Exporting SAS/GRAPH to Other Packages
What Format Should I Choose?
(Version 6 of the SAS System)

I. Introduction

(Paraphrased from Graphics File Formats by David Kay and John R. Levine).

Graphics from SAS/GRAPH can be stored in basically two different representations: the Vector format family and the Bitmap format family, (also called raster or pixel maps). These families have distinct advantages and disadvantages depending on what you wish to do. Before we get started, a few definitions are in order.

A. Definitions

1. Vector files

Vector representation means describing a picture as a series of discrete shapes or lines, such as a circle, a dashed line, square or polygon, and text. Some of these objects will also have descriptions of how these shapes are filled. Strictly speaking, the word "vector" actually refers to a line, but the popular meaning includes any shape in a graph. In this paper, page description languages such as Encapsulated PostScript are also included in this family. File types included in this family are CGM (Computer Graphics Metafile), HPGL (Hewlett Packard Graphics Language), EPS (Encapsulated PostScript), and WMF, (Windows Metafile). EPS, CGM, and WMF have bitmap representations as well, but are generally not used for exporting. Some of these formats can also be combined, which will be described later. These types of formats are best used for graphical charts such as bar charts or plots.

2. Bitmap files

Bitmap representation means that an picture has basically been broken into a grid of very small elements called *pixels*. The lightness and color value of each element or piece is recorded individually. Typically, the data point position in the grid or field determine what the pixel represents. In other words, the data points map to the image, which is where the name *bitmap* comes from. Filetypes of this family include GIF (Graphics Interchange Format), TIFF (Tagged Image File Format), PCX, (PC Paintbrush), and several others. This type of format is best used for photographic pictures and other complex graphical images.

B. Comparative Advantages and Disadvantages of Bitmap vs. Vector Formats

1. Advantages of Bitmaps

A. Ease of Manufacture

Bitmaps can record just about any conceivable graph such as a picture because any picture can be broken into a grid. They can be colorful and they can be animated in some cases such as in an Animated GIF file. They can also be easy to obtain via any screen capture program or digital camera. In SAS/GRAPH, you can simply select FILE=>Export on most platforms to create a bitmap file.

2. Disadvantages of Bitmaps

A. Image Size

A high resolution color image file can be many megabytes in size depending on the color depth that it was stored in.

B. Depth Complexity

The ability to display these images varies from computer to computer depending on the video display and the color depth set on the video display driver itself or the imaging software.

C. Lack of flexibility

1. Editing capability

The pixels in a bitmap do not have any relationship to one another. So, if you want to manipulate any portion of the image, the editing program has to do something complex, such as finding all of the pixels that match the same color. Even this operation can often be inadequate for some editing.

2. Fixed Resolution

When an image is created, it is created with a certain number of pixels across and down. If you attempt to enlarge an image, the pixels will become large enough to see their rectangular shape, an effect known as *aliasing* or *staircasing*. Some graphics programs can compensate for this problem by interpolating between the pixels (known as *anitailiasing*). Likewise, when you shrink an image, it often loses resolution because the program has to decide what pixels to throw away to make it fit. If you decide to resize it again after shrinking it, the image can be fuzzy and aliased, and shaded areas may appear patterned. The size of an image can also change depending on the device it is displayed or printed on.

1. Advantages of Vector Files

a. Efficiency of Storage

Rather than having to store an object as a collection of disconnected pixels, a vector file can store an object as a command. For example, a line could be described as two end points, or text be described as an actual text string.

b. Ease of Manipulation

Because each object is discrete, they can be changed easily by selecting them. Moving them on the page is also much easier.

c. Variable Resolution and Sizing

Because each object is a description rather than a collection of pixels, resolution is generally not a problem. The graph can be resized easily and displayed or printed on just about any device without the loss of resolution.

2. Disadvantages of Vector Files

Vector files have more limitations in what they can store, such as charts, plots or maps. If you attempted to store a picture in this manner, you would be storing thousands of very small polygons.

II. What Kind Of Formats Can SAS/GRAPH Generate?

SAS/GRAPH can generate output in several types of vector files on all platforms, and several bitmap formats on most platforms (the exceptions are the Mainframe and VAX Release 6.09e releases, which can only generate GIF files).

The following vector formats can be generated from SAS/GRAPH for export. The first four languages are most commonly used and will be discussed here.

CGM	Computer Graphics Metafile
PS and EPS	PostScript and Encapsulated PostScript
WMF	Windows Metafile – (available on Windows Platforms only)
HP-GL	Hewlett Packard Graphics Language
PCL	Page Control Language

The following bitmap formats can be generated from SAS/GRAPH for export:

BMP	Microsoft Windows Device Independent Bitmap v 1.0 and 2.0
DIB	Device Independent Bitmap
EPSI	Encapsulated PostScript Image Interchange
GIF	Graphics Interchange Format – both 87 , 89 and animated versions
MET	OS/2 Metafile (OS/2 only)
PBM	Portable Pixmap
TIFF	Tagged Image File Format (monochrome and color)
WMF	Windows Metafile Image (Windows only)
XBM XPM	X11 Bitmap and Pixmap (Unix only)

III. An Overview of the Vector File Formats

A. Computer Graphics Metafiles (CGM)

The Computer Graphics Metafile is intended to be a vendor neutral and hardware neutral interchange format between packages. CGM is a very rich format providing support for most hardware shapes including lines, circles, arcs, polygons, and text. It has three encoding variants: Binary, which is used in 99 % of all applicatons and is generally unreadable; Character, which contains a compressed form of the language in character; and CLEAR TEXT, which generates a verbose version.
Multiple pictures can be placed in a single metafile. The beginning of the Computer Graphics Metafile generally contains a BEGIN METAFILE header, followed by a BEGIN PICTURE for each picture contained in it. The end of each picture will have an END PICTURE at the end of the METAFILE.

