CHAPTER

7

SAS/GRAPH Colors

Overview

SAS/GRAPH software lets you set color in these places:

☐ Set color on any procedure that generates graphics output (refer to the chapter for the individual procedure).

☐ Set color on the SAS statements that enhance procedure output: AXIS, FOOTNOTE, LEGEND, NOTE, PATTERN, SYMBOL, and TITLE (see Chapter 8, "SAS/GRAPH Statements," on page 159).

☐ Use the GOPTIONS statement's color options to define default colors for graphics elements (see "Specifying Default Colors in a GOPTIONS Statement" on page 140).

☐ Use the GOPTIONS statement's COLORS= option to define a *colors list* that controls colors for graphics elements when explicit specifications and defaults are unavailable (see "Defining and Using a Colors List" on page 140).

□ Rely on your current device's default colors list. (See "Device Capabilities" on page 154 for general information about device capabilities. See Example 1 on page 671 for information on how you can view or modify a device's color list.)

These methods, singly or in combination, give SAS/GRAPH software the colors it needs to generate graphics output. Regardless of where you specify color, the value you specify for a color must not exceed eight characters and must be in a valid SAS color-naming scheme (see "Color-naming Schemes" on page 142).

Specifying Colors in SAS/GRAPH Programs

When you explicitly specify a color on a SAS procedure or statement, SAS/GRAPH uses that color, provided your device can display it. If you do not specify color, or if SAS/GRAPH needs more colors than are specified, it uses default colors specified on the GOPTIONS statement, or colors from the current colors list.

Specifying Default Colors in a GOPTIONS Statement

The GOPTIONS statement has several graphics options that specify default colors for graphics elements:

Option	Sets default color for
CBACK=	background for graphics output
CBY=	BY lines in graphics output
CPATTERN=	PATTERN statements
CSYMBOL=	SYMBOL statements
CTEXT=	all text and the border in graphics output
CTITLE=	border, plus all titles, footnotes, and notes

SAS/GRAPH software uses these values if you do not explicitly select colors in other statements. Refer to Chapter 9, "Graphics Options and Device Parameters Dictionary," on page 301 for complete information about each of these graphics options.

If you do not explicitly specify color in a SAS statement or set a default color for a graphic element in the graphics output, SAS/GRAPH software searches for a colors list.

Defining and Using a Colors List

If SAS/GRAPH software does not find a color specification on a procedure or statement, or a default for the graphic elements used in the output, it uses colors from the colors list, which it sequentially looks for in two places:

1 the COLORS= option on a GOPTIONS statement

2 the device's default color list.

The color selected from the colors list varies depending on the procedure using the color and the graphics element that is being drawn. Usually, the first color in the list is used; however, certain procedures may select other colors. For example, if the CAXIS= option is not specified in the GCONTOUR procedure's PLOT statement, the procedure selects the second color from the colors list to draw the axes.

Building a Colors List

To build a colors list, use the COLORS= option on the GOPTIONS statement. This specified colors list overrides the current device's default colors list. Building a colors list is useful for selecting a subset of colors to be used in a specific order for graphics output. For example, to ensure that the colors red, green, and blue are available in that order, you can specify:

```
goptions colors=(red green blue);
```

A specified color value must not exceed eight characters and must be in a valid SAS color-naming scheme (see "Color-naming Schemes" on page 142).

Note: The COLORS= graphics option only provides a default lookup table. Any time you explicitly select any other colors in your SAS/GRAPH program, those colors are used to draw the graphics elements for which you have selected them. △

For a pen plotter, SAS/GRAPH software uses the order of the colors in the COLORS= graphics option to define the order of pens for a multiple pen plotter, or to make a pen plotter prompt you to change the pen when a graph uses more colors than the plotter has.

Using a Device's Default Colors List

If you do not define a colors list with the COLORS= graphics option, SAS/GRAPH software uses the default colors list for your device. This colors list is found in the device entry of the specified device driver (for details on specifying a device driver, refer to Chapter 15, "The GDEVICE Procedure," on page 651). If you select a different device driver during a SAS session, the colors list changes unless you have specified the COLORS= graphics option.

To view and modify the device's default colors list, use the GDEVICE procedure (for details, refer to Chapter 15, "The GDEVICE Procedure," on page 651).

Overriding the Default Colors List

If you do not specify colors for certain graphics elements or a colors list with the COLORS= graphics option, SAS/GRAPH procedures assign colors from the device's default colors list. In some procedures, this assignment takes up some of the 256 colors that you can specify for a graph. For example, if no colors are specified, the G3D procedure uses the first 3 colors from the colors list to draw the text, the plot axes, and the plot symbols. These colors take up 3 of the 256 colors that you can specify for the graph. Therefore, you can specify 253 additional colors for your graph before a warning is issued and the colors are remapped.

To use only the colors that you explicitly specify, submit

```
goptions colors=(none);
```

This causes colors to be used only as they are encountered in your SAS program. This is useful if you want to generate graphics output with the maximum of 256 colors, and you do not want to use any of the device's default colors. It also prevents a procedure from using up some of the 256 colors with the default colors list and prevents SAS/GRAPH software from remapping colors because too many colors were specified.

