The HP-GL/2 Comparison Guide

This is a preliminary document. Some information may be incomplete.

HP Computer Museum
www.hpmuseum.net

For research and education purposes only.

Introduction

This manual provides information to aid in the design of hardware, firmware, or software for use with the HP family of HP-GL/2 plotters and other devices having HP-GL/2 capability. Its goal is to show the similarities and differences between devices and provide the information needed to define the HP-GL/2 instruction subset and general syntax that is compatible with any given combination of these devices.

This multiproduct-specific manual complements the product-independent *HP-GL/2 Reference Guide*. This manual also provides the same type of information for an update selection of products. The *HP-GL/2 Comparison Guide* contains information for the following products.

DraftMaster SX, RX, and MX
Shogun
Bunny
Flare
Galaxy

Each of these products comes with a manual instructing the customer on its use. Most of these manuals will contain an appendix listing the HP-GL/2 instructions and pertinent parameter ranges. The user manual appendix and this comparison guide assume prior knowledge of HP-GL/2

The *HP-GL/2 Comparison Guide* contains the following information.

- Plotter Features Overview
- HP-GL/2 Language Comparison
- Media Sizes and Plotting Areas

 Preliminary Document: 10-13-89

 Preliminary Document: 10-13-89

Product Features

The following is an overview of plotter features.

Feature	DraftMaster			Shogun	Galaxy	Flare
	SX	RX	MX	Bunny		
Maximum number of pens	32	32	32	1024	8	8
Internal disk size	NA	NA	20 MB	40 MB		NA
Internal buffer size	~ 1MB	~ 1MB	NA	18K		
Centronics interface	N	N	N	Y	Y	Y
HP-IB	Y	Y	Y	Y	Y	Y
RS-232-C	Y	Y	Y	Y	Y	Y
Other Interfaces	NA	NA	NA	Amigo (SCS)	NA	NA
LCD display on control panel?	Y	Y	Y	Y	N	N

HP-GL/2 Language Comparison

The tables in this section show you how HP-GL/2 is supported across a variety of products. After the HP-GL/2 tables are three additional sections. The first shows product defaults, the second shows reactions to ASCII control codes in label mode, and the last refers to device-control instructions (DCIs).

HP-GL/2 Overview

The following table shows the different component groups of HP-GL/2 and the devices on which they are supported.

HP-GL/2 Language Component	HP 7600 (240D/E)	Shogun Bunny	DraftMaster SX, RX, MX	Flare	Galaxy
HP-GL/2 Kernel	X	X	X	X	X
Technical Graphics Extension	X	X	X	X	
Palette Extension		X	X	X	X
Dual-Context Extension		X			X
Digitizing Extension			X		

In the list of tables that make up this section, the following notations indicate the status of an instruction or extension for a device.

X — Indicates the product's support of the instruction.
NOP — Indicates the plotter will ignore the instruction, but not generate an error. (The Transparency Mode (TR) instruction is the exception to this rule; an error is generated when it occurs on a device that NOPs it.)
NS — Indicates the extension is not supported for a particular device.

 Preliminary Document: 10-13-89

Parameter Format

In the tables that follow, the instruction's parameters (if any) are listed along with the their required format. The following lists the parameter format abbreviation along with its meaning and corresponding ranges for the specified devices.

Code	Parameter Format	HP 7600 (240D/E), Shogun and Bunny	DraftMaster SX, RX, MX and Flare
i	Integer	2^{26} to $2^{26}-1$ (-67 108 864 to 67 108 863)	2^{23} to $2^{23}-1$ (-8 388 608 to 8 388 607)
r	Real	2^{26} to $2^{26}-1$ (-67 108 864.0000 to 67 108 862.9999)	2^{23} to $2^{23}-1$ (-8 388 608.0000 to 8 388 607.9999)
ci	Clamped Integer	2^{15} to $2^{15}-1$ (-32 768 to 32 767)	
cr	Clamped Real	2^{15} to $2^{15}-1$ (-32 768.000 0 to 32 767.999 9)	

Other parameter formats include the following.

- **cu — Current Units.** Indicates *integer* if scaling is off, *real* if scaling is on.
- **c — Character.** Indicates a character or character string.
- **ns — Newstring.** Indicates a sequence of characters enclosed in double quotes (").

Parameter fields must be specified in the format defined by each instruction.

HP-GL/2 Kernel

The following table shows the functional groups that make up the HP-GL/2 kernel.

HP-GL/2 Kernel Functional Groups				
Configuration and Status Group	Vector Group	Polygon Group	Line and Fill Attributes Group	Character Group

The following tables list each instruction in the HP-GL/2 kernel in its functional group.

The Configuration and Status Group Instructions

Instruction/Parameters	Parameter Format	HP7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
DF, Default Values		X
IN, Initialize		X
IP, Input P1 and P2 (P1x,P1y(,P2x,P2y))	i	X
IR, Input Relative P1 and P2 (P1x,P1y(,P2x,P2y))	cr	X
IW, Input Window (XLL,YLL,XUR,YUR)	cu	X
PG, Advance Full Page (n)	ci	X*
RO, Rotate Coordinate System (angle)	ci	X
RP, Replot (n)	ci	X
SC, Scale (XMIN,XMAX,YMIN,YMAX) (,type) (,left, bottom) *or* (XMIN,XFACTOR,YMIN,YFACTOR) (type)	r ci cr r ci	X

* Galaxy NOPs this instruction.

The Vector Group Instructions

Instruction/Parameters	Parameter Format	HP 7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
AA, Arc Absolute XCENTER,YCENTER sweep angle (chord angle)	 cu cr cr	X
AR, Arc Relative XINCREMENT,YINCREMENT sweep angle (chord angle)	 cu cr cr	X
AT, Absolute Arc Three Point XINTER,YINTER XEND,YEND (chord angle)	 cu cu cr	X

Instruction/Parameters	Parameter Format	HP 7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
PA, Plot Absolute (X,Y)	 cu	X
PD, Pen Down (X,Y)	 cu	X
PE, Polyline Encoded (flag) (value)	 c c	X
PR, Plot Relative (X,Y)	 cu	X
PU, Pen Up (X,Y)	 cu	X
RT, Relative Arc Three Point XINTER, YINTER XEND, YEND (chord angle)	 cu cu cr	X

The Polygon Group Instructions

Instruction/Parameters	Parameter Format	HP 7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
CI, Circle radius (chord angle)	 cu cr	X
EA, Edge Rectangle Absolute X,Y	 cu	X
ER, Edge Rectangle Relative X,Y	 cu	X
EW, Edge Wedge radius start angle sweep angle (chord angle)	 cu cr cr cr	X
EP, Edge Polygon		X
FP, Fill Polygon		X
PM, Polygon Mode polygon definition	 ci	X
RA, Fill Rectangle Absolute X,Y	 cu	X

Instruction/Parameters	Parameter Format	HP 7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
RR, Fill Rectangle Relative X,Y	 cu	X
WG, Fill Wedge radius start angle sweep angle (chord angle)	 cu cr cr cr	X

The Line and Fill Attributes Group Instructions

Instruction/Parameters	Parameter Format	HP 7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
AC, Anchor Corner (X,Y)	 cu	X
FT, Fill Type (fill type) (option1(option2))	 ci cr	X*
LA, Line Attributes (kind,value)	 ci	X
LT, Line Type (line type) (pattern length) (mode)	 ci cr ci	X
PW, Pen Width (width) (pen)	 cr i	X
RF, Raster Fill Definition (index) (width) (height) (pen number)	 ci ci ci i	X**
SM, Symbol Mode (character)	 c	X
SP, Select Pen (pen number)	 i	X

Instruction/Parameters	Parameter Format	HP 7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
UL, User-Defined Line Type (index) (gap1.. .p20)	 ci cr	X
WU, Pen Width Unit Selection (type)	 ci	X

* DraftMaster SX, RX, MX NOP the instruction when option1 parameter is set to user-defined fill type.
** DraftMaster SX, RX, MX effectively NOP this instruction by defaulting the fill to a hatch pattern.

The Character Group Instructions

Instruction/Parameters	Parameter Format	HP 7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
AD, Alternate Font Definition (kind.) (value)	 ci cr	X
CF, Character Fill Mode (fill mode) (edge pen)	 ci i	X*
CP, Character Plot (spaces) (lines)	 cr cr	X
DI, Absolute Direction (run) (rise)	 cr cr	X
DR, Relative Direction (run) (rise)	 cr cr	X
DT, Define Label Terminator (label terminator) (mode)	 c ci	X
DV, Define Variable Text Path (path) (line)	 ci ci	X
ES, Extra Space (width) (height)	 cr cr	X
LB, Label (label)	 c	X
LO, Label Origin (position)	 ci	X
SA, Select Alternate Font		X

Instruction/Parameters	Parameter Format	HP 7600 (240D/E), Shogun, Bunny DraftMaster SX, RX, MX, Flare, Galaxy
SD, Standard Font Definition (kind,) (value)	 ci cr	X
SI, Absolute Character Size (width) (height)	 cr cr	X
SL, Character Slant (tangent of angle)	 cr	X
SR, Relative Character Size (width) (height)	 cr cr	X
SS, Select Standard Font		X
TD, Transparent Data (mode)	 ci	X

* DraftMaster SX, RX, MX NOP this instruction.

