

Enhancements and Changes for Version 6 SAS/GRAPH® Software

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ABSTRACT

Users of Version 6 SAS/GRAPH® software will find that programs written for Version 5 applications on other systems will run in Version 6 with little or no modification. However, a number of new features have been implemented for Version 6 that give users new capabilities while retaining upward compatibility with Version 5. This paper discusses some of these new features.

INTRODUCTION

Some of the major features that have been added to Version 6 SAS/GRAPH software for personal computers and UNIX® operating systems and derivatives include

- new device drivers
- new fonts
- new graphics options
- ability to use multiple hardware fonts on a single graph
- new map data sets
- new features in the GFONT procedure
- new ways to direct output to devices and files
- ability to modify device driver attributes using device catalogs
- the GDEVICE procedure, a new procedure that can be used to manage device catalogs
- ability to display host graphics on devices attached to your PC using the SAS® micro-to-host link.

This paper gives details on each of these new features.

NEW DEVICE DRIVERS

Except for some system-specific devices (such as the IBM® 3287 printer or Data General terminals), almost all devices supported in Version 5 SAS/GRAPH software are supported in Version 6. In addition, several new devices are supported in Version 6. These include PC display adapters, laser printers, dot matrix printers, and ink jet printers.

Display Adapters

Drivers are available for most common PC graphics display adapters, including CGA, EGA and Hercules™ Displays on the AT&T 6300, COMPAQ® III and IV, and IBM 3270 personal computers are also supported. For most of these devices, a range of drivers is available, with the choice based on the available memory on the adapter, the type of monitor being used, resolution, and colors.

In addition to the above devices, drivers are available for the Vectrix™ VX/PC adapter and the Tektronix® PC4100 system. Graphics output can also be displayed on the IBM PS/2, but the drivers in Release 6.03 use only EGA resolution and colors.

Laser Printers

Several laser printers are supported for the first time in Version 6. New drivers include those for the Hewlett-Packard® LaserJet, Imagen™ 2308, Apple® LaserWriter, and Xerox® 4045, as well as a driver for PostScript® devices. Laser printers that have been supported in previous versions of SAS/GRAPH software and are also supported for Version 6 include most QMS® models, Xerox 2700 and 3700, and Digital™ LN01 (Tektronix 4014 emulation).

Dot Matrix Printers

Several dot matrix printers are supported for the first time in Version 6. These include Epson® FX and LQ models, the IBM graphics printer, and the IBM ProPrinter. If you have a printer that is compatible with Epson or IBM printers, you should be able to use the SAS/GRAPH driver for one of the above devices with it.

Ink Jet Printers

Version 6 drivers are provided for several ink jet printers, including the HP PaintJet, the IBM Color JetPrinter (model 3852), the Digital LCP01, and the Matrix® TT200. Several other printers can also be used if attached to Tektronix or Lasergraphics™ rasterizers.

NEW FONTS

Several new fonts from Bitstream Inc. are available in Version 6. These include various Swiss, Century Roman, and Zapf Elliptical fonts, as well as a Brush font. A Marker font is also available, containing various symbols that can be used for annotation. Examples of the new fonts are shown in Figure 1.

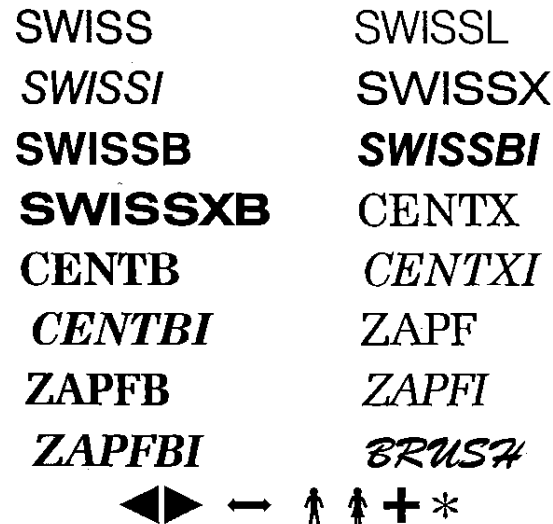


Figure 1 New Fonts for Version 6

NEW GRAPHICS OPTIONS

Several new graphics options (GOPTIONS) are available in Version 6. They include

- CTEXT=

- HTEXT=
- FTEXT=
- FCACHE=
- RESET=
- ROTATE=
- SWAP|NOSWAP.

