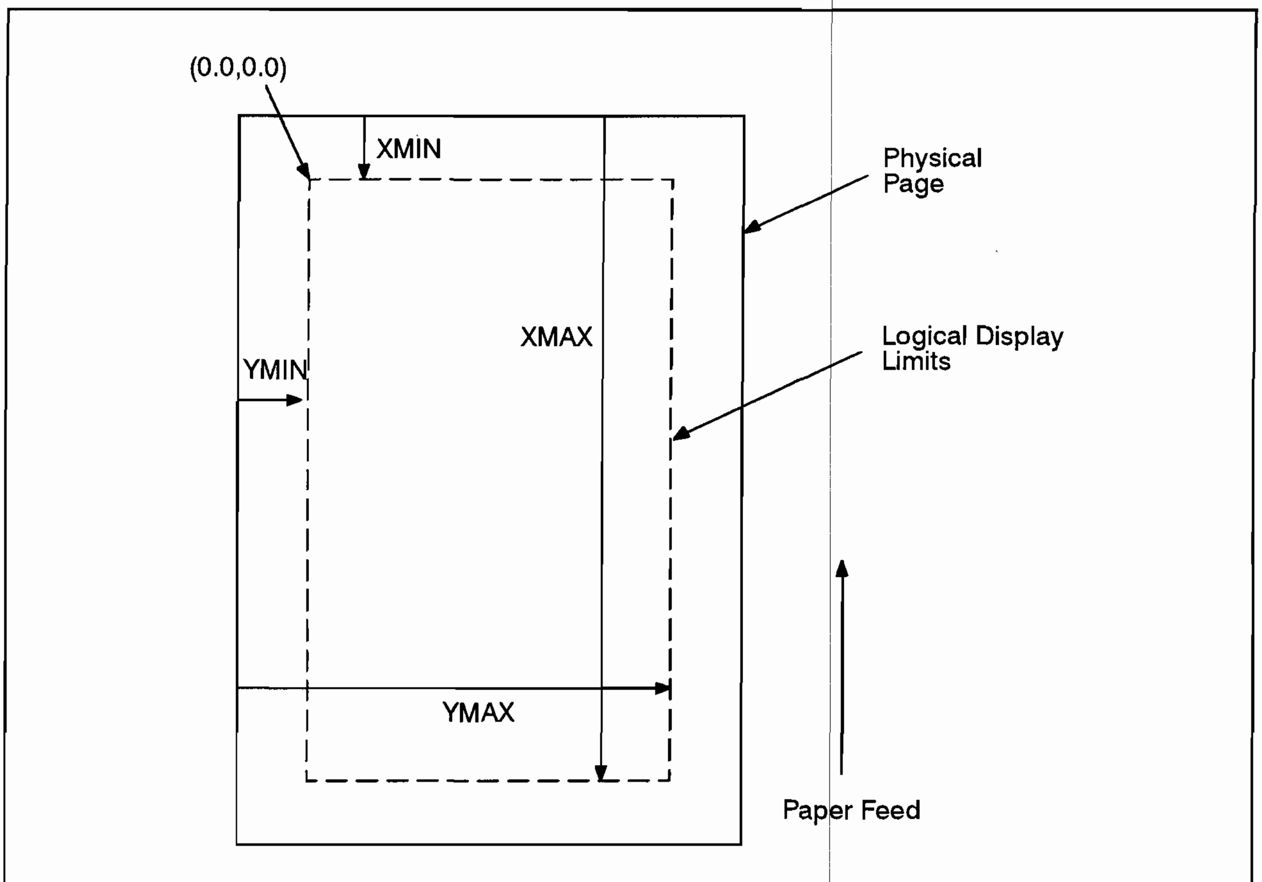

Figure 3. Paper Positioning and Limitations (non-rotated)

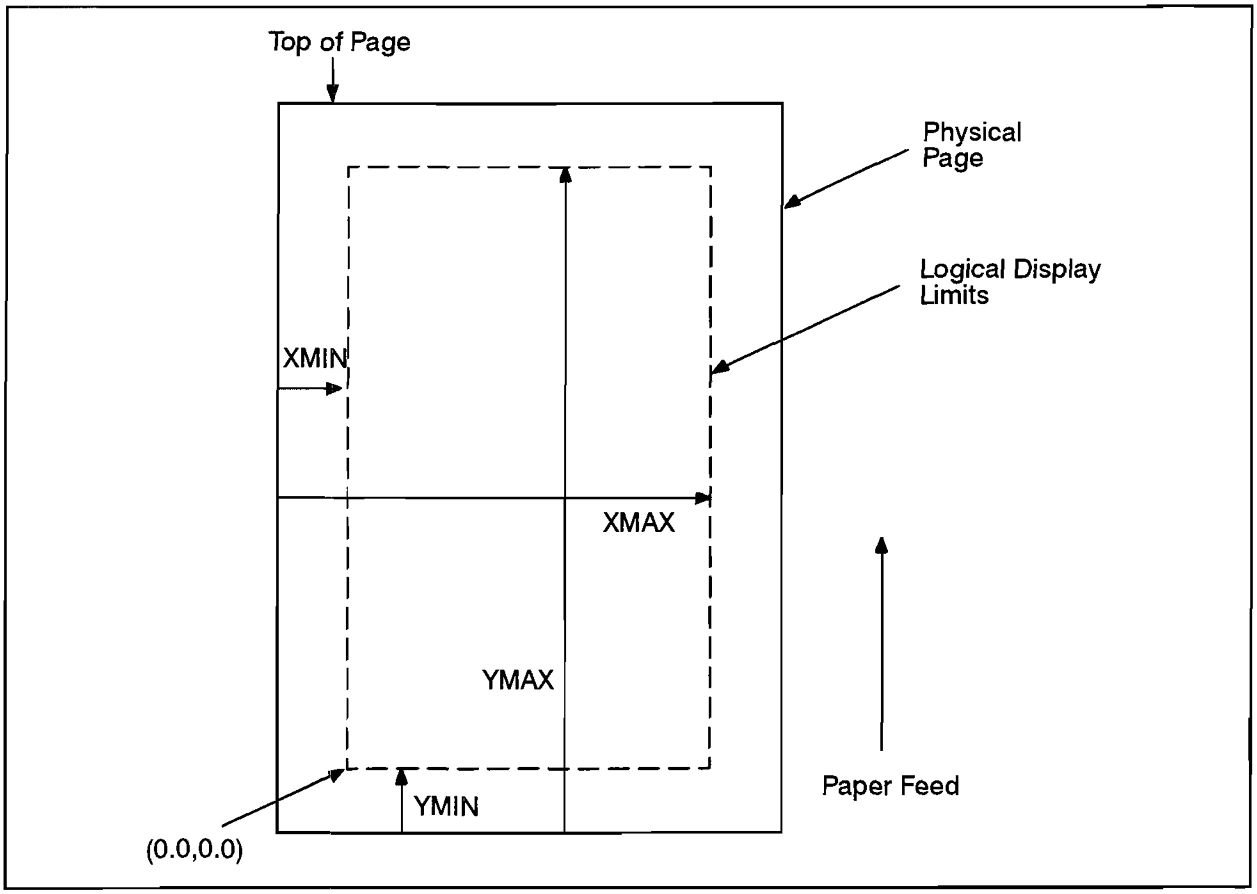

Figure 4. Paper Positioning and Limitations (rotated)

Supported Primitive Attributes

Color

(JCOLR/ZCOLR). The display handlers provide a software color table of two colors. The size of the color table cannot be changed. The color table is initialized when JDINT/ZDINT is called. The color selected corresponds to the color defined in Table 1.

Table 1. Color Table

Color Table Entry	Color
0	Color set to white (background color)
1	Color set to black

Redefining and Inquiring Color

(JDCOL/ZDCOL)(JICOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(JPICL/ZPICL). AGP/DGL supports two colors:

- black
- white

Both colors can be displayed at one time.

Polygon Style

(JDPST/ZDPST). Using JDPST/ZDPST does not cause polygons already displayed to change style.

Highlighting

(JSHI/JGHI/ZHIGH). Highlighting is not supported.

Line Style

(JLSTL/ZLSTL). Thirteen predefined line styles are supported. Line styles 1 through 7 may be classified as being continuous. Line styles 8 through 13 are the same patterns as styles 2 through 7 drawn in the vector adjusted format. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, or the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete description of a continuous and start adjusted line styles.

Polygon Interior Line Style

(JPILS/ZPILS). Refer to JLSTL and ZLSTL for information regarding line style.

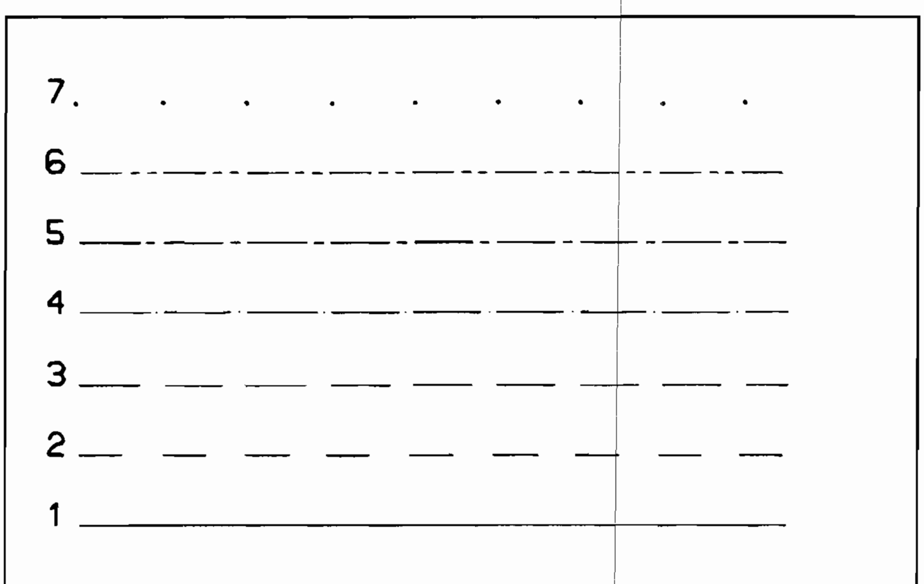

Figure 5. Supported Line Styles

Line Width

(JLWID/ZLWID). Four line widths are supported:

Line Width Index	Line
1	Primitives drawn with a line width one pixel wide
2	Primitives drawn with a line width three pixels wide
3	Primitives drawn with a line width five pixels wide
4	Primitives drawn with a line width seven pixels wide

Character Sizes

(JCSIZ/ZCSIZ). Medium- and low-quality text is generated in software using a vector character set. A vector character set is defined as a series of moves and draws and is affected by the viewing transformation, line style, and line width. Both handlers support all character cell sizes that have a width and height not less than 0.85 millimeters and not greater than 250 millimeters.

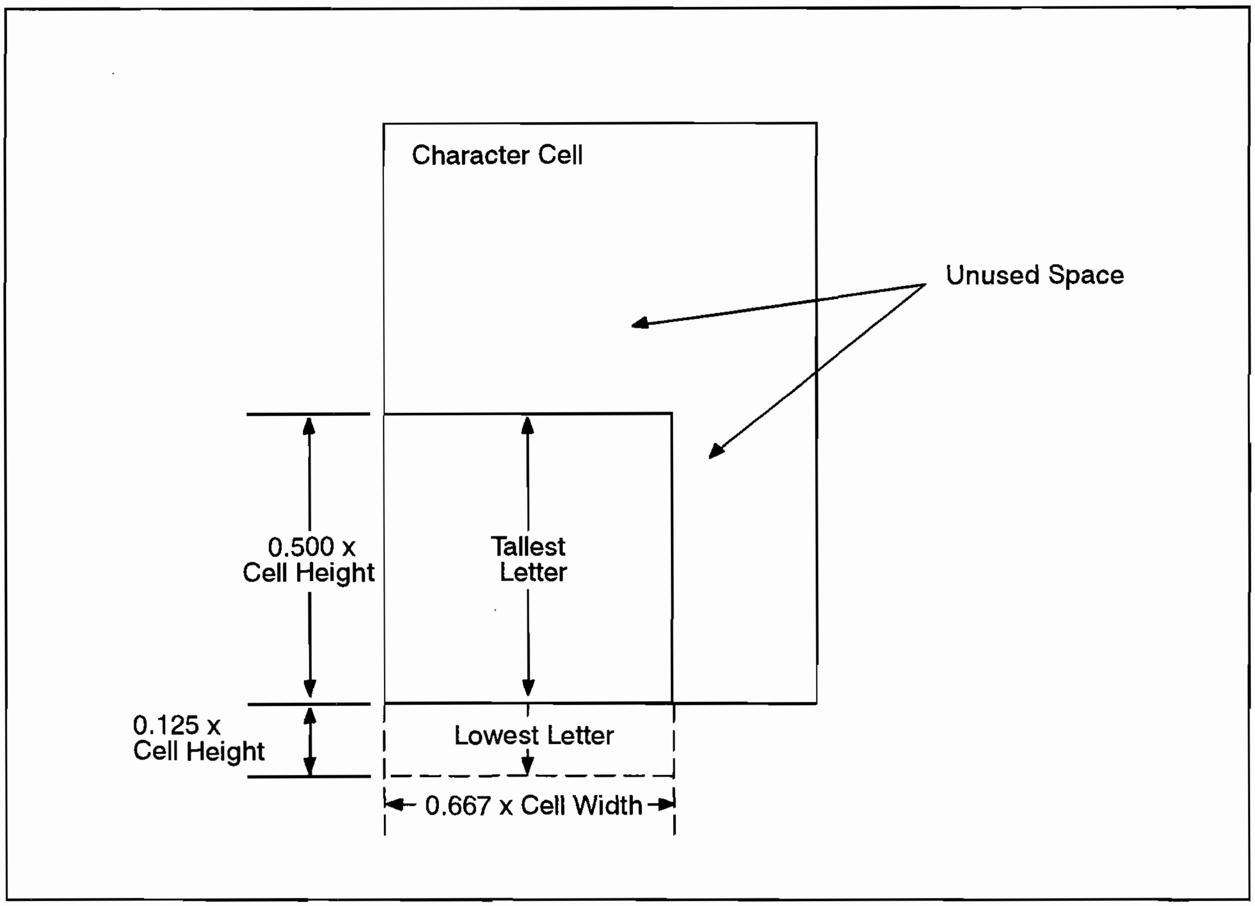

Figure 6. Placement of Character in Character Cell

Output Primitives

Clipping

These device handlers support vector and text clipping that is set to the view surface limits. Parts of graphics items that exceed the view surface limits are clipped.

If AGP window clipping is disabled and parts of the image are outside the view surface limits, then unpredictable results may occur.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG/ZPGDD). The HP 2227A and HP 2228A printers do not have hardware area fill. A polygon specified by ZPGDD is always represented as described in the *DGL Programmer's Reference Manual.*

Markers

(J2MRK/J3MRK/JR2MK/JR3MK/ZMARK). Nineteen standard markers are supported. A character size of 1.69 millimeters by 2.26 millimeters is used to generate markers. Markers are affected by the color attribute.

Medium- and Low-Quality Text (AGP)

(JTEXL/JTEXM). For text that is not clipped by AGP, only parts of characters extending beyond the current hardware clipping limits or the paper limits are clipped. Refer to ZTEXT for further information about AGP medium- and low-quality text that is the same as DGL text.

Text (DGL)

(ZTEXT). The only character set available is the standard 96-character ASCII set.

After a ZTEXT call, the starting position is set so that consecutive calls to ZTEXT have the effect of concatenation. In addition to the viewable characters, text strings can also include the control characters as listed in Table 2. Any other control characters are ignored.

Table 2. Text Control Characters

Octal Control	Code	Function
Backspace	10B	Move the starting position one character-cell width back.
Line Feed	12B	Move the starting position one character-cell height down.
Vertical Tab	13B	Move the starting position one character-cell height up.
Carriage Return	14B	Move the Starting position back to the beginning of the text string.

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RuggedWriter Device Handler

Introduction

This chapter combines the DGL and AGP information into one section. Unless otherwise specified, all references apply to both AGP and DGL. In general, AGP routines are prefixed with a J as in JOESC, while DGL routines are prefixed with a Z as in ZOESC.

You should be familiar with the operation of the HP 2235B or HP 2235D printer. If necessary, refer to the manuals listed below for operating instructions:

HP 2235 Operator's Manual, part number 02235-90002.

Supported Logical Device

The following logical devices are supported by the AGP/DGL graphics systems when using the HP 2235B/D printers:

Logical Device	Device Handler Name	Physical Device
Graphics Printer (Display)	D0074	HP 2235B/D

The HP 2235B/D printers do not respond to inquiries. This handler checks for the correct device handler and assumes the device at the Logical Unit (LU) is an HP 2235B/D printer.

Two densities are supported:

- 90 dots/inch
- 180 dots/inch

The density used by the handler is based on the control word sent with a JDINT or ZDINT call.

This device handler uses EMA/VMA. Please refer to the EMA/VMA Device Handlers section in the AGP or DGL Reference Manual.

This handler's architecture uses a raster image in EMA. All primitives are written into the raster image (or frame buffer) until a new-frame-action occurs. When the new-frame-action occurs, the raster image is sent to the printer. This architecture does not allow access to printer hardware capabilities, such as fonts or shading, because everything is done in software. This architecture was chosen because the printer supports alphanumeric characters and raster graphics, but not vector graphics.

The D0053 and D0054 handlers, used with the HP 293X printer, also work with the HP 2235B/D printer. If handler D0053 or D0054 is used, a different mapping of EMA is used and only 90 dots/inch density is allowed. The page size becomes 290 millimeters by 1080 millimeters. If you want to use one of these handlers, refer to the appropriate chapter of this manual for further information.

Graphics Display Device Handler

Plotting Area

Printer	Plotting Area
HP 2235B/D	Width: 266.70 millimeters Height: 345.44 millimeters

Plotting Capacity

Printer	Print Density	Plotting Capacity	
HP 2235B/D	90 dots/inch	Width: 945 points	Height: 1224 points
	180 dots/inch	Width: 1890 points	Height: 2448 points

Resolution

Printer	Print Density	Resolution
HP 2235B/D	90 dots/inch	3.5433 points/millimeter X-directions. 3.5433 points/millimeter Y-directions.
	180 dots/inch	7.0966 points/millimeter in X-directions. 7.0966 points/millimeter in Y-directions.

Aspect Ratio of Maximum Area

Printer	Ratio
HP 2235B/D	0.77

Initialization

(JDINT/ZDINT). Care should be used when loading paper. Make sure to align the top of the page with the first printing scan line.

When initialized, the following operations are performed:

Device name:	Set to "2235B " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Starting position:	Set to (0.0,0.0).
Physical origin:	Upper-left corner of the paper.
Logical display surface:	Set to the default limits. See the section Logical Display Surface.
View surface:	Always justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the maximum (physical) device limits.
Page advance:	If bit 7 in the control word is set, the paper is not advanced. If bit 7 is not set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized to default values.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.
Density:	If bit 10 in the control word is set, 180 dots/inch density is used. If bit 10 is not set, 90 dots/inch density is used.
Limits (JDLIM/ZDLIM):	The default logical display limits are specified relative to the upper corner of the paper.

Logical Display Surface

The logical display surface is set to the default value with bit 8 clear (not set). If bit 8 is set, the logical display surface is rotated.

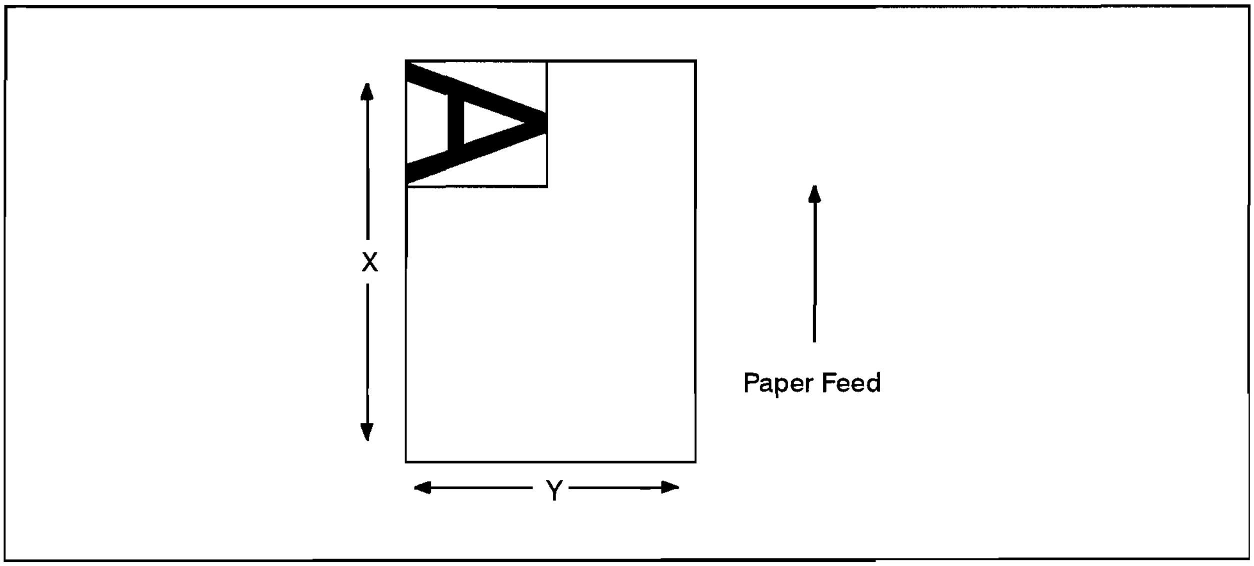

Figure 1. Default Orientation on the Physical Page - Bit 8 Clear

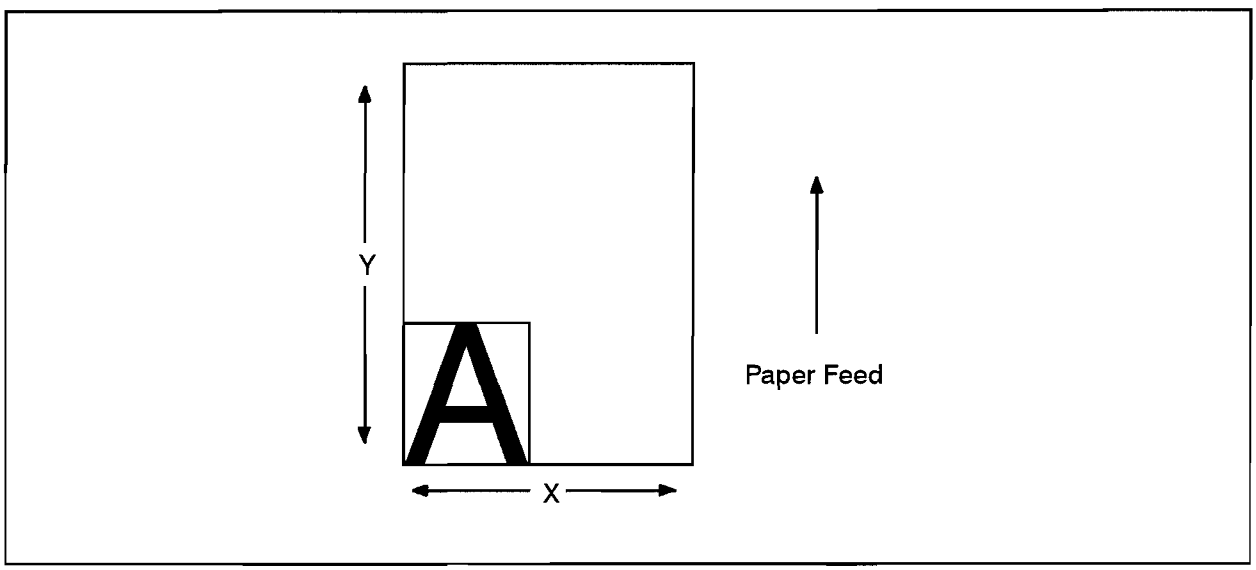

Figure 2. Rotated Orientation on the Physical Page - Bit 8 Set

Density

Bit 10 of the control word sent with the JDINT or ZDINT call is used to specify density in dots/inch as follows:

Bit 10	Resulting Density
0	96 dots/inch
1	180 dots/inch

Logical Display Limits

(JDLIM/ZDLIM). The default logical display limits are specified relative to the upper left corner of the paper when bit 8 of the control word sent with the JDINT or ZDINT call is clear (not set). When bit 8 is set, the logical display limits are specified in a rotated format. The origin in the Y-direction (non-rotated) or the origin in the X-direction (rotated) is column 1 of the printer unless modified by the Output Escape Function JOESC/ZOESC with OPCODE 2050.

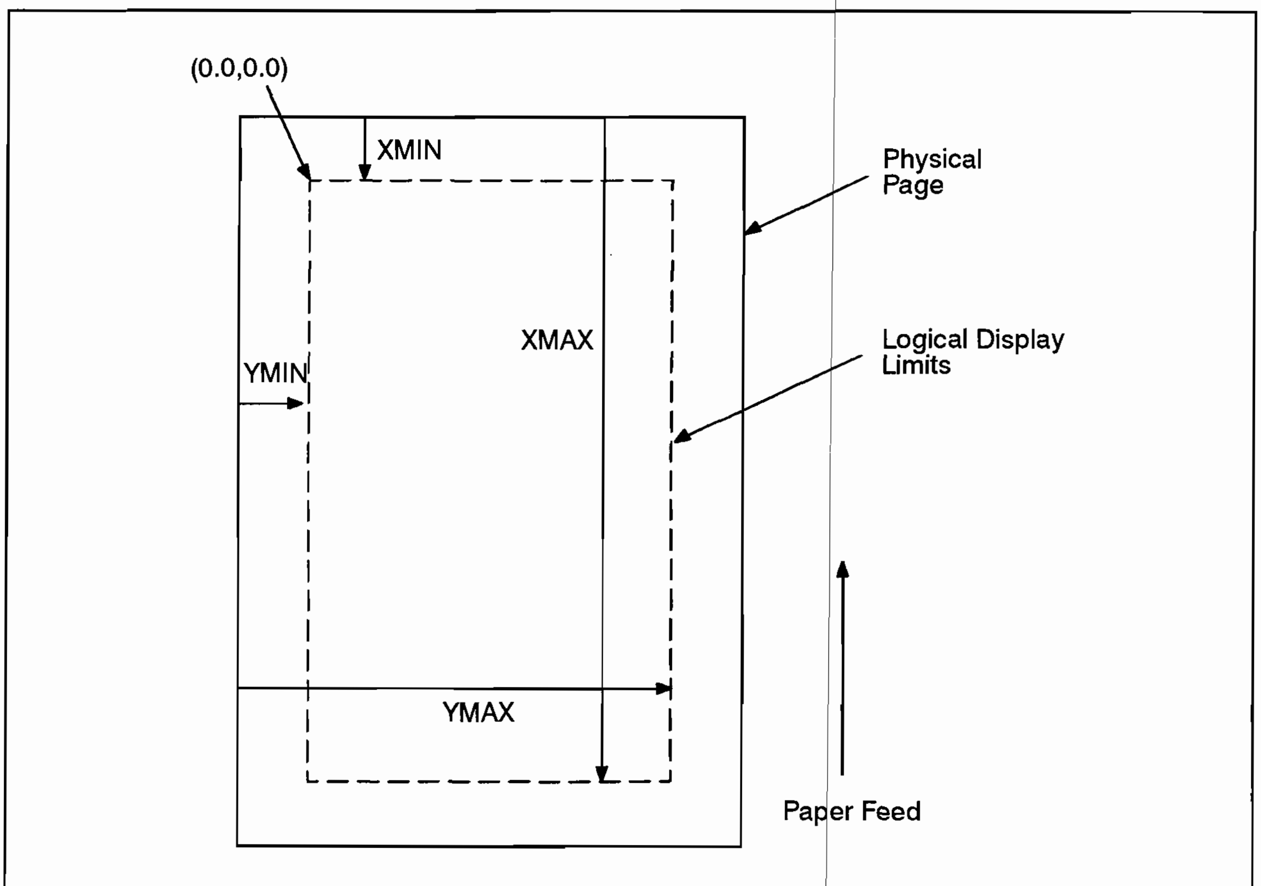

Figure 3. Paper Positioning and Limitations (non-rotated)

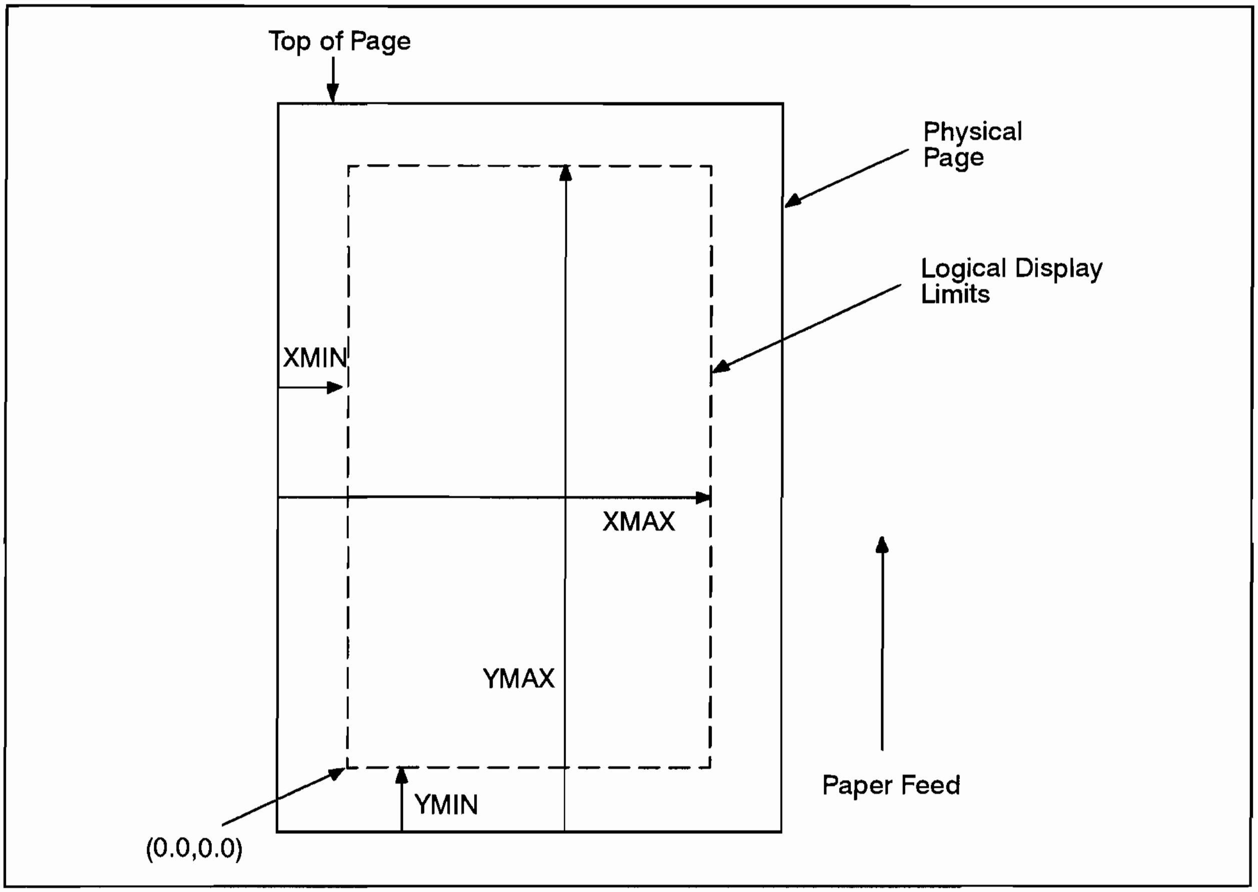

Figure 4. Paper Positioning and Limitations (rotated)

Supported Primitive Attributes

Color

(JCOLR/ZCOLR). The display handler provides a software color table of two colors. The size of the color table cannot be changed. The color table is initialized when JDINT/ZDINT is called. The color selected corresponds to the color defined in the color table.

Table 1. Color Table

Color Table Entry	Color
0	Color set to white (background color)
1	Color set to black

Redefining and Inquiring Color

(JDCOL/ZDCOL) (JICOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(JPICL/ZPICL). There are two colors supported by AGP/DGL:

- black
- white

Both colors can be displayed at one time.

Polygon Style

(JDPST/ZDPST). Using JDPST/ZDPST does not cause polygons already displayed to change style.

Highlighting

(JSHI/JGHI/ZHIGH). Highlighting is not supported.

Line Style

(JLSTL/ZLSTL). Thirteen predefined line styles are supported. Line styles 1 through 7 may be classified as being continuous. Line styles 8 through 13 are the same patterns as styles 2 through 7 drawn in the vector adjusted format. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, or the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete description of a continuous and start adjusted line styles.

Polygon Interior Line Style

(JPILS/ZPILS). Refer to JLSTL and ZLSTL for information regarding line style.

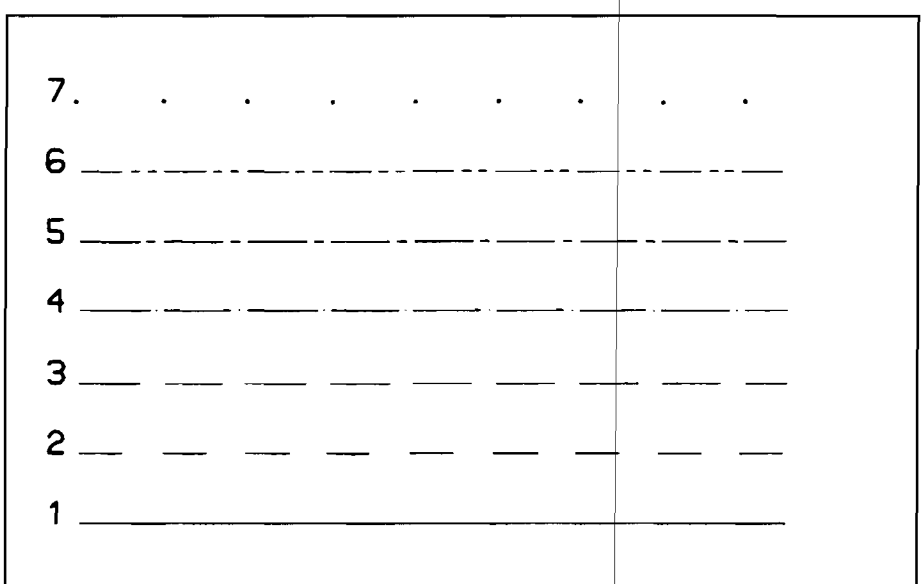

Figure 5. Supported Line Styles

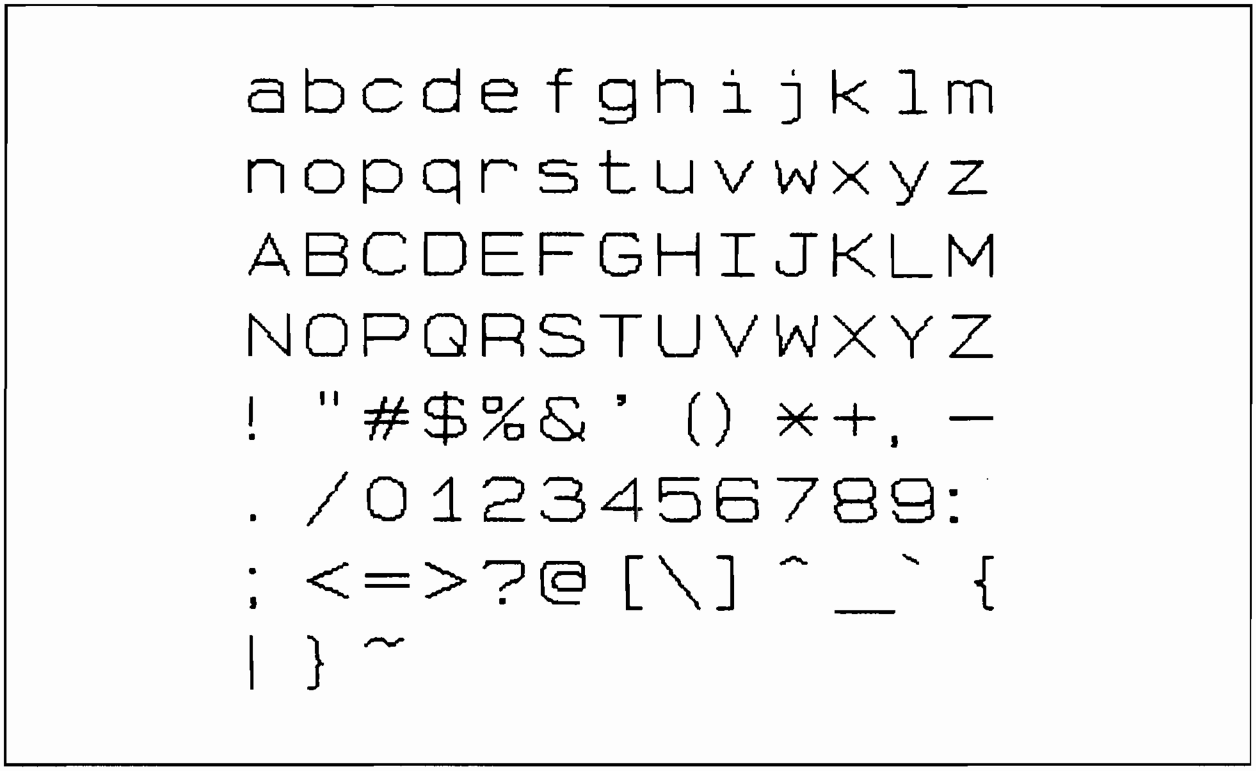

Figure 7. Supported Vector Character Set

Text (DGL)

(ZTEXT). The only character set available is the standard 96-character ASCII set.

After a ZTEXT call, the starting position is set so that consecutive calls to ZTEXT have the effect of concatenation. In addition to the viewable characters, text strings can also include the control characters listed in Table 2. Any other control characters are ignored.

Table 2. Text Control Characters

Octal Control	Code	Function
Backspace	10B	Move the starting position one character-cell width back.
Line Feed	12B	Move the starting position one character-cell height down.
Vertical Tab	13B	Move the starting position one character-cell height up.
Carriage Return	14B	Move the starting position back to the beginning of the text string.

New-Frame-Action (AGP)

(JNEWF/JPURG/JSVIX/JSHI/JVSAL/JDLIM/JCLR). A new-frame-action causes the picture to be sent to the display and a page advance is performed. The action taken when a new-frame-action is given depends on two bits in the JDINT control word:

- Bit 9 determines when a new-frame-action is necessary.
- The simulated raster erase bit in the JDINT call controls erasure.

A new-frame-action is necessary only if the picture contains some output when bit 9 is set.

A new-frame-action is always necessary when bit 9 is not set. When bit 9 is not set, blank pages may be generated.

Simulated Raster Erase Not Set

A new-frame-action can occur when the device is enabled and the program is not in a batch-of-updates condition. The state of the printer is not altered when a new-frame-action is given and the display is not enabled.

Simulated Raster Erase Set

These handlers can erase AGP images. When the simulated raster erase bit is set, AGP removes graphics elements without doing a page eject. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is like redrawing the image in white, that is, the background color; therefore, black lines crossing the image to be purged may also have parts erased, leaving holes.

An explicit JNEWF call always causes a page eject and redraws all visible segments when given on an enabled workstation outside a batch-of-updates (if the new-frame-action is necessary). This provides a means of generating a clean surface, that is, without holes. The other calls that implicitly cause a new-frame-action, that is, JPURG, use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations because the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside a batch-of-updates always results in a page eject and visible segments being redrawn when the JUPDT call is given (if the new-frame-action is necessary).

New-Frame-Action (DGL)

(ZNEWF). The action taken when a new-frame-action is given is dependent on bit 9 of the ZDINT control word. If bit 9 of the control word is set, a new-frame-action is performed only if the picture contains some output. When bit 9 is not set, blank pages may be generated. A necessary new-frame-action causes the picture to be made current, the picture is output and a page advance is performed.

Input Escape Functions

(JIESC/ZIESC). These handlers do not support inquiry escape functions.

Output Escape Functions

(JOESC/ZOESC)

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.

Locator Echoes on the Graphics Display

(JWLOC/ZWLOC). Locator echoing is not supported.

Termination

(JWOFF/ZDEND). The device name is set to "0075 " or "0076 " (the name is padded to 6 characters with trailing blanks). The device status and I/0 unit descriptor are set to 0.

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ThinkJet Device Handler

Introduction

You should be familiar with the operation of the HP 2225D printer. If necessary, refer to the manual listed below for operating instructions:

ThinkJet Printer Owners Manual, part number 02225-90034.

Supported Logical Devices

Logical Device	Device Handler Name	Physical Device
Graphics display	D0069	HP 2225D Thinkjet Printers

Special Considerations

This device handler uses EMA/VMA (38 pages). Please refer to the EMA/VMA Device Handlers section in the AGP or DGL Reference Manual.

This handler's architecture uses a raster image in EMA. All primitives are written into the raster image (or frame buffer) until a new-frame-action occurs. When the new-frame-action occurs, the raster image is sent to the printer. This architecture does not allow access to printer hardware capabilities, such as fonts or shading, because everything is done in software. This architecture was chosen because the printer supports alphanumeric characters and raster graphics, but not vector graphics.

Graphics Display Device Handler (AGP)

Plotting area:	Width: 254.00 mm	Height: 169.42 mm
Plotting capacity:	Width: 959 points	Height 639 points
Aspect ratio of maximum area:	0.67	
Resolution:	X-Direction: 2.9528 points/mm Y-Direction: 2.9528 points/mm	
Default limits:	Same as the plotting area Width: 165.0 mm	 Height: 165.00 mm

Aspect ratio of default limits:	1.0
Physical origin:	Upper left corner of the paper.
View surface justification:	Lower left corner of the current logical display surface.

Initialization

(JDINT). Upon initialization, the following operations are performed.

Device name:	Set to "2225A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Start position:	Set to (0.0,0.0).
Logical display surface:	Set to the default value of bit 8 cleared.
View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the maximum (physical) device limits.
Page advance:	Control word bit 7 set, paper is not advanced. Control word bit 7 clear and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized when JDINT is called.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.

Limits

(JDLIM). The logical display limits are specified relative to the upper left corner of the paper when bit 8 is not set. The display boundary is rotated if bit 8 is clear. The y-direction (non-rotated) or the origin in the x-direction (rotated) is column 1 of the printer.

Supported Primitive Attributes

Color

(JCOLR). The D0069 display handler provides a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The color table is initialized when JDINT is called and cannot be redefined or inquired using JDCOL or JICOL. The color selected corresponds to the color defined in the color table. Both colors can be displayed at one time.

Table 1. Color Table

Color Table Index	Color
0	White (Background color)
1	Black

Polygon Style

(JDPST). Using JDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(JPILS). Refer to JLSTL for information regarding line style.

Highlighting

(JSHI/JGHI). Highlighting is not supported.

Line Style

(JLSTL). Thirteen predefined line styles are supported. Line styles 1 through 7 may be classified as being continuous. Line styles 8 through 13 are the same patterns as styles 2 through 7 except start adjusted. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, for a complete description of continuous and start adjusted line styles.

Line Width

(JLWID). Four line widths are supported.

Table 2. Line Widths

Line Width Index	Line Width
1	Primitives drawn with a line width one pixel wide.
2	Primitives drawn with a line width three pixels wide.
3	Primitives drawn with a line width five pixels wide.
4	Primitives drawn with a line width seven pixels wide.

Character Size

(JCSIZ). When using D0069, medium- and low-quality text is generated in software using a vector character set. A vector character is defined as a series of moves and draws and is affected by the viewing transformation, line style, and line width. D0069 supports all character cell sizes that have a width and height not less than 0.85 mm and not greater than 250 mm.

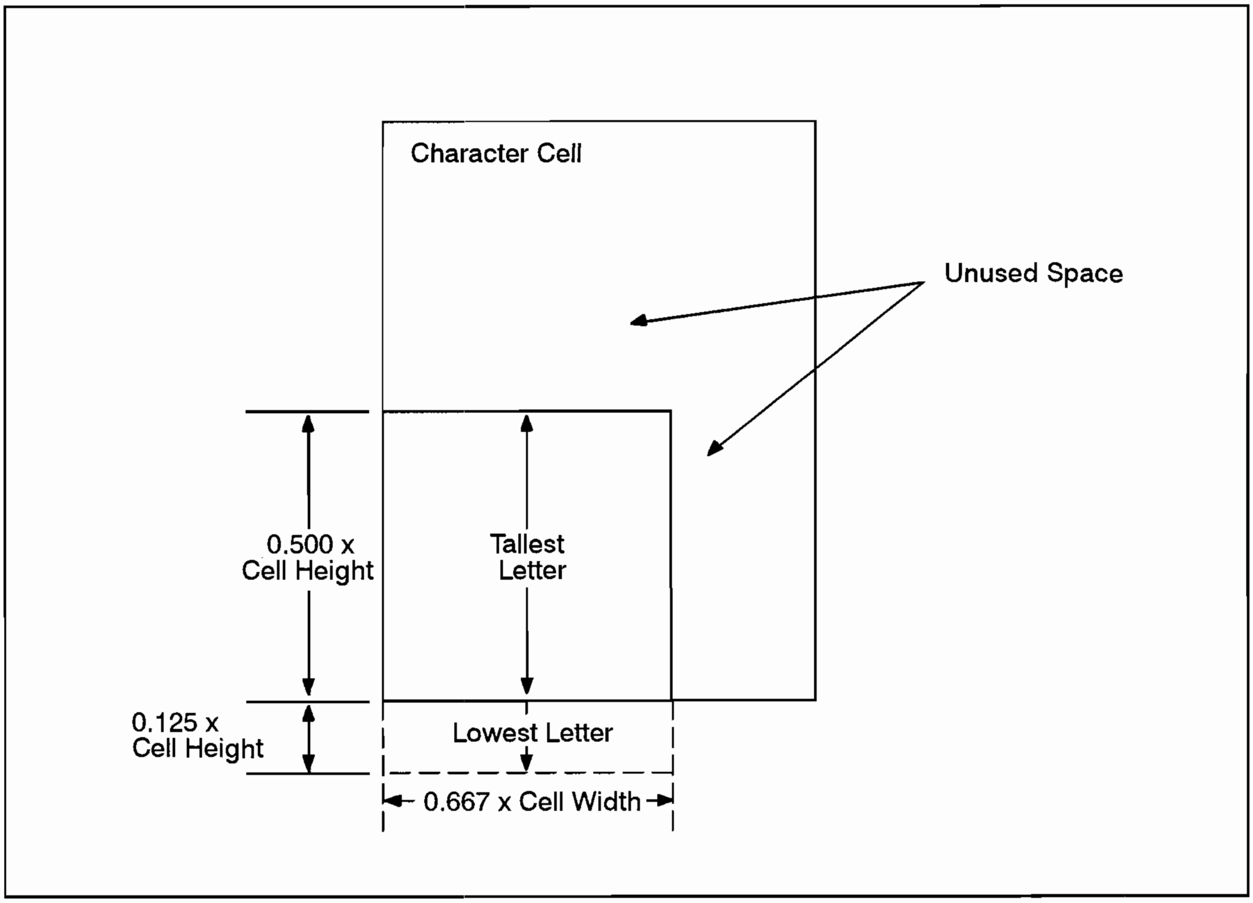

Figure 1. Placement of Character Within the Character Cell

Output Primitives

Clipping

If AGP window clipping is disabled and parts of the image are outside of the view surface limits, unpredictable results may occur.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). This device does not have hardware area fill.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). The nineteen standard markers are supported. The marker size is always 1.69 mm by 2.26 mm.

Text

(JTEXL/JTEXM). The only character set that is available is the standard 96-character ASCII set.

If a medium- or low-quality text string is not clipped by AGP and extends beyond the view surface limits of the graphics display, any portion of a character that extends outside of the view surface is clipped.

New-Frame-Action

(JNEWF/JPURG/JSVIX/JSHI/JVSAL/JDLIM/JCLR). The action taken when a new-frame-action is given is dependent on two bits in the JDINT control word: bit 9 and the simulated raster erase bit. Bit 9 determines if a new-frame-action is necessary for a given circumstance. If bit 9 is not set, a new-frame-action is always a necessary new-frame-action. Note that when bit 9 is not set, blank pages may be generated. If bit 9 of the control word is set, a new-frame-action is necessary only if the picture contains some output. A necessary new-frame-action causes the picture to be output and a page advance performed. The following sections describe the effect of the simulated raster erase bit on new-frame-actions.

Simulated Raster - Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates, causes a page eject and all visible segments are redrawn(if the new-frame-action is necessary). When the new-frame-action is given with the display not enabled, it does not alter the printer.

```
a b c d e f g h i j k l m
n o p q r s t u v w x y z
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
!  " # $ % & '  ( ) * + , -
. / 0 1 2 3 4 5 6 7 8 9 :
; < = > ? @ [ \ ] ^ _ ` {
| } ~
```

Figure 2. The Character Set

Simulated Raster - Erase Set

The implementation of the printer handler has the ability to erase images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call and to remove graphics elements without doing a page eject. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is like redrawing the image in white (that is, the background color); therefore, black lines crossing the image to be purged may also have parts of them erased, leaving holes.

An explicit JNEWF call always causes a page eject and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates (if the new-frame-action is necessary). This provides a means of generating a clean surface (one without holes). The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations because the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside of a batch-of-updates always results in a page eject and visible segments being redrawn when the JUPDT call is given (if the new-frame-action is necessary).

Input Escape Functions

(JIESC). Inquiry escape functions are not supported by AGP.

Output Escape Function

(JOESC)

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.

Locator Echoes on the Graphics Display

(JWLOC). Locator echoing is not supported.

Pick Echoes on the Graphics Display

(JPICK). Pick echoing is not supported.

Termination

(JWOFF). The printer is not set to initial values when JWOFF is called. Values remain as they were last set. For example, printing begins at the first column.

Graphics Display Device Handler (DGL)

Plotting area:	Width: 254.00 mm Height: 169.42 mm
Plotting capacity:	Width: 959 points Height 639 points
Aspect ratio of maximum area:	0.67
Resolution:	X-Direction: 2.9528 points/mm Y-Direction: 2.9528 points/mm
Default limits:	Same as the plotting area Width: 165.0 mm Height: 165.00 mm
Aspect ratio of default limits:	1.0
Physical origin:	Upper left corner of the paper.
View surface justification:	Lower left corner of the current logical display surface.

Initialization

(ZDINT). Upon initialization, the following operations are performed.

Device name:	Set to "2225A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Start position:	Set to (0.0,0.0).
Logical display surface:	Set to the default value of bit 8 cleared.
View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the maximum (physical) device limits.
Page advance:	Control word bit 7 set, paper is not advanced. Control word bit 7 clear and the paper has not yet reached a page boundary,the paper is advanced to the next page boundary.
Color table:	Initialized when ZDINT is called.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.

Limits

(ZDLIM). The logical display limits are specified relative to the upper left corner of the paper when bit 8 is not set. The top of page is the location of the paper at the time of initialization. The origin in the y-direction (non-rotated) or the origin in the x-direction (rotated) is column 1 of the printer.

If multiple ZDLIM calls are made when generating a picture, the maximum area requested during that picture is used when the picture is output.

Supported Primitive Attributes

Color

(ZCOLR). The D0069 display handler provides a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The color table is initialized when ZDINT is called and cannot be redefined or inquired using ZDCOL or ZICOL. The color selected corresponds to the color defined in the color table. Both colors can be displayed at one time.

Table 3. Color Table

Color Table Index	Color
0	Color set to white (Background color)
1	Color set to black

Redefining and Inquiring Color

(ZDCOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). Refer to ZLSTL for information regarding line style.

Highlighting

(ZHIGH). Highlighting is not supported.

Text

(ZTEXT). The only character set that is available is the standard 96-character ASCII set.

After a ZTEXT call, the starting position is set so that consecutive calls to ZTEXT have the effect of concatenation. In addition to the viewable characters, text strings can also include the control characters listed in Table 5. Any other control characters are ignored.

Table 5. Control Characters

Control	Octal Code	Function
Backspace	10B	Move the starting position one character-cell width back.
Line Feed	12B	Move the starting position one character-cell height down.
Vertical Tab	13B	Move the starting position one character-cell height up.
Carriage Return	14B	Move the starting position back to the beginning of the text string.

New-Frame-Action

(ZNEWF). The action taken when a new-frame-action is given is dependent on bit 9 of the ZDINT control word. If bit 9 of the control word is set, a new-frame-action is performed only if the picture contains some output. When bit 9 is not set, blank pages may be generated. A necessary new-frame-action causes the picture to be made current, the picture is output and a page advance is performed.

Input Escape Functions

(ZIESC). Inquiry escape functions are not supported by DGL.

Output Escape Functions

(ZOESC)

Opcode	**Function**
50	Perform a new-frame-action without clearing the frame buffer afterwards.

Locator Echoes on the Graphics Display

(ZWLOC). Locator echoing is not supported.

Termination

(ZDEND). The device name is set to "0069 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

```
abcdefghijklm
nopqrstuvwxyz
ABCDEFGHIJKLM
NOPQRSTUVWXYZ
! "#$%&' () *+, -
. /0123456789:
; <=>?@ [\] ^ _ ` {
| } ~
```

Figure 4. The Character Set

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HP 256x/2608 Line Printers

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HP 256x/2608 Line Printers

Introduction

The user should be familiar with the operation of the HP 2608A/2608S/256x Line Printers. If necessary, refer to the following manuals for the appropriate information:

HP 2608A Line Printer Operator's Manual, part number 02608-90901.

HP 2608S Line Printer Operator's Manual, part number 02608-90911.

HP 2608A Line Printer Technical Reference Manual, part number 02608-90903.

HP 2608S Line Printer Technical Reference Manual, part number 02608-90910.

HP 2608A Line Printer Driver DVB12, part number 92062-90004.

HP 2563 Line Printer Operator's Manual, part number 02563-90901.

HP 2563 Line Printer Technical Reference Manual, part number 02563-90905.

HP 2608S Line Printer Cypher Driver DVC12, part number 92068-90022.

or refer to the appropriate manual for your particular printer.

Supported Logical Devices

The following logical devices are supported:

Logical Device	Device Handler Name	Physical Device
Graphics display	D0026	HP 2608A/2608S/256x with stroke text and markers.
	D0055	HP 2608A/2608S/256x with raster text and markers.

Special Considerations

These device handlers use EMA/VMA. Please refer to the EMA/VMA Device Handlers section in the AGP or DGL Reference Manual.

This handler's architecture uses a raster image in EMA. All primitives are written into the raster image (or frame buffer) until a new-frame-action occurs. When the new-frame-action occurs, the raster image is sent to the printer. This architecture does not allow access to printer hardware capabilities, such as fonts or shading, because everything is done in software. This architecture was chosen because the printer supports alphanumeric characters and raster graphics, but not vector graphics.

Note that these handlers use control requests (EXEC 3 calls). Control requests are retained by the spooling system when an output LU is specified; control requests are omitted when the output is spooled to a standard file. Therefore, for control requests to be successfully placed into a file with spool headers, use "SP,ON,*lu*" on RTE-A and use the SL command specifying either an output LU or the SH option on RTE-6/VM. Note also that the format of the files containing spool headers is different between RTE-A and RTE-6/VM. Thus, files with spool headers may not be copied between operating systems and then spooled.

Restoring to Text Mode

If the printer is left in graphics mode (by OF'ing the DGL program, for example), it can be returned to text mode either programmatically, via FMGR, or via CI. Physically resetting the printer does not return it to text mode.

Programmatically, you can use the following EXEC call:

```
EXEC(3,ICNWD[,IPRAM])
```

where:

`ICNWD` = Control word

To reset all parameters:

`ICNWD` = Device I/O unit descriptor number
`IPRAM` not required

To only return to text mode:

`ICNWD` = 3000B + I/O unit descriptor
`IPRAM` = 0

Using FMGR or CI, you may return the printer to text mode using a control request. The example below shows the two CN calls made from FMGR.

`:CN, LU, 0`	This resets all parameters to default values.
`:CN, LU, 30B, 0`	This only places the printer in text mode.

Graphics Display Device Handler (AGP)

Description

The dimensions of the graphics display device are as follows:

Plotting area:	Width: 1082.68 mm	Height: 335.28 mm
Plotting capacity:	Width: 3068 points (4 pages)	Height: 923 points
Aspect ratio of maximum area:	0.31	
Resolution:	2.8346 points/mm in the X direction 2.7559 points/mm in the Y direction	
Default limits:	274.0 by 215.0 mm	
Aspect ratio of default limits:	0.78	

The physical origin is the upper left corner of the paper.

The view surface is always justified in the lower left corner of the current logical display surface.

The size of the logical display surface determines how many sheets of paper are required for output. The amount of paper is rounded up to the next page boundary, so a frame always starts at the beginning of a page.

Care should be used when loading paper to align the top of the form with the first printing scan line.

Initialization

(JDINT). Upon initialization, the following operations are performed:

Device name:	Set to "2608A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Start position:	Set to (0.0,0.0).
Logical display surface:	Set to the default value. The orientation of the logical display surface is shown in Figure 1, if bit 8 is not set. If bit 8 is set, the logical display surface is rotated as shown in Figure 2.
View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to view surface boundaries.
Page advance:	If bit 7 in the control word is set, the paper is not advanced. If bit 7 is not set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized when JDINT is called.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary, that is, when there is output to display. If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.

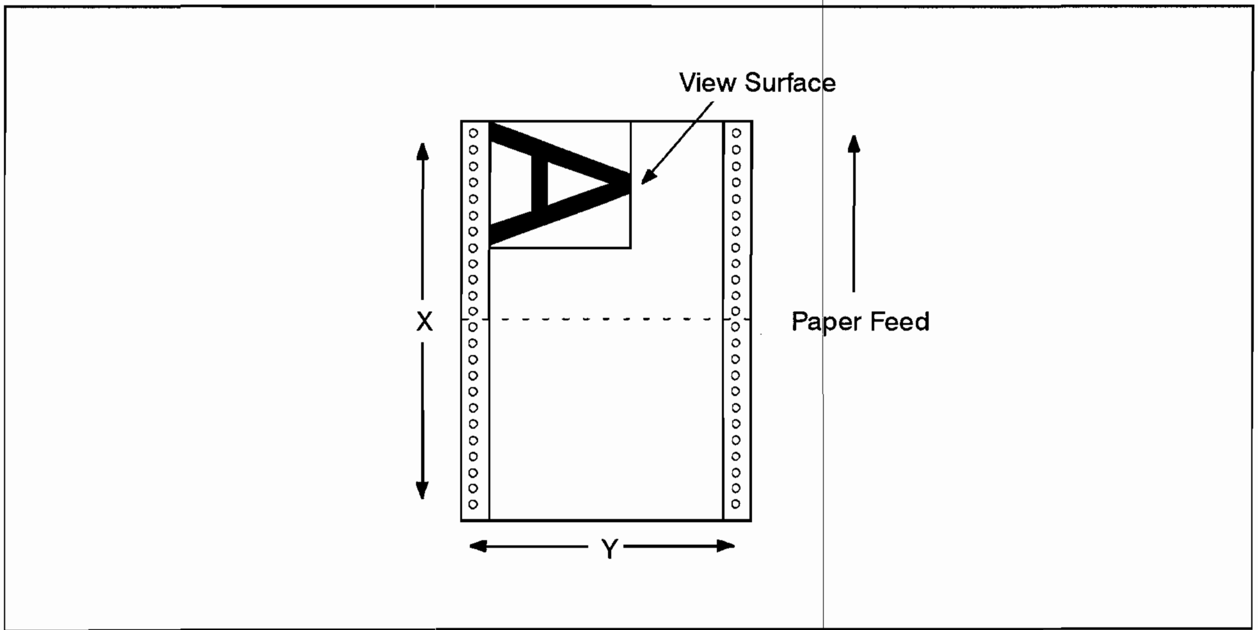

Figure 1. Default Orientation on the Physical Page

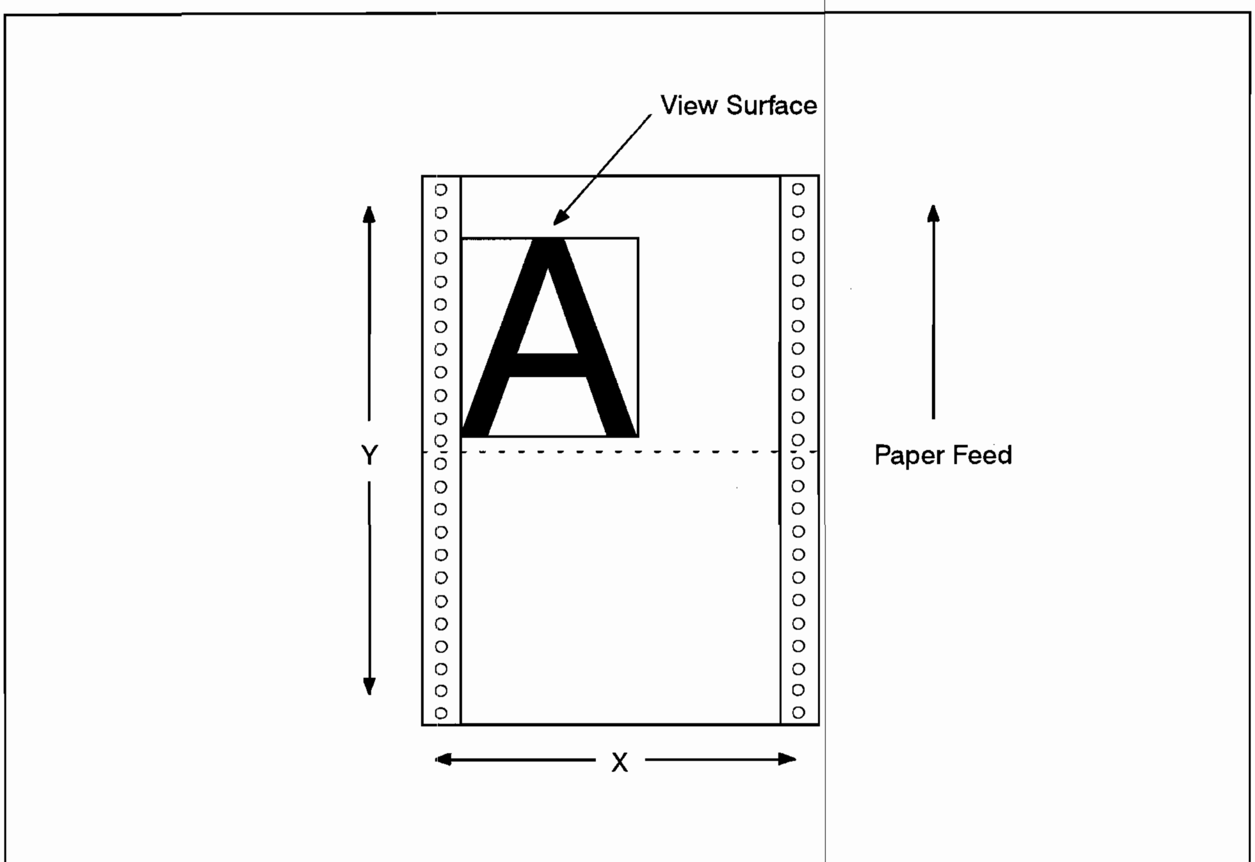

Figure 2. Rotated Orientation on the Physical Page

Limits

(JDLIM). The logical display limits are specified relative to the upper left corner of the paper when bit 8 is not set. See Figure 3. When bit 8 is set, the logical display limits are specified as shown in Figure 4. The top of page, as shown in the figures, is the top of the next page if bit 7 in the JDINT call was not set, causing a page eject at initialization. Otherwise, it is the location of the paper at the time of initialization. The origin in the Y-direction (non-rotated) or the origin in the X-direction (rotated) is always column 1 of the printer.

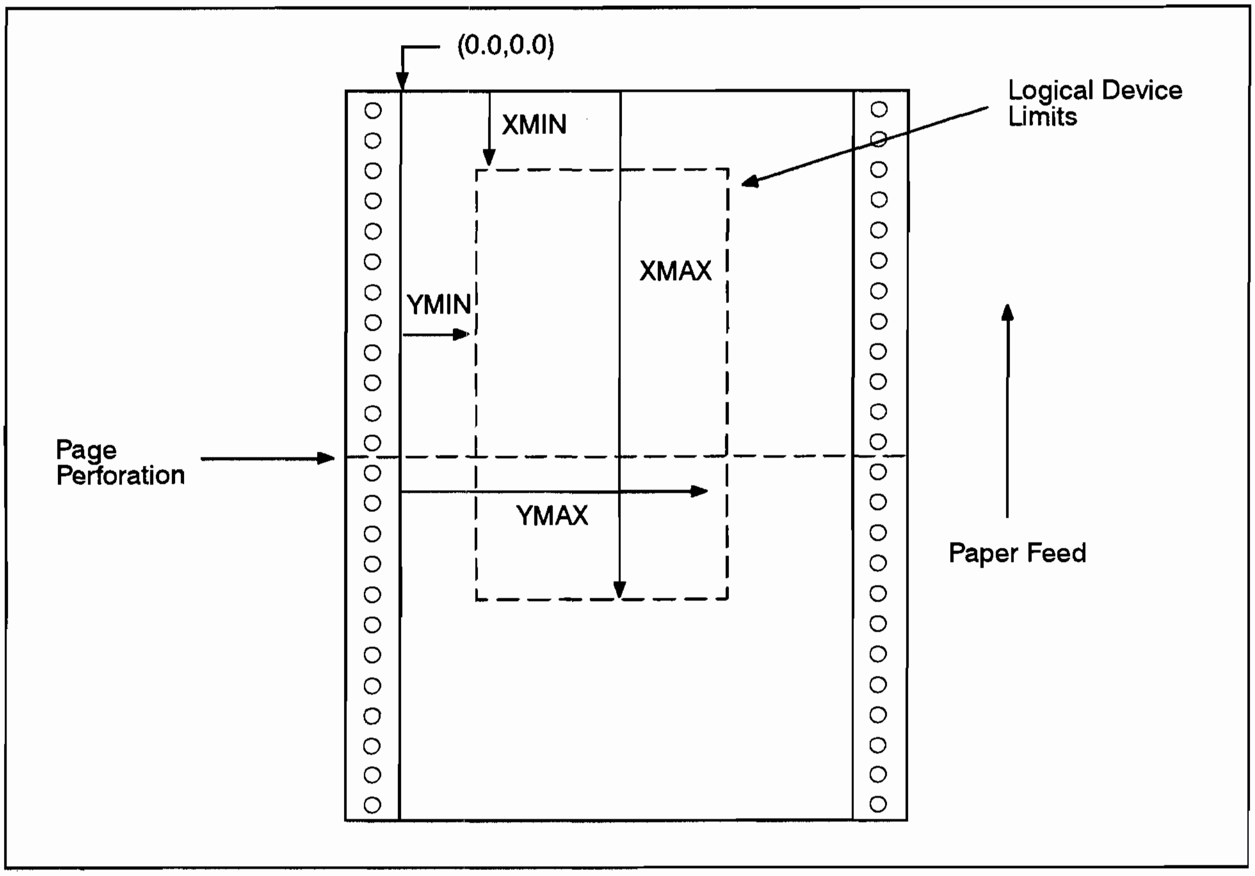

Figure 3. Paper Positioning and Limitations (non-rotated)

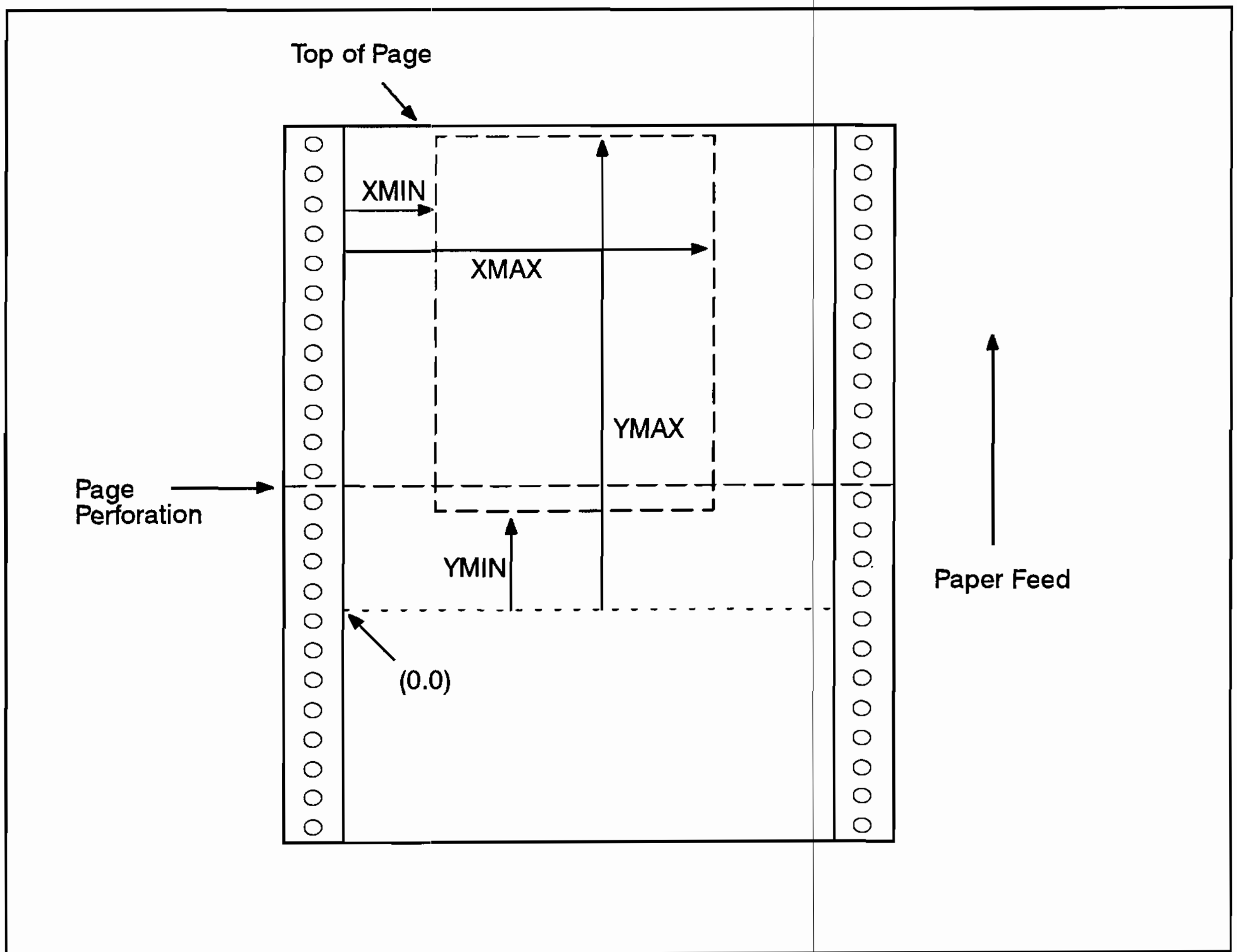

Figure 4. Paper Positioning and Limitations (rotated)

Supported Primitive Attributes

Color

(JCOLR). The D0026 and D0055 display handlers provide a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The default value of the color table is shown in Table 1.

Table 1. Default Color Table

Color Table Entry	Color
0	Color set to white (background)
1	Color set to black

The color table is initialized when JDINT is called and cannot be redefined or inquired using JDCOL or JICOL. The color selected corresponds to the color defined in the color table.

COLOR = 0 Color table entry 0 is selected.
1 Color table entry 1 is selected.

Redefining and Inquiring Color

(JDCOL/JICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(JPICL). There are two colors supported by AGP on the printers: black and white. Both colors can be displayed at one time. The supported value of the color attributes are:

COLOR = 0 Color set to white (background color).
1 Color set to black.

Polygon Style

(JDPST). Using JDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(JPILS). Refer to JLSTL for information regarding line style.

Highlighting

(JSHI/JGHI). Highlighting is not supported.

Line Style

(JLSTL). Thirteen predefined line styles are supported. Line styles 1 through 7 may be classified as being continuous. Line styles 8 through 13 are the same patterns as styles 2 through 7 except start adjusted. See Figure 5 for the line styles available. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, for a complete description of continuous and start adjusted line styles.

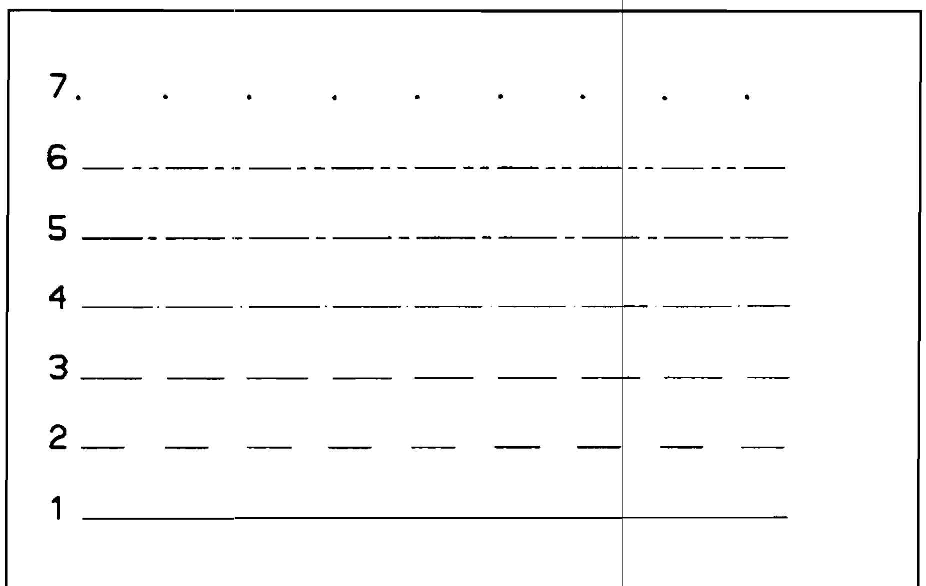

Figure 5. Supported Line Styles

Line Width

(JLWID). Four line widths are supported.

LINEWIDTH = 1 Primitives drawn with a line width one pixel wide.
= 2 Primitives drawn with a line width three pixels wide.
= 3 Primitives drawn with a line width five pixels wide.
= 4 Primitives drawn with a line width seven pixels wide.

Character Sizes

(JCSIZ). When using D0026, medium- and low-quality text is generated in software using a vector character set. A vector character is defined as a series of moves and draws and is affected by line style, line width, and color. D0026 supports all character sizes having a width and height not less than 0.7 mm and not greater than 250.0 mm. The default vector character size is 7.52 mm by 10.75 mm.

When using D0055, medium- and low-quality text is generated in software using a raster character set. A raster character is defined as a two-dimensional pattern of pixels. If the logical display surface is in the normal position, (that is, bit 8 of the JDINT control word is 0) then D0055 supports all character sizes having a width not less than 3.53 mm and not greater than 247.02 mm and a height not less than 6.54 mm and not greater than 248.46 mm. In this case, the default character size is 7.06 mm by 6.54 mm.

If the logical display surface is in the rotated position (that is, bit 8 of the JDINT control word is 1) then D0055 supports all character sizes having a width not less than 3.63 mm and not greater than 247.01 mm and a height not less than 6.35 mm and not greater than 247.73 mm. In this case, the default character size is 7.06 mm by 6.54 mm.

In either case, when using D0055, the actual character size is an integer multiple of the smallest size, and is chosen to be the largest size equal to or smaller than the requested size. There are 2660 possible raster character sizes.

When using medium- and low-quality text, the character is placed within the character cell as shown in Figure 6.

Output Primitives

Clipping

If AGP window clipping is disabled and parts of the image are outside of the view surface limits, unpredictable results may occur.

Polygons

(J2PGN/J2PGN/JR2PG/JR3PG). This device does not have hardware area fill.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). The 19 standard markers are supported. The marker size is always 2.18 mm by 2.82 mm.

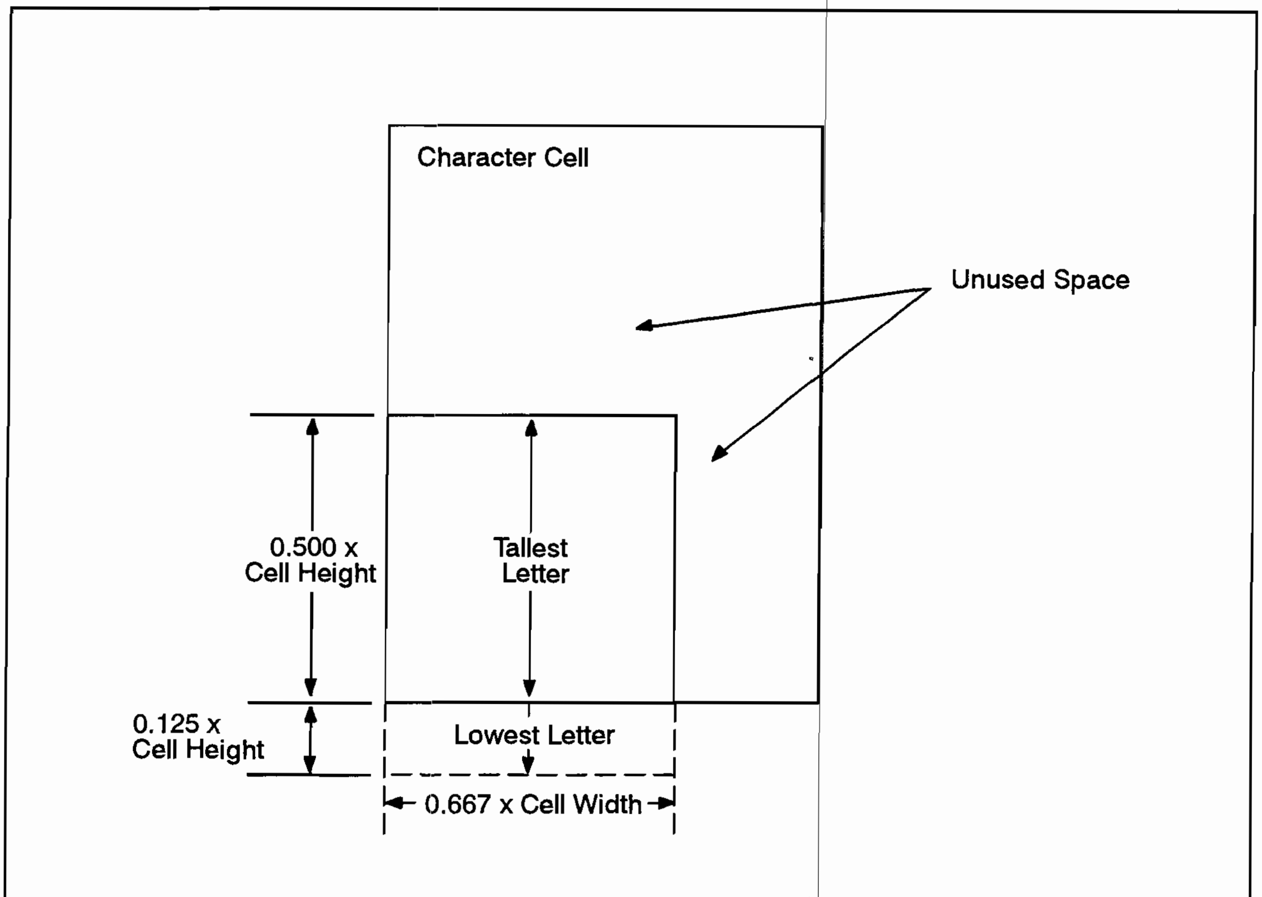

Figure 6. Placement of Character in Character Cell

Text

(JTEXL/JTEXM). The only character set available is the standard 96-character ASCII set. Figure 7 shows the vector character set obtained when using D0026. Figure 8 shows the raster character set obtained when using D0055.

If a medium- or low-quality text string is not clipped by AGP and extends beyond the view surface limits of the graphics display, any portion of a character extending outside of the view surface is clipped.

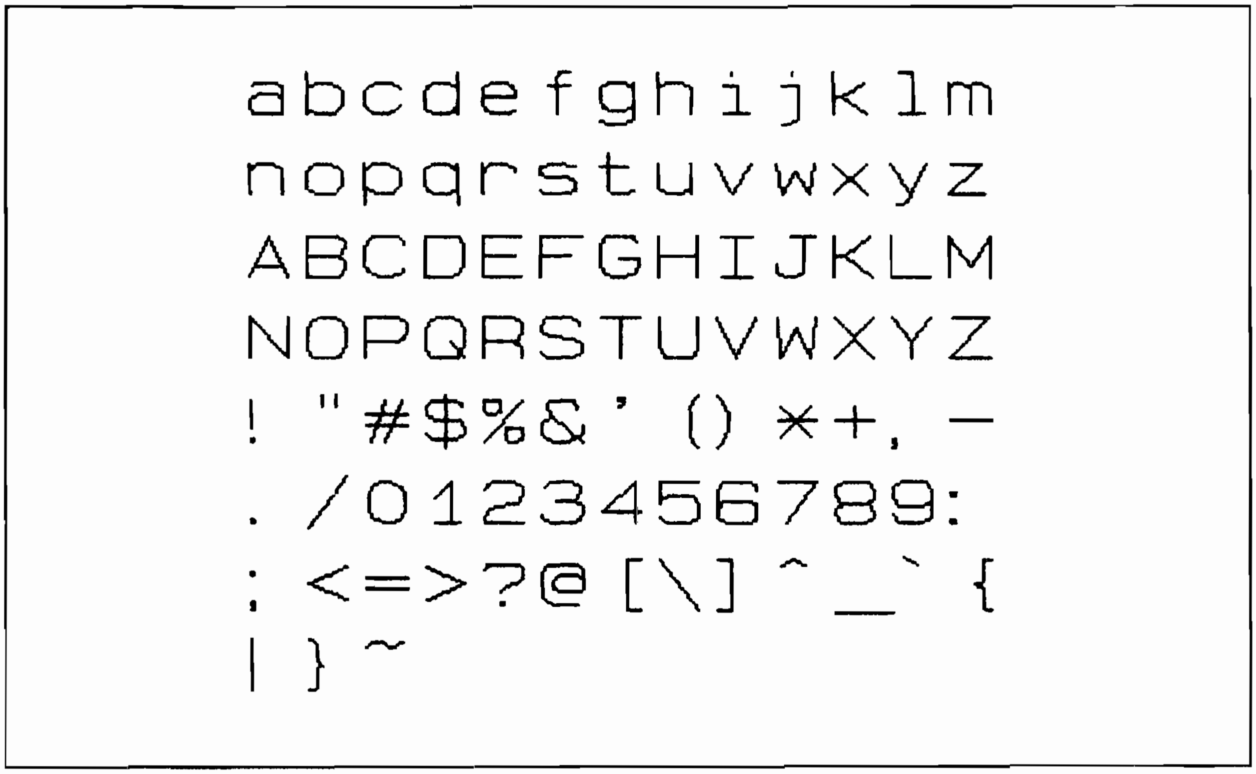

Figure 7. Supported Vector Character Set

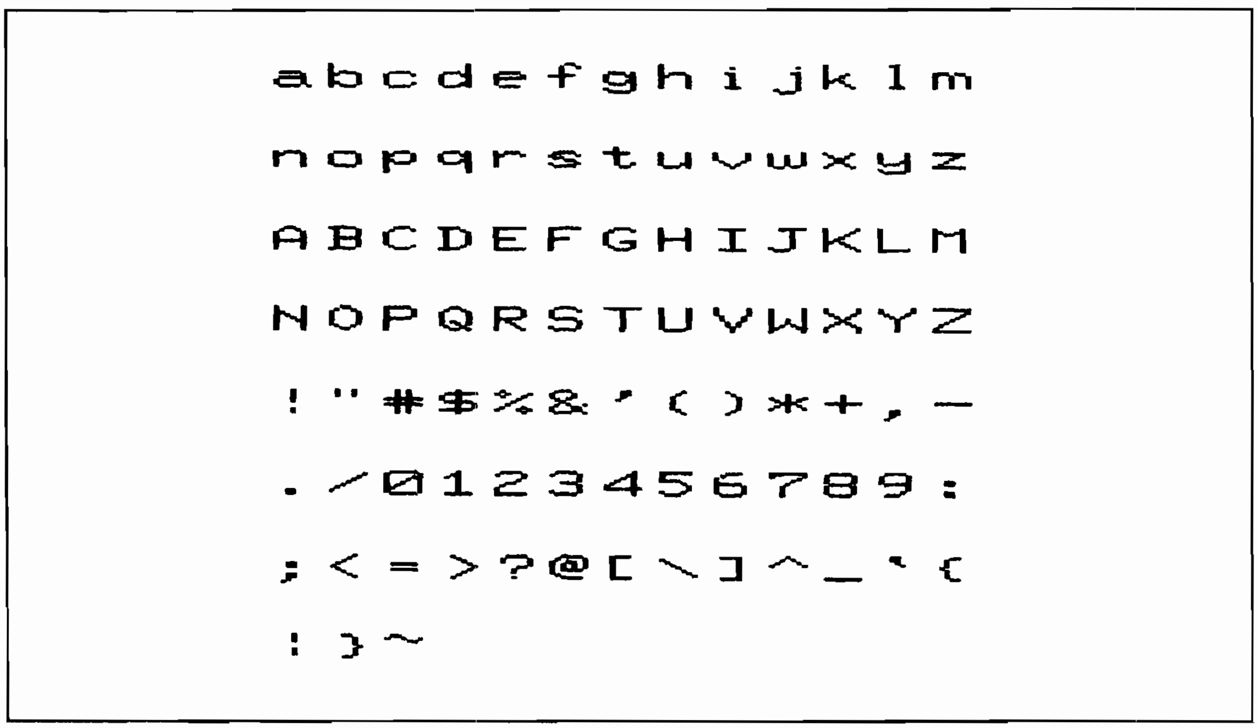

Figure 8. Supported Raster Character Set

New-Frame-Action

(JNEWF/JPURG/JSVIS/JSHI/JVSAL/JDLIM/JCLR). The action taken when a new-frame-action is given is dependent on two bits in the JDINT control word: bit 9 and the simulated raster erase bit. Bit 9 determines if a new-frame-action is necessary for a given circumstance. If bit 9 is not set, a new-frame-action is always a "necessary new-frame-action". Note that when bit 9 is not set, blank pages may be generated. If bit 9 of the control word is set, a new-frame-action is necessary only if the picture contains some output. A necessary new-frame-action causes the picture to be output and a page advance is performed. The following sections describe the effect of the simulated raster erase bit on new-frame-actions.