The Technical Graphics Extension Instructions

The following table lists the instructions in the Technical Graphics Extension.

The following devices do not support this extension.

Galaxy

Instruction/Parameters	Parameter Format	HP 7600 (240D/E)	Shogun, Bunny	DraftMaster SX, RX, MX	Flare
BP, Begin Plot (kind) (value)	 ci ••	NOP	X	X	X
CT, Chord Tolerance Mode (mode)	 ci	X	X	X	X
DL, Download Character (character number) (up) (X,Y)	 ci ci ci	X	X	X	X
EC, Enable Cutter (n)	 ci	X	X	X	X
FR, Frame Advance		X	X	X	NOP
MC, Merge Control (mode)	 ci	NOP	X	NOP	X
MG, Message (message)	 ns	NOP	X*	X	NOP
MT, Media Type (type)	 ci	NOP	X	X	X
NR, Not Ready (timeout)	 ci	NOP	X*	X	X
OE, Output Error		X	X	X	X
OH, Output Hard-Clip Limits		X	X	X	X
OI, Output Identification		X	X	X	X
OP, Output P1 and P2		X	X	X	X
OS, Output Status		X	X	X	X
PS, Plot Size (length) (width)	 i i	X	X	X	X
QL, Quality Level (quality level)	 ci	NOP	X	X	X

Instruction/Parameters	Parameter Format	HP 7600 (240D/E)	Shogun, Bunny	DraftMaster SX, RX, MX	Flare
ST, Sort (switches)	ci	NOP	X	X	NOP
VS, Velocity Select (pen velocity) (pen number)	ci ci	NOP	X	X	NOP

* Functionality of this instruction is not completely defined for this device.
** *land* dependent

The Palette Extension Instructions

The following devices do not support this extension.

HP 7600, Model 240D/E plotters

Note that Bunny is a monochrome device. Colors are represented on Bunny as variations in gray scale.

Instruction/Parameters	Parameter Format	Shogun Bunny	DraftMaster SX, RX, MX	Flare	Galaxy
CR, Set Color Range for Relative Color Data (b-ref) (w-ref)	cr cr	X	NOP*	X	NOP
NP, Number of Pens (n)	cr	X	X**	X	X
PC, Pen Color Assignment (pen) (red,green,blue)	i cr	X	NOP*	X	NOP
SV, Screened Vectors (screen type) (option1,(option2))	ci ci	X	NOP*	X	X
TR, Transparency Mode† (n)	ci	X	NOP	X	X

* Defaults to pen color.
** Maximum number of pens allowed for this device is 32.
† This instruction is not recommended for a hyperdriver. Does not NOP gracefully.

The Dual-Context Extension Instructions

The following table lists the instructions in the Dual-Context Extension. The purpose of this extension is to allow the merging of raster and vector graphics on the same page.

The following devices do not support this extension.

HP 7600, Model 240D/E plotters
HP DraftMaster SX, RX, MX plotter
Flare

Instruction/Parameters	Parameter Format	Shogun, Bunny	Galaxy
ESC %#A, Enter PCL Mode		X	X
ESC E, Reset		X	X
FI, Primary Font Selection by ID font ID	 i	NOP	X
FN, Secondary Font Selection by ID font ID	 i	NOP	X
SB, Scalable or Bitmap Fonts (n)	ci	NOP	X

The Digitizing Extension Instructions

The following table lists the instructions in the Digitizing Extension. Note that none of the instructions in this extension have parameters. Digitizing is a pen plotter feature only.

The following devices do not support this extension.

HP 7600, Model 240D/E plotters
Shogun
Bunny
HP DraftMaster SX, RX, MX plotter
Flare
Galaxy

Instruction/Parameters	HP DraftMaster SX, RX, MX
DC, Digitize Clear	X
DP, Digitize Point	X
OD, Output Digitized Point and Pen Status	X

Product Defaults

On application of power, each HP-GL/2 device performs an initialization cycle to set certain conditions to predefined default values. These default values differ from device to device, and some functions are not implemented on all devices.

Does your product match these default conditions? If there are differences, please highlight where your product differs and explain exactly what the difference is. Please write in any additional device-specific default conditions that apply to your product.

Function	Equivalent Instruction	Default Condition
Anchor Corner	AC	Anchor set to lower-left corner of hard-clip limits.
Alternate Font Definition	AD	*device specific*
Character Fill Mode	CF	Solid fill, no edging.*
Absolute Direction	DI	Character direction parallel to X-axis.
Define Label Terminator	DT	ETX and nonprinting mode.
Define Variable Text Path	DV	Text printed left to right with normal line feed.
Extra Space	ES	Turns off extra spacing.
Fill Type	FT	Solid bidirectional fill.
Input Window	IW	Solid bidirectional fill.
Line Attributes	LA	Butt caps, mitered joins, and miter limit = 5.
Label Origin	LO1	Standard labeling starting at current location.
Line Type	LT	Solid line, relative mode, pattern length = 4% of diagonal distance from P1 to P2.
Plotting Mode	PA	Absolute plotting.
Polygon Mode	PM0PM2	Polygon buffer cleared.

Function	Equivalent Instruction	Default Condition
Raster Fill	RF	Solid black.
Scale	SC	User-unit scaling off.
Standard Font Definition	SD	*device specific*
Character Size Absolute	SI	Turns off size transformation. (Characters do not change size with changes to P1 and P2.)
Character Slant	SL	No slant.
Symbol Mode	SM	Off.
Selected Font	SS	See Standard Font Definition.
Transparent Data	TD	Normal printing mode.
User-Defined Line Type	UL	Defaults all 8 line types.

* DraftMaster SX, RX, MX NOP this instruction.

Also, the default chord tolerance mode is chord angle. The default chord angle is 5°. Chord tolerance is changed using the CT (Chord Tolerance) instruction in the Technical Graphics Extension.

ASCII Control Codes in Label Mode

There are two modes of operation for printing HP-GL/2 labels: normal and transparent mode. In HP-GL 2, certain character codes do not print an image unless the device is in transparent mode. These nonprinting codes may instead perform some functionality. The following table lists these control codes and their associated functions.

Decimal Value	ASCII Character	Reaction
0	NULL	NOP
3	ETX	Label Terminator (default)
7	BEL	NOP
8	BS	Backspace
9	HT	Horizontal Tab
10	LF	Line Feed
11	VT	NOP
12	FF	NOP
13	CR	Carriage Return
14	SO	Select Alternate Font
15	SI	Select Standard Font
27	ESC	NOP
32	SP	Space

In normal mode, functionality is defined as follows.

NOP	No operation.
Backspace	Updates the current pen location to the pen position before the last character was printed. This code is ignored when it is the first character of a label.
Horizontal Tab	Updates the current pen location to the next tab stop. Stops are located at every eighth column from the carriage-return point. Column positions are equal to the current width of the space character in the active font.
Line Feed	Advances the pen location one line from its current location. A line is defined to be the height of the character cell of the active font.
Carriage Return	Updates the pen location to the carriage-return point.
Shift Out	Selects the designated alternate font for use.
Shift In	Selects the designated standard font for use.
Space	Updates the current pen location one column to the right of the current location. If the current font contains a character definition for the space code, it is printed. Otherwise, it is a nonprinting control code.

Normal mode is the default mode of labeling. Undefined characters for a given character set produce a control code space.

In transparent mode, all character codes within a label are printed using the current font. If a character is not defined or is not present, the device uses a control code space.

Device-Control Instructions

Device-control instructions differ from HP-GL instructions in that they control internal plotter functions. Device-control instructions (DCI's) are not a part of the HP-GL/2 language but are, instead, part of the I/O language. Avoid using DCIs, if possible, in an HP-GL/2 hyperdriver for the following reasons.

- DCI immediate status readback is difficult, if not impossible, in networked environments. Device-control instructions don't enter the plotter's buffer but are processed immediately. (HP-GL/2 instructions enter the buffer and are processed in the order they are received.)
- DCI's cannot be mixed with raster data or with the transparent data (TD) command in HP-GL/2.
- DCI's are not recognized by small format HP-GL/2 plotters (PaintJet XL).

Device Control Instructions

The following table shows which device-control instructions are supported on specific devices. Note that Flare does not support any DCIs.

Device Control Instruction	HP 7600 (240D/E)	Shogun Bunny	DraftMaster SX,RX,MX	Galaxy
ESC.A Output Identification	Yes	Yes	Yes	
ESC.B Output Buffer Space	Yes	Yes	Yes	
ESC.E Output Extended Error	Yes	Yes	Yes	
ESC.H Set Handshake Mode 1	Yes	Yes	Yes	
ESC.I Set Handshake Mode 2	Yes	Yes	Yes	
ESC.J Abort Device Control	Yes	Yes	Yes	

Device Control Instruction	HP 7600 (240D/E)	Shogun Bunny	DraftMaster SX,RX,MX	Galaxy
ESC.K Abort Graphics	Yes	Yes	Yes	
ESC.L Output Buffer Size When Empty	Yes	Yes	Yes	
ESC.M Set Output Mode	Yes	Yes	Yes	
ESC.N Set Extended Output and Handshake Mode	Yes	Yes	Yes	
ESC.O Output Extended Status	Yes	Yes	Yes	
ESC.P Set Handshake Mode	Yes	Yes	Yes	
ESC.R Reset	Yes	Yes	Yes	
ESC.S Output Configurable Memory Size	Yes	Yes	Yes	
ESC.T Allocate Configurable Memory	Yes	Yes*	Yes*	
ESC.U End Flush Mode	No	No	No	
ESC.Y or ESC.(Plotter On	No	No	No	
ESC.Z or ESC.) Plotter Off	No	No	No	
ESC.@ Set Plotter Configuration	Yes	Yes	Yes	

* Use not recommended. Can interfere with spooled plots.