1. Advantages of a Computer Graphics Metafiles

A. Complexity and Manipulation

The Computer Graphics Metafile is very rich in its description of circles, arcs, text, and polygons. Because of this, imported graphics of this type are easier to manipulate than most other formats. Polygon interiors can be changed, along with the color and style of any object.

B. Scalability

The Computer Graphics Metafile can be stretched or shrunk to any size or shape without losing resolution.

C. Hardware font Availability

Computer Graphics Metafiles can incorporate many different fonts depending on the CGM interpreter in the receiving package. These can be specified in SAS by using Font=HWCGMxxx, where xxx matches the font number in the driver.

D. SAS/GRAPH Importation

SAS/GRAPH can import Computer Graphics Metafiles fromother hosts using the GIMPORT procedure.

E. Availability

The CGM drivers can run on any platform from Release 6.04 and beyond.

F. Availability of Custom Drivers in SAS/GRAPH

The SAS System is equipped with multiple customized drivers to export SAS/GRAPH to other software packages. Each driver is customized for that particular package, and how to export the graph to the other package is extensively documented. In addition, the newer documents describe how to export other file formats such as HPGL, EPS, WMF, and image files to a particular package. If the driver is not available on your release, it can be built easily using the Technical Support Note associated with that package. The documents are listed in reverse order because the drivers for the latest packages were created last. You can access www.sas.com/service/techsup/tnote_graph to get copies of all of these documents. A subset of the most frequently requested drivers is shown below.

Commonly Requested Drivers by Package
(Note: all of the Technical Support Notes can be found on the Web).

TSNOTE Number	Package	Driver
TS252Z	Corel Word Perfect Office Suite 8 (WordPerfect, Quattro Pro and Presentations)	CGMWP80L, CGMWP80P
TS252Y	Lotus Smart Suite 97 (WordPro, 1-2-3, and Freelance)	CGMLT97L CGMLT97P
TS252X	Microsoft Office 97 (Word, Excel, and PowerPoint)	CGMOF97L CGMOF97P
TS252W	PaintShop Pro for Windows	CGMPSP
TS252V	Exporting SAS/GRAPH to Macintosh Apps.	Several
TS252U	WordPerfect for Unix	CGMWPUXL
TS252T	Harvard Graphics 3.0 for Windows	CGMHG3L, CGMHG3P
TS252S	WordPerfect 6.1 and 7.0 for Windows (WordPerfect and Presentations)	CGMWP61L, CGMWP61P

TSNOTE Number	Package	Driver
TS252R	Corel Draw 5.0 for Windows	CGMCOR5L, CGMCOR5P
TS252Q	Microsoft Excel 5.0 and 7.0 for Windows	CGMME5C*
TS252P	WordPerfect 6.0 A for Windows	CGMWP6CA
TS252O	WordPerfect 6.0 for Windows	CGMWP6C
TS252N	Lotus 1.2.3 4.0 for Windows	CGM123C
TS252L	Microsoft Word 6.0 and Word 7.0	CGMMW6C
TS252K	Lotus Freelance 2.0 for Windows	CGMFL2C
TS252E	Microsoft PowerPoint (all versions before Office 97)	CGMMPPA*

* The driver for Microsoft Word can be used for Excel and PowerPoint and vice-versa.

2. Disadvantages of a Computer Graphics Metafiles

A. Font Disparities and Customization

The Computer Graphics Metafile has no standard for its font families. As a result, every Computer Graphics Interpreter is a bit different in the font families that it uses and these can change depending on the release of the product. A CGM file created for one package may not work on another.

B. Lack of Double Sided Polygons

Double sided polygons are polygons with a hole in the middle of them. An example of this is the letter B in the SWISS font generated by SAS/GRAPH. As a result, these letters in the SWISS, ZAPF, and other filled font families are generated with a series of moves and draws. If you use these fonts, the output file may become very large. The use of a similar hardware font can reduce the size of the file at least ten-fold. A similar problem can occur in Areafill charts.

C. Fills Have Borders

When a rectangle fill is created, it is created with a fill and a border. Therefore, this type of fill must be grouped before it is moved.

D. Hardware Font Specification

If you want to use a hardware font, you must specify it using the HWCGMxxx font specification. These fonts are not displayable on your screen and can only be used when writing a graph to a Computer Graphics Metafile.

