



CHAPTER

3

Device Drivers

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Overview

SAS/GRAPH procedures that produce graphics output require a device driver to display the output. This chapter discusses the role of device drivers in generating SAS/GRAPH output, provides directions for selecting and specifying device drivers, and explains how you can change the settings of device parameters.

Other tasks related to device drivers are discussed in Chapter 4, “SAS/GRAPH Output,” on page 43 and Chapter 5, “Bringing SAS/GRAPH Output to the Web,” on page 71 and in the SAS Help facility for SAS/GRAPH. These include

- displaying graphics output (see “Displaying Graphics Output on Monitors or Terminals” on page 45)
- previewing on one device how output will look on another device (see “Previewing Output” on page 48)
- sending graphics output to a printer or other hardcopy device (see “Printing Graphics Output” on page 47)
- creating external files in other graphics formats for use with other applications (see “About Graphics Stream Files” on page 56)
- creating graphics output that can be referenced in an HTML file and viewed with a Web browser (see “About Graphics Stream Files” on page 56)

For a description of device catalogs and for information on creating and modifying device drivers, see Chapter 15, “The GDEVICE Procedure,” on page 651.

About Device Drivers

To produce graphics output on a graphics output device, SAS/GRAPH software uses a device driver. *Device drivers* are the components of SAS/GRAPH software that translate the device-independent output from SAS/GRAPH procedures into the appropriate commands to produce graphics output on particular output devices. Device drivers contain settings that determine the default appearance of the output, such as dimensions and orientation, cell size, colors, and hardware fonts. They can also contain host commands that are issued before and after the driver produces output.

A device driver is composed of two parts:

- a device entry in a SAS catalog
- an executable module.

The *device entry* is a SAS catalog entry of type DEV. It is created and accessed with the GDEVICE procedure and explicitly refers to the executable module. The device entry contains *device parameters* whose settings can control

- the appearance of the output
- the destination to which the output is sent (native SAS/GRAPH drivers only)
- communications between the operating environment and the device
- how the device generates the output.

You can change these settings either by modifying the device parameters using the GDEVICE procedure, or by overriding the parameter settings using graphics options in a GOPTIONS statement. For details, see “Controlling Output with Device Drivers” on page 41.

The *executable module* is a program that produces the device-specific commands from the device-independent output of a SAS/GRAPH procedure. The executable module uses the parameters specified in the device entry to tell it exactly how to do so.

SAS/GRAPH software provides device entries for your operating environment in the Institute-supplied catalog, SASHELP.DEVICES.

If your site has created custom device entries, they may also be stored in SASHELP.DEVICES, although typically custom devices are stored in the catalog GDEVICE0.DEVICES. For more information about custom device entries, see “About Device Catalogs” on page 652 or ask your SAS Support Consultant.

Types of Device Drivers

Most of the device drivers in SASHELP.DEVICES are SAS/GRAPH *native device drivers*, which are those SAS/GRAPH drivers that produce output in the native language of the device. For example, the PS300 driver is a “native device driver” because it directly produces PostScript output.

Some operating environments also use *host drivers*, which make generic calls to the print driver that the user has selected in Print Setup. The print driver is what writes out the output in the native language of the device.

How Device Drivers Are Assigned

Because many characteristics of the graphics output depend on parameter values that are stored in the device entry, SAS/GRAPH procedures that produce graphics output must know which device driver to use before they begin processing.

Usually SAS/GRAPH automatically selects a device driver for you and you are not required to explicitly specify one. If you use the GRAPH window to display graphics

output, SAS/GRAPH selects a device driver that is appropriate for your device. The default device driver for your site may also be selected by your SAS Installation Representative.

If you submit a SAS procedure without specifying a device driver and your display device does not support the GRAPH windows or you are running outside the SAS Display Manager, SAS/GRAPH prompts you for a driver name.

Whether or not a default device is assigned, you can always explicitly assign a device driver. See “Selecting a Device Driver” on page 39 for more information.