Media and Plotting Area

The tables that follow show the media sizes supported on each product, along with the hard-clip limits and P1 P2 coordinate values, and the maximum plotting area on the media. Values are given for ANSI (American National Standards Institute) and metric media sizes, using normal and expanded margins.

Shogun and Bunny Electrostatic Plotters

Shogun is an E-size only plotter. Bunny has a D-size and an E-size model. Each plotter model handles one size of rollfeed media only.

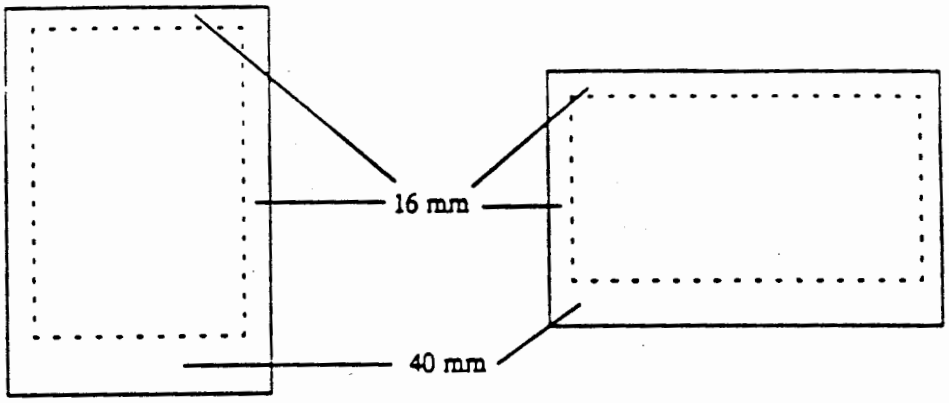
Media Size	Hard-Clip Limits and P1	P2	Maximum Plotting Area (X- and Y-axes)	
	P1X,P1Y	P2X,P2Y	millimetres	inches
D 609 mm (24 in.)	0,0		X 599.4 mm	X 23.60 in.
E 914 mm (36 in.)	0,0		X 895.86 mm	X 35.27 in.

 Preliminary Document: 10-13-89

DraftMaster SX, RX, and MX

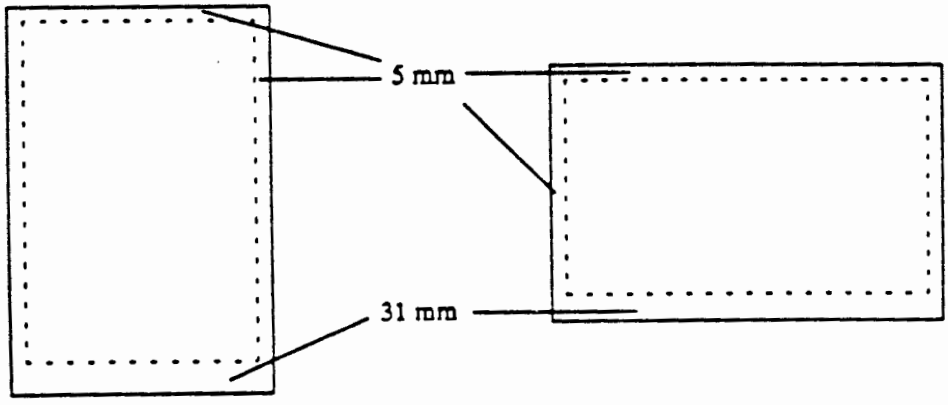
Note that the coordinate system tracks the orientation of the media. The X-axis is always the long side of the media. Note that the DraftMaster SX plotter handles only single sheet media, while both the DraftMaster RX and DraftMaster MX plotters handle rollfeed and single sheet media.

Also note that all sizes have listing for loading the media in the plotter vertically or horizontally. Your plotter may support a media size that can be loaded in only one direction. The examples below show margins as the media is loaded vertically and horizontally into the plotter.



Vertical *Horizontal*

Normal Margins



Vertical *Horizontal*

Expanded Margins

Normal Margins				
Media Size	Hard-Clip Limits and P1	P2	Maximum Plotting Area (X- and Y-axes)	
	P1X,P1Y	P2X,P2Y	millimetres	inches
A (vertical)	0.0	8 936.7 356	223.4 X 183.9 mm	8.80 X 7.24 in.
A (horizontal)	0.0	9 896.6 396	247.4 X 159.9 mm	9.74 X 6.30 in.
B (vertical)	0.0	15 032.9 896	375.8 X 247.4 mm	14.80 X 9.74 in.
C (horizontal)	0.0	21 072.15 032	399.8 X 223.4 mm	20.74 X 14.80 in.
D (vertical)	0.0	32 304.21 072	807.6 X 526.8 mm	31.80 X 20.74 in.
D (horizontal)	0.0	33 264.20 112	831.6 X 502.8 mm	32.74 X 19.80 in.
E (vertical)	0.0	42 464.33 264	1 061.6 X 831.6 mm	41.80 X 32.74 in.
Architectural C (horizontal)	0.0	23 104.16 048	577.6 X 401.2 mm	22.74 X 15.80 in.
Architectural D (vertical)	0.0	34 336.23 104	858.4 X 577.6 mm	33.80 X 22.74 in.
Architectural D (horizontal)	0.0	35 296.22 144	882.4 X 553.6 mm	34.74 X 21.80 in.
Architectural 30 X 42 (vertical)	0.0	40 432.29 200	1 010.8 X 730.0 mm	39.80 X 28.74 in.
Architectural 30 X 42 (horizontal)	0.0	41 392.28 240	1 034.8 X 706.0 mm	40.74 X 27.80 in.
Architectural E (vertical)	0.0	46 528.35 296	1 163.2 X 882.4 mm	45.80 X 34.74 in.
A4 (vertical)	0.0	9 640.7 120	241.0 X 178.0 mm	9.49 X 7.01 in.
A4 (horizontal)	0.0	10 600.6 160	265.0 X 154.0 mm	10.43 X 6.06 in.

Normal Margins				
Media Size	Hard-Clip Limits and P1 / P2		Maximum Plotting Area (X- and Y-axes)	
	P1X,P1Y	P2X,P2Y	millimetres	inches
A3 (vertical)	0,0	14 560,10 600	364.0 X 265.0 mm	14.33 X 10.43 in.
A2 (horizontal)	0,0	22 480,14 560	562.0 X 364.0 mm	22.13 X 14.33 in.
A1 (vertical)	0,0	31 400,22 480	785.0 X 562.0 mm	30.91 X 22.13 in.
A1 (horizontal)	0,0	32 360,21 520	809.0 X 538.0 mm	31.85 X 21.18 in.
A0 (vertical)	0,0	45 320,32 360	1 133.0 X 809.0 mm	44.61 X 31.85 in.

Expanded Margins				
Media Size	Hard-Clip Limits and P1 / P2		Maximum Plotting Area (X- and Y-axes)	
	P1X,P1Y	P2X,P2Y	millimetres	inches
A (vertical)	0,0	9 736,8 236	243.4 X 205.9 mm	9.58 X 8.11 in.
A (horizontal)	0,0	10 776,7 196	179.9 X 269.4 mm	7.08 X 10.61 in.
B (vertical)	0,0	15 832,10 776	395.8 X 269.4 mm	15.58 X 10.61 in.
C (horizontal)	0,0	21 952,15 832	548.8 X 395.8 mm	21.61 X 15.58 in.
D (vertical)	0,0	33 104,21 952	827.6 X 548.8 mm	32.58 X 21.61 in.
D (horizontal)	0,0	34 144,20 912	522.8 X 853.6 mm	20.58 X 33.61 in.
E (vertical)	0,0	43 264,34 144	1 081.6 X 853.6 mm	42.58 X 33.61 in.
Architectural C (horizontal)	0,0	23 984,16 848	599.6 X 421.2 mm	23.60 X 16.58 in.