B. Windows Metafiles

The Windows Metafile was invented by Microsoft® Corporation as a way of transporting graphics between Windows applications. A Windows Metafile is a list of Microsoft Windows graphical function calls. Only a subset of the total calls is allowed, but it is a large subset containing most of the calls. A Windows metafile contains a short header followed by some records. Each record corresponds to a Windows graphics device interface call (GDI). Because of its Windows-dependant nature, the SAS system can create this type of file on Windows versions of SAS. The following table documents where you can get more information on using Windows Metafiles with your package:

Package	Document
Microsoft Office 97	TS252X
Microsoft Office 95	TS352C
Lotus SmartSuite 97	TS252Y
Corel WordPerfect Suite 8	TS252Z
Any other release of software	TS352C

I. Creating Windows Metafiles:

A. Introduction and general techniques

You can create Windows Metafiles interactively or noninteractively in Release 6.11 and beyond on Windows, Windows 95, and Windows NT platforms. The interactive method exports the Windows Metafile directly from your screen. The non-interactive method generates a graphics stream file containing the Windows Metafile language using the WMF driver. Each method has advantages and disadvantages.

B. Noninteractive Method

To create a graphics stream file containing Windows Metafile code, you can use the following GOPTIONS with most SAS/GRAPH procedures. *Note: if you want to use hardware text, do not specify GOPTIONS HPOS or VPOS when running noninteractively.*

FILENAME *fileref* 'directory\filename.wmf';
GOPTIONS DEVICE=WMF GSFNAME=*fileref* GSFMODE=REPLACE;

Advantages of the Non-Interactive Method

1. You can create several graphs at once.
2. You can control the height and width of the graph before importing the picture into the application.

Disadvantages of the Non-Interactive Method

1. The GOPTIONS HPOS and VPOS cannot be used if you want to use hardware text
2. The CHARTYPE= GOPTION and HWDMX fonts cannot be used with the WMF driver (at least at this moment), except for the SAS monospace font.

C. Interactive Method

Note that steps 1, 2, and 3 only have to be done the first time you use the Windows Metafile driver and even then it is not required if you do not need to use hardware fonts.

1. In SAS, select **Help**=>**Utility Application** and select the "**Font Utility Application**"
2. Allow SAS to load hardware fonts into your WIN device driver catalog entry.
3. Use the GDEVICE procedure and look at the CHARTYPE screen of your WIN device driver catalog entry to see which hardware fonts are available. You can then use them in your graph by specifying HWDMX*xxx* where *xxx* is the number on the CHARTYPE screen associated with the desired font. You can also specify GOPTIONS CHARTYPE=*number* where the number matches the number specified on the screen. A monospace font such as the Courier font will give the best results. Sample code showing this specification is given below. The first title will generate the font found in character position 27 on your CHARTYPE screen. The second title will be generated in the font found in character position 7 on your CHARTYPE screen. The fonts will vary depending on the fonts that were loaded by the font utility into your WIN device driver catalog entry**.**

```
GOPTIONS DEVICE=WIN CHARTYPE=7;
TITLE FONT=HWDMX027  'This is Times Roman';
TITLE2 FONT=NONE  'This is CHARTYPE 7';
```

4. After the graph is displayed on your screen, select **File=>Export** from the top menu bar of the graph screen.
5. Select **WMF** from the dialog box, the name of your file, and select **OK**.

Advantages of the Interactive Method

1. The GOPTIONS HPOS and VPOS can be used with hardware text.
2. The CHARTYPE= GOPTION and HWDMX fonts can be used because the WIN device driver supports them.

Disdvantages of the Interactive Method

1. You can only create one Windows Metafile at a time.
2. You cannot control the height and width of the graph before importing the picture into the application; however, you can resize the graph after you import it.

II. Comparison of WMF files to CGM files

A. Advantages of Windows Metafiles:

1. Double sided polygons are supported which makes the manipulation and appearance of software text much better in Windows Metafiles than in Computer Graphics Metafiles.
2. Bar fills are single objects instead of a fill surrounded by a border. This can make them easier to manipulate. In addition, rectangle fills using the X1, L1, or R1 patterns are also hardware rectangle fills.
3. It is very easy to export a Windows Metafile; simply select **File**=>**Export** from the GRAPH or Graphics Editor window (interactive method). This allows for a WYSIWIG model.

4. There are generally more hardware fonts available (interactive method). You should modify your WIN device driver by using the **Help⇒Utility** pulldown and selecting the SAS/GRAPH Font Utility. This will place the TrueType fonts available on your computer into the CHARTYPE entry screen of your device driver. You can access these fonts by using the HWDMX*xxx* font, where *xxx* is 001-165, depending on how many fonts you have loaded into your WIN device driver.
5. You can specify the size of the graph in SAS using the GOPTIONS HSIZE= and VSIZE= options if you create the WMF file non-interactively.