Simulated Raster Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates, causes a page eject and all visible segments are redrawn (if the new-frame-action is necessary). When the new-frame-action is given with the display not enabled, it does not alter the printer.

Simulated Raster Erase Set

The implementation of the printer handler has the ability to erase images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call and to remove graphics elements without doing a page eject. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is like redrawing the image in white (that is, the background color); therefore, black lines crossing the image to be purged may also have parts of them erased, leaving holes.

An explicit JNEWF call always causes a page eject and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates (if the new-frame-action is necessary). This provides a means of generating a clean surface (one without holes). The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations because the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside a batch-of-updates always results in a page eject and visible segments being redrawn when the JUPDT call is given (if the new-frame-action is necessary).

View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the view surface boundaries.
Page advance:	If bit 7 in the control word is set, the paper is not advanced. If bit 7 is not set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized when ZDINT is called.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.

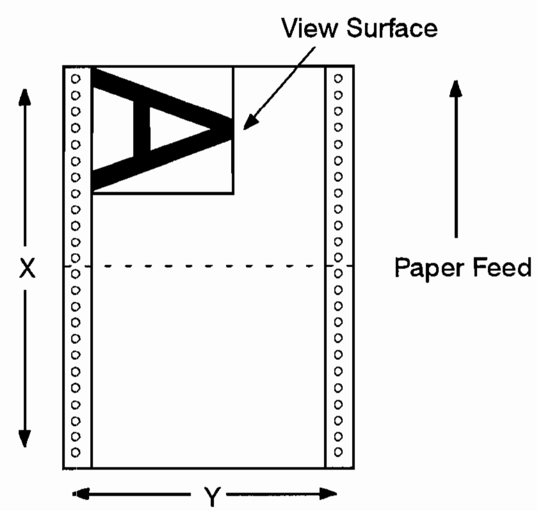

Figure 9. Default Orientation on the Physical Page

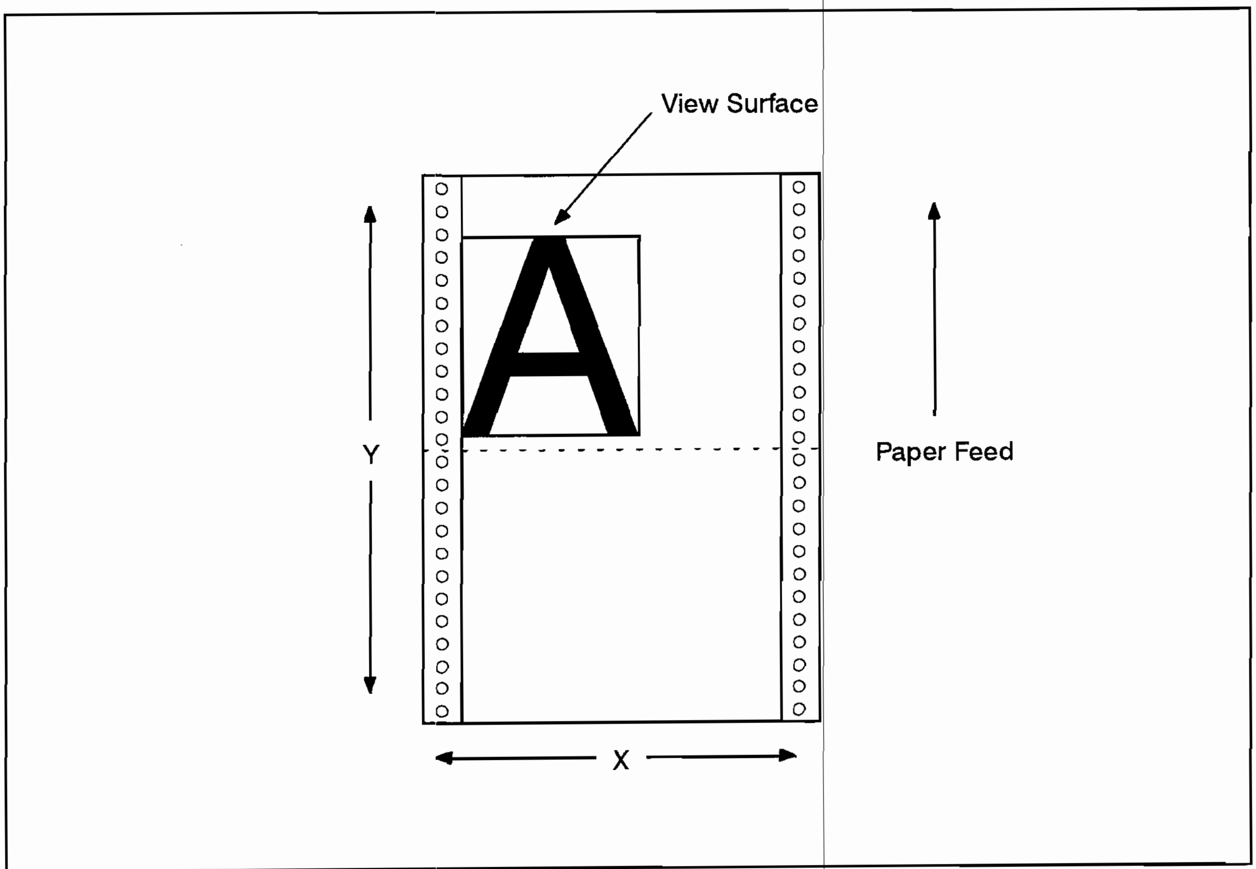

Figure 10. Rotated Orientation on the Physical Page

The color table is initialized when ZDINT is called and cannot be redefined or inquired using ZDCOL or ZICOL.

The color selected corresponds to the color defined in the color table.

COLOR = 0 Color table entry 0 is selected.
            1 Color table entry 1 is selected.

Redefining and Inquiring Color

(ZDCOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(ZPICL). There are two colors supported by DGL: black and white. Both colors can be displayed at one time. The supported value of the color attributes are:

COLOR = 0 Color set to white (background color).
            1 Color set to black.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). Refer to JLSTL for information regarding line style.

Highlighting

(ZHIGH). Highlighting is not supported.

Line Style

(ZLSTL). Thirteen predefined line styles are supported. Line styles 1 through 7 may be classified as being continuous. Line styles 8 through 13 are the same patterns as styles 2 through 7 except start adjusted. See Figure 13 for the line styles available. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete description of *continuous* and *start adjusted* line styles.

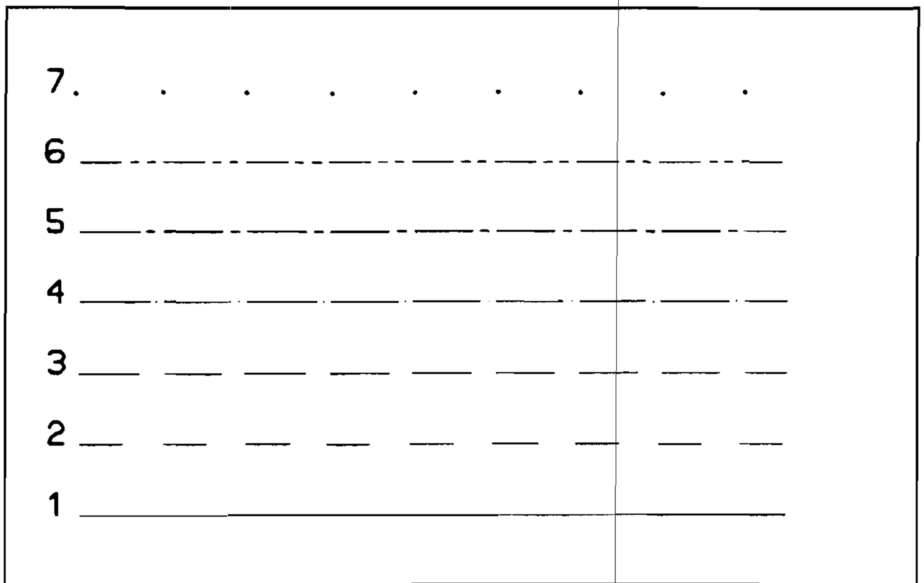

Figure 13. Supported Line Styles

Line Width

(ZLWID). Four line widths are supported.

LINEWIDTH= 1 Primitives drawn with a line width one pixel wide.
= 2 Primitives drawn with a line width three pixels wide.
= 3 Primitives drawn with a line width five pixels wide.
= 4 Primitives drawn with a line width seven pixels wide.

Character Sizes

(ZCSIZ). When using D0026, text is generated in software using a vector character set. A vector character is defined as a series of moves and draws and is affected by line style, line width, and color. D0026 supports all character sizes having a width and height not less than 0.7 mm and not greater than 250.0 mm. The default vector character size is 7.52 mm by 10.75 mm.

When using D0055, text is generated in software using a raster character set. A raster character is defined as a two-dimensional pattern of pixels. If the logical display surface is in the normal position, (that is, bit 8 of the ZDINT control word is 0) then D0055 supports all character sizes having a width not less than 3.53 mm and not greater than 247.02 mm and a height not less than 6.54 mm and not greater than 248.46 mm. In this case, the default character size is 7.06 mm by 6.54 mm.

If the logical display surface is in the rotated position (that is, bit 8 of the ZDINT control word is 1) then D0055 supports all character sizes having a width not less than 3.63 mm and not greater than 247.01 mm and a height not less than 6.35 mm and not greater than 247.73 mm. In this case, the default character size is 7.06 mm by 6.54 mm.

In either case, when using D0055, the actual character size is an integer multiple of the smallest size, and is chosen to be the largest size equal to or smaller than the requested size. There are 2660 possible raster character sizes.

The character is placed within the character cell as shown in Figure 14.

```
a b c d e f g h i j k l m
n o p q r s t u v w x y z
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
! " # $ % & ' ( ) * + , -
. / 0 1 2 3 4 5 6 7 8 9 :
; < = > ? @ [ \ ] ^ _ ` {
| } ~
```

Figure 16. Supported Raster Character Set

New-Frame-Action

(ZNEWF). The action taken when a new-frame-action is given is dependent on bit 9 of the ZDINT control word. If bit 9 of the control word is set, a new-frame-action is performed only if the picture contains some output. When bit 9 is not set, blank pages may be generated. A necessary new-frame-action causes the picture to be made current, the picture is output and a page advance is performed.

Input Escape Functions

(ZIESC). Inquiry escape functions are not supported.

Output Escape Functions

(ZOESC). The following output escape functions are supported:

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.

Locator Echoes on the Graphics Display

(ZWLOC). Locator echoing is not supported.

Termination

(ZDEND). The device name is set to "0026 " or "0055 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 256x with HP 26061A Device Handler

Introduction

The Vector Graphics PCA is an interface card used with the HP 256x family of line printers that uses the Vector Graphics Protocol. This handler communicates with the PCA using that protocol.

The Vector Graphics PCA does not respond to inquiries. This handler checks for the correct device driver and assumes that the PCA is installed.

Two density options are supported:

- 70 dots per inch
- 140 dots per inch

The density used by the handler is based on the control word sent with a JDINT or ZDINT call. There are two versions of the Vector Graphics PCA:

- option #22 which contains 128K bytes of memory
- option #23 which contains 512K bytes of memory

The handler does not check for which, if either, Vector Graphics PCA is installed.

Communication with the device is performed via an encapsulated binary data protocol that should not be interrupted. If a transmission is interrupted, for instance by OF'ing the running program, it may be necessary to send the following control requests:

```
CN LU AB, CN LU 0B
```

This sequence puts the printer and Vector Graphics PCA back into a known state.

Introduction to Fonts

The Vector Graphics PCA can process the character fonts associated with text sets provided with this family of printers. The output escape functions JOESC 2050 and ZOESC 2050 assign the text sets to the four-element G-Set table. The character sets are identified by an ID Number.

Table 1. Character Set ID Numbers (Opcodes 2050 and 2051)

ID #	Name
1	US ASCII
2	JIS ASCII
3	KATAKANA
4	ISO NORWAY v1
5	ISO FRENCH
6	ISO ITALIAN
7	ISO SWEDISH (for names)
9	ISO UNITED KINGDOM
256	ROMAN EXTENSIONS
266	HP GERMAN
267	HP SPANISH
269	MARKER SYMBOLS
513	ROMAN8
514	KATAKANA8

The text sets are invoked using output escape functions JOESC 2051 or ZOESC 2051. The invocation can be for one character (single shift) or multiple characters (locking shift).

Locking Shifts

Locking shifts may be used to place one of the four G sets into either GL or GR. They are in effect until replaced by another locking shift or by re-initialization of the device. Each locking shift is described by LS <g-set>[R]. Note that LS0 (SI or "shift in") and LS1 (SO or "shift out") retain their accustomed meanings.

Table 2. Locking Shifts

Name	Meaning	Code(s) to Send
LSO G0—> GL	locking shift (SI or ctrl-O)	0/15
LS1 G1—>GL	locking shift (SO or ctrl-N)	0/14
LS2 G2—>GL	locking shift ESC n	1/11 6/14
LS3 G3—>GL	locking shift ESC o	1/11 6/15
LS1R	locking shift ESC ~	1/11 7/14
LS2R G2—>GR	locking shift ESC }	1/11 7/13
LS3R G3—>GR	locking shift ESC |	1/11 7/12

Single Shifts

Single shifts specify that the next character is to be taken from the character set named.

Table 3. Single Shifts

Name	Meaning	8 Bit Code	7 Bit Code
SS2 G2)	(single shift 8th bit set)	8/14 (SO with ESC N)	1/11 4/14
SS3 G3)	(single shift 8th bit set)	8/15 (SI with ESC O	1/11 4/15

If an escape sequence is received in a text string which is not one of those listed above, that escape sequence is discarded. For the purposes of the text string, the ANSI/ISO definition of escape sequence is used, that is, the escape sequence consists of the character ESC (27 or 1/11) plus all characters up to and including the first "final" (character from columns 3-7).

Supported Logical Device

Logical Device	Device Handler Name	
Graphics Display	D0045	HP 256x (with HP 26061A Vector Graphics PCA)

Graphics Display Device Handler (AGP)

Description

All values are viewed from the normal printer orientation which is physical origin in the upper left corner. Wide and narrow paper refer to the normal 8 ½ by 11 inch and 11 by 14 inch computer paper.

Plotting Area

Table 4. Plotting Area

Paper Size	Plotting Area Size
Wide paper	397.93 mm. Wide by 334.92 mm. High
Narrow paper	536.10 mm. Wide by 215.54 mm. High

Plotting Capacity

High density may be used with graphics card option #22; however, because of the limited amount of memory on the option, full page images are not possible. The maximum size image which may be obtained using high density with narrow or wide paper is 1024 points wide by 1024 points high. The portion of the image which will not fit in the available memory is clipped. The image is not shrunk to fit in the available memory.

Table 5. Plotting Capacity

Option	Paper Size	Plotting Capacity
Option #22	Low density narrow paper	Width 1518 points (3 pages), Height 595 points
Option #22	Low density wide paper	Width 1129 points, Height 924 points
Option #23	High density narrow paper	Width 3036 points, Height 1190 points
Option #23	High density wide paper	Width 2259 points, Height 1848 points

Aspect Ratio of Maximum Area

Table 6. Aspect Ratio of Maximum Area

Paper Size	Aspect Ratio
Wide paper	0.84
Narrow paper	0.40

Resolution

Table 7. Resolution

Density	Resolution
Low density	2.7559 points/mm in the X direction 2.8346 points/mm in the Y direction
High density	5.5118 points/mm in the X direction 5.6692 points/mm in the Y direction

Default Limits

Table 8. Default Limits

Paper Size	Limits
Wide paper	Width 271.4 mm., Height 271.4 mm.
Narrow paper	Width 194.1 mm., Height 194.1 mm.

Aspect Ratio of Default Limits

1.0

Initialization (JDINT)

Device Name	**Initialization Value**
Device name:	26061A
Color:	1
Highlighting:	1
Line width:	1
Start position:	(0.0,0.0)
View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Physical origin:	The upper left corner of the display area.
Hardware clipping:	Set to the maximum physical device limits.
Page advance:	If bit 7 in the control word is set, the paper is not advanced.

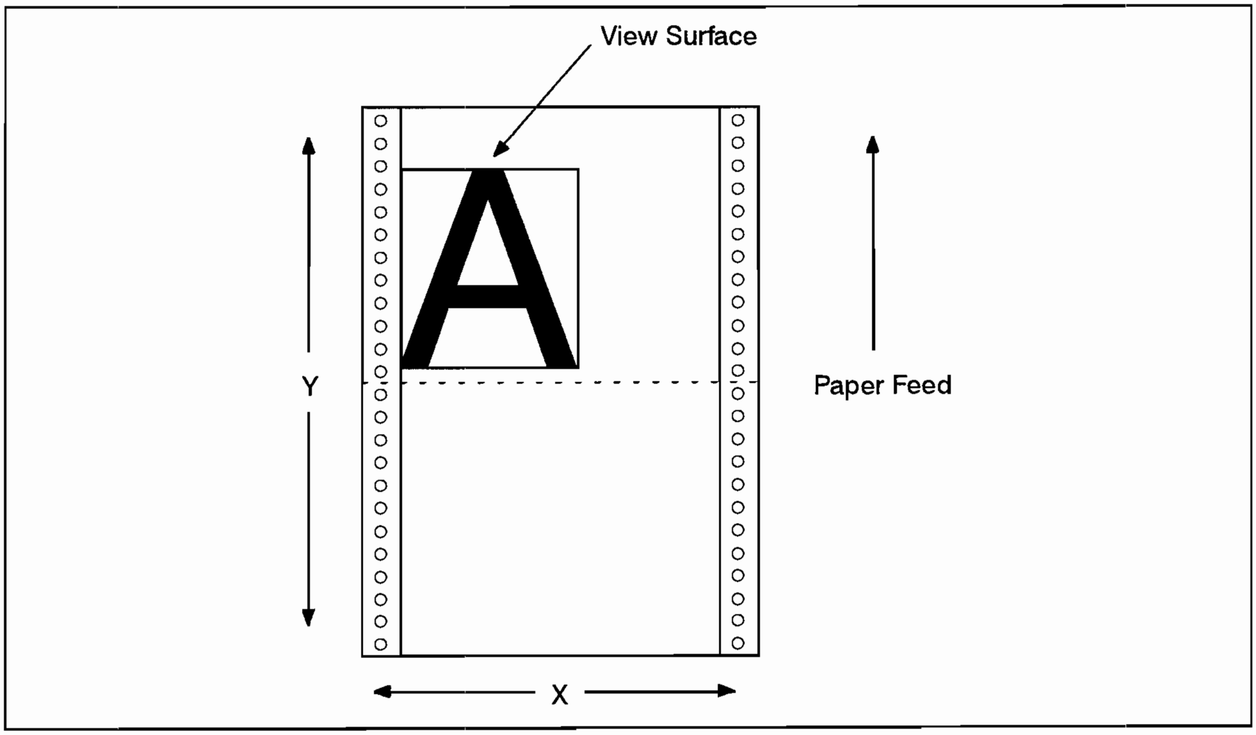


Figure 3. Rotated Orientation of the Logical Display Surface - Bit 8 Set

Supported Primitive Attributes

Color

(JCOLR). The D0045 display handler provides a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The color table is initialized when JDINT is called and cannot be redefined or inquired using JDCOL or JICOL. The color selected corresponds to the color defined in the color table.

Table 9. Color Table

Color Table Index	Color
0	Color set to white (background color)
1	Color set to black

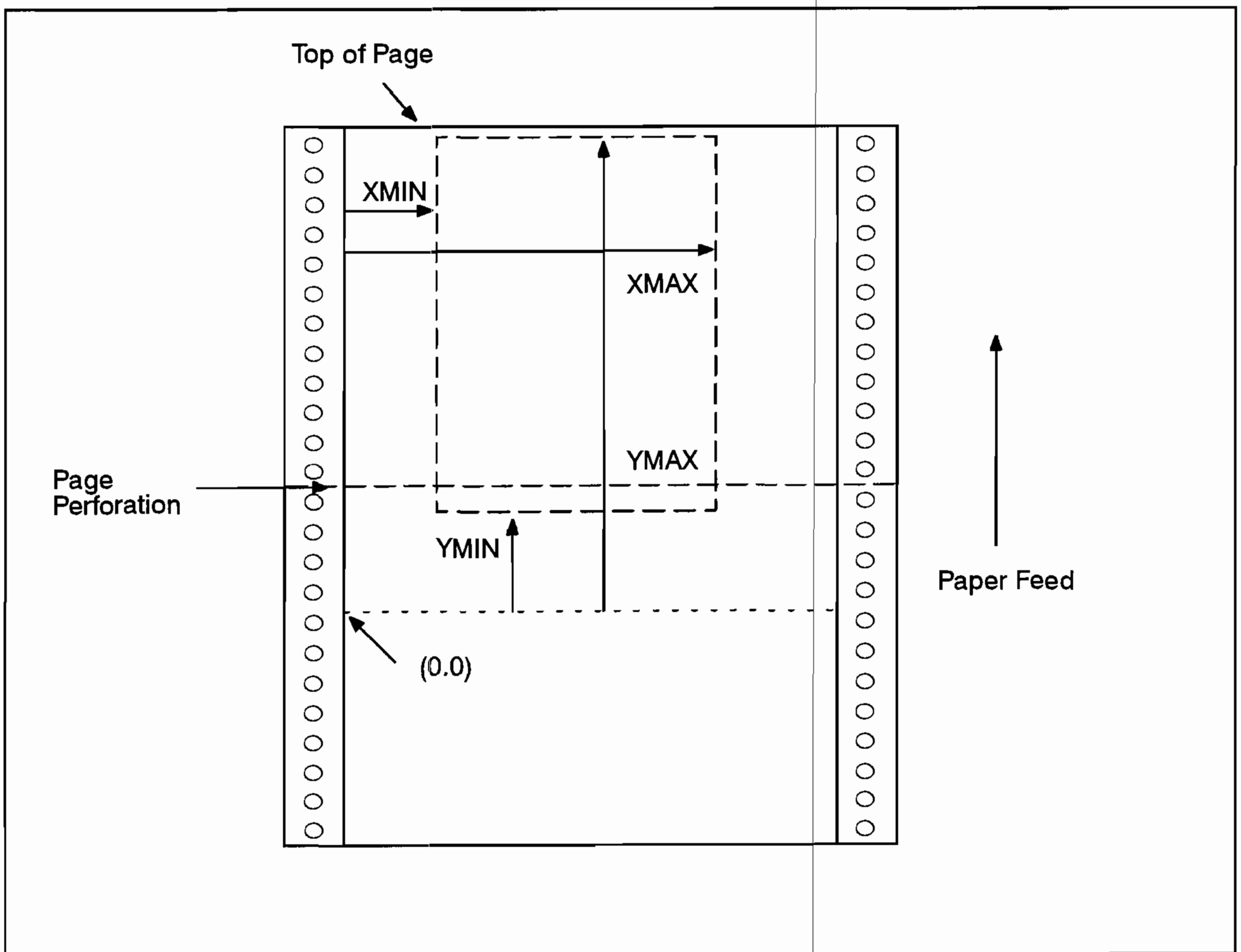


Figure 4. Rotated Paper Positioning and Limitation - Bit 8 Set

Polygon Style

(JDPST). Using JDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(JPILS). Refer to JLSTL for information regarding line style.

Highlighting

(JSHI/JGHI). Highlighting is not supported.

Line Style

(JLSTL). Eight predefined line styles are supported.

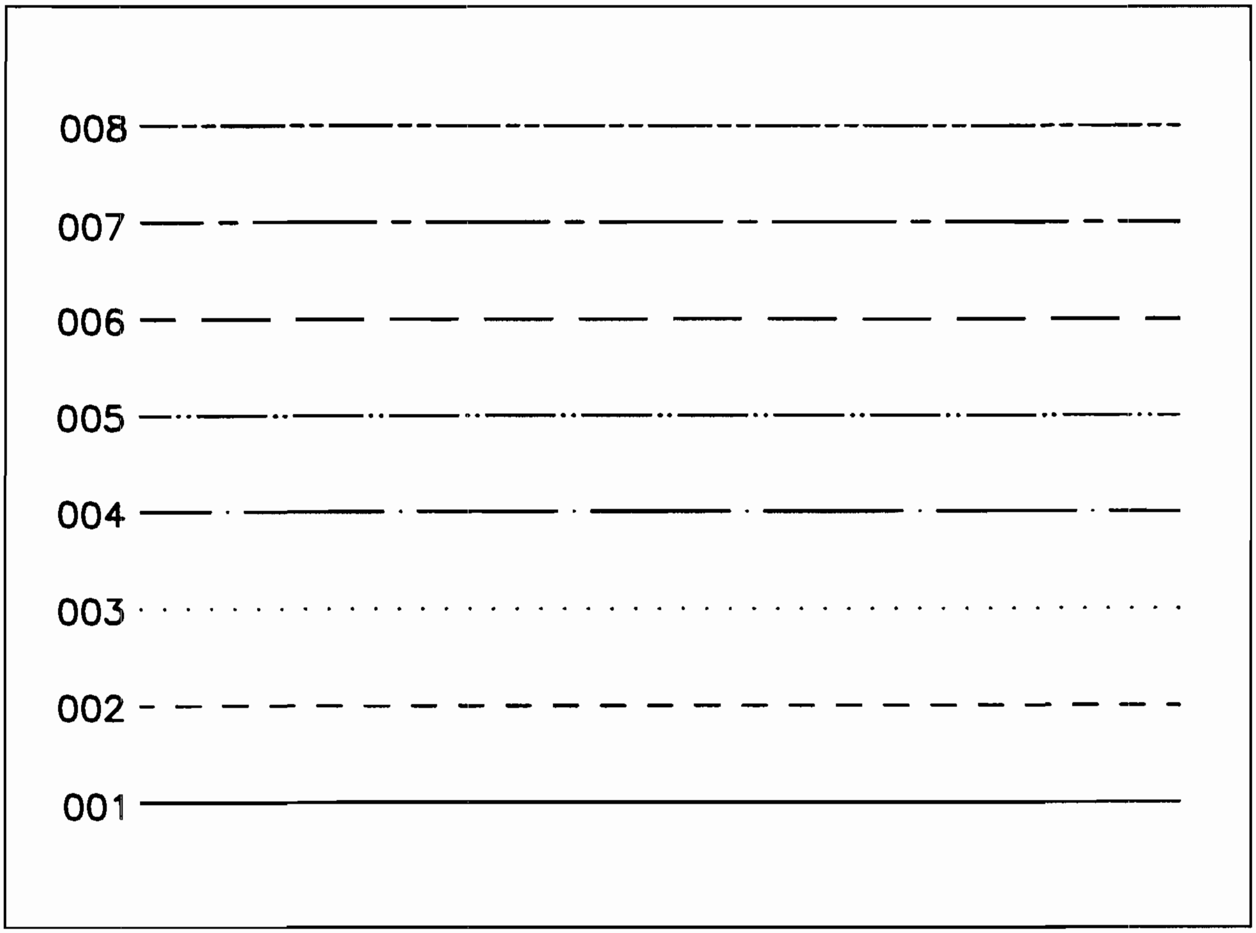


Figure 5. Supported Line Styles

Line Width

(JLWID). 255 line widths are supported.

Line Width Index	Line Width
1	Primitives drawn with a line width one pixel wide
2	Primitives drawn with a line width two pixels wide
.	
.	
.	
255	Primitives drawn with a line width 255 pixels wide

Character Sizes

(JCSIZ). Characters are generated in hardware. D0045 supports all character sizes having a width and height not less then .5 mm and not greater than 254.0 mm. The default character cell size is 9.49 by 13.56 mm.

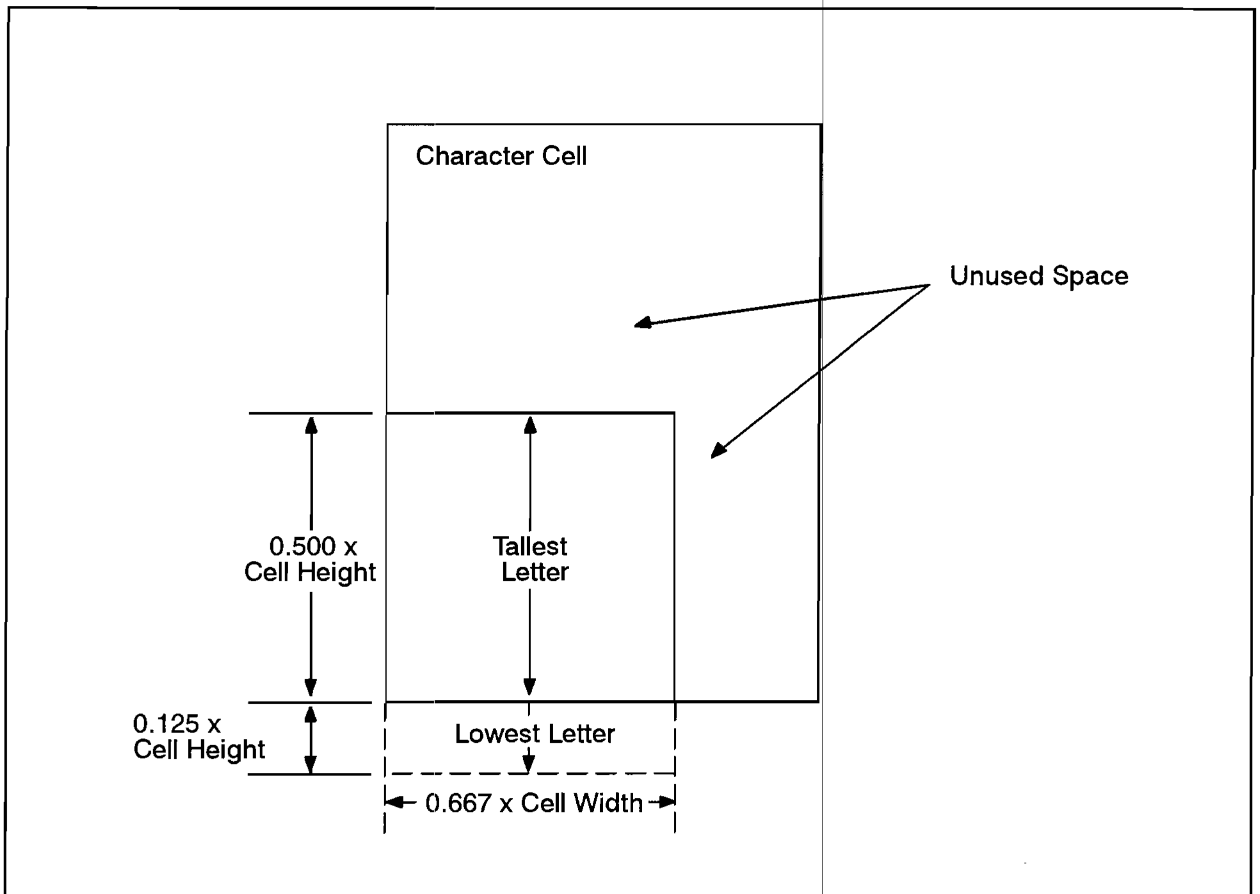


Figure 6. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware clipping is provided to the hardware clipping limits. Only parts of graphics primitives exceeding the hardware clipping limits are clipped.

Calls to JDINT set the hardware clipping limits to the physical display limits. The user can redefine the hardware clipping limits to be any region within the boundaries of the view surface by a call to JOESC (Opcode 450).

If AGP window clipping is disabled and parts of the image are outside of the view surface limits, unpredictable results may occur.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). Polygon sets with device-dependent polygon styles are displayed using the device's hardware hardware polygon fill. The device can handle 128 points (vertices) including those that must be added by the device to perform closure. The maximum number of points cannot be changed.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). Nineteen standard markers are supported. A character size of 2.4 mm by 2.4 mm is used to generate markers.

Text

(JTEXL/JTEXM). Medium- and low-quality graphics text is generated with a hardware character generator. For text that is not clipped by AGP, only parts of characters extending beyond the current hardware clipping limits or the paper limits are clipped.

The default character set depends on the primary character set selected from the printer's operator control panel as follows: If the primary set is JASCII, KATAKANA, or KATAKANA8, the default graphics character set is KATAKANA8. For all other primary sets selected the default graphics character set is ROMAN8. The default graphics character set is not affected by character set selection performed via print escape sequences.

There are 14 character sets available to the user via the output escape function (see JOESC, Opcode 2050 and Opcode 2051).

The user can modify the text direction, text path, and the slant of medium- and low-quality text through the output escape functions (see JOESC, Opcode 150, Opcode 250, and Opcode 1050).

New-Frame-Action

(JNEWF/JPURG/JSVIX/JSHI/JVSAL/JDLIM/JCLR). A new-frame-action causes the picture to be made current. All visible segments are then drawn, or redrawn, on the display surface. The picture is always output and a page advance is performed when a new-frame-action occurs.

Input Escape Functions

(JIESC). Inquiry escape functions are not supported by AGP.

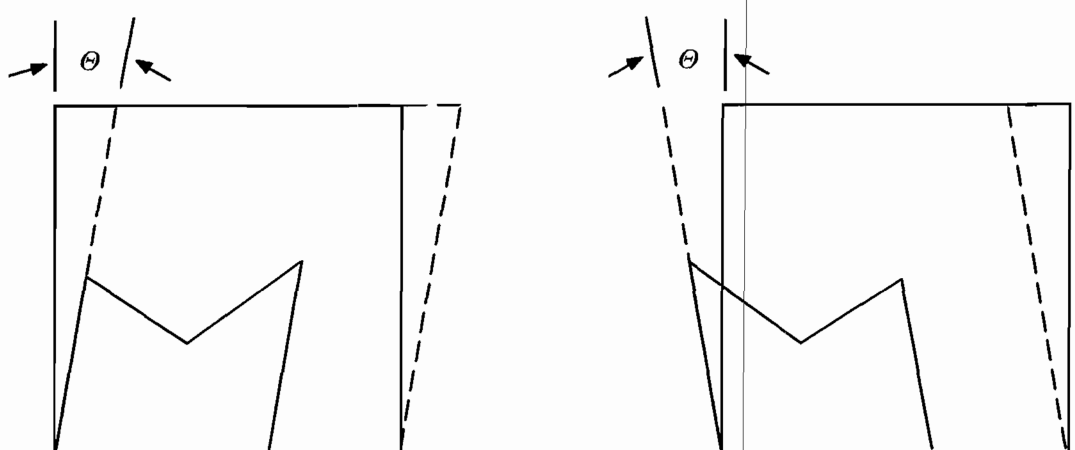
Output Escape Functions

None of the output escape functions affect the graphics current position.

The following output escape functions are supported by AGP.

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.
150	Set device character slant for subsequent medium- and low-quality text. RLIST(1) = Tangent of angle from vertical (from 127.999 to −127.999).
250	Set device character direction for subsequent medium- and low-quality text. RLIST(1) = X component of character direction slope (run) RLIST(2) = Y component of character direction slope (rise) If both X and Y components are 0 the device ignores this call.

The parameter is a decimal number between ±127.999 and is equivalent to the tangent of the angle Θ from the vertical as follows:



+ Parameter − Parameter

Figure 7. Opcode 150 - Character Slant

Run and rise are in decimal format between ±127.999 and specify the direction according to the relationship.

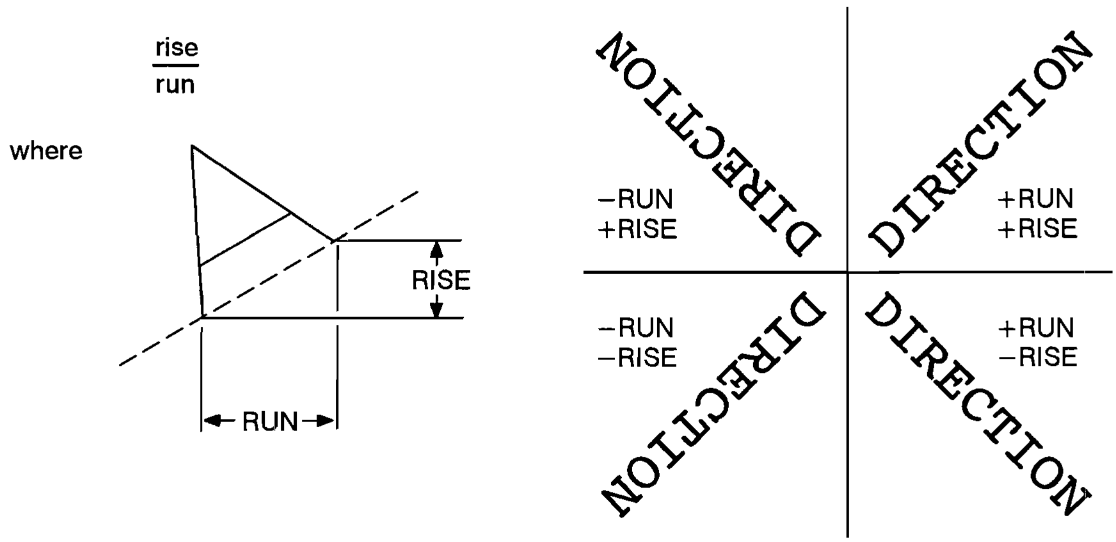


Figure 8. Opcode 250 - Character Direction

350 Draw circle. A circle is drawn at the given point with the given radius. The device treats this as a closed polygon and fills according to the current polygon style attributes (JDPST) in effect. The circle is approximated by a polygon. The user has no control over the chord tolerance of this device.

RLIST(1) = X coordinate (world units) of circle center.
RLIST(2) = Y coordinate (world units) of circle center.
RLIST(3) = circle radius (world units). Scaling of the radius parameter is done based on the current X axis scaling factor.

A radius of 0.0 causes a dot to be drawn.

450 Set hardware clipping limits. JDINT sets the hardware clipping limits to the physical view surface boundaries. JASPK, JWIND, JVIEW, and JDLIM do not change the hardware clipping limits. This output escape function can be used to set hardware clipping to a specific rectangle within the the current window. For example:

call JWIND (0.,1.,0.,1.)
call JOESC (450,0,4,ilist,rlist,ierr)

where rlist contains .2,.4,.2,.4

To reset the hardware clipping limits to the physical view surface boundaries the following sequence can be used:

call JWIND (0.,1.,0.,1.)
call JOESC (450,0,4,ilist,rlist,ierr)

where rlist contains 0.,1.,0.,1.

RLIST(1) = X min (world coordinate units).
RLIST(2) = X max (world coordinate units).
RLIST(3) = Y min (world coordinate units).
RLIST(4) = Y max (world coordinate units).

If the length of either or both dimensions of the clipping rectangle = 0, the device ignores the command.

550 This function draws a circular arc from the start point through a specified sweep angle, around a specified center point. The distance from the start point to the center point fixes the radius of the arc. The sweep angle is in degrees. A positive number indicates a counterclockwise arc, and a negative number indicates a clockwise arc. A zero-length radius produces a dot at the start point.

RLIST(1) = X start point (world coordinate units).
RLIST(2) = Y start point (world coordinate units).
RLIST(3) = X center point (world coordinate units).
RLIST(4) = Y center point (world coordinate units).
RLIST(5) = Sweep angle (degrees).

551 This function draws a circular arc as described in Output Escape Function 550. In addition line segments are drawn to close the polygon from the center point to the start point and from the center point to the end of the arc. The polygon is filled using current interior and perimeter attributes.

RLIST(1) = X start point (world coordinate units).
RLIST(2) = Y start point (world coordinate units).
RLIST(3) = X center point (world coordinate units).
RLIST(4) = Y center point (world coordinate units).
RLIST(5) = Sweep angle (degrees).

If the arc specified is 360 degrees, the arc is a circle and no wedge closing is possible.

552 This function draws a circular arc as described above in output escape function 550. In addition a line segment is drawn to close the polygon connecting the two end points of the arc. The polygon is filled using current interior and perimeter attributes.

RLIST(1) = X start point (world coordinate units).
RLIST(2) = Y start point (world coordinate units).
RLIST(3) = X center point (world coordinate units).
RLIST(4) = Y center point (world coordinate units).
RLIST(5) = Sweep angle (degrees).

If the arc specified is 360 degrees, the arc is a circle and no chord closing is possible.

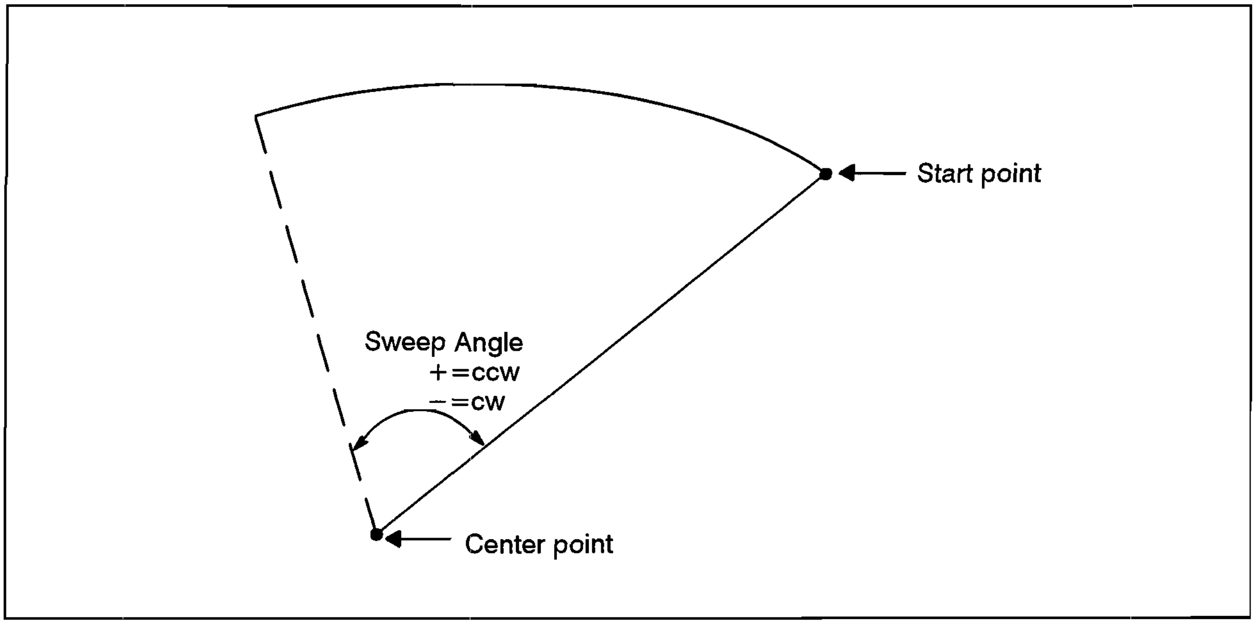


Figure 9. Opcode 550, 551, and 552 - Arc with 2 Points

650 A circular arc is drawn from the start point through the intermediate point to the end point. If the start point and end point are identical, a circle is drawn which passes through the three coordinates and has a diameter equal to the distance from the start point to the intermediate point. The resulting circle in this case will not be filled. If the three points are colinear, a straight line is drawn through the three coordinates.

RLIST(1) = X start point (world coordinate units)
RLIST(2) = Y start point (world coordinate units)
RLIST(3) = X intermediate point (world coordinate units)
RLIST(4) = Y intermediate point (world coordinate units)
RLIST(5) = X end point (world coordinate units)
RLIST(6) = Y end point (world coordinate units)

If the intermediate point equals the start or end point, the command is ignored.

651 A circular arc is drawn from the start point through the intermediate point to the end point. Line segments are drawn from the computed center point to the two end points. The resulting polygon is filled and edged according to the current interior and perimeter attributes.

RLIST(1) = X start point (world coordinate units)
RLIST(2) = Y start point (world coordinate units)
RLIST(3) = X intermediate point (world coordinate units)
RLIST(4) = Y intermediate point (world coordinate units)
RLIST(5) = X end point (world coordinate units)
RLIST(6) = Y end point (world coordinate units)

If the intermediate point equals the start or end point, the command is ignored.

652 A circular arc is drawn from the start point through the intermediate point to the end point. A line is drawn connecting the two end points and the resulting polygon is filled and edged according to the current interior and perimeter attributes.

RLIST(1) = X start point (world coordinate units)
RLIST(2) = Y start point (world coordinate units)
RLIST(3) = X intermediate point (world coordinate units)
RLIST(4) = Y intermediate point (world coordinate units)
RLIST(5) = X end point (world coordinate units)
RLIST(6) = Y end point (world coordinate units)

If the intermediate point equals the start or end point, the command is ignored.

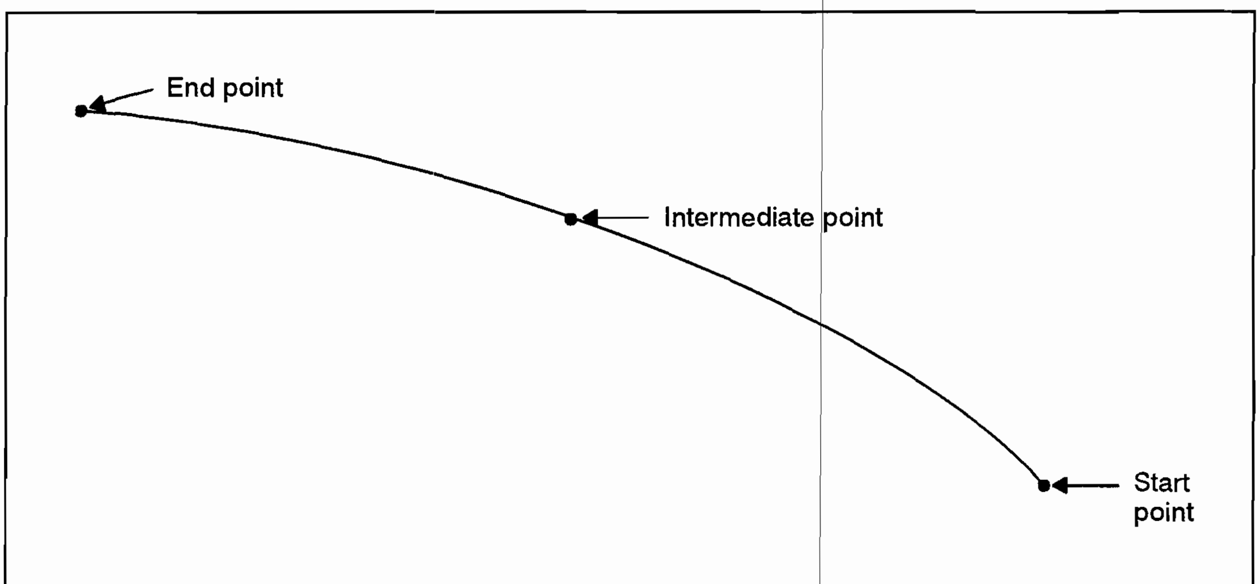


Figure 10. Opcode 650, 651, and 652 - Arc with 3 Points

1050 The character path is set to right, left, up, or down. This function selects the writing direction of text strings, which is the direction along which the character origin advances after each printing character or space.

ILIST(1) = 0 The character path is to the right (default).
ILIST(1) = 1 The character path is to the left.
ILIST(1) = 2 The character path is upward.
ILIST(1) = 3 The character path is downward.

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TFEL  HTAP  RETCARAHC           CHARACTER PATH RIGHT
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                         D
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                         W
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```

Figure 11. Opcode 1050 - Character Path

2050 This function associates one of the printer's 14 resident character sets with an entry in the four element G-Set table. A JDINT call reestablishes the default character set established by the printer's operator control panel. Refer to the notes in the introduction section of this device handler section.

ILIST(1) = Character set ID number.
ILIST(2) = GSET: 0 = G0; 1 = G1; 2 = G2; 3 = G3.

If the character set ID or G-SET are out of the above range, the command is ignored.

If the designated G-Set entry is the currently invoked G-Set, the designated set immediately becomes active.

If the designated G-Set entry is not the currently invoked G-Set, it may be invoked with Output Escape Function JOESC with Opcode 2051.

2051 This function associates one of the four character sets in the G-Set table with the two element In-Use table which consists of a left entry -GL and a right entry -GR. JTEXL and JTEXM use the character sets from the In-Use table. The set that is invoked into GL is used when the text character received has it's 8th bit = 0. GR is used when the 8th bit = 1. Refer to the notes in the introduction section of this device handler section.

ILIST(1) = GSET: 0 = G0; 1 = G1; 2 = G2; 3 = G3.
ILIST(2) = Side of code table: 0 = GL; 1 = GR.

The default invocation (after JDINT) has G0 invoked into GL and G1 invoked into GR.

G0 may not be invoked into GL (if attempted the command is ignored).

Invocation of GL or GR may also be accomplished by including control characters in the text string.

Locator Echoes on the Graphics Display

(JWLOC). Locator echoing is not supported.

Pick Echoes on the Graphics Display

(JPICK). Pick echoing is not supported.

Termination

(JWOFF). The printer is not set to initial values when JWOFF is called. Values remain as they were last set. For example, printing begins at column 1.

Graphics Display Device Handler (DGL)

Description

All values are viewed from the normal printer orientation which is physical origin in the upper left corner. Wide and narrow paper refer to the normal 8 ½ by 11 inch and 11 by 14 inch computer paper.

Plotting Area

Table 10. Plotting Area

Paper Size	Plotting Area Size
Wide paper	397.93 mm. Wide by 334.92 mm. High
Narrow paper	536.10 mm. Wide by 215.54 mm. High

Plotting Capacity

High density may be used with graphics card option #22; however, because of the limited amount of memory on the option, full page images are not possible. The maximum size image which may be obtained using high density with narrow or wide paper is 1024 points wide by 1024 points high. The portion of the image which does not fit in the available memory is clipped (the image is not shrunk to fit in the available memory).

Table 11. Plotting Capacity

Option	Paper Size	Plotting Capacity
Option #22	Low density narrow paper	Width 1518 points (3 pages), Height 595 points
Option #22	Low density wide paper	Width 1129 points, Height 924 points
Option #23	High density narrow paper	Width 3036 points, Height 1190 points
Option #23	High density wide paper	Width 2259 points, Height 1848 points

Aspect Ratio of Maximum Area

Table 12. Aspect Ratio of Maximum Area

Paper Size	Aspect Ratio
Wide paper	0.84
Narrow paper	0.40

Resolution

Table 13. Resolution

Density	Resolution
Low density	2.835 points/mm in the X direction 2.976 points/mm in the Y direction
High density	5.669 points/mm in the X direction 5.753 points/mm in the Y direction

Default Limits

Table 14. Default Limits

Paper Size	Limits
Wide paper	Width 271.4 mm., Height 271.4 mm.
Narrow paper	Width 194.1 mm., Height 194.1 mm.

Aspect Ratio of Default Limits

1.0

Initialization (ZDINT)

Device Name	Initialization Value
Device name:	26061A
Color:	1
Highlighting:	1
Line width:	1
Start position:	(0.0,0.0)
View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Physical origin:	The upper left corner of the display area.
Hardware clipping:	Set to the maximum physical device limits.
Page advance:	If bit 7 in the control word is set, the paper is not advanced.

Color table:	The colors in the color table cannot be re-defined or inquired.
Density:	If bit 10 of the control word is set, the handler uses high density. If bit 10 is clear, the handler uses low density.
Limits (ZDLIM):	The logical display limits are specified relative to the upper left corner of the paper when bit 8 is not set (default). When bit 8 is set, the logical display limits are rotated. The top of page is the location of the paper at the time of initialization. The origin in the y-direction (non-rotated Bit 8 Clear) or the origin in the x-direction (rotated Bit 8 Set) is always column 1 of the printer.

Logical Display Surface

Set to the default value with bit 8 clear.

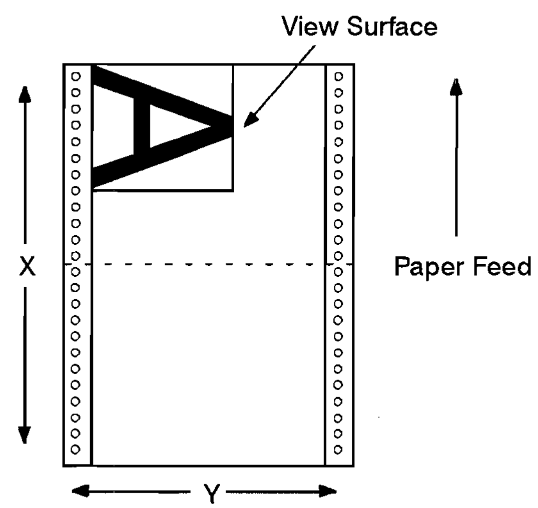

Figure 12. Default Orientation of the Logical Display Surface - Bit 8 Clear

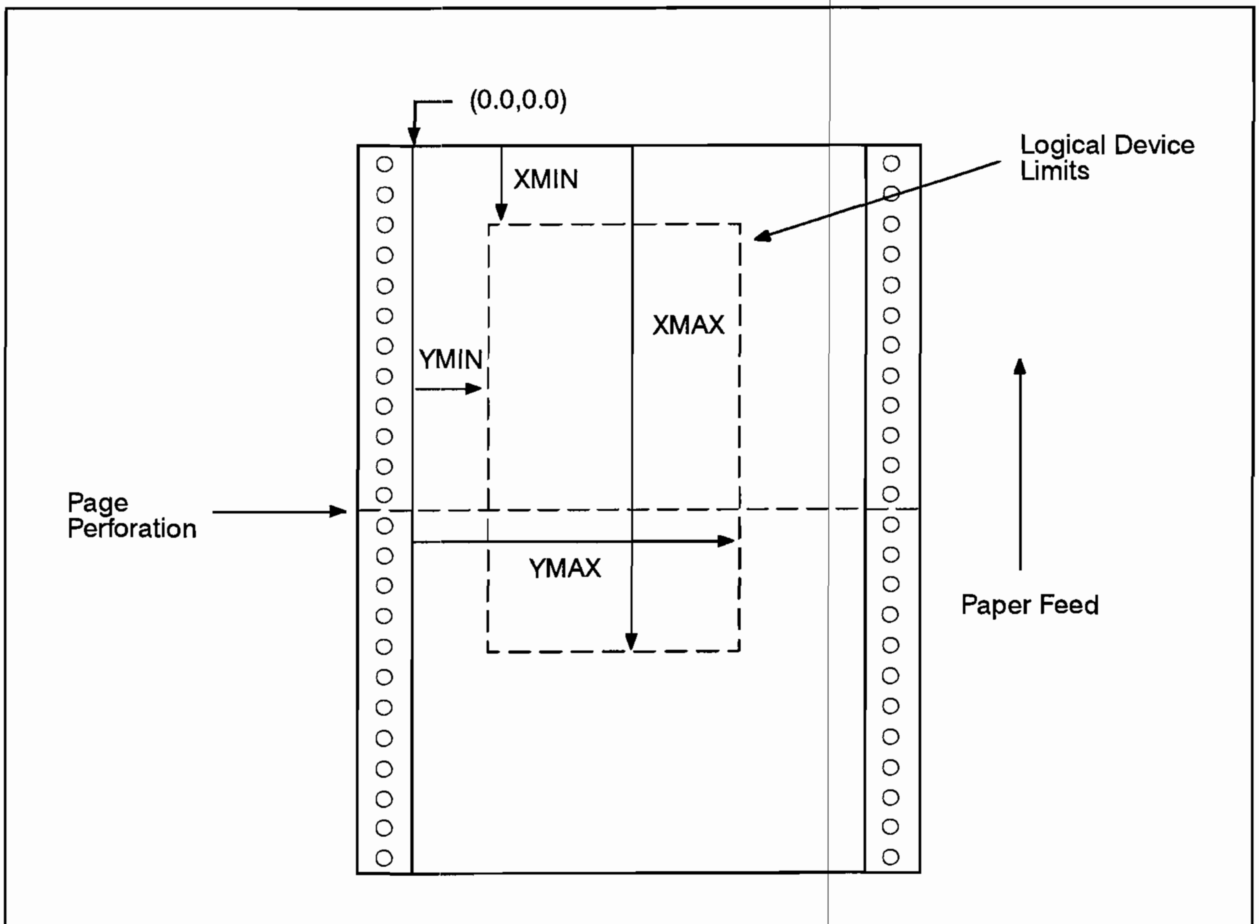

Figure 13. Default Paper Positioning and Limitation - Bit 8 Clear

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). Refer to ZLSTL for information regarding line style.

Highlighting

(ZHIGH). Highlighting is not supported.

Line Style

(ZLSTL). Eight predefined line styles are supported.

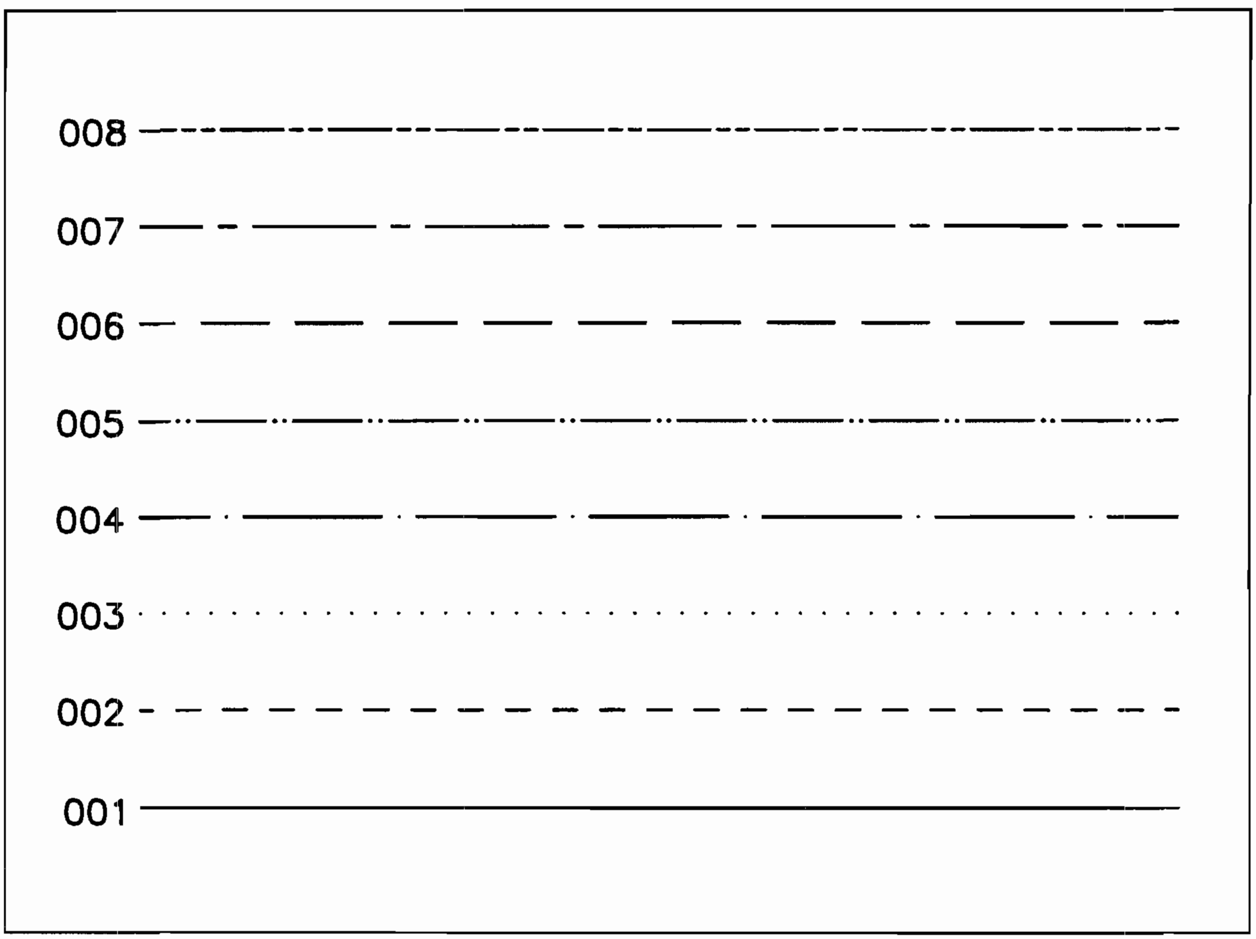

Figure 16. Supported Line Styles

Line Width

(ZLWID). 255 line widths are supported.

Line Width Index	Line Width
1	Primitives drawn with a line width one pixel wide
2	Primitives drawn with a line width two pixels wide
.	
.	
.	
255	Primitives drawn with a line width 255 pixels wide

Character Sizes

(ZCSIZ). Characters are generated in hardware. D0045 supports all character sizes having a width and height not less then .5 mm and not greater than 254.0 mm. The default character cell size is 9.49 by 13.56 mm.

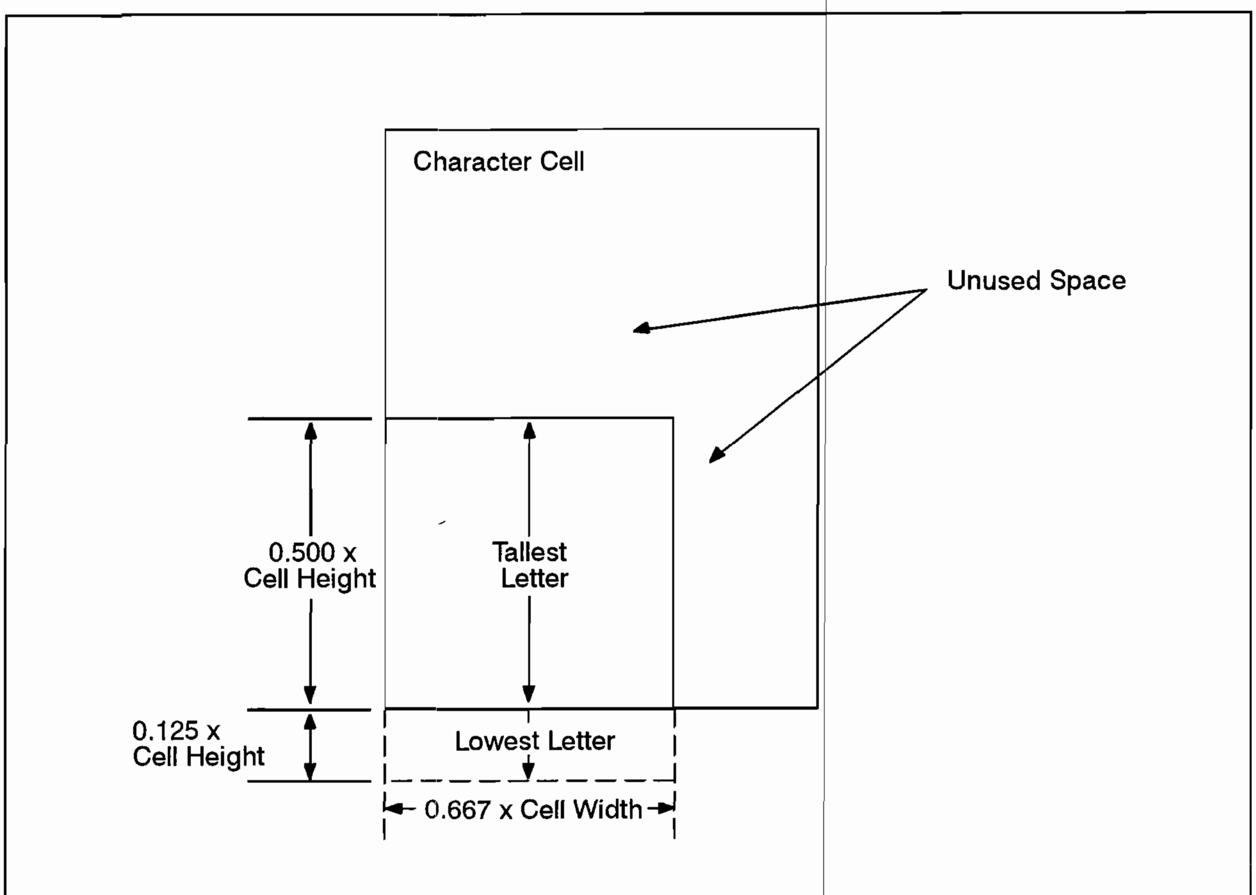

Figure 17. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware clipping is provided to the hardware clipping limits. Only parts of graphics primitives exceeding the hardware clipping limits are clipped.

Calls to ZDINT set the hardware clipping limits to the physical display limits. The user can redefine the hardware clipping limits to be any region within the boundaries of the view surface by a call to ZOESC (Opcode 450).

If DGL window clipping is disabled and parts of the image are outside of the view surface limits, unpredictable results may occur.

Polygons

(ZPGDD). Polygon sets with device-dependent polygon styles are displayed using the device's hardware hardware polygon fill. The device can handle 128 points (vertices) including those that must be added by the device to perform closure. The maximum number of points cannot be changed.

Markers

(ZMARK). Nineteen standard markers are supported. A character size of 2.4 mm by 2.4 mm is used to generate markers.

Text

(ZTEXT). Text is generated with a hardware character generator.

The default character set depends on the primary character set selected from the printer's operator control panel as follows: If the primary set is JASCII, KATAKANA, or KATAKANA8, the default graphics character set is KATAKANA8. For all other primary sets selected the default graphics character set is ROMAN8. The default graphics character set is not effected by character set selection performed via print escape sequences.

There are 14 character sets available to the user via the output escape function (see ZOESC, Opcode 2050 and Opcode 2051).

The user can modify the text direction, text path, and the slant of text through the output escape functions (see ZOESC, Opcode 150, Opcode 250, and Opcode 1050).

New-Frame-Action

Non-Buffered

(ZNEWF). A new-frame-action causes the picture to be made current. The picture is always output and a page advance is performed when a new-frame-action occurs.

Buffered

(ZNEWF). New-frame-action is not affected by bit 6 of the control word in the ZDINT call. Therefore, the action is the same as non-buffered.

Input Escape Functions

(ZIESC). Inquiry escape functions are not supported by DGL.

Output Escape Functions

None of the output escape functions effect the graphics current position.

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.
150	Set device character slant for subsequent text. RLIST(1) = Tangent of angle from vertical (from 127.999 to −127.999).
250	Set device character direction for subsequent text. RLIST(1) = X component of character direction slope (run) RLIST(2) = Y component of character direction slope (rise) If both X and Y components are 0 the device ignores this call.
350	Draw circle. A circle is drawn at the given point with the given radius. The device treats this as a closed polygon and fills according to the current polygon style attributes (ZDPST) in effect. The circle is approximated by a multi-sided polygon. The user has no control over the chord tolerance of this device. RLIST(1) = X coordinate (world units) of circle center. RLIST(2) = Y coordinate (world units) of circle center. RLIST(3) = circle radius (world units). Scaling of the radius parameter is done based on the current X axis scaling factor. A radius of 0.0 causes a dot to be drawn.

The parameter is a decimal number between ±127.999 and is equivalent to the tangent of the angle Θ from the vertical as follows:

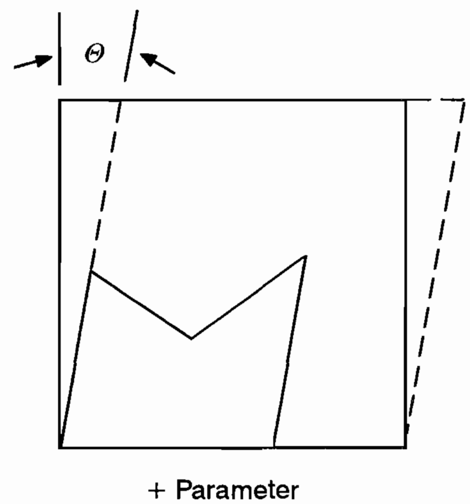

Figure 18. Opcode 150 - Character Slant

Run and rise are in decimal format between ±127.999 and specify the direction according to the relationship.

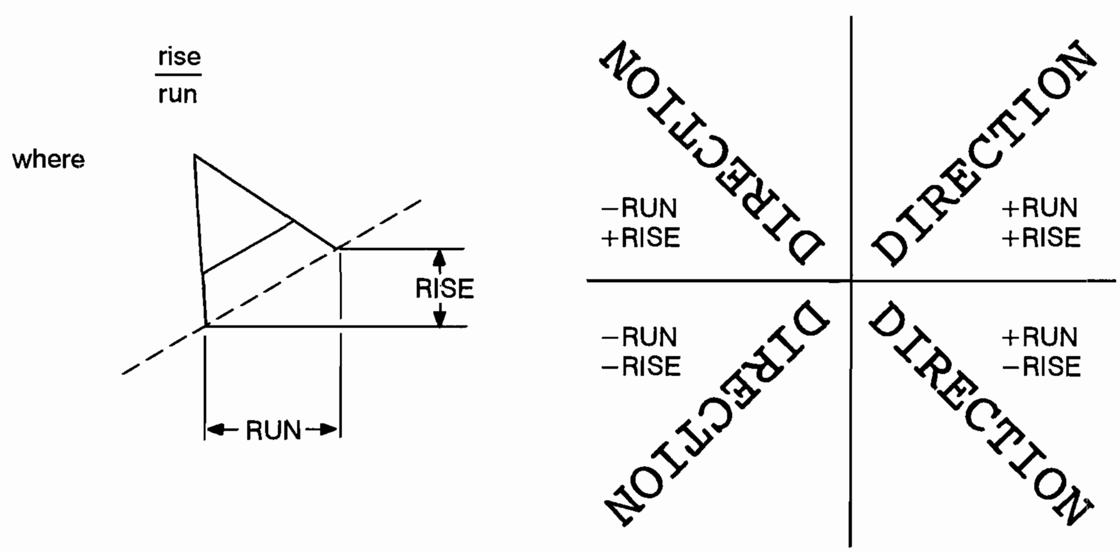

Figure 19. Opcode 250 - Character Direction

450 Set hardware clipping limits. ZDINT sets the hardware clipping limits to the physical view surface boundaries. ZASPK, ZWIND, ZVIEW, and ZDLIM do not change the hardware clipping limits. This output escape function can be used to set hardware clipping to a specific rectangle within the the current window. For example:

call ZWIND (0.,1.,0.,1.)
call ZOESC (450,0,4,ilist,rlist,ierr)

where rlist contains .2,.4,.2,.4

To reset the hardware clipping limits to the physical view surface boundaries the following sequence can be used:

call ZWIND (0.,1.,0.,1.)
call ZOESC (450,0,4,ilist,rlist,ierr)

where rlist contains 0.,1.,0.,1.

RLIST(1) = X min (world coordinate units).
RLIST(2) = X max (world coordinate units).
RLIST(3) = Y min (world coordinate units).
RLIST(4) = Y max (world coordinate units).

If the length of either or both dimensions of the clipping rectangle = 0, the device ignores the command.

550 This function draws a circular arc from the start point through a specified sweep angle, around a specified center point. The distance from the start point to the center point fixes the radius of the arc. The sweep angle is in degrees. A positive number indicates a counterclockwise arc, and a negative number indicates a clockwise arc. A zero-length radius produces a dot at the start point.

RLIST(1) = X start point (world coordinate units).
RLIST(2) = Y start point (world coordinate units).
RLIST(3) = X center point (world coordinate units).
RLIST(4) = Y center point (world coordinate units).
RLIST(5) = Sweep angle (degrees).

551 This function draws a circular arc as described in Output Escape Function 550. In addition line segments are drawn to close the polygon from the center point to the start point and from the center point to the end of the arc. The polygon is filled using current interior and perimeter attributes.

RLIST(1) = X start point (world coordinate units).
RLIST(2) = Y start point (world coordinate units).
RLIST(3) = X center point (world coordinate units).
RLIST(4) = Y center point (world coordinate units).
RLIST(5) = Sweep angle (degrees).

If the arc specified is 360 degrees, the arc is a circle and no wedge closing is possible.

552 This function draws a circular arc as described above in output escape function 550. In addition a line segment is drawn to close the polygon connecting the two end points of the arc. The polygon is filled using current interior and perimeter attributes.

RLIST(1) = X start point (world coordinate units).
RLIST(2) = Y start point (world coordinate units).
RLIST(3) = X center point (world coordinate units).
RLIST(4) = Y center point (world coordinate units).
RLIST(5) = Sweep angle (degrees).

If the arc specified is 360 degrees, the arc is a circle and no chord closing is possible.

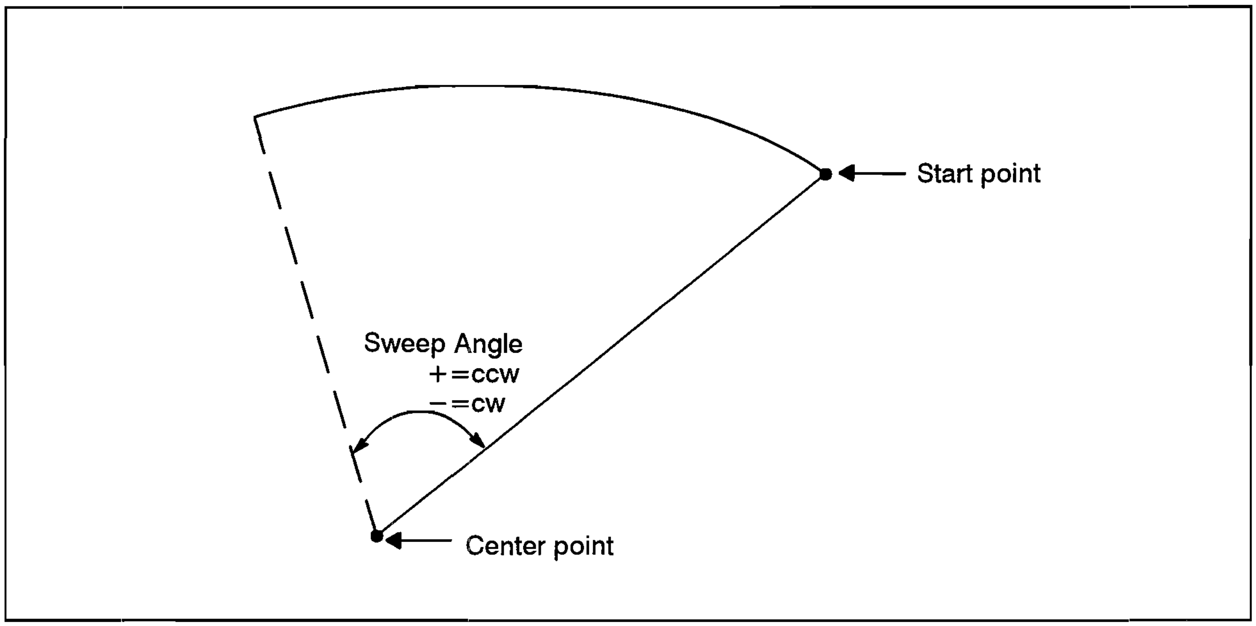

Figure 20. Opcode 550, 551, and 552 - Arc with 2 Points

650 A circular arc is drawn from the start point through the intermediate point to the end point. If the start point and end point are identical, a circle is drawn which passes through the three coordinates and has a diameter equal to the distance from the start point to the intermediate point. The resulting circle in this case will not be filled. If the three points are colinear, a straight line is drawn through the three coordinates.

RLIST(1) = X start point (world coordinate units)
RLIST(2) = Y start point (world coordinate units)
RLIST(3) = X intermediate point (world coordinate units)
RLIST(4) = Y intermediate point (world coordinate units)
RLIST(5) = X end point (world coordinate units)
RLIST(6) = Y end point (world coordinate units)

If the intermediate point equals the start or end point, the command is ignored.

651 A circular arc is drawn from the start point through the intermediate point to the end point. Line segments are drawn from the computed center point to the two end points. The resulting polygon is filled and edged according to the current interior and perimeter attributes.

RLIST(1) = X start point (world coordinate units)
RLIST(2) = Y start point (world coordinate units)
RLIST(3) = X intermediate point (world coordinate units)
RLIST(4) = Y intermediate point (world coordinate units)
RLIST(5) = X end point (world coordinate units)
RLIST(6) = Y end point (world coordinate units)

If the intermediate point equals the start or end point, the command is ignored.

652 A circular arc is drawn from the start point through the intermediate point to the end point. A line is drawn connecting the two end points and the resulting polygon is filled and edged according to the current interior and perimeter attributes.

RLIST(1) = X start point (world coordinate units)
RLIST(2) = Y start point (world coordinate units)
RLIST(3) = X intermediate point (world coordinate units)
RLIST(4) = Y intermediate point (world coordinate units)
RLIST(5) = X end point (world coordinate units)
RLIST(6) = Y end point (world coordinate units)

If the intermediate point equals the start or end point, the command is ignored.

1050 The character path is set to right, left, up, or down. This function selects the writing direction of text strings, which is the direction along which the character origin advances after each printing character or space.

ILIST(1) = 0 The character path is to the right (default).
ILIST(1) = 1 The character path is to the left.
ILIST(1) = 2 The character path is upward.
ILIST(1) = 3 The character path is downward.

List of Illustrations

Tables

HP 2686A LaserJet Device Handler

Introduction

The LaserJet, HP 2686A, does not respond to inquiries. This handler checks for the correct device driver and assumes the device at the Logical Unit (LU) is a LaserJet or LaserJet Plus printer.

Four densities are supported:

- 75 dots/inch
- 100 dots/inch
- 150 dots/inch
- 300 dots/inch

The density used by the handler is based upon the control word sent with a JDINT or ZDINT call.

All LaserJet Plus downloaded fonts are unloaded when a JDINT or ZDINT call is made in order to obtain the maximum available graphics memory. This device handler uses EMA/VMA. Please refer to the EMA/VMA Device Handlers section in the AGP or DGL Reference Manual.

This handler's architecture uses a raster image in EMA. All primitives are written into the raster image (or frame buffer) until a new-frame-action occurs. When the new-frame-action occurs, the raster image is sent to the printer. This architecture does not allow access to printer hardware capabilities, such as fonts or shading, because everything is done in software. This architecture was chosen because the printer supports alphanumeric characters and raster graphics, but not vector graphics.

Supported Logical Devices

Logical Device	Device Handler Name	Physical Device
Graphics display	D0058	HP 2686A LaserJet and LaserJet Plus

Graphics Display Device Handler (AGP)

Plotting Area

The LaserJet has 59K bytes of graphics memory available.

Table 1. LaserJet Plotting Area

Print Density	Plotting Area
75 dots/inch	266.70 mm wide by 200.49 mm high
100 dots/inch	201.93 mm wide by 152.40 mm high
150 dots/inch	134.62 mm wide by 101.60 mm high
300 dots/inch	67.31 mm wide by 50.12 mm high

The LaserJet Plus has 340K bytes of graphics memory available.

Table 2. LaserJet Plus Plotting Area

Print Density	Plotting Area
75 dots/inch	269.25 mm wide by 200.49 mm high
100 dots/inch	269.25 mm wide by 200.49 mm high
150 dots/inch	269.25 mm wide by 200.49 mm high
300 dots/inch	165.95 mm wide by 124.63 mm high

Plotting Capacity

The LaserJet has 59K bytes of graphics memory available.

Table 3. LaserJet Plotting Capacity

Print Density	Plotting Area
All densities	Width 785 points, Height 592 points

The LaserJet Plus has 340K bytes of graphics memory available.

Table 4. LaserJet Plus Plotting Capacity

Print Density	Plotting Area
75 dots/inch	Width 785 points, Height 592 points
100 dots/inch	Width 1050 points, Height 800 points
150 dots/inch	Width 1580 points, Height 1200 points
300 dots/inch	Width 1960 points, Height 1472 points

Aspect Ratio of Maximum Area

0.76

Resolution

Table 5. Resolution

Print Density	Plotting Area
75 dots/inch	2.9528 points/mm in x and y directions
100 dots/inch	3.9370 points/mm in x and y directions
150 dots/inch	5.9055 points/mm in x and y directions
300 dots/inch	11.8110 points/mm in x and y directions

Default Limits

Same as the plotting area.

The physical origin is the upper left corner of the paper.

The view surface is always justified in the lower left corner of the current logical display surface.

Aspect Ratio of Default Limits

0.76

Initialization

(JDINT). Upon initialization, the following operations are performed:

Device name:	Set to 2686A.
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Starting position:	Set to (0.0,0.0).
Logical display surface:	Set to default limits. See the section Logical Display Surface.
View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the maximum (physical) device limits.
Page advance:	If bit 7 in the control word is set, the paper is not advanced. If bit 7 is not set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized when JDINT is called.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.
Density:	Bits 10 and 11 are used to specify density.
Printer RAM configuration:	Bit 12 set selects LaserJet Plus mode (340K available graphics RAM). Bit 12 clear (not set) selects LaserJet mode (59K available graphics RAM).
Printer font configuration:	All LaserJet Plus downloaded fonts are unloaded (to obtain the maximum available graphics RAM) with a printer reset.
Limits (JDLIM):	The default logical display limits are specified relative to the upper left corner of the paper.

Logical Display Surface

The logical display surface is set to the default value with bit 8 clear (not set). If bit 8 is set, the logical display surface is rotated.