Expanded Margins				
Media Size	Hard-Clip Limits and P1	P2	Maximum Plotting Area (X- and Y-axes)	
	P1X,P1Y	P2X,P2Y	millimetres	inches
Architectural D (vertical)	0.0	35 136.23 984	878.4 X 599.6 mm	34.58 X 23.61 in.
Architectural D (horizontal)	0.0	36 176.22 944	904.4 X 573.6 mm	35.61 X 22.58 in.
Architectural 30 X 42 (vertical)	0.0	41 232.30 080	1 030.8 X 752.0 mm	40.58 X 29.61 in.
Architectural 30 X 42 (horizontal)	0.0	29 040.42 272	726.0 X 1 056.8 mm	28.58 X 41.61 in.
Architectural E (vertical)	0.0	43 264.33 128	1 081.6 X 828.2 mm	42.58 X 32.61 in.
A4 (vertical)	0.0	10 440.8 000	261.0 X 200.0 mm	10.28 X 7.87 in.
A4 (horizontal)	0.0	11 480.6 960	287.0 X 174.0 mm	11.30 X 6.85 in.
A3 (vertical)	0.0	15 360.11 480	384.0 X 287.0 mm	15.12 X 11.30 in.
A2 (horizontal)	0.0	23 360.15 360	584.0 X 384.0 mm	22.99 X 15.12 in.
A1 (vertical)	0.0	32 200.23 360	805.0 X 584.0 mm	31.69 X 22.99 in.
A1 (horizontal)	0.0	33 240.22 320	831.0 X 558.0 mm	21.97 X 32.72 in.
A0 (vertical)	0.0	46 120.33 240	1 153.0 X 831.0 mm	45.39 X 32.72 in.

Flare

You load media into Flare's media tray vertically; media cannot be loaded in a horizontal orientation.

Normal Margins				
Media Size	Hard-Clip Limits and P1 / P2		Maximum Plotting Area (X- and Y-axes)	
	P1X,P1Y	P2X,P2Y	millimetres	inches
A (vertical)	0.0		X mm	X in.
B (vertical)	0.0		X mm	X in.
A4 (vertical)	0.0		X mm	X in.
A3 (vertical)	0.0		X mm	X in.

Expanded Margins				
Media Size	Hard-Clip Limits and P1 / P2		Maximum Plotting Area (X- and Y-axes)	
	P1X,P1Y	P2X,P2Y	millimetres	inches
A (vertical)	0.0		X mm	X in.
B (vertical)	0.0		X mm	X in.
A4 (vertical)	0.0		X mm	X in.
A3 (vertical)	0.0		X mm	X in.

The HP-GL/2 Reference Guide

This is a preliminary document. Some chapters have not been written, some are still in production. In the copy you have, Chapters 1, 2, 3, and 8 are not included.

The HP-GL/2 Hyperdriver Cookbook

The HP-GL/2 Hyperdriver Cookbook

One of Hewlett-Packard's goals in defining HP-GL/2 as a new graphics standard is to minimize your driver development and testing time. HP-GL/2 plotters will share a consistent, verified command implementation across our product line. As a result, you can now write a single driver, or hyperdriver, that will provide support for all HP-GL/2 pen plotters, color raster plotters, and monochrome raster plotters.

The hyperdriver should be listed in your software as the Hewlett-Packard HP-GL/2 Plotter. If your application/driver requires separate plotter listings, they should be listed as Hewlett-Packard <plotter model> HP-GL/2.

Our primary objectives in working with you to obtain HP-GL/2 drivers are to ensure the following:

- The highest-possible level of plotter functionality is supported on each HP-GL/2 plotter.
- The highest level of software functionality available in your application is ported to the HP-GL/2 plotter via your HP-GL/2 driver(s).

We encourage you to write an HP-GL/2 hyperdriver that supports the highest level of HP-GL/2 plotter functionality that you will be supporting, using the largest set of HP-GL/2 commands/functionality that can be accessed by your software's graphics library. This will result in the best match of functionality between individual software and plotter combinations.

To help ensure the longevity of your HP-GL/2 driver development effort, we will continue to perform rigorous conformance testing to make certain all of our HP-GL/2 plotters adhere to the HP-GL/2 standard.

This document is intended as a supplement to the *HP-GL/2 Reference* and *Comparison* guides. To provide you with the basics to write an efficient driver to support all HP-GL/2 plotters, this document describes only the HP-GL/2 commands necessary for hyperdriver support.

We encourage you to also look through the *HP-GL/2 Reference Guide*, and add support for any other commands that meet the needs of your application. Since all plotters contain both the HP-GL/2 kernel commands and the technical extensions, they are treated as one unit in this document. For specifics on command parameters, refer to the *HP-GL/2 Reference Guide*.

The following model illustrates the groups of HP-GL/2 sequences that should be sent by a hyperdriver.

I	INITIALIZATION
II	PEN/PALETTE DEFINITION
III	THE DATA STREAM
IV	CLOSING SEQUENCE

I. Initialization

The beginning sequence of HP-GL/2 commands will initialize the plotter.

The following HP-GL/2 commands are necessary to initialize the plotter and prepare for the plot data. Parameters are not included.

IMPORTANT

Execute the commands in the order listed below. Otherwise, your hyperdriver may not support future devices.

ESC%-1B Some HP plotters understand both HP-GL/2 and PCL and require this command to insure that the plotter is in standalone HP-GL/2 mode.

☞ **NOTE:** *Do not follow* **ESC%-1B** *with a semicolon.* When this instruction is followed by a semicolon and a BP instruction, the plotter may interpret the semicolon as a complete plot file.■

BP **Begin Plot:** This command tells the plotter that a new picture is coming. BP is necessary to insure that HP-GL/2 plots are written to a clean page. It also insures that plotters with HP-GL/2 and HP-GL emulation are switched to the HP-GL/2 mode.

Extended BP functionality is described in the *HP-GL/2 Reference Guide*.

HP 7600 240D/E: This plotter does not understand BP. It will NOP the command, but if the plot name contains a valid HP-GL command, it will be executed. However, Hewlett-Packard will provide a firmware upgrade kit for the HP 7600 240D/E which adds the new HP-GL/2 commands like BP. The kit will make these plotters fully compatible with the current electrostatic plotters.

IN **Initialize Plotter:** This command initializes the plotter to specific defaults. IN1 overrides the front panel settings with the factory defaults and could affect how a user has set front panel features. We do not recommend using IN1 unless your application requires you to do so.

NOTE: IN1 does not clear the front panel settings, it just overrides them until an IN is received.■

PS **Plot Size:** This command allows you to specify the plot size, including long axis sizes. It is very important for electrostatic plotters as the media will then advance only the size of the page specified when a page advance command is received. This saves considerably on expensive media. This command is also used to specify large plot sizes so you only need to send data once to the plotter to do long axis plotting.

IMPORTANT

When specifying plot size, use the media sizes specified in the *Comparison Guide* for the HP DraftMaster plotter. The HP DraftMaster plotter has larger margins than other HP-GL/2 devices, so these media sizes will fit on all devices. Using larger plot sizes may result in clipped plots on pen plotters.

HP estimates that PS support will save a typical electrostatic plotter user approximately $3000/year in media costs.

Additional commands are used to define plot quality. Although the user can set the quality level using the plotter's front panel (for those devices that have smart front panels), it would be better to provide the capability through software so that the plotter can be used in a networked environment by users with differing needs. These commands include **QL** (Quality Level), **MT** (Media Type), and **VS** (Velocity Control). Refer to the *HP-GL/2 Reference Guide* for more information.

II. Pen/Palette Definition

In order to extend your hyperdriver to raster devices as well as pen plotters, it is necessary to predefine a palette of pen widths and pen colors before beginning the data stream. Once defined, pen colors or widths should not be updated. This is necessary because pen plotters need to receive a different pen number for each different pen color or width desired.

As usual, it's up to the end user to put the desired color and width physical pen in the correct pen plotter carousel position.

Also, in order to support the full range of HP-GL/2 monochrome and color plotters, hyperdrivers need to allow USERS to choose the desired color and width for each pen number used in a drawing.

NP **Number of Pens:** Defines the size of the HP-GL/2 pen palette. Pen attributes (color, width) are defined using the commands described below. The number of pens defined must be a power of two and are numbered beginning with zero, not one.

The maximum number of logical pens in HP-GL/2 pen plotters is 32. However, any logical pen number over 8 modulos back to call one of the 8 physical pens in the carousel.

The number of logical pens in some early models of the HP 7600 240D/E is fixed at 1. However, a firmware upgrade kit for these plotters adds full NP functionality.

PC **Pen Color:** Defines a color for a specific pen. Black and white devices default to 2 pens, 0 and 1 (white and black), color devices default to 8, 0 through 7 (white, black, red, green, yellow, blue, magenta and cyan in that order). This command works with the NP (Number of Pens) command to let you create a palette of pen colors. Monochrome plotters will recognize the PC command and will print lines of varying grayscale depending on the color used to draw lines.

Pen plotters: This command is not recognized. Pens will be selected based on the pen select (**SP**) command only.

Monochrome electrostatic plotters: Drawing screened vectors or raster fills using a non-black pen will produce unpredictable grayscaled results.

HP 7600 240D/E: The PC command is NOP'd. However, the firmware upgrade kit includes the PC command. This allows the plotter to print out colors as grayscales.

PW **Pen Width:** Defines the width of a specific pen. To provide optimum throughput, pen widths should be assigned to individual pens and accessed by selecting a pen (instead of just selecting a width for subsequent vectors). Pen plotters will then select the closest physical pen width to draw lines, minimizing unnecessary re-stroking (which degrades plotter throughput).

Pen Plotters: Pen widths can be assigned to any of the 32 logical pens, but the widths will be stroked out using the 8 physical pens in the carousel. Because stroking is slow, users may disable PW via the plotter's front panel. The plotter will then draw vectors using the physical pen selected, regardless of the specified width.