B. Disadvantages of Windows Metafiles:

1. Windows Metafiles can only be generated on the Windows, Windows 95, and Windows NT platforms. Computer Graphics Metafiles can be generated on any platform and any version of the SAS system. .
2. Font sizes are not the same height in the Windows Metafile as on the original screen. In general, they will be smaller than on the original graph.
3. The fonts available to your WIN device driver will vary depending on the fonts installed on your PC. This can make portable PC applications difficult.
4. WMF graphics cannot be resized in Microsoft Excel. If you need this capability, you should create the WMF file noninteractively with HSIZE and VSIZE specifications.
5. The background color cannot be changed in Excel. Use the GOPTIONS CBACK=*color* on your graph to get the desired background color.
6. Corel products will often remap the fonts in WMF files to another font.
7. To place a full sized graph into Microsoft Word, you must double click on it to make the entire graph visible. Sometimes when this is done polygons may deform. For best results, you should insert a Windows Metafile into Microsoft PowerPoint first if it is available.

C. Encapsulated PostScript

Encapsulated PostScript, or EPS is the major form of PostScript used to exchange graphics from one package to another. It cannot have more than one page of information in it. SAS/GRAPH can generate this format in two different ways depending on the platform. You can either use the PSEPSF, PSLEPSFC, or similar SAS/GRAPH based drivers, or on the PC or UNIX platforms you can use the WINPRTC or XPRINTC drivers with Host based drivers provided by the vendor. Encapsulated PostScript can also have several variants as far as the format involved:

1. A vector file with PostScript commands in them (this can be generated on any SAS platform).
2. A bitmap file that usually is in a TIFF style format, (this can be generated on PC, Alpha/VMS, and UNIX platforms).
3. A combination of both. Normally, the bitmap or WMF part is called a header. This requires Ghostview to display the graph and which will be discussed later.

I. Creating an Encapsulated PostScript Vector File

The following GOPTIONS can be used to generate an Encapsulated PostScript file in SAS.

```
FILENAME fileref 'yourfile.eps';
GOPTIONS DEVICE=PSEPSF or PSLEPSFC (color) GSFNAME=fileref
GSFMODE=REPLACE;
```

where the *fileref* name can be any name of eight characters or less, as long as the filerefs on both the FILENAME statement and the GOPTIONS statement match each other.

PC Platforms only

PC platforms can also generate an Encapsulated PostScript file using the Windows drivers that are installed on your PC. It does require that you install a PostScript driver on your PC. To create a Graphics Stream File (GSF), use the SYSPRINT system option to specify the name of the GSF and the Windows driver. For example:

```
OPTIONS SYSPRINT='C:\GRAFOUT.EPS' 'POSTSCRIPT PRINTER';
GOPTIONS DEVICE=WINPRTG;
PROC GTESTIT;
RUN;
```

The first parameter of the SYSPRINT option is any valid DOS file specification, enclosed in quotes. The second parameter is the name of the Windows printer driver exactly as it appears in the SAS Print Setup window, enclosed in quotes. There must be at least one space between the two quoted parameters. When creating a GSF in this manner, it is not possible to append information to a file. For example, in the above application, the GTESTIT procedure produces three graphs, but only the last one will reside in the GSF. Beginning with Release 6.12 of the SAS System, multiple graphs will be appended to a GSF when using BY-group or RUN-group processing within the same procedure. However, graphs will not be appended to the same GSF across multiple procedures.

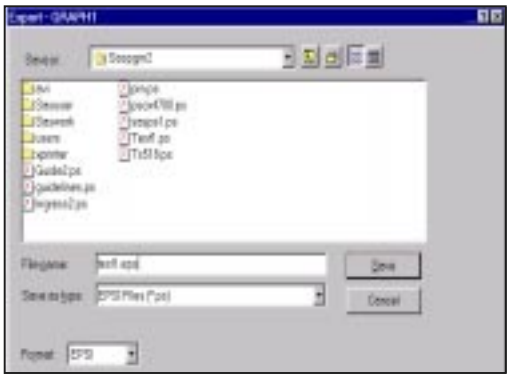
You can also specify 'FILE:' as the first parameter of the SYSPRINT option when creating a GSF. For example:

```
OPTIONS SYSPRINT='FILE:' 'POSTSCRIPT PRINTER';
GOPTIONS DEVICE=WINPRTG;
PROC GTESTIT;
RUN;
```

This will cause you to be prompted to specify a file name in a dialog box for each of the three graphs produced by the GTESTIT procedure. A separate file containing each graph will be created.

II. Creating an Encapsulated PostScript Bitmap File (Non Mainframe Only)

You can also generate bitmap PostScript files from SAS, but will not display as clearly as vector files. They also suffer from the same problems that other bitmap files do regarding resolution and scaling. The easiest way to create a bitmap PostScript file is to select **File=>Export** from the graphics window and select EPS as the filetype as shown below:



On Windows platforms, you can also generate a bitmap file by using a Windows PostScript printer and select the print as bitmap tab from the Print dialog box as shown in the illustration on the right.

III. Advantages and Disadvantages of Encapsulated PostScript

Advantages of Encapsulated PostScript

1. Consistency across all platforms and packages. The graph will look the same on one platform as another and can be created on almost any platform.
2. Richness of hardware fonts. Encapsulated PostScript has multiple fonts that are fairly consistant across all platforms.
3. Ease of printing. In most cases, the graph itself can be printed as well as embedded into other packages.
4. The graph can be converted to a PDF file for easy viewing with Adobe Acrobat Distiller.
5. Double sided polygons are supported. This means that the SWISS fonts and other fonts in SAS are smoother than in a CGM file.