Selecting a Device Driver

Although SAS/GRAPH software usually selects an appropriate device driver for displaying graphics output on your display device, you may need to select a different device driver if you want to direct your graphics output to another destination.

When you select a device driver, it must be one that is appropriate for your device. The device driver must

- send commands to the device that the device understands. For example, if you are using an X Windows display, the SAS/GRAPH device driver sends the appropriate data stream that can produce graphics output on the display device.
- contain values of device parameters that are appropriate for the device. For example, if you are using a color PostScript printer and you select a device driver for a black and white PostScript printer, your graph will not print in color.

Occasionally the device driver you use is not the one that bears your device's name. This can happen when

- your graphics device uses a common graphics language (for example, PostScript).
- your graphics device emulates a different graphics device. (For example, there is no SAS device driver for your plotter, but the plotter can be set up to emulate a Hewlett-Packard 7550 plotter.)

In this case, you use the device driver that matches the language that your device understands. For example, if your Hewlett-Packard LaserJet II printer has a PostScript card installed, you would use one of the PostScript device drivers rather than HPLJS2. Similarly, you could use an HP driver for a plotter (for example, HP7550A) when your plotter emulates a Hewlett-Packard 7550 plotter.

You cannot force a device to act as a device with different capabilities by choosing a different device driver.

Viewing the List of Available Device Drivers

You can view the list of device entries in SASHELP.DEVICES or in any other device catalog in the following ways:

- use the SAS Explorer window to display the contents of the device catalog.
- use the GDEVICE procedure to open the GDEVICE DIRECTORY window, which lists all of the device drivers in the current catalog. By default the current catalog is SASHELP.DEVICES. To specify a catalog, include the CATALOG= option, as shown in the following statement:

```
proc gdevice catalog=sashelp.devices;
```

See “Using the GDEVICE Windows” on page 664 for details.

- use GDEVICE procedure statements to write the list of device drivers to the Output window:

```
proc gdevice catalog=sashelp.devices nofs;
  list;
run;
quit;
```

The NOFS on page 657 option in the PROC GDEVICE statement causes the procedure not to use the GDEVICE windows.

If you want to write the list of devices to an external file you can

- save the contents of the Output window.
- use the PRINTTO procedure to redirect the GDEVICE procedure output to an external file. See *SAS Procedures Guide* for a description of the PRINTTO procedure.

Once you have generated the list of available device drivers, you can search the list until you find the description that matches your output device. The corresponding name is the name that you specify as the device driver.

Browsing the Contents of a Device Entry

You can also use any of the viewing methods to browse the contents of a device entry. From the GDEVICE Directory window, select the device name to open the GDEVICE Detail window. From there you can move to the other GDEVICE windows for the entry, using either the menus or commands. For details, see “Using the GDEVICE Windows” on page 664.

You can display the contents of a device entry in the Output window by selecting the entry from the Explorer window or by submitting GDEVICE statements. The following statements list in the Output window the contents of the PSCOLOR device entry:

```
proc gdevice c=sashelp.devices nofs;
  list pscolor;
run;
quit;
```

See Output 15.1 on page 654 for an illustration of the device listing.

Specifying a Device Driver in a SAS Session

You can specify a device driver in these ways:

- use the DEVICE= option in a GOPTIONS or OPTIONS statement. For example,


```
goptions device=pslepf;
```

 For details, see “GOPTIONS Statement” on page 182.
- change the device in the System Options window. To do so, type the OPTIONS command on the command line, and in the Graphics group, choose “Driver settings.” You can then enter a Device value. Use the window’s Help button if you need help editing values.
- enter the device name in the DEVICE prompt window. The DEVICE prompt window opens automatically if you submit a SAS/GRAPH program that produces graphics output, no device has been specified, and you are running outside of the SAS Display Manager environment.

If you specify a device driver in more than one way, the most recently specified device driver is used. The device driver stays in effect until you specify another device, submit the graphics option RESET=GOPTIONS or RESET=ALL, or end your SAS session.