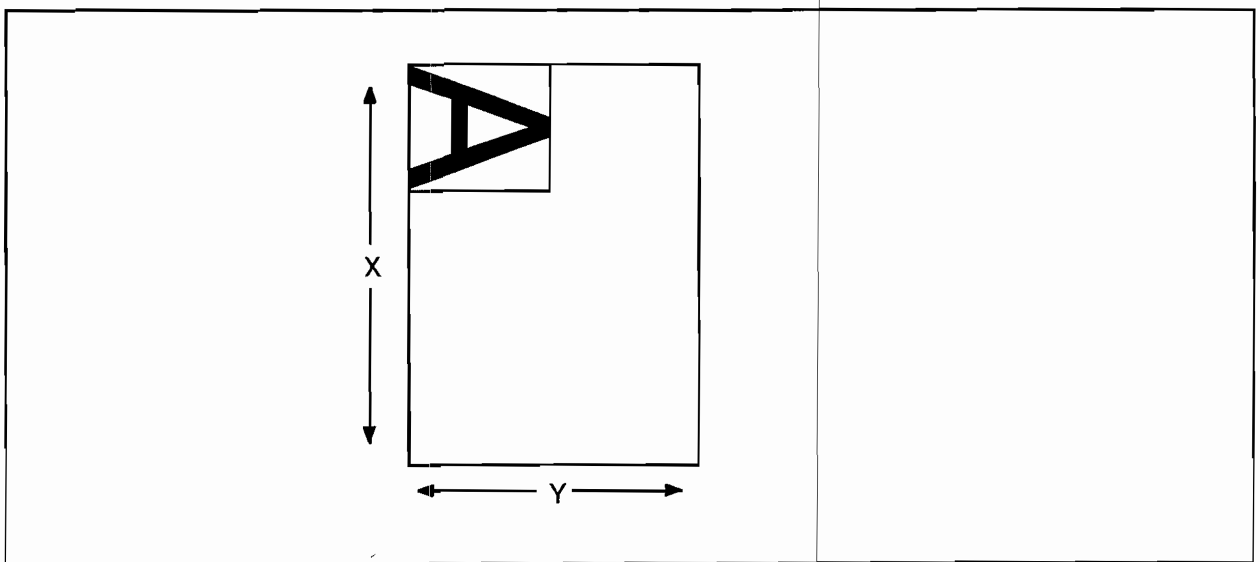

Figure 1. Default Orientation on the Physical Page - Bit 8 Clear

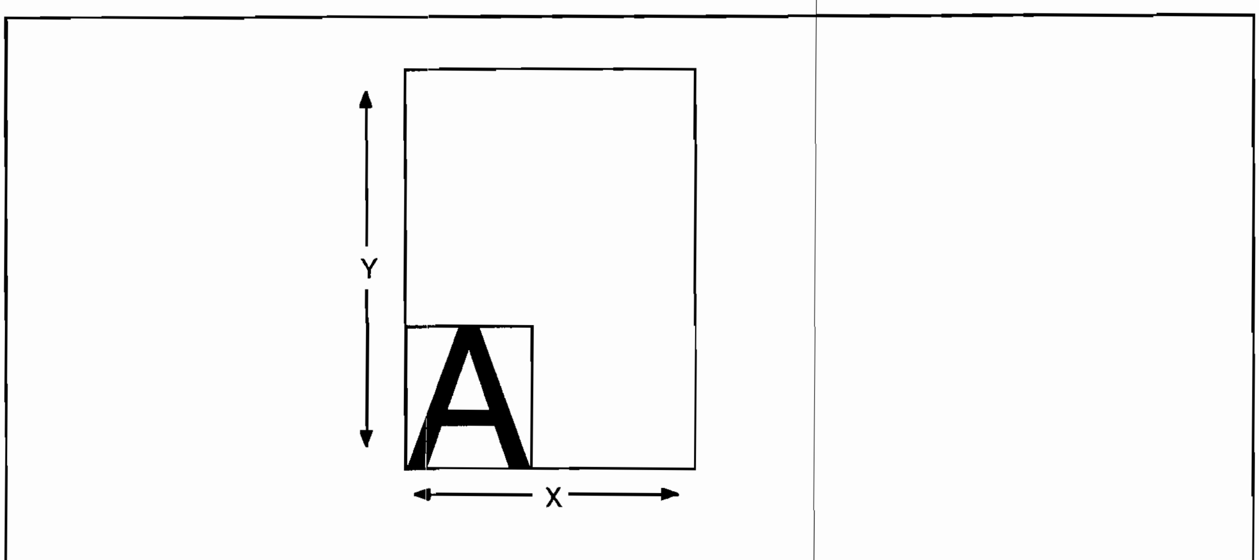

Figure 2. Rotated Orientation on the Physical Page - Bit 8 Set

Density

Bits 10 and 11 are used to specify density as follows:

Table 6. Density

Bit 10	Bit 11	Resulting Density
0	0	75 dots/inch
1	0	100 dots/inch
0	1	150 dots/inch
1	1	300 dots/inch

Limits

(JDLIM). The default logical display limits are specified relative to the upper left corner of the paper when bit 8 is clear (not set). When bit 8 is set, the logical display limits are specified in a rotated format. The origin in the Y-direction (non-rotated) or the origin in the X-direction (rotated) is column 1 of the printer unless modified by the Output Escape Function JOESC with Opcode 2050.

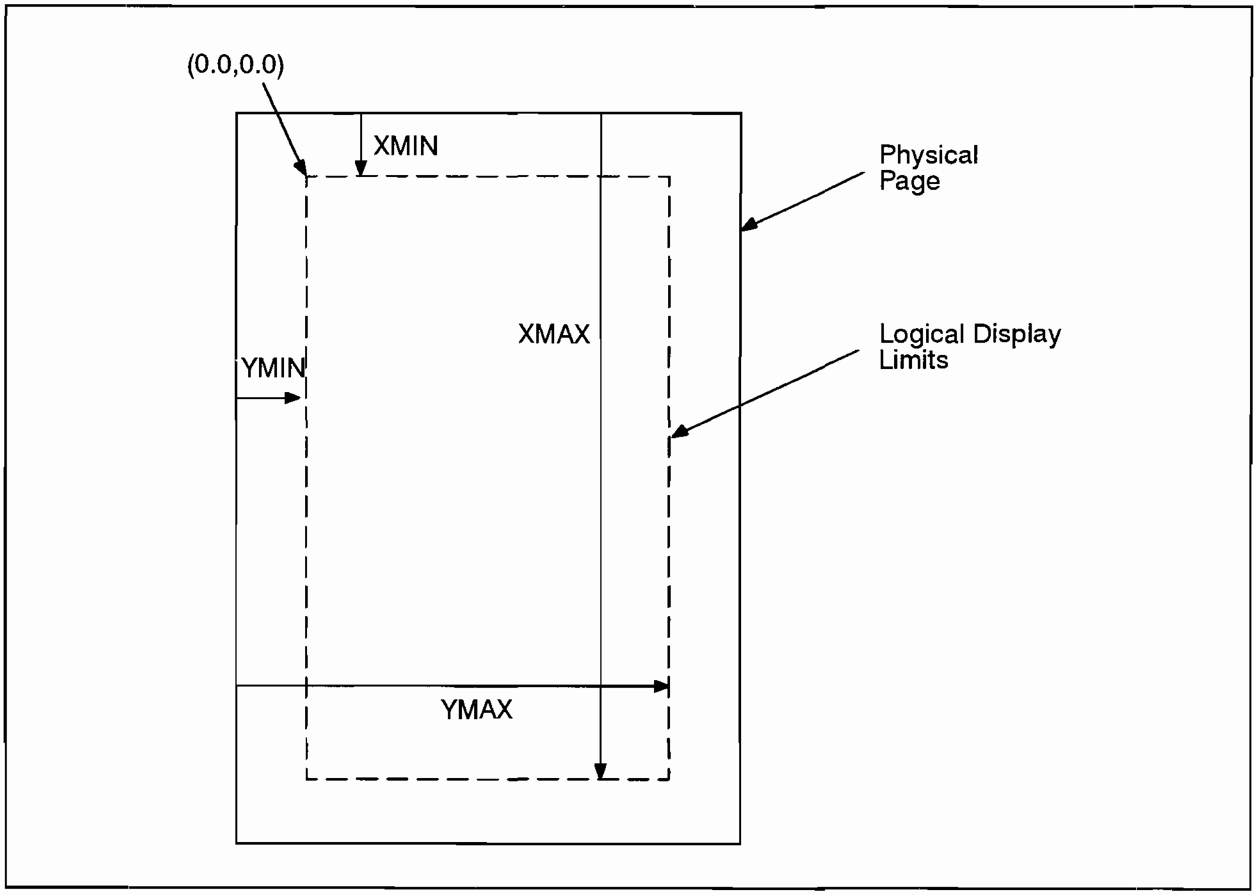

Figure 3. Paper Positioning and Limitations (non-rotated)

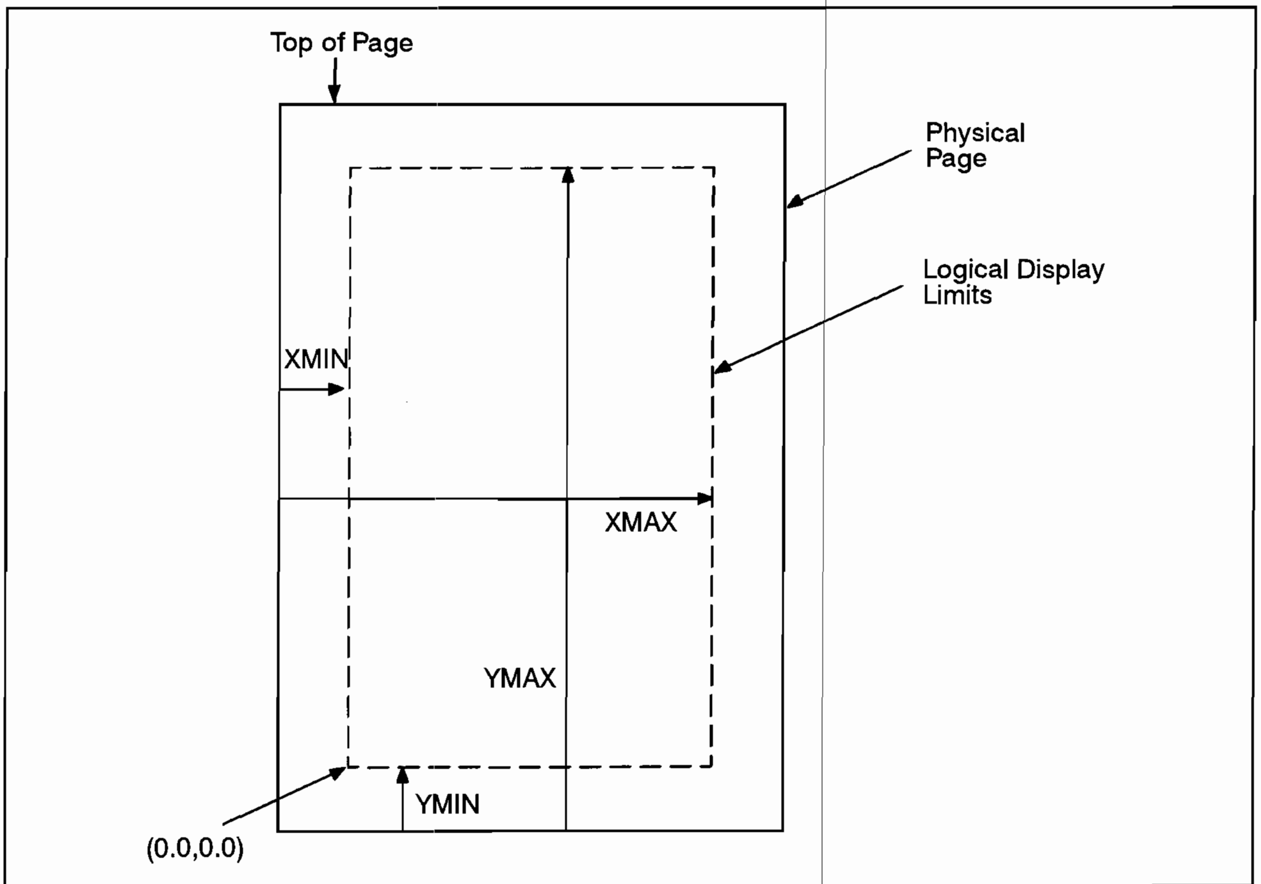

Figure 4. Paper Positioning and Limitations (rotated)

Supported Primitive Attributes

Color

(JCOLR). The D0058 display handler provides a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The color table is initialized when JDINT is called and cannot be redefined or inquired using JDCOL or JICOL. The color selected corresponds to the color defined in the color table.

Table 7. Color Table

Color Table Entry	Color
0	Color set to white (background color)
1	Color set to black

Redefining and Inquiring Color

(JDCOL/JICOL). The colors in the color table cannot be redefined or inquired.

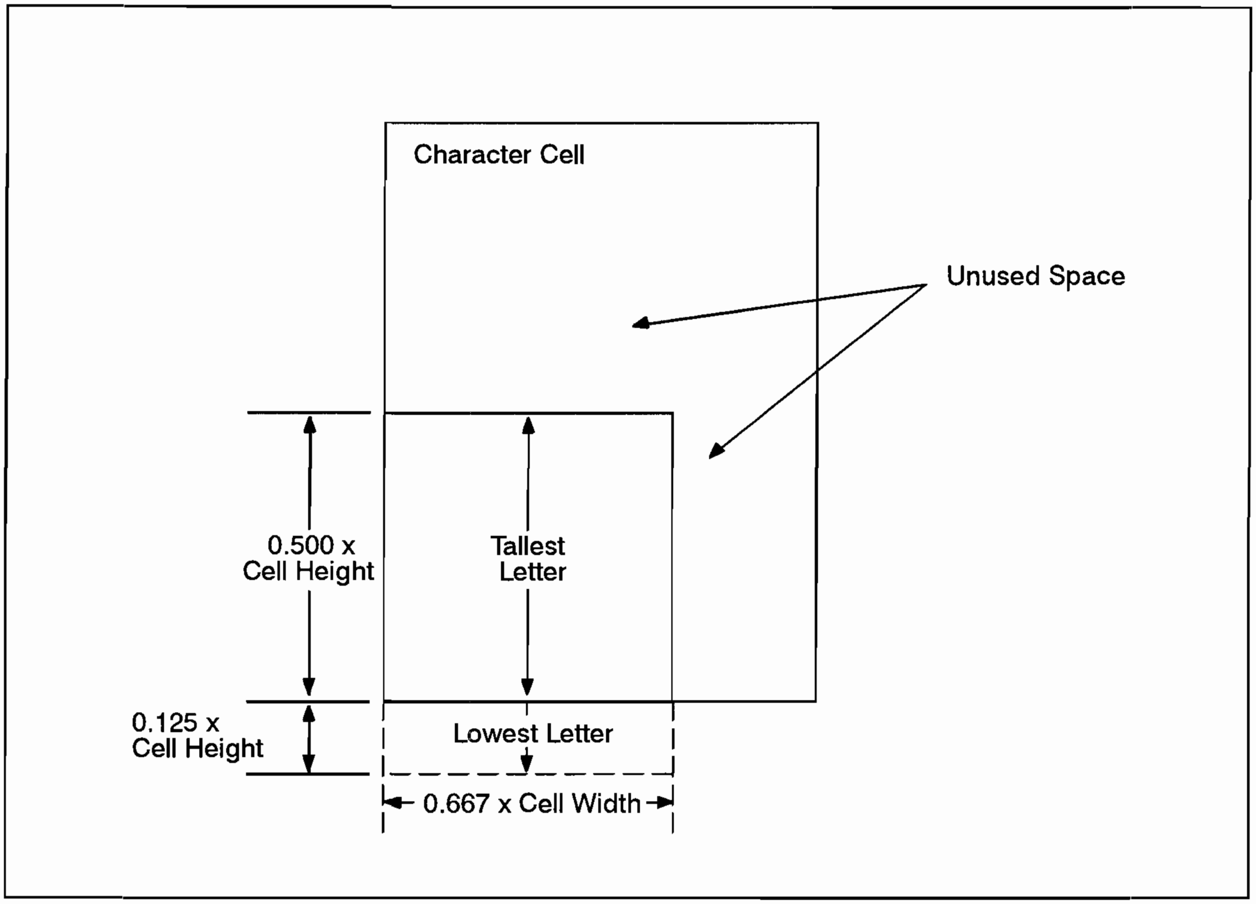

Figure 6. Placement of Character in Character Cell

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). Nineteen standard markers are supported. The marker size is always 1.69 mm by 2.26 mm.

Text

(JTEXL/JTEXM). The only character set that is available is the standard 96-character ASCII set.

If a medium- or low-quality text string is not clipped by AGP and extends beyond the view surface limits of the graphics display, any portion of a character that extends outside of the view surface is clipped.

```
a b c d e f g h i j k l m
n o p q r s t u v w x y z
A B C D E F G H I J K L M
N O P Q R S T U V W X Y Z
! " # $ % & ' ( ) * + , -
. / 0 1 2 3 4 5 6 7 8 9 :
; < = > ? @ [ \ ] ^ _ ` {
| } ~
```

Figure 7. Supported Vector Character Set

New-Frame-Action

(JNEWF/JPURG/JSVIX/JSHI/JVSAL/JDLIM/JCLR). The action taken when a new-frame-action is given depends on two bits in the JDINT control word: bit 9 and the simulated raster erase bit. Bit 9 determines if a new-frame-action is necessary for a given circumstance. If bit 9 is not set, a new-frame-action is always a necessary new-frame-action. Note that when bit 9 is not set, blank pages may be generated. If bit 9 of the control word is set, a new-frame-action is necessary only if the picture contains some output. A necessary new-frame-action causes the picture to be output and a page advance performed. The following sections describe the effect of the simulated raster erase bit on new-frame-actions.

Simulated Raster Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates, causes a page eject and all visible segments are redrawn (if the new-frame-action is necessary). When the new-frame-action is given with the display not enabled, it does not alter the printer.

Simulated Raster Erase Set

The implementation of the printer handler has the ability to erase images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call and to remove graphics elements without doing a page eject. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is like redrawing the image in white (that is, the background color); therefore black lines crossing the image to be purged may also have parts of them erased, leaving holes.

An explicit JNEWF call always causes a page eject and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates (if the new-frame-action is necessary). This provides a means of generating a clean surface (one without holes). The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations because the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside of a batch-of-updates always results in a page eject and visible segments being redrawn when the JUPDT call is given (if the new-frame-action is necessary).

Input Escape Functions

(JIESC). Inquiry escape functions are not supported by AGP.

Output Escape Functions

The following output escape functions are supported by AGP.

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.
2050	Move the printing origin in decipts (1 decipt = 11720 inch). ILIST(1) = decipt offset in X (width dimension of the physical page). ILIST(2) = decipt offset in Y (height dimension of the physical page). This opcode is intended for use in high density modes where the available graphics RAM memory does not allow a full page plot (for example, LaserJet printer using density greater then 75 dots/inch or LaserJet Plus printer using 300 dots/inch density). This opcode resets the graphics physical page boundaries, for example, the top and left margins. Care should be used in the choice of ILIST values to ensure the plot fits within the maximum available physical page boundaries (266.70 mm by 200.49 mm). There are 28.346 decipts/mm. Results are unpredictable when this opcode is used with ILIST parameter values that result in plotting beyond the maximum available physical page area.

Locator Echoes on the Graphics Display

(JWLOC). Locator echoing is not supported.

Pick Echoes on the Graphics Display

(JPICK). Pick echoing is not supported.

Termination

(JWOFF). The printer is not set to initial values when JWOFF is called. Values remain as they were last set. For example, printing begins at the first column.

Graphics Display Device Handler (DGL)

Plotting Area

The LaserJet has 59K bytes of graphics memory available.

Table 9. LaserJet Plotting Area

Print Density	Plotting Area
75 dots/inch	266.70 mm wide by 200.49 mm high
100 dots/inch	201.93 mm wide by 152.40 mm high
150 dots/inch	134.62 mm wide by 101.60 mm high
300 dots/inch	67.31 mm wide by 50.12 mm high

The LaserJet Plus has 340K bytes of graphics memory available.

Table 10. LaserJet Plus Plotting Area

Print Density	Plotting Area
75 dots/inch	269.25 mm wide by 200.49 mm high
100 dots/inch	269.25 mm wide by 200.49 mm high
150 dots/inch	269.25 mm wide by 200.49 mm high
300 dots/inch	165.95 mm wide by 124.63 mm high

Plotting Capacity

The LaserJet has 59K bytes of graphics memory available.

Table 11. LaserJet Plotting Capacity

Print Density	Plotting Area
All densities	Width 785 points, Height 592 points

The LaserJet Plus has 340K bytes of graphics memory available.

Table 12. LaserJet Plus Plotting Capacity

Print Density	Plotting Area
75 dots/inch	Width 785 points, Height 592 points
100 dots/inch	Width 1050 points, Height 800 points
150 dots/inch	Width 1580 points, Height 1200 points
300 dots/inch	Width 1960 points, Height 1472 points

Aspect Ratio of Maximum Area

0.76

Resolution

Table 13. Resolution

Print Density	Plotting Area
75 dots/inch	2.9528 points/mm in x and y directions
100 dots/inch	3.9370 points/mm in x and y directions
150 dots/inch	5.9055 points/mm in x and y directions
300 dots/inch	11.8110 points/mm in x and y directions

Default Limits

Same as the plotting area.

The physical origin is the upper left corner of the paper.

The view surface is always justified in the lower left corner of the current logical display surface.

Aspect Ratio of Default Limits

0.76

Initialization

(ZDINT). Upon initialization, the following operations are performed:

Device name:	Set to 2686A.
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Starting position:	Set to (0.0,0.0).
Logical display surface:	Set to default limits. See below.
View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the view surface boundaries.
Page advance:	If bit 7 in the control word is set, the paper is not advanced. If bit 7 is not set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized when ZDINT is called.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.
Density:	Bits 10 and 11 are used to specify density. See the section on Density below.

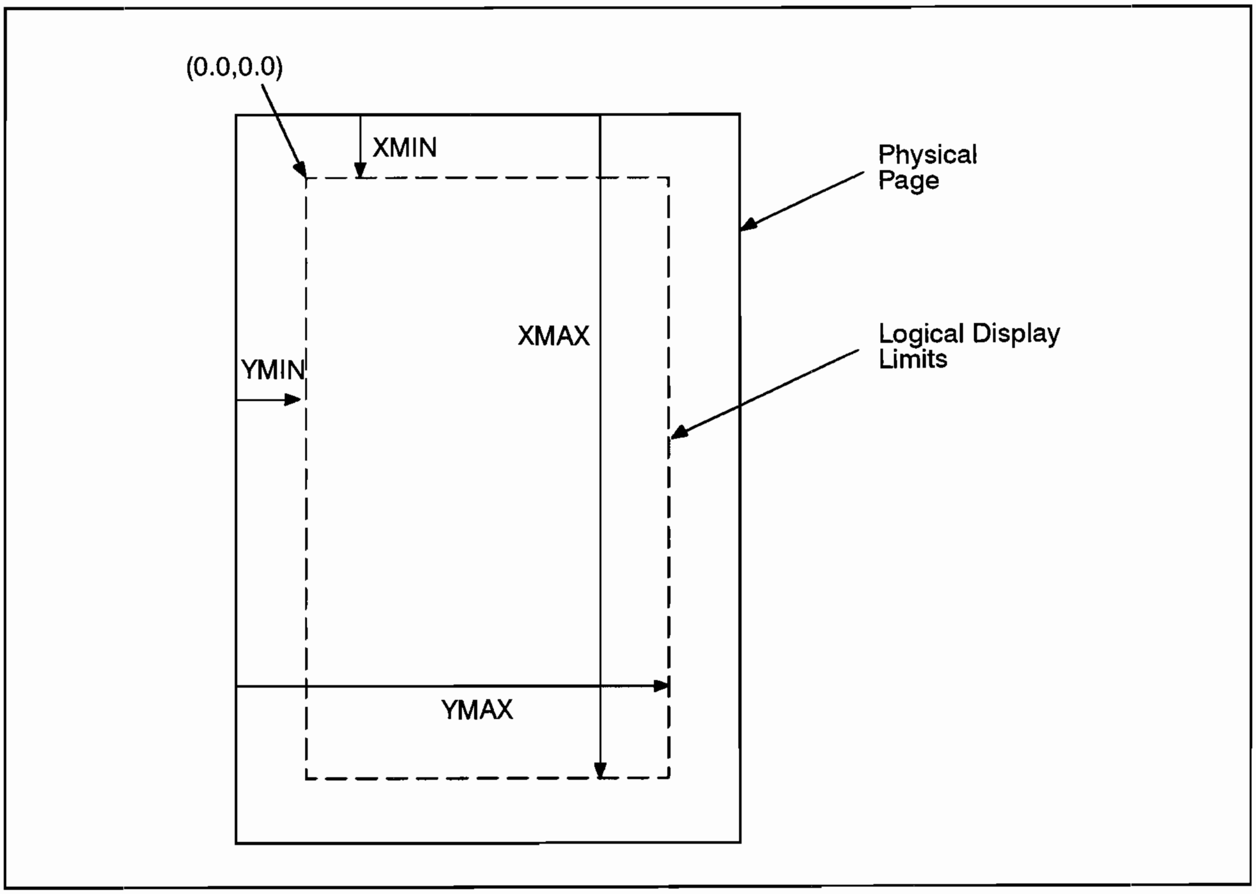

Figure 10. Paper Positioning and Limitations (non-rotated)

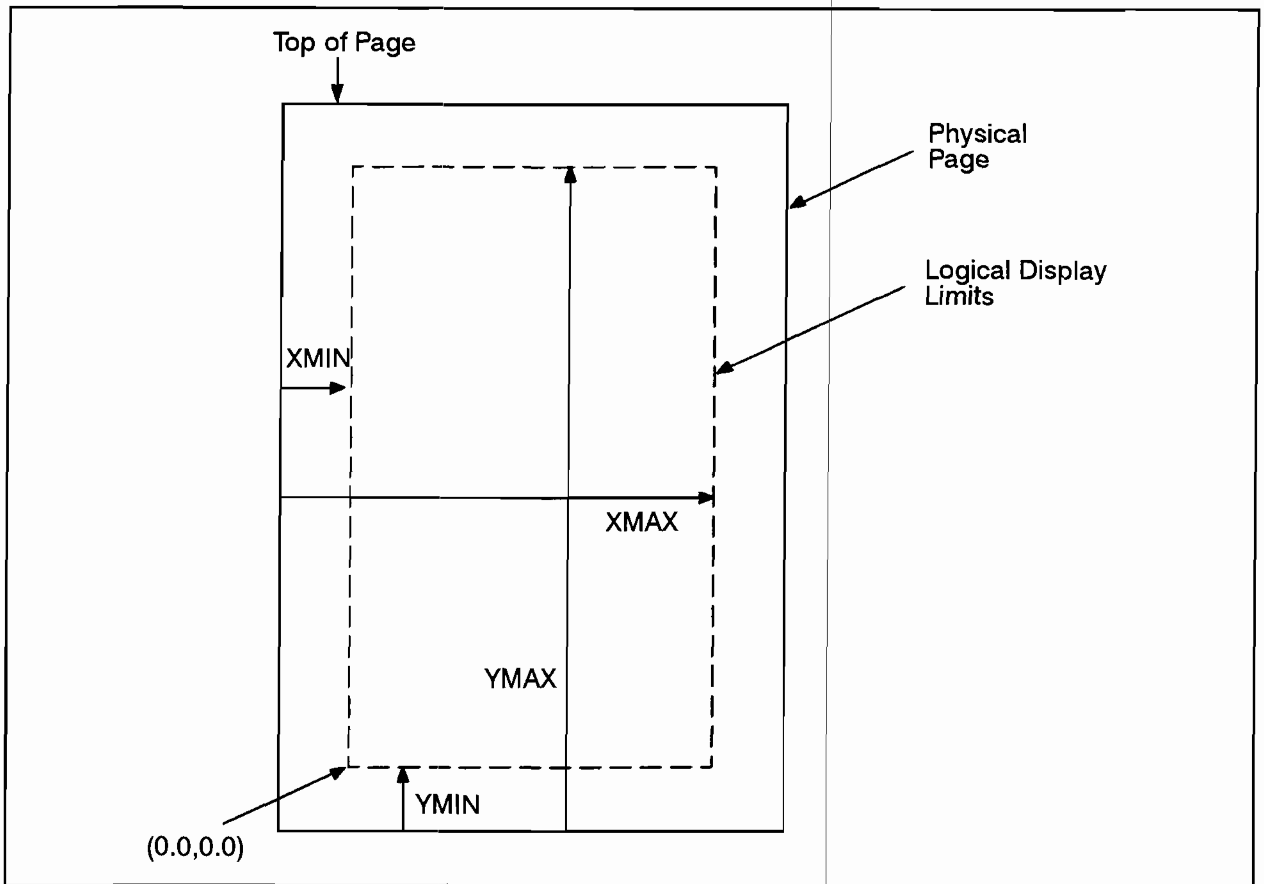

Figure 11. Paper Positioning and Limitation (rotated)

Supported Primitive Attributes

Color

(ZCOLR). The D0058 display handler provides a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The color table is initialized when ZDINT is called and cannot be redefined or inquired using ZDCOL or ZICOL. The color selected corresponds to the color defined in the color table.

Table 15. Color Table

Color Table Entry	Color
0	Color set to white (background color)
1	Color set to black

Redefining and Inquiring Color

(ZDCOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Input Escape Functions

(ZIESC). Inquiry escape functions are not supported by DGL.

Output Escape Functions

(ZOESC). The following output escape functions are supported.

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.
2050	Move the printing origin in decipts (1 decipt = 1/720 inch). ILIST(1) = decipt offset in X (width dimension of the physical page). ILIST(2) = decipt offset in Y (height dimension of the physical page). This opcode is intended for use in high density modes where the available graphics RAM memory does not allow a full page plot (for example, LaserJet printer using density greater then 75 dots/inch or LaserJet Plus printer using 300 dots/inch density). This opcode resets the graphics physical page boundaries, for example, the top and left margins. Care should be used in the choice of ILIST values to ensure the plot fits within the maximum available physical page boundaries (266.70 mm by 200.49 mm). There are 28.346 decipts/mm. Results are unpredictable when this opcode is used with ILIST parameter values that result in plotting beyond the maximum available physical page area.

Locator Echoes on the Graphics Display

(ZWLOC). Locator echoing is not supported.

Termination

(ZDEND). The device name is set to "0058 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 2932A/2933A/2934A Line Printers

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HP 2932A/2933A/2934A Line Printers

General Information

The user should be familiar with the operation of the HP 2932A/2933A/2934A Line Printers. If necessary, refer to the following manual for the appropriate information:

HP 2930 Series Printers Owner's Manual, part number 02932-90001.

Supported Logical Devices

The following logical devices are supported:

Logical Device	Device Handler Name	Physical Device
Graphics display	D0053	HP 2932A/2933S/2934A with stroke text and markers.
	D0054	HP 2932A/2933S/2934A with raster text and markers.

Special Considerations

These device handlers use EMA/VMA. Please refer to the EMA/VMA Device Handlers section in your AGP or DGL Reference Manual.

This handler's architecture uses a raster image in EMA. All primitives are written into the raster image (or frame buffer) until a new-frame-action occurs. When the new-frame-action occurs, the raster image is sent to the printer. This architecture does not allow access to printer hardware capabilities, such as fonts or shading, because everything is done in software. This architecture was chosen because the printer supports alphanumeric characters and raster graphics, but not vector graphics.

Graphics Display Device Handler (AGP)

Description

The dimensions of the graphics display device are as follows:

Plotting area:	Width: 1082.6 mm	Height: 289.0 mm
Plotting capacity:	Width: 3836 points (4 pages)	Height: 1024 points
Aspect ratio of maximum area:	0.3103	
Resolution:	3.5433 points/mm in the X direction 3.5433 points/mm in the Y direction	
Default limits:	274.0 by 215.0 mm	
Aspect ratio of default limits:	0.78	

The physical origin is the upper left corner of the paper.

The view surface is always justified in the lower left corner of the current logical display surface.

The size of the logical display surface determines how many sheets of paper are required for output. The amount of paper is rounded up to the next page boundary, so that a frame always starts at the beginning of a page.

Care should be used when loading paper. Make sure to align the top of the form with the first printing scan line.

Initialization

(JDINT). Upon initialization, the following operations are performed:

Device name:	Set to "2932A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Start position:	Set to (0.0,0.0).
Logical display surface:	Set to the default value. The orientation of the logical display surface is shown in Figure 1 if bit 8 is not set. If bit 8 is set, the logical display surface is rotated as shown in Figure 2.

View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to view surface boundaries.
Page advance:	If bit 7 in the control word is set, the paper is not advanced. If bit 7 is not set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized when JDINT is called.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.

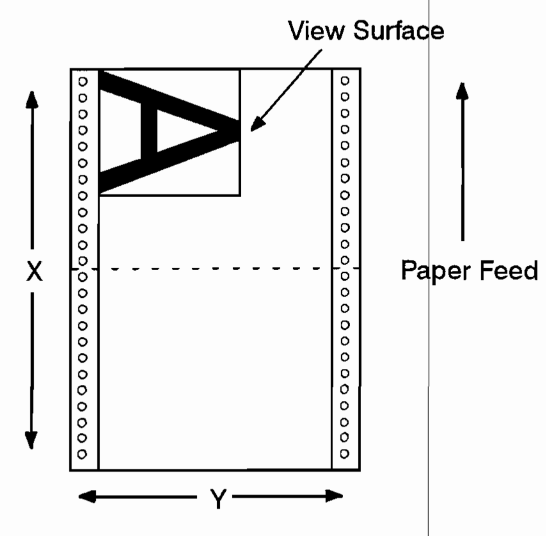

Figure 1. Default Orientation on the Physical Page

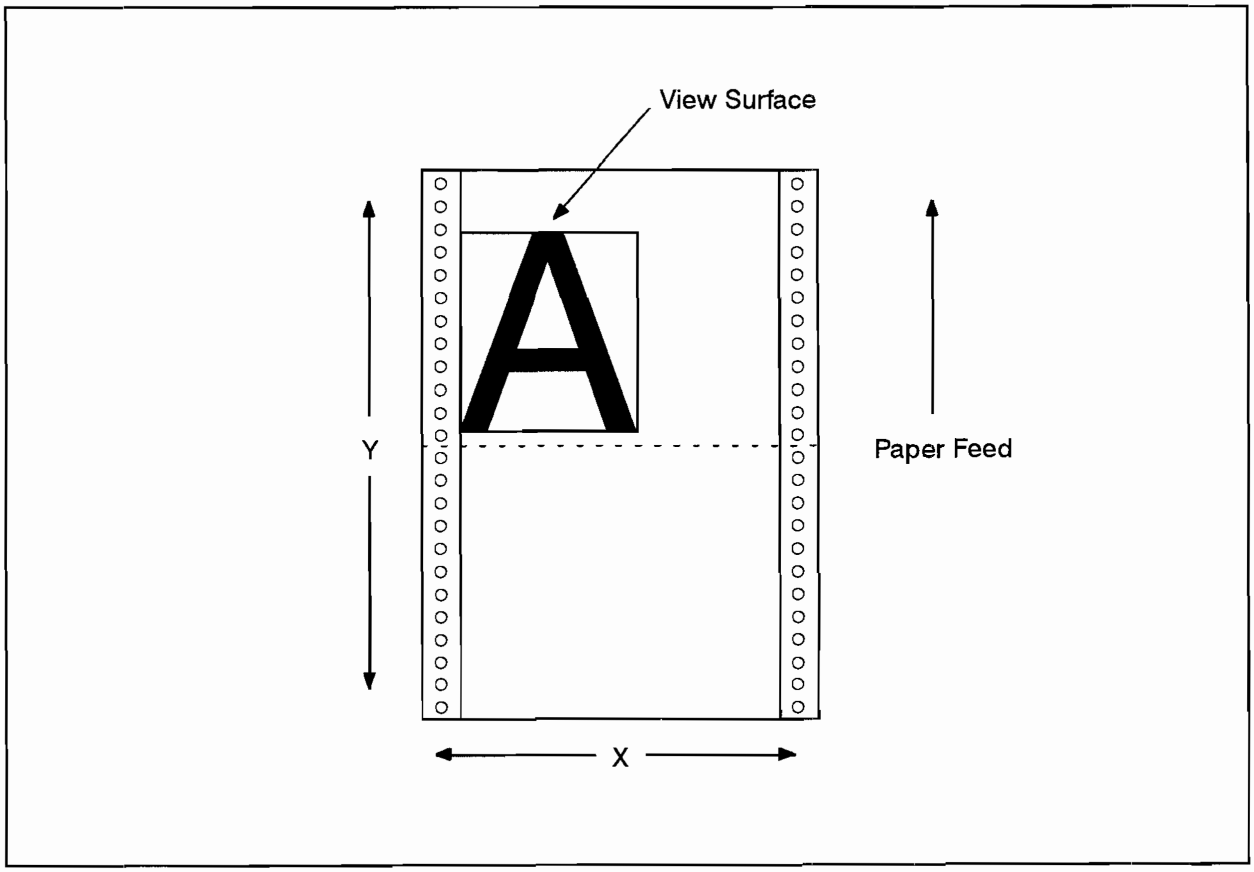

Figure 2. Rotated Orientation on the Physical Page

Limits

(JDLIM). The logical display limits are specified relative to the upper left corner of the paper when bit 8 is not set. (See Figure 3.) When bit 8 is set, the logical display limits are specified as shown in Figure 4. The top of page, as shown in the figures, is the top of the next page if bit 7 in the JDINT call is not set. This causes a page eject at initialization. Otherwise, it is the location of the paper at the time of initialization. The origin in the Y-direction (non-rotated) or the origin in the X-direction (rotated) is always column 1 of the printer.

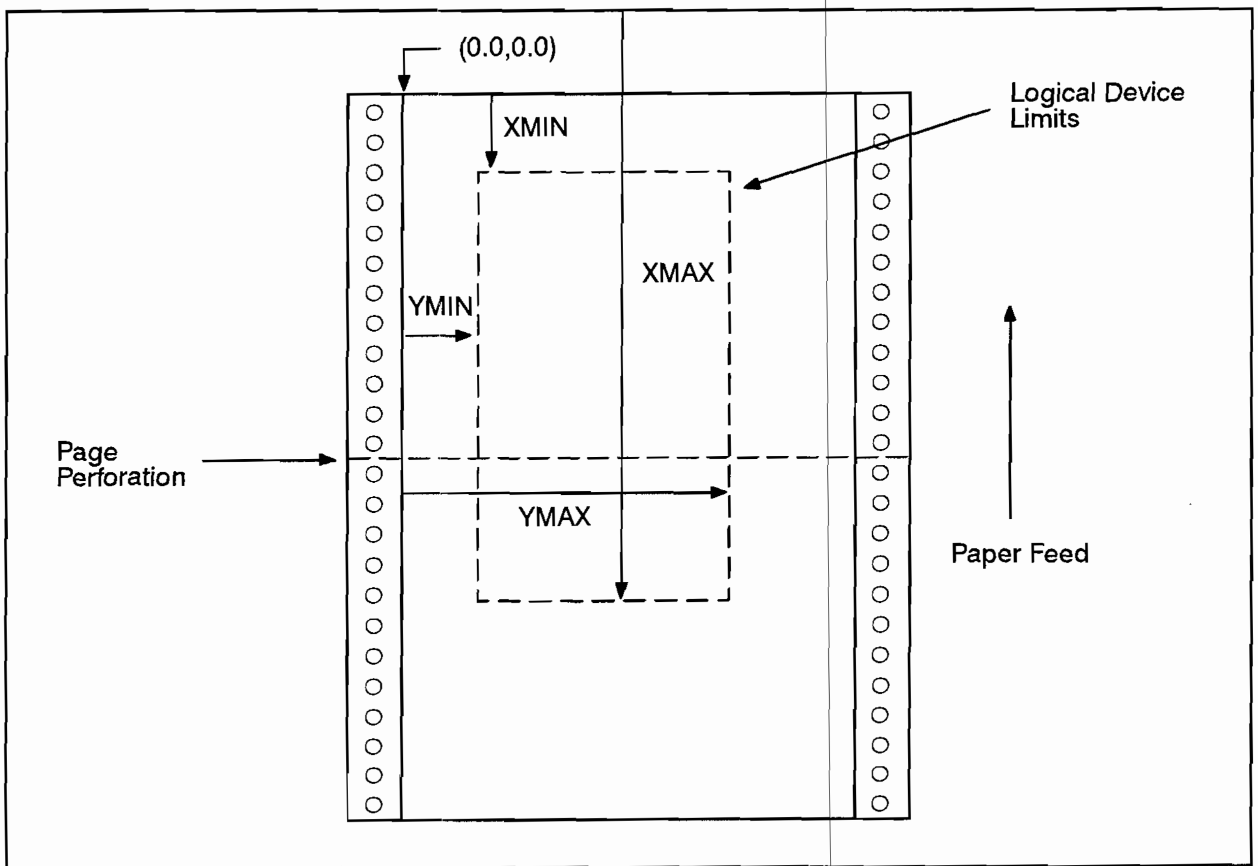

Figure 3. Paper Positioning and Limitations (non-rotated)

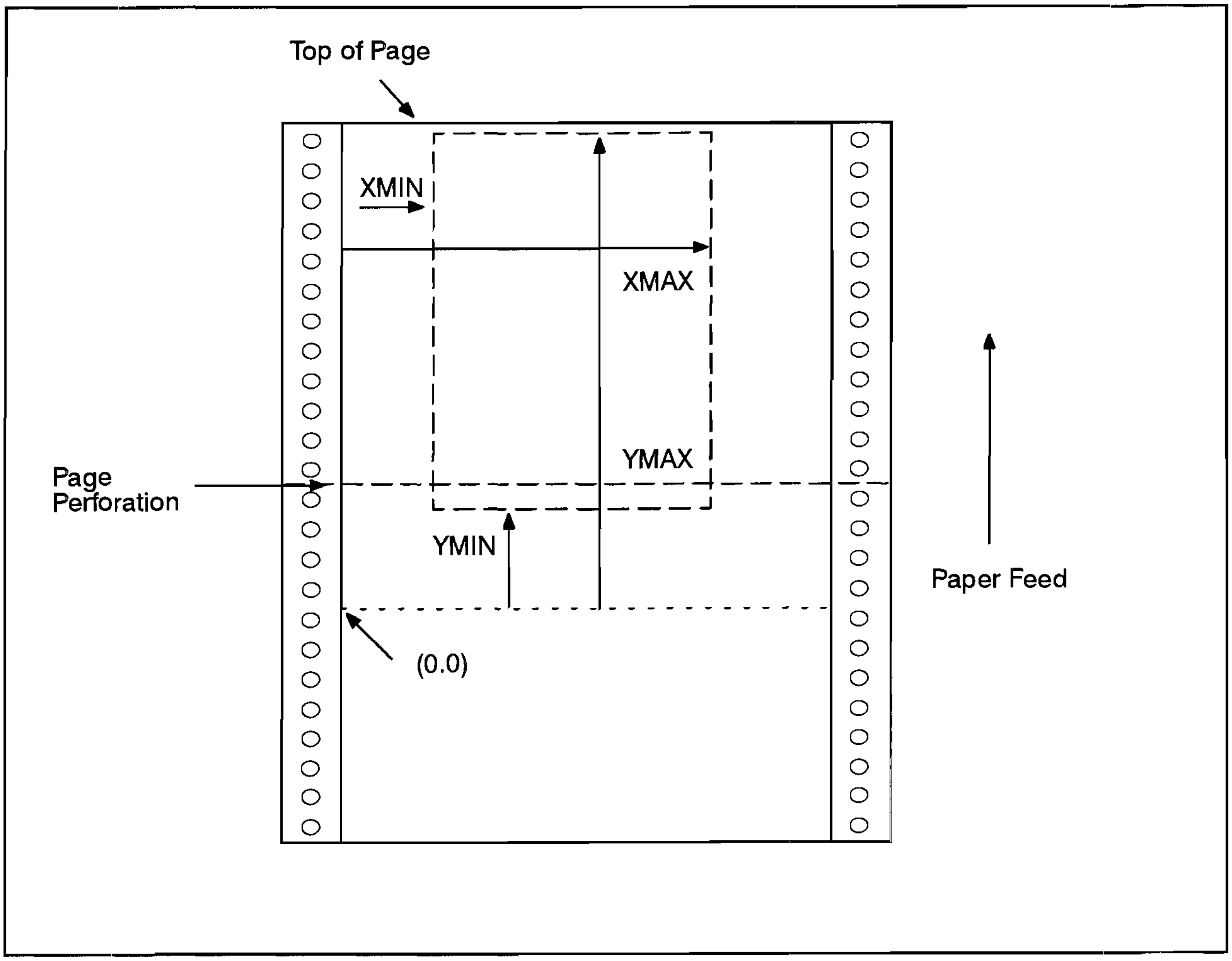

Figure 4. Paper Positioning and Limitations (rotated)

Supported Primitive Attributes

Color

(JCOLR). The D0053 and D0054 display handlers provide a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The default value of the color table is shown in Table 1.

Table 1. Default Color Table

Color Table Entry	Color
0	Color set to white (background)
1	Color set to black

The color table is initialized when JDINT is called and cannot be redefined or inquired using JDCOL or JICOL. The color selected corresponds to the color defined in the color table.

COLOR = 0 Color table entry 0 is selected.
1 Color table entry 1 is selected.

Redefining and Inquiring Color

(JDCOL/JICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(JPICL). There are two colors supported by AGP on the printers: black and white. Both colors can be displayed at one time. The supported value of the color attributes are:

COLOR = 0 Color set to white (background color).
1 Color set to black.

Polygon Style

(JDPST). Using JDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(JPILS). Refer to JLSTL for information regarding line style.

Highlighting

(JSHI/JGHI). Highlighting is not supported.

Line Style

(JLSTL). Thirteen predefined line styles are supported. Line styles 1 through 7 may be classified as being *continuous*. Line styles 8 through 13 are the same patterns as styles 2 through 7 except *start adjusted*. See Figure 5 for the line styles available. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, for a complete description of *continuous* and *start adjusted* line styles.

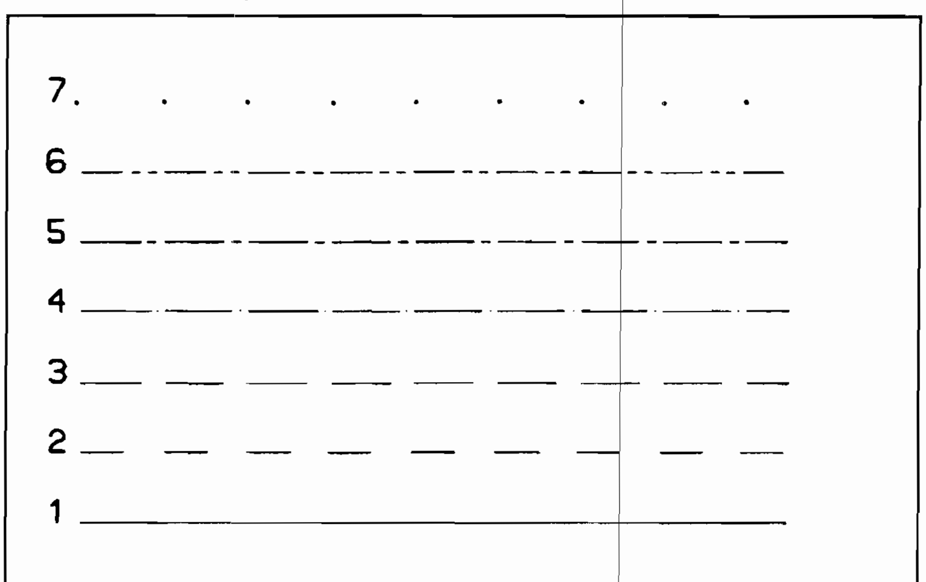

Figure 5. Supported Line Styles

```
abcdefghijklm
nopqrstuvwxyz
ABCDEFGHIJKLM
NOPQRSTUVWXYZ
! "#$%&' () *+, -
. /0123456789:
; <=>?@ [\] ^_` {
| } ~
```

Figure 7. Supported Vector Character Set

```
abcdefghijklm
nopqrstuvwxyz
ABCDEFGHIJKLM
NOPQRSTUVWXYZ
!"#$%&'()*+,-
./0123456789:
;<=>?@[\]^_`{
|}~
```

Figure 8. Supported Raster Character Set

New-Frame-Action

(JNEWF/JPURG/JSVIS/JSHI/JVSAL/JDLIM/JCLR). The action taken when a new-frame-action is given is dependent on two bits in the JDINT control word: bit 9 and the simulated raster erase bit. Bit 9 determines if a new-frame-action is necessary for a given circumstance. If bit 9 is not set, a new-frame-action is always a necessary new-frame-action. Note that when bit 9 is not set, blank pages may be generated. If bit 9 of the control word is set, a new-frame-action is necessary only if the picture contains some output. A necessary new-frame-action causes the picture to be output and a page advance performed. The following sections describe the effect of the simulated raster erase bit on new-frame-actions.

Simulated Raster Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates, causes a page eject and all visible segments are redrawn (if the new-frame-action is necessary). When the new-frame-action is given with the display not enabled, it does not alter the printer.

Simulated Raster Erase Set

The implementation of the printer handler has the ability to erase images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call and to remove graphics elements without doing a page eject. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is like redrawing the image in white (that is, the background color); therefore, black lines crossing the image to be purged may also have parts of them erased, leaving holes.

An explicit JNEWF call always causes a page eject and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates (if the new-frame-action is necessary). This provides a means of generating a clean surface (one without holes). The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations because the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside a batch-of-updates always results in a page eject and visible segments being redrawn when the JUPDT call is given (if the new-frame-action is necessary).

Input Escape Functions

(JIESC). Inquiry escape functions are not supported by AGP.

Output Escape Functions

(JOESC). The following output escape functions are supported:

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.

Locator Echoes on the Graphics Display

(JWLOC). Locator echoing is not supported.

Pick Echoes on the Graphics Display

(JPICK). Pick echoing is not supported.

Termination

(JWOFF). The printer is not set to initial values when JWOFF is called. Values remain as they were last set. For example, printing begins at column 1.

Graphics Display Device Handler (DGL)

Description

The dimensions of the graphics display device are as follows:

Plotting area:	Width: 1082.6 mm	Height: 289.0 mm
Plotting capacity:	Width: 3836 points (4 pages)	Height: 1024 points
Aspect ratio of maximum area:	0.3001	
Resolution:	3.5433 points/mm in the X direction 3.5433 points/mm in the Y direction	
Default limits:	279.0 by 215.0 mm	
Aspect ratio of default limits:	0.78	

The physical origin is the upper left corner of the paper.

The view surface is always justified in the lower left corner of the current logical display surface.

The size of the logical display surface determines how many sheets of paper are required for output. The amount of paper is rounded up to the next page boundary, so that a frame always starts at the beginning of a page.

Care should be used when loading paper to align the top of the form with the first printing scan line.

Initialization

(ZDINT). Upon initialization, the following operations are performed:

Device name:	Set to "2932A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Starting position:	Set to (0.0,0.0)
Logical display limits:	Set to the default value. The orientation of the logical display surface is shown in Figure 9, if bit 8 is not set. If bit 8 is set, the logical display surface is rotated as shown in Figure 10.
View surface:	Justified to the lower left corner of the logical display surface.
Frame buffer:	Cleared.
Hardware clipping:	Set to the view surface boundaries.
Page advance:	If bit 7 in the control word is set, the paper is not advanced. If bit 7 is not set and the paper has not yet reached a page boundary, the paper is advanced to the next page boundary.
Color table:	Initialized when ZDINT is called.
New-frame-action:	If bit 9 of the control word is set, a new-frame-action outputs the picture and does a page advance only when necessary (that is, when there is output to display). If bit 9 is not set, the picture is always output and a page advance is performed when a new-frame-action occurs. Note that when bit 9 is not set, blank pages may result.

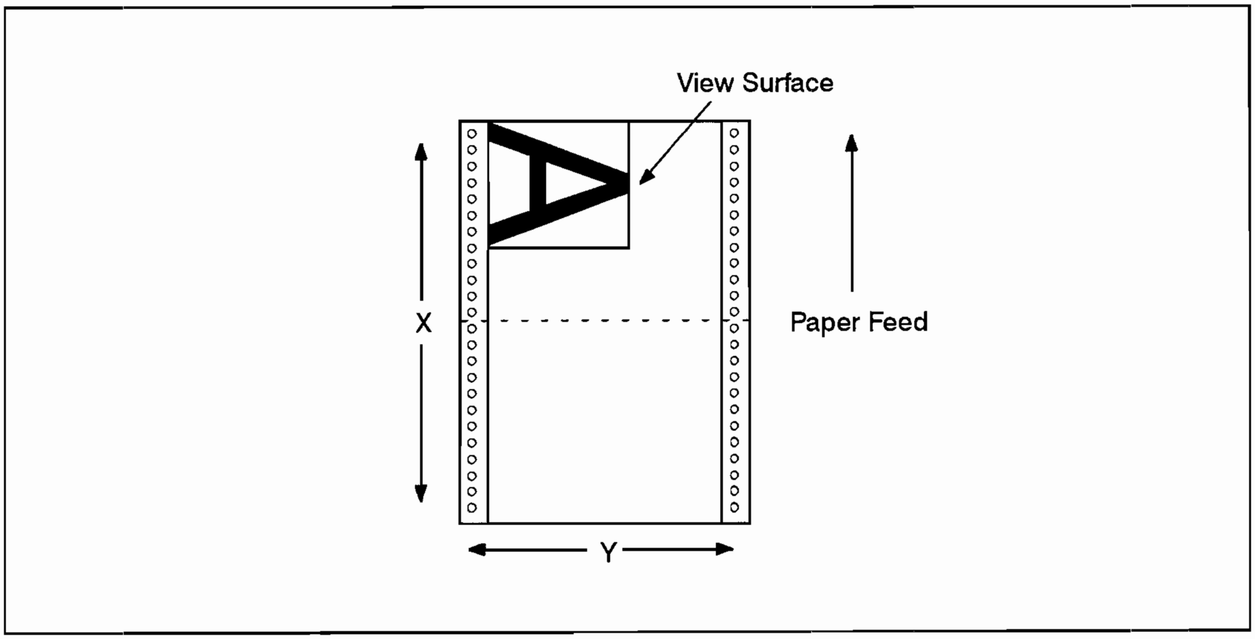

Figure 9. Default Orientation on the Physical Page

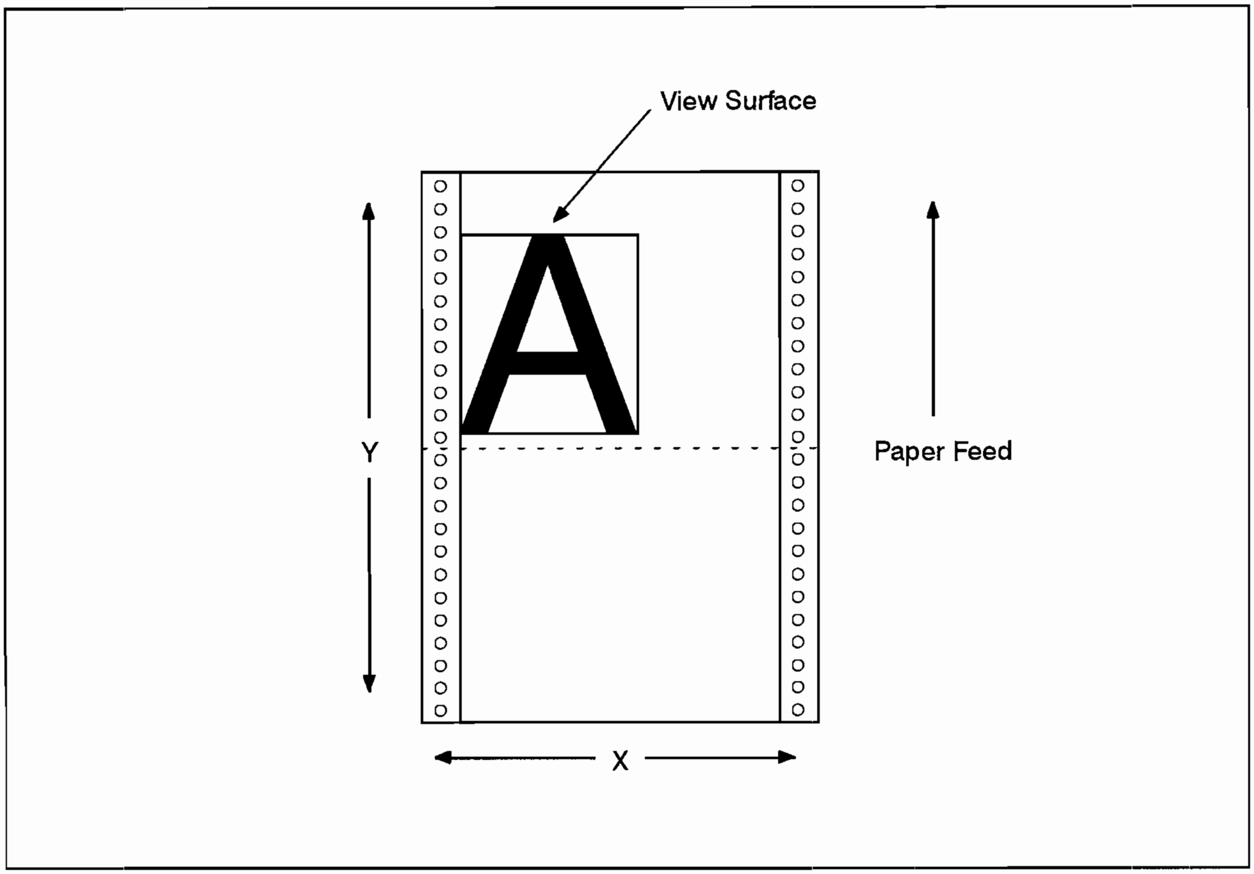

Figure 10. Rotated Orientation on the Physical Page

Limits

(ZDLIM). The logical display limits are specified relative to the upper left corner of the paper when bit 8 is not set. (See Figure 11.) When bit 8 is set, the logical display limits are specified as shown in Figure 12. The top of page, as shown in the figures, is the top of the next page if bit 7 in the ZDINT call is not set. This causes a page eject at initialization. Otherwise, it is the location of the paper at the time of initialization. The origin in the Y-direction (non-rotated) or the origin in the X-direction (rotated) is always column 1 of the paper.

If multiple ZDLIM calls are made when generating a picture, the maximum area requested during that picture is used when the picture is output. This applies even if output does not occur between each ZDLIM call.

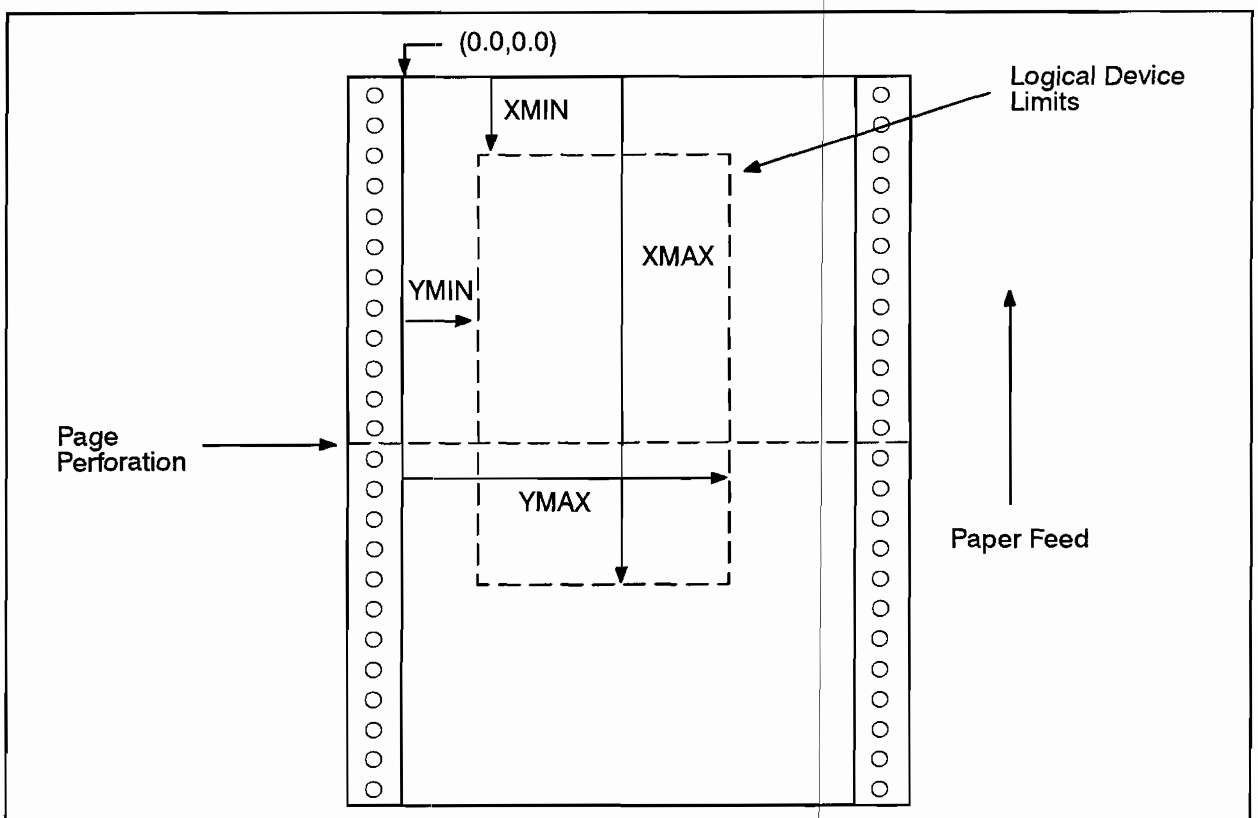

Figure 11. Paper Positioning and Limitations (non-rotated)

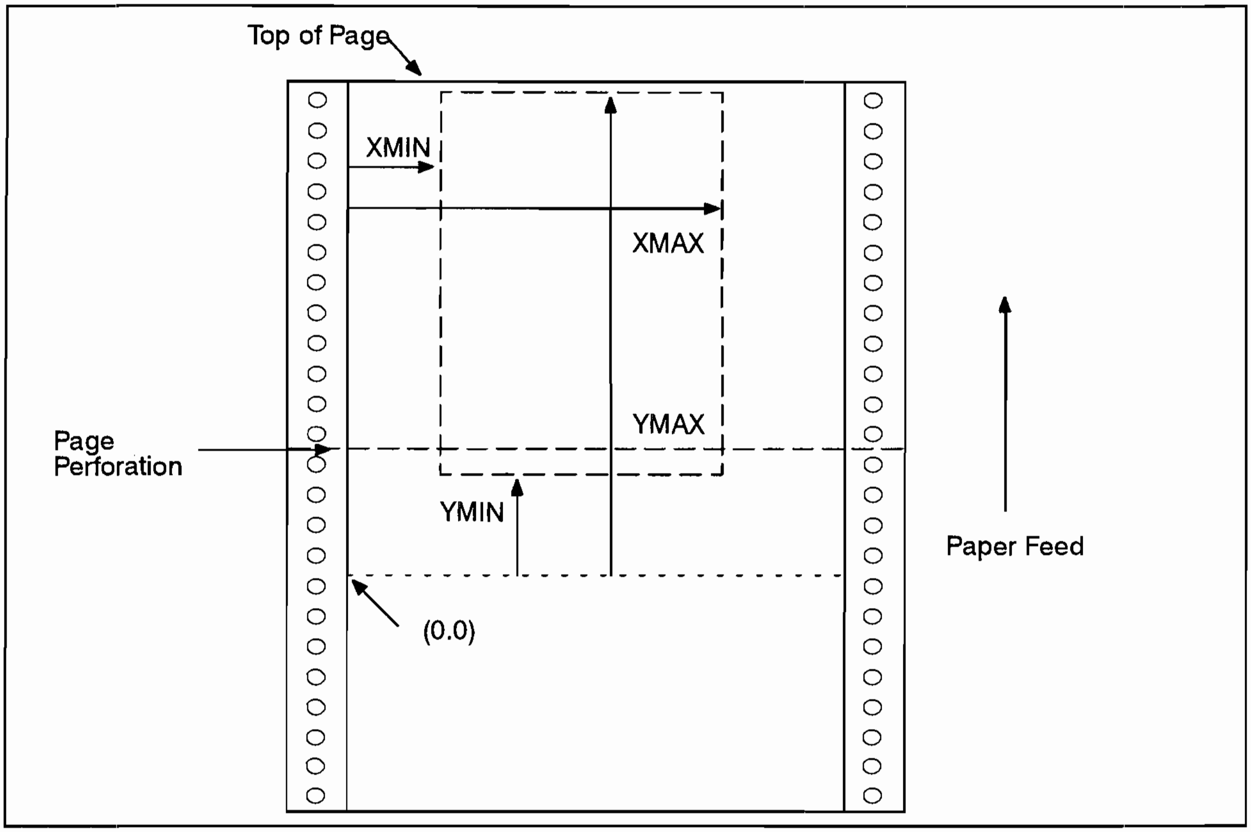

Figure 12. Paper Positioning and Limitations (rotated)

Supported Primitive Attributes

Color

(ZCOLR). The D0053 and D0054 display handlers provide a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The default value of the color table is shown in Table 2.

Table 2. Default Color Table

Color Table Entry	Color
0	Color set to white (background)
1	Color set to black

The color table is initialized when ZDINT is called and cannot be redefined or inquired using ZDCOL or ZICOL.

The color selected corresponds to the color defined in the color table.

COLOR = 0 Color table entry 0 is selected.
1 Color table entry 1 is selected.

Redefining and Inquiring Color

(ZDCOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(ZPICL). There are two colors supported by DGL: black and white. Both colors can be displayed at one time. The supported value of the color attributes are:

COLOR = 0 Color set to white (background color).
1 Color set to black.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). Refer to ZLSTL for information regarding line style.

Highlighting

(ZHIGH). Highlighting is not supported.

Line Style

(ZLSTL). Thirteen predefined line styles are supported. Line styles 1 through 7 may be classified as being *continuous*. Line styles 8 through 13 are the same patterns as styles 2 through 7 except *start adjusted*. See Figure 13 for the line styles available. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete description of *continuous* and *start adjusted* line styles.

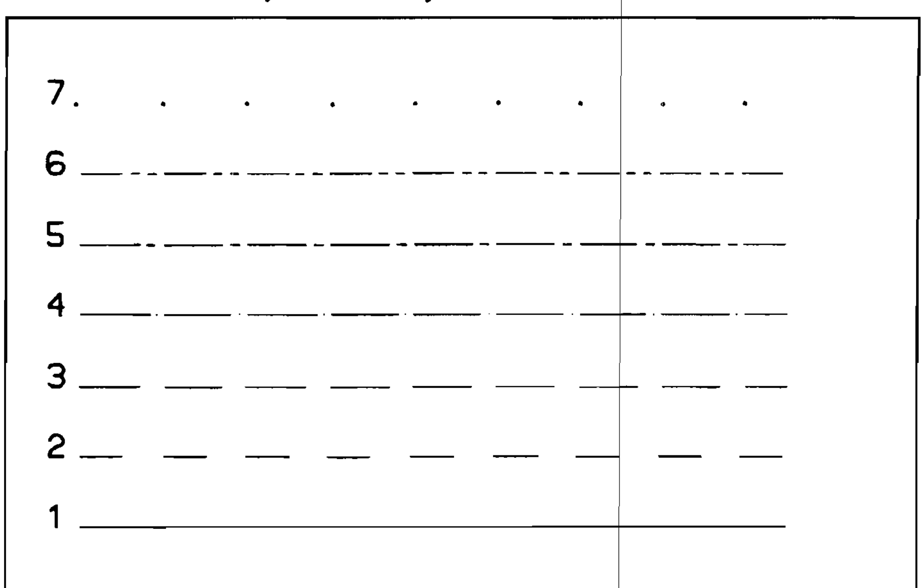

Figure 13. Supported Line Styles

Line Width

(ZLWID). Four line widths are supported.

LINEWIDTH	= 1	Primitives drawn with a line width one pixel wide.
	= 2	Primitives drawn with a line width three pixels wide.
	= 3	Primitives drawn with a line width five pixels wide.
	= 4	Primitives drawn with a line width seven pixels wide.

Character Sizes

(ZCSIZ). When using D0053, text is generated in software using a vector character set. A vector character is defined as a series of moves and draws and is affected by the viewing transformation, line style, and line width. D0053 supports all character cell sizes that have a width and height not less than 0.85 mm and not greater than 250 mm. The default vector character size is 7.5 mm by 10.75 mm.

When using D0054, text is generated using a raster character set. A raster character is defined as a two-dimensional pattern of pixels. D0054 supports all character cell sizes that have a width not less than 2.82 mm and not greater than 248.36 mm and a height of not less than 5.08 mm and not greater than 248.92 mm. The actual size is always an integer multiple of the smallest size, and is chosen to be the largest size which is equal to or smaller than the requested size. There are 4312 raster character sizes. The default raster character size is 5.65 mm by 10.16 mm.

The character is placed within the character cell as shown in Figure 14.

Output Primitives

Clipping

The device handler supports vector and text clipping that is set to the view surface limits. Parts of graphics items that exceed the view surface limits are clipped.

Polygons

(ZPGDD). The line printer does not provide hardware support of polygons. A polygon specified by ZPGDD is always represented as described in the *DGL Programmer's Reference Manual.*

Markers

(ZMARK). The 19 standard markers are supported. Marker size is always 1.69 mm by 2.26 mm.

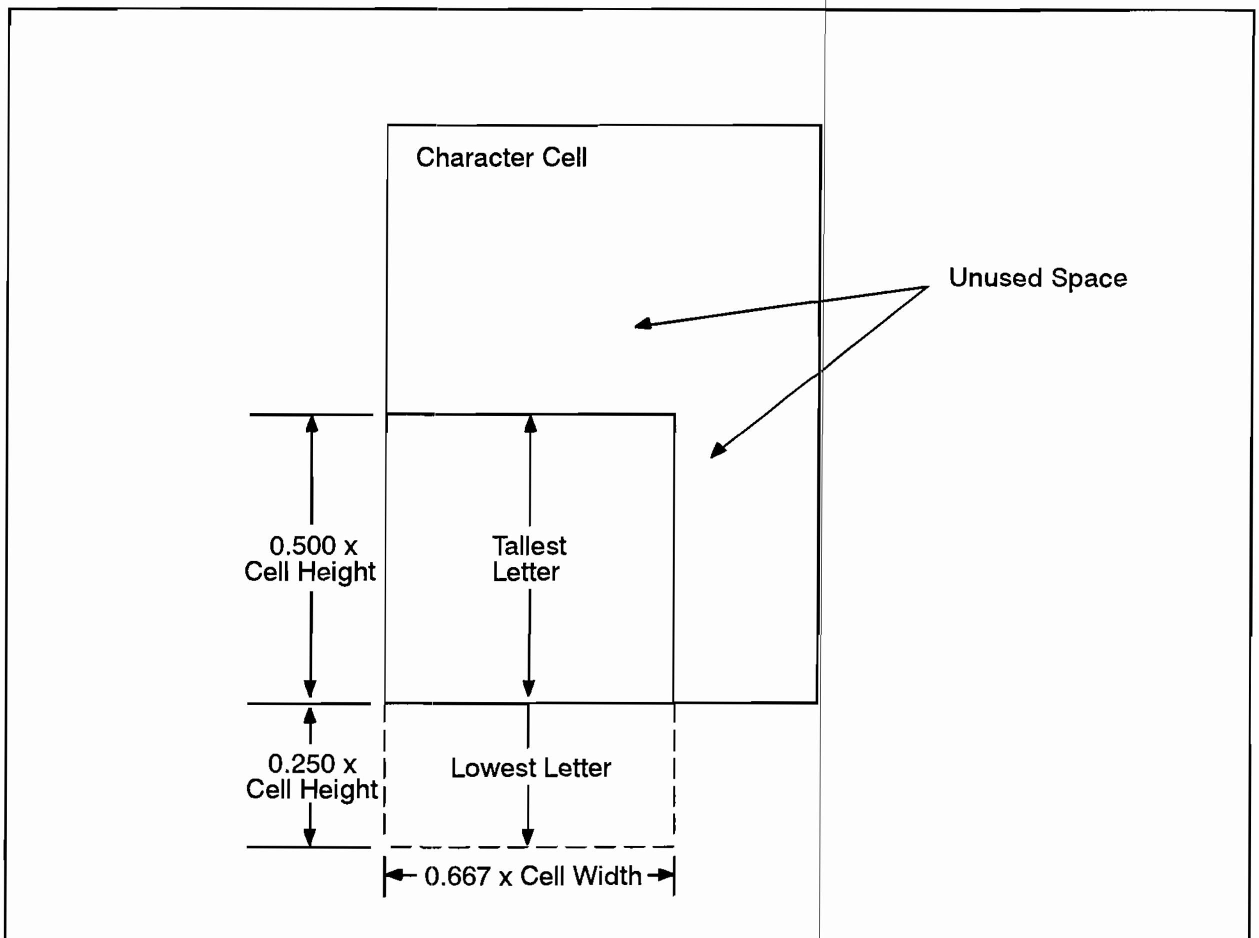

Figure 14. Placement of Character in Character Cell

Text

(ZTEXT). The only character set that is available is the standard 96-character ASCII set. Figure 15 shows the vector character set obtained when using D0053. The raster text, obtained when using D0054, is shown in Figure 16.

After a ZTEXT call, the starting position is set so that consecutive calls to ZTEXT will have the effect of concatenation. In addition to the viewable characters, text strings can also include the following control characters:

Control	Octal Code	Function
Backspace	10B	Move the starting position one character-cell width back.
Line Feed	12B	Move the starting position one character-cell height down.
Vertical Tab	13B	Move the starting position one character-cell height up.
Carriage Return	14B	Move the starting position back to the beginning of the text string.

Any other control characters are ignored.

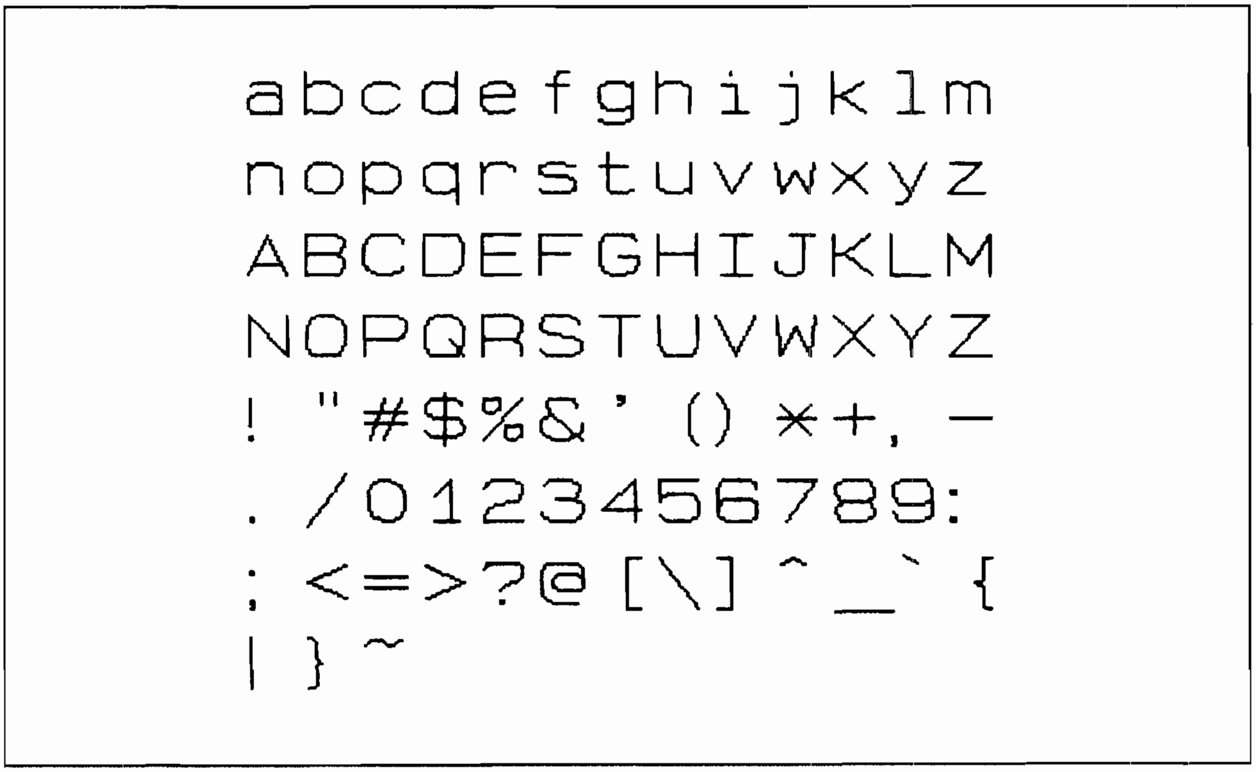

Figure 15. Supported Vector Character Set

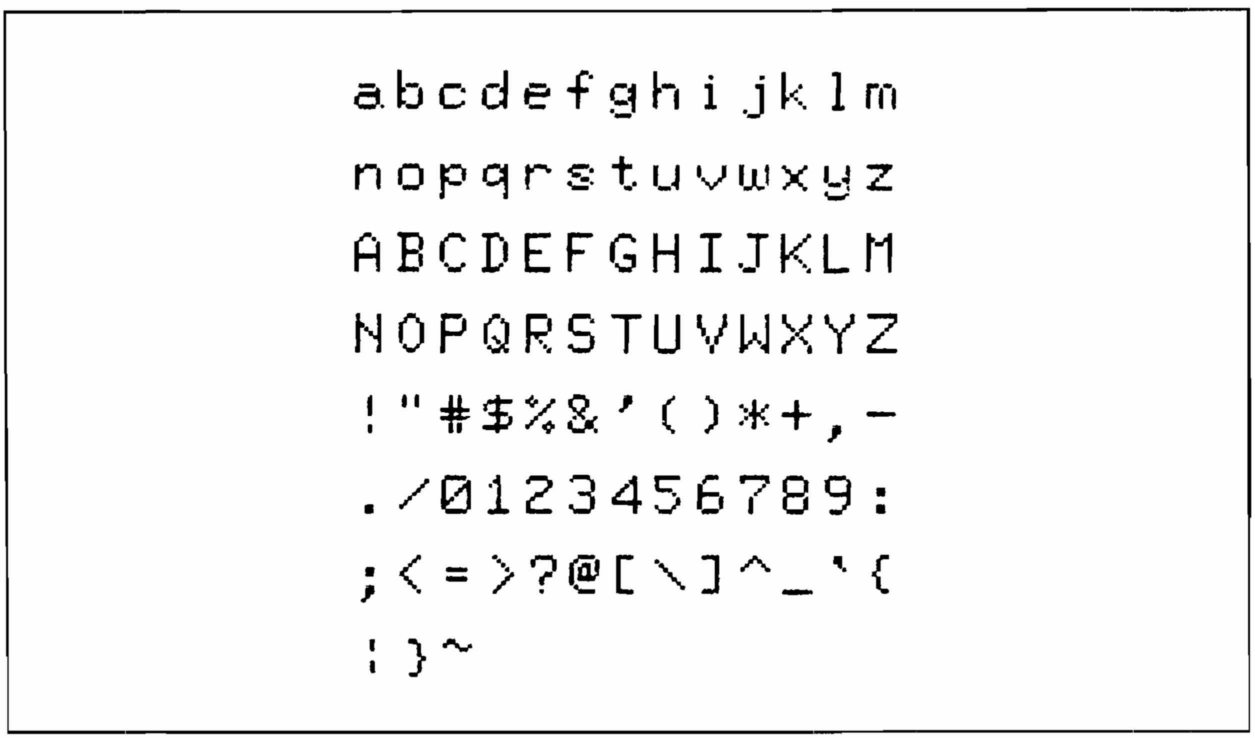

Figure 16. Supported Raster Character Set

New-Frame-Action

(ZNEWF). The action taken when a new-frame-action is given is dependent on bit 9 of the ZDINT control word. If bit 9 of the control word is set, a new-frame-action is performed only if the picture contains some output. When bit 9 is not set, blank pages may be generated. A necessary new-frame-action causes the picture to be made current, the picture is output and a page advance is performed.

Input Escape Functions

(ZIESC). Inquiry escape functions are not supported.

Output Escape Functions

(ZOESC). The following output escape functions are supported:

Opcode	Function
50	Perform a new-frame-action without clearing the frame buffer afterwards.

Locator Echoes on the Graphics Display

(ZWLOC). Locator echoing is not supported.

Termination

(ZDEND). The device name is set to "0053 " or "0054 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Generic Terminals

General Information

This document pertains to all alphanumeric terminals supported on a given HP system and not otherwise supported by AGP/DGL.

Supported Logical Devices

The following logical devices are supported:

Logical Device	Device Handler Name
Alphanumeric	A0000
Button	B0000
Keyboard	K0000

Device Configuration

The terminals should be strapped for normal point-to-point operation. All of the keyboard interface straps should be closed (the normal position). The terminal should not be in block mode.

Keyboard Device Handler

Description

Terminals that have a standard ASCII keyboard are supported as keyboard input devices. The device handler required to use the keyboard device is K0000.

Initialization

(JEDEV/ZKINT). When the keyboard device is initialized, the device name is set to "KEYBRD".

Keyboard Input

(JKYBD/ZKYBD). Once the keyboard device has been enabled, it is available for input operations. When JKYBD or ZKYBD are called, a read operation is set pending on the terminal. The operator then enters the desired text and terminates the operation by entering a carriage-return. Some keys have a special meaning when entered by the operator and are not returned to the application program. (See the appropriate reference manual for a description of these keys.)

Echoes Supported

The keyboard device supports the following echoes:

Echo #	Echo Performed
0	Text is not displayed on the terminal's alphanumeric display as it is entered.
1	Text is displayed on the terminal's alphanumeric display as it is entered.

Termination

(JDDEV/ZKEND). The alphanumeric display is unaltered. The device name is set to "0000 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 2393A Graphics Terminal

General Information

The user should be familiar with the operation of the HP 2393A Graphics Terminal. If necessary, refer to the following manuals for the appropriate operating instructions:

HP 2393A Terminal User Manual, part number 02393-90001.

HP 2393A Terminal Reference Manual, part number 02393-90002.

Supported Logical Devices

The following logical devices are supported by the AGP/DGL Graphics Systems:

Logical Device	Device Handler Name
Alphanumeric	A0001
Button	B0001
Graphics display	D0059
Keyboard	K0001
Locator	L0059
Pick (AGP only)	P0059
Valuator	V0059

Device Configuration

To use the locator and pick functions, you must enable the keypad for graphics operation by pressing the dash on the keypad and the shift key simultaneously. The terminal should be strapped for normal point-to-point operation. The terminal should not be in block mode. For the terminal to operate in low resolution mode, the terminal should be configured for 512 by 390 graphics resolution and the switch on the back of the monitor should be at the low resolution position. For the terminal to operate in the high resolution mode, the terminal should be configured for 640 by 400 graphics and the switch on the back of the monitor should be set at the high resolution position.