Disadvantages of Encapsulated PostScript

1. A graph containing vectors only cannot be viewed in the receiving package. In general, when a graph is imported into a word processing package, it appears as a gray box with a message that indicates that this is a PostScript file. If you have Ghostview, you can get around this problem. This will be discussed later in this document.
2. Documents and Graphics output that contains one of these files can only be printed on a PostScript compatible printer.
3. Graphics, even when they are viewable, can only be manipulated but the individual objects cannot be edited in any way. If you attempt to edit a viewable graph a warning will be issued that the PostScript portion will be lost.
4. Creating a PostScript importer is a complex business and varies depending on the package.

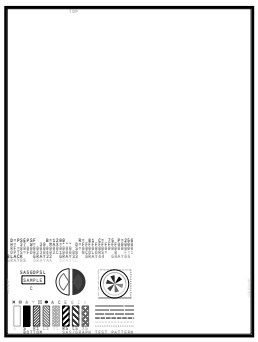
IV. How to Make EPS Files Viewable

When you import an Encapsulated PostScript vector file into another application the, graph will not be visible. Instead, the following message:

"File contains data for PostScript Printers" (or a similar message depending on the package)

will appear in an outline box. The box can be scaled or resized but cannot be edited. You can make the graphics viewable by using a third party PostScript viewer called Ghostview. You can download a copy of this from the internet or from SAS Institutes Web site at **http://www.sas.com/service/techsup/tnote_cindex.html .**
After you install Ghostview on your PC, you can do the following to make the Encapsulated PostScript file viewable.

1. Open Ghostview and open the EPS file.
2. Select **Edit=>Add EPS Preview=>Windows Metafile**
3. Save your graph. You will notice that the file size is considerably larger because the graph now has a Windows Metafile preview on it.
4. Insert the graph into the package.



It will now be viewable and scalable and will look similar to the graph shown on the left. You can stretch this to any size or shape. The Encapsulated Postscript drivers create a portrait graph. However, if you attempt to edit individual portions of the graph you will only retain the Windows Metafile and the PostScript portion will be lost

IV. Creating Landscape Graphics for Export

You cannot use GOPTIONS ROTATE=LANDSCAPE to create a landscape image in your receving graphics package. The graph will be turned 90 degrees vertical if you do this. You can use the rotation tools in the receiving package to spin the graph or you can create a landscape Encapsulated PostScript driver by using the GDEVICE procedure as shown below:

```
libname gdevice0 'your directory';
proc gdevice nofs c=gdevice0.devices;
delete psland;
copy psepsf from=sashelp.devices newname=psland;
modify psland
description='PostScript full land'
hsize=11.0
vsize=8.5
lrows=40
lcols=100
prows=40
pcols=100
horigin=0
vorigin=0
xmax=11.0
ymax=8.5
xpixels=3300
ypixels=2550
charrec=  ( 1,40,100,'/Courier',                      'Y',
            2,40,100,'/Courier-Oblique',              'Y',
            3,40,100,'/Courier-Bold',                 'Y',
            4,40,100,'/Courier-BoldOblique',          'Y',
            5,40,100,'/Times-Roman',                  'Y',
            6,40,100,'/Times-Italic',                 'Y',
            7,40,100,'/Times-Bold',                   'Y',
            8,40,100,'/Times-BoldItalic',             'Y',
            9,40,100,'/Helvetica',                    'Y',
           10,40,100,'/Helvetica-Oblique',            'Y',
           11,40,100,'/Helvetica-Bold',               'Y',
           12,40,100,'/Helvetica-BoldOblique',        'Y',
           13,40,100,'/Symbol',                       'Y',
           14,40,100,'/AvantGarde-Book',              'Y',
           15,40,100,'/AvantGarde-BookOblique',       'Y',
           16,40,100,'/AvantGarde-Demi',              'Y',
           17,40,100,'/AvantGarde-DemiOblique',       'Y',
           18,40,100,'/Bookman-Demi',                 'Y',
           19,40,100,'/Bookman-DemiItalic',           'Y',
           20,40,100,'/Bookman-Light',                'Y',
           21,40,100,'/Bookman-LightItalic',          'Y',
           22,40,100,'/Helvetica-Narrow',             'Y',
           23,40,100,'/Helvetica-Narrow-Bold',        'Y',
           24,40,100,'/Helvetica-Narrow-BoldOblique', 'Y',
           25,40,100,'/Helvetica-Narrow-Oblique',     'Y',
           26,40,100,'/NewCenturySchlbk-Roman',       'Y',
           27,40,100,'/NewCenturySchlbk-Bold',        'Y',
           28,40,100,'/NewCenturySchlbk-Italic',      'Y',
           29,40,100,'/NewCenturySchlbk-BoldItalic',  'Y',
           30,40,100,'/Palatino-Roman',               'Y',
           31,40,100,'/Palatino-Bold',                'Y',
           32,40,100,'/Palatino-Italic',              'Y',
           33,40,100,'/Palatino-BoldItalic',          'Y',
           34,40,100,'/ZapfChancery-MediumItalic',    'Y',
           35,40,100,'/ZapfDingbats',                 'Y');
run;
quit;
```

D. Hewlett Packard Graphics Language (HP-GL)

I. Introduction

HP-GL is the official command language for Hewlett Packard Pen Plotters. Because of the great acceptance of HP Plotters and Printers in the workplace, it has become a standard that is widely used in CAD and Architectural drawing applications. SAS/GRAPH also has several different drivers that can generate HP-GL of several different varieties and complexities.
This graphics language originated in the mid seventies with the HP7400 and HP7500 series of plotters. The language itself is comprised primarily of readable ASCII characters that can be easily decoded. In 1990 HP-GL/2 arrived to support LaserJet and DeskJet printers.
One of the main additions to HP-GL/2 is a palette extension to support color DeskJet printers and the Dual Context extension which allows HP-GL/2 to work with LaserJet printers more smoothly.