Resetting the Colors List to the Default

If you have specified a colors list with the COLORS= graphics option and you want to reset it back to the default colors list for your device, specify

```
goptions colors=();
```

Color-naming Schemes

The valid color-naming schemes are

☐ RGB (red green blue)

☐ CMYK (cyan magenta yellow black)

☐ HLS (hue lightness saturation)

☐ HSV (hue saturation brightness), also called HSB

☐ gray scale

☐ predefined SAS color names.

For the CMYK color scheme, color specifications must be enclosed in quotation marks. For all other color schemes, the quotes are optional.

You can freely intermix color-naming schemes in your programs; however, depending on your device capabilities, the color that is displayed may not be the color that you expect. See "Device Capabilities" on page 154 for information on how to tell if your device supports user-defined colors.

Note: The colors shown in the output in this book may be different from the colors you see on your device. △

RGB Color Codes

You can use the RGB color-naming scheme to specify a color in terms of its red, green, and blue components. Color names are of the form CX*rrggbb*, where

☐ CX indicates that this is an RGB color specification

☐ *rr* is the color's red component

☐ *gg* is the color's green component

☐ *bb* is the color's blue component.

The components are given as hexadecimal numbers in the range 00 through FF. This allows for up to 256 levels of each color component. For example, bright red is specified as CXFF0000, white as CXFFFFFF, black as CX000000, and green as CX00FF00.

Any combination of the color components is valid. Some combinations will match the color produced by predefined SAS color names. Refer to Table 7.2 on page 146 for those combinations that match predefined SAS color names.

CMYK Color Codes

To use a printer's Pantone Color Look-Up Table, you can use the CMYK color-naming scheme to specify colors in terms of their cyan, magenta, yellow, and black components. Color names are of the form '*ccmmyykk*', where

☐ *cc* is the color's cyan component

☐ *mm* is the color's magenta component

☐ *yy* is the color's yellow component

☐ *kk* is the color's black component.

The components are given as quoted hexadecimal numbers in the range 00 through FF. This scheme allows for up to 256 levels of each color component. For example, red is specified as '00FFFF00', green as 'FF00FF00', process black (uses cyan, magenta, and yellow ink) as 'FFFFFF00', and pure black (uses only black ink) as '000000FF'. For CMYK color specifications, the quotes are required.

CMYK color specifications should only be used for devices that support four colors. If a CMYK color is used on a three-color device, the color specification will be mapped to a color that the device supports, but the resulting colors may not be appealing. Moreover, different CMYK colors may map to the same device color because a four-color space supports more colors than a three-color space.
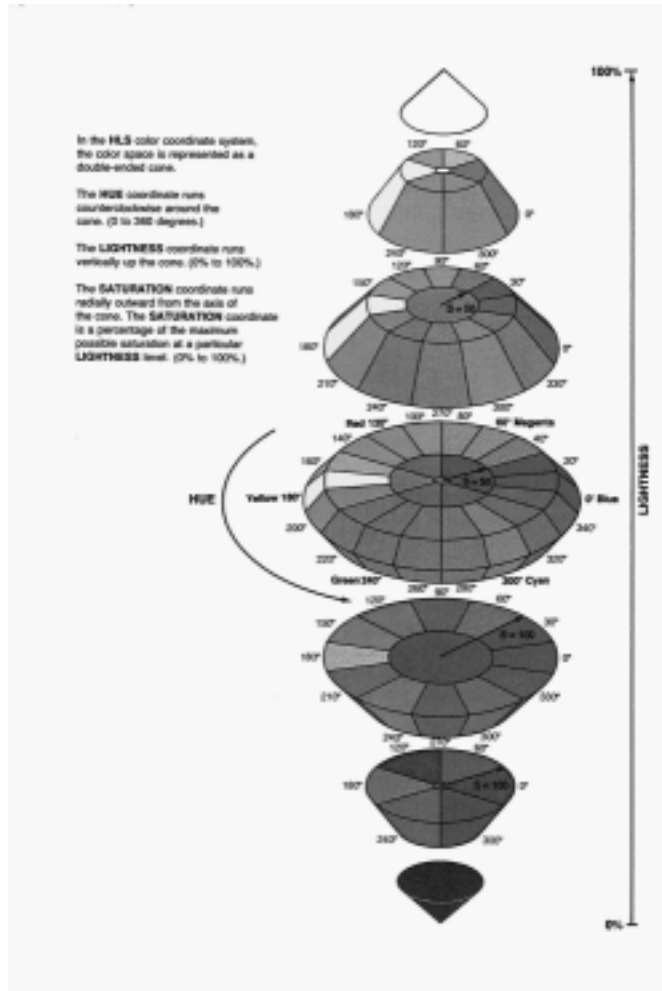
HLS Color Codes

You can use the HLS color-naming scheme to specify colors in terms of hue, lightness, and saturation components. SAS/GRAPH software uses an HLS color scheme that is modeled directly after the Tektronix Color Standard, which is shown in Figure 7.1 on page 144. HLS color names are of the form H*hhhllss*, where

- ☐ H indicates that this is an HLS color specification
- ☐ *hhh* is the color's hue component
- ☐ *ll* is the color's lightness component
- ☐ *ss* is the color's saturation component.