Graphics Display Device Handler (AGP)

Description

The dimensions of the graphics display device are as follows:

If the terminal is in low resolution mode:

- Maximum limits

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	512 points Wide	390 points High

  Aspect ratio of maximum area is 0.75

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

- Default limits

Screen size:	214 mm Wide	152 mm High
Screen capacity:	512 points Wide	370 points High

  Aspect ratio of maximum area is 0.72

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

If the terminal is in high resolution mode:

- Maximum limits

Screen size:	213.3 mm Wide	133.3 mm High
Screen capacity:	640 points Wide	400 points High

  Aspect ratio of maximum area is 0.625

Resolution:	3 points/mm in X direction 3 points/mm in Y direction

- Default limits

Screen size:	213.3 mm Wide	133.3 mm High
Screen capacity:	640 points Wide	400 points High

  Aspect ratio of maximum area is 0.625

Resolution:	3 points/mm in X direction 3 points/mm in Y direction

The physical origin is the lower-left corner of the display.

The view surface is always centered within the current logical display surface.

The logical display surface is set to the default physical limits of the display.

Initialization

(JDINT). When initialized, the following operations are performed:

Device name:	Set to "2390A " or "2393A " (padded to 6 characters with trailing blanks).
Alphanumeric and graphics displays:	Turned on.
Graphics cursor:	Turned off and is in the lower left corner of the display.
Graphics memory:	Cleared if bit 7 is not set in the control word for JDINT. If bit 7 is set, graphics memory is unaffected.
Color table:	Initialized to the default values.
Medium- and low-quality text:	Slant is set to 0 degrees (no slant). Label direction is set to 0 degrees (horizontal). Label origin is set to 1 (left, bottom, justified).
User-defined area and line patterns:	Set to solid.
Simulated raster erase:	Enabled if bit 3 of the control word is set.

Device Enabling

(JWON). Device-dependent actions are not performed.

Supported Primitive Attributes

Color

(JCOLR). The D0059 display handler provides a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The default values of the color table are shown in Table 1.

Table 1. Default Color Table

Color Table Entry	Action
0	Color set to black (background color)
1	Color set to white

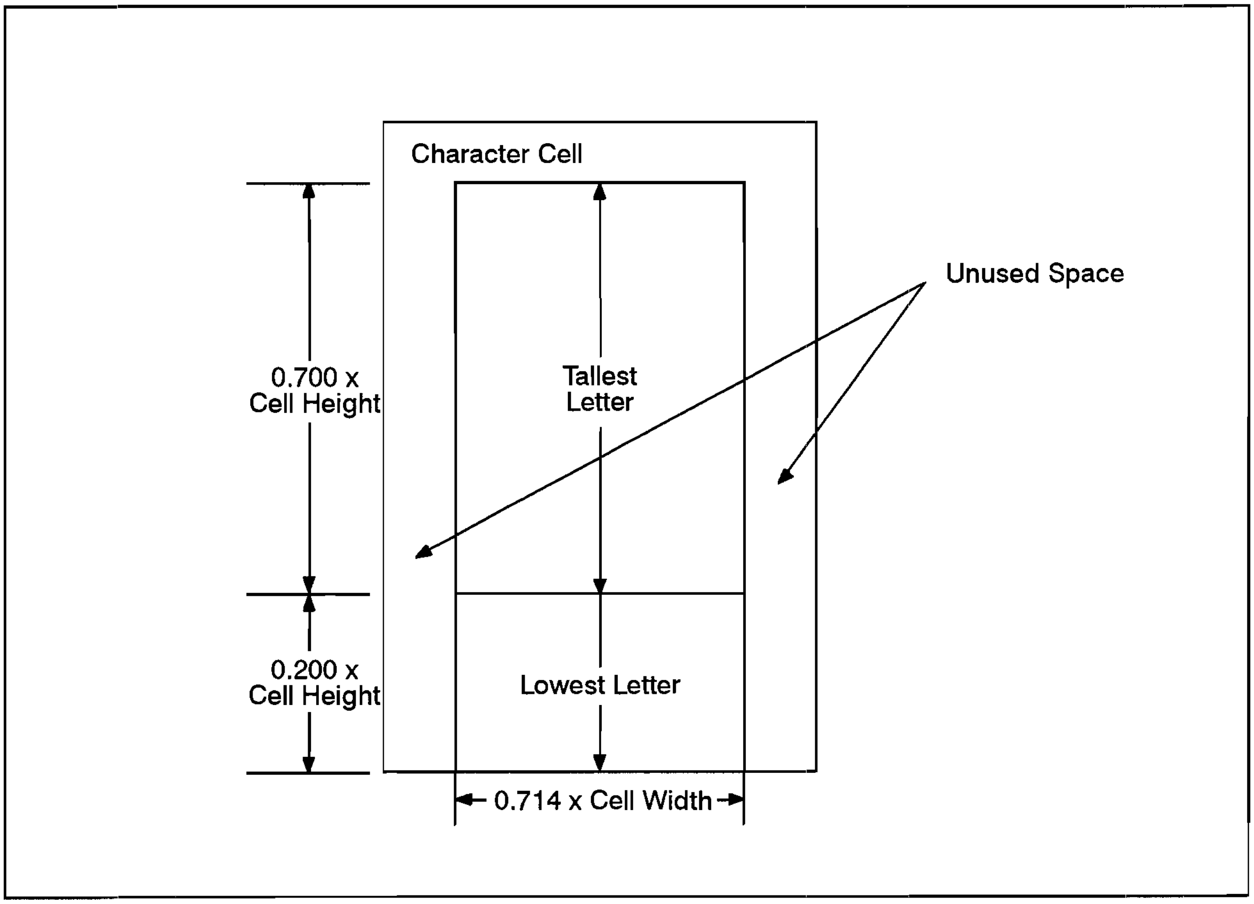


Figure 2. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not provided. If window clipping is turned off in AGP and vectors are created that lie entirely or partially outside of the view surface, unpredictable results may occur. Medium- and low-quality text strings are clipped if they do not lie entirely within the physical limits of the graphics display.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). Polygon sets with device-dependent polygon styles are displayed using hardware area fill. The terminal hardware supports convex, concave, and self-intersecting polygon sets. However, only some polygon sets with multiple polygons, (for example, simple donuts) are displayed as requested. The hardware does not fill polygon sets having more than 105 vertices after clipping by AGP.

If the user specifies a density that is less than 1/8 but greater than 0.0, then a density of 1/8 is used. If the density is greater than −1/8 but less than 0.0, than a density of −1/8 is used. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive, and up to the nearest 1/8 if the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding to the nearest multiple of 45 degrees. For densities other that −1.0, 1.0, and 0.0, crosshatching is supported. For all polygon fills, the interior line style is ignored. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive and up to the nearest 1/8 if the density is negative.

Except when the style specifies a fill density of −1.0 or 0.0, the user-defined area fill pattern is set to solid after device-dependent filling of a polygon set.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). Nineteen standard markers are supported. Markers are always 2.1 mm by 3.37 mm.

Medium- and Low-Quality Text

(JTEXM/JTEXL). Medium- and low-quality graphics text are generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide and 7 high in a character cell having a size ratio of 7 wide by 10 high. See Figure 3 for the viewable graphics character set.

If a medium- or low-quality text string is not clipped by AGP and extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped.

Medium- and low-quality text use only the color attribute. Characters are always generated using solid lines. The direction, slant, and justification of these types of text can be modified through the use of escape functions (see JOESC, Opcodes 1050, 1051, and 1052).

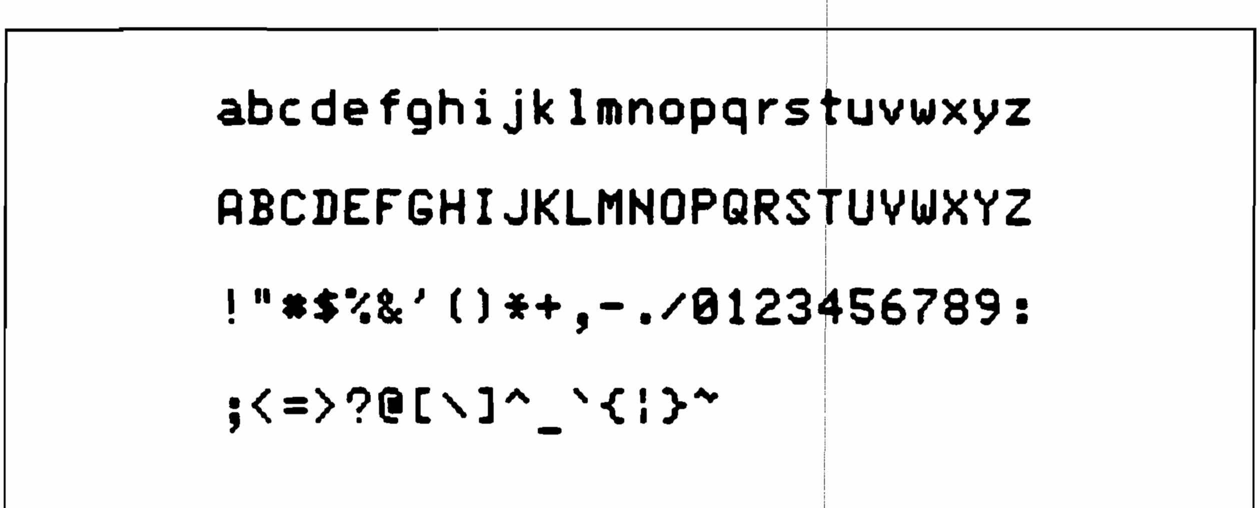


Figure 3. Supported Graphics Text Characters

New-Frame-Action

(JNEWF/JPURG/JSVIS/JSHI/JVSAL/JCLR). When a new-frame-action is given, the action taken is dependent on whether the simulated raster erase bit was set during the JDINT call. The actions taken are outlined below:

- Simulated Raster Erase Not Set

  A new-frame-action given when the device is enabled and not in a batch-of-updates clears the display to the background color and redraws all visible segments.

  When the new-frame-action is given with the display not enabled, it does not alter the display. When given inside a batch-of-updates, the screen does not change until the JUPDT call is given. At this time, the screen is cleared to the background color and all visible segments are redrawn.

- Simulated Raster Erase Set

  The terminal has the ability to erase images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call. AGP uses this feature to remove graphics elements without first clearing the display. For example, AGP uses simulated raster erase when a segment is purged.

  An explicit JNEWF call always clears the display and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates. This gives the user a means of generating a clean surface (one without holes).

The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations because, by definition, the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside a batch-of-updates always results in the screen being cleared and visible segments redrawn when the JUPDT call is given.

Note Erasing is done by redrawing the image in the background color; therefore, lines crossing the image to be purged may also have parts of them erased, leaving holes.

Inquire Escape Functions

(JIESC). The following inquire escape functions are supported by AGP:

Opcode	Function	
3050	Inquire medium- and low-quality text status.	
	ILIST(1) =	Current medium- and low-quality hardware text justification. See Figure 4 for possible values.
	ILIST(2) =	Current medium- and low-quality hardware text direction. Possible values are 0, 90, 180, or 270 degrees.
	ILIST(3) =	Current medium- and low-quality hardware text slant. Possible values are 0 and 45 degrees

Output Escape Functions

(JOESC). Several output escape functions are supported by AGP. Error checking is not performed by the graphics system on any of the parameters sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function.

Escape functions are not stored in the segment display area. This can have implications when used with AGP segments. For example, suppose the line style is set to 10 and the escape function (see JOESC, Opcode 2050) is used to define a line pattern. A segment is created and then appears on the screen with the given line pattern. If the line pattern is changed and a new-frame-action is given, the segment is redrawn with the current line pattern and not the line pattern used when it was originally created.

Escape functions may have undesirable effects on medium- and low-quality text. For example, if JJUST is used to set AGP justification to center and a hardware justification is chosen, the text may not end up justified.

Escape functions are sent from AGP directly to the device. The state of AGP may become undefined when an escape function is given that overrides a mode set by AGP (for example, hardware text justification).

The following output escape functions are supported:

Opcode	Function
450	Perform rectangular area fill using the current area pattern (see Opcode 1057) and color. The rectangular area is specified in virtual coordinates. RLIST(1) = Minimum X Border of rectangle. RLIST(2) = Maximum X Border of rectangle. RLIST(3) = Minimum Y Border of rectangle. RLIST(4) = Maximum Y Border of rectangle.
1050	Set device text direction for subsequent graphics text. ILIST(1) = 0 0 degrees (horizontal). ILIST(1) = 1 90 degrees counterclockwise. ILIST(1) = 2 180 degrees counterclockwise. ILIST(1) = 3 270 degrees counterclockwise.

1051 Set device character slant for subsequent output medium- and low-quality graphics text.

ILIST(1) = 0 0 degrees (normal).
ILIST(1) = 1 45 degrees.

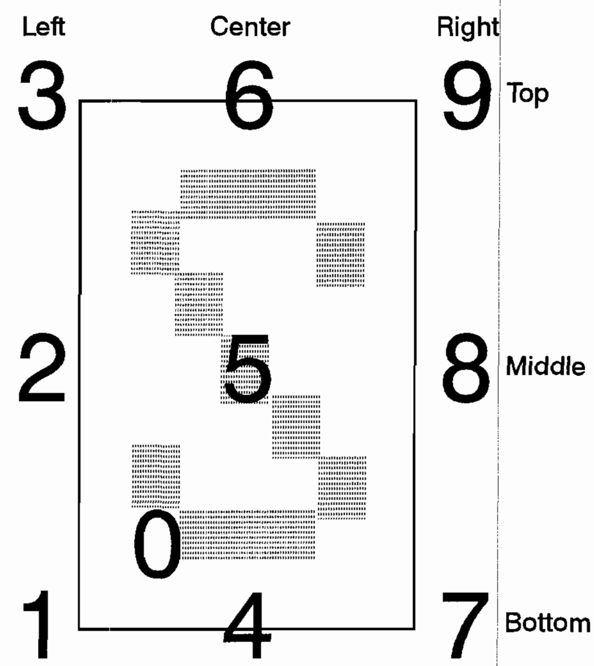
1052 Set device text justification for subsequent output medium- and low-quality graphics text. This applies to characters individually for medium-quality graphics text.

ILIST(1) = Text justification. See Figure 4 for the supported justification.

When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when centered or right justifying is 80 characters (not including the CR or LF). In all cases data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.

1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.



The numbers 1-9 represent the cursor position with respect to the character cell used for graphics text characters. The number 0 represents the cursor position with respect to the character (not this cell).

Justification/Origin. Text strings can be automatically right or left justified, or centered about a specified point. An ASCII character 0 through 9 indicates the origin (justification and base line) for characters with respect to the current pen position. This function is useful when drawing tables.

If text is left justified, the current pen position is the left margin. Center causes the label to be centered on the pen position. Right justify selects the pen position as the right margin. Bottom, middle, and top select the base line for the line of text.

For example, if text was to be right justified and set with a base line on top of the normal character position, the number "9" would be used.

Figure 4. Hardware Text Justification

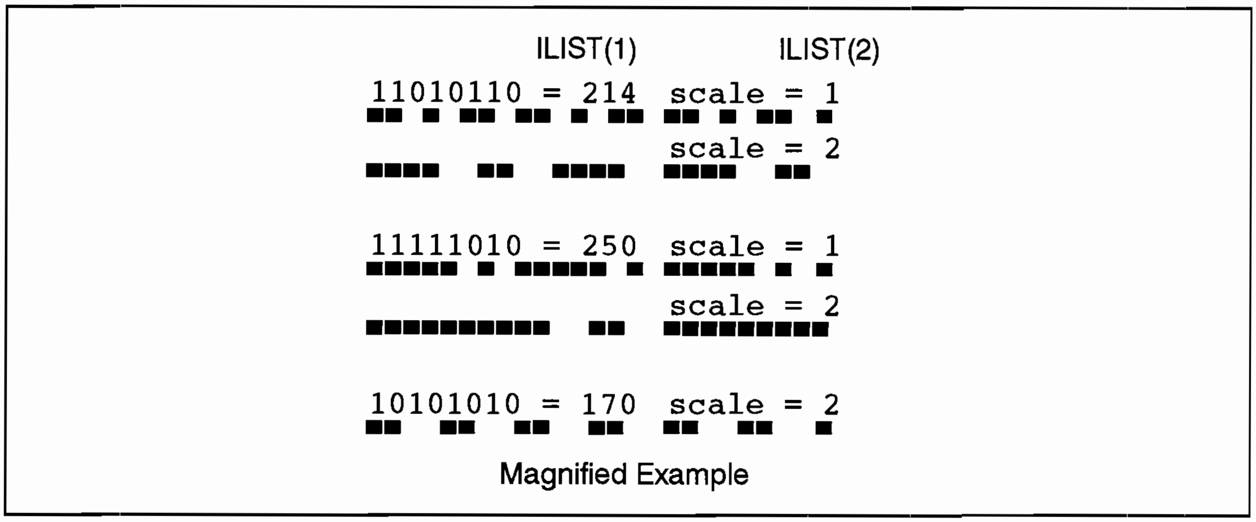
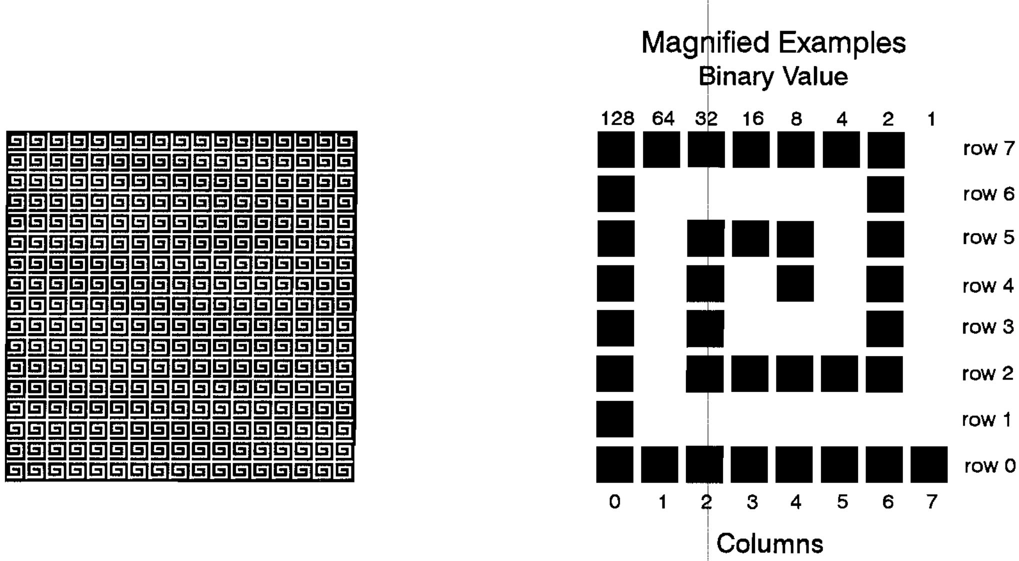


Figure 6. Magnified Examples of User-Defined Line Styles

8050 Define area pattern. An 8 by 8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging from 0 to 255 which defines an 8-bit binary pattern. The graphics display is divided into 8 by 8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used for drawing lines by setting the line style to 10 and selecting area pattern 2 (see Opcode 1057). Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling a rectangular area. The user-defined area pattern can be used for filling polygons when the current polygon style has a density of −1, and specified device-dependent output. Figure 7 and Figure 8 contain sample area fill patterns.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.




```
ILIST(8)  Row 7   11111110 - 254
ILIST(7)  Row 6   10000010 - 130
ILIST(6)  Row 5   10111010 - 186
ILIST(5)  Row 4   10101010 - 170
ILIST(4)  Row 3   10100010 - 162
ILIST(3)  Row 2   10111110 - 190
ILIST(2)  Row 1   10000000 - 128
ILIST(1)  Row 0   11111111 - 255

                  1 = dot on
                  0 = dot off
```

Figure 7. Defining Area Patterns

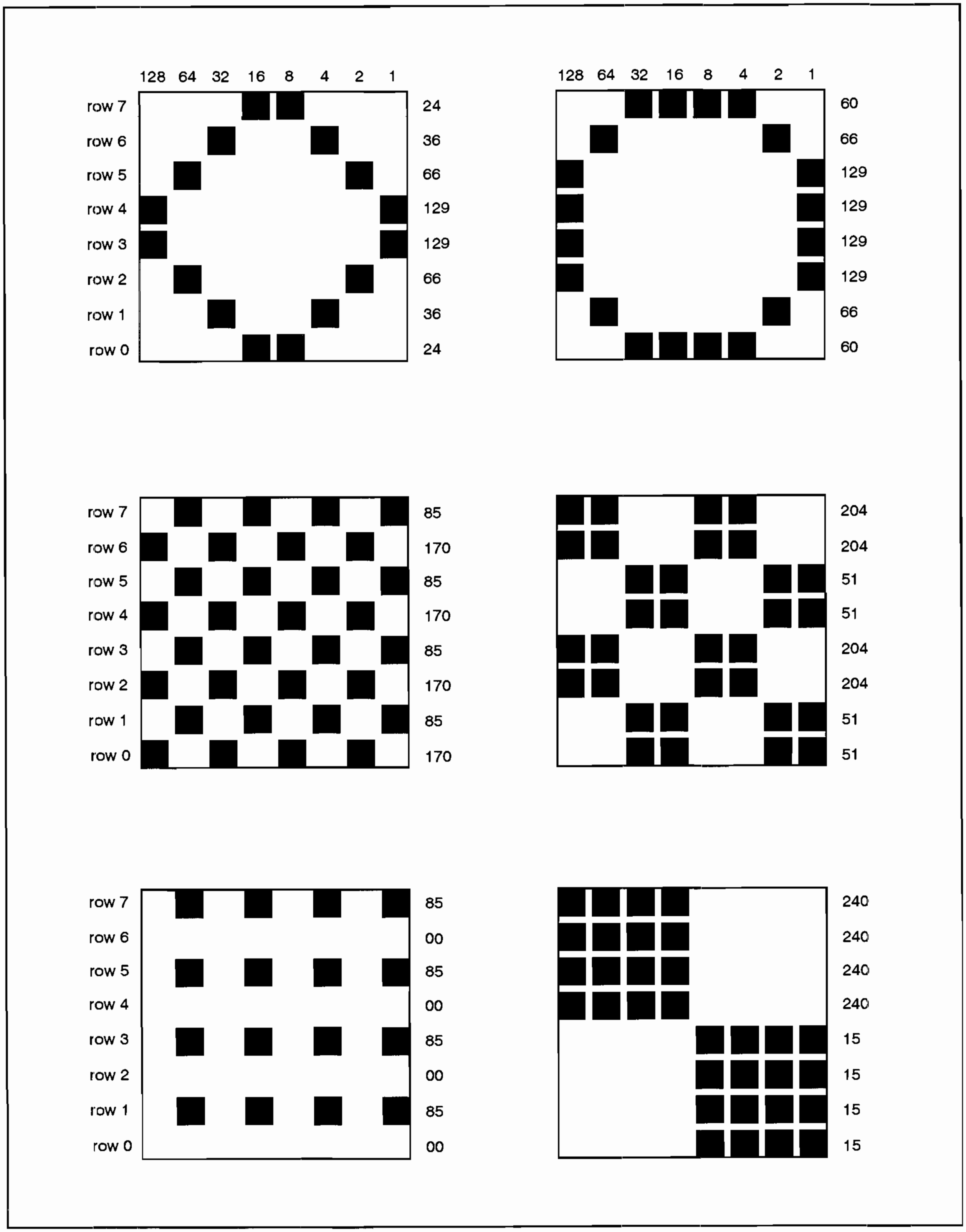


Figure 8. Magnified Examples of Area Patterns

Locator Echoes on the Graphics Display

(JWLOC). The type of echoes available on the graphics display depends on whether the graphics display and locator are the same physical device. For echoes supported on the locator device, see the device handler that discusses that specific locator device.

Same Physical Device

If the locator and the graphics display are the same physical device, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until an operator response occurs. When an operator response occurs, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X-coordinate of the graphics cursor and the Y-coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X-coordinate of the graphics cursor and the Y-coordinate of the locator echo position.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or ECHO 6, whichever defines a longer line from the locator echo position.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the position of the graphics cursor.

If an HP-HIL positioning device is attached to the terminal, it is considered the same logical device as the locator and is an extension of the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when tablet pen or mouse button is depressed.

Different Physical Devices

If the locator and the display devices are different physical devices and the locator device supports echoing on the graphics display, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Pick Echoes on the Graphics Display

(JPICK). For echoes supported on the pick device, see the corresponding device handler that discusses the pick device in question.

Echo #	Echo Performed
2	Initially, the graphics cursor is turned on at the current pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is completed. Before control returns to the application program, the graphics cursor is turned off. If an HP-HIL positioning device is attached to the terminal, it is considered the same logical device as the pick and is an extension of the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when tablet pen or mouse button is depressed.

Disabling

(JWOFF). The display is not reset to initial values when JWOFF is called. Values remain as they were last set. For example, color may remain set to the background color if the last operation was a simulated raster erase.

Graphics Display Device Handler (DGL)

Description

The dimensions of the graphics display device are as follows:

If the terminal is in low resolution mode:

- Maximum limits

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	512 points Wide	390 points High

  Aspect ratio of maximum area is 0.75

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

- Default limits

Screen size:	214 mm Wide	152 mm High
Screen capacity:	512 points Wide	370 points High

  Aspect ratio of maximum area is 0.72

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

If the terminal is in high resolution mode:

- Maximum limits

Screen size:	213.3 mm Wide	133.3 mm High
Screen capacity:	640 points Wide	400 points High

  Aspect ratio of maximum area is 0.625

Resolution:	3 points/mm in X direction 3 points/mm in Y direction

- Default limits

Screen size:	213.3 mm Wide	133.3 mm High
Screen capacity:	640 points Wide	400 points High

  Aspect ratio of maximum area is 0.625

Resolution:	3 points/mm in X direction 3 points/mm in Y direction

The physical origin is the lower-left corner of the display.

The view surface is always centered within the current logical display surface.

The logical display surface is set to the default physical limits of the display.

Initialization

(ZDINT). When initialized, the following operations are performed:

Device name:	Set to "2390A " or "2393A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Alphanumeric and graphics display:	Turned on.
Graphics cursor:	Turned off and is in the lower-left corner of the display.
Starting position:	Lower-left corner of the display.
Graphics memory:	Cleared if bit 7 is not set in the control word for ZDINT. If bit 7 is set, graphics memory is unaffected.
Alphanumeric memory:	Not cleared.
Color table:	Initialized to the default values.
Text slant:	Set to 0 degrees.
Text label direction:	Set to 0 degrees (horizontal).
Label origin:	Set to 1 (left, bottom, justified).
User-defined area and line patterns:	Set to solid.
New-frame-action:	Buffered if bit 6 of the control word in the ZDINT call is set.

Supported Primitive Attributes

Color

(ZCOLR). The D0059 display handler provides a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The default values of the color table are shown in Table 3.

Table 3. Default Color Table

Color Table Entry	Action
0	Color set to black (background color)
1	Color set to white

The color selected corresponds to the color defined in the color table.

COLOR = 0 Color table entry 0 is selected.
= 1 Color table entry 1 is selected.

Redefining and Inquiring Color

(ZDCOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(ZPICL). There are two colors supported by DGL, black and white. Both colors can be displayed at one time. The supported values of the color attributes are:

COLOR = 0 Color set to background color (black).
= 1 Color set to white.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). Refer to ZLSTL for information regarding line style.

Highlighting

(ZHIGH). Highlighting is not supported.

Line Style

(ZLSTL). Eight predefined line styles are supported. In addition, two user-definable styles can be selected. These line styles are defined through the use of an output escape function. (See ZOESC, Opcode 2050). Initially, the two user-definable line styles are set to solid.

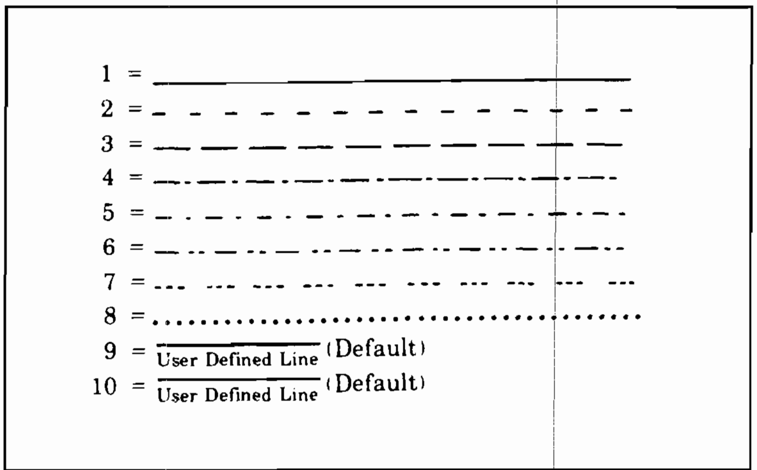


Figure 9. Supported Line Styles

All of the supported line styles are *continuous*. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete description of a continuous line style.

Line Width

(ZLWID). Only one line width is supported.

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

Character Sizes

(ZCISZ). There are eight distinct character sizes supported. They all have a constant aspect ratio of 1.4. The supported character sizes are:

Low Resolution Mode		High Resolution Mode	
Width	Height	Width	Height
2.93 mm	4.12 mm	2.3 mm	3.3 mm
5.86 mm	8.23 mm	4.6 mm	6.6 mm
8.79 mm	12.35 mm	7.0 mm	10.0 mm
11.72 mm	16.46 mm	9.3 mm	13.3 mm
14.64 mm	20.58 mm	11.6 mm	16.6 mm
17.57 mm	24.69 mm	14.0 mm	20.0 mm
20.5 mm	28.81 mm	16.3 mm	23.3 mm
23.43 mm	32.92 mm	18.6 mm	26.6 mm

The character is placed within the character cell as shown in Figure 10.

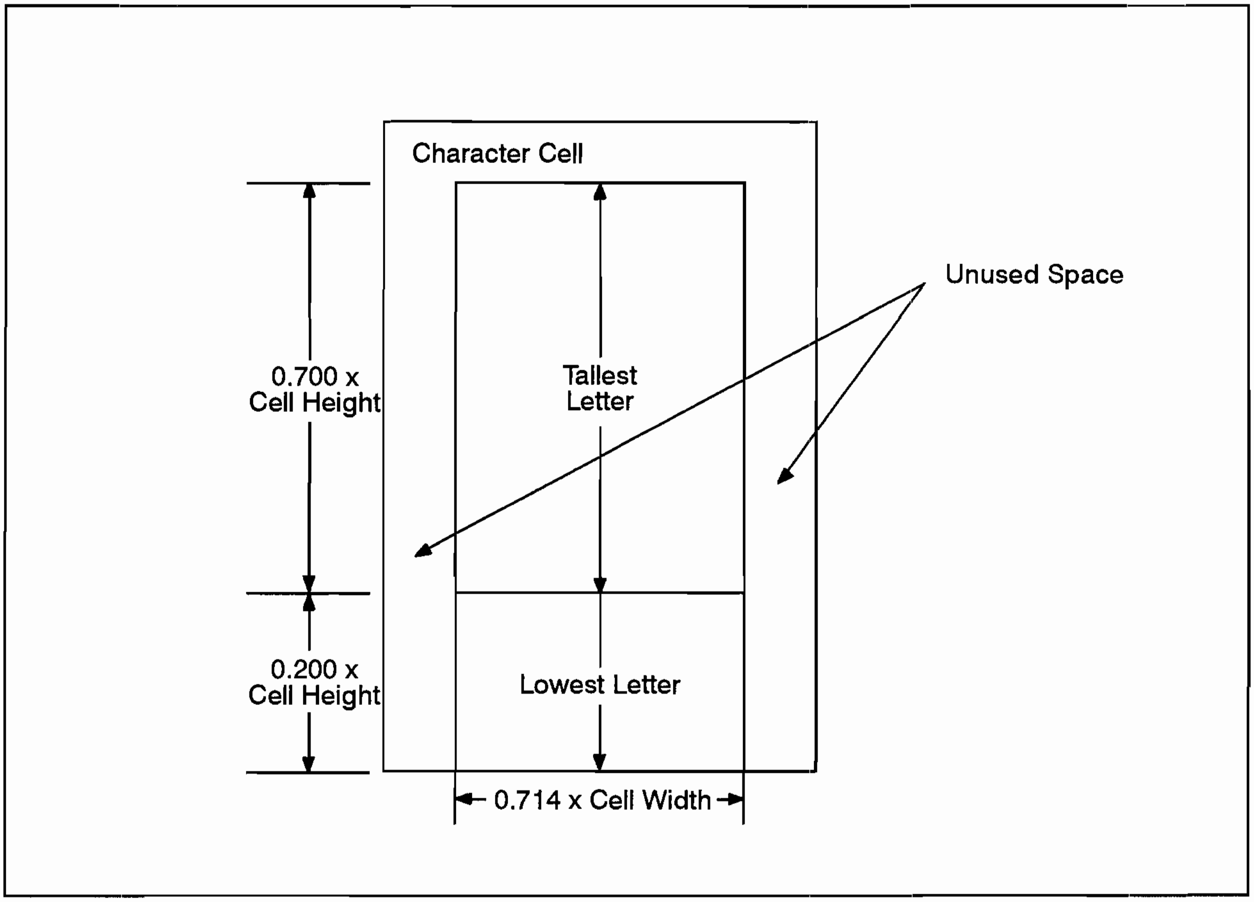


Figure 10. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not provided. A vector with one or both of its endpoints outside the physical limits is displayed in an unpredictable manner. Text characters are clipped if they do not lie within the physical limits of the display.

Polygons

(ZPGDD). Hardware filling is provided for polygon sets of up to 105 vertices. The terminal hardware supports convex, concave, and self-intersecting polygon sets. However, only some polygon sets with multiple polygons (for example, simple donuts) are displayed as requested.

If the polygon style specifies a density of 1.0, the polygon set is solid-filled. Hardware dithering may be necessary to approximate the current polygon interior color selection. If the user specifies a fill density of −1.0, the polygon is filled with the current user-defined area pattern. The default for this pattern is solid. (See ZOESC, Opcode 8050, for further details.) If the user specifies a density that is less than 1/8 but greater than 0.0, then a density of 1/8 is used. If the density is greater than −1/8 but less than 0.0, than a density of −1/8 is used. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive, and up to the nearest 1/8 if the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding to the nearest multiple of 45 degrees. For densities other that −1.0, 1.0, and 0.0, crosshatching is supported. For all polygon fills, the interior line style is ignored.

Except when the style specifies a fill density of 1.0, −1.0, or 0.0, the user-defined area fill pattern is set to solid by ZPGDD upon its completion.

Markers

(ZMARK). Nineteen standard markers are supported. Markers are always 2.1 mm by 3.37 mm.

Text

(ZTEXT). Graphics text is generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide and 7 high in a character cell having a size ratio of 7 wide by 10 high. See Figure 11 for the viewable graphics character set. In addition to the viewable characters, text strings can also include the following control characters:

Decimal Code	Function
8	Move backward one character cell.
9	Move forward one character cell.
10	Move down one character cell.
11	Move up one character cell.
13	Carriage-return.

The actual direction moved by these control functions is dependent on the text direction and the text origin in use. Only the above special characters should be included in graphics text strings in addition to the printable ASCII characters.

Graphics text is not affected by the line style attribute; character strings are output as solid lines. The direction, slant, and justification of text can be modified through the use of escape functions (see ZOESC, Opcodes 1050, 1051 and 1052). If a text string extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped by the terminal.

```
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
!"#$%&'()*+,-./0123456789:
;<=>?@[\]^_`{|}~
```

Figure 11. Supported Graphics Text Characters

New-Frame-Action

Non-Buffered

(ZNEWF). A call to ZNEWF makes the picture current, then erases the graphics display to the background color.

Buffered

(ZNEWF). When ZNEWF is called, the graphics display is made current. The instruction to clear the graphics display is stored in the DGL buffer and is not sent to the device until the next time the buffer is sent. When the buffer is sent, the display is cleared to the background color. Any calls to DGL that were put into the buffer after the ZNEWF call now take affect on the graphics display. The current display remains until the next buffer is sent. If immediately visibility is used, the action is the same as if new-frame-actions were not buffered; because the buffer is sent after every DGL call.

Inquire Escape Functions

(ZIESC). The following inquire escape functions are supported:

Opcode	Function
3050	Inquire text status. ILIST(1)= Current text justification. See Figure 12 for possible values. ILIST(2)= Current text direction. Possible values are 0, 90, 180, or 270 degrees. ILIST(3)= Current text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(ZOESC). Several output escape functions are supported by DGL. Error checking is not performed by the graphics system on any of the parameters sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function. None of the supported output escape functions alter the starting position for the next primitive.

The following output escape functions are supported:

Opcode	Function
450	Perform rectangular area fill using the current area pattern (see Opcode 1057) and color. The rectangular area is specified in virtual coordinates RLIST(1) = Minimum X Border of rectangle. RLIST(2) = Maximum X Border of rectangle. RLIST(3) = Minimum Y Border of rectangle. RLIST(4) = Maximum Y Border of rectangle.
1050	Set device text direction for subsequent graphics text. ILIST(1) = 0 0 degrees (horizontal). ILIST(1) = 1 90 degrees counterclockwise. ILIST(1) = 2 180 degrees counterclockwise. ILIST(1) = 3 270 degrees counterclockwise.
1051	Set character slant for subsequent output graphics text. ILIST(1) = 0 0 degrees (normal). ILIST(1) = 1 45 degrees.

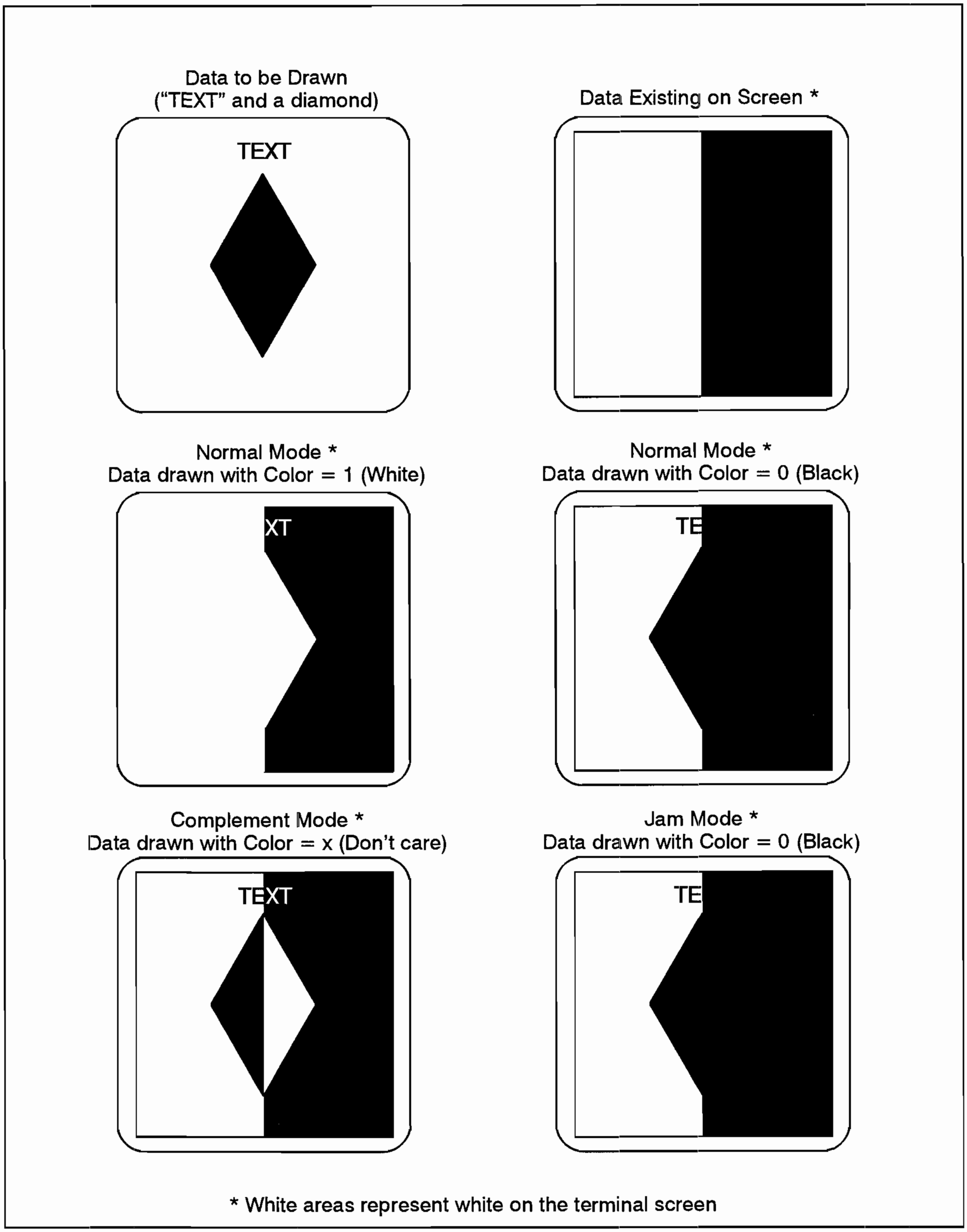


Figure 13. Special Drawing Modes

2050 Define line pattern. This allows the user to define the dot pattern used to draw vectors. Once a line pattern is defined, set the line style to 9. See Figure 14 for examples on defining line patterns.

ILIST(1) = A decimal value between 0 and 155 defining an 8-bit binary pattern.

ILIST(2) = A scale factor between 1 and 16 to be applied to the pattern.

8050 Define area pattern. An 8 by 8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging from 0 to 255 that defines an 8-bit binary pattern. The graphics display is divided into 8 by 8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used for drawing lines by setting the line style to 10 and selecting area pattern 2 (see Opcode 1057). Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling a rectangular area. The user-defined area pattern of -1, and specified device-dependent output. Figure 15 and Figure 16 contain sample area fill patterns.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.

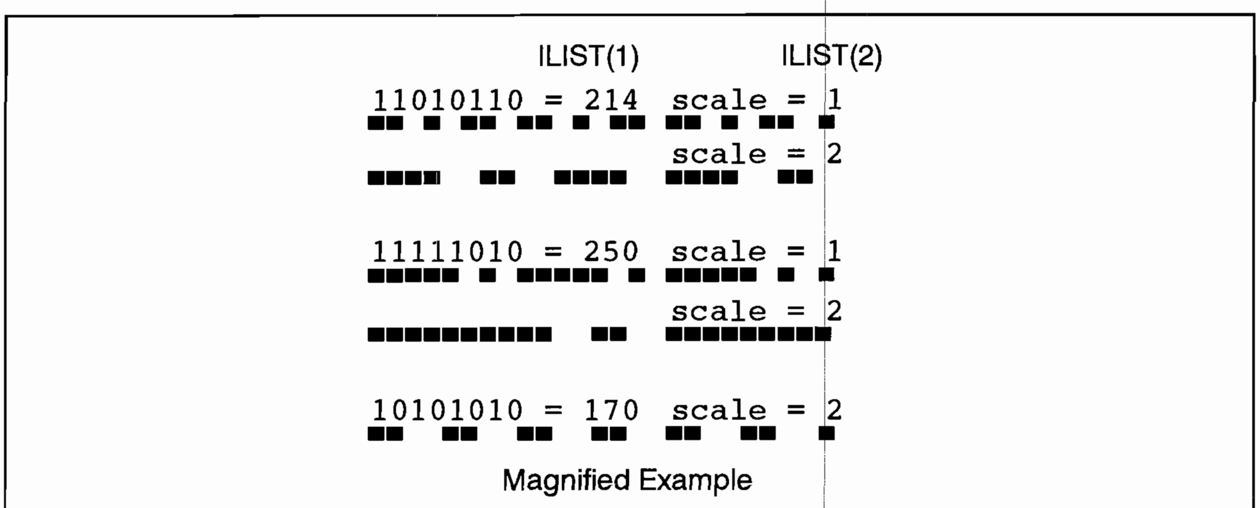
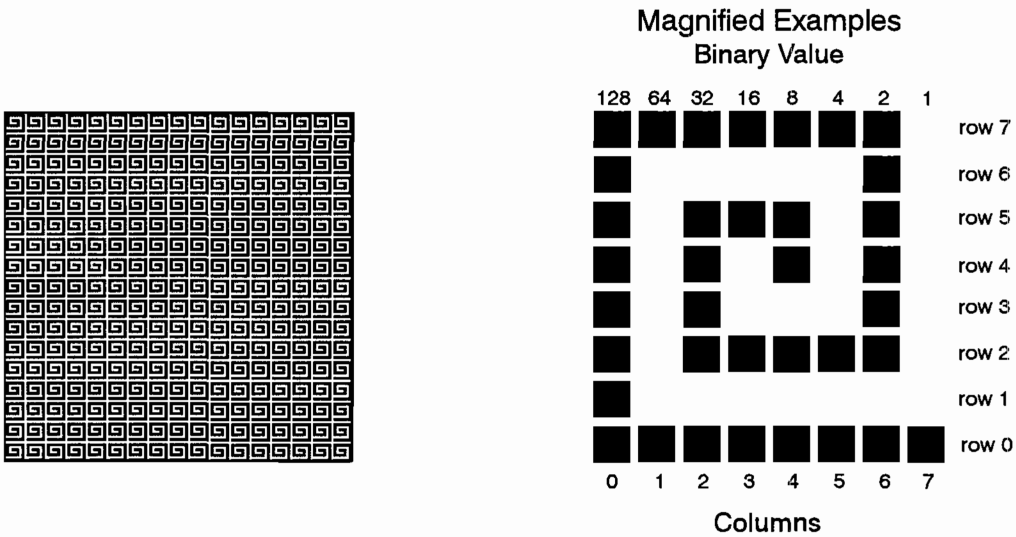


Figure 14. Magnified Examples of User-Defined Line Styles




```
ILIST(8)  Row 7   11111110 - 254
ILIST(7)  Row 6   10000010 - 130
ILIST(6)  Row 5   10111010 - 186
ILIST(5)  Row 4   10101010 - 170
ILIST(4)  Row 3   10100010 - 162
ILIST(3)  Row 2   10111110 - 190
ILIST(2)  Row 1   10000000 - 128
ILIST(1)  Row 0   11111111 - 255

                  1 = dot on
                  0 = dot off
```

Figure 15. Defining Area Patterns

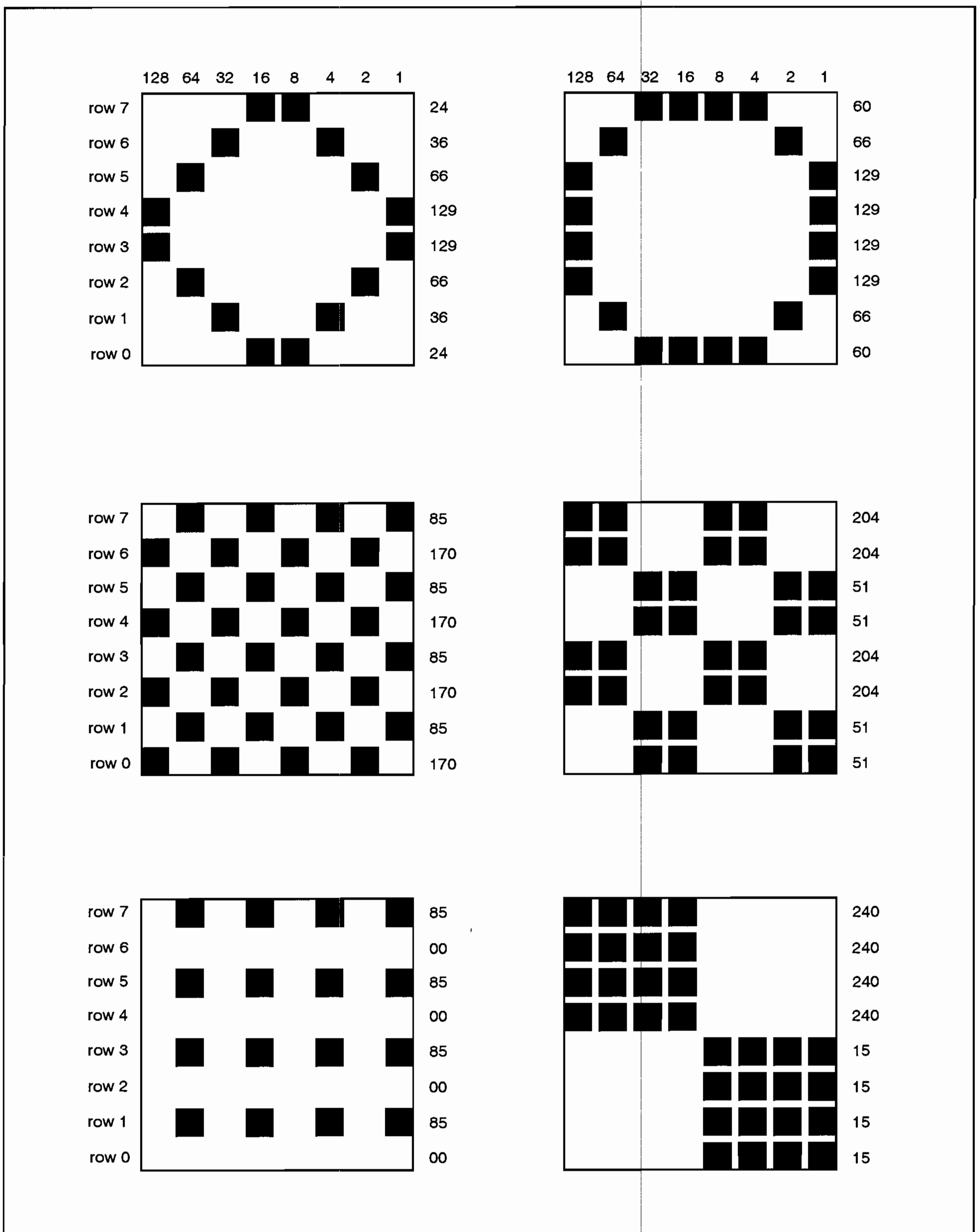


Figure 16. Magnified Examples of Area Patterns

Locator Echoes on the Graphics Display

(ZWLOC). The type of echoes available on the graphics display depends on whether the graphics display and locator are the same physical device. For echoes supported on the locator device, see the device handler that discusses that specific locator device.

Same Physical Device

If the locator and the graphics display are the same physical device, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until an operator response occurs. When an operator response occurs, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X-coordinate of the graphics cursor and the Y-coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X-coordinate of the graphics cursor and the Y-coordinate of the locator echo position.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or ECHO 6, whichever defines a longer line from the locator echo position.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the position of the graphics cursor.

If an HP-HIL positioning device is attached to the terminal, it is considered the same logical device as the locator and is an extension of the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when tablet pen or mouse button is depressed.

Different Physical Devices

If the locator and the display devices are different physical devices and the locator device supports echoing on the graphics display, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Termination

(ZDEND). The graphics display is unaltered. The device name is set to "0059 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0. All attribute values remain unaltered until the system is re-initialized or the display device is enabled again.

Keyboard Device Handler

Description

The terminal has a standard ASCII keyboard that is supported as a keyboard input device. The device handler required to use the keyboard device is K0001.

Initialization

(JEDEV/ZKINT). When the keyboard device is initialized, the alphanumeric display is turned on. The device name is set to "2390A ". The name is padded to 6 characters with trailing blanks.

Keyboard Input

(JKYBD/ZKYBD). Once the keyboard device is enabled, it is available for input operations. When JKYBD or ZKYBD are called, a read operation is set pending on the terminal. The operator then enters the desired text and terminates the operation by entering a CR. Some keys have special meanings when entered by the operator and are not returned to the application program. See the AGP or DGL Reference Manual for a description of these keys.

Echoes Supported

The keyboard device supports the following echoes:

Echo #	Echo Performed
0	Text is not displayed on the terminal alphanumeric display as it is entered.
1	Text is displayed on the terminal alphanumeric display as it is entered.

Termination

(JDDEV/ZBEND). The alphanumeric display is unaltered. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Locator Device Handler

Description

The dimensions of the locator device are listed below.

If the terminal is in low resolution mode:

- Maximum limits

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	512 points Wide	390 points High

  Aspect ratio of maximum area is 0.75

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

- Default limits

Screen size:	214 mm Wide	152 mm High
Screen capacity:	512 points Wide	370 points High

  Aspect ratio of maximum area is 0.72

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

If the terminal is in high resolution mode:

- Maximum limits

Screen size:	213.3 mm Wide	133.3 mm High
Screen capacity:	640 points Wide	400 points High

  Aspect ratio of maximum area is 0.625

Resolution:	3 points/mm in X direction 3 points/mm in Y direction

- Default limits

Screen size:	213.3 mm Wide	133.3 mm High
Screen capacity:	640 points Wide	400 points High

  Aspect ratio of maximum area is 0.625

Resolution:	3 points/mm in X direction 3 points/mm in Y direction

The default locator limits are set equal to the default physical limits of the display.

The physical origin is the lower-left corner of the display.

The terminal has a graphics locator that is capable of returning any point on the screen. The device handler required to use the locator device is L0059.

Initialization

(JEDEV/ZLINT). When initialized, the terminal's graphics display is left unaltered. The device name is set to "2390A ". The name is padded to 6 characters with trailing blanks.

Wait Locator Input

(JWLOC/ZWLOC). The wait locator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key. The (X,Y) coordinate value of the graphics cursor (which is a function of the echo) and the key struck are returned to the application program. Any of the ASCII keys can be used to terminate the locator function so the key returned to the application program can range from 0 to 127.

Echoes Supported

Locator input can be echoed on either a graphics display device or a locator device. The echo can only be performed on a graphics display device when the locator and the graphics display devices are implemented on the same physical device (that is, the same HP 2393A Graphics Terminal). Refer to the graphics display sections to see how the locator can echo input on the graphics display.

The locator device supports the following echoes:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator using the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the locator function is terminated. Before control returns to the application program, the graphics cursor is turned off.

Sample Locator Input

(JSLOC/ZSLOC). The sample locator function returns the current locator position without waiting for an operator response. The graphics cursor is turned off following the sample locator function.

Echoes Supported

Echo #	Echo Performed
0	Echo is not performed.
1	The bell in the terminal is sounded when the locator is sampled.

Termination

(JDDEV/ZLEND). The device name is set to "0059 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Pick Device Handler (AGP)

Description

The pick device is only supported with AGP. The dimensions of the pick device are listed below.

If the terminal is in low resolution mode:

- Maximum limits

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	512 points Wide	390 points High

Aspect ratio of maximum area is 0.75

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

- Default limits

Screen size:	214 mm Wide	152 mm High
Screen capacity:	512 points Wide	370 points High

Aspect ratio of maximum area is 0.72

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

If the terminal is in high resolution mode:

- Maximum limits

Screen size:	213.3 mm Wide	133.3 mm High
Screen capacity:	640 points Wide	400 points High

Aspect ratio of maximum area is 0.625

Resolution:	3 points/mm in X direction 3 points/mm in Y direction

- Default limits

Screen size	213.3 mm Wide	133.3 mm High
Screen capacity	640 points Wide	400 points High

Aspect ratio of maximum area is 0.625

Resolution	3 points/mm in X direction 3 points/mm in Y direction

The physical origin is the lower-left corner of the display.

The terminal has a pick device that is capable of differentiating between any point on the graphics display. The device handler required to use the pick device is P0059.

Wait Valuator Input

(JWVAL/ZWVAL). The wait valuator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key.

In addition to returning the subvaluator value, the key struck to terminate the valuator operation is also returned to the application program. Any of the ASCII keys can be used to terminate the valuator function so the key returned to the application program can range from 0 to 127.

The value returned is a function of the subvaluator specified as follows:

Subvaluator	Value Returned
1	The X-coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the left edge and a value of 1.0 is returned if the cursor is at the right edge of the display.
2	The Y-coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the bottom and a value of 1.0 is returned if the cursor is at the top of the display.

Echoes Supported

The valuator device supports the following echoes:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator using the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the valuator function is terminated. Before control returns to the application program, the graphics cursor is turned off.

Sample Valuator Input

(JSVAL/ZSVAL). The sample valuator function returns a subvaluator value without waiting for an operator response. The valuator simulation is performed in the same way as for the wait valuator input function.

Echoes Supported

The following echoes are supported when using the sample valuator function:

Echo #	Echo Performed
0	Echo is not performed.
1	The bell in the terminal is sounded when the valuator is sampled.

Termination

(JDDEV/ZVEND). The device name is set to "0059 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 2397A Graphics Terminal

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HP 2397A Graphics Terminal

General Information

The user should be familiar with the operation of the HP 2397A Graphics Terminal. If necessary, refer to the following manuals for the appropriate operating instructions:

HP 2397A Terminal User Manual, part number 02397-90001.

HP 2397A Terminal Reference Manual, part number 02397-90002.

Supported Logical Devices

The following logical devices are supported by the AGP/DGL Graphics Systems:

Logical Device	Device Handler Name
Alphanumeric	A0001
Button	B0001
Graphics Display	D0060
Keyboard	K0001
Locator	L0060
Pick (AGP only)	P0060
Valuator	V0060

Device Configuration

To use the locator and pick functions, you must enable the keypad for graphics operation by pressing the dash on the keypad and the shift key simultaneously.

The terminal should be strapped for normal point-to-point operation. The terminal should not be in block mode. The terminal should be configured for 512 by 390 graphics resolution.

Alphanumeric Device Handler

Description

The terminal has independent alphanumeric and graphics display memories that allow either or both types of data to be displayed on the same CRT. The alphanumeric device handler, A0001, allows the application programmer to send messages and alphanumeric display control commands to the terminal.

The dimensions of the alphanumeric device are as follows:

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	24 lines with 80 characters per line	
Character size:	4 mm Wide	7 mm High

Initialization

(JEDEV/ZAINT). When the alphanumeric device is initialized, the alphanumeric display is turned on and the contents of the alphanumeric memory are left unaltered. DGL sets the device name to "2390A ". The name is padded to 6 characters with trailing blanks.

Alphanumeric Output

(JALPH/ZALPH). The state of the alphanumeric display is not altered before sending the character string to the terminal. The entire character string is sent directly to the terminal. A maximum of 132 characters can be sent to the alphanumeric device at one time. If the text output exceeds the size of a line, the terminal performs a carriage-return line-feed and text output continues on the next line. The character string may contain alphanumeric characters or command sequences that control the alphanumeric display (for example, clear alphanumeric memory, alphanumeric cursor control, and so on). Command sequences that affect other parts of the terminal (that is, graphics display) should not be contained in the string because they could destroy the integrity of the graphics system.

Termination

(JDDEV/ZAEND). When the alphanumeric device is terminated, the alphanumeric display is not affected. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Button Device Handler

Description

The terminal has eight *softkeys* which together are supported as a button device. These keys are above the standard ASCII keys and are labeled *f1* through *f8*. The numeric keys 1 through 8 can also be used in the same way as the softkeys. The device handler required to use the button device is B0001.

Note If the softkeys are to be used, either the labels *f1* through *f8* must appear on the softkey area of the alphanumeric display or the labels must be turned off by pressing the SHIFT or AIDS keys.

Initialization

(JEDEV/ZBINT). When the button device is initialized, all previous softkey definitions are destroyed. The softkeys *f1* through *f8* are loaded with the ASCII characters 1 through 8, respectively. The device name is set to "2390A ". The name is padded to 6 characters with trailing blanks.

Button Input

(JBUTN/ZBUTN). Once the button device is enabled, it is available for input operations. When JBUTN or ZBUTN is called, a read operation is set pending on the terminal. Striking a softkey or an ASCII key between 1 and 8 returns the button as an integer value ranging from 1 to 8. If an invalid, transmittable (that is, ASCII) key is struck, an integer of 0 is returned as the button value.

Echoes Supported

The button device handler supports the following echoes:

Echo #	Echo Performed
0	Echoing is not performed.
1	The terminal bell is sounded if a valid button is activated.

Termination

(JDDEV/ZBEND). When the button device is terminated, the softkey definitions remain as they were defined by the button device initialization. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Graphics Display Device Handler (AGP)

Description

The dimensions of the graphics display device are as follows:

- Maximum limits

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	512 points Wide	390 points High

  Aspect ratio of maximum area is 0.75

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

- Default limits

Screen size:	214 mm Wide	152.3 mm High
Screen capacity:	512 points Wide	370 points High

  Aspect ratio of default area is 0.71

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

The physical origin is the lower-left corner of the display.

The view surface is always centered within the current logical display surface.

The logical display surface is set to the default physical limits of the display.

Initialization

(JDINT). When initialized, the following operations are performed:

Device name:	Set to "2390A " or "2397A " (padded to 6 characters with trailing blanks).
Alphanumeric and graphics displays:	Turned on.
Graphics cursor:	Turned off and is in the lower left corner of the display.
Graphics memory:	Cleared if bit 7 is not set in the control word for JDINT. If bit 7 is set, graphics memory is unaffected.
Color table:	Initialized to the default values.
Medium- and low-quality text:	Slant is set to 0 degrees (no slant). Label direction is set to 0 degrees (horizontal). Label origin is set to 1 (left, bottom, justified).

User-defined area and line patterns:	Set to solid.
Simulated raster erase:	Enabled if bit 3 of the control word is set.

Device Enabling

(JWON). Device-dependent actions are not performed.

Supported Primitive Attributes

Color

(JCOLR). The D0060 display handler provides a software color table of 32 colors. The size of the color table cannot be changed. The default values of the color table are shown in Table 1.

The terminal can display eight non-dithered colors at a time, selectable from a palette of 64 colors. The color table is initialized when JDINT is called. The initial values of entries 0-7 correspond to the eight non-dithered colors. The colors in the color table can be redefined at any time (see JDCOL/JICOL).

Any color other than the eight non-dithered colors can only be produced through dithering, using device dependent polygon generation with a solid fill pattern (see JPICL). JCOLR approximates the color selected from table entries greater than 7, with the closest non-dithered color in entries 0-7.

Table 1. Default Color Table

Color Table Index	Red	Green	Blue	Color
0	0.000	0.000	0.000	Black
1	1.000	1.000	1.000	White
2	1.000	0.000	0.000	Red
3	0.000	1.000	0.000	Green
4	1.000	1.000	0.000	Yellow
5	0.000	0.000	1.000	Blue
6	1.000	0.000	1.000	Magenta
7	0.000	1.000	1.000	Cyan
8	0.000	0.533	0.600	Turquoise
9	0.400	0.133	0.000	Brown
10	0.933	0.333	0.000	Toasted Orange
11	0.600	1.000	0.067	Lime Green
12	0.933	0.733	0.000	Golden Yellow
13	0.333	0.333	1.000	Medium Blue
14	0.600	0.133	1.000	Violet
15	0.000	0.400	0.533	Blue-Green
16	0.800	0.800	0.800	Light Gray
17	0.940	0.000	0.000	Red
18	0.940	0.313	0.000	Orange
19	0.940	0.627	0.000	Gold
20	0.940	0.940	0.000	Yellow
21	0.627	0.940	0.000	Yellow-Green
22	0.313	0.940	0.000	Green-Yellow
23	0.000	0.940	0.000	Green
24	0.000	0.940	0.313	Green-Blue
25	0.000	0.940	0.627	Aqua
26	0.000	0.940	0.940	Light Blue
27	0.000	0.470	0.940	Denim Blue
28	0.000	0.000	0.940	Blue
29	0.470	0.000	0.940	Violet
30	0.940	0.000	0.940	Dark Magenta
31	0.940	0.000	0.627	Deep Pink

Redefining and Inquiring Color

(JDCOL/JICOL). The colors in the color table can be redefined and inquired, including the background color (which has index 0 in the color table). Elements on the display (including the background itself) that have their color index redefined, are affected as soon as the change is made to the terminal.

When defining the new RGB color specification values, the terminal firmware rounds down to the nearest multiple of 0.25. The numbers are rounded down as follows:

Range of Input Values	"rounded" value
0.00-0.24	0.00
0.24-0.49	0.25
0.50-0.74	0.50
0.75-0.99	0.75
1.00-	1.00

Redefining the first eight entries in the color table affects the dithered colors, because the terminal firmware dither algorithm assumes the default color table specification for the first eight entries.

Polygon Interior Color

(JPICL). With the exception of solid filled, hardware generated (device dependent) polygon interiors, only the eight non-dithered colors are available for output primitives. If solid filled, hardware generated polygons are selected in the JPSTL call, hardware dithering is used to fill the polygon with a color pattern that is as close as possible to the selected color definition.

Polygon Style

(JDPST). Using JDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(JPILS). The interior line style attribute is not applied to device-dependent area fill. Refer to JLSTL for information regarding line style.

Highlighting

(JSHI/JGHI). Highlighting is not supported.

Line Style

(JLSTL). Eight predefined line styles are supported. In addition, two user-definable styles can be selected. These line styles are defined through the use of an output escape function. (See JOESC, Opcode 2050). Initially, the two user-definable line styles are set to solid.

All of the supported line styles are *continuous*. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, for a complete description of a continuous line style.

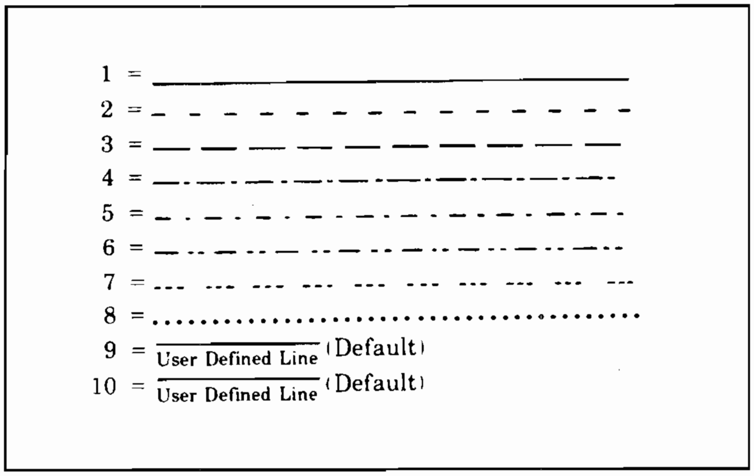


Figure 1. Supported Line Styles

Line Width

(JLWID). Only one line width is supported.

LINEWIDTH = 1 Primitives are drawn with a line width of one pixel.

Character Sizes

(JCISZ). There are eight distinct character sizes supported. They all have a constant aspect ratio of 1.4. The supported character sizes are:

Width	Height
2.93 mm	4.12 mm
5.86 mm	8.23 mm
8.79 mm	12.35 mm
11.72 mm	16.46 mm
14.64 mm	20.58 mm
17.57 mm	24.69 mm
20.5 mm	28.81 mm
23.43 mm	32.92 mm

When using medium- and low-quality text, the character is placed within the character cell as shown in Figure 2.

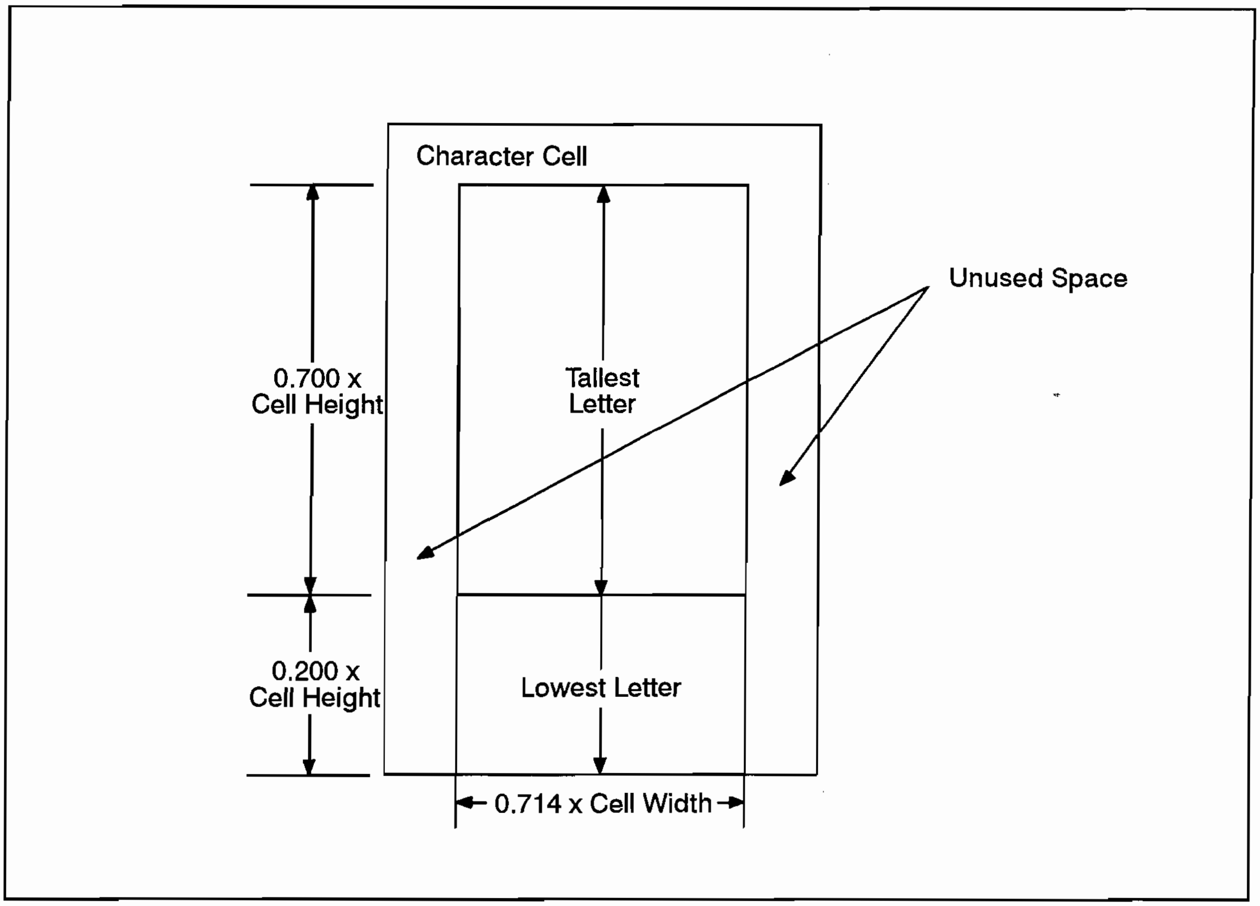


Figure 2. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not provided. If window clipping is turned off in AGP and vectors are created that lie entirely or partially outside of the view surface, unpredictable results may occur. Medium- and low-quality text strings are clipped if they do not lie entirely within the physical limits of the graphics display.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). Polygon sets with device-dependent polygon styles are displayed using hardware area fill. The terminal hardware supports convex, concave, and self-intersecting polygon sets. However, only some polygon sets with multiple polygons, (for example, simple donuts) are displayed as requested. The hardware does not fill polygon sets having more than 105 vertices after clipping by AGP.

If the user specifies a density that is less than 1/8 but greater than 0.0, then a density of 1/8 is used. If the density is greater than −1/8 but less than 0.0, than a density of −1/8 is used. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive, and up to the nearest 1/8 if the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding to the nearest multiple of 45 degrees. For densities other than −1.0, 1.0, and 0.0, crosshatching is supported. For all polygon fills, the interior line style is ignored. For densities other than −1.0 and 0.0, the color used in filling is the closest approximation of the interior color requested, chosen from the eight non-dithered colors. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive and up to the nearest 1/8 if the density is negative.

Except when the style specifies a fill density of −1.0 or 0.0, the user-defined area fill pattern is set to solid after device-dependent filling of a polygon set.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). Nineteen standard markers are supported. Markers are always 2.1 mm by 3.37 mm.

Medium- and Low-Quality Text

(JTEXM/JTEXL). Medium- and low-quality graphics text are generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide and 7 high in a character cell having a size ratio of 7 wide by 10 high. See Figure 3 for the viewable graphics character set.

```
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
!"#$%&'()*+,-./0123456789:
;<=>?@[\]^_`{|}~
```

Figure 3. Supported Graphics Text Characters

If a medium- or low-quality text string is not clipped by AGP and extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped.

Medium- and low-quality text use only the color attribute. Characters are always generated using solid lines. The direction, slant, and justification of these types of text can be modified through the use of escape functions (see JOESC, Opcodes 1050, 1051, and 1052).

New-Frame-Action

(JNEWF/JPURG/JSVIS/JSHI/JVSAL/JCLR). When a new-frame-action is given, the action taken is dependent on whether the simulated raster erase bit was set during the JDINT call. The actions taken are outlined below:

Simulated Raster Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates clears the display to the background color and redraws all visible segments.

When the new-frame-action is given with the display not enabled, it does not alter the display. When given inside a batch-of-updates, the screen does not change until the JUPDT call is given. At this time, the screen is cleared to the background color and all visible segments are redrawn.

Simulated Raster Erase Set

The HP 2397A terminal has the ability to erase images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call. AGP uses this feature to remove graphics elements without first clearing the display. For example, AGP uses simulated raster erase when a segment is purged.

An explicit JNEWF call always clears the display and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates. This gives the user a means of generating a clean surface (one without holes.)

The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations because, by definition, the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside a batch-of-updates always results in the screen being cleared and visible segments redrawn when the JUPDT call is given.

Note Erasing is done by redrawing the image in the background color; therefore, lines crossing the image to be purged may also have parts of them erased, leaving holes.

Inquire Escape Functions

(JIESC). The following inquire escape functions are supported by AGP:

Opcode	Function
3050	Inquire medium- and low-quality text status.
	ILIST(1) = Current medium- and low-quality hardware text justification. See Figure 4 for possible values.
	ILIST(2) = Current medium- and low-quality hardware text direction. Possible values are 0, 90, 180, or 270 degrees.
	ILIST(3) = Current medium- and low-quality hardware text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(JOESC). Several output escape functions are supported by AGP. Error checking is not performed by the graphics system on any of the parameters sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function.

Escape functions are not stored in the segment display area. This can have implications when used with AGP segments. For example, suppose the line style is set to 10 and the escape function (see JOESC, Opcode 2050) is used to define a line pattern. A segment is created and then appears on the screen with the given line pattern. If the line pattern is changed and a new-frame-action is given, the segment is redrawn with the current line pattern and not the line pattern used when it was originally created.

Escape functions may have undesirable effects on medium- and low-quality text. For example, if JJUST is used to set AGP justification to center and a hardware justification is chosen, the text may not end up justified.

Escape functions are sent from AGP directly to the device. The state of AGP may become undefined when an escape function is given that overrides a mode set by AGP (for example, hardware text justification).

The following output escape functions are supported:

Opcode	Function
450	Perform rectangular area fill using the current area pattern (see Opcode 1057) and color. The rectangular area is specified in virtual coordinates
	RLIST(1) = Minimum X Border of rectangle. RLIST(2) = Maximum X Border of rectangle. RLIST(3) = Minimum Y Border of rectangle. RLIST(4) = Maximum Y Border of rectangle.
1050	New text direction. Set device text direction for subsequent graphics text.
	ILIST(1) = 0 0 degrees (horizontal). ILIST(1) = 1 90 degrees counterclockwise. ILIST(1) = 2 180 degrees counterclockwise. ILIST(1) = 3 270 degrees counterclockwise.

1051 Text slant. Set device character slant for subsequent output medium- and low-quality graphics text.

ILIST(1) = 0 0 degrees (normal).
ILIST(1) = 1 45 degrees.

1052 Set device text justification for subsequent output medium- and low-quality graphics text. This applies to characters individually for medium-quality graphics text.

ILIST(1) = Text justification. See Figure 4 for the supported justification.

When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when centered or right justifying is 80 characters (not including the CR or LF). In all cases data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.

1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.

1056 Set special drawing modes. This escape function overrides the color as defined by the JCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to JCOLR. See Figure 5 for the effect of color and the special drawing modes.

ILIST(1) = 1 Enable complement drawing mode. All primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black, and all black pixels turn white. Colors will be toggled. For example, using the RGB color model, a color that has a red value of 'a', a green value of 'b', and a blue value of 'c', will have a red value of "1-a", a green value of "1-b" and a blue value of "1-c". Red (1,0,0) becomes cyan (0,1,1) and yellow (1,1,0) becomes blue (0,0,1).

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the effect of overlaying the output primitives generated with it over the current primitives on the graphics display.

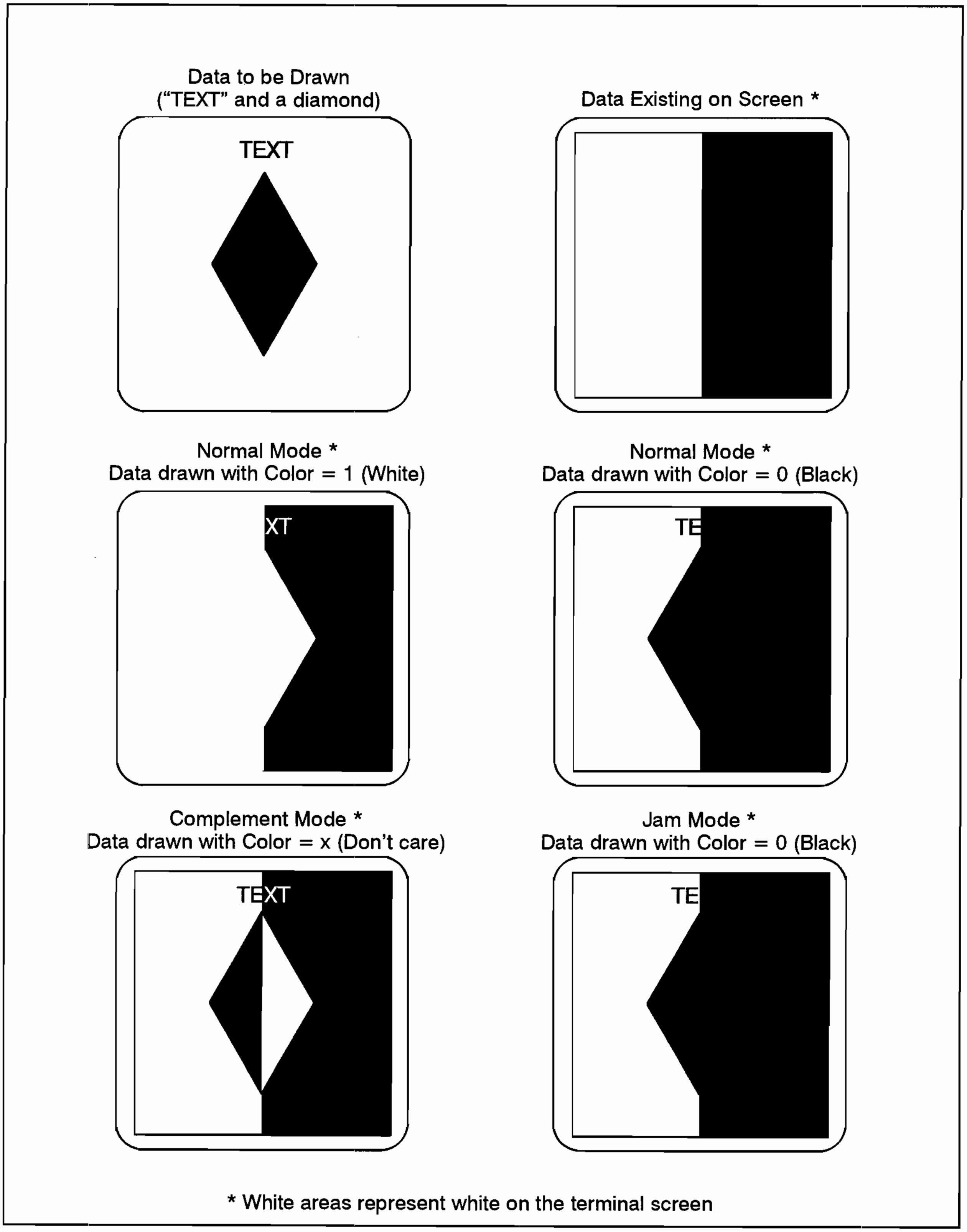


Figure 5. Special Drawing Modes

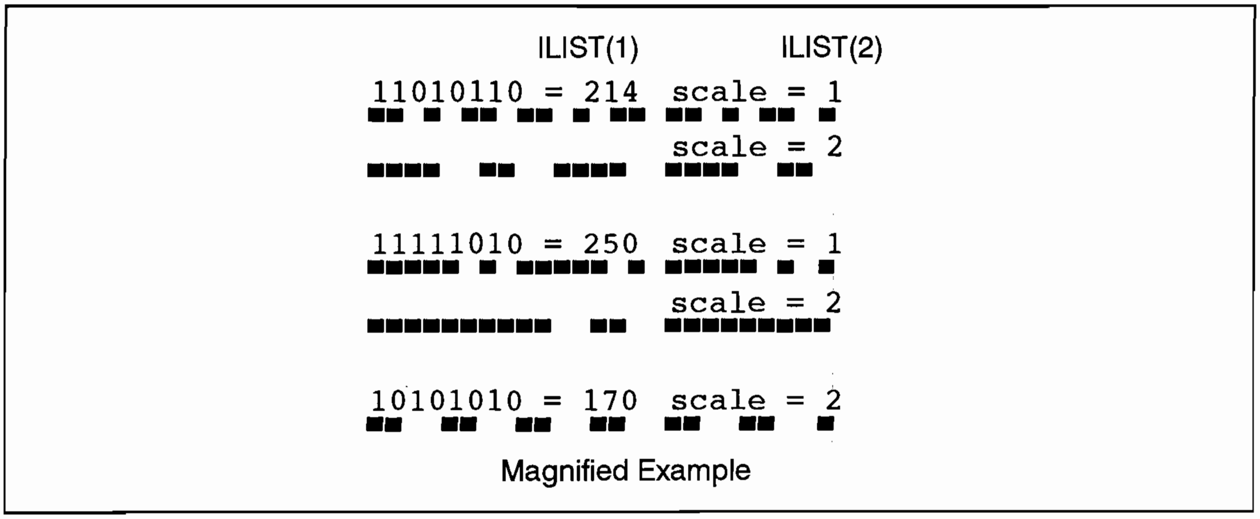
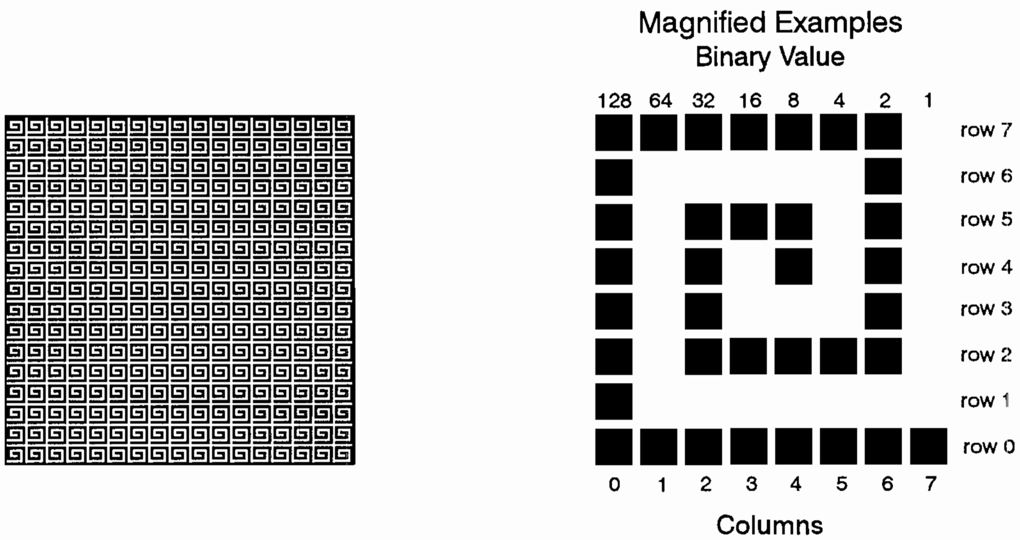


Figure 6. Magnified Examples of User-Defined Line Styles

8050 Define area pattern. An 8 by 8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging from 0 to 255 which defines an 8-bit binary pattern. The graphics display is divided into 8 by 8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used for drawing lines by setting the line style to 10 and selecting area pattern 2 (see Opcode 1057). Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling a rectangular area. The user-defined area pattern can be used for filling polygons when the current polygon style has a density of -1, and specified device-dependent output. Figure 7 and Figure 8 contain sample area fill patterns.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.




```
ILIST(8)  Row 7   11111110 - 254
ILIST(7)  Row 6   10000010 - 130
ILIST(6)  Row 5   10111010 - 186
ILIST(5)  Row 4   10101010 - 170
ILIST(4)  Row 3   10100010 - 162
ILIST(3)  Row 2   10111110 - 190
ILIST(2)  Row 1   10000000 - 128
ILIST(1)  Row 0   11111111 - 255

                  1 = dot on
                  0 = dot off
```

Figure 7. Defining Area Patterns

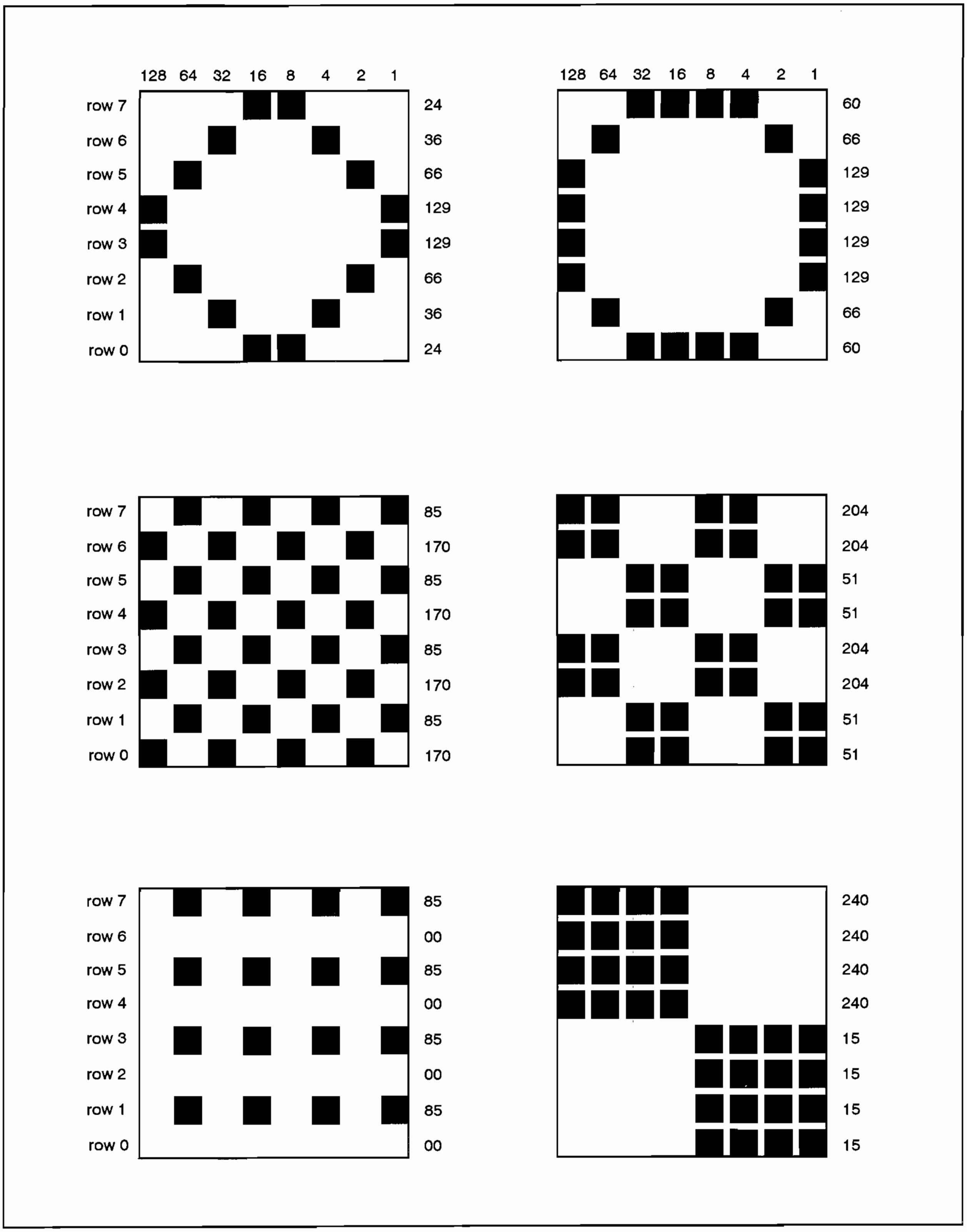


Figure 8. Magnified Examples of Area Patterns

Locator Echoes on the Graphics Display

(JWLOC). The type of echoes available on the graphics display depends on whether the graphics display and locator are the same physical device. For echoes supported on the locator device, see the device handler that discusses that specific locator device.