CTEXT=, HTEXT=, and FTEXT= Options

You can use the CTEXT=, HTEXT=, and FTEXT= options to control the default color, height, and font of text. These options control the attributes used for text that would normally be drawn using hardware characters. This includes titles (other than TITLE1), footnotes, notes, and axis and legend text. These options provide you with two new capabilities:

1. You can control the attributes of text without having to explicitly specify them in individual global statements (such as TITLE, AXIS, and LEGEND).
2. You can use these options to control the font and height of labels in pie, star, and block charts. Previously, the attributes of these labels could not be controlled, even with AXIS statements.

FCACHE= Option

You can use the FCACHE= option with the SAS System on personal computers to control the number of software fonts to keep open at one time. This option is useful if you want to reduce memory usage or execution time when drawing a graph that uses many fonts. Keeping a large number of fonts open (a large FCACHE value) increases memory requirements but speeds execution, whereas a small FCACHE value reduces memory requirements but slows execution. The default FCACHE value is 4.

RESET= Option

You can use the RESET= option to reset graphics options to their default values and to clear global statements. The value of the RESET= option determines what options and statements to reset. For example, RESET=GOPTIONS causes all graphics options to be set to default values, whereas RESET=GLOBAL causes all global statements (TITLE, FOOTNOTE, PATTERN, SYMBOL, AXIS, and LEGEND) to be cleared. RESET=ALL resets both options and global statements. You can also reset individual types of global statements. For example, RESET=PATTERN resets only PATTERN statements.

ROTATE= Option

In previous versions of SAS/GRAPH software, you could use the ROTATE or NOROTATE option to change the orientation of a graph. The actual orientation produced by the option would depend on the default orientation used by the driver. For example, if the default orientation of the driver were portrait, specifying GOPTIONS ROTATE would cause the graph to be drawn in landscape mode.

In Version 6, you can explicitly specify the orientation with the ROTATE= option. For example, you can now specify ROTATE=LANDSCAPE, which will produce the graph in a landscape orientation, irrespective of what the default orientation of the driver is. Note that you can still specify ROTATE or NOROTATE (without a value) in a GOPTIONS statement as

before, and the orientation used will depend on the default orientation.

SWAP|NOSWAP Option

You can use the SWAP option to swap the colors black and white when displaying a graph. The SWAP option is useful when you have created a graph on a monochrome display (white foreground and black background) and you are replaying it on a monochrome printer, or vice versa. If you do not use the SWAP option, the drivers for some printers will attempt to use white as a foreground color when replaying the graph, which will produce a blank page. If you use the SWAP option, the driver swaps the foreground color from white to black before generating the picture. (If you are using a driver for a device with a black background, the SWAP option will cause black foreground graphics to be drawn in white.)

USING MULTIPLE HARDWARE FONTS

In previous releases of SAS/GRAPH software, you could use the CHARTYPE= option to control the default hardware font used by many drivers. However, even using the CHARTYPE= option, only one hardware font could be used on a graph. Version 6 provides a way to use multiple hardware fonts on a single graph (when using a device that can display multiple fonts).

You can use a specific hardware font in a TITLE, NOTE, FOOTNOTE, AXIS, or LEGEND statement by specifying F=HWmmmnnn, where

- mmm* are the last three characters in the name of the driver module, and
- nnn* is the hardware font number (with leading zeros if necessary).

The module name can be obtained from the MODULE field in the device catalog entry, and the font number can be obtained from the CHARTYPE screen in the device catalog entry. (See the section on device catalogs and PROC GDEVICE later in this paper for instructions on how to access this information.) For example, if you are using the PS (PostScript) driver and you want to have a title drawn using the Times-Roman hardware font supplied with the printer, you should specify F=HWPSL005, where PSL is the last three characters in the module name for the PS driver (SASGDPSL), and 005 is the CHARTYPE value for the Times-Roman font.