II. Advantages and Disadvantages of HP-GL

Advantages of HP-GL

1. Widespread standard that is well known to most packages.
2. Strong polygon and polyline support. SAS fonts have a fairly smooth appearance.
3. Drivers are available on all platforms and have been debugged for a long time.
4. Hardware font is fully scalable and rotatable.
5. Imported graphics can be resized and reshaped.

Disadvantages of HP-GL

1. Colors are understood as a series of pens, so mapping the correct colors will vary depending on the receiving package. See the specific TS-252x document that maps to your package.
2. Lack of multiple hardware font support. Most of the time, there is only one hardware font that can be accessed and that maps differently depending on the package.
3. There are at least 25 variants to HP-GL depending on the driver standard that the vendor chooses.
4. Language can be quite verbose depending on the encoding used.
5. Graphics have a plotted appearance when imported.
6. Polygon fills and pie slices occasionally have stray lines that may need to be removed.

III. Common HPGL Drivers that can be used in SAS/GRAPH

HP7470 – 2 pen support, no polygon support
HP7475 – 6 pen support, no polygon support
HP7550 – 8 pen support, full polygon support
HP7575 – 8 pen support, D sized paper, full polygon support

III. Bitmap Formats

A. Introduction

SAS/GRAPH can also generate bitmap files in several formats. The most popular formats are GIF (Graphics Interchange Format), BMP (Windows Bitmap), TIFF (Tagged Image File Format), and JPEG (Joint Photographers Export Group). These can be generated interactively and in batch. The GIF file format is very useful for Web applications.

The following bitmap formats can be generated from SAS/GRAPH for export:

BMP	Microsoft Windows Device Independent Bitmap v 1.0 and 2.0
DIB	Device Independent Bitmap
EPSI	Encapsulated PostScript Image Interchange
GIF	Graphics Interchange Format – both 87 , 89 and animated versions
MET	OS/2 Metafile (OS/2 only)
PBM	Portable Pixmap
TIFF	Tagged Image File Format monochrome and color
XBM XPM	X11 Bitmap and Pixmap (Unix only)

B. Generating Bitmap files Interactively

You can generate a bitmap file from SAS/GRAPH by selecting **File⇒Export** from the Graphics or Graphics Editor window. This will work on any non-mainframe platform. You can also export from the Image Editor window. For more information see Techinical Support Note TS352B, and TS352C for more information on the interactive method. You can download these documents at **http://www.sas.com/service/techsup/tnote_graph.html**

Under Windows Release of the SAS system you can also create a bitmap by selecting **File=>Print** from the Graphics window and check the bitmap box as shown in the illustration below:

C. Drivers available for Non-interactive mode

1. Release 6.12 Systems

Driver	Designation	Size
BMP	Windows Bitmap	640 x 480
BMP20	Windows Bitmap V2.0	640 x440
GIF	Graphics Interchange Format	800 x 600
GIFANIM	Graphics Interchange Format 89A Animated	1280 x 1024
GIF160	Graphics Interchange Format	160 x 120
GIF260	Graphics Interchange Format	260 x 195
GIF373	Graphics Interchange Format	373x 280
GIF570	Graphics Interchange Format	570 x 480
GIF733	Graphics Interchange Format	733 x 550
IMGBMP	Windows Bitmap Format	615 x 345
IMGGIF	Graphics Interchange Format	615 x 345
IMGJPEG	Joint Photographics Experts Group	615 x 345
IMGPAINT	PCX PC Paintbrush – Size 615 x 344	615 x 344
IMGPBM	Portable Bitmap Format	615 x 345
IMGPPM	Portable Pixmap Format	615 x 345
IMGTIFB	Tagged Image File Format Uncompressed	615 x 345
IMGTIFG3	Tagged Image File Format Group 3	615 x 345
IMGTIFG4	Tagged Image File Format Group 4	615 x 345
IMGTIFP	Tagged Image File Format Color Uncompressed	615 x 345
TIFFB	Tagged Image File Format Compressed	615 x 345
TIBBBII	Tagged Image File Format Byte Order II	615 x 345
TIFFBMM	Tagged Image File Format Byte Order MM	615 x 345
TIFFP	Tagged Image File Format Color Uncompressed	615 x 345

2. Release 6.09 Systems

GIF	Graphics Interchange Format	800 x 600
TIBBBII	Tagged Image File Format Byte Order II	600 x 450
TIFFBMM	Tagged Image File Format Byte Order MM	600 x 450

D. Generating Bitmap Files Noninteractively

When creating these files, the .EXT should match the file that you are using such as .GIF when using a GIF driver or .BMP when using a BMP drivers. When downloading or uploading these files to other hosts, you should use a BINARY upload or download.