Same Physical Device

If the locator and the graphics display are the same physical device, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until an operator response occurs. When an operator response occurs, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X-coordinate of the graphics cursor and the Y-coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X-coordinate of the graphics cursor and the Y-coordinate of the locator echo position.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or ECHO 6, whichever defines a longer line from the locator echo position.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the position of the graphics cursor.

If an HP-HIL positioning device is attached to the terminal, it is considered the same logical device as the locator and is an extension of the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when tablet pen or mouse button is depressed.

Different Physical Devices

If the locator and the display devices are different physical devices and the locator device supports echoing on the graphics display, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Pick Echoes on the Graphics Display

(JPICK). For echoes supported on the pick device, see the corresponding device handler that discusses the pick device in question.

Echo #	Echo Performed
2	Initially, the graphics cursor is turned on at the current pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is completed. Before control returns to the application program, the graphics cursor is turned off.

If an HP-HIL positioning device is attached to the terminal, it is considered the same logical device as the pick and is an extension of the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen or mouse button is depressed.

Disabling

(JWOFF). The display is not reset to initial values when JWOFF is called. Values remain as they were last set. For example, color may remain set to the background color if the last operation was a simulated raster erase.

Graphics Display Device Handler (DGL)

Description

The dimensions of the graphics display device are as follows:

- Maximum limits

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	512 points Wide	390 points High

  Aspect ratio of maximum area is 0.75

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

- Default limits

Screen size:	214 mm Wide	152 mm High
Screen capacity:	512 points Wide	370 points High

  Aspect ratio of maximum area is 0.72

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

The physical origin is the lower-left corner of the display. The view surface is always centered within the current logical display surface. The logical display surface is set to the default physical limits of the display.

Initialization

(ZDINT). When initialized, the following operations are performed:

Device name:	Set to "2390A " or "2397A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Alphanumeric and graphics display:	Turned on.
Graphics cursor:	Turned off and is in the lower-left corner of the display.
Starting position:	Lower-left corner of the display.
Graphics memory:	Cleared if bit 7 is not set in the control word for ZDINT. If bit 7 is set, graphics memory is unaffected.
Alphanumeric memory:	Not cleared.
Color table:	Initialized to the default values.
Text slant:	Set to 0 degrees.
Text label direction:	Set to 0 degrees (horizontal).
Label origin:	Set to 1 (left, bottom, justified).
User-defined area and line patterns:	Set to solid.
New-frame-action:	Buffered if bit 6 of the control word in the ZDINT call is set.

Supported Primitive Attributes

Color

(ZCOLR). The D0060 display handler provides a software color table of 32 colors. The default values of the color table are shown in Table 2.

The terminal can display eight non-dithered colors at a time, selectable from a palette of 64 colors. The color table is initialized when ZDINT is called. The initial values of entries 0-7 correspond to the eight non-dithered colors. The colors in the color table can be redefined at any time (see ZDCOL/ZICOL).

Any color other than the eight non-dithered colors can only be produced through dithering, using device dependent polygon generation with a solid fill pattern (see ZPICL). ZCOLR approximates the color selected from table entries greater than 7, with the closest non-dithered color in entries 0-7.

Redefining and Inquiring Color

(ZDCOL/ZICOL). The colors in the color table can be redefined and inquired, including the background color (which has index 0 in the color table). Elements on the display (including the background itself) that have their color index redefined, are affected as soon as the change is made to the terminal.

When defining the new RGB color specification, values, the terminal firmware rounds down the value to the nearest multiple of 0.25. The numbers are rounded down as follows:

Range of Input Values	"rounded" value
0.00-0.24	0.00
0.24-0.49	0.25
0.50-0.74	0.50
0.75-0.99	0.75
1.00-	1.00

Redefining the first eight entries in the color table affects the dithered colors, because the terminal firmware dither algorithm assumes the default color table specification for the first eight entries.

Polygon Interior Line Style

(ZPILS). Refer to ZLSTL for information regarding line style.

Table 2. Default Color Table

Color Table Index	Red	Green	Blue	Color
0	0.000	0.000	0.000	Black
1	1.000	1.000	1.000	White
2	1.000	0.000	0.000	Red
3	0.000	1.000	0.000	Green
4	1.000	1.000	0.000	Yellow
5	0.000	0.000	1.000	Blue
6	1.000	0.000	1.000	Magenta
7	0.000	1.000	1.000	Cyan
8	0.000	0.533	0.600	Turquoise
9	0.400	0.133	0.000	Brown
10	0.933	0.333	0.000	Toasted Orange
11	0.600	1.000	0.067	Lime Green
12	0.933	0.733	0.000	Golden Yellow
13	0.333	0.333	1.000	Medium Blue
14	0.600	0.133	1.000	Violet
15	0.000	0.400	0.533	Blue-Green
16	0.800	0.800	0.800	Light Gray
17	0.940	0.000	0.000	Red
18	0.940	0.313	0.000	Orange
19	0.940	0.627	0.000	Gold
20	0.940	0.940	0.000	Yellow
21	0.627	0.940	0.000	Yellow-Green
22	0.313	0.940	0.000	Green-Yellow
23	0.000	0.940	0.000	Green
24	0.000	0.940	0.313	Green-Blue
25	0.000	0.940	0.627	Aqua
26	0.000	0.940	0.940	Light Blue
27	0.000	0.470	0.940	Denim Blue
28	0.000	0.000	0.940	Blue
29	0.470	0.000	0.940	Violet
30	0.940	0.000	0.940	Dark Magenta
31	0.940	0.000	0.627	Deep Pink

Polygon Interior Color

(ZPICL). With the exception of solid filled, hardware generated (device dependent) polygon interiors, only the eight non-dithered colors are available for output primitives. If solid filled, hardware generated polygons are selected in the ZPSTL call, hardware dithering is used to fill the polygon with a color pattern that is as close as possible to the selected color definition.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Highlighting

(ZHIGH). Highlighting is not supported.

Line Style

(ZLSTL). Eight predefined line styles are supported. In addition, two user-definable styles can be selected. These line styles are defined through the use of an output escape function. (See ZOESC, Opcode 2050). Initially, the two user-definable line styles are set to solid.

All of the supported line styles are *continuous*. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete description of a continuous line style.

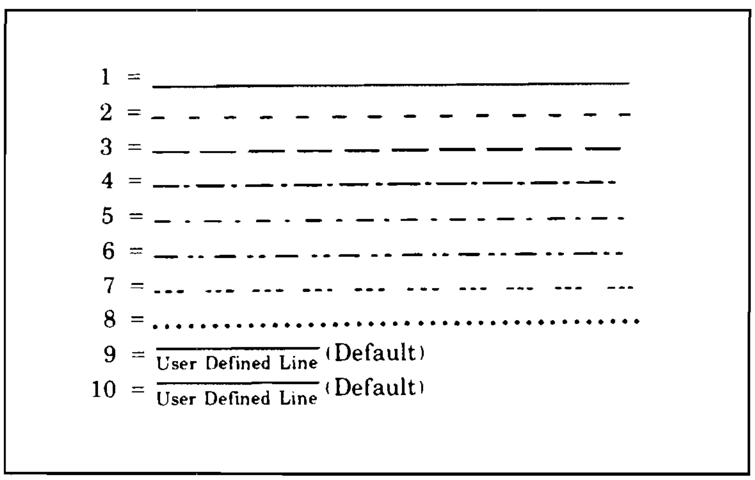


Figure 9. Supported Line Styles

Line Width

(ZLWID). Only one line width is supported.

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

Character Sizes

(ZCISZ). There are eight distinct character sizes supported. They all have a constant aspect ratio of 1.4. The supported character sizes are:

Width	Height
2.93 mm	4.12 mm
5.86 mm	8.23 mm
8.79 mm	12.35 mm
11.72 mm	16.46 mm
14.64 mm	20.58 mm
17.57 mm	24.69 mm
20.5 mm	28.81 mm
23.43 mm	32.92 mm

The character is placed within the character cell as shown in Figure 10.

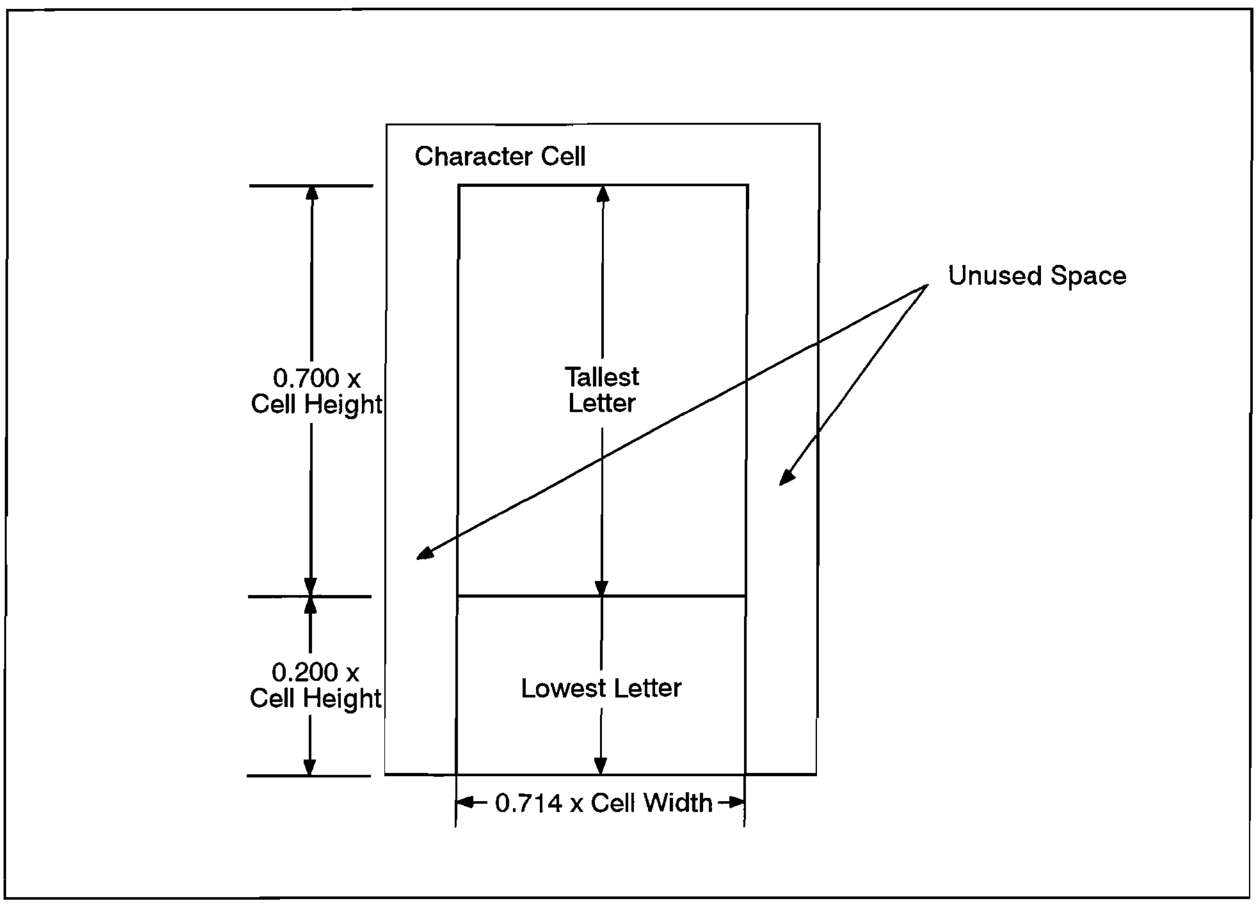


Figure 10. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not provided. A vector with one or both of its endpoints outside the physical limits is displayed in an unpredictable manner. Text characters are clipped if they do not lie within the physical limits of the display.

Polygons

(ZPGDD). Hardware filling is provided for polygon sets of up to 105 vertices. The terminal hardware supports convex, concave, and self-intersecting polygon sets. However, only some polygon sets with multiple polygons (for example, simple donuts) are displayed as requested.

If the polygon style specifies a density of 1.0, the polygon set is solid-filled. Hardware dithering may be necessary to approximate the current polygon interior color selection. If the user specifies a fill density of −1.0, the polygon is filled with the current user-defined area pattern. The default for this pattern is solid. (See ZOESC, Opcode 8050, for further details.) If the user specifies a density that is less than 1/8 but greater than 0.0, then a density of 1/8 is used. If the density is greater than −1/8 but less than 0.0, then a density of −1/8 is used. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive, and up to the nearest 1/8 if the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding to the nearest multiple of 45 degrees. For densities other than −1.0, 1.0, and 0.0, crosshatching is supported. For all polygon fills, the interior line style is ignored. For densities other than −1.0 and 0.0, the color used in filling is the closest approximation of the interior color requested, chosen from the eight non-dithered colors.

Except when the style specifies a fill density of 1.0, −1.0, or 0.0, the user-defined area fill pattern is set to solid by ZPGDD upon its completion.

Markers

(ZMARK). Nineteen standard markers are supported. Markers are always 2.1 mm by 3.37 mm.

Text

(ZTEXT). Graphics text is generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide by 7 high in a character cell having a size ratio of 7 wide by 10 high. See Figure 11 for the viewable graphics character set. In addition to the viewable characters, text strings can also include the following control characters:

Decimal Code	Function
8	Move backward one character cell.
9	Move forward one character cell.
10	Move down one character cell.
11	Move up one character cell.
13	Carriage-return.

The actual direction moved by these control functions is dependent on the text direction and the text origin in use. Only the above special characters should be included in graphics text strings in addition to the printable ASCII characters.

Graphics text is not affected by the line style attribute; character strings are output as solid lines. The direction, slant, and justification of text can be modified through the use of escape functions (see ZOESC, Opcodes 1050, 1051, and 1052). If a text string extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped by the terminal.

New-Frame-Action

Non-Buffered

(ZNEWF). A call to ZNEWF makes the picture current, then erases the graphics display to the background color.

Buffered

(ZNEWF). When ZNEWF is called, the graphics display is made current. The instruction to clear the graphics display is stored in the DGL buffer and is not sent to the device until the next time the buffer is sent. When the buffer is sent, the display is cleared to the background color. Any calls to DGL that were put into the buffer after the ZNEWF call now take affect on the graphics display. The current display remains until the next buffer is sent. If immediate visibility is used, the action is the same as if new-frame-actions were not buffered because the buffer is sent after every DGL call.

```
abcdefghijklmnopqrstuvwxyz

ABCDEFGHIJKLMNOPQRSTUVWXYZ

!"#$%&'()*+,-./0123456789:

;<=>?@[\]^_`{|}~
```

Figure 11. Supported Graphics Text Characters

Inquire Escape Functions

(ZIESC). The following inquire escape functions are supported:

Opcode **Function**

3050 Inquire text status.

ILIST(1) = Current text justification. See Figure 12 for possible values.

ILIST(2) = Current text direction. Possible values are 0, 90, 180, or 270 degrees.

ILIST(3) = Current text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(ZOESC). Several output escape functions are supported by DGL. Error checking is not performed by the graphics system on any of the parameters sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function. None of the supported output escape functions alter the starting position for the next primitive.

The following output escape functions are supported:

Opcode **Function**

450 Perform rectangular area fill using the current area pattern (see Opcode 1057) and color. The rectangular area is specified in virtual coordinates

RLIST(1) = Minimum X Border of rectangle.
RLIST(2) = Maximum X Border of rectangle.
RLIST(3) = Minimum Y Border of rectangle.
RLIST(4) = Maximum Y Border of rectangle.

1050 New text direction. Set device text direction for subsequent graphics text.

ILIST(1) = 0 0 degrees (horizontal).
ILIST(1) = 1 90 degrees counterclockwise.
ILIST(1) = 2 180 degrees counterclockwise.
ILIST(1) = 3 270 degrees counterclockwise.

1051 Text slant. Set character slant for subsequent output graphics text.

ILIST(1) = 0 0 degrees (normal).
ILIST(1) = 1 45 degrees.

1052 Set text justification for subsequent output graphics text.

ILIST(1) = Text justification. See Figure 12 for supported justifications.

When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when centered or right justifying is 80 characters (not including the CR or LF). In all cases data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.

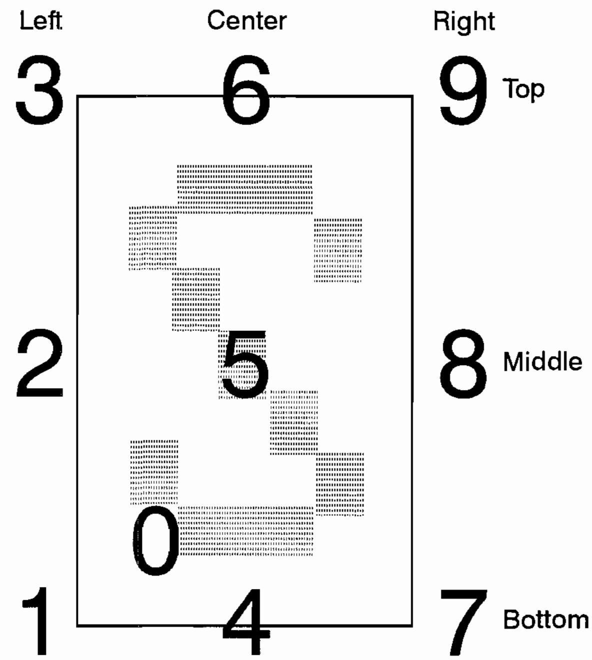
1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.

1056 Set special drawing modes. This escape function overrides the color as defined by the ZCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to ZCOLR. See Figure 13 for the effect of color and the special drawing modes.

ILIST(1) = 1 Enable complement drawing mode. All primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black, and all black pixels turn white. For example, when drawing a line in the mode, all white pixels in the line's path turn black, and all black pixels turn white. Colors will be toggled. For example, using the RGB color model, a color that has a red value of 'a', a green value of 'b', and a blue value of 'c', will have a red value of "1-a", a green value of "1-b" and a blue value of "1-c". Red (1,0,0) becomes cyan (0,1,1) and yellow (1,1,0) becomes blue (0,0,1).

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the effect of overlaying the output primitives generated with it over the current primitives on the graphics display.



The numbers 1-9 represent the cursor position with respect to the character cell used for graphics text characters. The number 0 represents the cursor position with respect to the character (not this cell).

Justification/Origin. Text strings can be automatically right or left justified, or centered about a specified point. An ASCII character 0 through 9 indicates the origin (justification and base line) for characters with respect to the current pen position. This function is useful when drawing tables.

If text is left justified, the current pen position is the left margin. Center causes the label to be centered on the pen position. Right justify selects the pen position as the right margin. Bottom, middle, and top select the base line for the line of text.

For example, if text was to be right justified and set with a base line on top of the normal character position, the number "9" would be used.

Figure 12. Hardware Text Justification

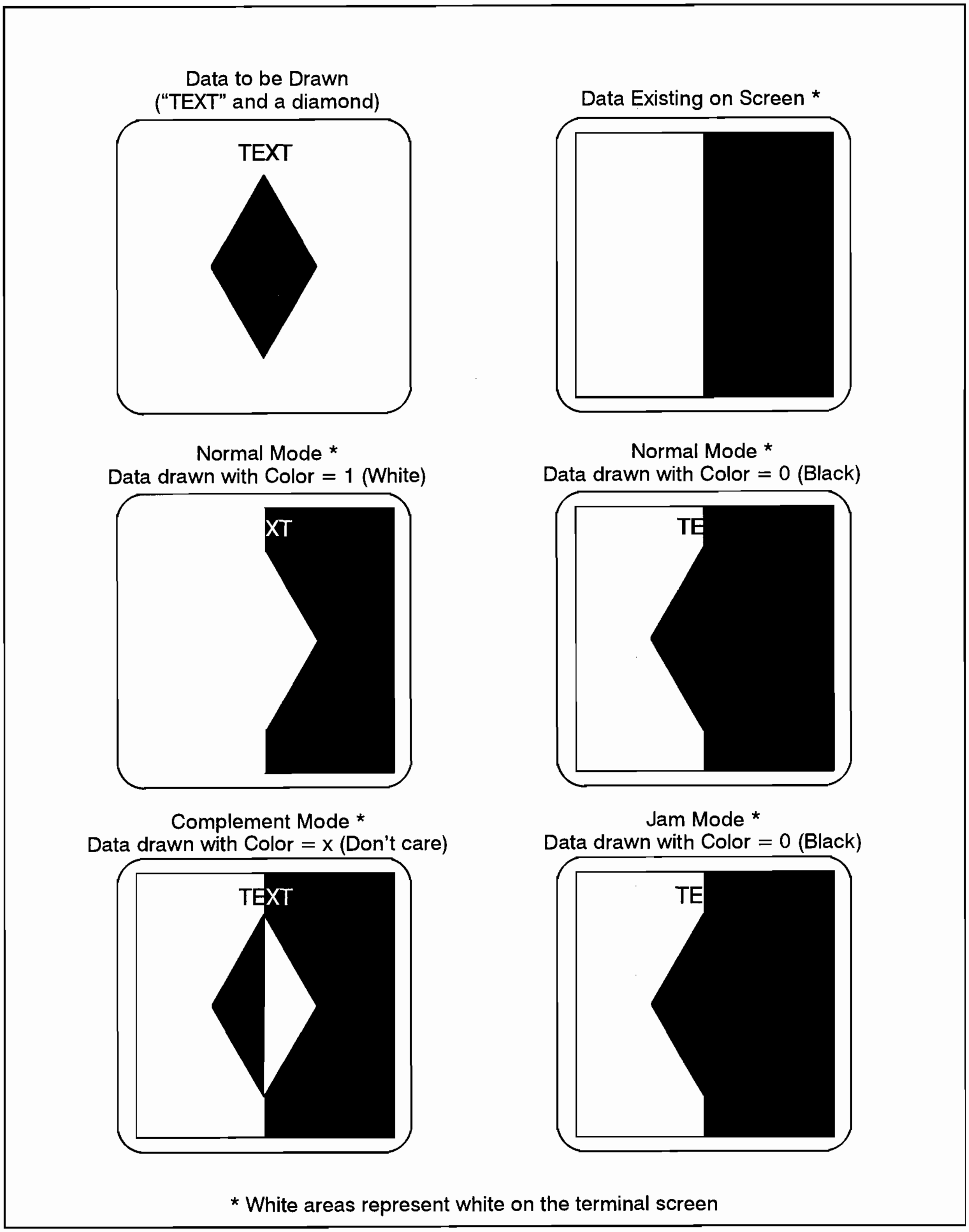


Figure 13. Special Drawing Modes

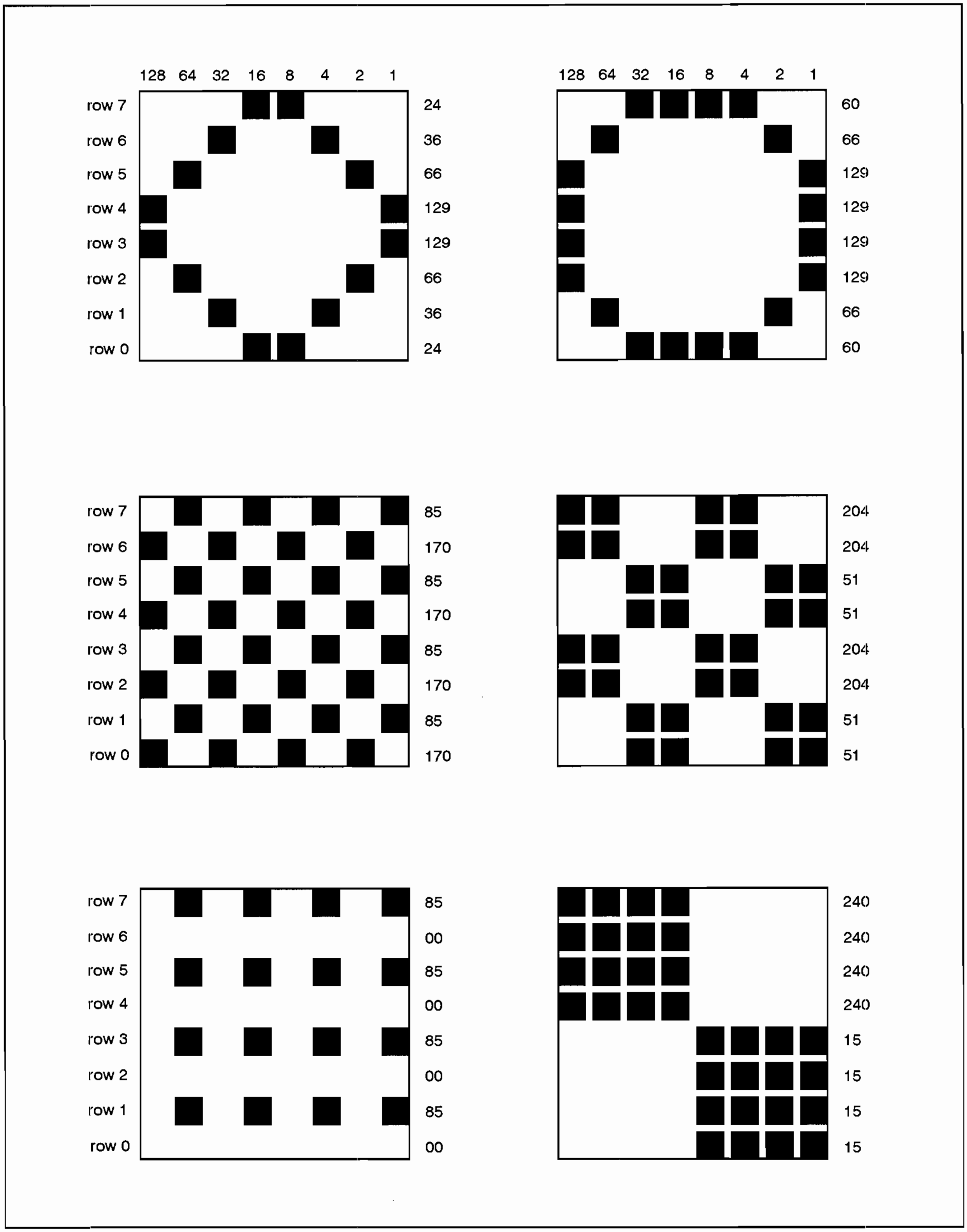


Figure 16. Magnified Examples of Area Patterns

Locator Echoes on the Graphics Display

(ZWLOC). The type of echoes available on the graphics display depends on whether the graphics display and locator are the same physical device. For echoes supported on the locator device, see the device handler that discusses that specific locator device.

Same Physical Device

If the locator and the graphics display are the same physical device, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until an operator response occurs. When an operator response occurs, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X-coordinate of the graphics cursor and the Y-coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X-coordinate of the graphics cursor and the Y-coordinate of the locator echo position.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or ECHO 6, whichever defines a longer line from the locator echo position.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the position of the graphics cursor.

If an HP-HIL positioning device is attached to the terminal, it is considered the same logical device as the locator and is an extension of the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen or mouse button is depressed.

Different Physical Device

If the locator and the display devices are different physical devices and the locator device supports echoing on the graphics display, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Termination

(ZDEND). The graphics display is unaltered. The device name is set to "0060 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0. All attribute values remain unaltered until the system is re-initialized or the display device is enabled again.

Keyboard Device Handler

Description

The terminal has a standard ASCII keyboard that is supported as a keyboard input device. The device handler required to use the keyboard device is K0001.

Initialization

(JEDEV/ZKINT). When the keyboard device is initialized, the alphanumeric display is turned on. The device name is set to "2390A ". The name is padded to 6 characters with trailing blanks.

Keyboard Input

(JKYBD/ZKYBD). Once the keyboard device is enabled, it is available for input operations. When JKYBD or ZKYBD are called, a read operation is set pending on the terminal. The operator then enters the desired text and terminates the operation by entering a CR. Some keys have special meanings when entered by the operator and are not returned to the application program. (See the AGP or DGL reference manual for a description of these keys.)

Echoes Supported

The keyboard device supports the following echoes:

Echo #	Echo Performed
0	Text is not displayed on the terminal alphanumeric display as it is entered.
1	Text is displayed on the terminal alphanumeric display as it is entered.

Termination

(JDDEV/ZBEND). The alphanumeric display is unaltered. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Locator Device Handler

Description

The dimensions of the locator device are as follows:

- Maximum limits

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	512 points Wide	390 points High

  Aspect ratio of maximum area is 0.75

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

- Default limits

Screen size:	214 mm Wide	152 mm High
Screen capacity:	512 points Wide	370 points High

  Aspect ratio of maximum area is 0.72

Resolution:	2.39 points/mm in X direction 2.43 points/mm in Y direction

The default locator limits are set equal to the default physical limits of the display.

The physical origin is the lower-left corner of the display.

The terminal has a graphics locator that is capable of returning any point on the screen. The device handler required to use the locator device is L0060.

Initialization

(JEDEV/ZLINT). When initialized, the terminal's graphics display is left unaltered. The device name is set to "2390A ". The name is padded to 6 characters with trailing blanks.

Wait Locator Input

(JWLOC/ZWLOC). The wait locator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key. The (X,Y) coordinate value of the graphics cursor (which is a function of the echo) and the key struck are returned to the application program. Any of the ASCII keys can be used to terminate the locator function so the key returned to the application program can range from 0 to 127.

Echoes Supported

Locator input can be echoed on either a graphics display device or a locator device. The echo can only be performed on a graphics display device when the locator and the graphics display devices are implemented on the same physical device (that is, the same HP 2397A Graphics Terminal). Refer to the graphics display sections to see how the locator can echo input on the graphics display.

The locator device supports the following echoes:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator using the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the locator function is terminated. Before control returns to the application program, the graphics cursor is turned off.

Sample Locator Input

(JSLOC/ZSLOC). The sample locator function returns the current locator position without waiting for an operator response. The graphics cursor is turned off following the sample locator function.

Echoes Supported

Echo #	Echo Performed
0	Echo is not performed.
1	The bell in the terminal is sounded when the locator is sampled.

Termination

(JDDEV/ZLEND). The device name is set to "0060 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Valuator Device Handler

Description

The dimensions of the valuator device are as follows:

- Maximum limits

Screen size:	214 mm Wide	160.5 mm High
Screen capacity:	512 points Wide	390 points High

- Default limits

Screen size:	214 mm Wide	152 mm High
Screen capacity:	512 points Wide	370 points High

The terminal can simulate a valuator device with the graphics locator. The simulation is done by splitting the X- and Y-coordinates into two subvaluators and scaling the locator coordinates to values that range from 0.0 to 1.0.

The device handler required to use the locator device is V0060.

Initialization

(JEDEV/ZVINT). When initialized, the terminal's graphics display is left unaltered. The device name is set to "2390A ". The name is padded to 6 characters with trailing blanks.

Wait Valuator Input

(JWVAL/ZWVAL). The wait valuator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key.

In addition to returning the subvaluator value, the key struck to terminate the valuator operation is also returned to the application program. Any of the ASCII keys can be used to terminate the valuator function so the key returned to the application program can range from 0 to 127.

The value returned is a function of the subvaluator specified as follows:

Subvaluator	Value Returned
1	The X-coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the left edge and a value of 1.0 is returned if the cursor is at the right edge of the display.
2	The Y-coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the bottom and a value of 1.0 is returned if the cursor is at the top of the display.

Echoes Supported

The valuator device supports the following echoes:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator using the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the valuator function is terminated. Before control returns to the application program, the graphics cursor is turned off.

Sample Valuator Input

(JSVAL/ZSVAL). The sample valuator function returns a subvaluator value without waiting for an operator response. The valuator simulation is performed in the same way as for the wait valuator input function.

Echoes Supported

The following echoes are supported when using the sample valuator function:

Echo #	Echo Performed
0	Echo is not performed.
1	The bell in the terminal is sounded when the valuator is sampled.

Termination

(JDDEV/ZVEND). The device name is set to "0060 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 2623A Graphics Terminal

General Information

The user should be familiar with the operation of the HP 2623A Graphics Terminal. If necessary, refer to the following manuals for the appropriate operating instructions:

HP 2623A Graphics Terminal User's Manual, part number 02623-90001.

HP 2623A Graphics Terminal Reference Manual, part number 02622-90002.

Supported Logical Devices

The following logical devices are supported by the AGP/DGL Graphics Systems:

Logical Device	Device Handler Name
Alphanumeric	A0001
Button	B0001
Graphics display	D0019
Keyboard	K0001
Locator	L0019
Pick (AGP only)	P0019
Valuator	V0019

Device Configuration

The terminal should be strapped for normal point-to-point operation. The terminal should not be in block mode.

Special Considerations

Only terminals with the following ROM numbers support rubber band line and the HP 17623A Graphics Tablet: 1818-3223, 1818-3224, 1818-3225, 1818-3226, 1818-3227, 1818-3228.

Alphanumeric Device Handler

Description

The terminal has independent alphanumeric and graphic display memories that allow either or both types of data to be displayed on the same CRT. The alphanumeric device handler, A0001, allows the application programmer to send messages and alphanumeric display control commands to the terminal.

The dimensions of the alphanumeric device are as follows:

Screen size:	215 mm wide by 164 mm high
Screen capacity:	24 lines and 80 characters per line
Character size:	2.4 mm wide by 4.24 mm high

Initialization

(JEDEV/ZAINT). When the alphanumeric device is initialized, the alphanumeric display is turned on and the contents of the alphanumeric memory are left unaltered. DGL sets the device name to "2623A ". The name is padded to 6 characters with trailing blanks.

Alphanumeric Output

(JALPH/ZALPH). The state of the alphanumeric display is not altered before sending the character string to the terminal. The entire character string passed is sent directly to the terminal. A maximum of 132 characters can be sent to the alphanumeric device at one time. If the text output exceeds the size of a line, the terminal performs a carriage-return line-feed and text output continues on the next line. The character string may contain alphanumeric characters or command sequences that control the alphanumeric display (for example, clear alphanumeric memory, alphanumeric cursor control, and so forth). Command sequences that affect other parts of the terminal (that is, graphics display) should not be contained in the string because they could destroy the integrity of the graphics system.

Termination

When the alphanumeric device is terminated, the alphanumeric display is not affected. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Button Device Handler

Description

The terminal has eight *softkeys* which together are supported as a button device. These keys are above the standard ASCII keys and are labeled *f1* through *f8*. The numeric keys 1 through 8 can also be used in the same way as the softkeys. The device handler required to use the button device is B0001.

Note If the softkeys are to be used, either the labels *f1* through *f8* must appear on the softkey area of the alphanumeric display or the labels must be turned off by pressing the SHIFT and AIDS keys.

Initialization

(JEDEV/ZBINT). When the button device is initialized, all previous softkey definitions are destroyed. The softkeys *f1* through *f8* are loaded with the ASCII characters 1 through 8 respectively. The device name is set to "2623A ". The name is padded to 6 characters with trailing blanks.

Button Input

(JBUTN/ZBUTN). Once the button device has been enabled, it is available for input operations. When JBUTN or ZBUTN are called, a read operation is set pending on the terminal. Striking a softkey or an ASCII key between 1 and 8 returns the button as an integer value ranging from 1 to 8. If an invalid, transmittable (that is, ASCII) key is struck, an integer 0 is returned as the button value.

Echoes Supported

The button device handler supports the following echoes:

Echo #	Echo Performed
0	Echoing is not performed.
1	The terminal bell is sounded if a valid button is activated.

Termination

(JDDEV/ZBEND). When the button device is terminated, the softkey definitions remain as they were defined by the button device at initialization. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O descriptor are set to 0.

Highlighting

(JSHI/JGHI). Highlighting is not supported.

Line Style

(JLSTL). Eight predefined line styles are supported. In addition, two user-definable styles can be selected. These line styles can be defined through the use of output escape functions (see JOESC, Opcodes 2050 and 8050). Initially, the two user-definable line styles are set to solid. See Figure 1 for the line styles available.

All of the supported line styles are *continuous*. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, for a complete description of a *continuous* line style.

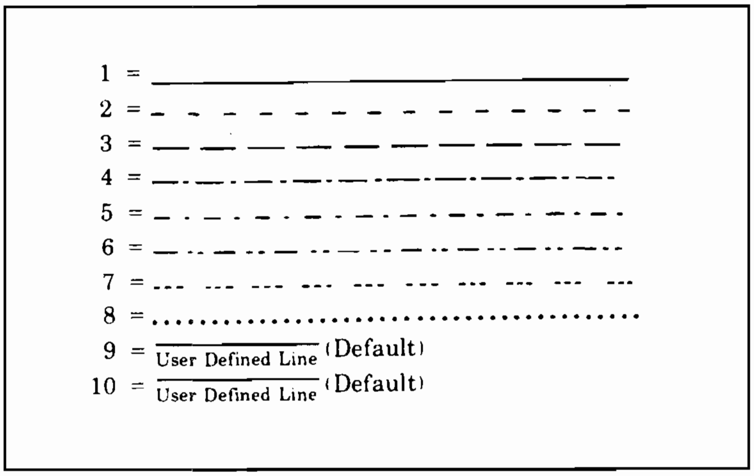


Figure 1. Supported Line Styles

Line Width

(JLWID). Only one line width is supported:

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

Character Sizes

(JCSIZ). There are eight distinct character sizes supported. They all have a constant aspect ratio of 1.43. The supported character sizes are:

Width	Height
2.9 mm	4.2 mm
5.9 mm	8.4 mm
8.8 mm	12.5 mm
11.8 mm	16.7 mm
14.7 mm	21.0 mm
17.7 mm	25.3 mm
20.5 mm	29.5 mm
23.5 mm	33.7 mm

When using medium- and low-quality text, the character is placed within the character cell as shown in Figure 2.

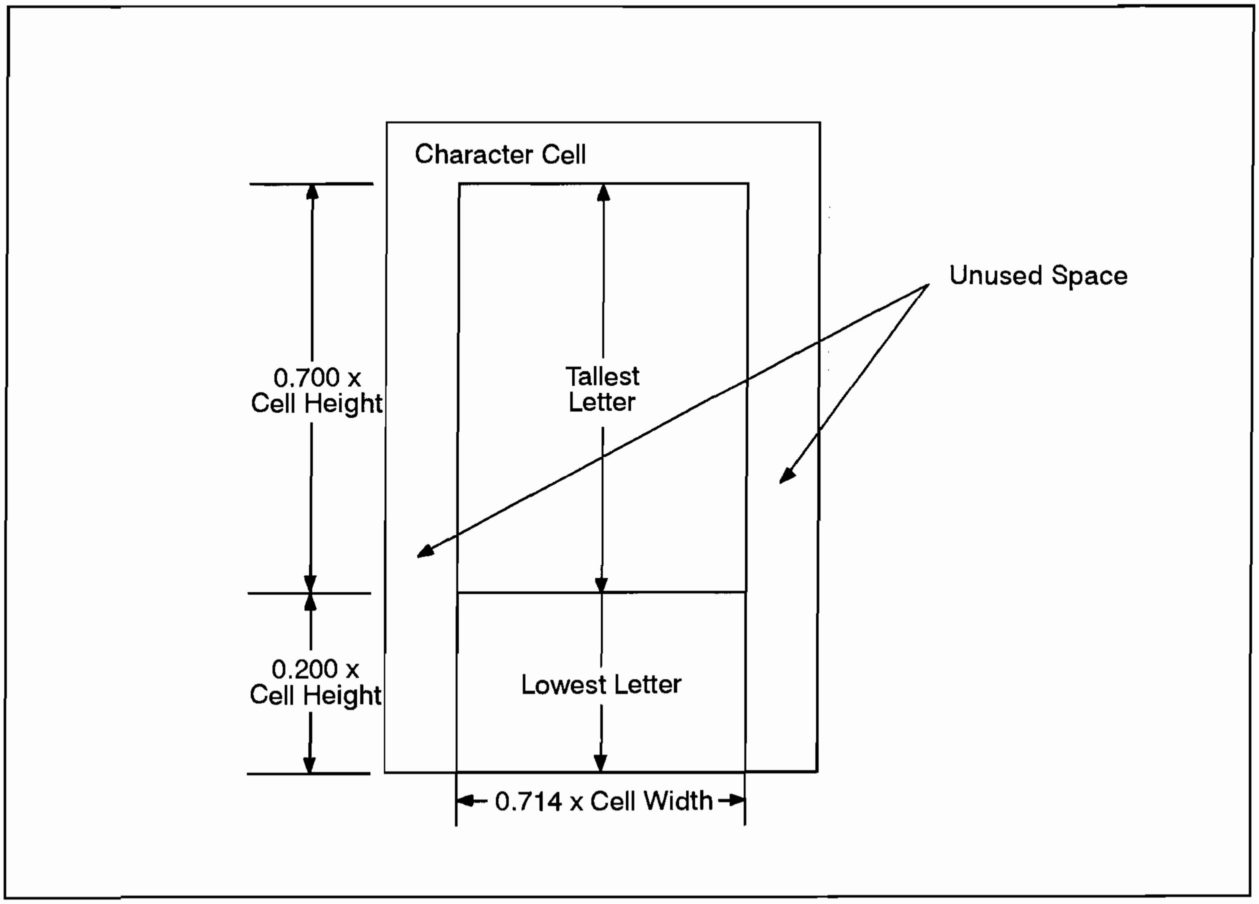


Figure 2. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not supported. If window clipping is turned off in AGP and vectors are created that lie entirely or partially outside of the view surface, unpredictable results may occur. Medium- and low-quality text strings are clipped if they do not lie entirely within the physical limits of the graphics display.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). Single rectangles with device-dependent polygon styles are displayed using hardware area fill. Their edges must be parallel to the X and Y axes of the virtual coordinate system. Other polygon sets are treated as if the device did not support hardware area fill.

Crosshatching is supported for all densities except −1.0, 1.0, and 0.0. For all polygon fills, the interior line style is ignored. For fill densities of 1.0 or −1.0, the polygon is filled with the current user-defined area pattern. (See JOESC, Opcode 8050, for further details.) If the user specifies a density that is less than 1/8 but greater than 0.0, then a density of 1/8 is used. If the density is greater than −1/8 but less than 0.0, then a density of −1/8 is used. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive and up to the nearest 1/8 if the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding up to the nearest multiple of 45 degrees. For densities other than −1.0, 1.0, and 0.0 crosshatching is supported. For all polygon fills the interior line style is ignored.

Except when the style specifies a fill density of 1.0, −1.0, or 0.0, the user-defined area fill pattern is set to solid, after device-dependent display of a rectangle.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). Nineteen standard markers are supported. The smallest character size (2.9 mm by 4.2 mm) is always used to generate markers.

Medium- and Low-Quality Text

(JTEXM/JTEXL). Medium- and low-quality graphics text are generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide and 7 high in a character cell with a size ratio of 7 wide by 10 high. See Figure 3 for the viewable graphics character set.

If a medium- or low-quality text string is not clipped by AGP and extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped by the terminal.

Medium- and low-quality text use the color attribute but do not use the line style and line width attributes. Characters are always generated using solid lines. The direction, slant, and justification of these types of text can be modified through the use of escape functions (see JOESC, Opcodes 1050, 1051, and 1052).

```
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ
!"#$%&'()*+,-./0123456789:
;<=>?@[\]^_`{|}~
```

Figure 3. Supported Graphics Text Characters

New-Frame-Action

(JNEWF/JPURG/JSVIS/JSHI/JVSAL/JCLR). The action taken when a new-frame-action is given is dependent on whether the simulated raster erase bit was set during the JDINT call and is outlined in the following two sections.

Simulated Raster Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates clears the CRT to the background color and redraws all visible segments.

When the new-frame-action is given with the display not enabled, it does not alter the display. When given inside a batch-of-updates the screen does not change until the call JUPDT is given. At this time the screen is cleared to the background color and all visible segments are redrawn.

Simulated Raster Erase Set

The terminal has the ability to undraw images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call. AGP uses this feature to remove graphics elements without first clearing the CRT. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is done by redrawing the image in black (that is, the background color); therefore, white lines crossing the image to be purged may also have parts of them erased, leaving holes.

An explicit JNEWF call always clears the CRT and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates. This gives the user of simulated raster erase a means of generating a clean surface (one without holes).

The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations, because by definition, the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside a batch-of-updates always results in the screen being cleared and visible segments being redrawn when the JUPDT call is given.

Inquiry Escape Functions

(JIESC). The following inquiry escape functions are supported by AGP:

Opcode	Function
3050	Inquire medium- and low-quality text status. ILIST(1) = Current medium- and low-quality hardware text justification. See Figure 4 for possible values. ILIST(2) = Current medium- and low-quality hardware text direction. Possible values are 0, 90, 180, or 270 degrees. ILIST(3) = Current medium- and low-quality hardware text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(JOESC). Several output escape functions are supported by AGP. Error checking is not performed by the graphics system on any of the parameters that are to be sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function.

Escape functions are not stored in the segment display area. This can have implications when used with AGP segments. For example, suppose the line style is set to 10 and the escape function (see JOESC, Opcode 2050) is used to define a line pattern. A segment is created and then appears on the screen with the given line pattern. If the line pattern is changed and a new-frame-action is given, the segment is redrawn with the current line pattern and not the line pattern with which it was originally created.

Escape functions may have undesirable effects on medium- and low-quality text. For example, if JJUST is used to set AGP justification to center and a hardware justification is chosen, the text may not end up justified.

Escape functions are sent from AGP directly to the device. The state of AGP may become undefined when an escape function is given that overrides a mode set by AGP (for example, hardware text justification).

The following output escape functions are supported:

Opcode	Function
450	Perform rectangular area fill using the current line style and color. The rectangular area is specified in virtual coordinates RLIST(1) = Minimum X border of rectangle. RLIST(2) = Maximum X border of rectangle RLIST(3) = Minimum Y border of rectangle. RLIST(4) = Maximum Y border of rectangle
1050	Set device text direction that applies to subsequently output low-quality graphics text. This applies to characters individually for medium-quality graphics text ILIST(1) = New text direction. 0 = 0 degrees (horizontal). 1 = 90 degrees counterclockwise. 2 = 180 degrees counterclockwise. 3 = 270 degrees counterclockwise.
1051	Set device character slant for subsequently output medium- and low-quality graphics text ILIST(1) = Text slant. 0 = 0 degrees (normal). 1 = 45 degrees.

1052 Set device text justification for subsequently output medium- and low-quality graphics text. This applies to characters individually for medium-quality graphics text

ILIST(1) = Text justification. See Figure 4 for the supported justifications.

When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when center or right justifying is 80 characters (not including the CR or LF). In all cases, data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.

1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off
ILIST(1) = 1 Turn graphics display on.

1056 Set special drawing modes. Using this escape function overrides the color as defined by the JCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to JCOLR. See Figure 5 for the color and the special drawing modes.

ILIST(1) = 1 Enable complement drawing mode. All primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black, and all black pixels turn white.

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the affect of overlaying the output primitives generated with the current primitives on the graphics display.

2050 Define line pattern. This allows the user to define the dot pattern used to draw vectors. Once a line pattern is defined, it can be used by setting the line style to 9. (See Figure 6 for examples on defining line patterns.)

ILIST(1) = A decimal value between 0 and 255 defining an 8-bit binary pattern.
ILIST(2) = A scale factor between 1 and 16 to be applied to the pattern.

8050 Define area pattern. An 8-by-8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging between 0 and 255 which defines an 8-bit binary pattern. The graphics display is divided into 8-by-8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used by setting the line style to 10. Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling rectangular area. The user-defined area pattern can be used for filling polygons when the current polygon style has density -1, and specifies device-dependent output. Figure 7 and Figure 8 contain sample area fill patterns.

ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.

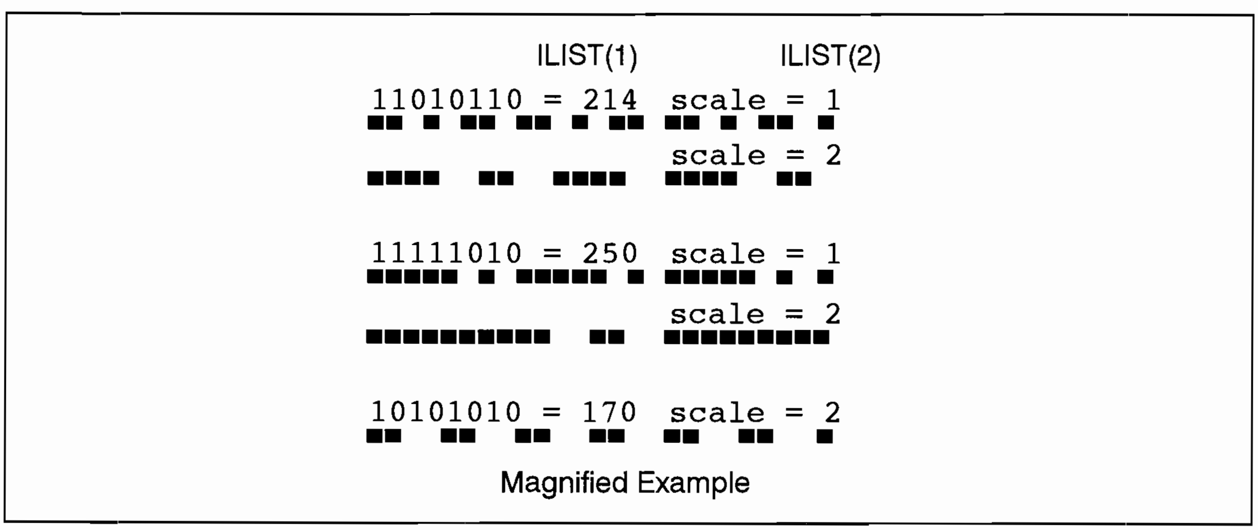
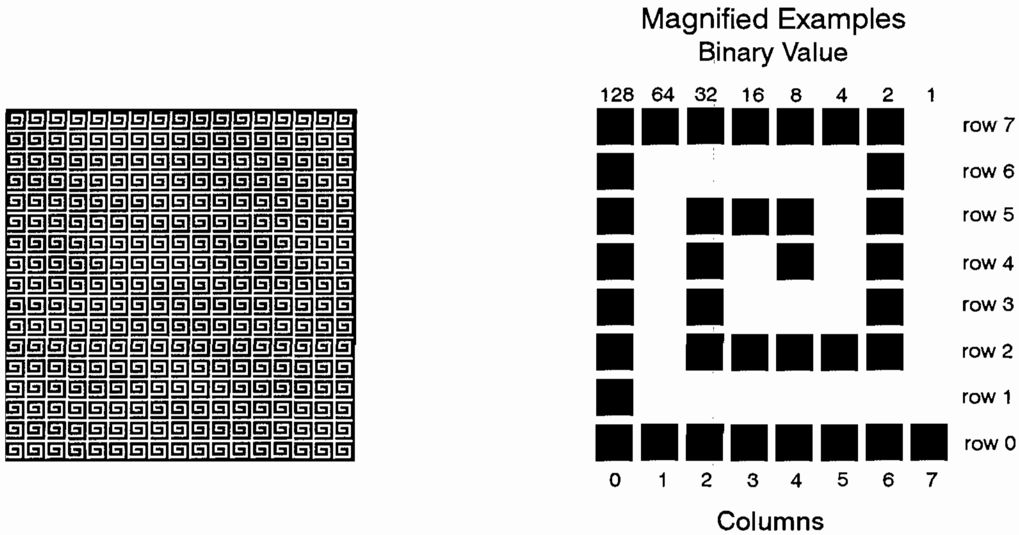


Figure 6. Magnified Examples of User-Defined Line Styles




```
ILIST(8)  Row 7   11111110 - 254
ILIST(7)  Row 6   10000010 - 130
ILIST(6)  Row 5   10111010 - 186
ILIST(5)  Row 4   10101010 - 170
ILIST(4)  Row 3   10100010 - 162
ILIST(3)  Row 2   10111110 - 190
ILIST(2)  Row 1   10000000 - 128
ILIST(1)  Row 0   11111111 - 255

                  1 = dot on
                  0 = dot off
```

Figure 7. Defining Area Patterns

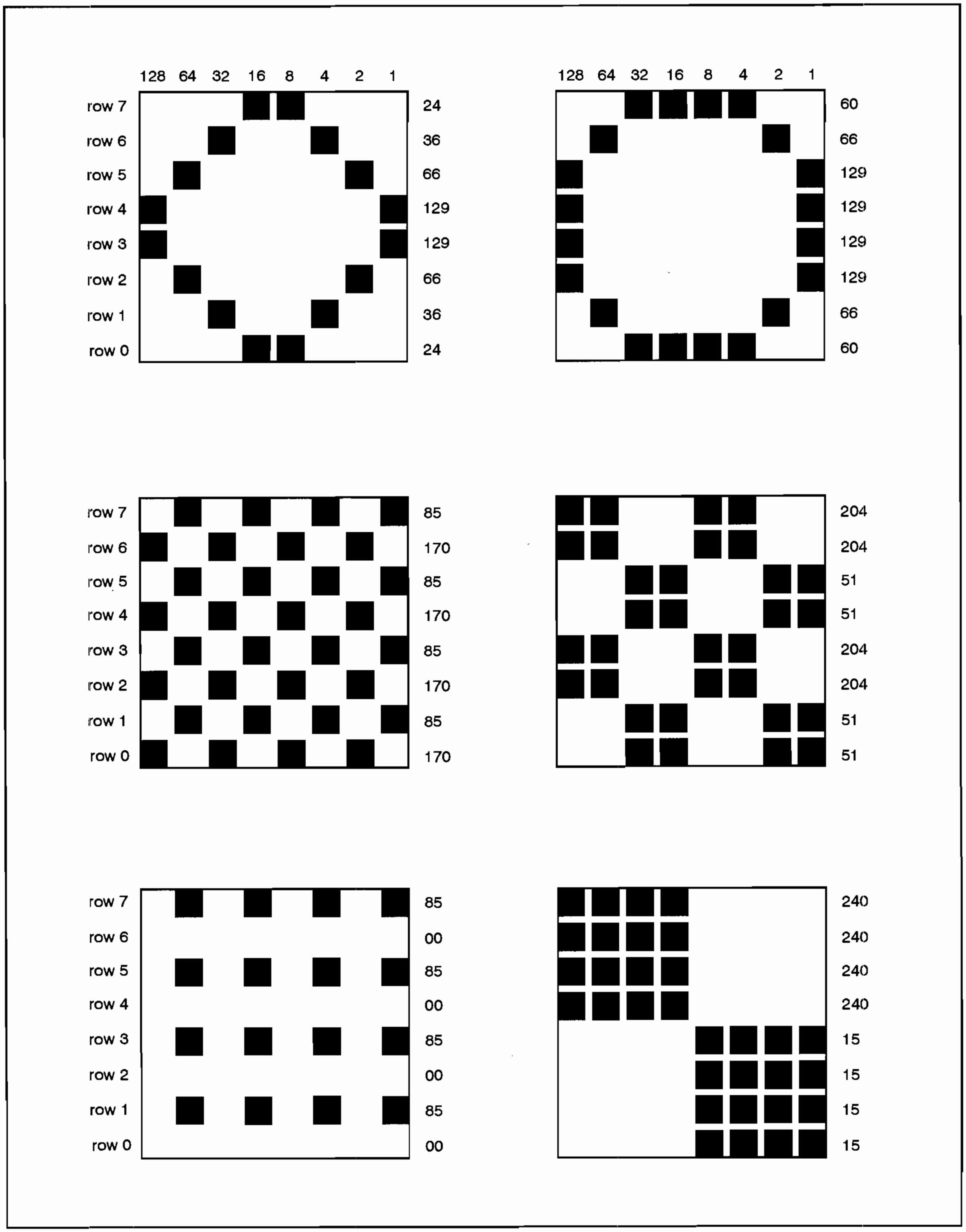


Figure 8. Magnified Examples of Area Patterns

Locator Echoes on the Graphics Display

(JWLOC). The type of echoes available on the graphics display depends on whether or not the graphics display and locator are the same physical device. For echoes supported on the locator device, see the corresponding device handler that discusses the locator device in question.

Same Physical Device

If the locator and graphics display are the same physical device, the following echoes are supported on the display:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until operator response. When an operator response occurs, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the graphics cursor and the Y coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the locator echo position and the Y coordinate of the graphics cursor.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or 6, whichever defines a longer line from the locator echo position.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are for ECHO 4. The point returned is the position of the graphics cursor.

If the HP 17623A Graphics Tablet is attached, it is considered the same logical device as the locator and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is a button value of 128 is returned when the tablet pen is depressed.

Different Physical Devices

If the locator and display devices are different physical devices and the locator device supports echoing on the graphics display, then the following echoes are supported on the graphics display:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Pick Echoes on the Graphics Display

(JPICK). For echoes supported on the pick device, see the corresponding device handler which discusses the pick device in question.

Echo #	Echo Performed
2	Initially, the graphics cursor is turned on at the current pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is completed. Before control is returned to the application program, the graphics cursor is turned off.

If the HP 17623A Graphics Tablet is attached, it is considered the same logical device as the pick and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is a button value of 128 is returned when the tablet pen is depressed.

Disabling

(JWOFF). The display is not reset to initial values when JWOFF is called. Values remain as they were last set. For example, color may remain set to the background color if the last operation was a simulated raster erase.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). Refer to ZLSTL for information regarding line style.

Highlighting

(ZHIGH). Highlighting is not supported.

Line Style

(ZLSTL). Eight predefined line styles are supported. In addition, two user-definable styles can be selected. These line styles can be defined through the use of output escape functions (see ZOESC, Opcodes 2050 and 8050). Initially, the two user-definable line styles are set to solid. See Figure 9 for the line styles available.

All of the supported line styles are *continuous*. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete discussion of a continuous line style.

Line Width

(ZLWID). Only one line width is supported.

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

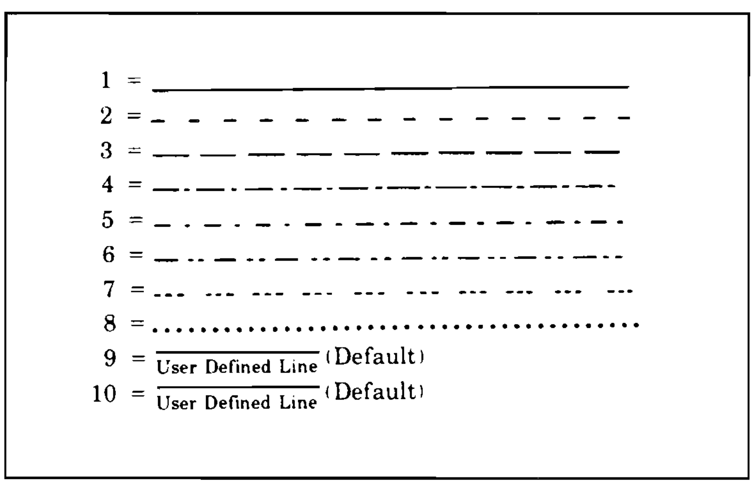


Figure 9. Supported Line Styles

Character Sizes

(ZCSIZ). There are eight distinct character sizes supported. They all have a constant aspect ratio of 1.43. The supported character sizes are:

Width	Height
2.9 mm	4.2 mm
5.9 mm	8.4 mm
8.8 mm	12.5 mm
11.8 mm	16.7 mm
14.7 mm	21.0 mm
17.7 mm	25.3 mm
20.5 mm	29.5 mm
23.5 mm	33.7 mm

The character is placed within the character cell as shown in Figure 10.

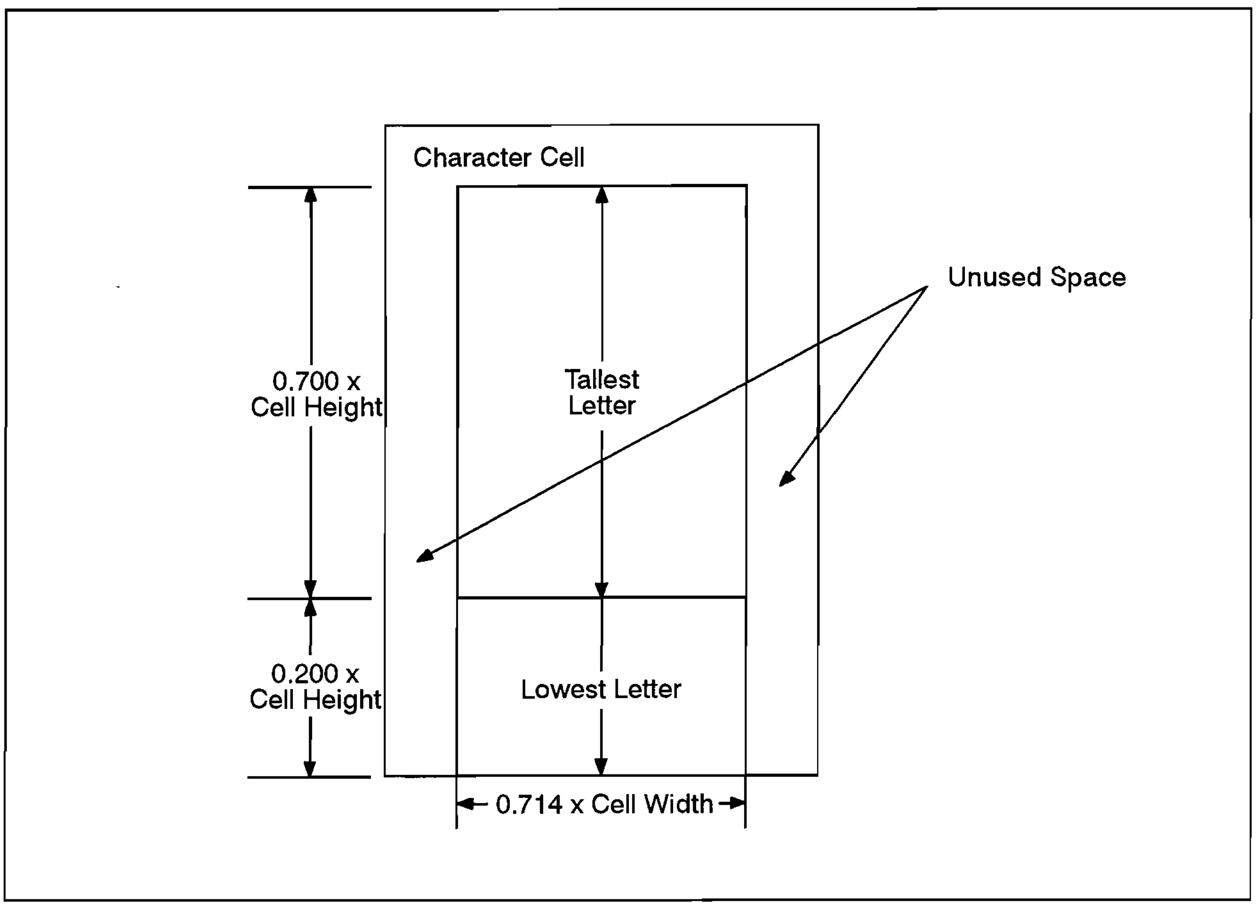


Figure 10. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not supported. A vector with one or both of its endpoints outside the physical limits is displayed in an unpredictable manner. Text characters are clipped if they do not lie within the physical limits of the graphics display.

Polygons

(ZPGDD). Hardware filling is provided for a single rectangular polygon which has edges parallel to the X and Y axes of the world coordinate system. (For other polygons, refer to the ZPGDD section of the *DGL Programmer's Reference Manual.*)

Crosshatching is supported for all densities except −1.0, 1.0, and 0.0. For all polygon fills, the interior line style is ignored. For fill densities of 1.0 or −1.0, the polygon is filled with the current user-defined area pattern. (See ZOESC, Opcode 8050, for further details.) If the user specifies a density that is less than 1/8 but greater than 0.0, then a density of 1/8 is used. If the density is greater than −1/8 but less than 0.0, then a density of −1/8 is used. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive and up to the nearest 1/8 if the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding up to the nearest multiple of 45 degrees. For densities other than −1.0, 1.0, and 0.0 crosshatching is supported. For all polygon fills the interior line style is ignored.

Except when the user specifies a fill density of 1.0, −1.0, or 0.0, the user-defined area fill pattern is set to solid by ZPGDD upon its completion.

Markers

(ZMARK). Nineteen standard markers are supported. The smallest character size (2.9 mm by 4.2 mm) is always used to generate markers.

Text

(ZTEXT). Graphics text is generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide and 7 high in a character cell with a size ratio of 7 wide and 10 high. See Figure 11 for the viewable graphics character set. In addition to the viewable characters, text strings can also include the following control characters:

Decimal Code	Function
8	Move backward one character cell
9	Move forward one character cell
10	Move down one character cell
11	Move up one character cell
13	Carriage-return

The actual direction moved by these control functions is dependent on the text direction and text origin in use. Only the above special characters should be included in graphics text strings in addition to the printable ASCII characters.

Graphics text is not affected by the line style attribute; character strings are output as solid lines. The direction, slant, and justification of text can be modified through the use of escape functions (see ZOESC, Opcodes 1050, 1051, and 1052). If a text string extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped by the terminal.

```
abcdefghijklmnopqrstuvwxyz

ABCDEFGHIJKLMNOPQRSTUVWXYZ

!"#$%&'()*+,-./0123456789:

;<=>?@[\]^_`{|}~
```

Figure 11. Supported Graphics Text Characters

New-Frame-Action

Non-Buffered

(ZNEWF). A call to ZNEWF makes the picture current and then erases the graphics display.

Buffered

(ZNEWF). When ZNEWF is called, the graphics display is made current. The instruction to clear the graphics display is stored in the DGL buffer and is not sent to the device until the next time the buffer is sent. When the buffer is sent, the display is cleared to the background color and whatever calls to DGL are put into the buffer after the ZNEWF call take effect on the graphics display. The current display remains until the next buffer is sent. If immediate visibility is being used, the action is the same as if new-frame-actions were not buffered because the buffer is sent after every DGL call.

Inquiry Escape Functions

(ZIESC). The following inquiry escape functions are supported:

Opcode	Function
3050	Inquire text status. ILIST(1) = Current text justification. See Figure 12 for possible values. ILIST(2) = Current text direction. Possible values are 0, 90, 180, or 270 degrees. ILIST(3) = Current text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(ZOESC). Several output escape functions are supported by DGL. Error checking is not performed by the graphics system on any of the parameters that are to be sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function. None of the supported output escape functions alter the starting position for the next primitive.

The following output escape functions are supported:

Opcode	Function
450	Perform rectangular area fill using the current line style and color. The rectangular area is specified in virtual coordinates. RLIST(1) = Minimum X border of rectangle. RLIST(2) = Maximum X border of rectangle. RLIST(3) = Minimum Y border of rectangle. RLIST(4) = Maximum Y border of rectangle.
1050	Set device text direction that applies to subsequently output low-quality graphics text. This applies to characters individually for medium-quality graphics text. ILIST(1) = New text direction. 0 = 0 degrees (horizontal). 1 = 90 degrees counterclockwise. 2 = 180 degrees counterclockwise. 3 = 270 degrees counterclockwise.
1051	Set device character slant for subsequently output medium- and low-quality graphics text. ILIST(1) = Text slant. 0 = 0 degrees (normal). 1 = 45 degrees.

1052 Set device text justification for subsequently output medium- and low-quality graphics text. This applies to characters individually for medium-quality graphics text.

ILIST(1) = Text justification. See Figure 12 for the supported justifications

When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when center or right justifying is 80 characters (not including the CR (LF)). In all cases, data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.

1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.

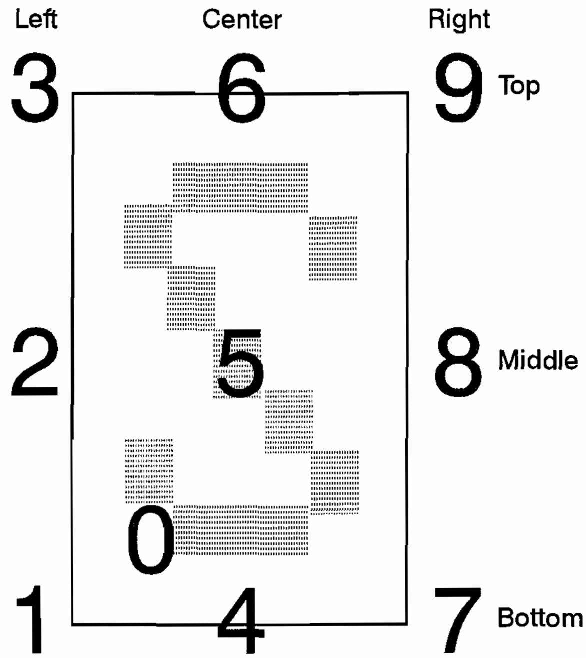
1056 Set special drawing modes. Using this escape function overrides the color as defined by the JCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to JCOLR. See Figure 13 for the color and the special drawing modes.

ILIST(1) = 1 Enable complement drawing mode. All primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black, and all black pixels turn white.

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the affect of overlaying the output primitives generated with the current primitives on the graphics display.

2050 Define line pattern. This allows the user to define the dot pattern used to draw vectors. Once a line pattern is defined, it can be used by setting the line style to 9. (See Figure 14 for examples on defining line patterns.)

ILIST(1) = A decimal value between 0 and 255 defining an 8-bit binary pattern.
ILIST(2) = A scale factor between 1 and 16 to be applied to the pattern.



The numbers 1-9 represent the cursor position with respect to the character cell used for graphics text characters. The number 0 represents the cursor position with respect to the character (not this cell).

Justification/Origin. Text strings can be automatically right or left justified, or centered about a specified point. An ASCII character 0 through 9 indicates the origin (justification and base line) for characters with respect to the current pen position. This function is useful when drawing tables.

If text is left justified, the current pen position is the left margin. Center causes the label to be centered on the pen position. Right justify selects the pen position as the right margin. Bottom, middle, and top select the base line for the line of text.

For example, if text was to be right justified and set with a base line on top of the normal character position, the number "9" would be used.

Figure 12. Hardware Text Justification

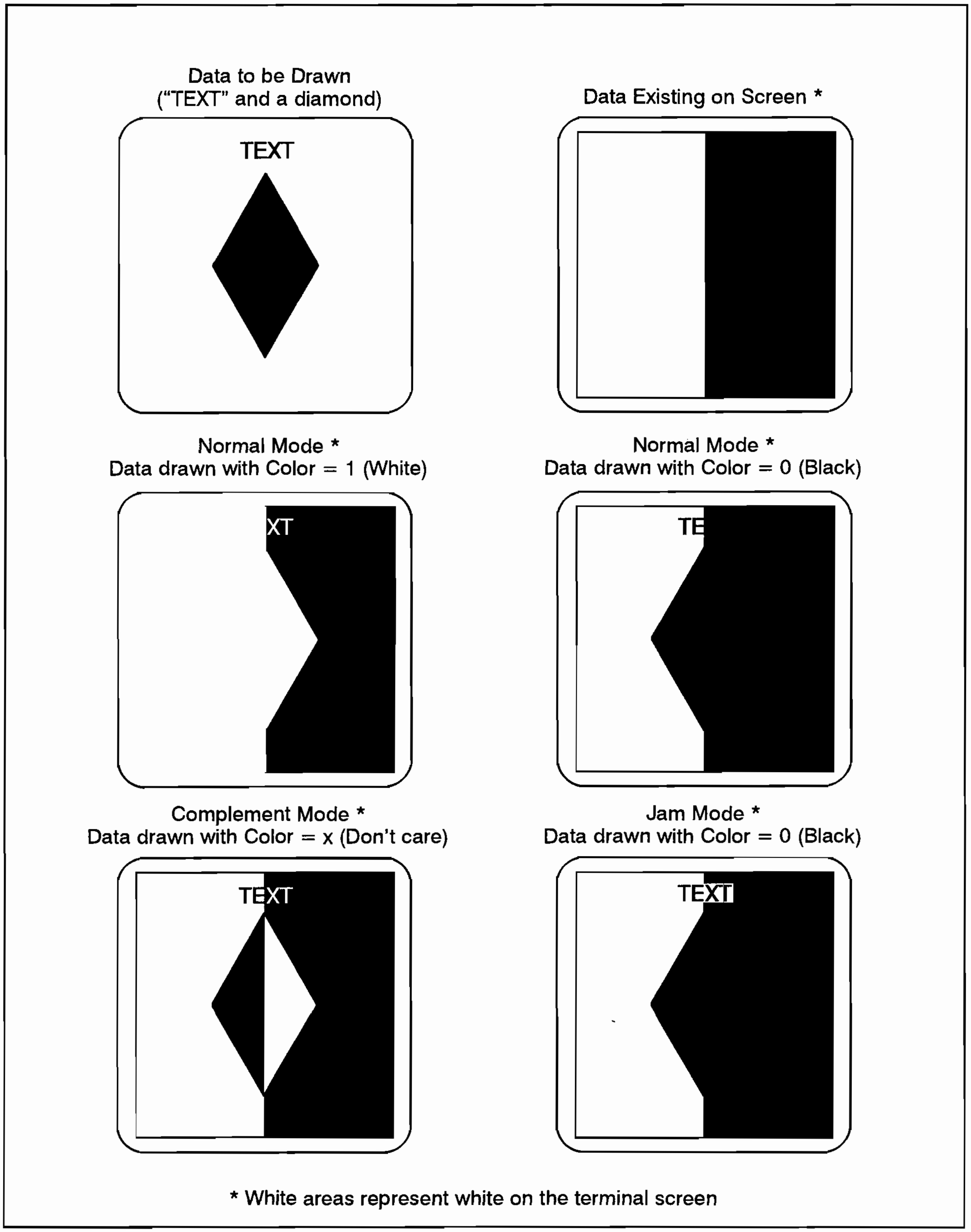


Figure 13. Special Drawing Modes

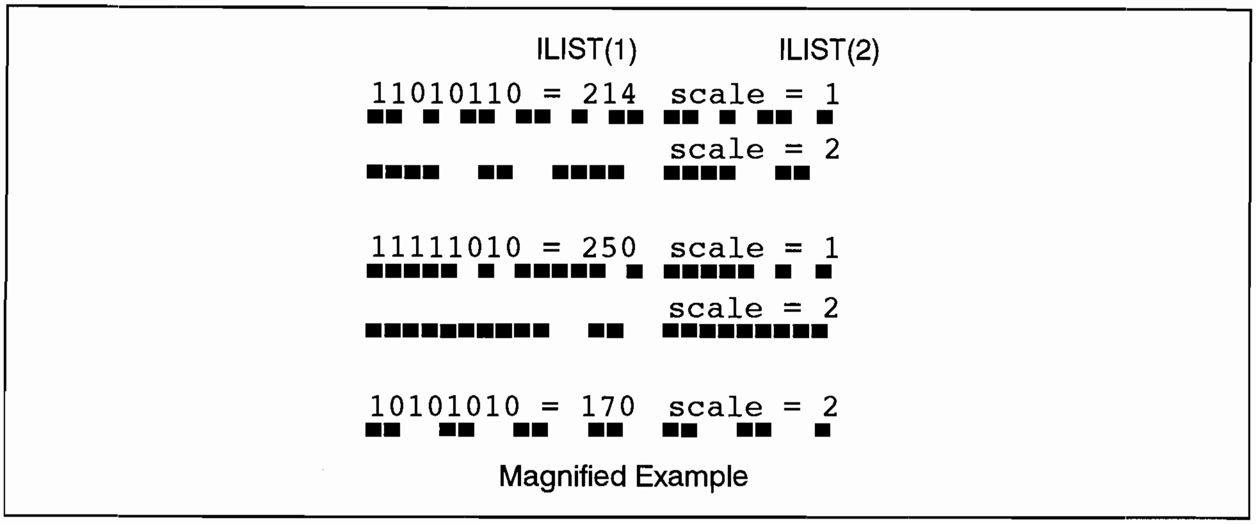
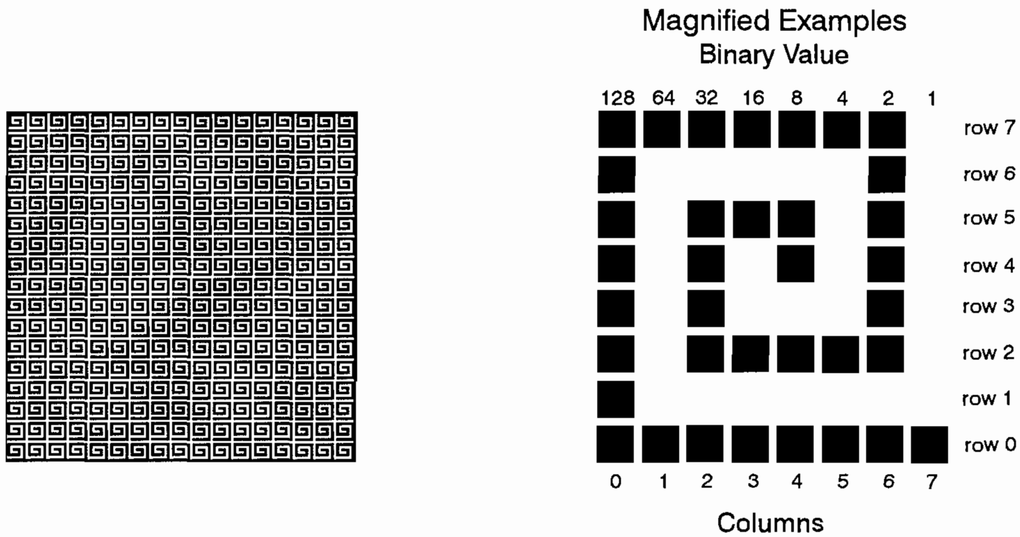


Figure 14. Magnified Examples of User-Defined Line Style

8050 Define area pattern. An 8-by-8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging between 0 and 255 that defines an 8-bit binary pattern. The graphics display is divided into 8-by-8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used by setting the line style to 10. Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling rectangular area. The user-defined area pattern can be used for filling polygons when the current polygon style has density -1, and specifies device-dependent output. Figure 15 and Figure 16 contain sample area fill patterns.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern
ILIST(8) = Row 7 of the area pattern.




```
ILIST(8)  Row 7   11111110 - 254
ILIST(7)  Row 6   10000010 - 130
ILIST(6)  Row 5   10111010 - 186
ILIST(5)  Row 4   10101010 - 170
ILIST(4)  Row 3   10100010 - 162
ILIST(3)  Row 2   10111110 - 190
ILIST(2)  Row 1   10000000 - 128
ILIST(1)  Row 0   11111111 - 255

                  1 = dot on
                  0 = dot off
```

Figure 15. Defining Area Patterns

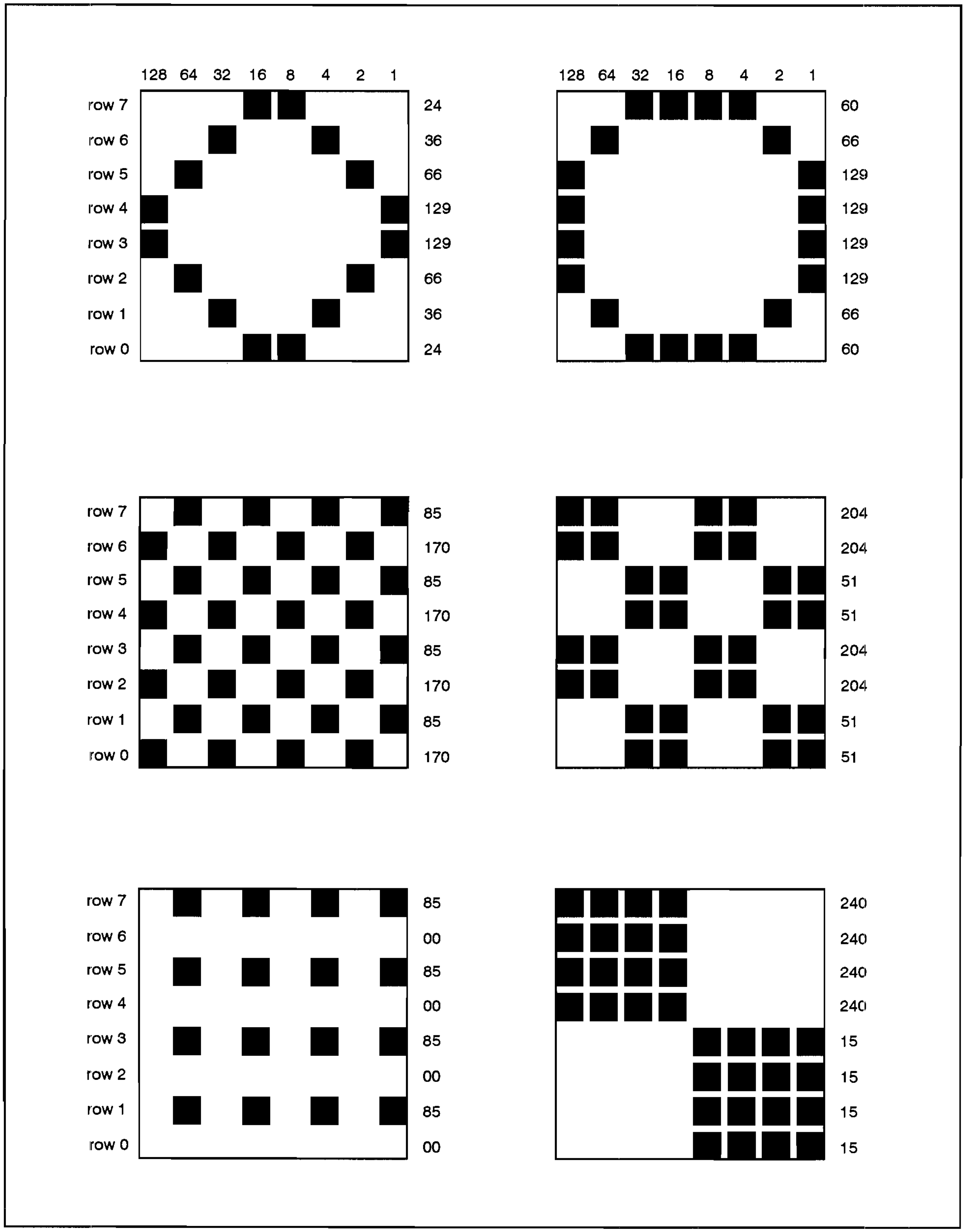


Figure 16. Magnified Examples of Area Patterns

Locator Echoes on the Graphics Display

(ZWLOC). The type of echoes available on the graphics display depends on whether or not the graphics display and locator are the same physical device. For echoes supported on the locator device, see the corresponding device handler that discusses the locator device in question.