By specifying hardware fonts in this format, you can create graphs using multiple hardware fonts. For example, you can use the following code to produce a title on a PostScript printer using the Times-Roman font and axis and tickmark labels using Times-Italic:

```
title h=3 f=hwpsl005 'Multiple Hardware Fonts';
axis1 label=(h=1.5 f=hwpsl006)
      value=(h=1.5 f=hwpsl006);
proc gchart;
  vbar city/sumvar=rate maxis=axis1 raxis=axis1;
run;
```

The graph produced by this program is illustrated in Figure 2.

Multiple Hardware Fonts

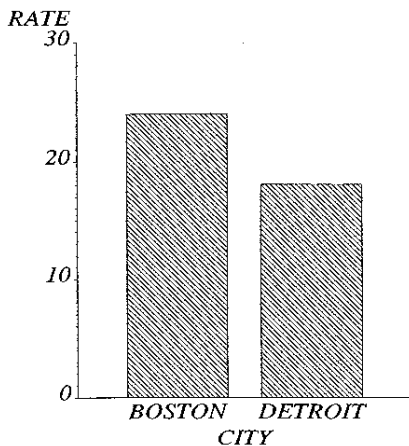


Figure 2 Illustration of Multiple Hardware Fonts

NEW MAP DATA SETS

Because of its size (over 300,000 observations), the COUNTIES map data set, which is available on mainframe and minicomputer systems, has not been included with the SAS System on personal computers. Instead, two smaller versions of the data set are supplied.

- The COUNTY map data set is a reduced (about 50,000 observations) version of the unprojected COUNTIES data set.
- The USCOUNTY map data set is a projected version of the COUNTY data set.

The difference in resolution between the COUNTIES and COUNTY data sets is unnoticeable on all but the highest resolution devices. Unless you have an application that requires an unprojected data set (such as annotating labels and symbols based on latitude and longitude), you will probably want to use the USCOUNTY map for all of your county mapping applications since USCOUNTY already contains projected coordinates.

NEW FEATURES FOR THE GFONT PROCEDURE

PROC GFONT contains new options that allow you to take advantage of character kerning and proportional spacing when creating fonts. "Kerning" is a method of adjusting spacing between characters so that part of one character extends over the body of the next. For example, when the capital letters A and W appear next to each other, text often looks more attractive if the bottom of the A actually extends into the area under the top left part of the W. You can create a data set with spacing requirements for particular pairs of characters and then use that data set by specifying the KERNDATA= option in PROC GFONT.

Proportional spacing is often necessary to adjust the spacing between characters as the size of the font changes. As the height of the font increases, less space is required between characters relative to their height. You can create a data set that dictates how much spacing to place between letters when a particular height is specified for the font. This information is used when building the font if you specify the SPACEDATA= option when using PROC GFONT.

Another new feature of PROC GFONT is the ability to specify arcs when creating characters. Previously, if you were creating a char-

acter that had an arc in it (the letter B, for example), you had to supply all of the points in the arc in your input data set to PROC GFONT. In Version 6, you can include an arc in your font simply by specifying the beginning, ending, and center points of the arc and indicating to PROC GFONT (using the PTYPE variable in your input data set) that the points define an arc. This approach can save you quite a bit of coding if you are creating characters or symbols that have curves in them.

NEW WAYS TO DIRECT OUTPUT

Users of SAS/GRAPH software on IBM mainframes may be familiar with using the GACCESS= option to direct output to a file or device when using a protocol converter. In Version 6, you can use the GACCESS= option in a much wider range of situations to control both the format and destination of output from SAS/GRAPH device drivers. The GACCESS parameter now has the form

```
GACCESS=accessmethod>destination;
```

where *accessmethod* refers to a module that controls how the output is written and *destination* dictates where to send the output.

Output on PC Systems

On PC systems, there are three possible *accessmethod* values: SASGASTD, SASGAEDT, and SASGAFIX. SASGASTD is the standard method (default for almost all drivers), which writes output in a continuous stream without carriage control. SASGAEDT adds system line-end characters between each record and is usually used when you are writing a file that you want to edit. A value of SASGAFIX causes fixed-length records to be written out, with the length of the records dictated by the GSFLLEN option. SASGAFIX is usually used when you want to write a file that is to be transferred to another computer that requires a fixed-record format.