The components are given as hexadecimal numbers. The hue component has the range 000 through FFF. Valid values are 000 through 360 (168 base 16). If the value for the Hue is greater than 360 (168 base 16), the Hue will be calculated by using modular arithmetic with a modulus of 360 (168 base 16). Both the lightness and saturation components are hexadecimal and have the range 00 through FF. Thus, they provide 256 levels for each component. For example, bright blue is specified as H14066FF and light gray as H000BB00. White is defined as H*xxx*FF00 and black as H*xxx*0000, where *xxx* can be any hue. For white and black, the lightness component determines the intensity of the gray level. When the saturation is zero, the color is a shade of gray that is determined by the lightness value.

Any combination of the color components is valid. Some combinations will match the color produced by predefined SAS color names. Refer to Table 7.2 on page 146 for those combinations that match predefined SAS color names.

Figure 7.1 Tektronix Color Standard

HSV (or HSB) Color Codes

You can use the HSV color-naming scheme to specify colors in terms of hue, saturation, and value (or brightness) components. HSV color names are of the form V*hhhssvv*, where

□ V indicates that this is an HSV color specification

□ *hhh* is the color's hue component

□ *ss* is the color's saturation component

□ *vv* is the color's value or brightness component.

The components are given as hexadecimal numbers. The hue component has the range 000 through FFF. Valid values are 000 through 360 (168 base 16). If the value for the Hue is greater than 360 (168 base 16), the Hue will be calculated by using modular arithmetic with a modulus of 360 (168 base 16). Both the saturation and value (brightness) components are hexadecimal and have the range 00 through FF (when the saturation is zero, the color is a shade of gray determined by the value). Thus, they provide 256 levels for each component.

For example, bright blue is specified as V0C8FFCC, light gray as V*xxx*00BB, and White as V*xxx*00FF, where *xxx* can be any hue. For white and black, the value

component determines the intensity of gray level. Any combination of the color components is valid.

Gray-Scale Color Codes

You can use gray scales to specify colors in terms of gray components. Gray-scale color names are of the form GRAY*ll*. The value *ll* is the lightness of the gray and is given as a hexadecimal number in the range 00 through FF. This scheme allows for 256 levels on the gray scale. For example, GRAYFF is white, GRAY00 is black, and GRAY4C is a dark gray.

Predefined SAS Colors

To specify colors in intuitive terms, use the predefined SAS color names, which form a color by combining the abbreviations for prefixes and prefix hues with the abbreviations for the names of several common hues. See Table 7.1 on page 145.

Table 7.1   Abbreviations for Hues and Prefixes Used in Predefined SAS/GRAPH Color Names

Hue	Abbreviation	Prefix	Abbreviation
red	R	pale	PA
pink	PK	brilliant	BI
olive	OL	light	LI
brown	BR	moderate	MO
orange	O	medium	ME
yellow	Y	strong	ST
yellow-green	LG	dark	DA
yellowish green	YG	deep	DE
green	G	vivid	VI
blue	B	very pale	VPA
purple	P	very light	VLI
violet	V	very dark	VDA
gray	GR	very deep	VDE
black	BL		
white	WH		

Predefined SAS color names follow the formulas *prefix+hue*, *prefix+hue+hue*, or *prefix+hue+hue+hue*. For example, the common hue red can be denoted by R. The common prefixes grayish and dark can be denoted by GR and DA. To construct the color dark grayish red, combine the prefix DA, the prefix hue GR, and the hue R to form the predefined SAS color DAGRR. The predefined colors are approximations only and may not produce the same results on different devices.

Generally, to describe a predefined SAS color name that uses more than one hue, add the suffix *ish* to the name of each prefix hue. In the previous example, the color name

from the prefix dark and the hues gray and red is described as dark grayish red (DAGRR).

Not all combinations of prefixes and hues are available as predefined SAS color names. You can specify colors that do not have a predefined SAS color name by using the RGB, HLS, HSV, CMYK, or gray-scale color-naming schemes.

Table 7.2 on page 146 provides a comprehensive list of the predefined SAS color names that you can use. The table lists the predefined SAS color name followed by the description and the equivalent RGB and HLS values.