III. The Data Stream

The key factor in the data stream is maximizing throughput. Using a high-speed interface is just one part of this. Efficient use of HP-GL/2 and compacting vector data is also a significant part of maximizing throughput.

PE **Polyline Encoded:** We cannot stress enough the importance of using the PE command to send vectors to the plotter as well as the use of a high speed interface. Use of PE will significantly reduce the amount of data necessary to create a plot—in many cases by 60-70%. The algorithm for encoding vectors is detailed in the *HP-GL/2 Reference Guide*.

The *HP-GL/2 Reference Guide* describes additional commands you can use in the data stream. The commands that draw arcs (**AA**, **AR**, **AT** and **RT**), are covered in Chapter 5 in the *HP-GL/2 Reference Guide*. Chapter 6 covers circles (**CI**), rectangles (**RA**, **RR**, **EA** and **ER**), pie wedges (**EW** and **WG**) and polygons (**PM**, **FP** and **EP**). Chapter 7 discusses area fills (**AC**, **FT** and **RF**), and line attributes (**LT**, **LA**, **PW**, **WU** and **UL**). Chapter 8 covers font selection (**SS**, **SA**, **SD** and **AD**), character size (**SI** and **SR**), label origin, path and direction (**LO**, **DV**, **DI** and **DR**) as well as the label command itself (**LB**). Chapter 10 discusses screened vectors (**SV**).

IV. Closing HP-GL/2 Sequence

The following commands should be sent *in this order* at the end of the plot. These commands will put the pen away (pen plotters) and begin rasterization on raster plotters or long axis plotting on pen plotters (if the plot fits within the current page on a pen plotter, it will be plotted as the commands are received).

IMPORTANT

Execute the commands in the order listed. Otherwise, your hyperdriver may not support future devices.

PUSP0 **Pen Up, Select Pen 0:** This command raises the pen on pen plotters and puts it away.

PG; **Page Advance:** If the plotter needs to buffer the entire image before plotting, the PG command tells the plotter all the vectors have been received and plotting can begin. When the plot is complete, the page advances to the next page. Unless this command is followed by a replot (RP) command, the semicolon is required.

RPn; **Replot:** This command creates additional (not total) copies from the information in the devices' buffer/disk. This always follows the PG command—and there cannot be any other commands between the PG and RP instructions.

V. General Issues

The following sections describe a variety of issues you should keep in mind or consider when planning and writing your driver.

Throughput Considerations

In environments where background spooling does not occur, a user must wait until all the HP-GL/2 data is sent to the plotter before getting both his plot as well as his computer back. Even though the plotters have 1mb buffers or 20–40mb hard disk drives, efficient HP-GL/2 drivers will minimize computer lockout. You can create efficient drivers by doing the following.

- Use the PE command to compact coordinates.
- Eliminate unnecessary command terminators (semicolons). The only necessary semicolon is after the last command (either PG or RP).
- Support high-speed interfaces (Centronics, HP-IB or RS-232 at 9600, 19.2K, and 38.4K baud).
- Provide pen sorting for pen plotters.
- Provide geographic sorting for pen plotters.

Plotter Output Commands

It is recommended that drivers do not interrogate the plotter for information. With a driver that only sends instructions to the plotter, applications can easily support a plotter on a network. But, if information is requested from the plotter, network and Centronics interface support becomes difficult, if not impossible.

HP-GL/2 devices all have their origin (0,0) in the lower left (P1) corner. If the application/driver lets the user specify plot size, the upper right corner can be easily computed. If the user specifies plot size in inches, the driver would multiply the size by 1016. If specified in mm, multiply by 40. Then use the plot size (PS) instruction to conserve paper (particularly on electrostatic plotters).

If your application allows the user to digitize from the plotter, note that this feature only works with pen plotters.

Aborted Plots

If you allow the user to abort a plot through your software driver, it is important that you complete the data to the plotter in such a way that the plotter is ready to receive data for a new or corrected plot.

To complete the plot information, send a semicolon (";"). This terminates your plot. The next BP instruction received by your plotter will erase the data on electrostatic plotters and advance the dirty page on pen plotters.

Device-Control Instructions

Device-control instructions (DCI's) are not a part of the HP-GL/2 language but are, instead, part of the I/O language. HP-GL/2 hyperdrivers should avoid DCI's if possible because of the following.

- DCI immediate status readback is difficult, if not impossible, in networked environments.
- DCI's cannot be mixed with raster data or with the transparent data (TD) command in HP-GL/2.
- DCI's are not recognized by small format HP-GL/2 plotters (PaintJet XL).

Since all HP-GL/2 devices use the same default Xon/Xoff handshaking, DCI's will not be necessary in most cases. The default RS-232/422 configuration for all HP-GL/2 plotters is:

Handshake:	Xon/Xoff
Xon character:	decimal 17
Xoff character:	decimal 19
Xoff threshold level:	80 bytes

Output parameters:

Output terminator character:	decimal 13 (carriage return)
Output trigger character:	none
Output initiator character:	none
Turn around delay:	none
Intercharacter delay:	none

Hewlett-Packard recognizes that in some case, these defaults will not meet the need of a particular system, and DCI's will be necessary for applications running on these systems. Note that enabling DCI's disables raster input automatically since it is impossible to differentiate raster information from DCI data.

Rate Your Driver

Use the following scorecard to evaluate the success of your driver. A minimum score of 80 will guarantee that your driver will perform on all current HP-GL/2 plotters as well as future HP-GL/2 devices.

Functionality	HP-GL/2 Commands	Supported (Yes/No)	Value	Your Score
Vector data compaction	PE	Y / N	20	
Driver listed as HP-GL/2		Y / N	10	
Correct initialization and closing sequences	ESC%-1B,BP,IN PUSP0PG;	Y / N	10	
Establishes plot size	PS	Y / N	10	
Supports pen palette	NP	Y / N	10	
Supports pen widths	PW	Y / N	10	
Supports pen colors	PC	Y / N	10	
Supports long-axis plotting	PS (or FR)	Y / N	2	
Supports hardware area fill	PM,FP,FT[1]	Y / N	2	
Supports replotting	RP	Y / N	2	
Supports hardware labeling	LB[2]	Y / N	2	
Supports arcs and circles	AA,AR,AT,CI,RT[3]	Y / N	2	
Supports hardware line types	LT	Y / N	2	
Supports screened lines	SV	Y / N	2	
Supports aligning preprinted media	DP, OD	Y / N	1	
Supports draft mode plotting	QL	Y / N	1	
Supports media type or velocity control	MT,VS	Y / N	1	
Supports multiple line joins and caps	LA	Y / N	1	
Supports merge and overlay modes	MC	Y / N	1	
Supports transparent layer selection	TD	Y / N	1	
			Total Driver Score	

1 You may also want to support rectangle and wedge commands.
2 This includes related commands for font selection, sizing, placement, and rotation.
3 Choose the arc commands that apply.

Additional HP-GL/2 Technical Documentation and Support Services

The HP-GL/2 Reference Guide: A device-independent reference guide containing command parameter, syntax, and usage information.

The HP-GL/2 Comparison Guide: A multiproduct-specific guide providing information on media sizes supported, P1/P2 limits, hard-clip limits, instructions supported and language implementation differences, if they exist.

On-line Technical Support: As always, you can give us a call at (619) 592–4697.

Modifying Your Hyperdriver for HP LaserJet III

The following procedures show you how to modify your hyperdriver so that an HP LaserJet III printer is treated like a standalone HP-GL/2 device.

Quick Modification

- Reset HP LaserJet III using the following instruction.

  ESCE

- Change the orientation from portrait to (reverse) landscape using the following instruction.

  ESC&l3O

  This defaults your printing region to 10 X 7.5 inches. Refer to your HP LaserJet III documentation for ways to increase/decrease that area.

- Then follows your hyperdriver instructions that begin with **ESC**%-1B to enter HP-GL/2 mode.

  NOTE: The first hyperdriver move must be in absolute coordinates. Until this happens, HP LaserJet III does not know where the current pen location is.■

- Remove any instructions in the Technical Graphics Extension.

  HP LaserJet III NOPs all instructions in the HP-GL/2 Technical Graphics Extension. Therefore, it will not respond to any output instructions.

- Add the Enter PCL Mode to your closing sequence, then follow this with a reset instruction (which ejects the printed page). HP LaserJet III ignores both the HP-GL/2 PG (Advance Full Page) and RP (Replot) instructions.

  The Enter PCL Mode instruction is:

  ESC%1A

  and the reset instruction is:

  ESCE

Modification to Maximize Plotting Area

This set of instructions will set up the HP LaserJet III so that it uses the maximum plotting area. The examples in this sequence show the appropriate parameter values for an A-size sheet of paper.

- Reset HP LaserJet III using the following instruction.

  ESCE

- Set the paper size. (The following sets the paper size to "A;" refer to your HP LaserJet III Printer User's Manual for more information on paper sizes.)

  ESC&l2A

- Change the orientation from portrait to (reverse) landscape using the following instruction.

  ESC&l3O

  This defaults your printing region to 10 X 7.5 inches. Refer to your HP LaserJet III documentation for ways to increase/decrease that area.

- Set the top margin to zero.

  ESC&l0E

- Move CAP to the first dot row.