The *destination* part of the GACCESS value indicates where output is to be written. On PC systems, the default destination for most drivers is COM1 (a serial port) or PRN (the printer port). For example, on PC systems, the drivers for most plotters use a default GACCESS value of SASGASTD>COM1, whereas drivers for dot matrix printers use SASGASTD>PRN. You can use the GACCESS= option to override the defaults. For example, suppose you want to write output from a driver to a file named MYFILE.DAT in your home directory, and you want to add carriage-return and line-feed characters to the end of each record so that you can later edit the file. You can specify

```
gaccess='sasgaedt>myfile.dat';
```

If you simply want to change the port to which the driver sends its output, you can modify the *destination*. For example, the driver for the HP 7475 plotter has a default GACCESS value of SASGASTD>COM1. If your plotter is attached to COM2, you can specify

```
gaccess='sasgastd>com2';
```

Output on UNIX Operating Systems and Derivatives

On UNIX operating systems and derivatives, the SASGASTD, SASGAFIX, and SASGAEDT *accessmethod* values operate the same way as on PC systems. When these values are used, *destination* points to a file, which in many cases is associated with a particular device. For example, the default GACCESS value for drivers for graphics terminals is SASGASTD>/dev/tty, which causes a continuous stream of records to be written to /dev/tty,

or your terminal. If you want to direct fixed-length records to the file /users/yourid/yourfile, you can specify

```
gaccess='sasgafix>/users/yourid/yourfile';
```

In addition to the values above, a special *accessmethod* value of SASGACMD is available on UNIX operating systems and derivatives. A value of SASGACMD causes the driver to pipe output to a UNIX command (usually lp) that is specified as the *destination* part of the GACCESS value. For example, the drivers for most printers have a GACCESS value of SASGACMD>lp dgoutput. This value causes the driver to pipe output to the UNIX lp command, which then sends it to the destination named goutput. You can modify the destination value to reflect the actual destination name of the device on your system.

You can also use the GSFNAME= and GSFMODE= options to write output to a file on both PC Systems and UNIX Systems and derivatives. See Chapter 2, "SAS/GRAPH Graphics Output," in the SAS/GRAPH User's Guide, Release 6.03 Edition for complete details on using the GACCESS=, GSFNAME=, and GSFMODE= options.

As an alternative to specifying GACCESS=, GSFNAME=, and GSFMODE= options in a GOPTIONS statement, you can permanently set them for specific drivers by altering device catalog entries. This is covered in the next section.

DEVICE CATALOGS AND THE GDEVICE PROCEDURE

The most notable new features of Version 6 SAS/GRAPH software are the addition of device catalogs and a new procedure, PROC GDEVICE, to manage them. Using PROC GDEVICE, you can

- obtain a list of all available drivers
- determine default values (such as graph size, orientation, and colors) used by each driver
- tailor Institute-supplied drivers to your requirements.

Device Catalogs

A device catalog is a SAS catalog with entries containing information used by SAS/GRAPH device drivers. Each entry corresponds to a driver name that you can specify with the DEVICE= option. The information contained in a device entry includes such parameters as the size of the graphics area, resolution of the device, default colors, hardware capabilities used by the driver, and where output from the driver goes. The catalog SASHELP.DEVICES is supplied by SAS Institute with SAS/GRAPH software and contains entries for all Institute-supplied drivers. You can create your own catalog, copy whatever entries you need into it, and modify them if necessary.

Device catalog entries are used by SAS/GRAPH software to determine how the corresponding driver will produce output. Suppose that you run the following SAS program:

```
goptions dev=hp7475;
title 'test';
proc gslide;
run;
```

When the GSLIDE procedure is executed, SAS/GRAPH looks for an entry named HP7475 in available device catalogs. The first catalog searched is GDEVICE0.DEVICES, which is the name you should give to a catalog you create. If there is no HP7475 entry in GDEVICE0.DEVICES (or if GDEVICE0.DEVICES does not exist), the catalogs GDEVICE1.DEVICES through

GDEVICE9.DEVICES (also user-supplied) are searched. If HP7475 is not found in any of these catalogs, (or the catalogs do not exist), the Institute-supplied catalog SASHELP.DEVICES is searched. When an HP7475 entry is found in one of the catalogs, the driver parameters in that entry are used in determining how the graph is drawn, where it will be sent, and so on. After this information is obtained from the catalog entry, SAS/GRAPH checks for any options that have been specified in a GOPTIONS statement. These options override any parameters or options specified in the HP7475 device catalog entry. Then using the options and parameters specified in the device catalog and GOPTIONS statements, the graph is generated. This process is illustrated in Figure 3.