Note: Hardware characteristics may cause some colors with different color definitions to appear the same. Also, the same predefined color is likely to appear different on different devices and may not appear correct on some devices. △

Table 7.2 Predefined SAS Colors That Can Be Used in SAS/GRAPH Software

Color Name	Color Description	RGB	HLS
	Basic Hues		
BLACK | BL	black	CX000000	H0000000
BLUE | B	blue	CX0000FF	H00080FF
BROWN | BR	brown	CXA05000	H09650FF
CHARCOAL	charcoal	CX4F4F4F	H0784F00
CREAM	cream	CXE8D898	H0A8C0A2
CYAN	cyan	CX00FFFF	H12C80FF
GOLD	gold	CXFFAA00	H0A080FF
GRAY | GREY | GR | A	gray	CX808080	H0008000
GREEN | G	green	CX00FF00	H0F080FF
LILAC	lilac	CXE06090	H062A0AC
LIME	lime	CXC0FF81	H0D2C0FF
MAGENTA	magenta	CXFF00FF	H03C80FF
MAROON	maroon	CX700000	H07838FF
OLIVE	olive	CX2A8307	H0DF45E6
ORANGE | O	orange	CXFF8000	H09680FF
PINK	pink	CXFF0080	H05980FF
PURPLE | P	purple	CX703070	H03C5066
RED | R	red	CXFF0000	H07880FF
ROSE	rose	CXFF6060	H078B0FF
SALMON	salmon	CXFF0055	H06480FF
STEEL	steel	CX3883A8	H1407080
TAN	tan	CXE0A860	H09AA0AC
VIOLET	violet	CXB090D0	H01EB067

Color Name	Color Description	RGB	HLS
WHITE | WH | W	white	CXFFFFFF	H000FF00
YELLOW | Y	yellow	CXFFFF00	H0B480FF
	Blacks		
RBK	reddish black	CX191919	H06D1904
BRBL	brownish black	CX010101	H0980101
GBL	greenish black	CX191919	H0F81900
OLBL	olive black	CX191919	H0CB1900
PBL	purplish black	CX191919	H0341901
BBL	bluish black	CX191919	H0011901
	Blues		
VIGB	vivid greenish blue	CX13478C	H14E4FC3
BIGB	brilliant greenish blue	CX4D7EBF	H14E8679
STGB	strong greenish blue	CX2E4C73	H14E506D
DEGB	deep greenish blue	CX142233	H14E246D
LIGB	light greenish blue	CX6E86A6	H14E8A3C
VLIGB	very light greenish blue	CX90B0D9	H14EB57C
MOGB	moderate greenish blue	CX4C5D73	H14E6033
DAGB	dark greenish blue	CX2A3440	H14E3533
VDAGB	very dark greenish blue	CX121519	H14E162D
VIB	vivid blue	CX090766	H00136DF
BIB	brilliant blue	CX3230B2	H0017194
STB	strong blue	CX201F73	H0014994
DEB	deep blue	CX100F26	H0011B6D
PAB	pale blue	CX8585A6	H0019528
VPAB	very pale blue	CXAEADD9	H001C35C
GRB	grayish blue	CX5C5C73	H001671C
DAGRB	dark grayish blue	CX373740	H0013B12
VIPB	vivid purplish blue	CX2B0766	H01736DF
BIPB	brilliant purplish blue	CX6130B2	H0177194
STPB	strong purplish blue	CX3F1F73	H0174994
DEPB	deep purplish blue	CX180F26	H0171B6D
VLIPB	very light purplish blue	CXA37AE5	H017B0AD
LIPB	light purplish blue	CX6D5299	H017754E
MOPB	moderate purplish blue	CX3F3059	H017444E
DAPB	dark purplish blue	CX151219	H017162D
LIB	light blue	CX5A58A6	H0017F4E

Color Name	Color Description	RGB	HLS
VLIB	very light blue	CX7674D9	H001A691
MOB	moderate blue	CX3E3D73	H001584E
DAB	dark blue	CX1B1B26	H001212D
PAPB	pale purplish blue	CX8A7AA6	H0179033
VPAPB	very pale purplish blue	CXC0A8E5	H017C78B
GRPB	grayish purplish blue	CX4A4159	H0174D27
BLB	blackish blue	CX171719	H001180D
	Browns		
LIBR	light brown	CX8C7962	H098772D
MOBR	moderate brown	CX594E41	H0984D27
DABR	dark brown	CX191714	H098171C
LIGRBR	light grayish brown	CX8C887A	H0A58313
GRBR	grayish brown	CX59564D	H0A55312
DAGRBR	dark grayish brown	CX33322E	H0A5300D
STYBR	strong yellowish brown	CX806A2B	H0A5557F
DEYBR	deep yellowish brown	CX332E14	H0AA246D
LIYBR	light yellowish brown	CXA69F7A	H0AA9033
MOYBR	moderate yellowish brown	CX736E58	H0AA6522
DAYBR	dark yellowish brown	CX26251F	H0AA221C
LIGRYBR	light grayish yellowish brown	CXA6A18A	H0AA9822
GRYBR	grayish yellowish brown	CX737060	H0AA6917
DAGRYBR	dark grayish yellowish brown	CX403E37	H0AA3B12
LIOLBR	light olive brown	CX8B8C4B	H0B56C4E
MOOLBR	moderate olive brown	CX595936	H0B54740
DAOLBR	dark olive brown	CX26261C	H0B52127
STBR	strong brown	CX593B18	H0983994
STRBR	strong reddish brown	CX4C2714	H08C3094
DERBR	deep reddish brown	CX26150D	H08C1980
LIRBR	light reddish brown	CX8C7367	H08C7A27
MORBR	moderate reddish brown	CX59453B	H08C4A33
DARBR	dark reddish brown	CX191614	H08C171C
LIGRRBR	light grayish reddish brown	CX8C7D75	H08C8118
GRRBR	grayish reddish brown	CX594F4A	H08C5217
DAGRRBR	dark grayish reddish brown	CX332E2C	H08C3012