1. PC Systems

```
GOPTIONS DEVICE=yourdriver GACCESS='SASGASTD>‘drive:\directory\filename.ext'
    GSFMODE=REPLACE;

    or

FILENAME fileref  'drive:\directory\filename.ext';
    GOPTIONS DEVICE=yourdriver GSFNAME=fileref GSFMODE=REPLACE;
```

2. Unix Systems

```
GOPTIONS DEVICE=yourdriver GACCESS='SASGASTD>/directory/filename.ext'
    GSFMODE=REPLACE;

    or

FILENAME fileref  '/directory/filename.ext';
GOPTIONS DEVICE=yourdriver GSFNAME=fileref GSFMODE=REPLACE;
```

3. Alpha/VMS and VMS Systems

```
FILENAME fileref  '/directory/filename.ext' GSFCC=NONE;
    GOPTIONS DEVICE=yourdriver GSFNAME=fileref GSFMODE=REPLACE;
```

4. MVS Systems

```
GOPTIONS DEVICE=yourdriver GSFNAME=fileref GPROTOCOL=SASGPASC
      GSFLEN=80  GSFMODE=REPLACE;

TSO 'ALLOC F(fileref) DA(filename) LRECL(137) RECFM(V B)
        SPACE(prim,sec) units ';

    or

FILENAME filref  'logonid.filename' LRECL=137 RECFM=VB  SPACE=(prim,sec) units;
```

5. CMS Systems

```
GOPTIONS DEVICE=yourdriver  GSFNAME=fileref GPROTOCOL=SASGPASC
            GSFLEN=80 GSFMODE=REPLACE;

FILENAME fileref 'fn ft fm';
```

This will create a file with LRECL 80 and a RECFM of V.

IV. Creating Graphics for the Web

A. Introduction

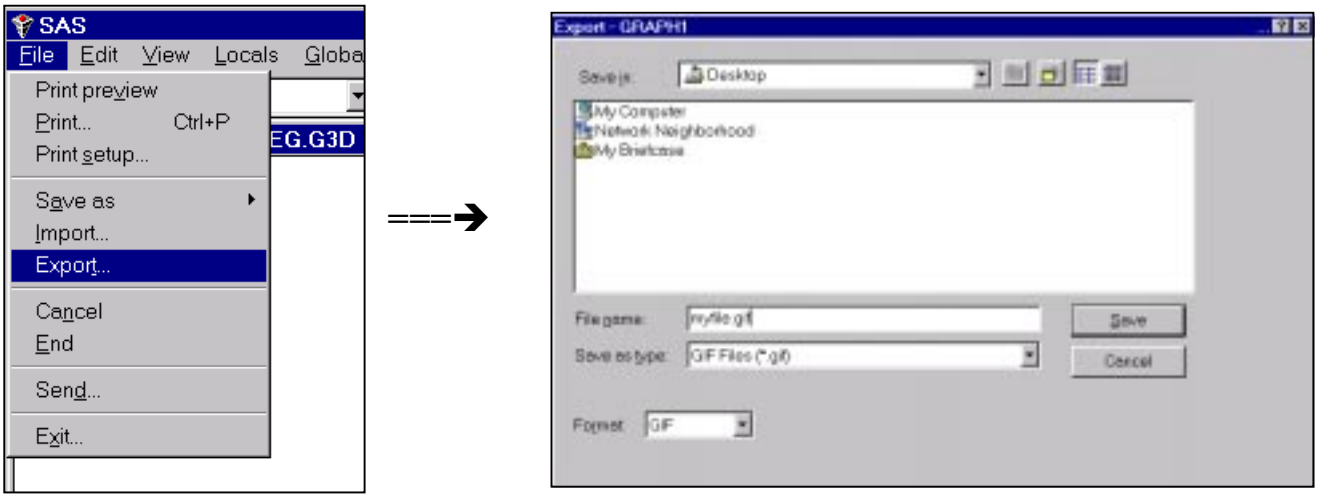
Note: an excellent web page for this information is located at:

http://www.sas.com/rnd/web/publish.html

The most commonly used format for exporting graphics to the Web is the GIF format. There are 4 different types of GIF drivers: the GIF interactive export driver which is selected by selecting **File=>Export** from the screen; the IMGGIF driver; the GIF driver; and the GIFANIM, which generates animated GIF files.

B. The Screen Image Export Driver

The Image Export driver takes whatever graphics window is available and turns it into a bitmap. The bitmap is the same size as the original screen. To use it, select **File=>Export** from the Graph, Graphics Editor or Image window and save the file as shown below:



Advantages of the Screen Image Export Driver

1. If you use hardware fonts on the screen, then these are captured in the driver. To generate hardware fonts on Windows platforms, see the Windows Metafile section under "Interactive method".
2. Use of the driver is easy. Simply select **File=>Export** from any window.