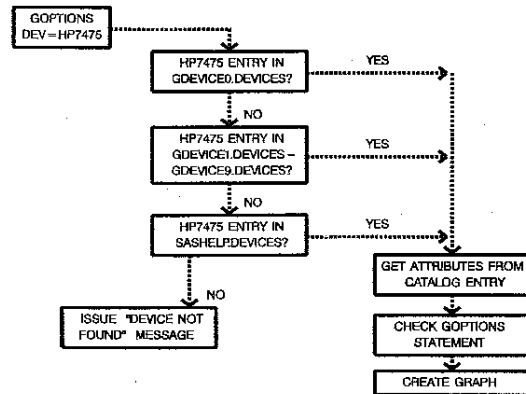


Figure 3 How Device Catalogs Are Used

Using the GDEVICE Procedure to Examine Catalogs

You can use PROC GDEVICE to examine and modify the contents of device catalogs. For example, to look at the entries that are included in SASHELP.DEVICES, you can submit the following SAS statement:

```
proc gdevice c=sashelp.devices browse;
```

This causes the catalog screen for SASHELP.DEVICES to be displayed, as shown in Screen 1.

Name	Type	Description	Updated
- AQS1000	DEV	AQS1000 terminal	11/23/87
- APLPLUS	DEV	Apple Laserwriter Plus	11/23/87
- APPLELW	DEV	Apple Laserwriter	11/23/87
- CAL81	DEV	CalComp 81 plotter	11/23/87
- CAL84	DEV	CalComp 84 plotter	11/23/87
- CGA	DEV	IBM CGA (palette 0)	11/23/87
- CGA0	DEV	IBM CGA (palette 0)	11/23/87
- CGA1	DEV	IBM CGA (palette 1)	11/23/87
- CGAH0	DEV	IBM CGA (high-intensity palette 0)	11/23/87
- CGAH1	DEV	IBM CGA (high-intensity palette 1)	11/23/87
- CGAM	DEV	IBM CGA (monochrome)	11/23/87
- COLORJET	DEV	IBM Colorjet printer	11/23/87
- COLORPRO	DEV	HP COLORPRO plotter	11/23/87
- COMPAQS	DEV	COMPAQ Portable III & IV	11/23/87
- DDL	DEV	DDL clear text format	11/23/87
- DDLBIN	DEV	DDL binary format	11/23/87
- DEBUCB	DEV	Color definable CRT debug driver	11/23/87
- DEBUON	DEV	Non-definable color CRT debug driver	11/23/87
- DEBUGP	DEV	Plotter debug driver	11/23/87

Screen 1 Catalog Screen for SASHELP.DEVICES

Each entry on the catalog screen corresponds to a driver name that can be specified in the DEVICE= option. You can use the PAGE UP and PAGE DOWN keys to scroll through the catalog. To examine the HP7475 entry, you can scroll down to the entry, place an S next to the entry name, and press ENTER. Alternatively, you can enter the command BROWSE HP7475 on the command line and press ENTER.

A device entry contains several screens. When you select an entry, the DETAIL screen is displayed over the catalog screen. This is illustrated in Screen 2.

```
GDEVICE: DIRECTORY SASHELP.DEVICES (8)
GDEVICE: Detail
Command ---)

Catalog: SASHELP.DEVICES          Entry:  HP7475

Orig Driver: HP7475                Module: SASGHPPL          Model:   307
Description: HP7475 graphics plotter w/B size paper  Type:   PLOTTER
Lrows:  40  Xmax:  14.981 IN  Hsize:  0.000 IN  Xpixels: 16200
Lcols:  100  Ymax:  10.827 IN  Vsize:  0.000 IN  Ypixels: 11000
Prows:   50                               Horigin: 0.000 IN
Pcols:   80                               Vorigin: 0.000 IN
Aspect:  0.000                               Rotate:
Driver query: --                               Queued message: N
Gprotocol: -----                               Paperfeed:  0.000 IN
Gaccess: sasgaald.com:-----
Gafname: -----                               Gafmode:  PORT          Gafien:   0
Gtrantab: -----                               Devmap:

- DDL      DEV      DDL clear text format          11/23/87
- DDLBIN   DEV      DDL binary format                 11/23/87
- DEBUGC   DEV      Color definable CRT debug driver    11/23/87
- DEBUGM   DEV      Non-definable color CRT debug driver 11/23/87
- DEBUGP   DEV      Plotter debug driver                11/23/87
```