Same Physical Device

If the locator and graphics display are the same physical device, then the following echoes are supported on the display:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until operator response. When an operator response occurs the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the graphics cursor and the Y coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the locator echo position and the Y coordinate of the graphics cursor.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or 6, whichever defines a longer line from the locator echo position.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are for ECHO 4. The point returned is the position of the graphics cursor.

If the HP 17623 Graphics Tablet is attached, it is considered the same logical device as the locator and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen is depressed.

Different Physical Devices

If the locator and display devices are different physical devices and the locator device supports echoing on the display, then the following echoes are supported on the graphics display:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Same as ECHO 2.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the locator echo position until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor then is displayed at a point defined by the X coordinate of the locator echo position and the Y coordinate of the current locator position until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
7	Horizontal/vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. Subsequently, when the locator's X displacement becomes greater than its Y displacement, ECHO 5 is simulated. When the locator's Y displacement becomes greater than its X displacement, ECHO 6 is simulated.
8	Rubber band box. Same as ECHO 2.

Termination

(ZDEND). The graphics display is unaltered. The device name is reset to "0019 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0. All attribute values remain unaltered until the system is reinitialized or the display device is enabled again.

Keyboard Device Handler

Description

The terminal has a standard ASCII keyboard that is supported as a keyboard input device. The device handler required to use the keyboard device is K0001.

Initialization

(JEDEV/ZKINT). When the keyboard device is initialized the terminal alphanumeric display is turned on. The device name is set to "2623A ". The name is padded to 6 characters with trailing blanks.

Keyboard Input

(JKYBD/ZKYBD). Once the keyboard device has been enabled it is available for input operations. When JKYBD or ZKYBD are called, a read operation is set pending on the terminal. The operator then enters the desired text and terminates the operation by entering a carriage-return. Some keys have a special meaning when entered by the operator and are not returned to the application program. (See the AGP or DGL Reference Manual for a description of these keys.)

Echoes Supported

The keyboard device supports the following echoes:

Echo #	Echo Performed
0	Text is not displayed on the terminal alphanumeric display as it is entered.
1	Text is displayed on the terminal alphanumeric display as it is entered.

Termination

(JDDEV/ZKEND). The alphanumeric display is unaltered. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Pick Device Handler (AGP)

Description

The pick device is only supported with AGP. The dimensions of the pick device are as follows:

Screen size:	215 mm by 164 mm
Screen capacity:	512 points by 390 points
Resolution:	2.3814 points/mm in X direction and 2.3780 points/mm in Y direction

The physical origin of the pick device is the lower left corner of the display.

The terminal has a pick device that is capable of differentiating between any point on the graphics display. The device handler required to use the pick device is P0019.

Initialization

(JEDEV). When the pick device is initialized, the terminal's graphics display is left unaltered. The device name is set to "2623A ". The name is padded to 6 characters with trailing blanks.

Pick Input

(JPICK). The pick input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key. The segment name, pick-ID, and the value of the pick button are then returned to the application program. Any of the ASCII keys can be used to terminate the pick function so that the value of the pick button returned to the application program can range from 0 to 127.

If the HP 17623A Graphics Tablet is attached, it is considered the same logical device as the pick and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen is depressed.

Echoes Supported

Pick input can be echoed on either a graphics display device or a pick device. The echo can only be performed on a graphics display device when the pick and the graphics display devices are implemented on the same physical device (that is, the same terminal). Refer to the AGP graphics display section to determine the supported pick echoes on the graphics display. The following lists the echoes that can be performed by the pick device:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator through the use of the graphics cursor control keys. When the graphics cursor is positioned over the desired point the operator strikes an alphanumeric key and the pick function is terminated. Before control is returned to the application program, the graphics cursor is turned off.

Termination

(JDDEV). The device name is set to "0019 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Valuator Device Handler

Description

The dimensions of the valuator device are as follows:

Screen size:	215 mm by 164 mm
Screen capacity:	512 points by 390 points

The terminal can simulate a valuator device with the graphics locator. The simulation is done by splitting the X and Y coordinates into two subvaluators and scaling the locator coordinates to values that range from 0.0 to 1.0. The device handler required to use the valuator device is V0019.

Initialization

(JEDEV/ZVINT). When the valuator device is initialized, the terminal's graphics display is left unaltered. The device name is set to "2623A ". The name is padded to 6 characters with trailing blanks.

Wait Valuator Input

(JWVAL/ZWVAL). The wait valuator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key.

In addition to returning the subvaluator value, the key struck to terminate the valuator operation is also returned to the application program. Any of the ASCII keys can be used to terminate the valuator function so that the button returned to the application program can range from 0 to 127.

If the HP 17623A Graphics Tablet is attached, it is considered the same logical device as the valuator and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen is depressed.

The values returned are a function of the subvaluator specified as follows:

Subvaluator	Value Returned
1	The X coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the left edge and a value of 1.0 is returned if the cursor is at the right edge of the display.
2	The Y coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the bottom of the display and a value of 1.0 is returned if the cursor is at the top of the display.

Echoes Supported

The supported echoes for the wait valuator function are as follows:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator through the use of the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the valuator function is terminated. Before control is returned to the application program, the graphics cursor is turned off.

Sample Valuator Input

(JSVAL/ZSVAL). The sample valuator input function returns a subvaluator value without waiting for an operator response. The valuator simulation is performed in the same way as for the wait valuator function.

Echoes Supported

The following valuator echoes are supported when using the sample valuator function:

Echo #	Echo Performed
0	Echo not performed.
1	The terminal bell is sounded when the valuator is sampled.

Termination

The device name is set to "0019 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 2625A/2628A Graphics Terminal

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Tables

Alphanumeric Device Handler

Description

The terminal has independent alphanumeric and graphics display memories that allow either or both types of data to be displayed on the same CRT. The alphanumeric device handler, A0001, allows the application programmer to send messages and alphanumeric display control commands to the terminal.

The dimensions of the alphanumeric device are as follows:

Screen size:	Width: 215 mm	Height: 164 mm
Screen capacity:	24 lines and 80 characters per line	
Character size:	Width: 2.4 mm	Height: 4.24 mm

Initialization

(JEDEV/ZAINT). When the alphanumeric device is initialized, the alphanumeric display is turned on and the contents of the alphanumeric memory are left unaltered. DGL sets the device name to "2620A ". The name is padded to 6 characters with trailing blanks.

Alphanumeric Output

(JALPH/ZALPH). The state of the alphanumeric display is not altered before sending the character string to the terminal. The entire character string is sent directly to the terminal. A maximum of 132 characters can be sent to the alphanumeric device at one time. If the text output exceeds the size of a line, the terminal performs a carriage-return line-feed and text output continues on the next line. The character string may contain alphanumeric characters or command sequences that control the alphanumeric display (for example, clear alphanumeric memory, alphanumeric cursor control, etc.). Command sequences that affect other parts of the terminal (that is, graphics display) should not be contained in the string because they could destroy the integrity of the graphics system.

Termination

(JDDEV/ZAEND). When the alphanumeric device is terminated, the alphanumeric display is not affected. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Button Device Handler

Description

The terminal has eight *softkeys* which together are supported as a button device. These keys are above the standard ASCII keys and are labeled *f1* through *f8*. The numeric keys 1 through 8 can also be used in the same way as the softkeys. The device handler required to use the button device is B0001.

Note If the softkeys are to be used, either the labels f1 through f8 must appear on the softkey area of the alphanumeric display or the labels must be turned off by pressing the *SHIFT* and *AIDS* keys.

Initialization

(JEDEV/ZBINT). When the button device is initialized, all previous softkey definitions are destroyed. The softkeys *f1* through *f8* are loaded with the ASCII characters 1 through 8 respectively. The device name is set to "2620A ". The name is padded to 6 characters with trailing blanks.

Button Input

(JBUTN/ZBUTN). Once the button device is enabled, it is available for input operations. When JBUTN or ZBUTN is called, a read operation is set pending on the terminal. Striking a softkey or an ASCII key between 1 and 8 returns the button as an integer value ranging from 1 to 8. If an invalid, transmittable (that is, ASCII) key is struck, an integer of 0 is returned as the button value.

Echoes Supported

The button device handler supports the following echoes:

Echo #	Echo Performed
0	Echoing is not performed.
1	The terminal bell is sounded if a valid button is activated.

Termination

(JDDEV/ZBEND). When the button device is terminated, the softkey definitions remain as they were defined by the button device initialization. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Line Style

(JLSTL). Eight predefined line styles are supported. In addition, two user-definable styles can be selected. These line styles are defined through the use of an output escape function see (JOESC, Opcode 2050). Initially, the two user-definable line styles are set to solid. See Figure 1 for the line styles available.

All of the supported line styles are *continuous*. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, for a complete description of a *continuous* line style.

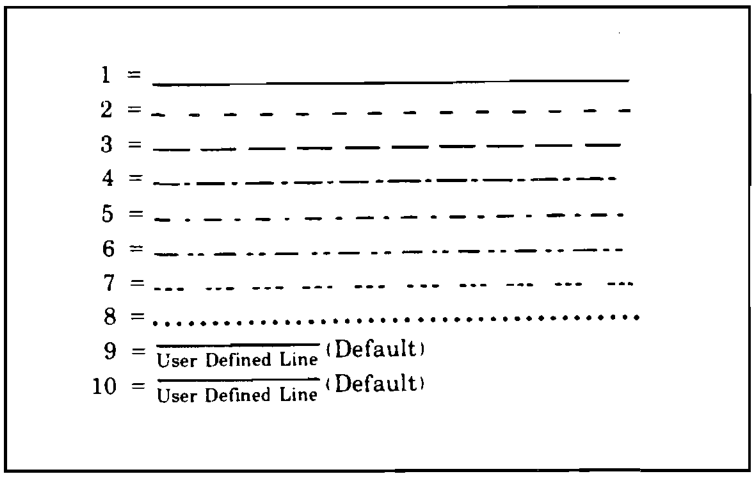


Figure 1. Supported Line Styles

Line Width

(JLWID). Only one line width is supported.

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

Character Sizes

(JCSIZ). There are eight distinct character sizes supported. They all have a constant aspect ratio of 1.43. The supported character sizes are:

Width	Height
2.9 mm	4.2 mm
5.9 mm	8.4 mm
8.8 mm	12.5 mm
11.8 mm	16.7 mm
14.7 mm	21.0 mm
17.7 mm	25.3 mm
20.5 mm	29.5 mm
23.5 mm	33.7 mm

When using medium- and low-quality text, the character is placed within the character cell as shown in Figure 2.

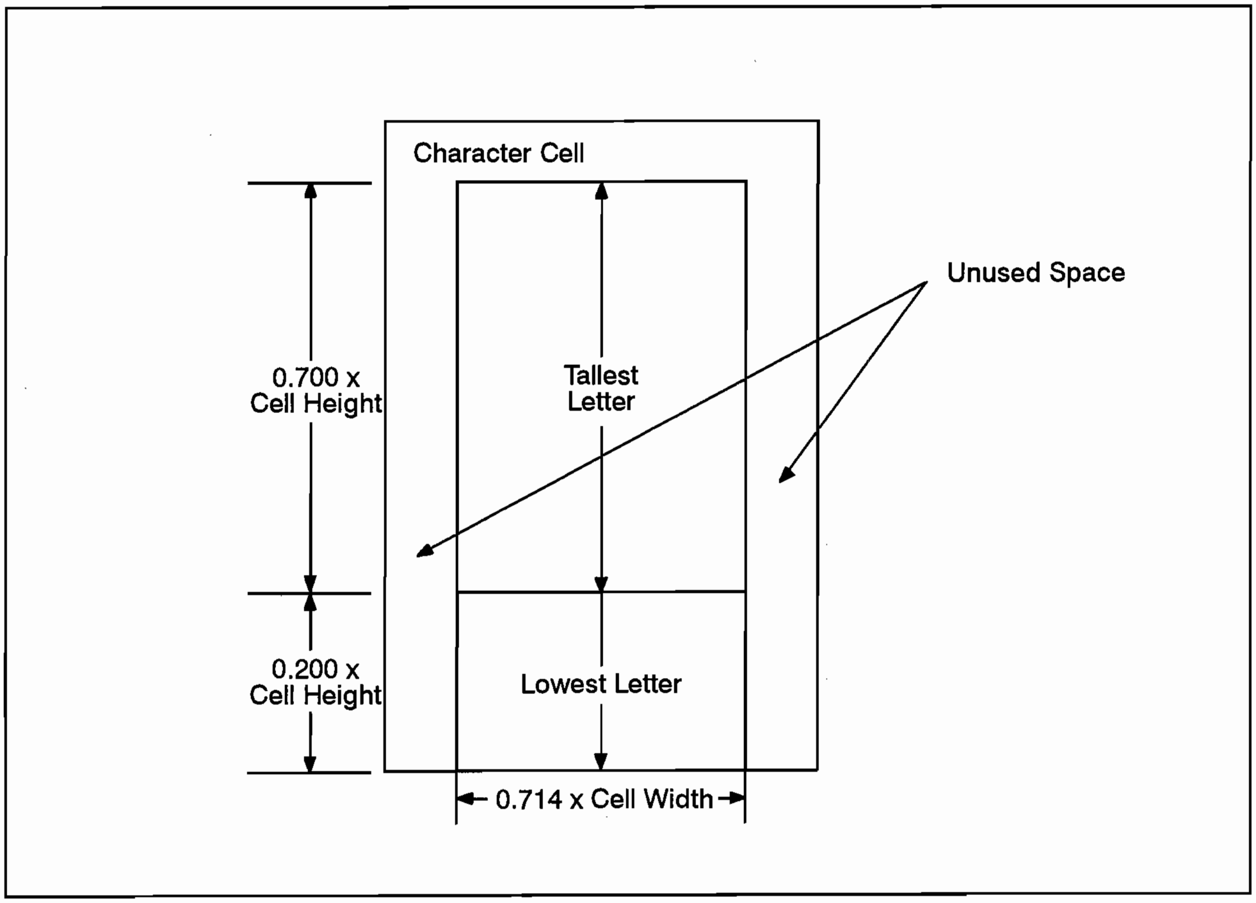


Figure 2. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not provided. If window clipping is turned off in AGP and vectors are created that lie entirely or partially outside of the view surface, unpredictable results may occur. Medium- and low-quality text strings are clipped if they do not lie entirely within the physical limits of the graphics display.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). Polygon sets with device-dependent polygon styles are displayed using hardware area fill. The terminal hardware supports convex, concave, and self-intersecting polygon sets. However, only some polygon sets with multiple polygons (for example, simple

Inquiry Escape Functions

(JIESC). The following inquiry escape functions are supported by AGP:

Opcode **Function**

3050 Inquire medium- and low-quality text status.

ILIST(1) = Current medium- and low-quality hardware text justification. See Figure 4 for possible values.

ILIST(2) = Current medium- and low-quality hardware text direction. Possible values are 0, 90, 180, or 270 degrees.

ILIST(3) = Current medium- and low-quality hardware text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(JOESC). Several output escape functions are supported by AGP. Error checking is not performed by the graphics system on any of the parameters that are sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function.

Escape functions are not stored in the segment display area. This can have implications when used with AGP segments. For example, suppose the line style is set to 10 and the escape function (see JOESC, Opcode 2050) is used to define a line pattern. A segment is created and then appears on the screen with the given line pattern. If the line pattern is changed and a new-frame-action is given, the segment is redrawn with the current line pattern and not the line pattern used when it was originally created.

Escape functions may have undesirable effects on medium- and low-quality text. For example, if JJUST is used to set AGP justification to center and a hardware justification is chosen, the text may not end up justified.

Escape functions are sent from AGP directly to the device. The state of AGP may become undefined when an escape function is given that overrides a mode set by AGP (for example, hardware text justification).

The following output escape functions are supported:

450 Perform rectangular area fill using the current line style and color. The rectangular area is specified in virtual coordinates.

RLIST(1) = Minimum X border of rectangle.
RLIST(2) = Maximum X border of rectangle.
RLIST(3) = Minimum Y border of rectangle.
RLIST(4) = Maximum Y border of rectangle.

1050 Set device text direction that applies to subsequently output low-quality graphics text. This applies to characters individually for medium-quality graphics text.

ILIST(1) = New text direction.
0 = 0 degrees (horizontal).
1 = 90 degrees counterclockwise.
2 = 180 degrees counterclockwise.
3 = 270 degrees counterclockwise.

1051 Set device character slant for subsequently output medium- and low-quality graphics text.

ILIST(1) = Text slant.
0 = 0 degrees (normal).
1 = 45 degrees.

1052 Set device text justification for subsequently output medium- and low-quality graphics text. This applies to characters individually for medium-quality graphics text.

ILIST(1) = Text justification. See Figure 4 for the supported justifications.

When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when center or right justifying is 80 characters (not including the CR or LF). In all cases, data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.

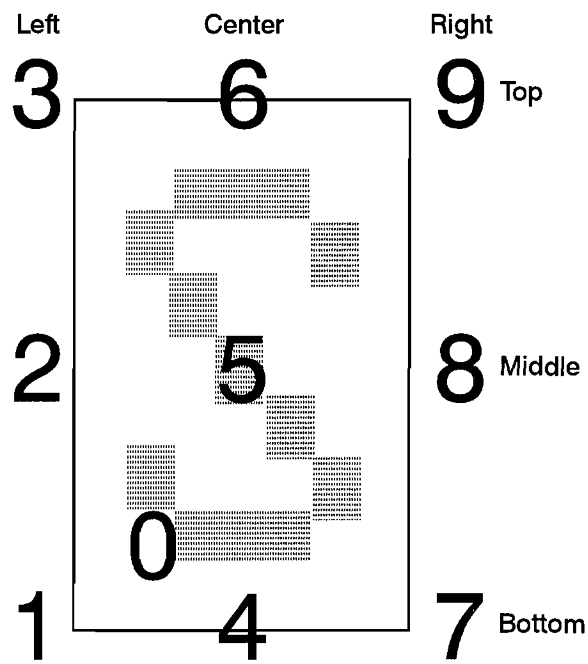
1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.

1056 Set special drawing modes. Using this escape function overrides the color as defined by the JCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to JCOLR. See Figure 5 for the color and the special drawing modes.

ILIST(1) = 1 Enable complement drawing mode. All primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black, and all black pixels turn white.

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the affect of overlaying the output primitives generated with the current primitives on the graphics display.



The numbers 1-9 represent the cursor position with respect to the character cell used for graphics text characters. The number 0 represents the cursor position with respect to the character (not this cell).

Justification/Origin. Text strings can be automatically right or left justified, or centered about a specified point. An ASCII character 0 through 9 indicates the origin (justification and base line) for characters with respect to the current pen position. This function is useful when drawing tables.

If text is left justified, the current pen position is the left margin. Center causes the label to be centered on the pen position. Right justify selects the pen position as the right margin. Bottom, middle, and top select the base line for the line of text.

For example, if text was to be right justified and set with a base line on top of the normal character position, the number "9" would be used.

Figure 4. Hardware Text Justification

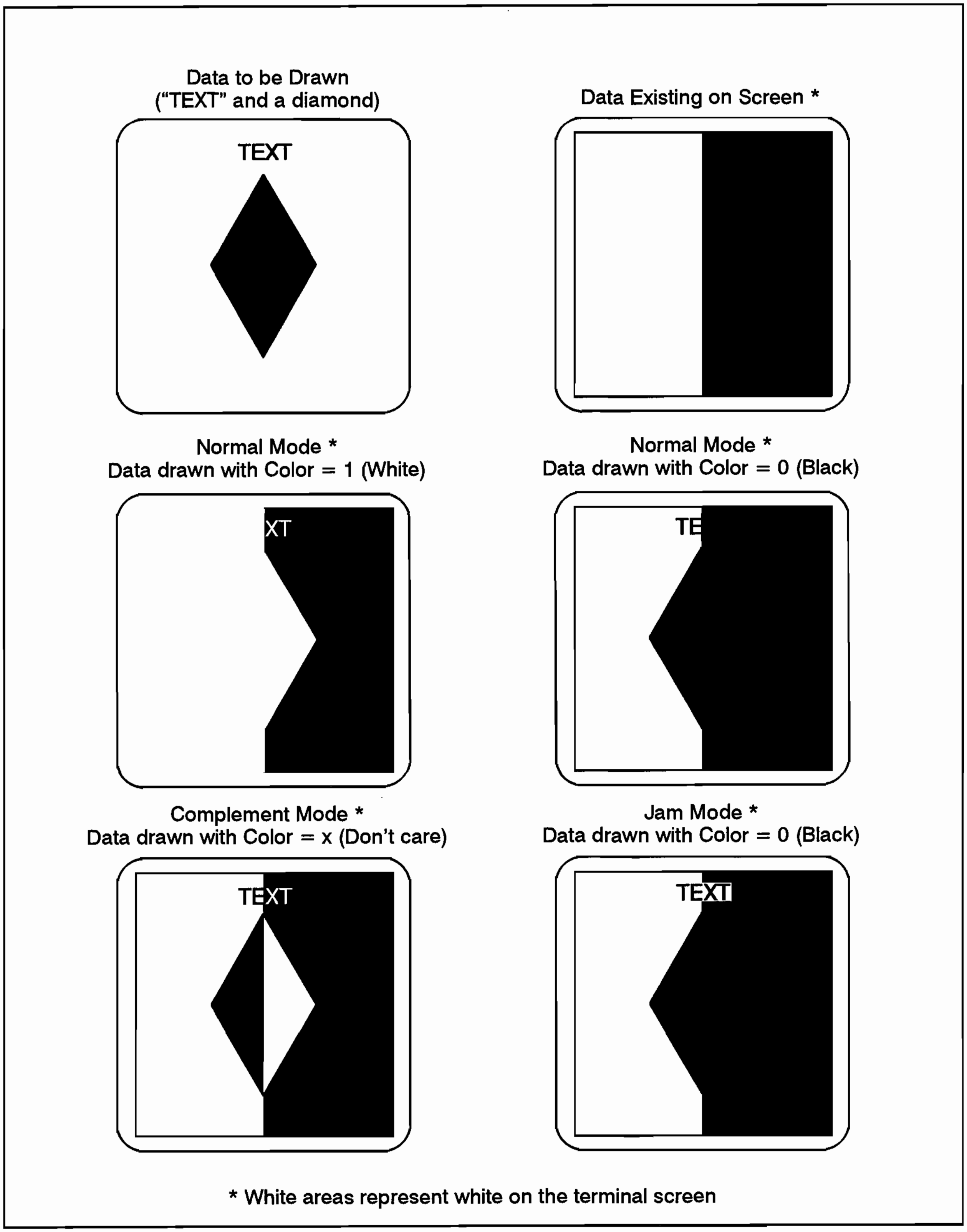


Figure 5. Special Drawing Modes

1057 Select area pattern. Polygons drawn using device-dependent polygon style causes the selection of an area pattern, based on the polygon style used, and thus changes any previously selected area pattern.

ILIST(1) = 1 Solid area fill.
ILIST(1) = 2 User-defined area fill pattern (see Opcode 8050).
ILIST(1) = 3 Short-dashed hatching.
ILIST(1) = 4 Long-dashed hatching.
ILIST(1) = 5 Hatching.
ILIST(1) = 6 Crosshatching.
ILIST(1) = 7 Fine crosshatching.
ILIST(1) = 8 Medium checkerboard.
ILIST(1) = 9 Fine checkerboard, 1:1 blend.
ILIST(1) = 10 3:1 blend.

2050 Define line pattern. This allows the user to define the dot pattern used to draw vectors. Once a line pattern is defined, it can be used by setting the line style to 9. (See Figure 6 for examples on defining line patterns.)

ILIST(1) = A decimal value between 0 and 255 defining an 8-bit binary pattern.

ILIST(2) = A scale factor between 1 and 16 to be applied to the pattern.

8050 Define area pattern. An 8-by-8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging between 0 and 255 which defines an 8-bit binary pattern. The graphics display is divided into 8-by-8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used by setting the line style to 10. Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling rectangular area. The user-defined area pattern can be used for filling polygons when the current polygon style has density −1, and specifies device-dependent output. Figure 7 and Figure 8 contain sample area fill patterns.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.

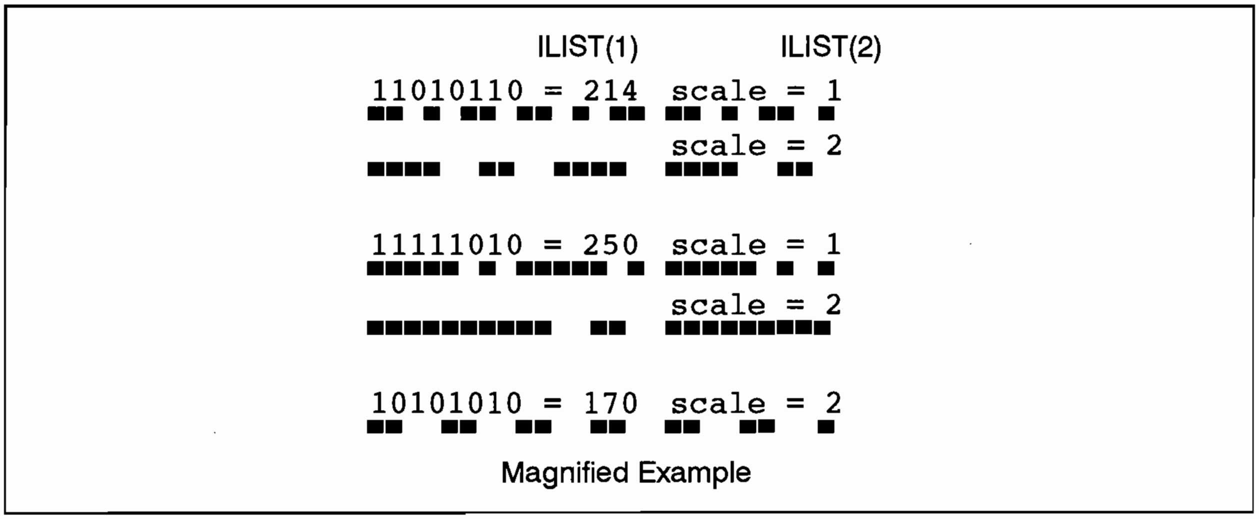
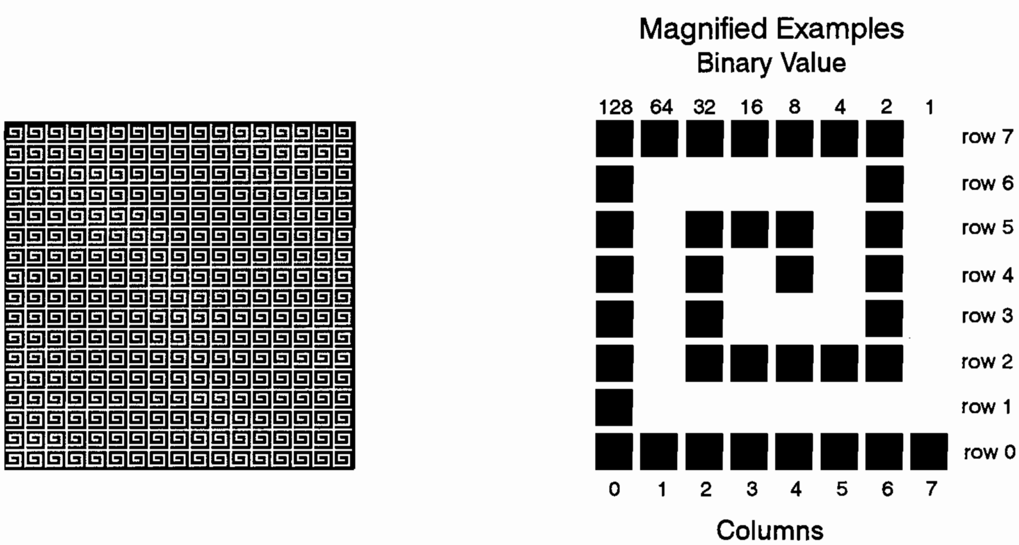


Figure 6. Magnified Examples of User-Defined Line Styles




```
ILIST(8)  Row 7   11111110 - 254
ILIST(7)  Row 6   10000010 - 130
ILIST(6)  Row 5   10111010 - 186
ILIST(5)  Row 4   10101010 - 170
ILIST(4)  Row 3   10100010 - 162
ILIST(3)  Row 2   10111110 - 190
ILIST(2)  Row 1   10000000 - 128
ILIST(1)  Row 0   11111111 - 255

                  1 = dot on
                  0 = dot off
```

Figure 7. Defining Area Patterns

Different Physical Devices

If the locator and the display devices are different physical devices and the locator device supports echoing on the graphics display, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before the control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points. Otherwise, the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Pick Echoes on the Graphics Display

(JPICK). For echoes supported on the pick device, see the corresponding device handler that discusses the pick device in question.

Echo #	Echo Performed
2	Initially, the graphics cursor is turned on at the current pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is completed. Before control returns to the application program, the graphics cursor is turned off.

Disabling

(JWOFF). The display is not reset to initial values when JWOFF is called. Values remain as they were last set. For example, color may remain set to the background color if the last operation was a simulated raster erase.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Highlighting

(ZHIGH). Highlighting is not supported.

Line Style

(ZLSTL). Eight predefined line styles are supported. In addition, two user-definable styles can be selected. These line styles can be defined through the use of an output escape function (see ZOESC, Opcode 2050). Initially, the two user-definable line styles are set to solid. See Figure 9 for the line styles available.

All of the supported line styles are *continuous*. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete discussion of a *continuous* line style.

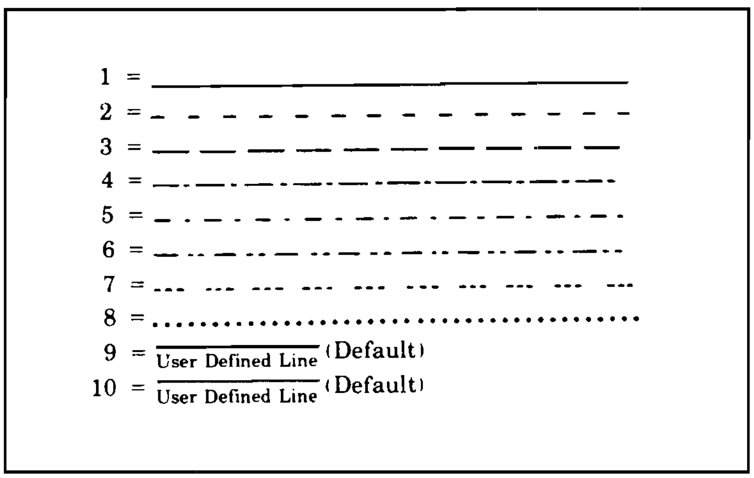


Figure 9. Supported Line Styles

Line Width

(ZLWID). Only one line width is supported.

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

Character Sizes

(ZCSIZ). There are eight distinct character sizes supported. They all have a constant aspect ratio of 1.43.

The supported character sizes are:

Width	Height
2.9 mm	4.2 mm
5.9 mm	8.4 mm
8.8 mm	12.5 mm
11.8 mm	16.7 mm
14.7 mm	21.0 mm
17.7 mm	25.3 mm
20.5 mm	29.5 mm
23.5 mm	33.7 mm

The character is placed within the character cell as shown in Figure 10.

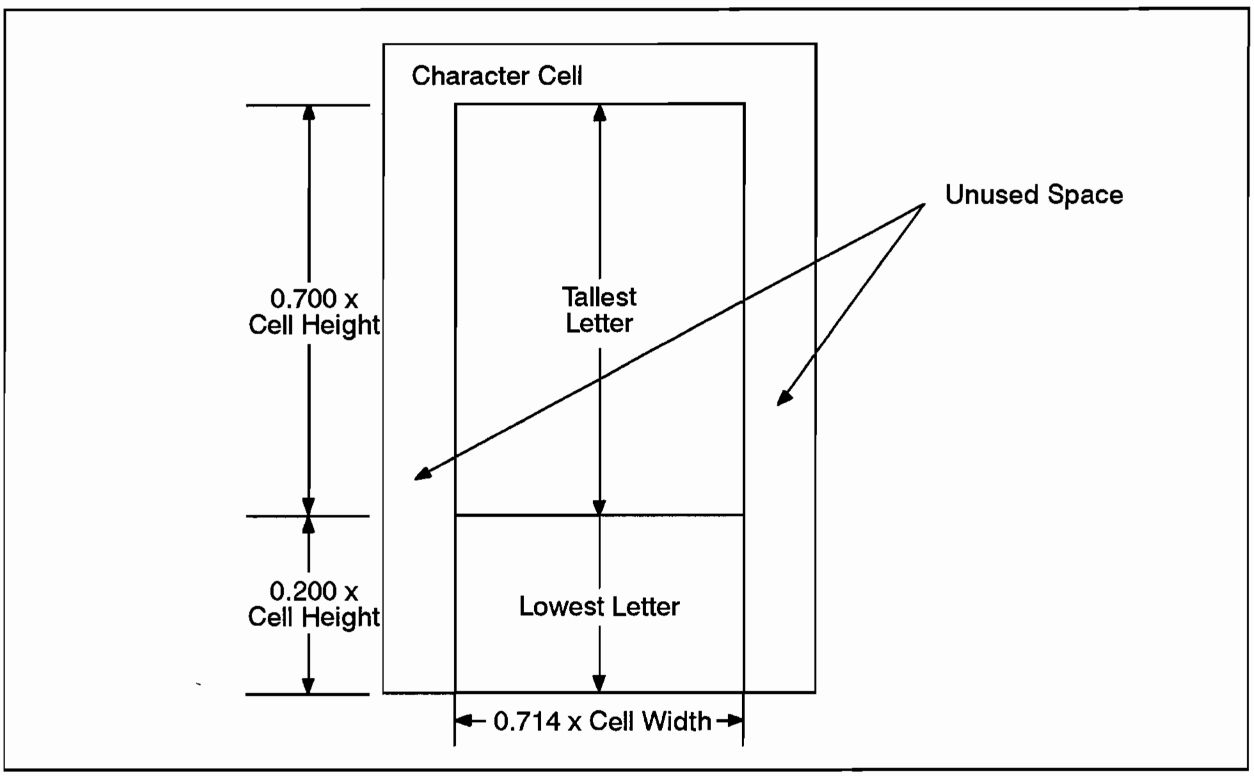


Figure 10. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not provided. A vector with one or both of its endpoints outside the physical limits is displayed in an unpredictable manner. Text characters are clipped if they do not lie within the physical limits of the display.

Polygons

(ZPGDD). Hardware filling is provided for polygon sets of up to 105 vertices. The terminal hardware supports convex, concave and self-intersecting polygon sets. However, only some polygon sets with multiple polygons (for example, simple donuts) are displayed as requested.

If the polygon style specifies a fill density of 1.0, the polygon set is solid-filled. Hardware dithering may be necessary to approximate the current polygon interior color selection. If the user specifies a fill density of −1.0, the polygon is filled with the current user-defined area pattern. The default for this pattern is solid. (See ZOESC, Opcode 8050, for further details.) If the user specifies a density that is less than 1/8, but greater than 0.0, a density of 1/8 is used. If the density is greater than −1/8, but less than 0.0, a density of −1/8 is used. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive, and up to the nearest 1/8 if the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding to the nearest multiple of 45 degrees. For densities other than −1.0, 1.0, and 0.0, crosshatching is supported. For all polygon fills, the interior line style is ignored. For densities other than −1.0 and 0.0, the color used in filling is the closest approximation of the interior color requested, chosen from the eight non-dithered colors.

Except when the user specifies a fill density of 1.0, −1.0, or 0.0, the user-defined area fill pattern is set to solid by ZPGDD upon its completion.

Markers

(ZMARK). Nineteen standard markers are supported. Markers are always 2.1 mm by 3.37 mm.

Text

(ZTEXT). Graphics text is generated with a hardware character generator. The characters are drawn with a size ratio 5 wide and 7 high in a character cell having a size ratio of 7 wide and 10 high. See Figure 11 for the viewable graphics character set. In addition to the viewable characters, text strings can also include the following control characters:

Decimal Code	Function
8	Move backward one character cell
9	Move forward one character cell
10	Move down one character cell
11	Move up one character cell
13	Carriage-return

The actual direction moved by these control functions is dependent on the text direction and text origin in use. Only the above special characters should be included in graphics text strings in addition to the printable ASCII characters.

Graphics text is not affected by the line style attribute; character strings are output as solid lines. The direction, slant, and justification of text can be modified through the use of escape functions (see ZOESC, Opcodes 1050, 1051, and 1052). If a text string extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped by the terminal.

```
abcdefghijklmnopqrstuvwxyz

ABCDEFGHIJKLMNOPQRSTUVWXYZ

!"#$%&'()*+,-./0123456789:

;<=>?@[\]^_`{|}~
```

Figure 11. Supported Graphics Text Characters

New-Frame-Action

Non-Buffered

(ZNEWF). A call to ZNEWF makes the picture current, then erases the graphics display to the background color.

Buffered

(ZNEWF). When ZNEWF is called, the graphics display is made current. The instruction to clear the graphics display is stored in the DGL buffer and is not sent to the device until the next time the buffer is sent. When the buffer is sent, the display is cleared to the background color. Any calls to DGL that were put into the buffer after the ZNEWF call will now take affect on the graphics display. The current display remains until the next buffer is sent. If immediate visibility is used, the action is the same as if new-frame-actions were not buffered; because the buffer is sent after every DGL call.

Inquiry Escape Functions

(ZIESC). The following inquiry escape functions are supported:

Opcode	Function
3050	Inquire text status. ILIST(1) = Current text justification. See Figure 12 for possible values. ILIST(2) = Current text direction. Possible values are 0, 90, 180, or 270 degrees. ILIST(3) = Current text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(ZOESC). Several output escape functions are supported by DGL. Error checking is not performed by the graphics system on any of the parameters sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function. None of the supported output escape functions alter the starting position for the next primitive.

The following output escape functions are supported:

Opcode	Function
450	Perform rectangular area fill using the current line style and color. The rectangular area is specified in virtual coordinates. RLIST(1) = Minimum X border of rectangle. RLIST(2) = Maximum X border of rectangle. RLIST(3) = Minimum Y border of rectangle. RLIST(4) = Maximum Y border of rectangle.
1050	Set device text direction that applies to subsequently output low-quality graphics text. This applies to characters individually for medium-quality graphics text. ILIST(1) = New text direction. 0 = 0 degrees (horizontal). 1 = 90 degrees counterclockwise. 2 = 180 degrees counterclockwise. 3 = 270 degrees counterclockwise.
1051	Set device character slant for subsequently output medium- and low-quality graphics text. ILIST(1) = Text slant. 0 = 0 degrees (normal). 1 = 45 degrees.

1052 Set device text justification for subsequently output medium- and low-quality graphics text. This applies to characters individually for medium-quality graphics text.

ILIST(1) = Text justification. See Figure 12 for the supported justifications.

When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when center or right justifying is 80 characters (not including the CR or LF). In all cases, data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.

1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.

1056 Set special drawing modes. Using this escape function overrides the color as defined by the JCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to JCOLR. See Figure 13 for the color and the special drawing modes.

ILIST(1) = 1 Enable complement drawing mode. All primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black, and all black pixels turn white.

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the affect of overlaying the output primitives generated with the current primitives on the graphics display.

1057 Select area pattern. Polygons drawn using device-dependent polygon style causes the selection of an area pattern, based on the polygon style used, and thus changes any previously selected area pattern.

ILIST(1) = 1 Solid area fill.
ILIST(1) = 2 User-defined area fill pattern (see Opcode 8050).
ILIST(1) = 3 Short-dashed hatching.
ILIST(1) = 4 Long-dashed hatching.
ILIST(1) = 5 Hatching.
ILIST(1) = 6 Crosshatching.
ILIST(1) = 7 Fine crosshatching.
ILIST(1) = 8 Medium checkerboard.
ILIST(1) = 9 Fine checkerboard, 1:1 blend.
ILIST(1) = 10 3:1 blend.

2050 Define line pattern. This allows the user to define the dot pattern used to draw vectors. Once a line pattern is defined, it can be used by setting the line style to 9. (See Figure 14 for examples on defining line patterns.)

ILIST(1) = A decimal value between 0 and 255 defining an 8-bit binary pattern.

ILIST(2) = A scale factor between 1 and 16 to be applied to the pattern.

8050 Define area pattern. An 8-by-8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging from 0 to 255 that defines an 8-bit binary pattern. The graphics display is divided into 8-by-8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used by setting the line style to 10. Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling rectangular area. The user-defined area pattern can be used for filling polygons when the current polygon style has density −1, and specifies device-dependent output. Figure 15 and Figure 16 contain sample area fill patterns.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.

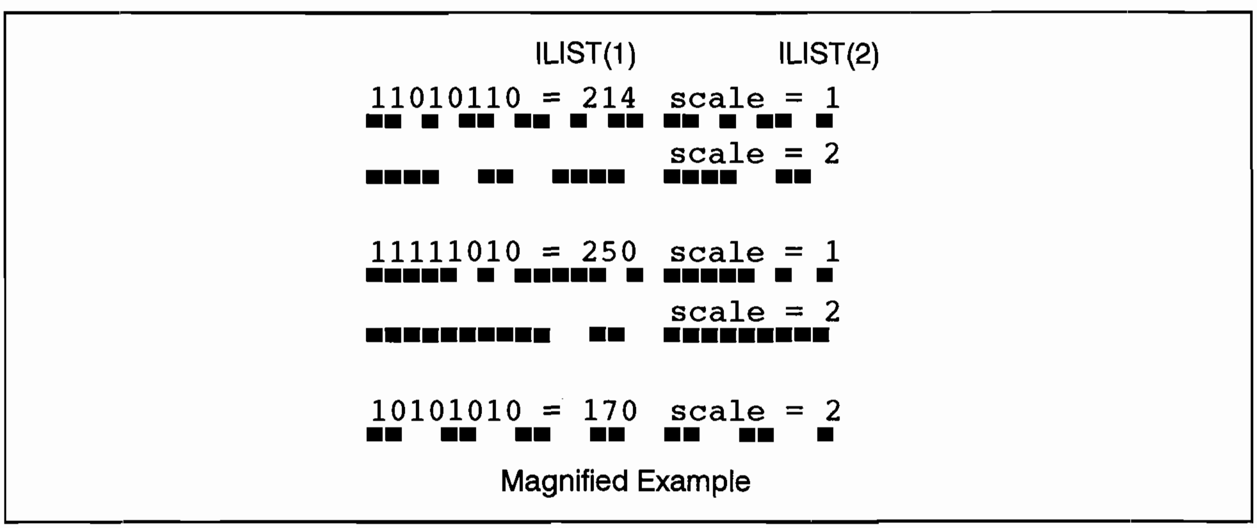
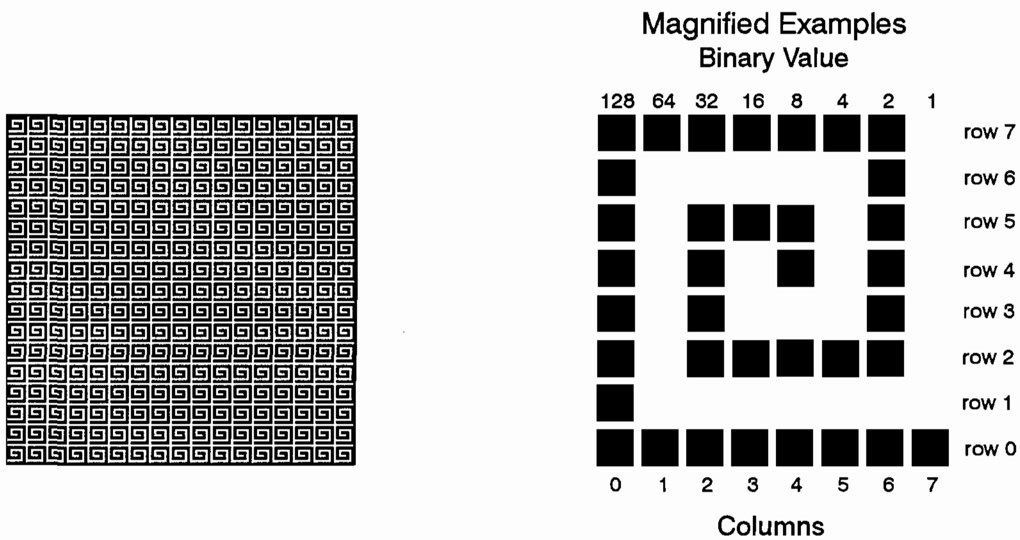


Figure 14. Magnified Examples of User-Defined Line Styles




```
ILIST(8)  Row 7   11111110 - 254
ILIST(7)  Row 6   10000010 - 130
ILIST(6)  Row 5   10111010 - 186
ILIST(5)  Row 4   10101010 - 170
ILIST(4)  Row 3   10100010 - 162
ILIST(3)  Row 2   10111110 - 190
ILIST(2)  Row 1   10000000 - 128
ILIST(1)  Row 0   11111111 - 255

                  1 = dot on
                  0 = dot off
```

Figure 15. Defining Area Patterns

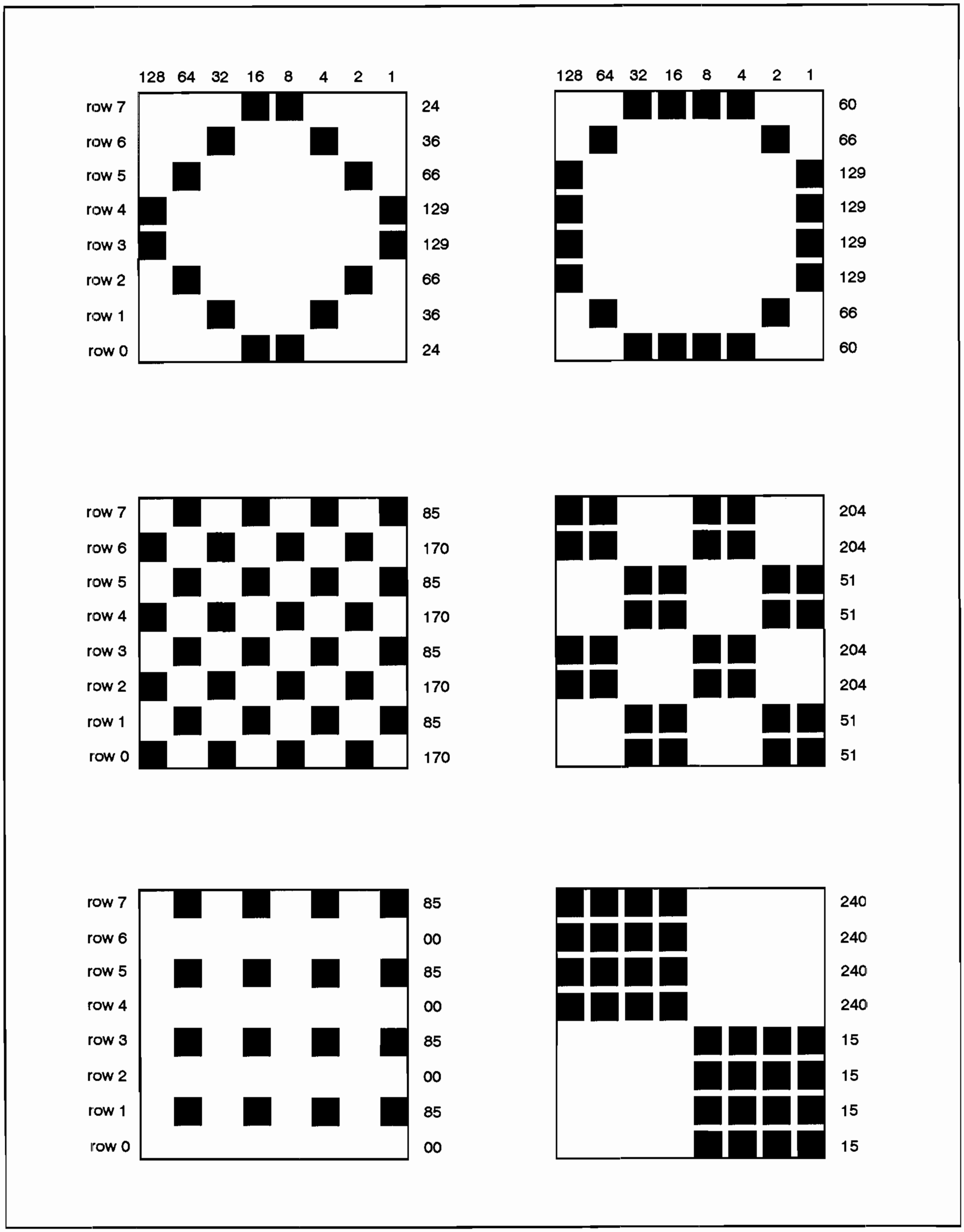


Figure 16. Magnified Examples of Area Patterns

Locator Echoes on the Graphics Display

(ZWLOC). The type of echoes available on the graphics display depends on whether the graphics display and the locator are the same physical device. For echoes supported on the locator device, see the device handler that discusses that particular locator device.

Same Physical Device

If the locator and the graphics display are the same physical device, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until an operator response occurs. When an operator response occurs, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the graphics cursor and the Y coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the locator echo position and the Y coordinate of the graphics cursor.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or ECHO 6, whichever defines a longer line from the locator echo position.
8	Rubber band box The graphics cursor and the locator echo position are handled in the same manner as they are for ECHO 4. The point returned is the position of the graphics cursor.

Different Physical Devices

If the locator and the display devices are different physical devices and the locator device supports echoing on the display, then the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before the control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Termination

(ZDEND). The graphics display is unaltered. The device name is set to "0020 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0. All attribute values remain unaltered until the system is reinitialized or the display device is enabled again.

Keyboard Device Handler

Description

The terminal has a standard ASCII keyboard that is supported as a keyboard input device. The device handler required to use the keyboard device is K0001.

Initialization

(JEDEV/ZKINT). When the keyboard device is initialized, the alphanumeric display is turned on. The device name is set to "2620A ". The name is padded to 6 characters with trailing blanks.

Keyboard Input

(JKYBD/ZKYBD). Once the keyboard device is enabled, it is available for input operations. When JKYBD or ZKYBD are called, a read operation is set pending on the terminal. The operator then enters the desired text and terminates the operation by entering a carriage-return. Some keys have special meanings when entered by the operator and are not returned to the application program. See the AGP or DGL Reference Manual for a description of these keys.

Echoes Supported

The keyboard device supports the following echoes:

Echo #	Echo Performed
0	Text is not displayed on the terminal alphanumeric display as it is entered.
1	Text is displayed on the terminal alphanumeric display as it is entered.

Termination

(JDDEV/ZKEND). The alphanumeric display is unaltered. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Locator Device Handler

Description

The dimensions of the locator device are as follows:

Screen size:	Width: 215 mm	Height: 164 mm
Screen capacity:	Width: 512 points	Height: 390 points
Resolution:	2.3814 points/mm in X direction 2.3780 points/mm in Y direction	

The default locator limits are set equal to the maximum physical limits of the screen.

The physical origin of the locator device is the lower left corner of the display.

The terminal has a graphics locator that is capable of returning any point on the screen. The device handler required to use the locator device is L0019.

Initialization

(JEDEV/ZLINT). When the locator device is initialized, the terminal's graphics display is left unaltered. The device name is set to "2620A ". The name is padded to 6 characters with trailing blanks.

Wait Locator Input

(JWLOC/ZWLOC). The wait locator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key. The (X,Y) coordinate value of the graphics cursor (which is a function of the echo) and the key struck are returned to the application program. Any of the ASCII keys can be used to terminate the locator function so the key returned to the application program can range from 0 to 127.

Echoes Supported

Locator input can be echoed on either a graphics display device or a locator device. The echo can only be performed on a graphics display device when the locator and the graphics display devices are implemented on the same physical device (that is, same HP 2625A/2628A Graphics Terminal). Refer to the graphics display sections to see how the locator can echo input on the graphics display.

The following echoes are supported by the locator device:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator using the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the locator function is terminated. Before control returns to the application program, the graphics cursor is turned off.

Sample Locator Input

(JSLOC/ZSLOC). The sample locator function returns the current locator position without waiting for an operator response. The graphics cursor is turned off following the sample locator function.

Echoes Supported

The following locator echoes are supported when using the sample locator function:

Echo #	Echo Performed
0	Echo is not performed.
1	The bell in the terminal is sounded when the locator is sampled.

Termination

(JDDEV/ZLEND). The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Pick Device Handler (AGP)

Description

The pick device is only supported with AGP. The dimensions of the pick device are as follows:

Screen size:	Width: 215 mm	Height: 164 mm
Screen capacity:	Width: 512 points	Height: 390 points
Resolution:	2.3814 points/mm in X direction 2.3780 points/mm in Y direction	

The physical origin of the pick device is the lower left corner of the display.

The terminal has a pick device that is capable of differentiating between any point on the graphics display. The device handler required to use the pick device is P0019.

Initialization

(JEDEV). When the pick device is initialized, the terminal's graphics display is left unaltered. The device name is set to "2620A ". The name is padded to 6 characters with trailing blanks.

Pick input

(JPICK). The pick input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key. The segment name, pick-ID, and the value of the pick button are then returned to the application program. Any of the ASCII keys can be used to terminate the pick input function. The value of the pick button returned to the application program can range from 0 to 127.

Echoes Supported

Pick input can be echoed on either a graphics display device or a pick device. The echo can only be performed on a graphics display device when the pick device and the graphics display device are implemented on the same physical device (that is, the same HP 2625A/2628A Graphics Terminal). Refer to the AGP graphics display section to determine the supported pick echoes on the graphics display.

The following echoes are supported by the pick device:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator through the use of the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the pick input function is terminated. Before control returns to the application program, the graphics cursor is turned off.

Termination

(JDDEV). The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Valuator Device Handler

Description

The dimensions of the valuator device are as follows:

Screen size:	Width: 215 mm	Height: 164 mm
Screen capacity:	Width: 512 points	Height: 390 points

The terminal can simulate a valuator device with the graphics locator. The simulation is done by splitting the X and Y coordinates into two subvaluators and scaling the locator coordinates to values that range from 0.0 to 1.0.

The device handler required to use the valuator device is V0019.

Initialization

(JEDEV/ZVINT). When the valuator device is initialized, the terminal's graphics display is left unaltered. The device name is set to "2620A ". The name is padded to 6 characters with trailing blanks.

Wait Valuator Input

(JWVAL/ZWVAL). The wait valuator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key.

In addition to returning the subvaluator value, the key struck to terminate the valuator operation is also returned to the application program. Any of the ASCII keys can be used to terminate the valuator function. The button returned to the application program can range from 0 to 127.

The values returned are a function of the subvaluator specified as follows:

Subvaluator	Value Returned
1	The X coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the left edge and a value of 1.0 is returned if the cursor is at the right edge of the display.
2	The Y coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the bottom of the display and a value of 1.0 is returned if the cursor is at the top of the display.

Echoes Supported

The following echoes are supported when using the wait valuator input function:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator using the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the valuator function is terminated. Before control returns to the application program, the graphics cursor is turned off.

Sample Valuator Input

(JSVAL/ZSVAL). The sample valuator function returns a subvaluator value without waiting for an operator response. The valuator simulation is performed in the same way as for the wait valuator input function.

Echoes Supported

The following echoes are supported when using the sample valuator function:

Echo #	Echo Performed
0	Echo not performed.
1	The terminal bell is sounded when the valuator is sampled.

Termination

(JDDEV/ZVEND). The device name is set to "0019 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 2627A Graphics Terminal

General Information

The user should be familiar with the operation of the HP 2627A Graphics Terminal. If necessary, refer to the following manuals for the appropriate operating instructions:

HP 2627A Graphics Terminal User's Manual, part number 02627-90001.

HP 2627A Graphics Terminal Reference Manual, part number 02627-90002.

Supported Logical Devices

Logical Device	Device Handler Name
Alphanumeric	A0001
Button	B0001
Graphics display	D0036
Keyboard	K0001
Locator	L0019
Pick (AGP only)	P0019
Valuator	V0019

Device Configuration

The terminal should be strapped for normal point-to-point operation. The terminal should not be in block mode.

Alphanumeric Device Handler

Description

The terminal has independent alphanumeric and graphic display memories that allow either or both types of data to be displayed on the same display. The alphanumeric device driver, A0001, allows the application programmer to send messages and alphanumeric display control commands to the terminal.

The dimensions of the alphanumeric device are as follows:

Screen size:	215 mm wide by 164 mm high
Screen capacity:	24 lines and 80 characters per line
Character size:	2.4 mm wide by 4.24 mm high

Initialization

(JEDEV/ZAINT). When the alphanumeric device is initialized, the alphanumeric display is turned on and the contents of the alphanumeric memory are left unaltered. DGL sets the device name to "2627A ". The name is padded to 6 characters with trailing blanks.

Alphanumeric Output

(JALPH/ZALPH). The state of the alphanumeric display is not altered before sending the character string to the terminal. The entire character string passed is sent directly to the terminal. A maximum of 132 characters can be sent to the alphanumeric device at one time. If the text output exceeds the size of a line, the terminal performs a carriage-return line-feed and text output continues on the next line. The character string may contain alphanumeric characters or command sequences which control the alphanumeric display (for example, clear alphanumeric memory, alphanumeric cursor control, and so forth). Command sequences that affect other parts of the terminal (that is, graphics display) should not be contained in the string because they could destroy the integrity of the graphics system.

Termination

(JDDEV/ZAEND). When the alphanumeric device is terminated, the alphanumeric display is not affected. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Button Device Handler

Description

The terminal has eight *softkeys* which together are supported as a button device. These keys are above the standard ASCII keys and are labeled *f1* through *f8*. The numeric keys 1 through 8 can also be used in the same way as the softkeys. The device driver required to use the button device is B0001.

Note If the softkeys are to be used, either the labels *f1* through *f8* must appear on the softkey area of the alphanumeric display or the labels must be turned off by pressing the *SHIFT* and *AIDS* keys.

Initialization

(JEDEV/ZBINT). When the button device is initialized, all previous softkey definitions are destroyed. The softkeys *f1* through *f8* are loaded with the ASCII characters 1 through 8 respectively. The device name is set to "2627A ". The name is padded to 6 characters with trailing blanks.

Button Input

(JBUTN/ZBUTN). Once the button device has been enabled, it is available for input operations. When JBUTN or ZBUTN are called, a read operation is set pending on the terminal. Striking a softkey or an ASCII key between 1 and 8 returns the button as an integer value ranging from 1 to 8. If an invalid, transmittable (that is, ASCII) key is struck, an integer 0 is returned as the button value.

Echoes Supported

The button device driver supports the following echoes:

Echo #	Echo Performed
0	Echoing is not performed.
1	The terminal bell is sounded if a valid button is activated.

Termination

(JDDEV/ZBEND). When the button device is terminated, the softkey definitions remain as they were defined by the button device at initialization. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O descriptor are set to 0.

Table 1. Default Color Table

Color Table Entry	Color	Red	Green	Blue
0	Black	0.0	0.0	0.0
1	White	1.0	1.0	1.0
2	Red	1.0	0.0	0.0
3	Green	0.0	1.0	0.0
4	Yellow	1.0	1.0	0.0
5	Blue	0.0	0.0	1.0
6	Magenta	1.0	0.0	1.0
7	Cyan	0.0	1.0	1.0
8	Turquoise	0.0	0.533	0.600
9	Brown	0.400	0.133	0.0
10	Toasted Orange	0.933	0.333	0.0
11	Lime Green	0.6	1.0	0.067
12	Golden Yellow	0.933	0.733	0.0
13	Medium Blue	0.333	0.333	1.0
14	Violet	0.6	0.133	1.0
15	Blue Green	0.0	0.4	0.533
16	Light Gray	0.8	0.8	0.8

Polygon Interior Color

(JPICL/ZPICL). With the exception of solid-filled, hardware generated (device-dependent) polygon interiors, only the eight non-dithered colors are available for output primitives. If solid-filled, hardware generated polygons are selected in the JPISTL/ZPISTL call, hardware dithering is used to fill the polygon with a color pattern that is as close as possible to the selected color definition.

Polygon Style

(JDPST/ZDPST). Using JDPST/ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(JPILS/ZPILS). The interior line style attribute is not applied to device-dependent area fill. Refer to JLSTL/ZLSTL for information regarding line style.

Highlighting

(JSHI/JGHI/ZHIGH). Highlighting is not supported.

Line Style

(JLSTL/ZLSTL). Eight predefined line styles are supported. In addition, two user-definable styles can be selected. These line styles can be defined through the use of output escape functions (see JOESC/ZOESC, Opcodes 2050 and 8050). Initially, the two user-definable line styles are set to solid. See Figure 1 for the line styles available.

All of the supported line styles are *continuous*. Refer to the JLSTL subroutine description in the *AGP User's Guide*, part number 97085-90010, for details. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for details.

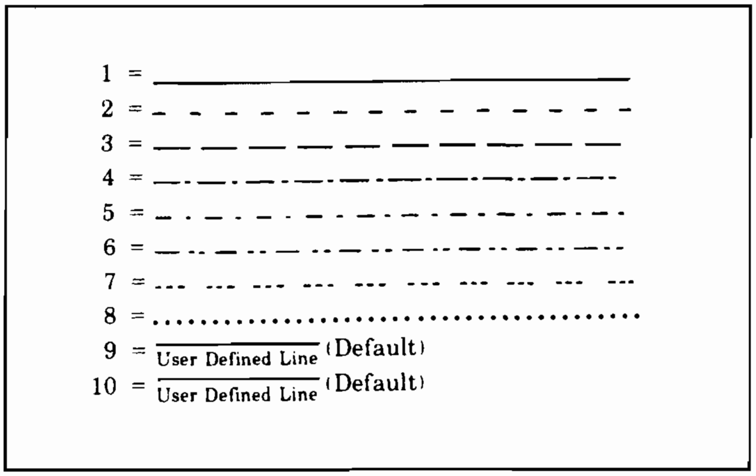


Figure 1. Supported Line Styles

Line Width

(JLWID/ZLWID). Only one line width is supported:

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

Character Sizes

(JCSIZ/ZCISZ). There are eight distinct character sizes supported. They all have a constant aspect ratio of 1.43. The supported character sizes are:

Width	Height
2.9 mm	4.2 mm
5.9 mm	8.4 mm
8.8 mm	12.5 mm
11.8 mm	16.7 mm
14.7 mm	21.0 mm
17.7 mm	25.3 mm
20.5 mm	29.5 mm
23.5 mm	33.7 mm

When using medium- and low-quality text, the character is placed within the character cell as shown below.

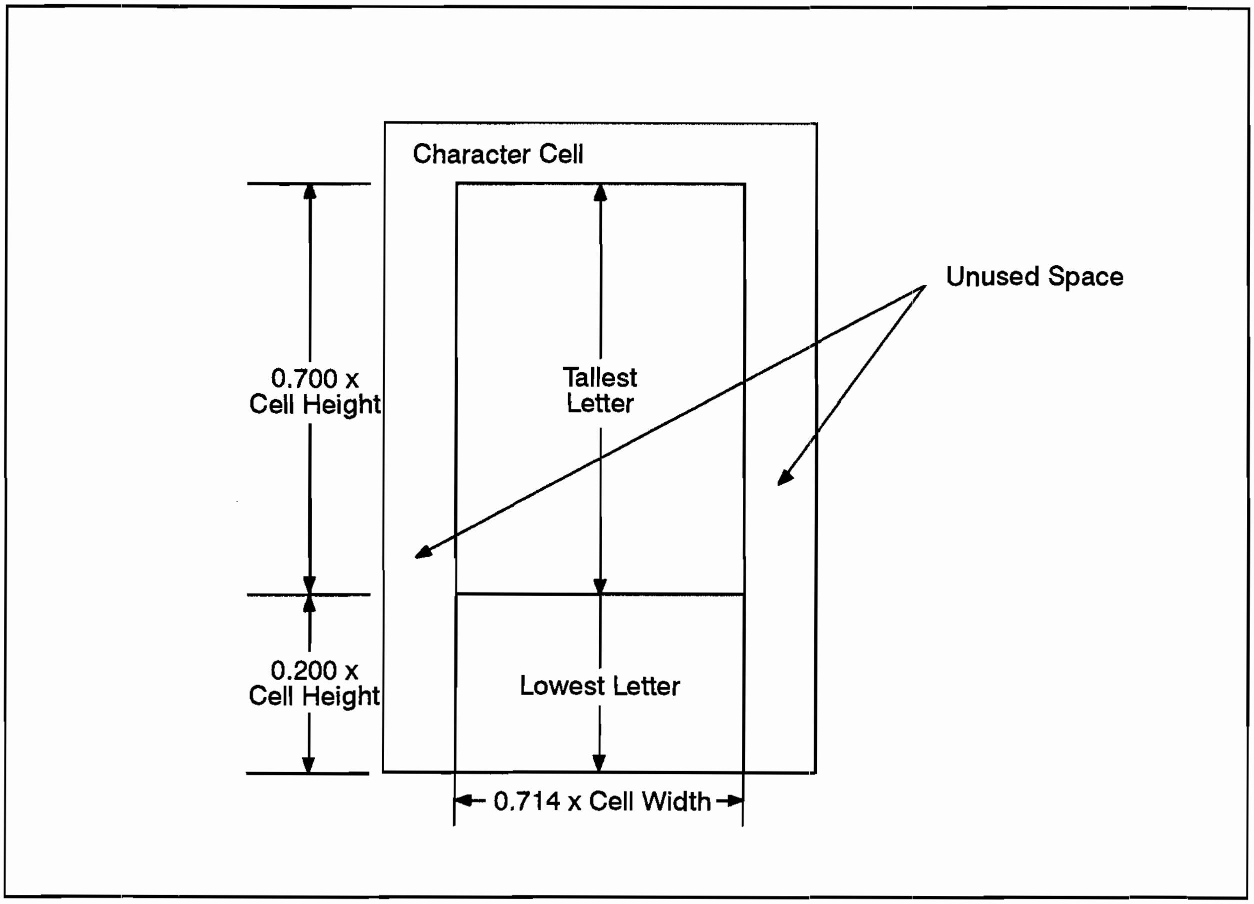


Figure 2. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not supported. If window clipping is turned off in AGP and vectors are created that lie entirely or partially outside of the view surface, unpredictable results may occur. Medium- and low-quality text strings are clipped if they do not lie entirely within the physical limits of the graphics display.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG/ZPGDD). Polygon sets with device-dependent polygon styles are displayed using hardware area fill. The terminal hardware supports convex, concave, and self-intersecting polygon sets. However, only some polygon sets with multiple polygons (that is, simple donuts) are displayed as requested. The hardware does not fill polygon sets having more than 148 vertices after clipping by AGP.

If the user specifies a density that is less than 1/8 but greater than 0.0, then a density of 1/8 is used. If the density is greater than −1/8 but less than 0.0, then a density of −1/8 is used. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive and up to the nearest 1/8 is the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding up to the nearest multiple of 45 degrees. For densities other than −1.0, 1.0, and 0.0 crosshatching is supported. For all polygon fills the interior line style is ignored. For densities other than −1.0 and 0.0, the color used in filling is the closest approximation of the interior color requested, chosen from the eight non-dithered colors. Any other fill density is rounded down to the nearest multiple of 1/8 if the density is positive, and up to the nearest 1/8 if the density is negative.

Except when the style specifies a fill density of −1 or 0, the user-defined area fill pattern is set to solid after device-dependent display of a polygon set.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK/ZMARK). Nineteen standard markers are supported. Markers are always 2.9 mm by 4.2 mm.

Medium- and Low-Quality Text (AGP)

(JTEXM/JTEXL). Medium- and low-quality graphics text are generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide and 7 high in a character cell with a size ratio of 7 wide by 10 high.

If a medium- or low-quality text string is not clipped by AGP and extends beyond the physical limits of the graphics display, all characters which do not lie entirely within the physical limits are clipped.

Medium- and low-quality text use only the color attribute. Characters are always generated using solid lines. The direction, slant, and justification of these types of text can be modified through the use of escape functions (see JOESC, Opcodes 1050, 1051 and 1052).

Text (DGL)

(ZTEXT). Graphics text is generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide and 7 high in a character cell with a size ratio of 7 wide and 10 high. In addition to the viewable characters, text strings can also include the following control characters:

Decimal Code	Function
8	Move backward one character cell
9	Move forward one character cell
10	Move down one character cell
11	Move up one character cell
13	Carriage-return

The actual direction moved by these control functions is dependent on the text direction and text origin in use. Only the above special characters should be included in graphics text strings in addition to the printable ASCII characters.

Graphics text is not affected by the line style attribute; character strings are output as solid lines. The direction, slant, and justification of text can be modified through the use of escape functions (see ZOESC, Opcodes 1050, 1051, and 1052). If a text string extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped by the terminal.

```
abcdefghijklmnopqrstuvwxyz

ABCDEFGHIJKLMNOPQRSTUVWXYZ

!"#$%&'()*+,-./0123456789:

;<=>?@[\]^_`{|}~
```

Figure 3. Supported Graphics Text Characters

New-Frame-Action (AGP)

(JNEWF/JPURG/JSVIS/JSHI/JVSAL/JCLR). The action taken when a new-frame-action is given is dependent on whether the simulated raster erase bit was set during the JDINT call and is outlined in the following two sections.

Simulated Raster Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates clears the display to the background color and redraws all visible segments.

When the new-frame-action is given with the display not enabled, it does not alter the display. When given inside a batch-of-updates the screen is not changed until the call JUPDT is given. At this time the screen is cleared to the background color and all visible segments are redrawn. The background color is be rendered as the closest non-dithered color.

Simulated Raster Erase Set

The terminal has the ability to undraw images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call. AGP uses this feature to remove graphics elements without first clearing the display. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is done by redrawing the image in the background color; therefore, lines crossing the image to be purged may also have parts of them erased, leaving holes. The image is not erased if any graphics primitives outside of segments have been drawn.

An explicit JNEWF call always clears the display and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates. This gives the user of simulated raster erase a means of generating a clean surface (one without holes).

The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations, because by definition, the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside a batch-of-updates always results in the screen being cleared and visible segments being redrawn when the JUPDT call is given.

New-Frame-Action (DGL)

Non-Buffered

(ZNEWF). A call to ZNEWF makes the picture current and then erases the graphics display. The background color is rendered as the closest non-dithered color.

Buffered

(ZNEWF). When ZNEWF is called, the graphics display is made current. The instruction to clear the graphics display is stored in the DGL buffer and is not sent to the device until the next time the buffer is sent. When the buffer is sent, the display is cleared to the background color and whatever calls to DGL were put into the buffer after the ZNEWF call take effect on the graphics display. The current display remains until the next buffer is sent. If immediate visibility is being used, the action is the same as if new-frame-actions were not buffered because the buffer is sent after every DGL call.

Input Escape Function

(JIESC/ZIESC). The following inquiry escape functions are supported:

Opcode	Function
3050	Inquire text (medium- and low-quality) status. ILIST(1) = Current text (medium- and low-quality) justification. ILIST(2) = Current text (medium- and low-quality) direction. Possible values are 0, 90, 180, or 270 degrees. ILIST(3) = Current text (medium- and low-quality) slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(JOESC/ZOESC). Several output escape functions are supported by AGP and DGL. Error checking is not performed by the graphics system on any of the parameters that are to be sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function.

AGP escape functions are not stored in the segment display area. This can have implications when used with AGP segments. For example, suppose the line style is set to 10 and the escape function (see JOESC, Opcode 2050) is used to define a line pattern. A segment is created and then appears on the screen with the given line pattern. If the line pattern is changed and a new-frame-action is given, the segment is redrawn with the current line pattern and not the line pattern with which it was originally created.

AGP escape functions may have undesirable effects on medium- and low-quality text. For example, if JJUST is used to set AGP justification to center and a hardware justification is chosen, the text may not end up justified.

Escape functions are sent from AGP directly to the device. The state of AGP may become undefined when an escape function is given that overrides a mode set by AGP (for example, hardware text justification).

The following output escape functions are supported:

Opcode	Function
450	Perform rectangular area fill using the current line style and color. The rectangular area is specified in virtual coordinates. RLIST(1) = Minimum X border of rectangle. RLIST(2) = Maximum X border of rectangle. RLIST(3) = Minimum Y border of rectangle. RLIST(4) = Maximum Y border of rectangle.
1050	Set device text direction that applies to subsequently output low-quality graphics text. This applies to characters individually for medium-quality graphics text. ILIST(1) = New text direction. 0 = 0 degrees (horizontal). 1 = 90 degrees counterclockwise. 2 = 180 degrees counterclockwise. 3 = 270 degrees counterclockwise.
1051	Set device character slant for subsequently output medium- and low-quality graphics text. ILIST(1) = Text slant. 0 = 0 degrees (normal). 1 = 45 degrees.

1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.

1056 Set special drawing modes. Using this escape function overrides the color as defined by the JCOLR/ZCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to JCOLR/ZCOLR.

ILIST(1) = 1 Enable complement drawing mode. All primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black, and all black pixels turn white.

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the affect of overlaying the output primitives generated with the current primitives on the graphics display.

1057 Select area pattern. Polygons drawn using device-dependent polygon style causes the selection of an area pattern, based on the polygon style used, and thus changes any previously selected area pattern.

ILIST(1) = 1 Solid area fill.
ILIST(1) = 2 User-defined area fill pattern (see Opcode 8050).
ILIST(1) = 3 Short-dash hatching.
ILIST(1) = 4 Long-dash hatching.
ILIST(1) = 5 Hatching.
ILIST(1) = 6 Crosshatching.
ILIST(1) = 7 Fine crosshatching.
ILIST(1) = 8 Medium checkerboard.
ILIST(1) = 9 Fine checkerboard, 1:1 blend.
ILIST(1) = 10 3:1 blend.

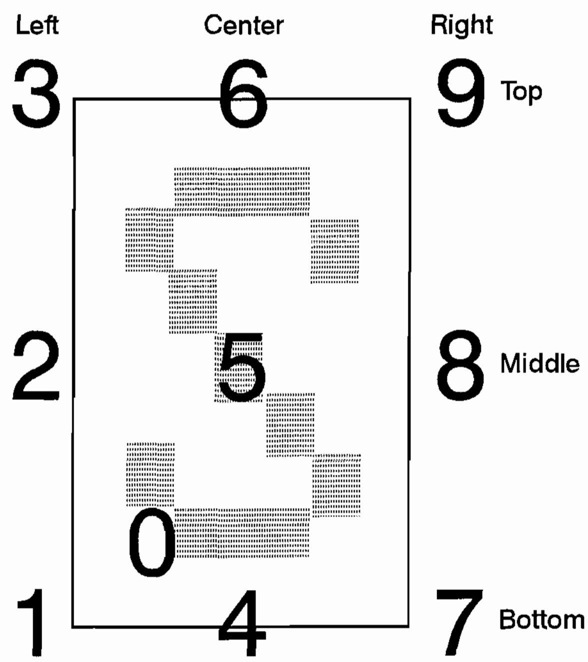
2050 Define line pattern. This allows the user to define the dot pattern used to draw vectors. Once a line pattern is defined, it can be used by setting the line style to 9.

ILIST(1) = A decimal value between 0 and 255 defining an 8-bit binary pattern.
ILIST(2) = A scale factor between 1 and 16 to be applied to the pattern.

8050 Define area pattern. An 8 by 8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging between 0 and 255 that defines an 8-bit binary pattern. The graphics display is divided into 8 by 8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used by setting the line style to 10. Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling rectangular area. The user-defined area pattern can be used for filling polygons when the current polygon style has density -1, and specifies device-dependent output.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.



The numbers 1-9 represent the cursor position with respect to the character cell used for graphics text characters. The number 0 represents the cursor position with respect to the character (not this cell).

Justification/Origin. Text strings can be automatically right or left justified, or centered about a specified point. An ASCII character 0 through 9 indicates the origin (justification and base line) for characters with respect to the current pen position. This function is useful when drawing tables.

If text is left justified, the current pen position is the left margin. Center causes the label to be centered on the pen position. Right justify selects the pen position as the right margin. Bottom, middle, and top select the base line for the line of text.

For example, if text was to be right justified and set with a base line on top of the normal character position, the number "9" would be used.