Disadvantages of the Screen Image Export Driver

1. You can only generate one image file at a time.
2. Sizing can be difficult depending on the GRAPH window used at the time. You need to set the size of the graph window before exporting.

C. Generating GIF files with drivers in Non-interactive mode

You can generate GIF files using the GIF and IMGGIF drivers in non-interactive mode. This can allow you to generate multiple graphics at the same time. See section III D. "Generating Bitmap Files Non-Interactively" for more details on the specific GOPTIONS for your system.

Advantages of Generating GIF files Non-interactively

1. Multiple graphics

When you run in non interactive mode, you can create as many GIF files as you wish.

2. Transparency

You can build a transparent GIF driver that allows other objects to bleed through. See section E below for more information.

3. Sizing

You can use the GOPTIONS HSIZE and VSIZE to size image files or use the macro IMGSIZE to size the graph according to the pixel size. As shown below:

```
/*    | The IMGSIZE macro lets you modify the size of the image area
      |    in pixel units.
      |    Notes:
      |       1. The dots per inch value (dpi) should be the same as
      |          that used by the driver (dpi=xpixels/xmax).
      |       2. The maximum width and height values specified as
      |          parameters should not exceed the xmax and ymax values
      |          of the device used. The default values used below
      |          are arbitrary.      */

     %macro IMGSIZE(w=1280, h=1024, dpi=95, rows=43, cols=83);
        %if &dpi<=0 %then          %put DPI must be greater than zero.;
        %else %do;
           goptions hsize=%sysevalf(&w/&dpi)in vsize=%sysevalf(&h/&dpi)in
                    hpos=&cols                vpos=&rows;       %end;
     %mend IMGSIZE;

     filename out 'sample.gif';
     goptions dev=gif gsfname=out gsfmode=replace;
     %imgsize(w=300, h=200, dpi=95, rows=30, cols=50);
     proc gtestit pic=1;run;
```

Disadvantages of Generating GIF files Non-Interactively

1. Lack of Hardware Font Support

The GIF drivers do not support hardware fonts until Version 7

.

2. Inability to Preview the Graphics

The drivers do not display to the screen by default. However you can use the GOPTION TARGETDEVICE=*gifdriver* to display the graph to your screen as it would appear in the GIF file.

D. The IMGGIF driver

The IMGGIF driver is available on PC, UNIX, and Alpha/VMS hosts from Release 6.09 and beyond. The IMGGIF driver will generate a graph with a black background with white text by default. The size of the file in pixels will vary depending on the host. The UNIX host creates this at 800 x 600 pixel resolution and the PC host creates this at a 615 x 345 dpi resolution. Transparency is not supported and output can only be routed to files instead of sockets or other output. For more information, see **http://www.sas.com/rnd/web/driver/GIF/drivers.html#imggif**

E. The GIF driver

The GIF device driver is available in Releases 6.09e and 6.12 of SAS software. The other device drivers listed are only available with Release 6.12 of the SAS system. The size of the original driver was changed in each case to provide easy access to various image sizes. This device driver set uses white backgrounds with black text by default. You can create your own device drivers for similar sizes in Release 6.09 using the GDEVICE procedure. Output from the GIF driver can be routed to sockets or any other appropriate destination with the use of the FILENAME statement and transparency is supported. For more information see **http://www.sas.com/rnd/web/driver/GIF/drivers.html**

GIF	**Graphics Interchange Format**	**800 x 600**
GIF160	**Graphics Interchange Format**	**160 x 120**
GIF260	**Graphics Interchange Format**	**260 x 195**
GIF373	**Graphics Interchange Format**	**373x 280**
GIF570	**Graphics Interchange Format**	**570 x 480**
GIF733	**Graphics Interchange Format**	**733 x 550**

Transparent GIF files allow other text or graphics to bleed through them.
Transparency can be enabled by copying the GIF device entry and modifying the UCC (User Control Characters) field, as in the following example:

```
libname gdevice0 'SAS-data-library';
proc gdevice c=gdevice0.devices nofs;
    copy gif from=sashelp.devices newname=giftrans;
    mod giftrans ucc='01'x;
    quit;
```

F. GIF Animation

Animated GIF graphics can be created with SAS/GRAPH software by using a special version of the GIF driver called GIFANIM (available with Release 6.12) or by using a third party application such as GIF Construction Set to combine individual GIF images that you have created with the GIF and IMGGIF drivers. The GIFANIM driver is the preferred way of constructing animated images for those of you who have Release 6.12 of SAS Software. The driver uses selected GOPTIONS to combine graphic images created with SAS/GRAPH procedures and to control the behavior of the GIF animation. The following are WEB addresses can give you more information:

http://www.sas.com/rnd/web/driver/GIF/animatn.html

http://www.sas.com/techsup/download/sample/graph/other-examples-list.html

V. Future Enhancements

Version 7 of the SAS system will have several enhancements, including:

1. A HTML driver that generates pure HTML. This will be very useful for batch jobs that create HTML on the fly.
2. A WEBFRAME driver that creates one or more GIF files and several HTML files that are used to display the GIF images with thumbnail links.
3. The ability to drill down on specific portions of a graph that is created.
4. Object Linking and Embedding between PC SAS and other applications.