Screen 2 DETAIL Screen for HP7475 Entry

This screen contains a number of attributes used by the HP7475 driver, including the size of the graphics area, rows and columns, default GACCESS value, and the resolution used by the driver. See Chapter 11, "The GDEVICE Procedure," in the SAS/GRAPH User's Guide, Release 6.03 Edition for details.

The PARAMETERS screen shows more information. You can display this screen by pressing the NEXTSCR key (usually SHIFT-F9) or by entering PARAMETERS on the command line of the DETAIL screen. The PARAMETERS screen is illustrated in Screen 3.

```
GDEVICE: DIRECTORY SASHELP.DEVICES (8)
GDEVICE: Detail
GDEVICE: Parameters
Command ---)

Catalog: SASHELP.DEVICES          Entry:  HP7475

Erase:  -           Autofeed: -           CharType:  0
Swap:   -           Call:    -           Maxcolors: 7
Autocopy: -         Characters: -       Repaint:   0
Handshake: HARDWARE  Circlears: -       Goopies:   0
Dash:   -           Dash:    -           Gsize:     0
Prompt: start up:  X  Fill:    -           Speed:     0
end of graph: -    Plotfill: -        Fillinc:   10
mount pens: X      Polyfill: -       Maxpoly:   0
change paper: X    Symbol:  -         Lfactor:   0

Prompchar: -----          Dashline: -----
Rectfill:  -----          Symbols:  -----
Devopis:  -----
UCC: -----

- DEBUGM   DEV      Non-definable color CRT debug driver    11/23/87
- DEBUGP   DEV      Plotter debug driver                11/23/87
```

Screen 3 PARAMETERS Screen for HP7475 Entry

The PARAMETERS screen contains additional options used by the HP7475 driver, including what prompts the driver issues, what

type of handshake is used, and what hardware capabilities of the device should be used.

By pressing the NEXTSCR key, you can access the following screens in the catalog entry:

- the GCOLORS screen, which contains the default colors used by the driver,
- the CHARTYPE screen, which contains definitions for the different hardware character sets that can be used by the driver,
- the METAGRAF screen, which contains parameters used when building a Metagraphics driver,
- the GPROLOG, GEPILOG, GSTART, and GEND screens, where you can specify strings to be sent by the driver at the beginning and end of each graph or record. (These correspond to the GPROLOG=, GEPILOG=, GSTART=, and GEND= options.)

Creating Your Own Catalog

After SAS/GRAPH software is installed, you will probably want to create your own device catalog, containing only those entries that you will be using. When a SAS/GRAPH procedure runs, your catalog is searched before SASHELP.DEVICES, and if the entry specified in the DEVICE= option is found, the search stops. Limiting the search to only your catalog can reduce processing time. If you plan to modify any Institute-supplied entries, you should copy them to your own catalog before modifying them.

Suppose that you want to use an HP 7475 plotter to produce several graphs for your company's annual report. The format of the report requires that the graphs be 5 inches by 5 inches. Since the default graph size produced by the HP7475 driver is approximately 15 by 11 inches, you can specify the reduced size using the HSIZE= and VSIZE= options in a GOPTIONS statement. However, if you are creating a large number of graphs, you can eliminate the need to always include a GOPTIONS statement by modifying the HSIZE and VSIZE parameters in the device catalog entry used by the driver. To do this, you should create your own catalog, copy the HP7475 entry to it, and modify the entry there.