  ESC*p50Y

- Set anchor point to CAP.

  ESC*c0T

- Set the picture frame height. In the following example, the "5880" will change depending on the frame height you want. The maximum plotting area on the HP LaserJet III for a A-size sheet of paper is 10 750 × 8 300 plotter units.

  ESC*c5880Y

- Then follows your hyperdriver instructions that begin with **ESC**%-1B to enter HP-GL/2 mode. Return to the instructions on the previous page for the closing sequences.

HP-GL/2

Driver Development Guide

Version 2.0
7/20/92

HP-GL/2 Driver Development Guide

One of Hewlett-Packard's goals in defining HP-GL/2 as a new graphics standard is to minimize your driver development and testing time. HP-GL/2 plotters will share a consistent verified command implementation across our product line. As a result, you can now write a single driver, that will provide support for all HP-GL/2 pen plotters, color raster plotters, and monochrome raster plotters.

The driver should be listed in your software as the Hewlett-Packard HP-GL/2 Plotter. If your application/driver requires separate plotter listings, they should be listed as Hewlett-Packard <plotter model> HP-GL/2.

Our primary objectives in working with you to obtain HP-GL/2 drivers are to ensure the following:

* The highest possible level of plotter functionality is supported on each HP-GL/2 plotter.

* The highest level of software functionality available in your application is ported to the HP-GL/2 plotter via your HP-GL/2 driver(s).

We encourage you to write an HP-GL/2 driver that supports the highest level of HP-GL/2 plotter functionality that you will be supporting, using the largest set of HP-GL/2 commands/functionality that can be accessed by your software's graphics library. This will result in the best match of functionality between individual software and plotter combinations.

To help ensure the longevity of your HP-GL/2 driver development effort, we will continue to perform rigorous conformance testing to make certain all of our HP-GL/2 plotters. This document is intended as a supplement to the HP-GL/2 Reference and Comparison Guides. To provide you with the basics to write an efficient driver to support all HP-GL/2 plotters this document describes only theHP-GL/2 commands necessary for developing a single driver.

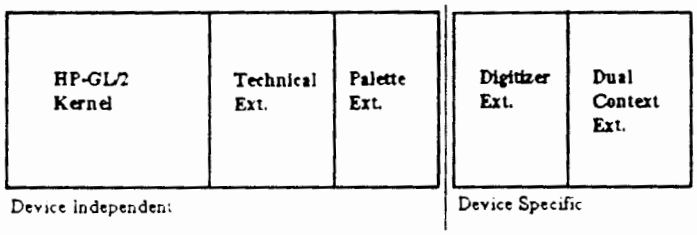
We encourage you to also look through the HP-GL/2 Reference Guide, and add support for any other commands that meet the needs of your application. For specifics on command parameters, refer to the HP-GL/2 Reference Guide.

HP-GL/2 Overview

HP-GL/2 is designed to provide consistent functionality that can be supported across a wide range of peripherals, reducing driver development efforts.

HP-GL/2 is made up of a core set of instructions (kernel) and several extensions. All devices support the HP-GL/2 kernel. Most devices will also support the Technical and Palette extensions.

HP-GL/2 Language Architecture



HP-GL/2 Driver Model

The following model illustrates the groups of HP-GL/2 sequences that should be sent by the HP-GL/2 driver.

I INITIALIZATION

II PEN PALETTE DEFINITION

III PLOT DATA STREAM

IV CLOSING SEQUENCE

I. Initialization

The following commands should be sent at the beginning of the HP-GL/2 plot.

Enter HP-GL/2 Mode: **<esc>%#B**

This command causes the device to begin interpreting incoming data as HP-GL/2 commands. There are two options to enter HP-GL/2 mode:

<esc>%-1B - enter HP-GL/2 mode as a stand-alone plotter

<esc>%0B - enter HP-GL/2 mode for merged vector and raster plotting

Begin Plot: **BP***kind,value*;

This command tells the plotter that a new picture is coming. BP is necessary to insure that HP-GL/2 plots are written to a clean page. It also insures that plotters with HP-GL/2 and HP-GL emulation are switched to the HP-GL/2 mode.

Extended BP functionality is described in the HP-GL/2 Reference Guide.

Initialize Plotter: **IN**;

This command initializes the plotter to specific plotter defaults.

Plot Size: **PS***length,width*;

The PS command sets the hard-clip limits using the specified length and width, including long-axis plots. It is strongly recommended to specify both plot length and width with the PS command. It is important for plotters with plot nesting capability to be able to determine the plot size with the PS command.

It is also important for roll feed plotters as the media will then advance only the size of the page specified.

Recommended Initialization strings:

Stand-alone HP-GL/2: **<esc>%-1BBPINPS***length,width*;

Merged vector and raster: **<esc>%0BBPINPS***length,width*;

Other Plotter Initialization Commands

Line Attribute: **LA***kind,value...*;

The LA command specifies how line ends and joins are physically shaped. This command is strongly recommended to use in your HP-GL/2 driver.

The recommended setting is rounded for both line attributes: **LA1,4,2,4;**

Quality Level: **QL***value*;

Sets 'draft', 'final', or 'enhanced' mode for plotter output. A plotter with two or more levels will support at least 0 and 100 and map any other value to one of the supported values.

Recommended QL values:

For a default mode, send a ***QL;*** to allow front panel selection of print quality mode.

Three Modes

QL0; - Draft mode
QL50; - Final mode
QL100; - Enhanced mode

Two Modes

QL0; - Draft mode
QL100; - Final mode

Merge Control: **MC***mode*;

This command provides control over the color of two or more objects intersecting on the page.

MC0; - Merge off, source overwites destination
MC1; - Merge on, color merged at intersection

Sample HP-GL/2 command string using these initialization commands:

LA1,4,2,4QL100MC1 ... - Rounded ends/joins, final/enhanced mode, merge on

II. Pen/Palette Definition

In order to extend your HP-GL/2 driver to raster devices as well as pen plotters, it is necessary to predefine a palette of pen widths and pen colors before beginning the plot data stream. Once defined, pen colors or widths should not be updated. This is necessary because pen plotters need to receive a different pen number for each different pen color or width desired.

Also, in order to support the full range of HP-GL/2 monochrome and color plotters, HP-GL/2 drivers need to allow USERS to choose the desired color and width for each pen number used in a drawing.

Number of Pens: **NP***n*;

Defines the size of the HP-GL/2 pen palette, up to 256 pens are supported. Pen attributes (color, width) are defined using the commands described below. The number of pens defined must be a power of two and are numbered beginning with zero, not one. Example: NP4 means pens 0 to 3.

Pen Color: **PC***pen,red,green,blue*;

This command works with the NP (Number of Pens) command to let you create a palette of pen colors. Monochrome plotters will recognize the PC command and will plot lines of varying grayscale depending on the color used to draw lines.

Pen Width: **PW***width,pen*;

Defines the width of a specific pen. To provide optimum throughput, pen widths should be assigned to individual pens and accessed by selecting a pen (instead of just selecting a width for subsequent vectors). Pen plotters will then select the closest physical pen width to draw lines, minimizing unnecessary re-stroking (which degrades plotter throughput.)

Because stroking is slow, pen plotter users may disable PW via the plotter's front panel. The plotter will then draw vectors using the physical pen selected, regardless of the specified width.

Sample HP-GL/2 command sequence for pen palette definition:

NP4PC0,255,0,255PC1,0,0,0;
PC2,255,0,0PC30,255,0;
PW0.20,1PW0.30,2PW0.40,3;

III. Plot Data Stream

The key factor in the plot data stream is maximizing throughput. Efficient use of HP-GL/2 and compacting vector data is a significant part of maximizing throughput.

Polyline Encoded: **PE***<compacted data>*;

Use of PE will significantly reduce the amount of data necessary to create a plot - in most cases by 50-80%. The PE command incorporates the most commonly used commands to draw vectors (PA, PR, PU, and PD) into an encrypted format that substantially decreases the size of the HP-GL/2 plot file and the time required for data transmission.

Plot data are encoded into a base 64 or base 32. The algorithm for encoding plot data is detailed in the HP-GL/2 Reference Guide.

Select Pen: **SP***pen*;

Selects the plotter's physical or logical pen for subsequent plotting.

Complex Objects

HP-GL/2 provides additional commands to draw complex objects such as:

Polygons	- PM, FP, EP commands
Arcs/Circles	- AA, AR, CI commands
Rectangles	- RA, RR commands
Area fills	- FT, RF commands
Text/Labels	- LB, SD, AD, commands

For detailed description of these commands, please refer to the HP-GL/2 Reference Guide.

IV. Closing HP-GL/2 Sequence

The following commands should be sent at the end of the plot. These commands will put the pen away (pen plotters) and begin rasterization on raster plotters or long axis plotting on pen plotters (if the plot fits within the current page on a pen plotter it will be plotted as the commands are received).

Store Pen: **PUSP0**

This command raises the pen on pen plotters and puts it away.

Page Advance: **PG**;

Terminates the plot file and instruct the plotter to begin plotting or advance the page.

Replot: **RP***n*;

This command creates additional (not total) copies from the information in the devices' buffer/disk. This always follows the PG command - and there cannot be any other commands between the PG and RP instructions.