Figure 4. Hardware Text Justification

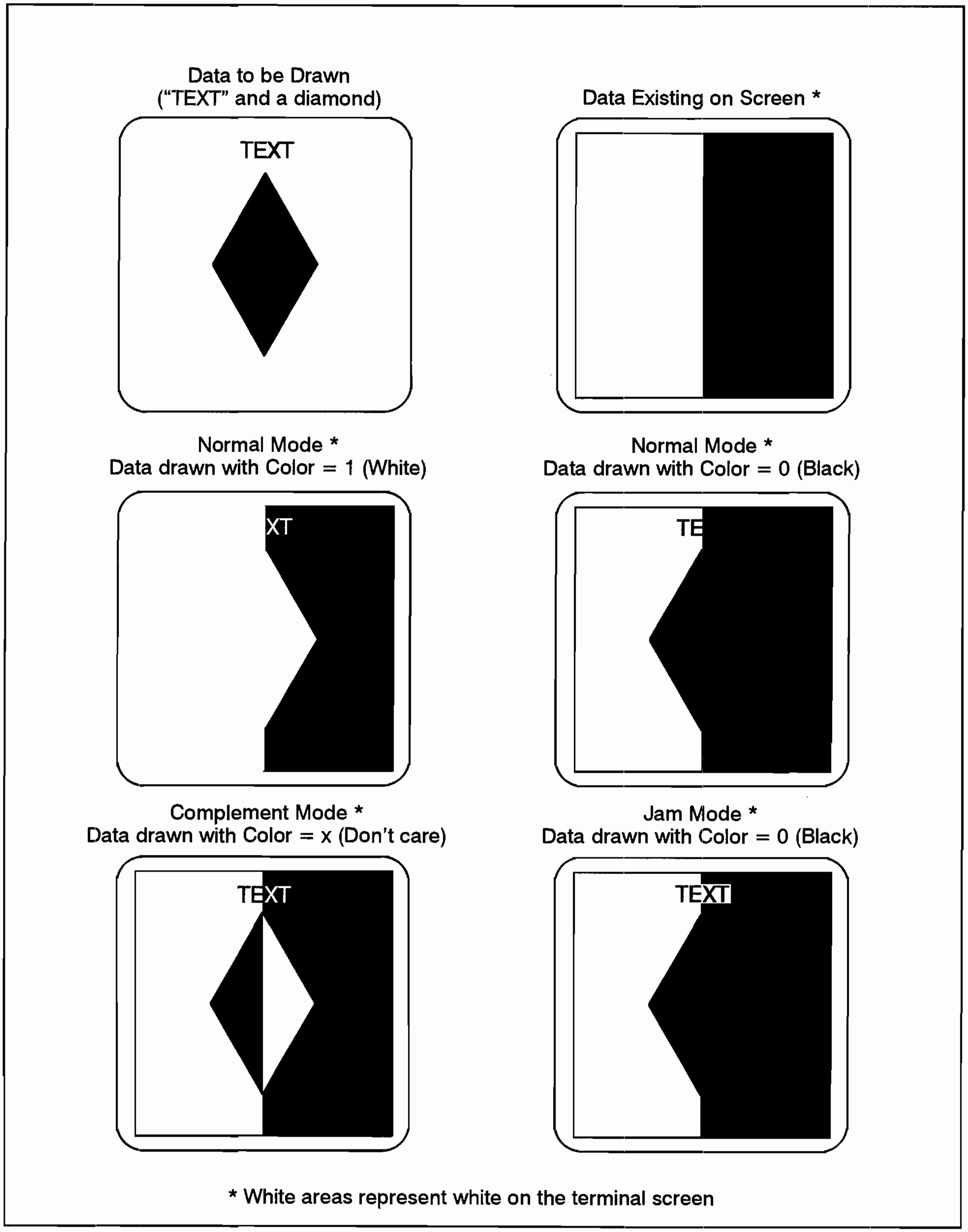


Figure 5. Special Drawing Modes

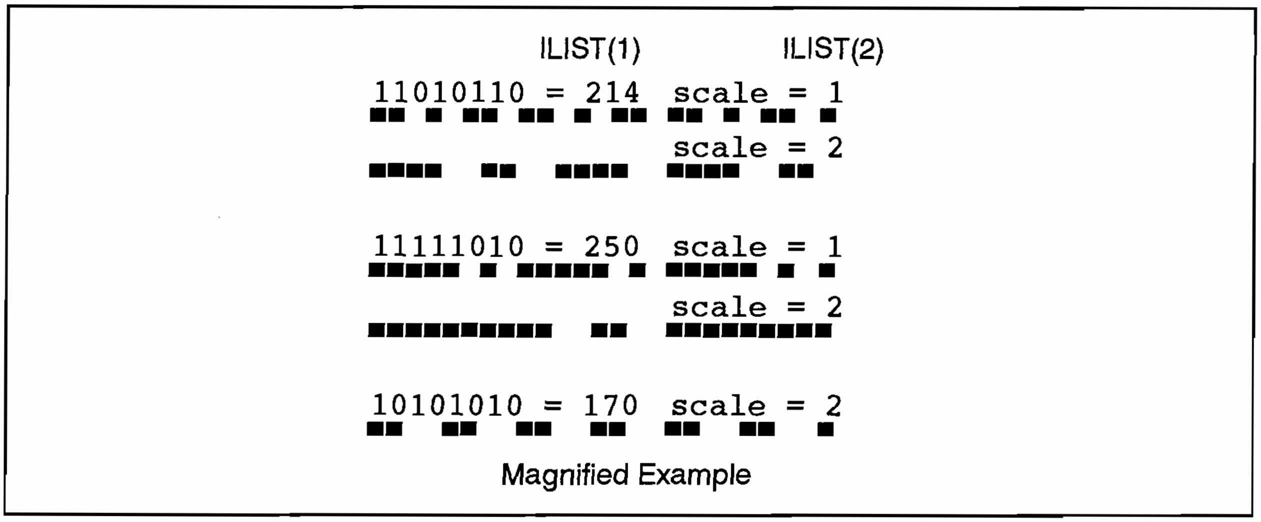
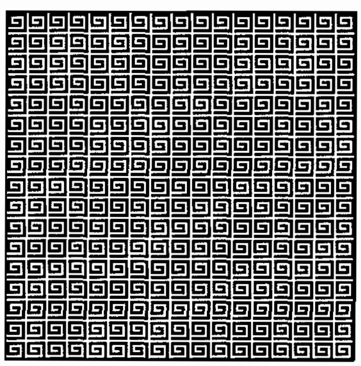
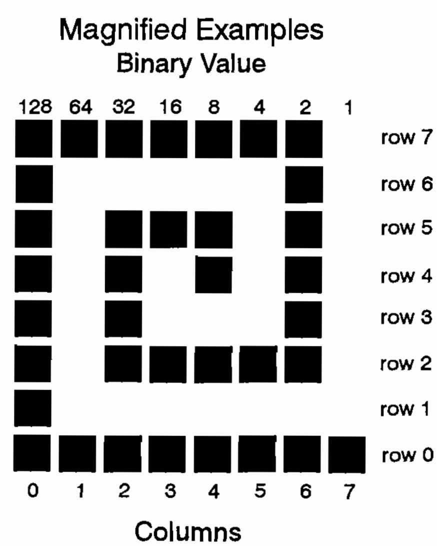


Figure 6. Magnified Examples of User-Defined Line Styles





ILIST(8)	Row 7	11111110 - 254
ILIST(7)	Row 6	10000010 - 130
ILIST(6)	Row 5	10111010 - 186
ILIST(5)	Row 4	10101010 - 170
ILIST(4)	Row 3	10100010 - 162
ILIST(3)	Row 2	10111110 - 190
ILIST(2)	Row 1	10000000 - 128
ILIST(1)	Row 0	11111111 - 255

1 = dot on
0 = dot off

Figure 7. Defining Area Patterns

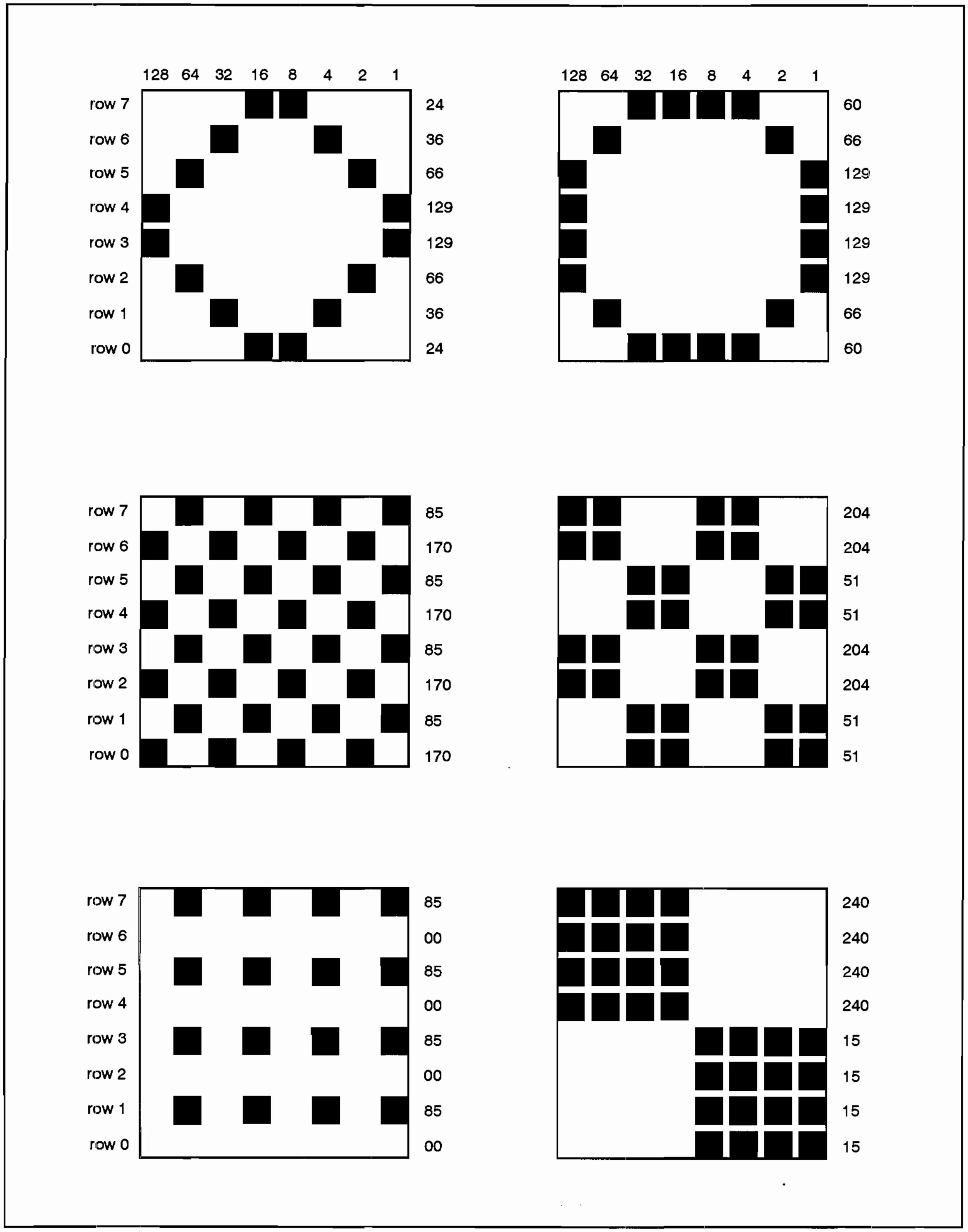


Figure 8. Magnified Examples of Area Patterns

Locator Echoes on the Graphics Display

(JWLOC/ZWLOC). The type of echoes available on the graphics display depends on whether or not the graphics display and locator are the same physical device. For echoes supported on the locator device, see the corresponding device driver that discusses the locator device in question.

Same Physical Device

If the locator and graphics display are the same physical device, the following echoes are supported on the display:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until operator response. When an operator response occurs, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as echo 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/Vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

If the HP 17623A Graphics Tablet is attached, it is considered the same logical device as the locator and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen is depressed.

Different Physical Devices

If the locator and display devices are different physical devices and the locator device supports echoing on the graphics display, then the following echoes are supported on the graphics display:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Pick Echoes on the Graphics Display (AGP)

(JPICK). For echoes supported on the pick device, see the corresponding device driver which discusses the pick device in question.

Echo #	Echo Performed
2	Initially, the graphics cursor is turned on at the current pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is completed. Before control is returned to the application program the graphics cursor is turned off.

If the HP 17623A Graphics Tablet is attached, it is considered the same logical device as the locator and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen is depressed.

Disabling (AGP)

(JWOFF). The display is not reset to initial values when JWOFF is called. Values remain as they were last set. For example, color may remain set to the background color if the last operation was a simulated raster erase.

Termination (DGL)

(ZDEND). The graphics display is unaltered. The device name is reset to "0036 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0. All attribute values remain unaltered until the system is reinitialized or the display device is enabled again.

Keyboard Device Handler

Description

The terminal has a standard ASCII keyboard that is supported as a keyboard input device. The device driver required to use the keyboard device is K0001.

Initialization

(JEDEV/ZKINT). When the keyboard device is initialized the terminal alphanumeric display is turned on. The device name is set to "2627A ". The name is padded to 6 characters with trailing blanks.

Keyboard Input

(JKYBD/ZKYBD). Once the keyboard device has been enabled it is available for input operations. When JKYBD or ZKYBD are called, a read operation is set pending on the terminal. The operator then enters the desired text and terminates the operation by entering a carriage-return. Some keys have a special meaning when entered by the operator and are not returned to the application program. See the AGP or DGL Reference Manual for a description of these keys.

Echoes Supported

The keyboard device supports the following echoes:

Echo #	**Echo Performed**
0	Text is not displayed on the terminal alphanumeric display as it is entered.
1	Text is displayed on the terminal alphanumeric display as it is entered.

Termination

(JDDEV/ZKEND) The alphanumeric display is unaltered. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Locator Device Handler

Description

The dimensions of the locator device are as follows:

Screen size:	215 mm wide by 164 mm high
Screen capacity:	512 points wide by 390 points high
Resolution:	2.3814 points/mm in X direction 2.3780 points/mm in Y direction
Physical origin:	Lower-left corner of display
Default locator limits:	Set to maximum physical limits of the screen.

The terminal has a graphics locator that is capable of returning any point on the screen. The device driver required to use the locator device is L0019.

Initialization

(JEDEV/ZLINT). When the locator device is initialized, the terminal's graphics display is left unaltered. The device name is set to "2627A ". The name is padded to 6 characters with trailing blanks.

Wait Locator Input

(JWLOC/ZWLOC). The wait locator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key. The (X,Y) coordinate value of the graphics cursor (which is a function of the echo) and the key struck are returned to the application program. Any of the ASCII keys can be used to terminate the locator input function so the key returned to the application program can range from 0 to 127.

If the HP 17623A Graphics Tablet is attached, it is considered the same logical device as the locator and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen is depressed.

Echoes Supported

Locator input can be echoed on either a graphics display device or a locator device. The echo can only be performed on a graphics display device when the locator and the graphics display devices are implemented on the same physical device (that is, same terminal). Refer to the graphics display sections to see how the locator can echo input on the graphics display. The following lists the echoes that can be performed by the locator device:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the oper-

Echoes Supported

Pick input can be echoed on either a graphics display device or a pick device. The echo can only be performed on a graphics display device when the pick and the graphics display devices are implemented on the same physical device (that is, the same terminal). Refer to the AGP graphics display section to determine the supported pick echoes on the graphics display. The following lists the echoes that can be performed by the pick device:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator through the use of the graphics cursor control keys. When the graphics cursor is positioned over the desired point the operator strikes an alphanumeric key and the pick function is terminated. Before control is returned to the application program, the graphics cursor is turned off.

Termination

(JDDEV) The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Valuator Device Handler

Description

The dimensions of the valuator device are as follows:

Screen size:	215 mm wide by 164 mm high
Screen capacity:	512 points wide by 390 points high

The terminal can simulate a valuator device with the graphics locator. The simulation is done by splitting the X and Y coordinates into two subvaluators and scaling the locator coordinates to values which range from 0.0 to 1.0. The device driver required to use the valuator device is V0019.

Initialization

(JEDEV/ZVINT) When the valuator device is initialized, the terminal's graphics display is left unaltered. The device name is set to "2627A ". The name is padded to 6 characters with trailing blanks.

Wait Valuator Input

(JWVAL/ZWVAL) The wait valuator input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key.

In addition to returning the subvaluator value, the key struck to terminate the valuator operation is also returned to the application program. Any of the ASCII keys can be used to terminate the valuator function so that the button returned to the application program can range from 0 to 127.

If the HP 17623A Graphics Tablet is attached, it is considered the same logical device as the locator and is an extension to the terminal. It can be used in conjunction with the terminal's original functionality. The only difference is that a button value of 128 is returned when the tablet pen is depressed.

The values returned are a function of the subvaluator specified as follows:

Subvaluator	Value Returned
1	The X coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the left edge and a value of 1.0 is returned if the cursor is at the right edge of the display.
2	The Y coordinate of the graphics cursor position scaled to a number between 0.0 and 1.0. A value of 0.0 is returned if the cursor is at the bottom of the display and a value of 1.0 is returned if the cursor is at the top of the display.

Echoes Supported

The supported echoes for the wait valuator function are as follows:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator through the use of the graphics cursor control keys. When the graphics cursor is positioned over the desired point, the operator strikes an alphanumeric key and the valuator function is terminated. Before control is returned to the application program, the graphics cursor is turned off.

Sample Valuator Input

(JSVAL/ZSVAL). The sample valuator input function returns a subvaluator value without waiting for an operator response. The valuator simulation is performed in the same way as for the wait valuator function.

Echoes Supported

The following valuator echoes are supported when using the sample valuator function:

Echo #	Echo Performed
0	Echo not performed.
1	The terminal bell is sounded when the valuator is sampled.

Termination

(JDDEV/ZVEND). The device name is set to "0019 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 2647A/2647F/2648A Graphics Terminal

General Information

This document pertains to the HP 2647A, HP 2647F, and HP 2648A Graphics Terminals. If necessary, refer to the following manuals for the appropriate operating instructions:

HP 2647A Intelligent Graphics User's Manual, part number 02647-90001.

HP 2647A Intelligent Graphics Reference Manual, part number 02647-90002.

HP 2647F Intelligent Graphics Reference Manual, part number 02647-90037.

HP 2647F Intelligent Graphics BASIC/47 Manual, part number 02647-90038.

HP 2647F Intelligent Graphics AUTOPLOT/47 Manual, part number 02647-90042.

HP 2648A Graphics Terminal User's Manual, part number 02648-90001.

HP 2648A Graphics Terminal Reference Manual, part number 02648-90002.

Supported Logical Devices

The following logical devices are supported by the AGP/DGL Graphics Systems:

Logical Device	Device Handler Name
Alphanumeric	A0001
Button	B0001
Graphics display	D0001
Keyboard	K0001
Locator	L0001
Pick (AGP only)	P0001
Valuator	V0001

Device Configuration

The terminals should be strapped for normal point-to-point operation. All of the keyboard interface straps should be closed (the normal position). The terminal should not be in block mode.

Alphanumeric Device Handler

Description

The graphics terminals have independent alphanumeric and graphics display memories which allow either or both types of data to be displayed. The alphanumeric device handler, A0001, allows the application programmer to send messages and alphanumeric display control commands to the terminals.

The dimensions of the alphanumeric device are as follows:

Screen size:	Width: 254 mm	Height: 127 mm
Screen capacity:	24 lines and 80 characters per line	
Character size:	Width: 2.46 mm	Height: 3.175 mm

Initialization

(JEDEV/ZAINT). When the alphanumeric device is initialized, the alphanumeric display is turned on and the contents of the alphanumeric memory are left unaltered. DGL sets the device name to the terminal name, for example "2648A ". The name is padded to 6 characters with trailing blanks.

Alphanumeric Output

(JALPH/ZALPH). The state of the alphanumeric display is not altered before sending the character string to the terminal. The entire character string passed is sent directly to the terminal. A maximum of 132 characters can be sent to the alphanumeric device at one time. If the text output exceeds the size of a line, the terminal performs a carriage-return line-feed and text output continues on the next line. The character string may contain alphanumeric characters or command sequences that control the alphanumeric display (for example, clear alphanumeric memory, alphanumeric cursor control, and so forth). Command sequences that affect other parts of the terminal (for example, graphics display) should not be contained in the string because they could destroy the integrity of the graphics system.

Termination

(JDDEV/ZAEND). When the alphanumeric device is terminated, the alphanumeric display is not affected. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Button Device Handler

Description

The graphics terminals have eight softkeys which together are supported as a button device. These keys are above the standard ASCII keys and are labeled f1 through *f8*. The numeric keys 1 through 8 can also be used in the same way as the softkeys. The device handler required to use the button device is B0001.

Initialization

(JEDEV/ZBINT). When the button device is initialized, all previous softkey definitions are destroyed. The softkeys f1 through *f8* are loaded with the ASCII characters 1 through 8 respectively. The device name is set to the terminal name, for example, "2648A ". The name is padded to 6 characters with trailing blanks.

Button Input

(JBUTN/ZBUTN). Once the button device has been enabled, it is available for input operations. When JBUTN or ZBUTN are called, a read operation is set pending on the terminal. Striking a softkey or an ASCII key between 1 and 8 returns the button as an integer value ranging from 1 to 8. If an invalid, transmittable (that is, ASCII) key is struck, an integer 0 is returned as the button value.

Echoes Supported

The button device handler supports the following echoes:

Echo #	Echo Performed
0	Echoing is not performed.
1	The terminal bell is sounded if a valid button is activated.

Termination

(JDDEV/ZBEND). When the button device is terminated, the softkey definitions remain as they were defined by the button device at initialization. The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Polygon Interior Line Style

(JPILS). The interior line style attribute is not applied to device-dependent area fill. Refer to JLSTL for information regarding line style.

Highlighting

((JSHI/JGHI). Highlighting is not supported on the graphics terminals.

Line Style

(JLSTL). Eight predefined line styles are supported on the graphics terminals. In addition, two user-definable styles can be selected. These line styles can be defined through the use of output escape functions (see JOESC, Opcodes 2050 and 8050). Initially, the two user-definable line styles are set to solid. See Figure 1 for the line styles available on the graphics terminals.

All of the supported line styles are continuous. Refer to the JLSTL subroutine description in the *AGP Reference Manual*, part number 97085-90007, for a complete description of a continuous line style.

Line Width

(JLWID). Only one line width is supported on the graphics terminals.

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

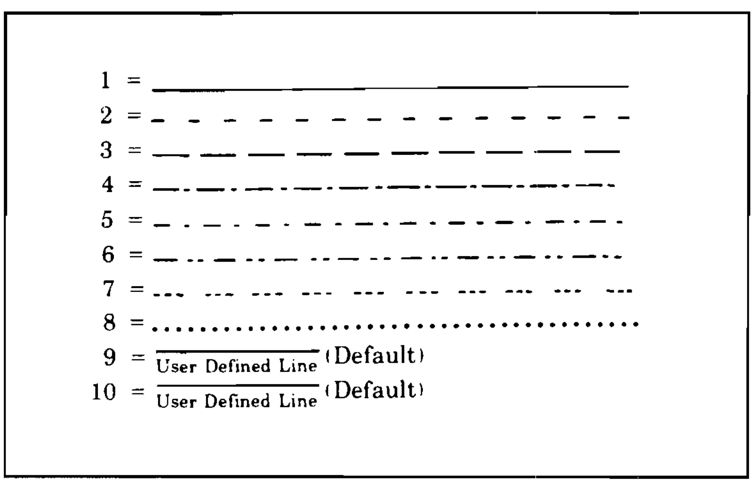


Figure 1. Supported Line Styles

Character Sizes

(JCSIZ). There are eight distinct character sizes supported on the graphics terminals. They all have a constant aspect ratio of 1.43. The supported character sizes are:

Width	Height
2.45 mm	3.5 mm
4.9 mm	7.0 mm
7.35 mm	10.5 mm
9.8 mm	14.0 mm
12.75 mm	17.5 mm
14.7 mm	21.0 mm
17.15 mm	24.5 mm
19.6 mm	28.0 mm

When using medium- and low-quality text, the character is placed within the character cell as shown in Figure 2.

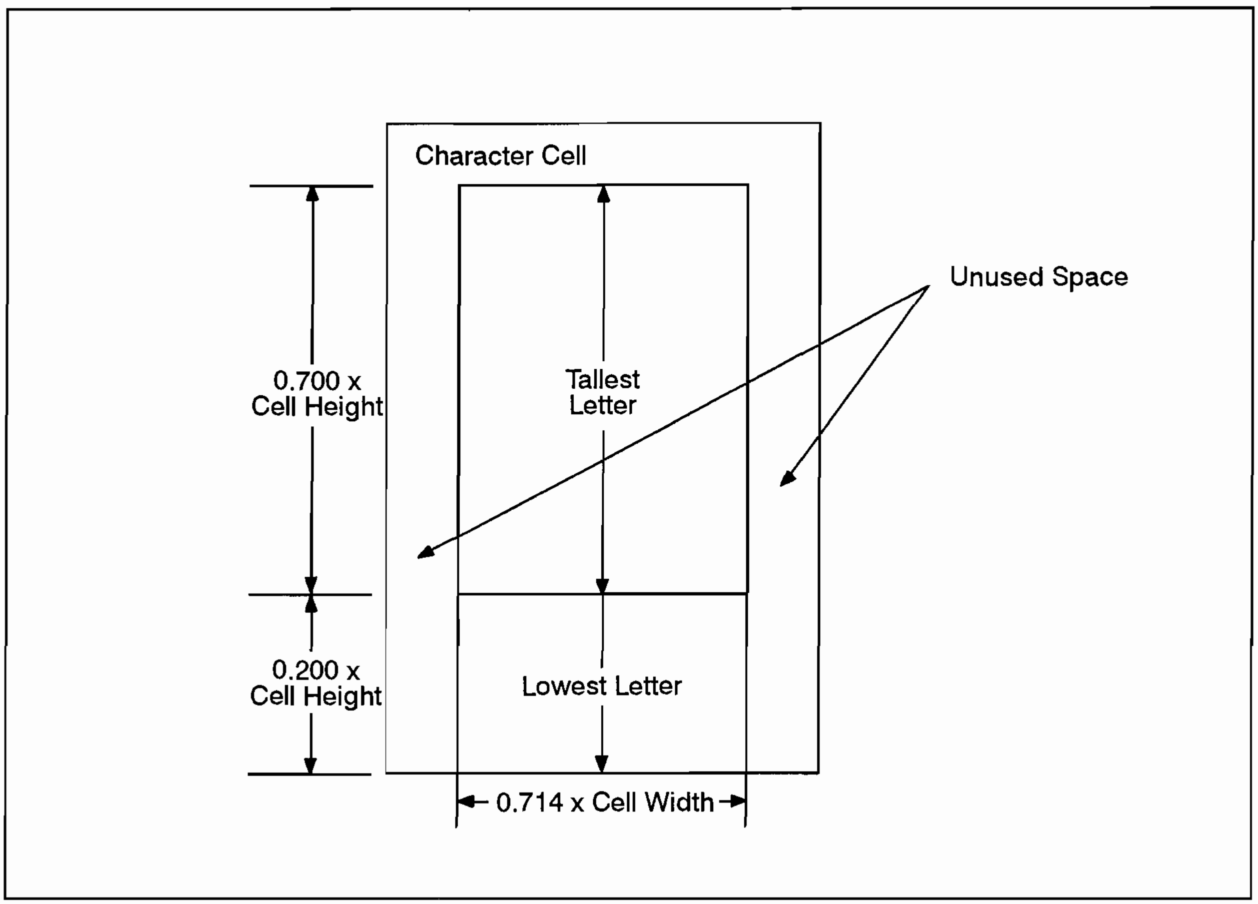


Figure 2. Placement of Character in Character Cell

Output Primitives

Clipping

The graphics terminals do not provide hardware vector clipping. If window clipping is turned off in AGP and vectors are created that lie entirely or partially outside of the view surface, unpredictable results may occur. Medium- and low-quality text strings are clipped if they do not lie entirely within the physical limits of the graphics display.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). Single rectangles with device-dependent polygon styles are displayed using hardware area fill. Their edges must be parallel to the X and Y axes of the virtual coordinate system. Other polygon sets are treated as if the device did not support hardware area fill.

If the polygon style specifies a fill density of 1.0 or −1.0, then the rectangle is filled with the current user-defined area pattern. The default for this pattern is solid. (See JOESC, Opcode 8050, for further details.)

If the user specifies a density that is less than 1/8 but greater than 0.0, then a density of 1/8 is used. If the density is greater than −1/8 but less than 0.0, then a density of −1/8 is used. If the user specifies any other fill density it is rounded up to the nearest multiple of 1/8 if the density is positive, and down to the nearest 1/8 if the density is negative.

The interior orientation for densities other than −1.0, 1.0, and 0.0 is calculated by rounding to the nearest multiple of 45 degrees. For densities other than −1.0, 1.0, and 0.0, crosshatching is supported. For all polygon fills, the interior line style is ignored.

Except when the style specifies a fill density of 1.0, −1.0, or 0.0, the user-defined area fill pattern is set to solid, after device-dependent display of a rectangle.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). Nineteen standard markers are supported. The smallest character size (2.45 mm by 3.5 mm) is always used to generate markers that are actually 1.77 mm by 2.48 mm without the unused space.

Medium- and Low-Quality Text

(JTEXM/JTEXL). Medium- and low-quality graphics text are generated with a hardware character generator. The characters are drawn with a size ratio of 5 wide and 7 high in a character cell with a size ratio of 7 wide by 10 high. See Figure 3 for the viewable graphics character set.

If a medium- or low-quality text string is not clipped by AGP and extends beyond the physical limits of the graphics display, all characters which do not lie entirely within the physical limits are clipped by the terminal.

Medium- and low-quality text use the color attribute but do not use the line style and line width attributes. Characters are always generated using solid lines. The direction, slant, and justification of these types of text can be modified through the use of escape functions (see JOESC, Opcodes 1050, 1051, and 1052).

```
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ

!"*$%&'()#+,-./0123456789:

;<=>?@[\]^_`{|}~
```

Figure 3. Supported Graphics Text Characters

New-Frame-Action

(JNEWF/JPURG/JSVIS/JSHI/JVSAL/JCLR). The action taken when a new-frame-action is given is dependent on whether the simulated raster erase bit was set during the JDINT call and is outlined in the following two sections.

Simulated Raster Erase Not Set

A new-frame-action given when the device is enabled and not in a batch-of-updates clears the CRT to the background color and redraws all visible segments.

When the new-frame-action is given with the display not enabled, it does not alter the display. When given inside a batch-of-updates, the screen is not changed until the call JUPDT is given. At this time the screen is cleared to the background color and all visible segments are redrawn.

Simulated Raster Erase Set

The supported graphics terminals have the ability to undraw images. AGP uses this feature when the simulated raster erase bit is set in the JDINT call. In this way graphics elements are removed without first clearing the display. For example, AGP uses simulated raster erase when a segment is purged.

Note Erasing is done by redrawing the image in black (that is, the background color); therefore, white lines crossing the image to be purged can also have parts of them erased, leaving holes.

An explicit JNEWF call always clears the display and redraws all visible segments when given on an enabled workstation outside of a batch-of-updates. This gives the user of simulated raster erase a means of generating a clean surface (one without holes).

The other calls that implicitly cause a new-frame-action (for example, JPURG) use simulated raster erase only when the workstation is enabled. Simulated raster erase is not used on disabled workstations, because by definition, the display must not change. Simulated raster erase is not used in a batch-of-updates because changes cannot occur to the display until the JUPDT call is given. A new-frame-action inside a batch-of-updates always results in the screen being cleared and visible segments being redrawn when the JUPDT call is given.

Inquiry Escape Functions

(JIESC). The following inquiry escape functions are supported by AGP:

Opcode	Function
2050	Inquire hardware zoom status. ILIST(1) = Zoom size between 1 and 16. ILIST(2) = Zoom on/off. (0 = off, 1 = on).
3050	Inquire medium- and low-quality text status. ILIST(1) = Current medium- and low-quality hardware text justification. See Figure 4 for possible values. ILIST(2) = Current medium- and low-quality hardware text direction. Possible values are 0, 90, 180, or 270 degrees. ILIST(3) = Current medium- and low-quality hardware text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(JOESC). Several output escape functions are supported by AGP with the graphics terminals. Error checking is not performed by the graphics system on any of the parameters that are to be sent to the device. If a parameter is outside of the range specified in the escape function definition, the terminal ignores the function.

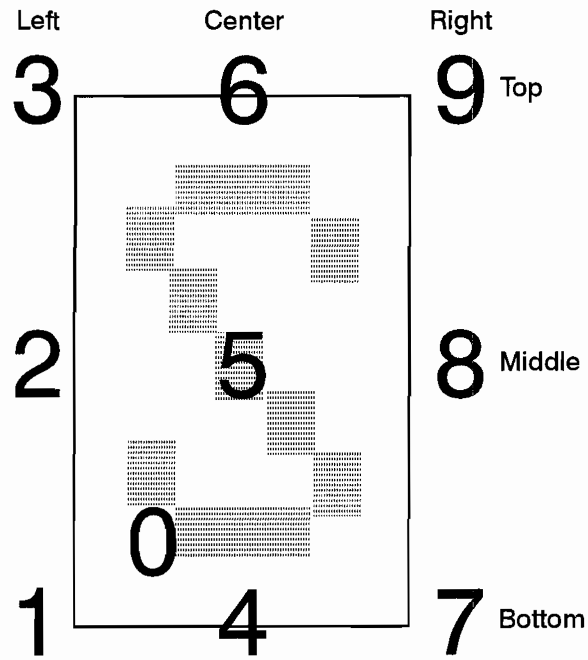
Escape functions are not stored in the segment display area. This can have implications when used with AGP segments. For example, suppose the line style is set to 10 and the escape function (see JOESC, Opcode 2050) is used to define a line pattern. A segment is created and then appears on the screen with the given line pattern. If the line pattern is changed and a new-frame-action is given, the segment is redrawn with the current line pattern, (not the line pattern with which it was originally created).

Escape functions may have undesirable effects on medium- and low-quality text. For example, if JJUST is used to set AGP justification to center, and a hardware justification is chosen, the text may not end up justified.

Escape functions are sent from AGP directly to the device. The state of AGP may become undefined when an escape function is given that overrides a mode set by AGP (for example, hardware text justification).

The following output escape functions are supported:

Opcode	Function
250	Set zoom position to a virtual coordinate point. RLIST(1) = X position in virtual coordinates. RLIST(2) = Y position in virtual coordinates.
450	Perform rectangular area fill using the current line style and color. The rectangular area is specified in virtual coordinates. RLIST(1) = Minimum X border of rectangle. RLIST(2) = Maximum X border of rectangle. RLIST(3) = Minimum Y border of rectangle. RLIST(4) = Maximum Y border of rectangle.
1050	Set device text direction that will apply to subsequently output low quality graphics text. This applies to characters individually for medium-quality graphics text. ILIST(1) = New text direction. 0 = 0 degrees (horizontal). 1 = 90 degrees counterclockwise. 2 = 180 degrees counterclockwise. 3 = 270 degrees counterclockwise.
1051	Set device character slant for subsequently output medium- and low-quality graphics text. ILIST(1) = Text slant. 0 = 0 degrees (normal). 1 = 45 degrees.
1052	Set device text justification for subsequently output medium- and low-quality graphics text. This applies to characters individually for medium-quality graphics text. ILIST(1) = Text justification. Refer to Figure 4 for the supported justifications. When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when center or right justifying is 80 characters (not including the CR or LF). In all cases, data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.
1053	Turn zoom on/off. ILIST(1) = 0 Turn zoom off. ILIST(1) = 1 Turn zoom on.
1054	Set zoom size. ILIST(1) = Zoom size (1-16). Size 1 is smallest (no zoom).



The numbers 1-9 represent the cursor position with respect to the character cell used for graphics text characters. The number 0 represents the cursor position with respect to the character (not this cell).

Justification/Origin. Text strings can be automatically right or left justified, or centered about a specified point. An ASCII character 0 through 9 indicates the origin (justification and base line) for characters with respect to the current pen position. This function is useful when drawing tables.

If text is left justified, the current pen position is the left margin. Center causes the label to be centered on the pen position. Right justify selects the pen position as the right margin. Bottom, middle, and top select the base line for the line of text.

For example, if text was to be right justified and set with a base line on top of the normal character position, the number “9” would be used.

Figure 4. Hardware Justification

1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.

1056 Set special drawing modes. Using this escape function overrides the color as defined by the JCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to JCOLR. See Figure 5 for the color and the special drawing modes.

ILIST(1) = 1 Enable complement drawing mode. All primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black, and all black pixels turn white.

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the affect of overlaying the output primitives generated with it over the current primitives on the graphics display.

2050 Define line pattern. This allows the user to define the dot pattern used to draw vectors. Once a line pattern is defined, it can be used by setting the line style to 9. See Figure 6 for examples on defining line patterns.

ILIST(1) = A decimal value between 0 and 255 defining an 8-bit binary pattern.
ILIST(2) = A scale factor between 1 and 16 to be applied to the pattern.

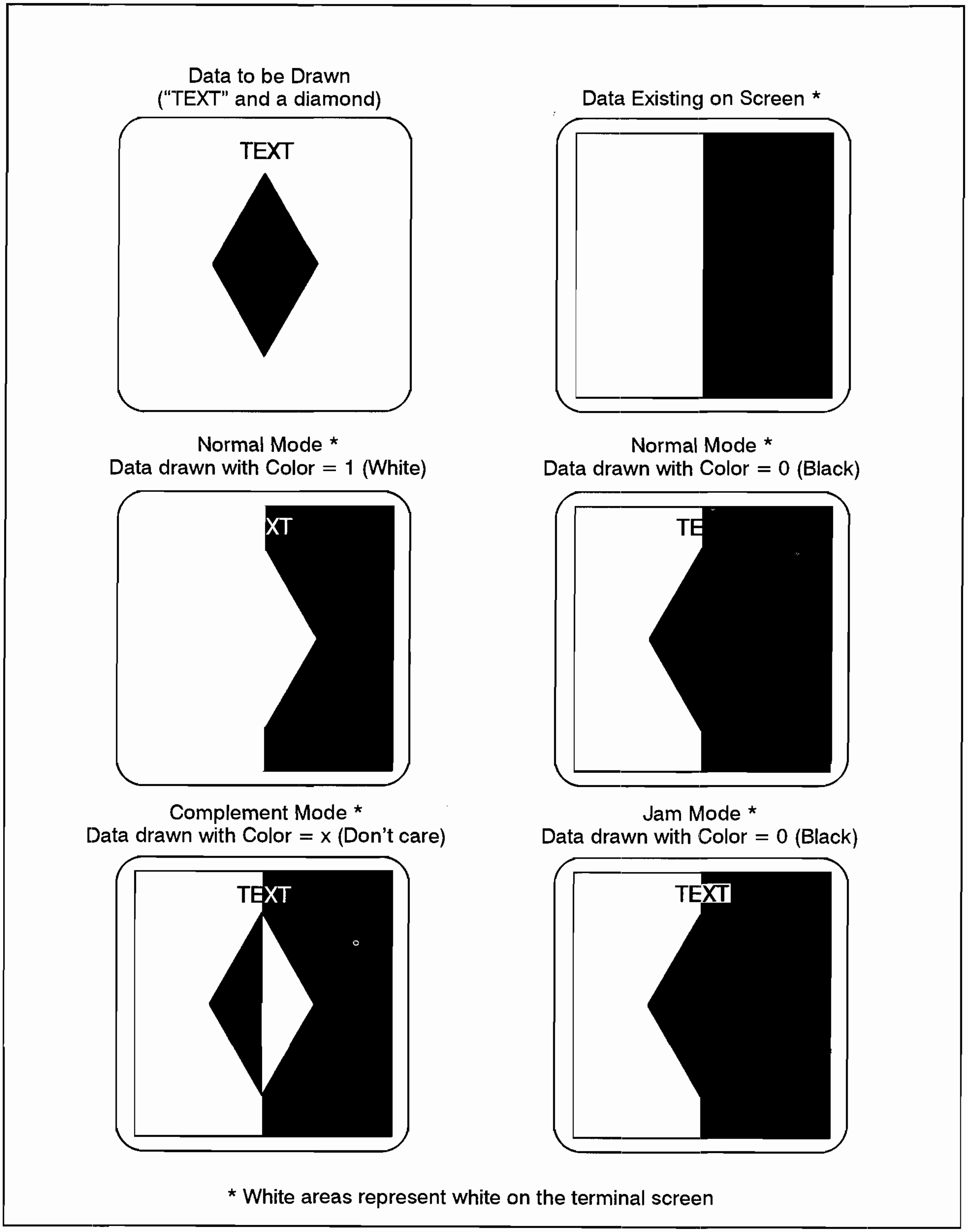


Figure 5. Special Drawing Modes

8050 Define area pattern

An 8 by 8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and for device-dependent polygon filling. The area pattern is defined by specifying each row of the pattern with a decimal number ranging between 0 and 255 that defines an 8-bit binary pattern. The graphics display is divided into 8 by 8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used by setting the line style to 10. Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling rectangular area. The user-defined area pattern can be used for filling polygons when the current polygon style has density −1, and specifies device-dependent output. Figure 7 and Figure 8 contain sample area fill patterns.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.

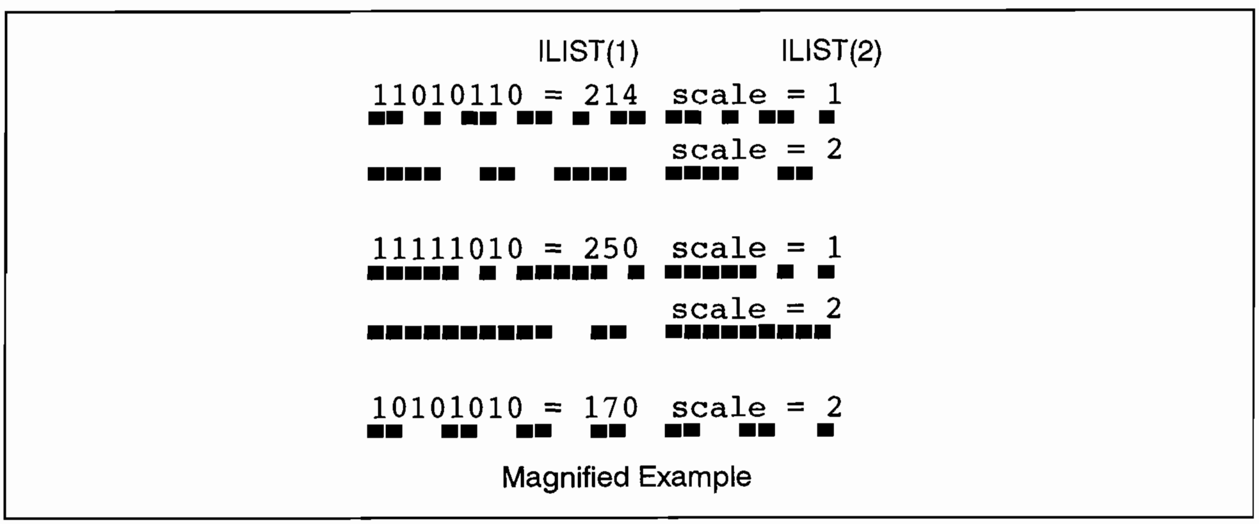
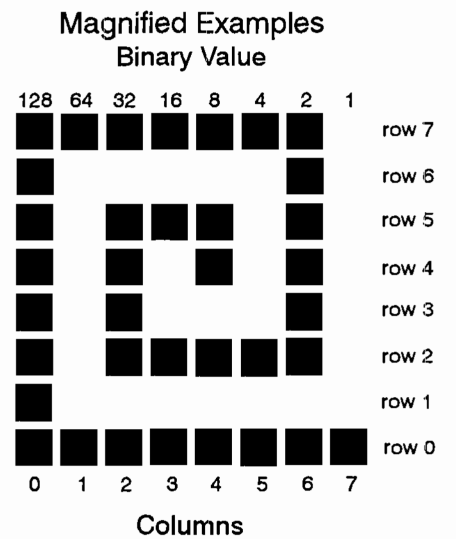


Figure 6. Magnified Examples of User-Defined Line Styles

```
ILIST(8)  Row 7    11111110 - 254
ILIST(7)  Row 6    10000010 - 130
ILIST(6)  Row 5    10111010 - 186
ILIST(5)  Row 4    10101010 - 170
ILIST(4)  Row 3    10100010 - 162
ILIST(3)  Row 2    10111110 - 190
ILIST(2)  Row 1    10000000 - 128
ILIST(1)  Row 0    11111111 - 255

                   1 = dot on
                   0 = dot off
```



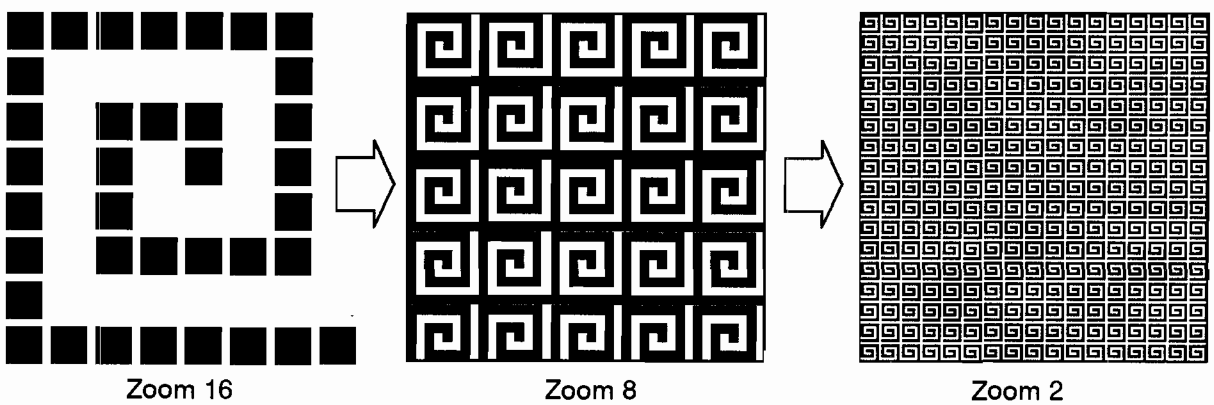


Figure 7. Defining Area Patterns

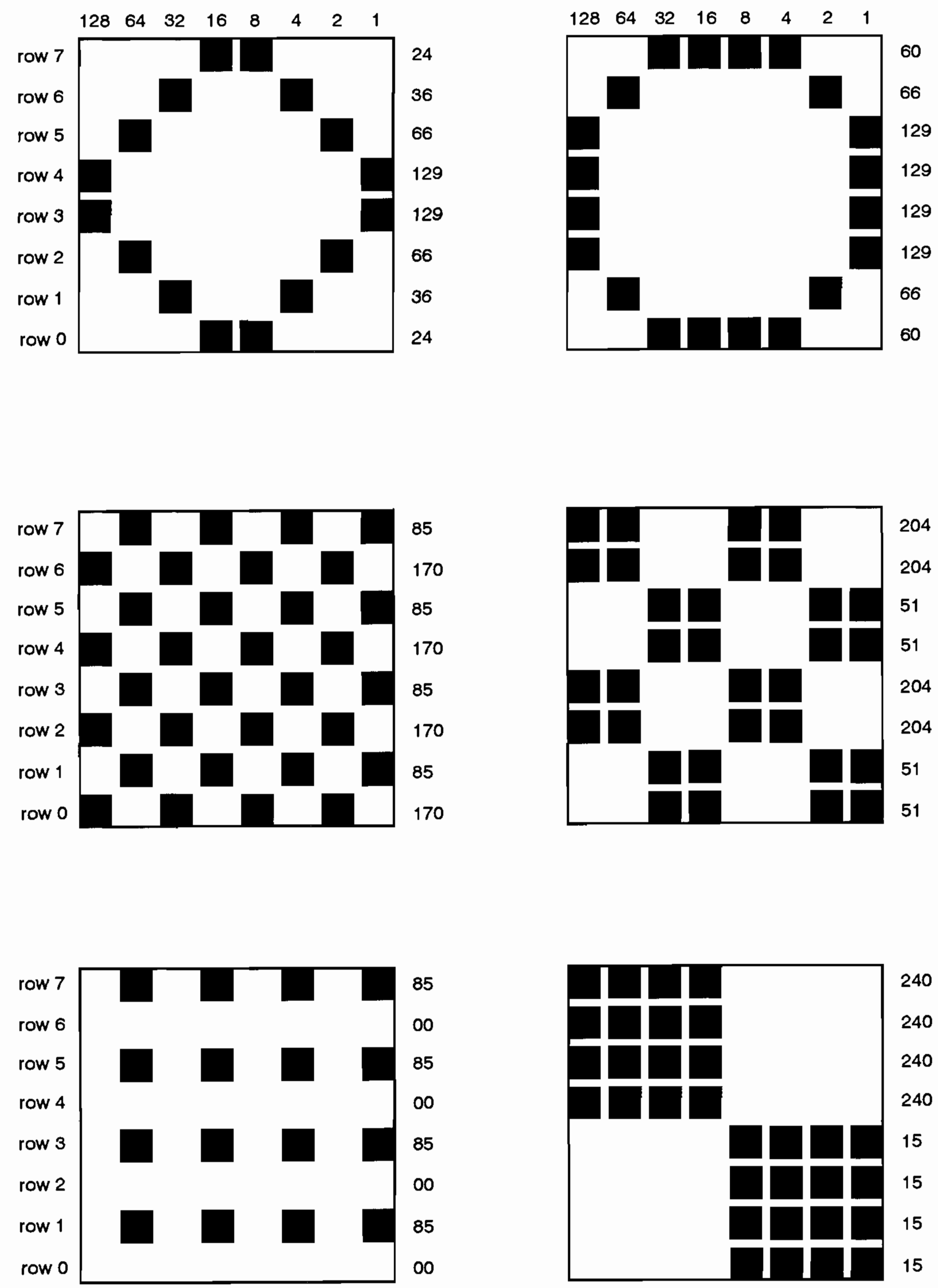


Figure 8. Magnified Example of Area Patterns

Locator Echoes on the Graphics Display

(JWLOC). The type of echoes available on the graphics display depends on whether or not the graphics display and locator are the same physical device. For echoes supported on the locator device, see the corresponding device handler that discusses the locator device in question.

Same Physical Device

If the locator and graphics display are the same physical device, the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until operator response. When an operator response occurs, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the graphics cursor and the Y coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the locator echo position and the Y coordinate of the graphics cursor.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or ECHO 6, whichever defines a longer line from the locator echo position.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the position of the graphics cursor.

Different Physical Devices

If the locator and display devices are different physical devices and the locator device supports echoing on the graphics display, then the following echoes are supported on the graphics display. Because of the eavesdrop configuration allowed with some plotters, the locator device and display device can have the same I/O unit descriptor, but be different physical devices.

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Pick Echoes on the Graphics Display

(JPICK). For echoes supported on the pick device, see the corresponding device handler that discusses the pick device in question.

Echo #	Echo Performed
2	Initially, the graphics cursor is turned on at the current pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is completed. Before control is returned to the application program the graphics cursor is turned off.

Disabling

(JWOFF). The display is not reset to initial values when JWOFF is called. Values remain as they were last set. For example, color may remain set to the background color if the last operation was a simulated raster erase.

Graphics Display Device Handler (DGL)

Description

The dimensions of the graphics display device are as follows:

Screen size:	Width: 254 mm	Height: 127 mm
Screen capacity:	Width: 720 points	Height: 360 points
Aspect ratio of maximum area:	0.4993.	
Resolution:	2.8346 points/mm in X and Y directions.	

The physical origin is the lower left corner of the display.

The view surface is always centered within the current logical display surface.

Initialization

(ZDINT). When initialized, the following operations are performed:

Device name:	Set to "2647A ", "2647F ", or "2648A " (padded to 6 characters with trailing blanks).
Color:	Set to 1.
Highlighting:	Set to 1.
Line width:	Set to 1.
Line style:	Set to 1.
Graphics and alphanumeric displays:	Turned on and are not cleared.
Graphics cursor:	Turned off and is in the lower left corner of the display.
Starting position	The lower left corner of the display.
Graphics display:	Cleared unless bit 7 is set in the control word for the ZDINT call.
Zoom:	Set to size 1 and is turned off.
Zoom position:	Same as the graphics cursor.
Text:	Slant is set to 0 degrees. Label direction is set to 0 degrees. Label origin is set to 1 (left, bottom justified).

User-defined area and line patterns:	Set to solid
Logical display limits:	Set to the maximum physical limits of the display.
New-frame-action:	Buffered if bit 6 of the control word for ZDINT is set.
View surface:	Centered within the logical display limits.

Supported Primitive Attributes

Color

(ZCOLR). The D0001 display handler provides a software color table of two colors. The colors available are black and white. The size of the color table cannot be changed. The default values of the color table are shown in Table 2.

Table 2. Default Color Table

Color Table Entry	Color
0	Color set to black (background)
1	Color set to white

The color table is initialized when ZDINT is called. The color table cannot be redefined or inquired using ZDCOL or ZICOL.

The color selected corresponds to the color defined in the color table.

COLOR = 0 Color table entry 0 is selected.
= 1 Color table entry 1 is selected.

Redefining and Inquiring Color

(ZDCOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(ZPICL). There are two colors supported by DGL on the graphics terminals; black and white. Both colors can be displayed at one time. The supported values of the color attributes are:

COLOR = 0 Color set to black (background color).
= 1 Color set to white.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). Refer to ZLSTL for information regarding line style.

Highlighting

(ZHIGH). Highlighting is not supported.

Line Style

(ZLSTL). Eight predefined line styles are supported with the graphics terminals. In addition there are two user-definable styles that can be selected. These line styles can be defined through the use of output escape functions (see ZOESC, Opcodes 2050 and 8050). Initially, the two user-definable line styles are set to solid. See Figure 9 for the line styles available on the graphics terminals.

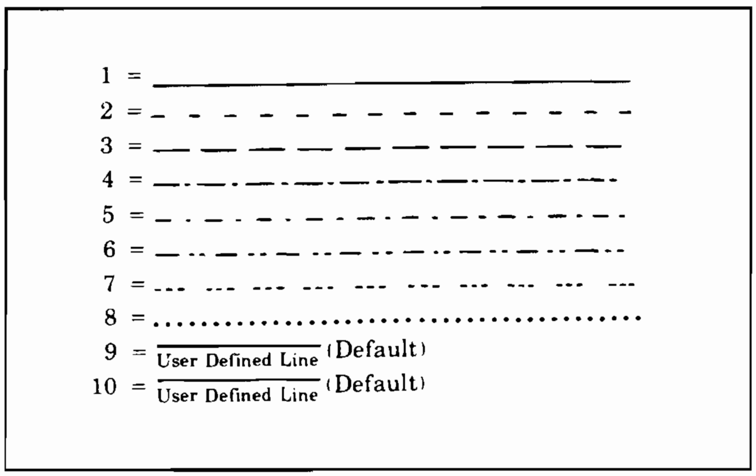


Figure 9. Supported Line Styles

All of the supported line styles are continuous. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete discussion of a line style.

Line Width

(ZLWID). Only one line width is supported on the graphics terminals.

LINEWIDTH = 1 Primitives drawn with a line width of one pixel.

The actual direction moved by these control functions is dependent on the text direction and text origin in use. Only the above special characters should be included in graphics text strings in addition to the printable ASCII characters.

Graphics text is not affected by the line style attribute; character strings are output as solid lines. The direction, slant, and justification of text can be modified through the use of escape functions (see ZOESC, Opcodes 1050, 1051, and 1052). If a text string extends beyond the physical limits of the graphics display, all characters that do not lie entirely within the physical limits are clipped by the terminal.

```
abcdefghijklmnopqrstuvwxyz
ABCDEFGHIJKLMNOPQRSTUVWXYZ

!"*$%&'()#+,-./0123456789:

;<=>?@[\]^_`{|}~
```

Figure 11. Supported Graphics Text Characters

New-Frame-Action

Non-Buffered

(ZNEWF). A call to ZNEWF makes the picture current and then erases the graphics display.

Buffered

(ZNEWF). When ZNEWF is called, the graphics display is made current. The instruction to clear the graphics display is stored in the DGL buffer and is not sent to the device until the next time the buffer is sent. When the buffer is sent, the display is cleared to the background color and whatever calls to DGL were put into the buffer after the ZNEWF call will take effect on the graphics display. The current display remains until the next buffer is sent. If immediate visibility is being used, the action is the same as if new-frame-actions were not buffered because the buffer is sent after every DGL call.

Inquiry Escape Functions

(ZIESC). The following inquiry escape functions are supported with the graphics terminals:

Opcode	Function
2050	Inquire hardware zoom status. ILIST(1) = Zoom size between 1 and 16. ILIST(2) = Zoom on/off (0 = off, 1 = on).
3050	Inquire text status. ILIST(1) = Current text justification. See Figure 12 for possible values. ILIST(2) = Current text direction. Possible values are 0, 90, 180, or 270 degrees. ILIST(3) = Current text slant. Possible values are 0 and 45 degrees.

Output Escape Functions

(ZOESC). Several output escape functions are supported by DGL with the graphics terminals. Error checking is not performed by the graphics system on any of the parameters that are to be sent to the device. If a parameter is outside of the range specified in the escape function definition, then the terminal ignores the function. None of the supported output escape functions alter the starting position for the next primitive.

The following output escape functions are supported:

Opcode	Function
250	Set zoom position to a world coordinate point. RLIST(1) = X position in world coordinates. RLIST(2) = Y position in world coordinates
450	Perform rectangular area fill using the current line style and color. The rectangular area is specified in world coordinates. RLIST(1) = Minimum X border of rectangle. RLIST(2) = Maximum X border of rectangle. RLIST(3) = Minimum Y border of rectangle. RLIST(4) = Maximum Y border of rectangle.
1050	Set text direction for subsequently output graphics text. ILIST(1) = New text direction. 0 = 0 degrees (horizontal). 1 = 90 degrees counterclockwise. 2 = 180 degrees counterclockwise. 2 = 270 degrees counterclockwise.
1051	Set character slant for subsequently output graphics text. ILIST(1) = Text slant. 0 = 0 degrees (normal). 1 = 45 degrees.

1052 Set text justification for subsequently output graphics text.

ILIST(1) = Text justification. See Figure 12 for the supported justifications.

When center or right justification is used, the text strings are buffered (stored) until all of the characters in the string have been received. The string must be terminated by a CR or LF and is not displayed until the CR or LF is received. The maximum length of a string when center or right justifying is 80 characters (not including the CR(LF)). In all cases, data written beyond the edge of the screen is lost. There is no automatic RETURN when the screen boundary is reached.

1053 Turn zoom on/off.

ILIST(1) = 0 Turn zoom off.
ILIST(1) = 1 Turn zoom on.

1054 Set zoom size.

ILIST(1) = Zoom size ranging from 1 to 16. Size 1 is smallest (no zoom).

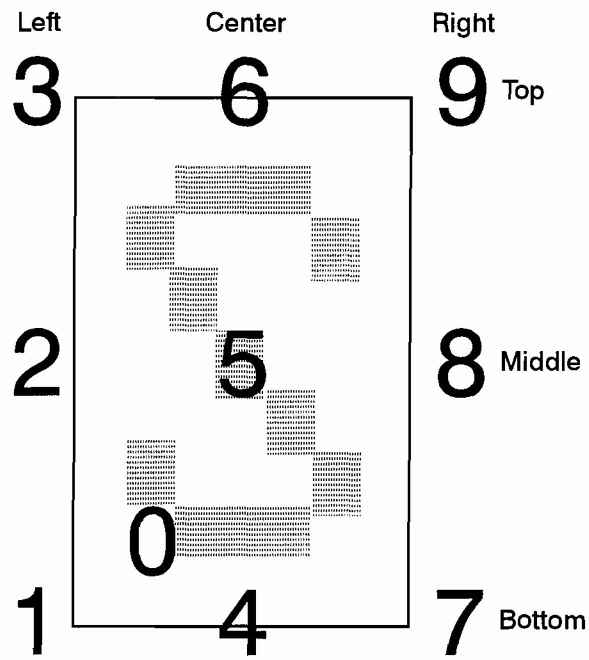
1055 Turn graphics display on/off. This only controls whether the graphics memory is displayed by the terminal. It does not affect the contents or output primitives sent.

ILIST(1) = 0 Turn graphics display off.
ILIST(1) = 1 Turn graphics display on.

1056 Set special drawing modes. Using this escape function overrides the color as defined by the ZCOLR call. After generating output primitives in a special drawing mode, the application program can terminate the special drawing mode by making any call to ZCOLR. See Figure 13 for the color and the special drawing modes.

ILIST(1) = 1 Enable complement drawing mode. All output primitives output in this mode toggle the color of the pixels on the display. For example, when drawing a line in this mode, all white pixels in the line's path turn black and all black pixels turn white.

ILIST(1) = 2 Enable jam drawing mode. Jam mode has the affect of overlaying the output primitives generated with it over the current primitives on the graphics display.



The numbers 1-9 represent the cursor position with respect to the character cell used for graphics text characters. The number 0 represents the cursor position with respect to the character (not this cell).

Justification/Origin. Text strings can be automatically right or left justified, or centered about a specified point. An ASCII character 0 through 9 indicates the origin (justification and base line) for characters with respect to the current pen position. This function is useful when drawing tables.

If text is left justified, the current pen position is the left margin. Center causes the label to be centered on the pen position. Right justify selects the pen position as the right margin. Bottom, middle, and top select the base line for the line of text.

For example, if text was to be right justified and set with a base line on top of the normal character position, the number "9" would be used.

Figure 12. Hardware Text Justification

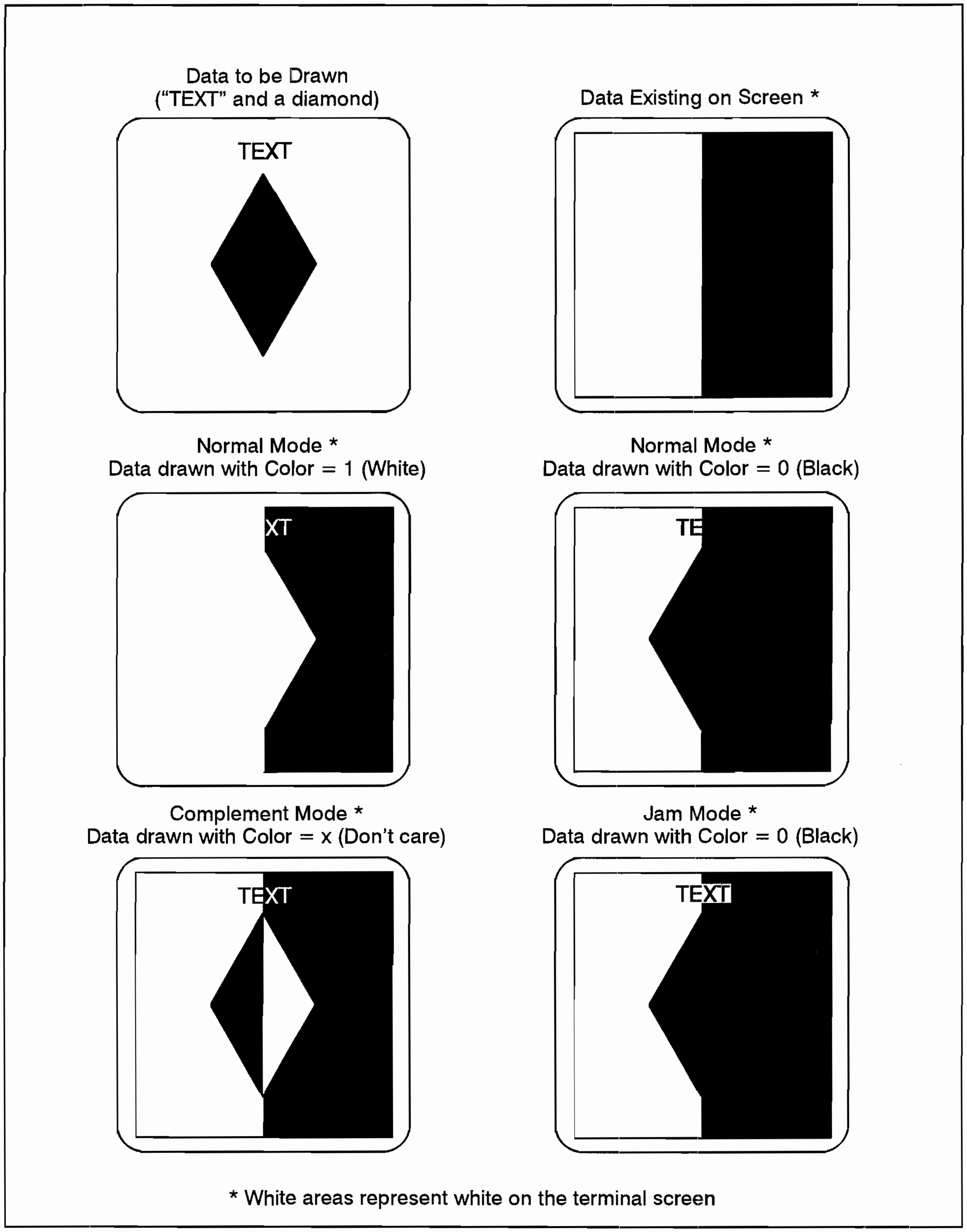


Figure 13. Special Drawing Modes

2050 Define line pattern. This allows the user to define the dot pattern used to draw vectors. Once a line pattern is defined, it can be used by setting the line style to 9. See Figure 14 for examples on defining line patterns.

ILIST(1) = A decimal value between 0 and 255 defining an 8-bit binary pattern.
ILIST(2) = A scale factor between 1 and 16 to be applied to the pattern.

8050 Define area pattern

An 8 by 8 pattern can be defined for use in drawing horizontal and vertical lines, filling rectangular areas (see Opcode 450), and filling polygons via ZPGDD. The area pattern is defined by specifying each row of the pattern with a decimal number ranging between 0 and 255 which defines an 8-bit binary pattern. The graphics display is divided into 8 by 8 cells such that every point on the display maps to a corresponding bit in the pattern.

Once the area pattern has been defined, it can be used for drawing lines by setting the line style to 10. Drawing any horizontal and vertical lines causes the corresponding row or column of the pattern to be used as the line pattern. See Opcode 450 for use in filling rectangular areas. The user-defined area pattern can be used for filling polygons by calling ZPGDD when the current polygon style has density −1. Figure 15 and Figure 16 contain sample area fill patterns.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.

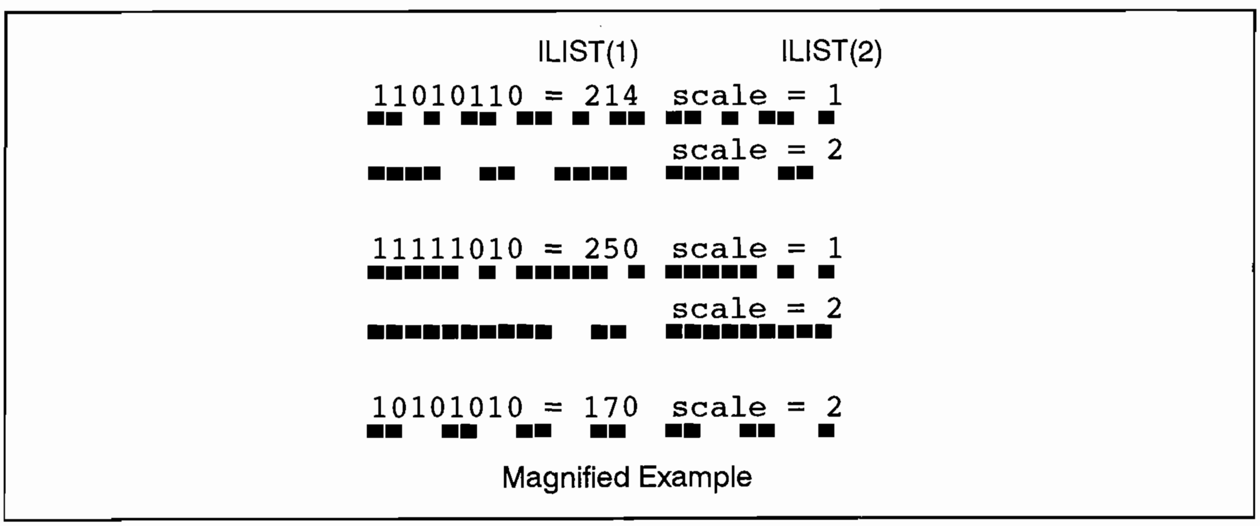
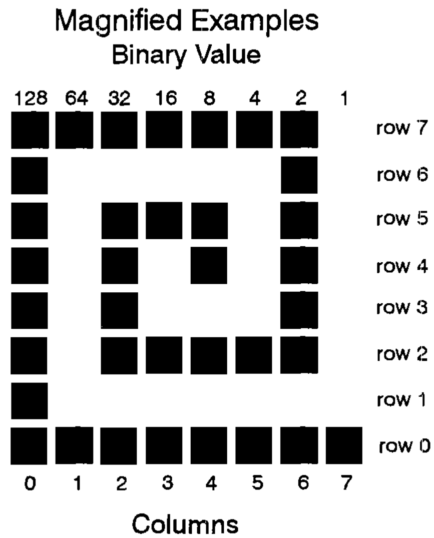


Figure 14. Examples of User-Defined Line Styles

```
ILIST(8)  Row 7   11111110 - 254
ILIST(7)  Row 6   10000010 - 130
ILIST(6)  Row 5   10111010 - 186
ILIST(5)  Row 4   10101010 - 170
ILIST(4)  Row 3   10100010 - 162
ILIST(3)  Row 2   10111110 - 190
ILIST(2)  Row 1   10000000 - 128
ILIST(1)  Row 0   11111111 - 255

                  1 = dot on
                  0 = dot off
```



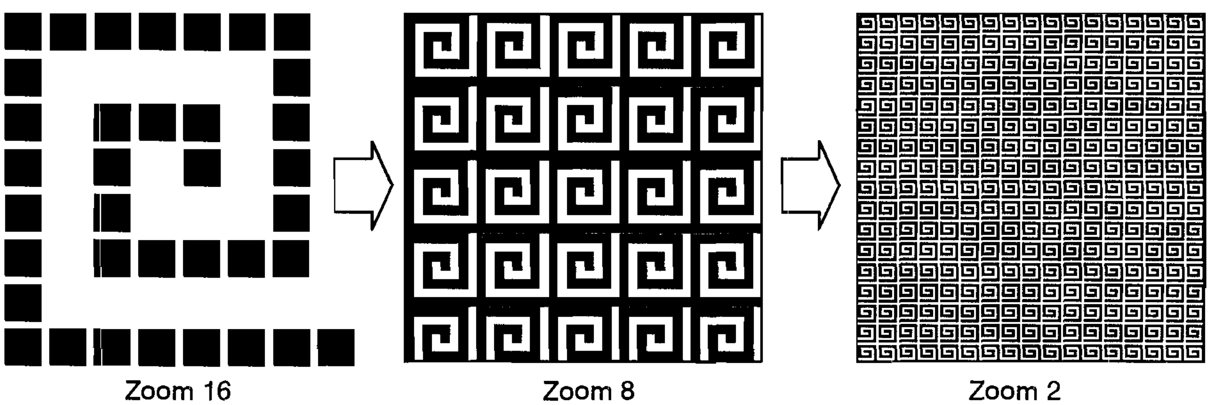


Figure 15. Defining Area Patterns

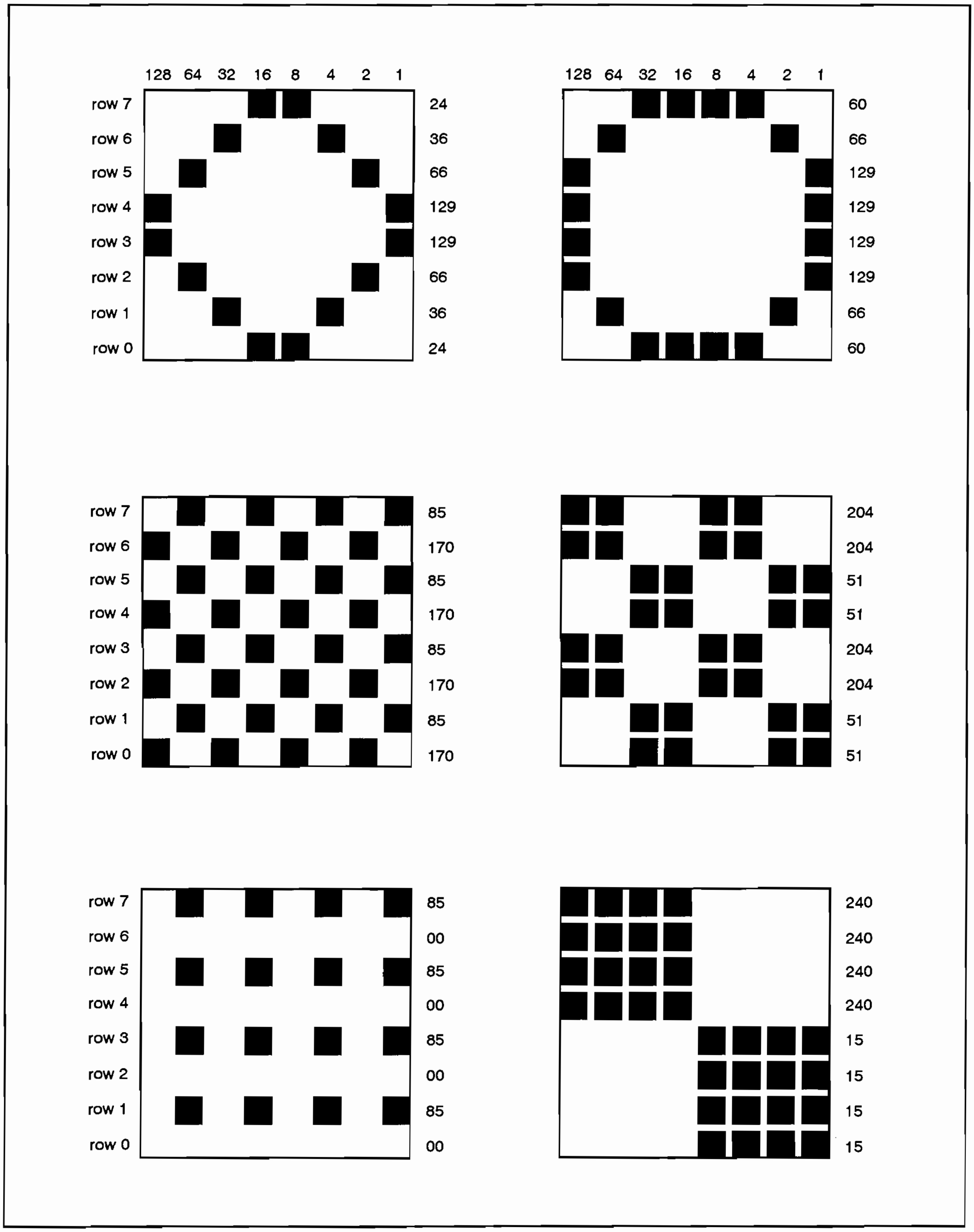


Figure 16. Magnified Example of Area Patterns

Locator Echoes on the Graphics Display

(ZWLOC). The type of echoes available on the graphics display depends on whether or not the graphics display and locator are the same physical device. For echoes supported on the locator device, see the corresponding device handler that discusses the locator device in question.

Same Physical Device

If the locator and graphics display are the same physical device, then the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until operator response. When an operator response occurs the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the graphics cursor and the Y coordinate of the locator echo position.
6	Vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned has the X coordinate of the locator echo position and the Y coordinate of the graphics cursor.
7	Horizontal/vertical rubber band line. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the same as ECHO 5 or ECHO 6, whichever defines a longer line from the locator echo position.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The point returned is the position of the graphics cursor.

Different Physical Devices

If the locator and display devices are different physical devices and the locator device supports echoing on the display, then the following echoes are supported on the graphics display. (Because of the eavesdrop configuration allowed with some plotters, the locator device and display device can have the same system identifier, but be different physical devices.

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2.
4	Rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The cursor then reflects the current locator position and a line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
5	Horizontal rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A horizontal line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
6	Vertical rubber band line. Initially, the graphics cursor is turned on at the current locator echo position. The graphics cursor is then displayed at a point defined by the X coordinate of the current locator echo position and the Y coordinate of the current locator echo position. A vertical line extends from the locator echo position to the position of the graphics cursor until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off and the line is removed.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. The graphics cursor and the locator echo position are handled in the same manner as they are in ECHO 4. The rubber band line represents the diagonal of the box defined with corner points at the locator echo position and the current locator position.

Sample Locator Input

(JSLOC/ZSLOC). The sample locator input function returns the current locator position without waiting for an operator response. The graphics cursor is turned off following the sample locator function.

Echoes Supported

The following locator echoes are supported with the graphics terminals when using the sample locator function:

Echo #	Echo Performed
0	Echo is not performed.
1	The bell in the terminal is sounded when the locator is sampled.

Termination

(JDDEV/ZLEND). The device name is set to "0001 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Pick Device Handler (AGP)

Description

The dimensions of the pick device are as follows:

Screen size:	Width: 254 mm	Height: 127 mm
Screen capacity:	Width: 720 points	Height: 360 points
Resolution:	2.8346 points/mm in X and Y directions.	
Physical origin:	Lower left corner of display.	

The graphics terminals have a pick device that is capable of differentiating between any point on the graphics display.

Initialization

(JEDEV). When the pick device is initialized, the terminal's graphics display is left unaltered. The device name is set to the terminal name, for example, "2648A ". The device name is padded to 6 characters with trailing blanks.

Pick Input

(JPICK). The pick input function sets a read operation pending on the graphics terminal. The operator then positions the graphics cursor to the desired position and strikes an alphanumeric key. The segment name, pick-ID, and the value of the pick button are then returned to the application program. Any of the ASCII keys can be used to terminate the pick function so the value of the pick button returned to the application program can range from 0 to 127.

Echoes Supported

Pick input can be echoed on either a graphics display device or a pick device. The echo can only be performed on a graphics display device when the pick and the graphics display devices are implemented on the same terminal. The following lists the echoes that can be performed by the pick device:

Echo #	Echo Performed
0	Same as ECHO 1.
1	Initially, the graphics cursor is turned on and appears wherever it was last positioned on the display. The graphics cursor can then be moved by the operator through the use of the graphics cursor control keys. When the graphics cursor is positioned over the desired point the operator strikes an alphanumeric key and the pick function is terminated. Before control is returned to the application program, the graphics cursor is turned off.

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HP 12065A Color Video Interface

General Information

The user should be familiar with the operation of the HP 12065A Color Video Interface. If necessary, refer to the following manual for the appropriate operating instructions:

HP 12065A Video Output Interface Reference Manual, part number 12065-90001.

The following logical devices are supported by the AGP/DGL Graphics Systems:

Logical Device	Device Handler Name
HP 12065A Alphanumeric	A0025
HP 12065A Graphics Display	D0025
HP 12065A Keyboard	K0025

Special Considerations

The HP 12065A Color Video Interface is capable of displaying graphical and alphanumeric information on a video color monitor. The physical dimensions of the display vary from monitor to monitor. All dimensions specified in this document are based on a 4 by 3, 19-inch monitor, such as the HP 13279B color monitor.

The HP 12065A is a four-color plane device. All four planes are used solely for graphical display, unless the A0025 Alphanumeric Device Handler is initialized by a JEDEV/ZAINT call. Once the JEDEV/ZAINT call is made within a program, only the first three planes are used for graphical display; the fourth plane becomes write protected and reserved for alphanumeric overlay. The HP 12065A needs to be properly configured for the desired display. The configuration is determined according to the value of four display switches on the interface card (refer to the *HP 12065A Video Output Interface Reference Manual*).

The following are example IFT and DVT statements for the HP 12065A Interface card:

```
ift,/rte_a/%id*50,Eid.50,sc:35b,tx:9,it:50b
dvt,,,LU:10,TX:2,DX:3,DP:1:0:0:0,DT:45B
```

Alphanumeric Device Handler

Description

The alphanumeric device handler, A0025, allows the application programmer to send messages and alphanumeric display control commands to the monitor.

The dimensions of the HP 12065A (512 by 512) Graphics Color Video Interface are as follows:

Screen size:	Width: 267.0 mm	Height: 267.0 mm
Screen capacity:	51 lines at 85 characters per line	
Character size:	Width: 2.6 mm	Height: 3.7 mm

The dimensions of the HP 12065A (576 by 455) Graphics Color Video Interface are as follows:

Screen size:	Width: 338.0 mm	Height: 267.0 mm
Screen capacity:	45 lines at 96 characters per line	
Character size:	Width: 2.9 mm	Height: 4.1 mm

Initialization

(JEDEV/ZAINT). When the alphanumeric device is initialized, the alphanumeric display is turned on and the contents of the alphanumeric memory are left unaltered. DGL sets the device name to "12065S" (512 by 512 pixels) or "12065D" (576 by 455 pixels). If both the A0025 alphanumeric handler and the D0025 graphics display handler are used concurrently in the same program, it is strongly recommended to initialize them (JEDEV/ZAINT and JDINT/ZDINT) at the same place in the program. Once the JEDEV/ZAINT call is made in a program, the fourth color plane is write protected, thus reducing the graphics display color capability to only three planes. Alphanumeric text color defaults to white with a black background but can be redefined using the HP 12065A graphics display device handler (ZOESC, Opcode 351).

Alphanumeric Output

(JALPH/ZALPH). The state of the alphanumeric display is not altered before sending the character string to the terminal. The entire character string passed is sent directly to the terminal. A maximum of 132 characters can be sent to the alphanumeric device at one time. If the text output exceeds the size of a line, the terminal performs a carriage-return/line-feed, and text output continues on the next line. The character string may contain alphanumeric characters or command sequences that control the alphanumeric display (for example, clear alphanumeric memory, alphanumeric cursor control, and so forth). Command sequences that affect graphics display should not be contained in the string because they could destroy the integrity of the graphics system.

Termination

(JDDEV/ZAEND). When the alphanumeric device is terminated, the alphanumeric display is not affected. The device name is set to "0025 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Graphics Display Device Handler (AGP)

Descriptions

The dimensions of the HP 12065A (512 by 512) Graphics Color Video Interface are as follows:

Screen size:	Width: 267.0 mm Height: 267.0 mm
Screen capacity:	Width: 512 points Height: 512 points
Aspect ratio of maximum area is 1.000	
Resolution:	1.9176 points/mm in the X direction 1.9176 points/mm in the Y direction
Physical origin:	Upper left corner of the display

The dimensions of the HP 12065A (576 by 455) Graphics Color Video Interface are as follows:

Screen size:	Width: 338.0 mm Height: 267.0 mm
Screen capacity:	Width: 576 points Height: 455 points
Aspect ratio of maximum area is 0.7899	
Resolution:	1.7041 points/mm in the X direction 1.7041 points/mm in the Y direction
Physical origin:	Upper left corner of the display

Dimensions for the HP 12065A are based on a 4 by 3, 19-inch monitor, such as the HP 13279B 19-inch color monitor.

Performance

Performance can be improved by the following:

- Using the polyline calls instead of moves and draws.
- Using blanking (see JOESC Opcode 1051).

Initialization

(JDINT). Upon initialization, the following operations are performed:

Device name:	"12065S" for an HP 12065 (512 by 512). "12065D" for an HP 12065 (576 by 455).
Color:	Color table set to default values. If bit 12 of the control word is 0, the D0025 display handler provides a hardware color table with 15 colors. If bit 12 of the control word is 1, the D0025 display handler provides a hardware color table with seven colors.
Color plane definition:	The color planes are defined according to bit 12 of the control word in the JDINT call. If bit 12 is 0, then all four color planes are used as graphics display. If bit 12 is 1, then three planes are used as graphics display and one plane is used as alphanumeric overlay display.
Line width:	Set to 1.
Line style:	Set to 1.
Logical display limits:	Set to the physical limits of the screen. The screen capacity is determined according to the configuration set by the display switches (512 by 512 points or 576 by 455 points).
View surface:	Centered within the logical display limits.
Drawing mode:	Dominant drawing mode is used.
Graphics memory:	Screen cleared and graphics display turned on unless bit 7 is set in the control word for JDINT. Display limits and resolution are altered according to the device and the value of bit 8 in the JDINT control word. The starting position is undefined.
Simulated raster erase:	Enabled if bit 3 of the control word in the JDINT call was set. See section on simulated raster erase.
Polygon fill pattern:	Set to empty fill.
Outspooling:	Outspooling is not supported. If bit 0 of the control word is set to 1, IERR is returned as 3 and the device is not enabled.

Device Enabling

(JWON). Device-dependent actions are not performed.

Supported Primitive Attributes

Color

(JCOLR). If bit 12 of the control word (JDINT) is 0, the D0025 display handler provides a hardware color table with fifteen colors. If bit 12 of the control word is 1, the D0025 display handler provides a hardware color table with seven colors. Color table entry 0 is the background color and is always drawn using dominant drawing mode.

The entries in the color table can be chosen from a color palette of 4096 colors. The color table is initialized when JDINT is called. The default values of the color table are shown in Table 1.

The color selected corresponds to the color defined in the color table.

COLOR = 0	Color table entry 0 is selected.
= 1	Color table entry 1 is selected.
	.
	.
	.
= 7	Color table entry 7 is selected.
= 8	Color table entry 8 is selected (if bit 12 = 0).
	.
	.
	.
= 14	Color table entry 14 is selected (if bit 12 = 0).

Redefining and Inquiring Color

(JDCOL/JICOL). The colors in the color table, including the background color, can be redefined and inquired. Changing one of these color table entries immediately changes the display of that color. Subsequent additions to the display use the updated table entry.