To create your own catalog, you should first use a LIBNAME statement to point the libref GDEVICE0 to the directory where you want to store your catalog. Then access the catalog using PROC GDEVICE. For example,

```
libname gdevice0 'yourdir';
proc gdevice c=gdevice0.devices;
```

These statements bring up a blank CATALOG screen (assuming the catalog did not previously exist), which is illustrated in Screen 4.

```
GDEVICE: DIRECTORY GDEVICE0.DEVICES (E)
Command ---)

```

Name	Type	Description	Updated

Screen 4 CATALOG Screen for GDEVICE0.DEVICES

To copy the HP7475 entry from SASHELP.DEVICES, enter the command

```
copy sashelp.devices.hp7475.dev
```

on the command line. When you press ENTER, the HP7475 entry appears in your catalog. Since you are modifying an Institute-supplied entry, you will probably want to rename the entry (perhaps to MYHP7475) to avoid confusion with the entry in SASHELP.DEVICES. To rename the entry, enter

```
rename hp7475.dev myhp7475.dev
```

on the command line. After the entry is renamed, your catalog screen appears as in Screen 5.

```
GDEVICE: DIRECTORY GDEVICE0.DEVICES (E)
Command ---)

```

Name	Type	Description	Updated
MYHP7475	DEV	HP7475 graphics plotter w/B size paper	01/27/88

Screen 5 CATALOG Screen after Entry Renamed to MYHP7475

To edit the MYHP7475 entry, enter

```
edit mybp7475
```

on the command line. This brings up the DETAIL screen shown in Screen 6.

```
GDEVICE: DIRECTORY GDEVICE0.DEVICES (E)
GDEVICE: Detail
Command ---)

```

Catalog: GDEVICE0.DEVICES		Entry: MYHP7475
Orig Driver: HP7475	Module: SASQDHP1	Model: 307
Description: HP7475 graphics plotter w/B size paper	Type: PLOTTER	
Rows: 40 Xmax: 14.961 IN	Heize: 0.000 IN	Xpixels: 16200
Loops: 100 Ymax: 10.827 IN	Velze: 0.000 IN	Ypixels: 11000
Prows: 50	Horigin: 0.000 IN	
Pcols: 50	Verigin: 0.000 IN	
Aspect: 0.000	Rotate: -----	
Driver query: -	Queued messages: N	
Protocol: -----	Paperfeed: 0.000 IN	
Success: sasgetdloom!		
Qsname: -----	Qsmode: PORT	Qslen: 0
Tranlab: -----	Devmap: -----	

Screen 6 DETAIL Screen for MYHP7475 Entry

To change the default size used by the driver, type 5.000 IN in both the HSIZE and VSIZE fields. (The default value of 0.000 in these fields meant that the driver would use the XMAX and YMAX values (14.961 and 10.827) for HSIZE and VSIZE. Any nonzero value in the HSIZE and VSIZE fields is the value that is actually used by the driver.) You may also want to change the DESCRIPTION field to indicate that you have modified the driver. After making your changes, the DETAIL screen appears as in Screen 7.

```
GDEVICE: DIRECTORY GDEVICE0.DEVICES (E)
GDEVICE: Detail
Command ---)

```

Catalog: GDEVICE0.DEVICES		Entry: MYHP7475
Orig Driver: HP7475	Module: SASQDHP1	Model: 307
Description: HP7475 graphics plotter *MODIFIED DRIVER*	Type: PLOTTER	
Rows: 40 Xmax: 14.961 IN	Heize: 5.000 IN	Xpixels: 16200
Loops: 100 Ymax: 10.827 IN	Velze: 5.000 IN	Ypixels: 11000
Prows: 50	Horigin: 0.000 IN	
Pcols: 50	Verigin: 0.000 IN	
Aspect: 0.000	Rotate: -----	
Driver query: -	Queued messages: N	
Protocol: -----	Paperfeed: 0.000 IN	
Success: sasgetdloom!		
Qsname: -----	Qsmode: PORT	Qslen: 0
Tranlab: -----	Devmap: -----	

Screen 7 Modified DETAIL Screen for MYHP7475 Entry

At this point, you can go to any of the other screens and make changes. For example, if the order of the pens in your plotter does not correspond to the order on the GCOLORS screen, you can go to that screen and change the values as necessary. After making changes, press the END key until you return to the SAS Display Manager System.