Color Name	Color Description	RGB	HLS
DEBR	deep brown	CX261C0F	H0981B6D
	Grays		
LIBRGR	light brownish gray	CX8C8883	H098880A
BRGR	brownish gray	CX595753	H0985609
PKGR	pinkish gray	CXBFB2B5	H06DB917
RGR	reddish gray	CX8C8385	H06D880A
DARGR	dark reddish gray	CX595354	H06D5609
YGR	yellowish gray	CXBBBFAC	H0C2B621
LIGGR	light greenish gray	CXBFBFBF	H0F8BF01
GGR	greenish gray	CX8C8C8C	H0F88C01
DAGGR	dark greenish gray	CX595959	H0F85900
LIOLGR	light olive gray	CX878C7E	H0CB850F
LIPGR	light purplish gray	CXBDB2BF	H034B917
PGR	purplish gray	CX8B838C	H034880A
DAPGR	dark purplish gray	CX585359	H0345609
LIGR	light gray	CXBFBFBF	H000BF00
MEGR	medium gray	CX8C8C8C	H0008C00
DAGR	dark gray	CX595959	H0005900
LTGRAY	light gray	CXC0C0C0	H000C000
DAGRAY	dark gray	CX404040	H0004000
LIBGR	light bluish gray	CXB3B2BF	H001B917
BGR	bluish gray	CX83838C	H001880A
OLGR	olive gray	CX575953	H0CB5609
DABGR	dark bluish gray	CX535359	H0015609
VIBG	vivid bluish green	CX138C89	H12A4FC3
BIBG	brilliant bluish green	CX4DBFBC	H12A8679
STBG	strong bluish green	CX2E7371	H12A506D
DEBG	deep bluish green	CX143332	H12A246D
LIBG	light bluish green	CX6EA6A4	H12A8A3C
VLIBG	very light bluish green	CX90D9D7	H12AB57C
MOBG	moderate bluish green	CX4C7372	H12A6033
DABG	dark bluish green	CX2D403F	H12A362D
VDABG	very dark bluish green	CX121919	H12A162D
VILG	vivid yellow-green	CX44A616	H0DD5EC3
BILG	brilliant yellow-green	CX88E55C	H0DDA1BA
STLG	strong yellow-green	CX5B993D	H0DD6B6D
DELG	deep yellow-green	CX3C6629	H0DD476D

Color Name	Color Description	RGB	HLS
LILG	light yellow-green	CXB1E599	H0DDBF99
MOLG	moderate yellow-green	CX769966	H0DD7F33
PALG	pale yellow-green	CXD1E5C7	H0DDD660
GRLG	grayish yellow-green	CX8B9985	H0DD8F17
STOLG	strong olive green	CX264C14	H0DD3094
DEOLG	deep olive green	CX15260D	H0DD1980
MOOLG	moderate olive green	CX45593B	H0DD4A33
DAOLG	dark olive green	CX1F261C	H0DD2127
GROLG	grayish olive green	CX8B9985	H0DD8F17
DAGROLG	dark grayish olive green	CX2E332C	H0DD3012
VIYG	vivid yellowish green	CX16A629	H0F85EC3
BIYG	brilliant yellowish green	CX52CC62	H0F88F8B
STYG	strong yellowish green	CX388C4C	H0F8626D
DEYG	deep yellowish green	CX185920	H0F83994
VDEYG	very deep yellowish green	CX0A260E	H0F81894
VLIYG	very light yellowish green	CX9EEDA8	H0F8C6B0
LIYG	light yellowish green	CX80BF88	H0F89F55
MOYG	moderate yellowish green	CX5D8C64	H0F87533
DAYG	dark yellowish green	CX3B593F	H0F84A33
VDAYG	very dark yellowish green	CX172118	H0F81C2D
VIG	vivid green	CX118044	H10C48C3
BIG	brilliant green	CX4DBF81	H10C8679
STG	strong green	CX2E734E	H10C506D
DEG	deep green	CX143322	H10C246D
LIG	light green	CX6EA688	H10C8A3C
VLIG	very light green	CX99E5BC	H10CBF99
MOG	moderate green	CX4C735E	H10C6033
DAG	dark green	CX364C40	H10C412D
VDAG	very dark green	CX121915	H10C162D
PAG	pale green	CX90A69A	H10C9B1C
VPAG	very pale green	CXBCD9C5	H103CA46
GRG	grayish green	CX63736A	H10C6B12
DAGRG	dark grayish green	CX454C48	H10C490D
BLG	blackish green	CX171918	H10C180D
	Olives		
LIOL	light olive	CX628033	H0CB596D
MOOL	moderate olive	CX47592A	H0CB415D