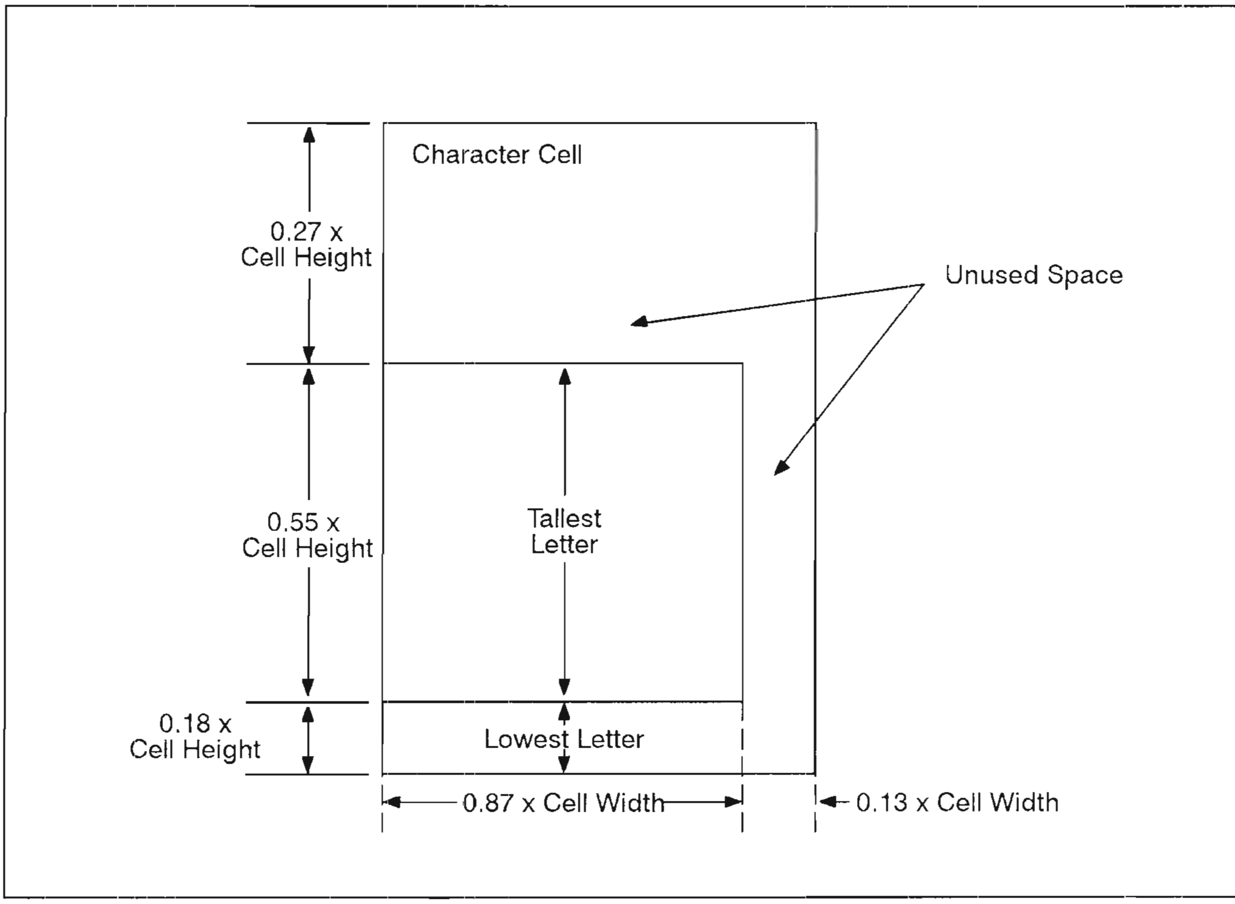

Figure 2. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware clipping is not provided. If window clipping is turned off in AGP and vectors are created that lie entirely or partially outside of the view surface, unpredictable results may occur. Even when clipping is enabled, care must be taken when using medium-quality text, low-quality text, or markers. Unpredictable results may occur if characters or markers are not clipped by AGP, yet extend beyond the window.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). The devices support device-dependent, convex, concave, and self-intersecting polygons with the following fill styles:

empty fill	DENSITY = 0.0,	ORIENT = anything
solid fill	DENSITY = −1.0 or +1.0	ORIENT = anything
half fill	DENSITY = −0.5 or +0.5	ORIENT = anything
horizontal lines	DENSITY = anything other than 0.0, −1.0 or +1.0, or −0.5 or +0.5	ORIENT = 0.0
vertical lines	DENSITY = anything other than 0.0, −1.0 or +1.0, or −0.5 or +0.5	ORIENT = −90.0 or +90.0

Half fill is every other pixel. Horizontal and vertical lines are spaced one pixel width apart. Half, horizontal, and vertical fill each have complementing patterns. The complement of a pattern is the exact opposite of that pattern, such that together a pattern and its complement form a solid color. This is useful for creating dithering effects in polygons with two different colors drawn in non-dominant drawing mode (JOESC, Opcode 1050). The sign of the DENSITY component determines the complement of the fill style (that is, complementing styles exist if two styles have equal orientations and densities that are equal in magnitude but opposite in sign).

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). Nineteen standard markers are supported. If a marker is not clipped by AGP and extends beyond the physical limits of the graphics display, unpredictable results may occur. The marker size is:

HP 12065A (512 by 512) 4.2 mm by 4.2 mm
HP 12065A (576 by 455) 4.7 mm by 4.7 mm

Medium- and Low-Quality Text

(JTEXM/JTEXL). Medium- and low-quality graphics text are generated with a hardware character generator. If a medium- or low-quality text string is not clipped by AGP and extends beyond the physical limits of the graphics display, unpredictable results may occur. Medium- and low-quality text use only the color and line style attributes.

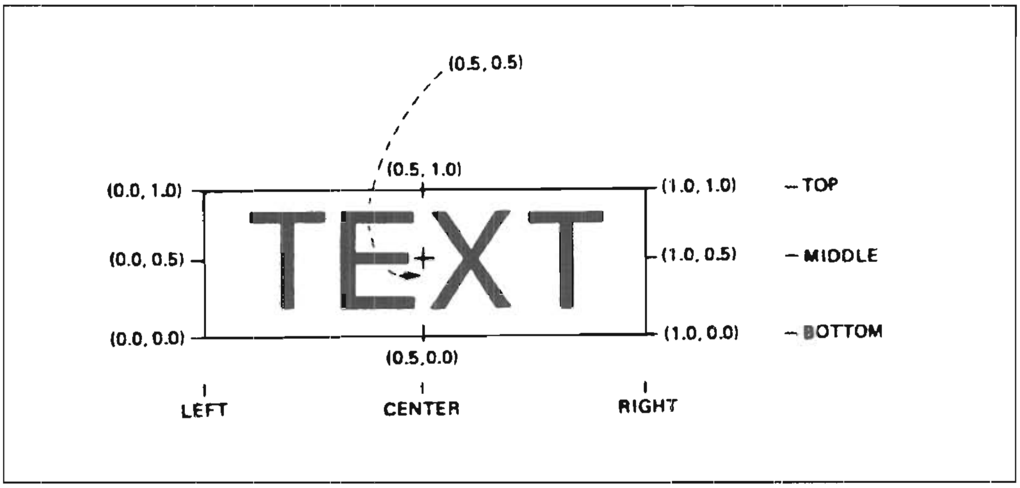

Figure 3. Hardware Text Alignment

351 Define color for plane 4. Color is defined according to the current color model (RGB or HSL).

RLIST(1) = COLP1
RLIST(2) = COLP2
RLIST(3) = COLP3
{0.0 ≤ COLP1,COLP2,COLP3 ≤ 1.0}

This JOESC function is intended to be used to change the color of the alphanumeric text if A0025 is enabled as an alphanumeric device.

450 Rectangular area fill with pattern. Performs rectangular area fill using the current polygon interior color and the current pattern selected by the JOESC function, OPCODE 8050. Dithering is not performed. No edges are drawn.

RLIST(1) = Minimum X border of the rectangle in virtual coordinates.
RLIST(2) = Maximum X border of the rectangle in virtual coordinates.
RLIST(3) = Minimum Y border of the rectangle in virtual coordinates.
RLIST(4) = Maximum Y border of the rectangle in virtual coordinates.

1050 Set Special Drawing Mode

ILIST(1) = 0 Dominant drawing mode.
ILIST(1) = 1 Non-dominant drawing mode.
ILIST(1) = 2 Complement mode.

1051 Enable/disable plane 4 for writing. This JOESC function may affect what color gets displayed during primitive generation. Also, the number of available colors is affected.

ILIST(1) = 0 Disable plane 4 for writing.
ILIST(1) = 1 Enable plane 4 for writing.

1052 Blank and unblank the graphics display. When blanked, vectors can be drawn faster than when the graphics display is not blanked.

ILIST(1) = 0 Blank the graphics display.
ILIST(1) = 1 Unblank the graphics display.

1053 Select Highlight Index (only valid if Color/Highlight Mode = 1). This selects the current color index that all following highlight requests act upon (JHIGH or JOESC, Opcodes 1054, 9050).

ILIST(1) = New Highlight Index.
{0 ≤ Highlight Index ≤ last available index}

There is no default highlight index for Color/Highlight Mode 1; therefore, this call must be made to select an index.

1054 Select Highlight Blink Rate. Defines the highlight blinking rate for the current highlight index. The rate becomes effective on the next JHIGH request. The rate does not affect the blink rate for other defined highlight indices (if Color/Highlight Mode = 1).

ILIST(1) = Blink rate in tenths of a second (default is 0.3 seconds).

8050 Define Area Pattern. An 8-by-8 pattern can be defined for use in drawing horizontal and vertical lines and filling rectangular areas (see Opcode 450). The area pattern is defined by specifying each row of the pattern with a decimal number ranging between 0 and 255 which defines an 8-bit binary pattern. The graphics display is divided into 8-by-*i* cells such that every point on the display maps to a corresponding bit in the pattern.

ILIST(1) = Row 0 of the area pattern.
ILIST(2) = Row 1 of the area pattern.
ILIST(3) = Row 2 of the area pattern.
ILIST(4) = Row 3 of the area pattern.
ILIST(5) = Row 4 of the area pattern.
ILIST(6) = Row 5 of the area pattern.
ILIST(7) = Row 6 of the area pattern.
ILIST(8) = Row 7 of the area pattern.

9050 Define Blink Color. Creates a highlight sequence for the current highlight index. The defined colors alternate in sequential order at a frequency defined by JOESC, Opcode 1054. One to nine colors can be included in the sequence selectable from the current color map definitions. Termination of the sequence is represented by the first −1 value entry in ILIST or nine entries, whichever comes first.

ILIST(1) = Color index of 1st blinking entry.
ILIST(2) = Color index of 2nd blinking entry.
ILIST(3) = Color index of 3rd blinking entry.
ILIST(4) = Color index of 4th blinking entry.
ILIST(5) = Color index of 5th blinking entry.
ILIST(6) = Color index of 6th blinking entry.
ILIST(7) = Color index of 7th blinking entry.
ILIST(8) = Color index of 8th blinking entry.
ILIST(9) = Color index of 9th blinking entry.

There is a limit of 80 total blink entries that can be held in memory, regardless of how they are divided up between sequences. This means that the total sum of blink entries from all defined blink sequences (up to 16 possible) must be less than 80. If more than 80 are defined, those defined after the maximum is exceeded are not displayed.

9051 Define Video Interface Command Sequence

Create a list of command words that are to be sent. One to nine words can be included in the list. Termination of the sequence is represented by the first −1 value entry in ILIST or nine words, whichever comes first.

ILIST(1) = Command Word 1.
ILIST(2) = Command Word 2.
ILIST(3) = Command Word 3.
ILIST(4) = Command Word 4.
ILIST(5) = Command Word 5.
ILIST(6) = Command Word 6.
ILIST(7) = Command Word 7.
ILIST(8) = Command Word 8.
ILIST(9) = Command Word 9.

This JOESC function is intended to allow functions not supported by AGP to be included and buffered in the AGP system. Examples of such functions include scrolling and text direction. Refer to the *HP 12065A Reference Manual*, part number 12065-90001, for valid command words.

Locator Echoes on the Graphics Display

(JWLOC). If the locator and display devices are different physical devices, then the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the small cross-hair cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the cross-hair cursor is removed.
3	Full cross-hair cursor. Same as ECHO 2, except the cursor extends across the screen.
4	Rubber band line. A line extends from the locator echo position to the current locator position (that is, rubber band line) with a small cursor at the current locator position until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. Initially, the full-cross-hair cursor is turned on at the current locator echo position. The cursor continues to reflect the X coordinate of the current locator position and the Y coordinate of the current locator position.
6	Vertical rubber band line. Initially, the full cross-hair cursor is turned on at the current locator echo position. The cursor continues to reflect the X coordinate of the current locator echo position and the Y coordinate of the current locator position.
7	Horizontal/vertical rubber band line. Initially, the full cross-hair cursor is turned on at the current locator echo position. Subsequently, when the locator's X displacement becomes greater than its Y displacement, ECHO 5 is simulated. When the locator's displacement becomes greater than its X displacement, ECHO 6 is simulated.
8	Rubber band box. A rectangle, defined by its diagonal line (from the initial locator position), is used as the locator echo. When the locator operation is terminated, the box is removed and control is returned to the application program.

Pick Echoes on the Graphics Display

(JPICK). For echoes supported on the pick device, see the corresponding device handler that discusses the pick device in question.

Echo #	Echo Performed
2	Initially, the small cross-hair cursor is turned on at the current pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is completed. Before control returns to the application program, the cross-hair cursor is removed.

Supported Primitive Attributes

Color

(ZCOLR). The number of available color indices is a function of two items. The first is whether or not the A0025 alphanumeric handler is currently initialized. The second is what Color/Highlight Mode the D0025 graphics display handler is set to. "CH Mode" in the first column of Table 2 determines the number of available color indices.

The entries in the color table can be chosen from a color palette of 4096 colors. The color table is initialized when ZDINT is called. The default values of the color table are shown in Table 2. All entries of the color table correspond directly to the hardware color map in Color/Highlight Mode 1 only. In Mode 0, the color table index is one value less than the hardware color map index, except for the background index, which is 0 for both.

Redefining and Inquiring Color

(ZDCOL/ZICOL). The colors in the color table, including the background color, can be redefined and inquired. Changing one of these color table entries causes immediate retroactive change to the display of that color. Subsequent additions to the display uses the updated color table entry.

As stated above, the number of available colors is not always constant. Table 2 shows the default color table; the indicators to the left of the table determine the last available color in the table for all possible configurations.

Polygon Interior Color

(ZPICL). Refer to ZCOLR for information regarding color.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). The interior line style attribute is ignored for device-dependent polygon interiors. Refer to ZLSTL for information regarding line style for other polygon filling.

Table 2. Default Color Table

Color Table Entry	Color	Red	Green	Blue
0	Black	0.000	0.000	0.000
1	White	1.000	1.000	1.000
2	Red	1.000	0.000	0.000
3	Green	0.000	1.000	0.000
4	Yellow	1.000	1.000	0.000
5	Blue	0.000	0.000	1.000
A0025 enabled, CH Mode = 0 → 6	Magenta	1.000	0.000	1.000
A0025 enabled, CH Mode = 1 → 7	Cyan	0.000	1.000	1.000
8	Turquoise	0.000	0.533	0.600
9	Brown	0.400	0.133	0.000
10	Toasted Orange	0.933	0.333	0.000
11	Lime Green	0.600	1.000	0.067
12	Golden Yellow	0.933	0.733	0.000
13	Medium Blue	0.333	0.333	1.000
A0025 disabled, CH Mode = 0 → 14	Violet	0.600	0.133	1.000
A0025 disabled, CH Mode = 1 → 15	White	1.000	1.000	1.000
CH Mode = Color/Highlight Mode				

Highlighting

(ZHIGH). Two highlighting values are supported:

HIGHLIGHT = 1 No highlighting.
HIGHLIGHT = 2 Blinking sequence of colors.

Highlighting is done by displaying a sequence of colors that alternate at a constant but programmable rate. Up to nine different colors can be included in the sequence, repeating itself continuously. The color monitor operates in one of two color/highlighting modes determined by the ZDINT control word at initialization.

Mode 0 (default) permits one highlight sequence to be displayed. Other color indices are not affected by the highlighting. The highlight color defaults to alternating between black and white.

Mode 1 allows each available color index to be, at any one time, defined either as a single color (default) or as a highlight color sequence. The index is enabled by first declaring that index to be the current highlight index (ZOESC, Opcode 1053) and then making a ZHIGH(2) call. From then on, until highlighting is disabled, everything drawn in that index is highlighted. The highlight sequences for each index are independent of each other and can sequence through different colors at different rates. Highlighting in this mode is retroactive, in that all objects previously drawn in a certain color index turn to highlight if that index is enabled to highlight. Each index has a default color highlight sequence alternating between black and the default color (Table 2) for the index. The default rate for each index is 0.3 seconds.

For both modes, the color sequence(s) and rate(s) can be modified by ZOESC, Opcodes 1054 and 9050.

Line Style

(ZLSTL). Six predefined line styles are supported. See Figure 4 for the line styles available. All of the supported line styles are continuous. Refer to the ZLSTL subroutine description in the *DGL Programmer's Reference Manual*, part number 97084-90000, for a complete description of a *continuous* line style.

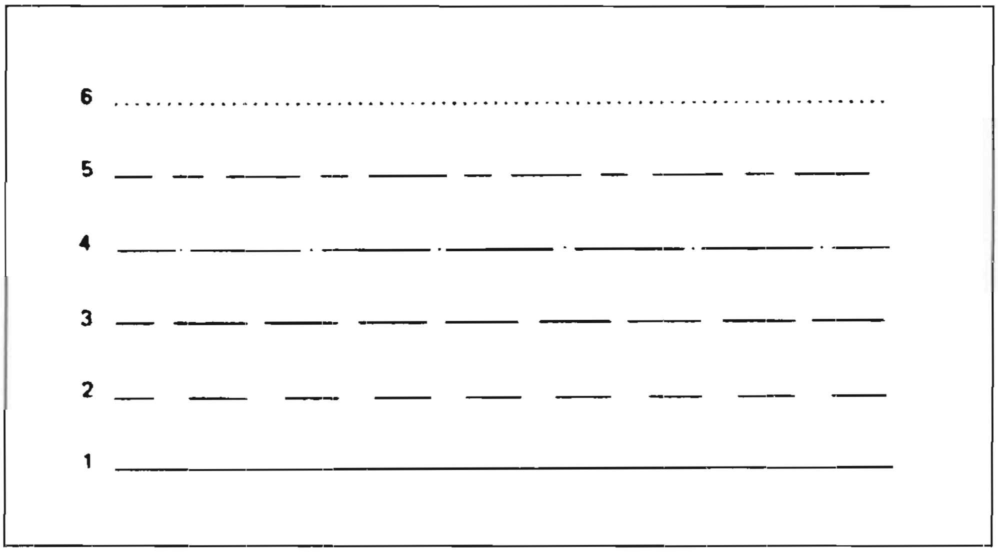

Figure 4. Supported Line Styles

Line Width

(ZLWID). The device supports line widths from 1 to 255. If wide lines (a line width greater than 1) are drawn with complement drawing mode enabled (ZOESC, Opcode 1050), lines drawn at any angle other than horizontal or vertical have unpredictable coloring.

LINEWIDTH= 1 primitives drawn with a line width of one pixel.
= n primitives drawn with a line width of (2 * n)−1 pixels.

Character Sizes

(ZCSIZ). For text, 13 character sizes are available. Character sizes have a constant aspect ratio and are multiples of the smallest size. The character sizes range as follows:

HP 12065A (512 by 512) 3.66 mm to 42.85 mm wide and 5.75 mm to 78.9 mm high.
HP 12065A (576 by 455) 4.11 mm to 48.20 mm wide and 6.47 mm to 88.8 mm high.

Default character sizes are:

HP 12065A (512 by 512) 8.23 mm high and 12.94 mm wide.
HP 12065A (576 by 455) 7.32 mm high and 11.50 mm wide.

The character is placed within the character cell as shown in Figure 5. The proportional dimensions given are default values. The amount of unused space in a character cell can be modified to different proportions using ZOESC, Opcode 251.

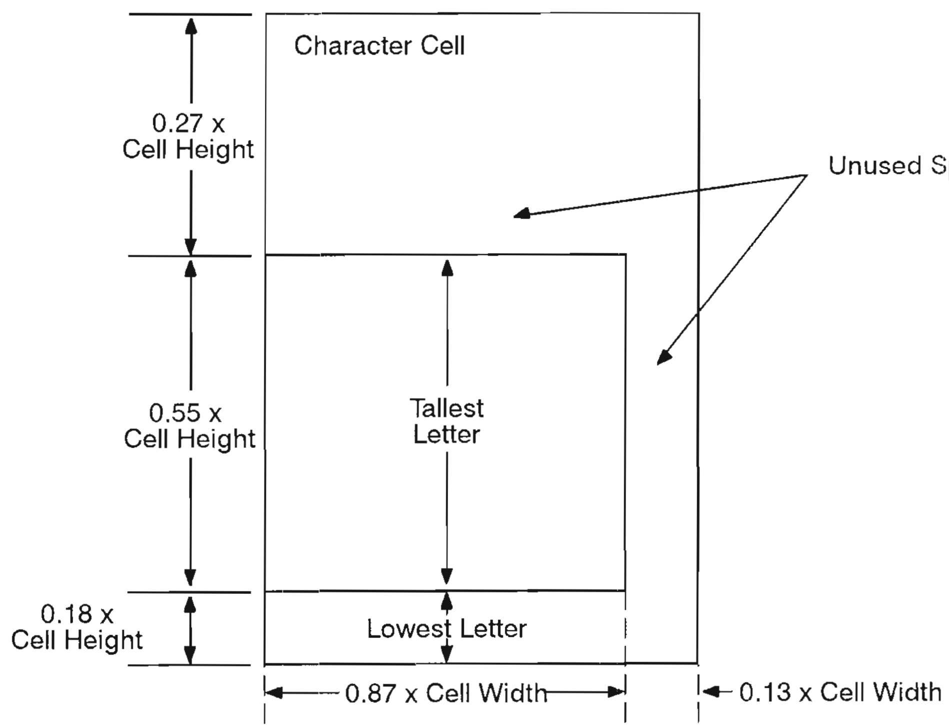

Figure 5. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware vector clipping is not provided. A vector with one or both of its endpoints outside the physical limits is displayed in an unpredictable manner. If text characters or markers extend beyond or lie completely outside of the physical limits, unpredictable results may occur.

Polygons

(ZPGDD). The device supports device-dependent, convex, concave, and self-intersecting polygons with the following fill styles:

empty fill	DENSITY = 0.0,	ORIENT = anything
solid fill	DENSITY = −1.0 or +1.0	ORIENT = anything
half fill	DENSITY = −0.5 or +0.5	ORIENT = anything
horizontal lines	DENSITY = anything other than 0.0, −1.0 or +1.0, or −0.5 or +0.5	ORIENT = 0.0
vertical lines	DENSITY = anything other than 0.0, −1.0 or +1.0, or −0.5 or +0.5	ORIENT = −90.0 or +90.0

Horizontal lines and vertical lines are always spaced one pixel apart.

For half fill, horizontal lines, and vertical lines, the sign (+, −) of the DENSITY attribute determines the "sign" of the style. A polygon drawn with a positive sign style is the exact complement of the same polygon drawn with the negative sign of the same style. This allows "dithering" two complementing polygons of different colors to produce a single polygon with a color that appears to be a mix of the two original colors.

The device is capable of filling polygons that have up to 127 vertices. However, only polygons with 49 vertices can be filled with the default size of the DGL I/O buffer (100 words). To allow for 127 vertices, increase the size of the DGL I/O buffer to at least 256 words (refer to the "Polygon Efficiency Considerations" section under "Using DGL" in the *DGL Programmer's Reference Manual*).

Markers

(ZMARK). Nineteen standard markers are supported. If markers extend beyond or lie completely outside of the physical limits, unpredictable results may occur. The marker size is:

HP 12065A (512 by 512) 4.2 mm by 4.2 mm
HP 12065A (576 by 455) 4.7 mm by 4.7 mm

Text

(ZTEXT). Graphics is generated with a hardware character generator. Graphics text is affected only by the color attribute. If text characters extend beyond or lie completely outside of the physical limits, unpredictable results may occur. Text justification and text spacing can be modified using ZOESC, Opcodes 250 and 251.

New-Frame-Action

Buffered

(ZNEWF). A call to ZNEWF makes the picture current and then erases the graphics display to the background color. When ZNEWF is called, the graphics display is made current. The instruction to clear the graphics display is stored in the DGL buffer and is not cleared to the background color, and whatever calls to DGL are put into the buffer after the ZNEWF call takes effect. The effect in the current display remains until the next buffer is sent. If immediate visibility is used, the action is the same if bit 6 were not set, because the buffer is sent after every DGL call. New-frame-action is always done in dominant drawing mode.

Non-Buffered

(ZNEWF). A call to ZNEWF makes the picture current and then erases the graphics display. The background is set to the background color. New-frame-action is always done in dominant drawing mode and only affects planes that are enabled for writing.

Inquiry Escape Functions

(ZIESC). No inquiry escape functions are supported with these devices.

Output Escape Functions

(ZOESC). Several output escape functions are supported by DGL. Error checking is not performed by the graphics system on any of the parameters sent to the device. If a parameter is outside of the range specified in the escape function definition, unpredictable results may occur.

The following output escape functions are supported:

Opcode	Function
250	Graphics Text Justification. Specify the graphics text justification for graphics text strings. Typical justifications are shown in Figure 6. RLIST(1) = X dimension justification. RLIST(2) = Y dimension justification. $\{0.0 \leq$ RLIST(1),RLIST(2) $\leq 1.0\}$ Default text justification is (X=0.0, Y=0.0).
251	Graphics Text Spacing. Specify the graphics text spacing for graphics text strings. The text spacing in each direction defines the amount of unused space (Figure 6) in the character cell. RLIST(1) = X dimension spacing. RLIST(2) = Y dimension spacing. $\{0.0 \leq$ RLIST(1), RLIST(2) $< 1.0\}$ The X and Y dimension spacing represents space/cell size ratio. For example, if RLIST(1) is set to .5, the amount of space filled after each character in a string is half the width of one character cell. Similarly, if RLIST(2) is set to .75, the amount of space under each character in a string is three fourths the height of one character cell.

9050 Define Blink Color. Creates a highlight sequence for the current highlight index. The defined colors alternate in sequential order at a frequency defined by ZOESC, Opcode 1054. One to nine colors can be included in the sequence selectable from the current color map definitions. Termination of the sequence is represented by the first −1 value entry in ILIST or nine entries, whichever comes first.

ILIST(1) = Color index of 1st blinking entry.
ILIST(2) = Color index of 2nd blinking entry.
ILIST(3) = Color index of 3rd blinking entry.
ILIST(4) = Color index of 4th blinking entry.
ILIST(5) = Color index of 5th blinking entry.
ILIST(6) = Color index of 6th blinking entry.
ILIST(7) = Color index of 7th blinking entry.
ILIST(8) = Color index of 8th blinking entry.
ILIST(9) = Color index of 9th blinking entry.

There is a limit of 80 total blink entries that can be held in memory, regardless of how they are divided up between sequences. This means that the total sum of blink entries from all defined blink sequences (up to 16 possible) must be less than 80. If more than 80 are defined, those defined after the maximum is exceeded are not displayed.

9051 Define Video Interface Command Sequence. Create a list of command words that are to be sent. One to nine words can be included in the list. Termination of the sequence is represented by the first −1 value entry in ILIST or nine words, whichever comes first.

ILIST(1) = Command Word 1.
ILIST(2) = Command Word 2.
ILIST(3) = Command Word 3.
ILIST(4) = Command Word 4.
ILIST(5) = Command Word 5.
ILIST(6) = Command Word 6.
ILIST(7) = Command Word 7.
ILIST(8) = Command Word 8.
ILIST(9) = Command Word 9.

This ZOESC function is intended to allow functions not supported by DGL to be included and buffered in the DGL system. Examples of such functions include scrolling and text direction. Refer to the *HP 12065A Reference Manual* for valid command words.

Locator Echoes on the Graphics Display

(ZWLOC). If the locator and display devices are different physical devices, then the following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the small cross-hair cursor is turned on at the current locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the cross-hair cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2, except the cursor extends across the screen.
4	Rubber band line. Initially, the full cross-hair cursor is turned on at the current locator echo position. The cursor then reflects the current locator position, and a line extends from the locator echo position to the current locator position (that is, rubber band line) until the locator operation is terminated. Before control returns to the application program, the graphics cursor is turned off and the rubber band line is removed.
5	Horizontal rubber band line. Initially, the full cross-hair cursor is turned on at the current locator echo position. The cursor continues to reflect the X coordinate of the current locator position and the Y coordinate of the current locator echo position.
6	Vertical rubber band line. Initially, the full cross hair cursor is turned on at the current locator echo position. The cursor continues to reflect the X coordinate of the current locator echo position and the Y coordinate of the current locator position.
7	Horizontal/vertical rubber band line. Initially, the full cross-hair cursor is turned on at the current locator echo position. Subsequently, when the locator's X displacement becomes greater than its Y displacement, ECHO 5 is simulated. When the locator's Y displacement becomes greater than its X displacement, ECHO 6 is simulated.
8	Rubber band box. A rectangle is defined by its diagonal line (from the initial locator position) and used as the locator echo. When the locator operation is terminated, the box is removed and control is returned to the application program.

Termination

(ZDEND). The graphics display is unaltered. The device name is set to "0025 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Keyboard Device Handler

Description

The HP 12065A Video Interface has a dual asynchronous receiver/transmitter (DUART) built on the card. The DUART can be used to support a keyboard device. The device handler required to use a keyboard device is K0025.

Initialization

(JDEDEV/ZKINT). When the keyboard is initialized, the alphanumeric display is turned on. The device name is set to "12065A".

Keyboard Input

(JKYBD/ZKYBD). Once the keyboard device has been enabled, it is available for input operations. When JKYBD or ZKYBD are called, a read operation is set pending on the terminal. The operator then enters the desired text and terminates the operation by entering a carriage return.

Echoes Supported

The keyboard device supports the following echoes:

Echo #	Echo Performed
0	Text is not displayed on the alphanumeric display as it is entered.
1	Text is displayed on the alphanumeric display as it is entered.

Termination

(JDDEV/ZKEND). The alphanumeric display is unaltered. The device name is set to "0025 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 1350A/S/1351A/S Graphics Translator

General Information

Description

AGP and DGL only support those HP 1350A/S/1351A/S Graphics Translators containing the HP-IB device interface card, part number 52101-66505. HP 1350A/S Graphics Translators with a serial number prefix greater than or equal to 2006A already contain the 52101-66505 interface card.

The user should be familiar with the operation of the HP 1350A/S/1351A/S Graphics Translators. If necessary, refer to the following manuals for the appropriate operating instructions:

HP 1350A/S Graphics Translator Operating and Programming Manual, part number 01350-90908.

HP 1350A Graphics Translator Operating and Service Manual, part number 01350-90904.

HP 1351A Graphics Translator Operating and Service Manual, part number 01351-90901.

There are four displays which are currently supported with the HP 1350A/S/1351A/S Graphics Translators. The main difference is the size of their viewing areas. The supported displays are listed below:

Model	**Viewing Area**	
HP 1310	Width: 279 mm	Height: 279 mm (11 in by 11 in)
HP 1311	Width: 216 mm	Height: 216 mm (8.5 in by 8.5 in)
HP 1317	Width: 254 mm	Height: 254 mm (10 in by 10 in)
HP 1321	Width: 305 mm	Height: 305 mm (12 in by 12 in)

If necessary, refer to the following manuals for specifications on the CRT Displays:

Model 1310B Display Operating and Service Manual, part number 01310-90903.

Model 1311B Display Operating and Service Manual, part number 01311-90902.

Model 1317 Display Operating and Service Manual, part number 01317-90905.

Model 1321 Display Operating and Service Manual, part number 01321-90903.

Supported Logical Devices

The following logical devices are supported:

Logical Device	**Device Handler Name**	**Physical Device**
Graphics display	D0007	1350A/S/1351A/S w/1310 CRT
Graphics display	D0008	1350A/S/1351A/S w/1311 CRT
Graphics display	D0009	1350A/S/1351A/S w/1317 CRT
Graphics display	D0010	1350A/S/1351A/S w/1321 CRT

Multiple Displays

The HP 1350A/S/1351A/S can display separate pictures on four different displays at one time. Multiple picture displays are controlled by auxiliary functions. These functions can be accessed through the use of escape functions (ZOESC/JOESC). Initially, all graphics primitives generated will appear on all of the displays connected.

Because of the difference in display sizes, each device handler holds unique transformation constants for mapping between millimeter and device coordinates. If the millimeter calls, JDLIM/ZDLIM and JDPMM/ZDPMM, are not used by the application program, any combination of display libraries and CRTs are possible without ill effects.

Graphics Display Device Handler (AGP)

Description

The graphics display devices are supported with four graphics display CRTs and may drive any combination of the four at one time. Their dimensions are as follows:

Screen size:	Width: 279 mm	Height: 279 mm	(HP 1310)
	Width: 216 mm	Height: 216 mm	(HP 1311)
	Width: 254 mm	Height: 254 mm	(HP 1317)
	Width: 305 mm	Height: 305 mm	(HP 1321)
Screen capacity:	Width: 1021 points	Height: 1021 points	
Aspect ratio of maximum ratio:	1.0		
Resolution:	3.667 points/mm in X and Y directions		(HP 1310)
	4.736 points/mm in X and Y directions		(HP 1311)
	4.028 points/mm in X and Y directions		(HP 1317)
	3.354 points/mm in X and Y directions		(HP 1321)

The default logical display surface corresponds to the maximum physical limits of the CRT display.

The view surface is always centered within the current logical display surface.

The physical origin of the graphics display is the lower left corner of display.

Memory Management

Each time a graphics item (that is, vector endpoint or hardware-generated character) is sent to the device, it is added to the internal memory of the translator. The HP 1350A/S Graphics Translator has 2048 memory locations and the HP 1351A/S Graphics Translator has 8192 memory locations. See the *HP 1350A/S/1351A/S Operating and Programming Manuals* for details on how graphics translator memory is organized.

As each endpoint or hardware character is written into a memory word, the write pointer is automatically incremented by one count. The write pointer value is the memory word (0-2047/0-8191) where the next move, draw, or character is stored. The write pointer can be manipulated by the programmer through escape functions.

The values of the write pointers are maintained in software. This software-maintained value accurately represents the hardware value with the exception that some of the supported escape functions do not update the software-maintained value (see JOESC). The software-maintained value may be inquired by calling JIESC with Opcode 1050.

AGP uses the first six locations in the translator memory (six graphics items) for cursor manipulation. This limits the user to 2042 displayable graphics items with the HP 1350A/S, or 8186 with the HP 1351A/S.

The write pointer value is set to word 6 by AGP at initialization. When a new-frame-action occurs the CRT is cleared, the write pointer is reset to word 6, and all visible segments are output.

If more than 2042/8186 graphics items are sent to the device, (that is, if the write pointer is greater then 2041/8185) a wraparound condition is produced. If wraparound occurs, new graphics items replace the oldest items in a sequential manner. Wraparound can result in an unspecified vector appearing on the screen if the oldest and newest graphics items are vector endpoints. If pick or locator echoing is performed on the display after wraparound occurs, the integrity of the display is destroyed until a new-frame-action occurs.

Calculating the number of graphics items used in an AGP call is not always easy. For example, because moves are optimized when in batch-of-updates or system batching modes, a move might not use a graphics item. On the other hand, in immediate visibility a graphics item is used for the implicit move given to "0., 0., 0." when a segment is opened. It should also be noted that the different types of text use a different number of graphics items.

Initialization

(JDINT). Because these are listen-only devices, AGP cannot confirm that an HP 1350A/S/1351A/S is at the specified I/O unit descriptor. AGP will, however, check for the correct system driver and make sure the I/O unit descriptor is up. Upon initialization, the following operations are performed:

Device name:	See Table 1.
Power interrupt light:	Turned off.
File memory:	Cleared of vector, text, and attribute data. Left unblanked and the file names are cleared. File 0 is enabled for vectors and text. Write pointer is set to location 6.
Logical display surface:	Set to physical limits of screen.
View surface:	Centered within the logical display limits.

Table 1. Device Naming Conventions

Display Library	CRT Display	Default Name *	Name Set at Initialization
D0007	1310	"0007 "	"135010"
D0008	1311	"0008 "	"135011"
D0009	1317	"0009 "	"135017"
D0010	1321	"0010 "	"135021"

* The name is padded to 6 characters with trailing blanks.

Device Enabling

(JWON). Device-dependent actions are not performed.

Supported Primitive Attributes

Color

(JCOLR). The D0007, D0008, D0009, and D0010 display handlers provide a software color table of one color. The size of the color table cannot be changed. The default value of the color table is shown in Table 2.

Table 2. Default Color Table

Color Table Entry	Color
1	Color set to green or white, depending on the phospher in the CRT.

The color table is initialized when JDINT is called. The color table cannot be redefined or inquired using JDCOL or JICOL.

The color selected corresponds to the color defined in the color table.

COLOR = 1 Color table entry 1 is selected.

Redefining and Inquiring Color

(JDCOL/JICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(JPICL). There is one color supported by AGP. The supported value of the color attribute is:

COLOR = 1 Color set to green or white, depending on the phospher in the CRT.

Polygon Style

(JDPST). Using JDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(JPILS). Refer to JLSTL for information regarding line style.

Highlighting

(JSHI/JGHI). Pictures are highlighted by blinking at a rate of approximately four times per second. Highlighting affects the output on the displays connected to the TTL outputs l, 2, and 3. A display connected to the TTL output 4 is never affected by highlighting. In order to have any one of the displays blink, the corresponding blinking switches located on the input/output board must be on.

HIGHLIGHT= 1 Primitives drawn without highlighting.
= 2 Primitives drawn with blinking.

Line Style

(JLSTL). Only one line style is supported.

LINESTYLE = 1 Primitives drawn with a solid line.

Line Width

(JLWID). Only one line width is supported.

LINEWIDTH = 1 Primitives drawn with a line width one point wide.

Character Sizes

(JCSIZ). Four character cell sizes are supported on each type of display. They all have a constant aspect ratio of 1.67. The supported character sizes are:

HP 1310	Width: 3.27 mm	Height: 5.46 mm
	6.55 mn	10.91 mm
	13.09 mm	21.82 mm
	26.18 mm	43.64 mm
HP 1311	Width: 2.53 mm	Height: 4.22 mm
	5.07 mm	8.45 mm
	10.14 mm	16.89 mm
	20.27 mm	33.78 mm
HP 1317	Width: 2.98 mm	Height: 4.97 mm
	5.96 mm	9.93 mm
	11.92 mm	19.86 mm
	23.83 mm	39.73 mm
HP 1321	Width: 3.57 mm	Height: 5.96 mm
	7.16 mm	11.93 mm
	14.31 mm	23.85 mm
	28.62 mm	47.70 mm

When using medium- and low-quality text, the character is placed within the character cell as shown in Figure 1.

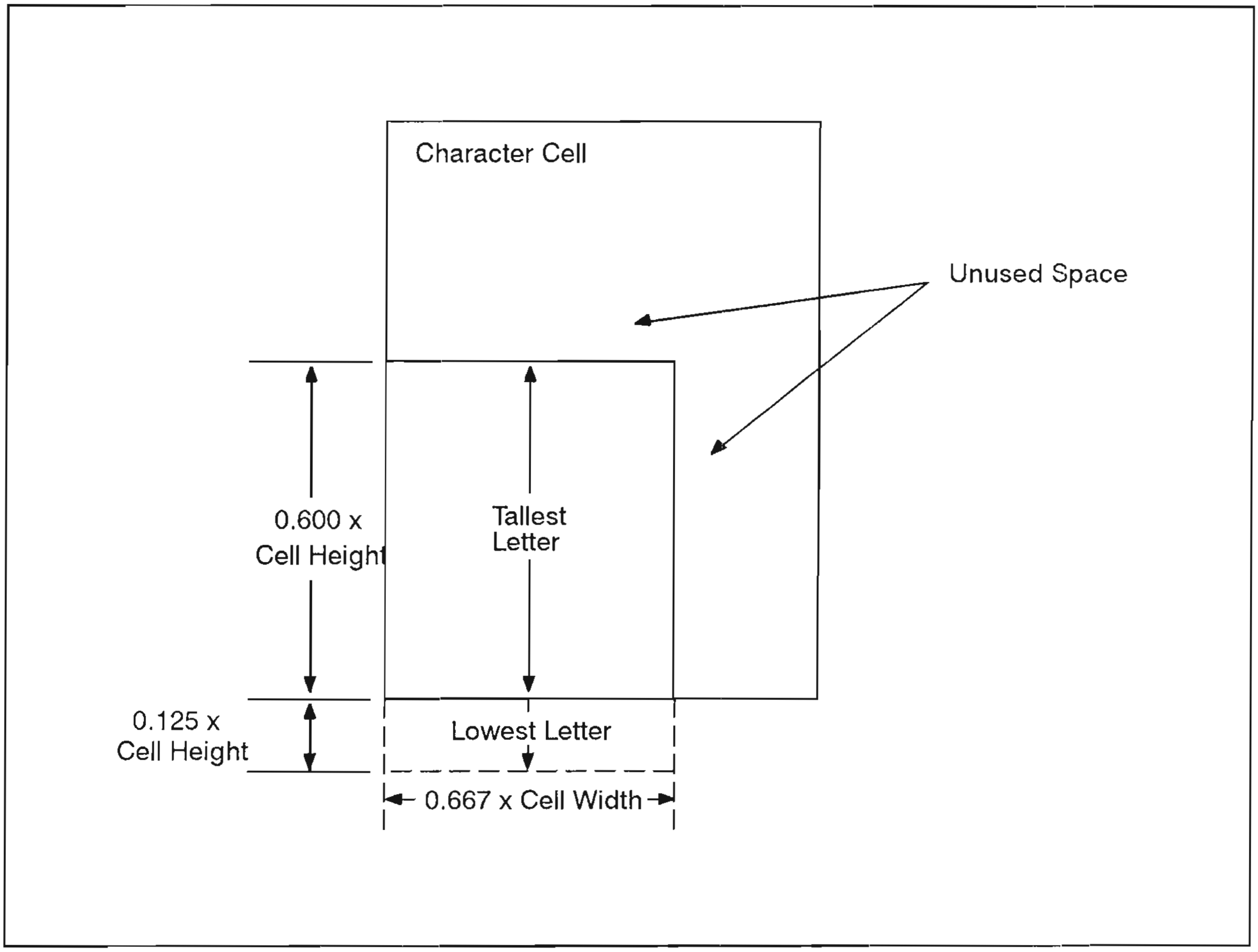

Figure 1. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware clipping is not provided. If clipping is turned off in AGP, and vectors or text are created with endpoints entirely or partially outside of the view surface, unpredictable results may occur.

Polygons

(J2PGN/J3PGN/JR2PG/JR3PG). This device does not have hardware area fill.

Markers

(J2MRK/J3MRK/JR2MK/JR3MK). Nineteen standard markers are supported. Markers are never larger than the box defined by the smallest character size. Marker 6 (triangle) uses five memory locations, marker 9 uses six memory locations, and all other markers use three memory locations.

Medium- and Low-Quality Text

(JTEXM/JTEXL). Medium- and low-quality graphics text are generated with a hardware character generator. The characters are drawn with a size ratio of 8 wide by 12 high in a character cell with a size ratio of 10 wide by 20 high. Refer to Table 3 for the hardware character set.

Table 3. Supported Hardware Character Sets

Decimal Value	Octal Value	Character	Decimal Value	Octal Value	Character
3	003	ETX	55	067	7
8	010	Backspace	56	070	8
9	011	Inverse Line feed	57	071	9
10	012	Line feed	58	072	:
11 *	013	Vertical Tick Mark (|)	59	073	;
12 *	014	Horizontal Tick Mark (—)	60	074	<
13	015	Carriage Return	61	075	=
14 *	016	X Marker Symbol	62	076	>
15 *	017	Rectangle Symbol ▭	63	077	?
19	023	Pointer (←)	64	100	@
20	024	DC4	65	101	A
30 *	036	Diamond Symbol ◇	66	102	B
32	040	space	67	103	C
33	041	!	68	104	D
34	042	"	69	105	E
35	043	#	70	106	F
36	044	$	71	107	G
37	045	%	72	110	H
38	046	&	73	111	I
39	047	'	74	112	J
40	050	(	75	113	K
41	051	)	76	114	L
42	052	*	77	115	M
43	053	+	78	116	N
44	054	,	79	117	O
45	055	-	80	120	P
46	056	.	81	121	Q
47	057	/	82	122	R
48	060	0	83	123	S
49	061	1	84	124	T

* These are plotting characters that do not automatically advance the beam to the next character starting point. They are useful when drawing graphs. The beam is left at the center of the character.

Table 3. Supported Hardware Character Sets (continued)

Decimal Value	Octal Value	Character	Decimal Value	Octal Value	Character
50	062	2	85	125	U
51	063	3	86	126	V
52	064	4	87	127	W
53	065	5	88	130	X
54	066	6	89	131	Y
90	132	Z	109	155	m
91	133	[	110	156	n
92	134	$\sqrt{}$	111	157	o
93	135	]	112	160	p
94	136	↑	113	161	q
95	137	_	114	162	r
96	140	\	115	163	s
97	141	a	116	164	t
98	142	b	117	165	u
99	143	c	118	166	v
100	144	d	119	167	w
101	145	e	120	170	x
102	146	f	121	171	y
103	147	g	122	172	z
104	150	h	123	173	π
105	151	i	124	174	|
106	152	j	125	175	→
107	153	k	126	176	Σ
108	154	l	127	177	⊢

New-Frame-Action

(JNEWF/JPURG/JSVIS/JSHI/JVSAL/JCLR). When using D0007, D0008, D0009, and D0010, a new-frame-action causes the picture to be made current. The display is cleared and the write pointer is reset to location 6. The new-frame-action does not affect auxiliary bits or file names which may have been set by escape functions. All visible segments are then drawn, or redrawn on the display surface.

Inquiry Escape Function

(JIESC). AGP supports one inquiry escape function.

Opcode	Function
1050	Inquire write pointer. This function returns the value of the software-maintained value of the write pointer. The write pointer specifies the address in the memory where the next graphics item will be placed. ILIST(1) = Current value of the software-maintained write pointer.

Output Escape Functions

(JOESC). Several output escape functions are supported. Error checking is not performed by the graphics system on any parameters sent to the device. Unless explicitly stated, the supported output escape functions do not modify the software-maintained value of the write pointer.

The state of AGP may become undefined when an escape function is given that overrides a mode set by AGP (for example, override highlighting by Opcode 54).

In order to use the following escape codes, the user should be familiar with the *HP 1350A/S/1351A/S Operating and Programming Manuals*. The following output escape functions are supported:

Opcode	Function
50	Blank Memory. This instruction prevents the device from displaying any information. The data in memory is not altered.
51	Unblank Memory. This instruction allows the HP 1350A/S/1351A/S to display information according to the data in the display memory (for example, vectors and text). If a file is blanked, it remains blanked at the completion of this call.
52	Erase Names. This erases all file names from memory and causes all memory locations to be assigned to file zero.
53	Stop Naming. Stops assigning data, vector endpoints and text characters to the last file named. This closes the current file. This function may affect highlighting of future primitives.
54	Erase Auxiliary. Removes all multiple display blanking information from memory. This function unhighlights all highlighted vectors on the display.
55	Stop Auxiliary. Stops assigning vectors and/or characters to memory which was set up by Opcode 1056.
1050	Blank File. Prevents information associated with specified file from being displayed. ILIST(1) = File to be blanked. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1051 Erase File. Erases memory associated with specified file by writing *dummy vectors* (move to 0, 0) in file memory. This command sets the hardware write pointer to location zero but does NOT modify the software-maintained value of the write pointer.

ILIST(1) = File to be erased. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1052 Find File. Moves the write pointers to the first memory location of the file specified. The file specified by the integer must have been previously named and must contain data. This command modifies the hardware write pointer but does NOT modify the software-maintained value of the write pointer.

ILIST(1) = File to be located. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1053 Name File. Assigns each subsequent vector endpoint and text character to the file specified.

ILIST(1) = File to be specified. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1054 Unblank File. Causes a blanked file to be displayed.

ILIST(1) = File to be unblanked. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1055 Find Location. Sets both the hardware and software-maintained value of the write pointer to the location specified.

ILIST(1) = memory location. Specify an integer from 0-2047 inclusive for the HP 1350A/S and from 0-8191 inclusive for the HP 1351A/S.

1056 Write Auxiliary. Sets the combination of which displays are turned on and off when the device is outputting vectors and/or character information. This function may affect highlighting.

ILIST(1) = Display parameter (0-15).

Locator Echoes on the Graphics Display

(JWLOC). Locator input can be echoed on either a graphics display device or a locator device. For locator echoes on the locator device, refer to the section on the locator in question.

The HP 1350A/S/1351A/S should not be buffered by the operating system when performing locator tracking. The following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross hair cursor. Same as ECHO 2 except cursor extends across the screen.
4	Rubber band line. A line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the line is removed.
5	Horizontal rubber band line. A horizontal line is displayed and extends from the locator echo position to the X value of the current locator position until the locator operation is terminated. The line is removed before control is returned to the application program.
6	Vertical rubber band line. A vertical line is displayed and extends from the locator echo position to the Y value of the current locator position until the locator operation is terminated. The line is removed before control is returned to the application program.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer than the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. A rectangle, defined by its diagonal (the line from the initial locator echo position to the current locator position), is used as the locator echo. When the locator operation is terminated, the box is removed and control is returned to the application program.

Pick Echoes on the Graphics Display

(JPICK). For echoes supported on the pick device, see the section which describes the pick device in question.

The HP 1350A/S/1351A/S should not be buffered by the operating system when tracking a cursor with the pick function. The following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.

Disabling

(JWOFF). Device-dependent actions are not performed.

Graphics Display Device Handler (DGL)

Description

The graphics display devices are supported with four graphics display CRTs and may drive any combination of four at one time. Their dimensions are as follows:

Screen size:	Width: 279 mm	Height: 279 mm	(HP 1310)
	Width: 216 mm	Height: 216 mm	(HP 1311)
	Width: 254 mm	Height: 254 mm	(HP 1317)
	Width: 305 mm	Height: 305 mm	(HP 1321)
Screen capacity:	Width: 1021 points	Height: 1021 points	
Aspect ratio of maximum area:	1.0		
Resolution:	3.667 points/mm in the X and Y directions		(HP 1310)
	4.736 points/mm in the X and Y directions		(HP 1311)
	4.028 points/mm in the X and Y directions		(HP 1317)
	3.354 points/mm in the X and Y directions		(HP 1321)

The default logical display surface corresponds to the maximum limits of the CRT display.

The view surface is centered within the current logical display surface.

The physical origin is the lower left corner of the display.

Memory Management

Each time a graphics item (that is, vector endpoint or hardware-generated character) is sent to the device, it is added to the internal memory of the translator. The HP 1350A/S Graphics Translator has 2048 memory locations and the HP 1351A/S Graphics Translator has 8192 memory locations. See the *HP 1350A/S/1351A/S Operating and Programming Manuals* for details on how graphics translator memory is organized.

As each endpoint or hardware character is written into a memory word, the write pointer is automatically incremented by one count. The write pointer value is the memory word (0-2047/0-8191) where the next endpoint or character is stored. The write pointer can be manipulated by the programmer through escape functions.

The values of the write pointers are maintained in software. These software-maintained values accurately represent the hardware values with the exception that some of the supported escape functions do not update the software-maintained values (see ZOESC). The software-maintained values may be inquired by calling ZIESC with Opcode 1050.

DGL uses the first six locations in the translator memory for cursor manipulation. This limits the user to 2042 displayable graphics items with the HP 1350A/S, or 8186 items with the HP 1351A/S.

The write pointer value is set to word 6 by DGL. If the application program produces more than 2042/8186 graphics items before a command is sent which resets the write pointer, a wraparound condition is produced. If wraparound occurs, new graphics items replace the oldest items in a sequential manner. Wraparound can result in an unspecified vector appearing on the screen if the oldest and newest graphics items are vector endpoints. If pick or locator echoing is performed on the display after wraparound occurs, the integrity of the display is destroyed until a new-frame-action occurs.

Initialization

(ZDINT). Because these are listen-only devices, DGL cannot confirm that an HP 1350A/S/1351A/S is at the specified I/O unit descriptor. DGL checks for the correct system driver and makes sure the I/O unit descriptor is up. Upon initialization, the following operations are performed:

Device name:	See Table 4.
Highlighting:	Set to 1.
Graphics memory:	In the lower left corner of the display.
Power interrupt light:	Turned off.
File memory:	Cleared of vector, text, and attribute data. The file memory is then displayed (unblanked). File names are cleared. File 0 is enabled for vectors and text. The write pointer is set to word 6. Text label direction is set to 0 degrees (horizontal).
Logical display:	Set to the physical limits of the screen.
View surface:	Centered within the logical display surface.
Color table:	Initialized when ZDINT is called.

Table 4. Device Naming Conventions

Display Library	CRT Display	Default Name *	Name Set at Initialization
D0007	1310	"0007 "	"135010"
D0008	1311	"0008 "	"135011"
D0009	1317	"0009 "	"135017"
D0010	1321	"0010 "	"135021"

* The name is padded to 6 characters with trailing blanks.

Supported Primitive Attributes

Color

(ZCOLR). The D0007, D0008, D0009, and D0010 display handlers provide a software color table of one color. The size of the color table cannot be changed. The default value of the color table is shown in Table 5.

Table 5. Default Color Table

Color Table Entry	Color
1	Color set to green or white, depending on the phospher in the CRT.

The color selected corresponds to the color defined in the color table.

COLOR = 1 Color table entry 1 is selected.

Redefining Color

(ZDCOL/ZICOL). The colors in the color table cannot be redefined or inquired.

Polygon Interior Color

(ZPICL). One color is supported. The supported value of the color attribute is:

COLOR = 1 Color set to green or white, depending on the phospher in the CRT.

Polygon Style

(ZDPST). Using ZDPST does not cause polygons already displayed to change style.

Polygon Interior Line Style

(ZPILS). Refer to JLSTL for information regarding line style.

Highlighting

(ZHIGH). Two levels of highlighting are supported. Vectors and text are highlighted by blinking at a rate of approximately four times per second. Highlighting affects the output on displays which are connected to the TTL outputs 1, 2, and 3. A display connected to TTL output 4 is never affected by highlighting. In order to have any one of the displays blink, the corresponding blinking switches located on the input/output board must be on.

HIGHLIGHT= 1 Primitives drawn without highlighting.
= 2 Primitives drawn with blinking.

Line Style

(ZLSTL). Only one line style is supported:

LINESTYLE = 1 Primitives drawn with solid line style.

Line Width

(ZLWID). Only one line width is supported.

LINEWIDTH = 1 Primitives drawn with a line width one point wide.

Character Sizes

(ZCSIZ). Four character cell sizes are supported on each type of display. They all have a constant aspect ratio of 1.67. ZCSIZ disables text rotation (see ZOESC (1057)).

The supported character sizes are:

HP 1310	Width: 3.27 mm	Height: 5.46 mm
	6.55 mm	10.91 mm
	13.09 mm	21.82 mm
	26.18 mm	43.64 mm
HP 1311	Width: 2.53 mm	Height: 4.22 mm
	5.07 mm	8.45 mm
	10.14 mm	16.89 mm
	20.27 mm	33.78 mm
HP 1317	Width: 2.98 mm	Height: 4.97 mm
	5.96 mm	9.93 mm
	11.92 mm	19.86 mm
	23.83 mm	39.73 mm
HP 1321	Width: 3.57 mm	Height: 5.96 mm
	7.16 mm	11.93 mm
	14.31 mm	23.85 mm
	28.62 mm	47.70 mm

The character is placed within the character cell as shown in Figure 2.

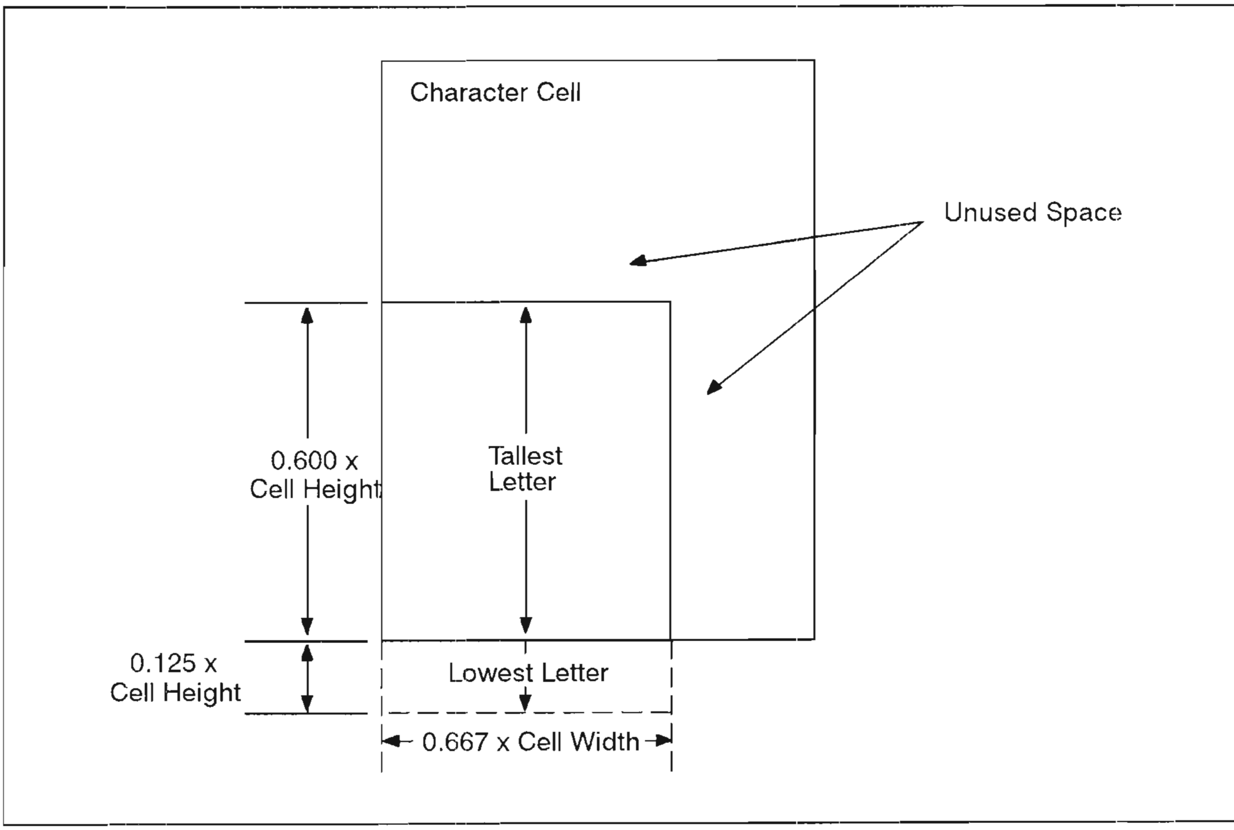

Figure 2. Placement of Character in Character Cell

Output Primitives

Clipping

Hardware clipping is not provided. Vectors or text with endpoints entirely or partially outside the physical limits of the display may generate unpredictable results.

Polygons

(ZPGDD). Hardware support of polygons is not provided. A polygon specified by ZPGDD is always represented as described in the *DGL Programmer's Reference Manual,* part number 97084-90000.

Markers

(ZMARK). Nineteen standard markers are supported. Markers are never larger than the box defined by the smallest character size. Marker 6 (triangle) uses five memory locations, marker 9 uses six memory locations, and all other markers use three memory locations.

Text

(ZTEXT). Graphics text is generated with a hardware character generator. The characters are drawn with a size ratio of 8 high by 12 wide in a character cell with a size ratio of 10 wide by 20 high. Refer to Table 6 for the hardware character set.

Through the use of escape functions ZOESC, Opcode 1057, text may be rotated 90 degrees. Carriage returns imbedded in the ZTEXT string move the pen to the left-most border of the current row. After a call to ZTEXT, the starting position is set so that an additional call to ZTEXT continues to generate characters along the same line of text.

Table 6. Supported Hardware Character Sets

Decimal Value	Octal Value	Character	Decimal Value	Octal Value	Character
3	003	ETX	55	067	7
8	010	Backspace	56	070	8
9	011	Inverse Line feed	57	071	9
10	012	Line feed	58	072	:
11 *	013	Vertical Tick Mark (|)	59	073	;
12 *	014	Horizontal Tick Mark (—)	60	074	<
13	015	Carriage Return	61	075	=
14 *	016	X Marker Symbol	62	076	>
15 *	017	Rectangle Symbol ▭	63	077	?
19	023	Pointer (←)	64	100	@
20	024	DC4	65	101	A
30 *	036	Diamond Symbol ◇	66	102	B
32	040	space	67	103	C
33	041	!	68	104	D
34	042	"	69	105	E
35	043	#	70	106	F
36	044	$	71	107	G
37	045	%	72	110	H
38	046	&	73	111	I
39	047	'	74	112	J
40	050	(	75	113	K
41	051	)	76	114	L
42	052	*	77	115	M
43	053	+	78	116	N
44	054	,	79	117	O
45	055	-	80	120	P
46	056	.	81	121	Q
47	057	/	82	122	R
48	060	0	83	123	S
49	061	1	84	124	T

* These are plotting characters that do not automatically advance the beam to the next character starting point. They are useful when drawing graphs. The beam is left at the center of the character.

Table 6. Supported Hardware Character Sets (continued)

Decimal Value	Octal Value	Character	Decimal Value	Octal Value	Character
50	062	2	85	125	U
51	063	3	86	126	V
52	064	4	87	127	W
53	065	5	88	130	X
54	066	6	89	131	Y
90	132	Z	109	155	m
91	133	[	110	156	n
92	134	$\sqrt{\ }$	111	157	o
93	135	]	112	160	p
94	136	↑	113	161	q
95	137	_	114	162	r
96	140	\	115	163	s
97	141	a	116	164	t
98	142	b	117	165	u
99	143	c	118	166	v
100	144	d	119	167	w
101	145	e	120	170	x
102	146	f	121	171	y
103	147	g	122	172	z
104	150	h	123	173	π
105	151	i	124	174	|
106	152	j	125	175	→
107	153	k	126	176	Σ
108	154	l	127	177	⊢

New-Frame-Action

Non-Buffered

(ZNEWF). (Bit 6 of the ZDINT control word not set)

A call to ZNEWF makes the picture current and then erases the display. The write pointers are reset to location 6. The new-frame-action does not affect auxiliary bits or file names which may have been set by escape functions.

Buffered

(ZNEWF). (Bit 6 of the ZDINT control word is set)

When ZNEWF is called, the graphics display is made current. The instruction to clear the graphics display is stored in the DGL buffer and is not sent to the device until the next time the buffer is sent. When the buffer is sent, the display is cleared, the write pointers are reset to location 6, and whatever calls to DGL were put into the buffer after the ZNEWF call takes effect on the graphics display. The new-frame-action does not affect auxiliary bits or file names which may have been set by escape functions. The current display remains until the next buffer is sent. If immediate visibility is used, the action is the same as if bit 6 were not set because the buffer is sent after every DGL call.

Inquiry Escape Function

(ZIESC). DGL supports one inquiry escape function:

Opcode	Function
1050	Inquire write pointer. This function returns the value of the software-maintained write pointer. The write pointer specifies the address in memory where the next graphics item is placed. ILIST(1) = Current value of the software-maintained write pointer.

Output Escape Functions

(ZOESC). Several output escape functions are supported. Error checking is not performed by the graphics system on any parameters sent to the device. Unless explicitly stated, the supported output escape functions do not modify the value of the software-maintained write pointer.

In order to use the following escape codes, the user should be familiar with the *HP 1350A/S/1351A/S Operating and Programming Manual.* The following output escape functions are supported:

Opcode	Function
50	Blank Memory. This instruction prevents the device from displaying any information. The data in memory is not altered.
51	Unblank Memory. This instruction allows the device to display information according to the data in the display memory (for example, vectors and text). If a file is blanked before memory is blanked, it remains blanked at the completion of this call.
52	Erase Names. This erases all file names from memory and causes all memory locations to be assigned to file zero.
53	Stop Naming. Stops assigning data, vector endpoints, and text characters to the last file named. This closes the current file. This function may affect highlighting.
54	Erase Auxiliary. Removes all multiple display blanking information from memory. This function unhighlights all highlighted vectors on the display.
55	Stop Auxiliary. Stops assigning vectors and/or characters to memory which was set up by Opcode 1056.

1050 Blank File. Prevents information associated with specified file from being displayed.

ILIST(1) = File to be blanked. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1051 Erase File. Erases memory associated with specified file by writing *dummy vectors* (move to 0, 0) in file memory. This command sets the hardware write pointer to location zero but does NOT modify the software-maintained value of the write pointer.

ILIST(1) = File to be erased. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1052 Find File. Moves the write pointers to the first memory location of the file specified. The file specified by the integer must have been previously named and must contain some data. This command modifies the hardware write pointer but does not modify the software-maintained value.

ILIST(1) = File to be located. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1053 Name File. Assigns each subsequent vector endpoint and text character to the file specified.

ILIST(1) = File to be specified. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1054 Unblank File. Causes a blanked file to be displayed.

ILIST(1) = File to be unblanked. Specify an integer between 0-31 for the HP 1350A/S and 0-63 for the HP 1351A/S.

1055 Find Location. Sets the write pointer to the memory location specified. Updates the software-maintained value of the write pointer.

ILIST(1) = memory location. Specify an integer from 0-2047 inclusive for the HP 1350A/S and from 0-8191 inclusive for the HP 1351A/S.

1056 Write Auxiliary. Sets the combination of which displays are turned on and off when the device is outputting vectors and/or character information. This function may affect highlighting.

ILIST(1) = Display parameter (0-15).

1057 Sets text direction. ZCSIZ and ZMARK resets text direction.

ILIST(1) = 1 Text is rotated 90 degrees.
≠ 1 Text is reset to horizontal direction (0 degrees).

Locator Echoes on the Graphics Display

(ZWLOC). Locator input can be echoed on either a graphics display device or a locator device. For echoes supported on the locator device, refer to the section that describes the locator in question.

The HP 1350A/S/1351A/S should not be buffered by the operating system when performing locator tracking.

The following echoes are supported:

Echo #	Echo Performed
2	Small cursor. Initially, the graphics cursor is turned on at the locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross hair cursor. Same as ECHO 2 except cursor extends across screen.
4	Rubber band line. A line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the line is removed.
5	Horizontal rubber band line. A horizontal line is displayed extending from the locator echo position to the X value of the current locator position until the locator operation is terminated. The line is removed before control is returned to the application program.
6	Vertical rubber band line. A vertical line is displayed extending from the locator echo position to the Y value of the current locator position until the locator operation is terminated. The line is removed before control is returned to the application program.
7	Horizontal/vertical rubber band line. Either a horizontal or vertical line is displayed from the current locator echo position to the graphics cursor. The effect is the same as ECHO 5 if the length of the horizontal line between the locator echo position is longer the vertical line between the same two points, otherwise the effect is the same as ECHO 6.
8	Rubber band box. A rectangle, defined by its diagonal (the line from the initial locator echo position to the current locator position), is used as the locator echo. When the locator operation is terminated, the box is removed and control is returned to the application program.

Termination

(ZDEND). When the device is terminated, the device name is reset as specified in Table 4. All attribute values remain unchanged until the system is reinitialized or the display device is enabled again.

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HP 9111A Graphics Tablets

HP 9111A Graphics Tablets

General Information

This chapter pertains to all versions of the HP 9111 Graphics Tablet. The user should be familiar with the operation of their version of the tablet. If necessary, refer to the following manuals for the appropriate operating instructions:

HP 9111A Graphics Tablet User's Manual, part number 09111-90000.

HP 9111A Graphics Tablet Operator's Manual, part number 09111-90003.

HP 9111A Graphics Tablet Programming Manual, part number 09111-90004.

HP 9111A Graphics Tablet Service Manual, part number 09111-90009.

HP 9111A Graphics Tablet Service Documentation, part number 09111-90030.

HP 9111T User's Manual Supplement, part number 09111-90050.

HP 9111T Service Documentation Supplement, part number 09111-90035.

Special Considerations

There are several versions of the HP 9111 Graphics Tablet. Originally, only two existed: the HP 9111A and the HP 9111T. The HP 9111T offered local cursor tracking capability in conjunction with an HP 1350A/S/1351A/S Graphics Translator. This tablet identified itself as a "9111T". It was obsoleted and the local cursor tracking capability was offered as an option to the HP 9111A. This tablet was called the HP 9111A option 50. It had the same functionality as the HP 9111T and identified itself as a "9111T". Eventually, the HP 9111A option 50 was also obsoleted but the local cursor tracking capability was added as a standard capability of the HP 9111A. HP 9111A Graphics Tablets with a serial number prefix of 2251 or greater includes this local tracking as standard. These new tablets also identify themselves as "9111T".

Refer to the section HP 9111A with the HP 1350A/S/1351A/S when using the local cursor tracking capability of the HP 9111A with an HP 1350A/S/1351A/S Graphics Translator.

Supported Logical Devices

The following logical devices are supported by the AGP/DGL Graphics Systems:

Logical Device	Device Handler Name
Button	B0004
Locator	L0004
Pick (AGP only)	P0004
Valuator	V0004

Button Device Handler

Description

The tablets have a menu area that consists of sixteen boxes at the top of the tablet.

Initialization

(JEDEV/ZBINT). When the button device is initialized, any error conditions that exist are cleared and the device name is set to "9111A " or "9111T " depending on the device being used. The name is padded to 6 characters with trailing blanks.

Button Input

(JBUTN/ZBUTN). When the button input function is invoked, the graphics tablet is continuously sampled until the stylus is positioned over the desired box and depressed. Control does not return to the application program until a valid box (button) is selected. Selecting a box between 1 and 16 returns the button as an integer value ranging from 1 to 16.

Echoes Supported

The button device handler supports the following echoes:

Echo #	Echo Performed
0	When a box (button) is selected, the *menu* light blinks once.
1	When a box (button) is selected, the *menu* light blinks once and the beeper is sounded.

Termination

(JDDEV/ZBEND). The device name is set to "0004 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Locator Device Handler

Description

The dimensions of the locator device are as follows:

Active platen size:	Width: 300.8 mm Height: 217.6 mm (The entire area within the outline on the platen.)
Platen addressability:	Width: 12032 points Height: 8704 points (The entire area within the outline on the platen.)
Resolution:	40.0 points/mm in X and Y directions
Physical origin:	Lower left corner of outlined area on platen
Default locator limits:	Active platen limits

Initialization

(JEDEV/ZLINT). When the locator device is initialized, any existing errors are cleared and the device name is set to "9111A " or "9111T ", depending on the unit used. The name is padded to 6 characters with trailing blanks.

Wait Locator Input

(JWLOC/ZWLOC). When the wait locator input function is invoked, the *digitize* light on the data tablet is turned on and the position of the stylus is constantly monitored until the stylus (locator button) is depressed. To digitize a point, the operator positions the stylus to the desired position and depresses it. When the stylus is depressed, the *digitize* light is turned off, the digitized point is returned, and the value of the locator button is returned to the application program.

Echoes Supported

The tablets can echo on any graphics display that supports locator echoes. For the echoes supported on the graphics display device, see the corresponding device handler that discusses the graphics display in question. The supported echoes on the locator device are as follows:

Echo #	Echo Performed
0	Echo is not performed.
1	The beeper is sounded when the stylus is depressed.

Sample Locator Input

(JSLOC/ZSLOC). The sample locator input function returns the current position of the stylus on the platen without waiting for an operator response.

Echoes Supported

The following locator echoes are supported when using the sample locator function:

Echo #	Echo Performed
0	Echo is not performed.
1	The beeper is sounded when the locator is sampled.

Termination

(JDDEV/ZLEND). The device name is set to "0004 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Pick Device Handler (AGP)

Description

The dimensions of the pick device are as follows:

Active platen size:	Width: 300.8 mm Height: 217.6 mm (The entire area within the outline on platen.)
Platen addressability:	Width: 12032 points Height: 8704 points (The entire area within the outline on platen.)
Resolution:	40.0 points/mm in X and Y directions
Physical origin:	Lower left corner of outlined area on platen
Default pick limits:	Active platen area

Initialization

(JEDEV). When the pick device is initialized, any existing errors are cleared and the device name is set to "9111A " or "9111T ", depending on the unit used. The name is padded to 6 characters with trailing blanks.

Pick Input

(JPICK). When the pick input function is invoked, the *digitize* light on the data tablet is turned on and the position of the stylus is constantly tracked until the stylus (pick button) is depressed. To digitize a point, the operator positions the stylus to the desired position and depresses it. The *digitize* light is turned off when the stylus is depressed. The segment name, pick-ID, and the value of the pick button are then returned to the application program.

Echoes Supported

The tablets can echo on any graphics display that support pick echoes. For the echoes supported on the graphics display device, see the corresponding device handler that discusses the graphics display in question. The supported echoes on the pick device are as follows:

Echo #	**Echo Performed**
0	Echo is not performed.
1	The beeper is sounded when the stylus is depressed.

Termination

(JDDEV). The device name is set to "0004 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 9111A Graphics Tablet with 1350/1351

Locator Device Handler

Description

The dimensions of the locator device are as follows:

Active area:	Width: 204.0 mm	Height: 204.0 mm
Addressability:	Width: 8160 points.	Height: 8160 points
Resolution:	40.0 points/mm in the X and Y direction	

The default locator limits are the active platen area.

The physical origin is 48.4 mm to the right of the left border.

Initialization

(JEDEV/ZLINT). When the locator device is initialized, the device name is set to "9111T ".

Limits

(JLLIM/ZLLIM) When using this device handler, the locator limits cannot be changed. Any calls to JLLIM or ZLLIM are ignored.

Wait Locator Input

(JWLOC/ZWLOC). When the wait locator input function is invoked, the *digitize* light on the data tablet is turned on. To digitize a point, the operator positions the stylus to the desired position and depresses it. When the stylus is depressed, the *digitize* light is turned off, the digitized point is returned, and the value of the locator's button is returned to the application program.

Echoes Supported

The HP 9111A can echo on the HP 1350/1351. The echoes supported on the locator device are as follows:

Echo #	Echo Performed
0	Echo is not performed.
1	The beeper is sounded when the stylus is depressed.
2	Small cursor. Initially, the small graphics cursor is turned on at the locator echo position. The cursor then reflects the current locator position (that is, tracked) until the locator operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.
3	Full cross-hair cursor. Same as ECHO 2 except cursor extends across the screen.
4	Rubber band line. A line extends from the locator echo position to the current locator position (rubber band line) until the locator operation is terminated. Before control is returned to the application program, the line is removed.
5	Horizontal rubber band line. A horizontal line is displayed that extends from the locator echo position to the X value of the current locator position until the locator operation is terminated. The line is removed before control is returned to the application program.
6	Vertical rubber band line. A vertical line is displayed that extends from the locator echo position to the Y value of the current locator position until the locator operation is terminated. The line is removed before control is returned to the application program.
7	Horizontal/vertical rubber band line. Same as ECHO 4.
8	Rubber band box. A rectangle, defined by its diagonal (the line from the initial locator echo position to the current locator position), is used as the locator echo. When the locator operation is terminated, the box is removed and control is returned to the application program.

Sample Locator Input

(JSLOC/ZSLOC). The sample locator input function returns the current position of the stylus on the platen without waiting for an operator response.

Echoes Supported

The following locator echoes are supported:

Echo #	Echo Performed
0	Echo is not performed.
1	The beeper is sounded when the locator is sampled.

Termination

(JDDEV/ZLEND). The device name is set to "0005 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Pick Device Handler (AGP)

Description

The dimensions of the pick device are as follows:

Active area:	Width: 204.0 mm	Height: 204.0 mm
Addressability:	Width: 8160 points	Height: 8160 points
Resolution:	40.0 points/mm in the X and Y direction	

The default pick limits are the active platen area.

The physical origin is 48.4 mm to the right of the left border.

Initialization

(JEDEV). When the pick device is initialized, any existing errors are cleared and the device name is set to "9111T ". The name is padded to 6 characters with trailing blanks.

To perform local cursor tracking using JWLOC/ZWLOC and JPICK (AGP only), with the HP 1350/1351 Graphics Translators, the following requirements must be met:

1. The HP 9111A and the HP 1350/1351 must be on the same HP-IB interface card.
2. The LU of the HP 9111A must be mapped to subchannel 1 of the HP-IB EQT. The value of this LU must be one greater than the LU of subchannel 0 of the HP-IB EQT. The user must set the HP-IB address of the HP 9111A to 1 by setting the switches on the back of the HP 9111A (for example, if LU 40, subchannel 0, is the HP-IB card, then LU 41 subchannel 1 refers to the 9111A Tablet.)
3. The LU of the HP 1350/1351 must be mapped to subchannel 2 of the HP-IB EQT. The user must set the HP-IB address to 2 by setting the switches inside the HP 1350/1351. *Note: the LU of the 1350/1351 can be any logical LU value.*
4. The HP 1350/1351 should not have the outspooling bit set (see ZDINT or JDINT).
5. No other device on the HP-IB bus can be doing any I/O operations while echoing is being performed.

Limits

(JPLIM) When using this device handler, the pick limits cannot be changed. Any calls to JPLIM are ignored.

Pick Input

(JPICK). When the pick input function is invoked, the position of the stylus is constantly tracked until the stylus (pick button) is depressed. To digitize a point, the operator positions the stylus to the desired position and depresses it. The segment name, pick-ID, and the value of the pick button are then returned to the application program.

Echoes Supported

The HP 9111A can echo on the HP 1350/1351. The echoes supported on the pick device are as follows:

Echo #	Echo Performed
0	Echo is not performed.
1	The beeper is sounded when the stylus is depressed.
2	Small cursor. Initially, the small graphics cursor is turned on at the pick echo position. The cursor then reflects the current pick position (that is, tracked) until the pick operation is terminated. Before control is returned to the application program, the graphics cursor is turned off.

Termination

(JDDEV). The device name is set to "0005 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

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HP 9874A Digitizer

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HP 9874A Digitizer

General Information

The user should be familiar with the operation of the HP 9874A Digitizer. If necessary, refer to the following manual for the appropriate operating instructions:

HP 9874A Installation and Service Manual, part number 09874-90000.

Supported Logical Devices

The following logical devices are supported:

Logical Device	Device Handler Name
Alpha	A0017
Button	B0017
Keyboard	K0017
Locator	L0017
Pick (AGP only)	P0017
Valuator	V0017

Alphanumeric Device Handler

Description

The alphanumeric device has a one-line by 15 character LED display accessible through the DGL alpha display handler, A0017. ASCII characters supported by this handler are listed in Table 1. The device uses a low resolution grid composed of LEDs, primarily for the display of numeric data. Only low-quality alpha characters are supported.

The dimensions of the alphanumeric device are as follows:

Screen capacity:	1 line by 15 characters

Initialization

(JEDEV/ZAINT). When initialized, the device name is set to "9874 ". The name is padded to 6 characters with trailing blanks.

Alphanumeric Output

(JALPH/ZALPH). The alpha display is cleared before character data is displayed on the alpha device unless the previous alpha string was terminated by an underscore " _". A maximum of 15 characters can be displayed.

Termination

(JDDEV/ZAEND). The alphanumeric display is not affected. The device name is set to "0017 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Table 1. ASCII Characters

DECIMAL VALUE	STD. ASCII CHARACTER	HP 9874A CHARACTER	DECIMAL VALUE	STD. ASCII CHARACTER	HP 9874A CHARACTER
0-32	Space	Space	99 & 67	C c	C
33	!	!	100 & 68	D d	d
34	"	"	101 & 69	E e	E
35	#	Space	102 & 70	F f	F
36	$	Space	103 & 71	G g	G
37	%	%	104 & 72	H h	H
38	&	Space	105 & 73	I i	I
39	'	'	106 & 74	J j	J
40	(	[	107 & 75	K k	K
41	)	]	108 & 76	L l	L
42	*	·	109 & 77	M m	m
43	+	Space	110 & 78	N n	n
44	,	Space	111 & 79	O o	o
45	-	-	112 & 80	P p	P
46	.	.	113 & 81	Q q	Q
47	/	/	114 & 82	R r	r
48	0	0	115 & 83	S s	S
49	1	1	116 & 84	T t	t
50	2	2	117 & 85	U u	u
51	3	3	118 & 86	V v	U
52	4	4	119 & 87	W w	W
53	5	5	120 & 88	X x	X
54	6	6	121 & 89	Y y	Y
55	7	7	122 & 90	Z z	Z
56	8	8	91	[	[
57	9	9	92	\	\
58	:	Space	93	]	]
59	;	Space	94	^	^
60	<	<	95	_	-
61	=	=	96	`	'
62	>	>	123	{	[
63	?	?	124	|	|
64	@	@	125	}	]
97 & 65	A a	A	126	~	-
98 & 66	B b	b			

Button Device Handler

Description

The logical button device on the digitizer is a set of function keys and a foot switch that simulates 11 buttons.

The digitizer is supported as a button device with the device handler B0017.

Initialization

(JEDEV/ZBINT). When initialized, the device name is set to "9874 ". The name is padded to 6 characters with trailing blanks.

Button Input

(JBUTN/ZBUTN). When the button input function is invoked, the digitizer is continuously sampled until the operator has selected a valid button sequence. Some button sequences require activating two keys before the associated button value is returned to the application program. In this case, the operator first strikes the *prefix* key and then strikes one of the five function keys to return the desired button value. The *prefix* key is the tan key located in the upper left-hand corner of the keyboard. Refer to Table 2 for the button values associated with the button sequence entered.

Echoes Supported

The following echoes are supported:

Echo #	Echo Performed
0	Echoing is not performed.
1	When a button is selected, the light above the selected button blinks once and the beeper sounds.

Termination

(JDDEV/ZBEND). The device name is set to "0017 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Table 2. Valid Button Sequences and Values Returned

Key	Value Returned
f_a	1
f_b	2
f_c	3
f_d	4
f_d	5
Prefix f_a	6
Prefix f_b	7
Prefix f_c	8
Prefix f_d	9
Prefix f_e	10
Prefix Switch (accessory)	11

Locator Device Handler

Description

The dimensions of the locator device are as follows:

Active platen size:	Width: 435.0 mm	Height: 315.0 mm
Platen addressability:	Width: 17400 points	Height: 12600 points
Resolution:	40.0 points/mm in the X and Y directions	

The default locator limits are the active platen limits.

The physical origin is the lower left corner of the display.

Initialization

(JEDEV/ZLINT). The device name is set to "9874 ". The name is padded to 6 characters with trailing blanks.

Wait Locator Input

(JWLOC/ZWLOC). When invoked, the *single* light is turned on and the position of the stylus is constantly monitored until the operator responds. To digitize a point, the operator positions the stylus or cursor to the desired position and activates it. The operator activates the stylus by pressing it down at the desired point. The cursor is activated by pressing the button on the cursor labeled 'D'. When the stylus or cursor is activated, the *single* light is turned off, the digitized point is returned, and the value of the locator's button (always 1) is returned to the application program.

Echoes Supported

The locator device can echo on any graphics display supporting locator echoes.

The following echoes are supported:

Echo #	Echo Performed
0	Echo not performed.
1	The beeper is sounded when the stylus or cursor is activated.

Sample Locator Input

(JSLOC/ZSLOC). This function returns the current position of the stylus or cursor on the platen without waiting for an operator response.

Echoes Supported

The following echoes are supported:

Echo #	Echo Performed
0	Echo not performed.
1	The beeper is sounded when the locator is sampled.

Termination

(JDDEV/ZLEND). The device name is set to "0017 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.

Echoes Supported

The following echoes are supported:

Echo #	Echo Performed
0	Echo not performed.
1	The beeper is sounded when the cursor or stylus is activated.

Sample Valuator Input

(JSVAL/ZSVAL). The sample valuator input function samples the current position of the cursor or stylus on the platen without waiting for an operator response. The value returned is a function of the subvaluator specified as follows:

Subvaluator	Value Returned
1	The X coordinate of the cursor or stylus position scaled to a number between 0.0 and 1.0. If the point selected is on or to the left of the left border of the active area, 0.0 is returned. If the stylus is on or to the right of the right border of the active area, 1.0 is returned.
2	The Y coordinate of the cursor or stylus position scaled to a number between 0.0 and 1.0. If the point selected is on or below the lower border of the active area, 0.0 is returned. If the point selected is on or above the upper border of the active area, 1.0 is returned.
3	Depends on whether the cursor or stylus is depressed at the time the sample function occurs. If the cursor or stylus is not depressed, 0.0 is returned. If it is depressed, 1.0 is returned.

Echoes Supported

The following echoes are supported:

Echo #	Echo Performed
0	Echo not performed.
1	The beeper is sounded when the valuator is sampled.

Termination

The device name is set to "0017 " (the name is padded to 6 characters with trailing blanks). The device status and I/O unit descriptor are set to 0.