Recommended closing sequence:

Single plot	- **PUSP0PG;**
Multiple copies	- **PUSP0RP***n*;

Sample HP-GL/2 plot file:

```
<esc>%-1BBPINPS10160,8116;          - Initialize plot
LA1,4,2,4QL100MC1;                  - Set Line attribute, Quality level, Merge Mode
NP4PC0,255,0,255PC1,0,0,0;          - Define pen palette of 4 pens (0-3), pen 0 = white
PC2,255,0,0PC3,0,255,0;               pen 1 = black, pen 2 = red, pen 3 = green
PW0.20,1PW0.30,2PW0.40,3;           - Set PW, pen 1 = 0.20, pen 2 = 0.30, pen 3 = 0.40
SP1PE<...data...>;
SP2PE<...data...>;                  - Plot data using pens 1 to 3
SP3PE<...data...>;
PUSP0PG;                            - Terminate plot, advance page
```

V. General Issues

The following sections describe a variety of issues you should keep in mind or consider when planning and writing your driver.

Throughput Considerations

In environments where background spooling does not occur, a user must wait until all the HP-GL/2 data is sent to the plotter before getting both the plot as well as the computer back. Even though the plotters have 1 MB or 20-40 MB buffers, efficient HP-GL/2 drivers will minimize computer lockout. You can create an efficient driver by doing the following:

* Use the PE command to compact plot data.

* Eliminate unnecessary command terminators (semicolons). The only necessary semicolon is after a PE command and the last HP-GL/2 command (either PG or RP).

* Support high-speed interfaces (Parallel, HP-IB, or RS-232 at 19.2K or 38.4K baud).

Plotter Output Commands

It is recommended that HP-GL/2 drivers do not interrogate the plotter for information. With a driver that only sends instructions to the plotter, applications can easily support a plotter on a network. But, if information is requested from the plotter, network and Centronics interface support becomes difficult, if not impossible.

Hard-clip Limits

The default orientation is landscape. HP-GL/2 devices all have their origin (0,0) in the lower left (P1) corner. If the application /driver lets the user specify plot size, the upper right corner can be easily computed. If the user specifies plot size in inches, the driver would multiply the size by 1016. If specified in mm, multiply by 40. Then use the PS instruction to specify the plot size.

Graceful NOPs

The following commands are NOPed (No Operation) by these HP-GL/2 plotters.

HP LaserJet III: Tech. ext. commands, PG, RP, CR, PC, VS, BZ, BR

HP DraftMaster: CF, MC, CR, PC, SV, TR, BZ, BR

HP DesignJet: MG, NR, ST, VS, MT, BZ, BR

HP PaintJet XL: EC, MG, ST, VS, BZ, BR

Plotter Margins:

Plotter margin varies from one plotter to another.

Normal margins

HP DraftMaster - 16mm (top and sides), 40mm (bottom)
HP DesignJet - 5mm (sides), 17mm (top and bottom)
HP DesignJet 600 - 5mm (sides), 17mm (top and bottom)

Expanded margins

HP DraftMaster - 5mm (top and sides), 31mm (bottom)
HP DesignJet 600 - 5mm (sides), 10mm (top and bottom)

Aborted Plots

If you allow the user to abort a plot through your software driver, it is important that you complete the data to the plotter in such a way that the plotter is ready to receive data for a new or corrected plot.

Send the string '<etx>;' to terminate an aborted plot. This prevents the next plot to be overlayed on the aborted plot. The "<etx>;" string terminates the PE and/or the LB (Label) command.

Line Attribute/Pen Widths

In HP-GL/2, the default line join is mitered. A mitered join may cause a problem when using pen widths (PW) of 0.60 mm and greater. The result is an extended (pointed) cap at the join.

To resolve this problem, use the Line Attribute (LA) command to control the line ends and joins. The recommended value is rounded for both line attribute.

Recommended HP-GL/2 command sequence: LA1,4,2,4;

HP LaserJet III

The following commands allows you to support the HP LaserJet III printer as an HP-GL/2 device. Refer to the HP LaserJet III Technical manual for details.

<esc>E - Reset printer
<esc>&l3O - Change orientation from portrait to (reverse) landscape

[... HP-GL/2 data beginning with the <esc>%-1B ...]

<esc>E - Reset, advance page

Additional HP-GL/2 Technical Documentation and Support Services

The HP-GL/2 Reference Guide: A device-independent reference guide containing command parameter, syntax, and usage information.

The HP-GL/2 Product Comparison Guide: A multiproduct-specific guide providing information on media sizes supported, P1/P2 limits, hard-clip limits, instructions supported and language implementation differences, if they exist.

On-line Technical Support: As always, you can give us a call at (619) 592-4697.

HP-GL vs HP-GL/2 Language Comparison Guide

Rev 1.0

HP-GL vs HP-GL/2 Language Comparison Guide

This document provides comparative language information to aid you in converting your existing HP-GL language drivers into a single, HP-GL/2 hyperdriver that will support all HP-GL/2 language plotters. The goal is to show you the similarities and differences between the two vector languages.

There are over 25 different implementations of HP-GL. The differences in implementations include:

- The number of commands supported by each plotter.
- Parameter ranges supported by each plotter.
- Placement of the 0,0 origin.
  Small format plotters place the origin at the lower left.
  Large format plotters place the origin in the center of the page.
- Positioning of P1/P2 in relationship to the hard-clip limits.

HP-GL/2 is a standard vector graphics language with a common implementation across all HP-GL/2 language products. Implementation on HP-GL/2 devices includes:

- A set of 86 commands supported or gracefully defaulted by *all* HP-GL/2 devices.
- Consistent parameter ranges and functionality.
- The 0,0 origin is in the lower left corner for all devices.

The family of HP-GL language plotters include the HP 7220, HP 7470, HP 7475, HP 7550, HP 7580, HP 7585, HP7586, HP ColorPro, HP DraftPro, HP DraftPro DXL/EXL, and, HP DraftMaster I/II. Refer to the *HP-GL Product Comparison Guide* (P/N (11)5954-7124) for a complete listing of commands and their parameter ranges supported by each of these plotters.

The HP family of HP-GL/2 language plotters include the HP 7550 Plus, HP PaintJet XL with the HP-GL/2 language cartridge, HP DraftMaster SX/RX/MX, HP DraftMaster SX/RX/MX Plus, the HP DesignJet, and the HP 7600 Models 240D/240E/250/255/355 plotters. In addition, HP-GL/2 is a part of the PCL 5 printer language in the HP LaserJet III family. Refer to the *HP-GL/2 Product Comparison Guide* for information on which language extensions are supported by each HP-GL/2 device as well as information on device specific implementations of some commands.

The following charts list all the HP-GL/2 commands, their corresponding HP-GL commands, HP-GL commands dropped from the HP-GL/2 language, and notes areas of major differences. HP-GL/2 was created from HP-GL, it is not a subset or a superset, rather it is a bit of both. The commands are listed in the order and grouping you will find in the *HP-GL/2 Reference Guide*. The grayed commands are former HP-GL commands that are not included in HP-GL/2. Refer to the *Hyperdriver Cookbook* and *The HP-GL/2 Reference Guide* (P/N 5959-9733) when you write your HP-GL/2 hyperdriver.

HP-GL/2 Kernel

The kernel is the foundation of the HP-GL/2 language and contains most of the instructions. All HP-GL/2 devices support the kernel instructions. The kernel instructions are divided into five functional groups: configuration and status, vector, polygon, line and fill attributes, and character.

The Configuration and Status Group Instructions

The instructions in this group help you set up your plot be reestablishing default conditions, scaling and manipulating the plotting area (through soft-clip limits and rotation). This group contains no graphics instructions but does set up your plotting area for the graphics information it is about to receive.

HP-GL/2	HP-GL	Function	Comments
	AF	Advance full page	*Removed.* Provided redundant functionality. Use the PG command to advance the page.
	AH	Advance half page	*Removed.* Use the PS command to define the actual page size. PG will cause the media to advance just the length of the defined page.
	AP	Automatic pen operations	*Removed.* Functionality no longer required.
	AS	Select pen acceleration	*Removed.* Functionality no longer required.
	BF	Buffer plot	*Removed.* Functionality no longer required.
DF	DF	Default values	
	FS	Select tip force for pen	*Removed.* Functionality provided by the pen carousel or via the plotter front panel.
	GC	Set count number	*Removed.* Functionality provided by the plotter front panel.
	GM	Graphics memory configuration	*Removed.* All HP-GL/2 plotters support a single standard minimum memory configuration - this functionality no longer required.
IN	IN	Initialize	In HP-GL mode, the IN instruction placed P1/P2 to default *inside* the hardclip limits. In HP-GL/2 mode, the IN instruction places P1/P2 at the hardclip limits.
	IM	Input mask	*Removed.* Functionality no longer required.
IP	IP	Input P1 and P2	
IR		Input Relative P1 and P2	*New.* Provides support for device independent scaling.
IW	IW	Input Window	
	KY	Assign function to key	*Removed.* Functionality does not exist in HP-GL/2 plotters.
	OF	Output factors	*Removed.* All HP-GL/2 plotters plot with 40 plotter units to the millimeter - functionality no longer required.
	OG	Output count number and escape status	*Removed.* Associated with pen grouping, a function now available through the plotter's front panel.
	OK	Output function key	*Removed.* Associated with KY and now unnecessary.