Once you have created the MYHP7475 entry, specify DEVICE=MYHP7475 in an OPTIONS or GOPTIONS statement to use the modified driver.

Using the GDEVICE Procedure in Line Mode

The example above illustrates using PROC GDEVICE in full-screen mode, but you can also use this procedure in line mode

or noninteractively. The following program illustrates how to create your own catalog, copy an entry, and modify it in line mode.

```
libname gdevice0 'yourdir';
proc gdevice c=gdevice0.devices nofs;
  copy hp7475 from=sashelp.devices newname=myhp7475;
  modify hp7475 des='HP7475 plotter *MODIFIED DRIVER*'
    hsize=6 vsize=6;
quit;
```

DISPLAYING GRAPHICS USING THE SAS MICRO-TO-HOST LINK

You can use the SAS micro-to-host link to create graphs on your host computer and display them on your PC monitor or on a device attached to your PC. This approach is especially useful if you want to develop an application on your PC but run it using a large data base on your host computer.

Using the Link

To use the micro-to-host link to display graphics output on your PC, follow these steps:

- Log on to your host computer, using communications software and/or hardware available on your PC. Exit or hot-key back to DOS while remaining logged on.
- Invoke the SAS System on your PC.
- Use the SIGNON command to start up the link between your PC and host machine and to start a SAS session on the host. (See the *SAS Guide to the Micro-to-Host Link, Version 6 Edition* for details on signing on to a host computer.)
- From your SAS session on the PC, submit the following statement to the host using the RSUBMIT command:

```
goptions dev=grlink;
```

The GRLINK driver is a special driver available beginning with Release 5.18 of the SAS System for mainframe and minicomputers. You must always use the GRLINK driver on the host when using the micro-to-host link to do graphics. Do not specify the driver for the device you are using with the PC.

- Submit the following statement to your SAS session on the PC:

```
goptions device=xxx;
```

where xxx is the name of the graphics driver for your PC display adapter or attached hardcopy device. For example, if your PC has a CGA board, you can specify

```
goptions device=cga;
```

If you have a PostScript printer attached to your PC and you want to output the host graph on the printer, you can specify

```
goptions device=ps;
```

- Use the RSUBMIT command to submit your SAS statements and any required file definitions to the host. When the SAS/GRAPH procedure runs on the host, the output will be displayed on your PC monitor or attached device depending on the driver you specified in your PC session.
- After you generate your graphs, use the SIGNOFF command to terminate the link between your PC and host machine.

When you use the GRLINK driver, the GRLINK host driver uses the attributes of the driver specified in the PC session when selecting default colors, character sizes, and other attributes. For example, if you specify DEVICE=EGAL in your PC session, the GRLINK driver will use the default colors of the EGAL driver, but if you specify DEVICE=FX85 in your PC session, the GRLINK driver will use only black.

Hardware options are used only on the PC. In other words, you cannot specify hardware options that are not available with your particular PC hardware configuration even though they are legitimate on the host.

Moving Graphics Catalogs

When you run a host graphics program using the GRLINK driver, an entry is created in the graphics catalog WORK.GSEG on the PC. Then you can use PROC GREPLAY on the PC to redisplay the graphs in this catalog, or you can copy them to a permanent catalog.

If you specify GOPTIONS NODISPLAY in your PC session and use the GRLINK driver on the host, no graph is displayed on your PC (or attached device), but the picture is placed in WORK.GSEG on your PC. You can use this feature to transfer graphics catalogs from host to PC by running PROC GREPLAY on the host using the GRLINK driver on the host and the NODISPLAY option on the PC. Any pictures replayed from the host catalog will be placed into WORK.GSEG on the PC, where they may be replayed or copied to another catalog.

SUMMARY

This paper has presented an overview of many of the new features that are available with Version 6 SAS/GRAPH software. Because of space limitations, only summary descriptions of the new features have been presented. For details on these enhancements, you should refer to the *SAS/GRAPH User's Guide, Release 6.03 Edition*, *SAS/GRAPH Hardware Interfaces for Personal Computers, Version 6 Edition*, and *SAS/GRAPH Guide to Hardware Interfaces, Release 6.03 Edition*.

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