Color Name	Color Description	RGB	HLS
DAOL	dark olive	CX161911	H0CB1533
LIGROL	light grayish olive	CX838C75	H0CB8118
GROL	grayish olive	CX54594A	H0CB5217
DAGROL	dark grayish olive	CX30332C	H0CB3012
	Oranges		
VIRO	vivid reddish orange	CX803009	H08C44DF
STRO	strong reddish orange	CX8C411C	H08C54AA
DERO	deep reddish orange	CX662F14	H08C3DAA
MORO	moderate reddish orange	CX8C5438	H08C626D
DARO	dark reddish orange	CX663D29	H08C476D
GRRO	grayish reddish orange	CX8C6754	H08C7040
VIO	vivid orange	CXB26306	H0985CEF
BIO	brilliant orange	CXD9892B	H0988281
STO	strong orange	CXA66921	H09863AA
DEO	deep orange	CX80511A	H0984DAA
LIO	light orange	CXD9A465	H0989F99
MOO	moderate orange	CXA67D4D	H0987A5D
BRO	brownish orange	CX80603C	H0985E5D
	Pinks		
VIPK	vivid pink	CXCC1B2B	H06D74C3
STPK	strong pink	CXD9576E	H06D98A1
DEPK	deep pink	CX99293D	H06D6194
LIPK	light pink	CXE599A7	H06DBF99
MOPK	moderate pink	CXBA7C87	H06D9B4F
DAPK	dark pink	CX995C67	H06D7A40
GRPK	grayish pink	CXBA9BA1	H06DAB2F
PAPK	pale pink	CXE5BFC6	H06DD26D
VIYPK	vivid yellowish pink	CXCC2B1B	H07D74C3
STYPK	strong yellowish pinf	CXCC5D52	H07D8F8B
DEYPK	deep yellowish pink	CX993329	H0706194
LIYPK	light yellowish pink	CXE5A099	H07DBF99
MOYPK	moderate yellowish pink	CXBF8580	H07D9F55
DAYPK	dark yellowish pink	CX99615C	H07D7A40
PAYPK	pale yellowish pink	CXE5C5C2	H07DD468
GRYPK	grayish yellowish pink	CXBFA5A2	H07DB130
BRPK	brownish pink	CXBFB9A6	H0A5B22A
STPPK	strong purplish pink	CXB2309E	H0467194

Color Name	Color Description	RGB	HLS
DEPPK	deep purplish pink	CX991F85	H0465CAA
LIPPK	light purplish pink	CXD974C9	H046A691
MOPPK	moderate purplish pink	CXB25FA5	H046895A
DAPPK	dark purplish pink	CX995278	H058754E
PAPPK	pale purplish pink	CXE5B8D0	H058CF79
GRPPK	grayish purplish pink	CXB28FA2	H058A130
BIPPK	brilliant purplish pink	CXD93ABF	H04689AC
	Purples		
VIP	vivid purple	CX6F0980	H0347194
BIP	brilliant purple	CXA030B2	H0347194
STP	strong purple	CX671F73	H0344994
DEP	deep purple	CX3E1745	H0342E80
VDEP	very deep purple	CX170819	H034117F
LIP	light purple	CX9B58A6	H0347F4E
VLIP	very light purple	CXCB74D9	H034A691
MOP	moderate purple	CX6B3D73	H034584E
DAP	dark purple	CX423045	H0343B2D
VDAP	very dark purple	CX181219	H034162D
PAP	pale purple	CXA185A6	H0349528
VPAP	very pale purple	CXD3ADD9	H034C35C
GRP	grayish purple	CX705C73	H034671C
DAGRP	dark grayish purple	CX443C45	H0344012
BLP	blackish purple	CX191719	H034180D
VIRP	vivid reddish purple	CX59064C	H04630DF
STRP	strong reddish purple	CX731F65	H0464994
DERP	deep reddish purple	CX45173E	H0462E80
VDERP	very deep reddish purple	CX190817	H046117F
LIRP	light reddish purple	CX99528E	H046754E
MORP	moderate reddish purple	CX733D6A	H046584E
DARP	dark reddish purple	CX453042	H0463B2D
VDARP	very dark reddish purple	CX191218	H046162D
GRRP	grayish reddish purple	CX73546E	H0466327
PARP	pale reddish purple	CX997092	H046852A
	Reds		
VIR	vivid red	CX33070F	H06D1DC3
STR	strong red	CX731727	H06D45AA
DER	deep red	CX4C1923	H06D3380