	OO	Output options	*Removed.* The HP-GL/2 kernel guarantees a standard implementation so it is not necessary to know what command features a plotter has.
	OT	Output carousel status	*Removed.* Was used to provide info about the pen type in the plotter's carousel. Functionality now through carousel setting.
PG	PG	Advance full page	
RO	RO	Rotate coordinate system	In HP-GL/2 mode, rotations of 180 and 270 degrees were added.
RP	RP	Replot	
SC	SC	Scale	In HP-GL/2 mode, a point factor scaling option has been added.
	SG	Select pen group	*Removed.* Associated with pen grouping which is now performed through the plotter's front panel.

The Vector Group

The instructions in this group enable you to draw vector graphics (lines and arcs) using either absolute or relative coordinates.

HP-GL/2	HP-GL	Function	Comments
AA	AA	Arc absolute	
AR	AR	Arc relative	
AT		Arc absolute three point	*New.* Allows arc definition through three points.
CI	CI	Circle	
	CV	Enables curved line generator for delay	*Removed.* Functionality no longer required.
PA	PA	Plot absolute	
PD	PD	Pen down	
PE		Polyline encoded	*New.* The most important HP-GL command for improving data transfer throughput.
PR	PR	Plot relative	
PU	PU	Pen up	
RT		Relative arc three point	*New.* Provides relative three point arc capability.
	TL	Set tick length	*Removed.* This functionality is better done by a software subroutine using moves and draws.
	VA	Activate adaptive velocity	*Removed.* Only in the early HP 9872A's - this function is no longer required.
	VN	Reactivate normal velocity	*Removed.* See above.

	WD	Write to display	*Removed.* Associated with KY. Functionality no longer required.
	XT	Draw x-axis tick	*Removed.* See TL above.
	YT	Draw y-axis tick	*Removed.* See TL above.

The Polygon Group

The instructions in this group use the polygon buffer in your HP-GL/2 device. Some of the instructions draw shapes while others act on the contents of the polygon buffer (filling or edging).

Note: All HP-GL/2 devices can support a polygon with 512 vertices - the maximum number of vertices is device dependent.

HP-GL/2	HP-GL	Function	Comments
EA	EA	Edge rectangle absolute	
ER	ER	Edge rectangle relative	
EW	EW	Edge wedge	
EP	EP	Edge polygon	
FP	FP	Fill polygon	
PM	PM	Polygon mode	
RA	RA	Fill rectangle absolute	
RR	RR	Fill rectangle relative	
WG	WG	Fill wedge	

The Line and Fill Attributes Group

The instructions in this group enable you to enhance your plots through the use of different line and fill types. You can manipulate area fill patterns and specify varying widths for different pens.

HP-GL/2	HP-GL	Function	Comments
AC		Anchor corner	*New.* Positions the starting point of any fill pattern.
FT	FT	Fill type	Additional fill types, including raster fill, have been added.
LA		Line attributes	*New.* Specifies how line ends and joins are physically shaped.
LT	LT	Line type	In HP-GL/2, more line types are available and an additional parameter has been added to specify how the pattern length is interpreted (% of P1/P2 or millimeters).
	PT	Pen thickness	*Removed.* Use the PW command to set the pen thickness. The plotter will adjust area fills according to the thickness of the current pen.
PW		Pen width	*New.* Defines the pen width.
RF		Raster fill definition	*New.* Defines a raster pattern for use with area fills and screened lines.
SM	SM	Symbol mode	
SP	SP	Select pen	
	UF	Create user-defined fill type	*Removed.* Replaced by the RF command which provides greater functionality.
UL		User-defined line type	*New.* Creates line types by specifying gap patterns.
WU		Pen width unit selection	*New.* Specifies whether the pen width is expressed in millimeters or as a percentage of the P1/P2 distance.

The Character Group

The instructions in this group enable you to select different fonts or character sets and manipulate their direction, size, and appearance.

HP-GL/2	HP-GL	Function	Comments
AD		Alternate font definition	*New.* Replaces the HP-GL command CA. Provides greater character set/font definition capabilities.
	CA	Designate alternate character set	*Removed.* Use the AD command which provides increased functionality.
CF		Character fill mode	*New.* Specifies the way outline fonts will be rendered. NOP'd by plotters that do not support outline fonts (currently all plotters).
	CM	Character selection mode	*Removed.* Functionality available with the AD/SD commands.
CP	CP	Character plot	
	CS	Designate character set	*Removed.* Use the SD command with increased functionality instead.
DI	DI	Absolute direction	
*	DL	Define downloadable character	Now part of the technical extension group of HP-GL/2 commands.
DR	DR	Relative direction	
	DS	Designate character set into slot	*Removed.* Functionality available with the AD/SD commands.
DT	DT	Define label terminator	Additional functionality added to make terminator printing or non-printing.
DV	DV	Define variable text path	Increased functionality to add all orthogonal directions (i.e., 90, 180, and 270 degrees).
ES	ES	Extra space	
	IC	Input character for sizing with OB instruction	*Removed.* Use the DV command to stack characters.
	IV	Invoke slot into character table	*Removed.* Functionality available with the AD/SD commands.
LB	LB	Label	
LO	LO	Label origin	
	OB	Output box dimensions of character from IC	*Removed.* Use the functionality of the DV command.
*	OL	Output length of buffered label	*Removed.* Functionality rarely used.
	PB	Plot label from buffer	*Removed.* Functionality rarely used.
SA	SA	Select alternate font	

SD		Standard font definition	*New.* Replaces HP-GL CS command and provides greater functionality.
SI	SI	Absolute character size	
SL	SL	Character slant	
SR	SR	Relative character size	
SS	SS	Select standard font	
TD		Transparent data	*New.* Defines how control characters are to be handled by the plotter.
	UC	Plot user defined character	*Removed.* Use the DL command.

HP-GL/2 Technical Graphics Extension

The instructions in this extension add flexibility often required in technical fields such as CAD, architectural rendering, IC layout, etc. All HP-GL/2 devices support the Technical Graphics Extension (though it may not be supported on devices for which HP-GL/2 is an option).

Technical Graphics Extension Instructions

HP-GL/2	HP-GL	Function	Comments
BP		Begin plot	*New.* Indicates the beginning of a new plot.
CT	CT	Chord tolerance mode	
DL	DL	Download character	
EC	EC	Enable cutter	
FR	FR	Frame advance	Use the PS command to define your long axis page size. The plotter will automatically perform the frame-to-framing for you. Use FR if a long-axis plot might exceed the 1MB buffer on the DraftMaster RX and RX Plus.
MC		Merge control	*New.* Defines how overlapping color pixels are to be plotted.
MG	MG	Message	
MT		Media type	*New.* Indicates the type of media in the plotter.
NR	NR	Not ready	*Modified.* A timeout parameter has been added.
OE	OE	Output error	
OH	OH	Output hard-clip limits	
OI	OI	Output identification	
OP	OP	Output P1 and P2	
OS	OS	Output status	
PS	PS	Plot size	*Modified.* Defines the hardclip limits. Some HP-GL language plotters defined PS as page size, some as page length and width. The HP-GL/2 devices only support length and width.
QL		Quality level	*New.* Sets "draft" or "final" mode.
ST		Sort	*New.* Specifies how the plotter sorts vectors for plotting.
VS	VS	Velocity select	

HP-GL/2 Palette Extension

The instructions in this extension help maximize raster technology. However, this extension is not limited to HP-GL/2 raster devices. Pen plotters may support this extension and default some instructions in accordance with pen plotter technology.

Palette Extension Instructions

HP-GL/2	HP-GL	Function	Comments
CR		Set color range for relative color data	*New.* Establishes the range for RGB color data.
NP		Number of pens	*New.* Establishes the size of the HP-GL/2 palette.
PC		Pen color assignment	*New.* Assigns a color (based on RGB values) to a specific pen.
SV		Screened vector	*New.* Defines the type of screening applied to vectors.
TR		Transparency mode	*New.* Defines how the color white is plotted.

HP-GL/2 Dual-Context Extension

The instructions in this extension help satisfy desktop presentation requirements, specifically the merging of word-processed text and raster graphics images with vector graphics images.

Dual-Context Extension Instructions

HP-GL/2	HP-GL	Function	Comments
Esc%#A		Enter PCL mode	*New.* Instructs the device to interpret subsequent instructions as PCL commands.
EscE		Reset	*New.* Restores the raster device to certain defaults.
FI		Primary font selection by ID	*New.* Designates a font as primary.
FN		Secondary font selection by ID	*New.* Designates a font as secondary.
SB		Scalable or bitmap fonts	*New.* Specifies the type of font that may be used in labeling.

HP-GL/2 Digitizing Extension

The instructions in this group can be used on pen plotters only. Raster devices are incapable of digitizing an image.

Digitizing Extension Instructions

HP-GL/2	HP-GL	Function	Comments
DC	DC	Digitize clear	
DP	DP	Digitize point	
	OA	Output actual position and pen status	*Removed.* Must use the digitizing process to determine the actual pen position.
	OC	Output commanded position and pen status	*Removed.* See above.
OD	OD	Output digitized point and pen status