If you use the same device driver for most or all of your SAS/GRAPH programs, you can put the GOPTIONS DEVICE= statement in an AUTOEXEC file. See the SAS companion for your operating environment for details on setting up an AUTOEXEC file.

You can also specify a device for previewing or printing your output with the TARGETDEVICE= graphics option. For details, see “Printing Graphics Output” on page 47.

Controlling Output with Device Drivers

When a SAS/GRAPH procedure produces output, it first checks to see what device driver you have specified. It then looks in the device entry for that driver to find the current parameter settings. In general, parameter values control

- the appearance of the graphics output. Device parameters control such aspects as the size of the graphics output, units (such as inches or points) used to draw the output, colors displayed, and text fonts and sizes used.
- how the operating environment communicates with the device. For example, some devices require the graphics commands to be formatted in a specific way or require a particular communications protocol. Others may require that a set of initialization commands precede the graphics commands.
- how the output is produced – that is, how the output is displayed or printed. Some device parameters control the behavior of a hardcopy device, such as the paper feed between graphs as well as the display characteristics, such as orientation.

The parameter values for device entries in SASHELP.DEVICES reflect the most common modes of operation of the supported devices. You can control the way the device driver produces output for your device by changing values in the device entry. You can change device parameters either permanently or temporarily.

Modifying Device Parameters Permanently

To change a device parameter permanently, you must make the change in the device entry itself using the GDEVICE procedure. The modifications made to a device entry are in effect for all SAS sessions.

The new values that you specify for device parameters must be within the device's capabilities. For example, all devices are limited in the size of the output they can display. Some output devices cannot display color. If you try to increase the size of the display past the device's capability or if you specify colors for a device that cannot display them, you will get unpredictable results.

Note: If you run SAS/GRAPH software in a multi-user environment, you should not change the device entries in the Institute-supplied catalog, SASHELP.DEVICES, unless you are the system administrator or the SAS Support Consultant. △

If you need to change a device driver in SASHELP.DEVICES, copy it into a personal catalog named DEVICES, and then modify the copy. To use the new device driver, assign the libref GDEVICE0 to the library that contains the modified copy. See “Creating or Modifying Device Entries” on page 670 for details.

Overriding Device Parameters Temporarily

You can temporarily override the settings of device parameters by using graphics options in a GOPTIONS statement or by specifying options in other SAS/GRAPH statements.

Graphics Options

To override device parameter settings with graphics options, simply submit the options in a GOPTIONS statement. For example, the HSIZE= and VSIZE= graphics options control the default size of the graphics output area and override the values of the HSIZE= and VSIZE= device parameters in the current device entry. The following GOPTIONS statement changes the dimensions of the graphics output area:

```
options hsize=6in vsize=4in;
```

These new values remain in effect until you change them, use the RESET= graphics option to reset them, or end your SAS session.

The values that you specify for graphics options must be supported by your graphics device. If you use an option that is not supported, SAS/GRAPH software ignores the option. See “GOPTIONS Statement” on page 182 for information about specifying graphics options.

Statement Options

You can also override parameters that control such attributes as text color and font by using options in other SAS/GRAPH statements. For example, this TITLE statement explicitly specifies the text color and font:

```
title color=blue font=zapf 'Production Quality';
```

The COLOR= option overrides the default color selection from the device entry's colors list as well as any graphics options that affect text color. The FONT= option overrides the device's default font and any graphics options that affect the font. As long as the values are supported by your graphics device, the values you specify in the statements override the corresponding device parameters and graphics options when the SAS program is executed.

When you specify options that override device parameter settings, this is the order of precedence that SAS/GRAPH software uses:

- 1 options in a SAS/GRAPH procedure statement or AXIS, FOOTNOTE, LEGEND, NOTE, PATTERN, SYMBOL, or TITLE statement
- 2 graphics options in a GOPTIONS statement
- 3 device parameters in a device entry
- 4 default hardware settings of a device.

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