Color Name	Color Description	RGB	HLS
VDER	very deep red	CX190A0D	H06D126D
MOR	moderate red	CX732E3A	H06D506D
DAR	dark red	CX40262B	H06D3340
VDAR	very dark red	CX191213	H06D162D
LIGRR	light grayish red	CX997078	H06D852A
GRR	grayish red	CX73545A	H06D6327
LIGRPR	light grayish purplish red	CX997086	H058852A
DAGRR	dark grayish red	CX453C3D	H06D4012
BLR	blackish red	CX191717	H06D180D
VIPR	vivid purplish red	CX4C052C	H05829DF
STPR	strong purplish red	CX731749	H05745AA
DEPR	deep purplish red	CX45122E	H0582C94
VDEPR	very deep purplish red	CX190A12	H058126D
MOPR	moderate purplish red	CX732E53	H058506D
DAPR	dark purplish red	CX452938	H0583740
GRPR	grayish purplish red	CX734C61	H0586033
VDAPR	very dark purplish red	CX191216	H058162D
	Violets		
VIV	vivid violet	CX53098C	H0244BDF
BIV	brilliant violet	CX7930B2	H0227194
STV	strong violet	CX3C1859	H0223994
DEV	deep violet	CX1B0D26	H0221980
LIV	light violet	CX7A5299	H022754E
VLIV	very light violet	CXAC74D9	H022A691
MOV	moderate violet	CX473059	H022444E
DAV	dark violet	CX161219	H022162D
PAV	pale violet	CX877099	H022852A
VPAV	very pale violet	CXCBA8E5	H022C78B
GRV	grayish violet	CX4F4159	H0224D27
	Whites		
YWH	yellowish white	CXE8EDD5	H0C2E166
GWH	greenish white	CXECEDEC	H0F8ED06
PKWH	pinkish white	CXEDDDE0	H06DE54E
PWH	purplish white	CXEBDDED	H034E54E
BWH	bluish white	CXDEDDED	H001E54E
	Yellows		
VIOY	vivid orange-yellow	CXBF9106	H0A563EF

Color Name	Color Description	RGB	HLS
BIOY	brilliant orange-yellow	CXE5B82E	H0A58AC8
STOY	strong orange-yellow	CXBF9926	H0A573AA
DEOY	deep orange-yellow	CX997A1F	H0A55CAA
LIOY	light orange-yellow	CXE5C76B	H0A5A8B4
MOOY	moderate orange-yellow	CXBAA157	H0A5896B
DAOY	dark orange-yellow	CX998547	H0A5705D
PAOY	pale orange-yellow	CXE5D4A1	H0A5C392
DAY	dark yellow	CX99BF1A	H0C26CC3
PAY	pale yellow	CXC6E55C	H0C2A1BA
GRY	grayish yellow	CXA3BF46	H0C2837C
DAGRY	dark grayish yellow	CX839938	H0C26976
VIGY	vivid greenish yellow	CXCDE57A	H0C2B0AD
BIGY	brilliant greenish yellow	CXABBF66	H0C29369
STGY	strong greenish yellow	CX899952	H0C2754E
DEGY	deep greenish yellow	CXD9E5B0	H0C2CB83
VIY	vivid yellow	CXB5BF93	H0C2A942
BIY	brilliant yellow	CX8E996B	H0C2822F
STY	strong yellow	CX80BF1A	H0CB6CC3
DEY	deep yellow	CXAEE554	H0CB9DB0
LIY	light yellow	CX8DBA44	H0CB7F76
MOY	moderate yellow	CX749938	H0CB6976
LIGY	light greenish yellow	CXBDE57A	H0CBB0AD
MOGY	moderate greenish yellow	CX9DBF66	H0CB9396
DAGY	dark greenish yellow	CX7E9952	H0CB754E
GRGY	grayish greenish yellow	CXA9BF86	H0CBA34F
PAGY	pale greenish yellow	CXCBE5A1	H0CBC392

Device Capabilities

Your graphics output device determines the colors that you can use. SAS/GRAPH software translates the color that you specify to the color definition system on your device. It then checks to see if the color is available. If the color is not available, SAS/GRAPH software remaps the color either to a color that closely matches the color you specified or to the next available color in the colors list. The remapping behavior depends on the capabilities of your device.

Graphics devices can be grouped into the following categories:

- □ devices that do not support user-defined colors
- □ devices that support user-defined colors
- □ pen plotters.

You can determine whether your device supports user-defined colors in two ways:

□ Check the documentation for your graphics device.

□ Run the GTESTIT procedure and display picture 1. The OPTS= string indicates if the device supports user-defined colors. If the eighth bit of the first byte in the string is turned on, the device supports user-defined colors. For example, if

OPTS=D582100000000000

then byte 1 is D5. Hexadecimal D5 is equal to

1 1 0 1 0 1 0 1 <— eighth bit is 1

The eighth bit is 1, which means the device supports user-defined colors.

Devices That Do Not Support User-defined Colors

Devices that do not support user-defined colors are those that come with predefined nonalterable color palettes. These devices have a palette of between 1 and 256 predefined colors, but the actual number of colors that can be displayed at one time may be less than that.

When using devices that do not support user-defined colors, you can specify colors using any color-naming scheme; however, any colors that you specify in RGB, HLS, or gray-scale format are remapped to colors in your device's default colors list. Some devices try to match the user-defined color with the closest color in the device's color palette. Others merely remap the color to the next available color in the device's color palette. To avoid having colors remapped, use the colors in your device's default colors list.

Devices That Support User-defined Colors

Devices that support user-defined colors are graphics devices that allow you to configure the colors from the device's color palette. A device in this category may have a palette of over 16 million colors, but it may only be able to display a subset of colors from the color palette at any one time.

On a device that supports user-defined colors, you can use any color-naming scheme to specify colors. If you specify a color that your device does not support, SAS/GRAPH software remaps the color to an available color that is the closest match.

Pen Plotters

The colors you can use with a pen plotter are determined by your set of pens. You specify the color names in the GOPTIONS statement's COLORS= option, then place pens with those color names in the plotter when the following message appears (the message does not appear if you specify the NOPROMPT graphics option):

```
Please mount the following pens: . . .
```

By default, SAS/GRAPH software tries to keep a standard set of pens in the plotter's carousel. If colors in the standard set of pens are named in the COLORS= graphics option, a mount request is issued for the entire standard set, even if all of them are not used in the output. This minimizes the number of times pens must be reshuffled as a graph is being drawn. If GOPTIONS COLORS=(NONE) is used, you are only prompted to mount pens for the colors that are actually used in the output.

Note: You can specify any valid SAS name for a color when using a pen plotter. It does not have to be a predefined or user-defined color name. For example, you can

specify COLOR=PEN3, and you will be prompted to mount PEN3 or SAS/GRAPH software will assume a pen of that color is in the appropriate slot. This feature is often helpful if you are using transparency pens or other special pens. △

Limitations

Using colors in SAS/GRAPH software is limited by the number of colors that you can use in one graph and by the capabilities of your device. The following sections discuss these limitations.

Maximum Number of Colors Displayable in SAS/GRAPH Software

You can use a maximum of 256 unique colors on each graph, including the background color (specified with the CBACK= graphics option or the CBACK device parameter). If you use more than 256 unique names in a program, SAS/GRAPH software issues a warning and remaps the 257th and any subsequent colors to existing color names.

Note: If you specify a color using two different color-naming schemes for the same graph (for example, WHITE and RGB white, CXFFFFFF), SAS/GRAPH software assumes that those two color specifications are different colors. It counts them as two color specifications out of the 256 colors that you are allowed to use on one graph. On some systems, they may appear as different colors if one of them is a DMS (Display Manager) color. △

Maximum Number of Colors Displayable on a Device

The number of colors that you can display is limited by the type of graphics output device that you have. If you generate a graph with more colors than the device can display, the colors that cannot be displayed are mapped to an existing color. You may also receive a note in the SAS log telling you when a color is mapped to another color in the colors list and what color will be used instead.

Although your device may support 256 colors, it may not let you use all of them at once. The MAXCOLORS device parameter tells SAS/GRAPH software the maximum number of colors that can be displayed at one time. If you use more than the number of colors in the MAXCOLORS device parameter, the excess colors are remapped.

Note: The MAXCOLORS device parameter defaults to the number of displayable colors on the basic model of each graphics device supported. If your graphics device can display more colors than the base model, use the PENMOUNTS= graphics option to specify the number of colors that can be displayed. Optionally, you can use PROC GDEVICE to modify the value of the MAXCOLORS device parameter. △

For pen plotters, you use the PENMOUNTS= graphics option to indicate the number of pen holders on the plotter. Using this graphics option does not limit the number of colors that you can specify for a graph that is produced on a pen plotter. If you use more colors than the plotter has pen holders, you will be prompted to change pens unless you have used the NOPROMPT graphics option.

Replaying Graphs on a Device That Displays Fewer Colors

You can use the GREPLAY procedure to display graphs previously generated. Sometimes you may need to replay the graphs on a device that cannot display as many colors as the device on which the graph was originally developed.

When you replay graphs on devices that display fewer colors than are in the graph, two situations may cause problems:

□ specifying colors that the device does not support

□ specifying more colors than the device can display at one time.

If you specify colors on a device that does not support those colors, the colors are remapped to those available for that device. You may also receive a note in the SAS log telling you when a color is mapped to another color in the colors list and what the new color is.

The number of colors that your device can display affects the actual color displayed. If your graphics output device can generate a maximum of 64 distinct colors and your graph contains 256 colors, the 65th through the 256th color specifications are remapped to the device's available colors and may not display as the color you specify.

You can use the TARGETDEVICE= graphics option to preview the way a graph is going to look on a different device. You set this graphics option to the device entry name of the device driver that will be used later. The graph is displayed as close as possible to the way it will display when the other device is used.

Note: When you use the TARGETDEVICE= graphics option, SAS/GRAPH software uses the colors list of the target device as the default colors list; any color that you explicitly use is displayed when you preview the graph, although the target device may cause the color to be mapped. Refer to "TARGETDEVICE" on page 393 for complete information about the TARGETDEVICE= graphics option. △

Trueness of Color Displayed on a Device

The size of the color palette in your device determines the trueness of the color that is actually produced. For example, a device with a palette of 64 colors can only produce colors that contain a combination of four shades of red (including *no* red), four shades of green (including *no* green), and four shades of blue (including *no* blue). Consequently, color specifications CX008080, CX258080, and CX3F8080 will all look the same (no red). CX408080 through CX7F8080 will look redder; CX808080 through CXBF0000, redder still; and CXC08080 through CXFF8080, the reddest. Larger palettes have more color resolution but may not have more simultaneous colors.