The versatility of the personal computer is highlighted by considering the number of ways SAS/GRAPH output can be generated for display on your PC monitor or on hardcopy via PC-attached plotters and printers. And "How do I use SAS/GRAPH software with my PC?" is a common question received by the Institute's Technical Support Department. The answer is complicated by the many varieties of and enhancements to the old-fashioned IBM PC. There are also a number of different PC graphics boards and, perhaps, a communications system to worry about.

Worry over the communications system can be eliminated by producing SAS/GRAPH software output locally on your PC. That makes life a lot easier, and that is the good news that SAS/GRAPH software for PCs brings. Later, we will preview a few of the graphics hardware-related highlights of SAS/GRAPH software for PCs.

However, we will discuss the more complicated situation first and assume that your PC is connected to a host with version 5 of SAS/GRAPH software available for your use.

We need to know what communications protocol is being used to communicate with your host. Communications protocol refers to the set of rules used to control data transfer and we have two basic types of communications protocol to choose between: asynchronous or synchronous.

Asynchronous means that data transmission is not based on any predefined timing pattern and each character is sent independently. Synchronous means that transmission of data is based on a standard timing signal. Characters are sent in contiguous units within a block.

Let's discuss the hardware and software required by the PC to communicate.

A communications adapter is the circuit board that permits the PC to communicate with the host system. It plugs into an internal expansion slot within the PC and provides a serial port or a coaxial port. The function of the communications adapter is to monitor the communications link to allow software control of communications parameters and buffering of data waiting to be transmitted or received.

An asynchronous communications adapter transmits and receives bits serially or one at a time. It plugs into a PC expansion slot and provides the serial or RS-232 port. The Hayes 1200B internal modem is a communications adapter that combines a serial port and a modem translator into one board. Many manufacturers now sell multi-function boards that act as communications adapters by providing a serial port along with other features such as extra memory, a permanent clock, and so forth.

The serial port is designed for a wide range of uses and, therefore, requires the setting of communication parameters that need to be adjusted to suit your host system. These communication parameters are baud rate, data bits, stop bits and parity. Values for these parameters are set to match your host system so that the PC and host can recognize each other's signals.

Now, let's look at synchronous communications adapters. These communications boards also fit into a PC expansion slot but they permit attachment to a BSC or SDLC control unit via a coaxial port and coaxial lines. Examples of synchronous communications adapters are the IRMAX Forte PJ and PCOX boards. Although these boards allow synchronous communications, very few of them allow graphics capability with SAS/GRAPH software at the present time.

In addition to the communications adapter, the PC also needs communications software. At the most basic level, you could use ROM BIOS or DOS services to set communications parameters for your async adapter. However, most people find it easier to purchase terminal-emulating software rather than write their own. A terminal emulator is a real-time program that transmits and receives characters to and from the host. Synchronous communications adapters always come with their own terminal emulators. IBM 3270 PCs are purchased with control programs that provide the 3270 functions.

Now that we've considered the PC's communications hardware and software, let's look at communications protocol on the host side. There are three asynchronous-only host operating systems that SAS/GRAPH software supports PRIMOS® from PRIME Corp., AOS/VS from Data General Corp. and VMS™ from Digital Equipment Corp. They make life easy since all of these hosts require asynchronous communications.

IBM hosts, however, are a different story. They may use synchronous or synchronous communications. On IBM systems, asynchronous communications are achieved through installation of software (NCP with NTO or EP) in the communications controller or via protocol converters. IBM hosts by nature use synchronous data transmission in the form of BSC or SNA/SDLC protocol.

Let's look at graphics adapters now. Graphics adapters also plug into a PC expansion slot. They assume a specific communications protocol, so you can see why we discussed communications first.

If we are using some type of synchronous protocol, there are two types of graphics that SAS/GRAPH software will work with. The first is Programmed Symbols and the second is Vector Graphics.

Programmed Symbols (PS) is an IBM-defined term that describes how the IBM 3279 (S3G) graphics terminal does graphics. A bit map is generated on the IBM host, the bit map is divided into character cells, the character cells are compressed and the data arrives at the display in pixel form. When IBM began selling IBM 3270 PCs, IBM also began selling PS boards for these PCs. In the past couple of years, other manufacturers have begun selling PS-type adapters. The first of these is the ForteGraph™ card that must be used in conjunction with the Forte PJ card; the Forte PJ card acts as the synchronous communications adapter. The IRMAX™ and PCOX/GRAPHICS™ adapters provide Programmed Symbols-style graphics and synchronous communications all wrapped up in one board. Four device drivers are available within SAS/GRAPH for PS boards: GDDM79, IBM3279, IBM3270 and IBM3295. The last two drivers are available with Version 5 of SAS/GRAPH software. The first two are available in Version 5 and earlier versions of SAS/GRAPH software.

Vector graphics is the second type of graphics possible with synchronous protocols. With vector graphics, graphics commands are used to describe image data with the work being done mainly by the PC rather than the host. This is a special case because vector graphics boards for use with synchronous proto-
cols are not readily available; the IRMAX APA™ card is the only vector graphics adapter available at the present time. Instead, these are graphics-capable IBM 3270 PCs: the IBM 3270 PC/G and the IBM 3270 PC/GX. SAS/GRAPH software provides four device drivers for use with vector graphics devices: GDMDPC and GDMDPCGX are available with Version 5.08 of SAS/GRAPH software and can be used in conjunction with release 4 of GDDM. IBMPCG and IBMPCGX are available with Version 5.16 of SAS/GRAPH software.

Next, we look at graphics adapters in the asynchronous world. If the communications protocol is asynchronous, there are two types of graphics adapters that will work with SAS/GRAPH software: the IBM Color Graphics Adapter (CGA) or compatible, and the IBM Enhanced Graphics Adapter (EGA) or compatible.

The CGA has been around for a long time and may even come with your PC if you buy some sort of bundled package deal. With Version 5 or host SAS/GRAPH software, the EGA is only supported in CGA-compatibility mode at the present time. There are dip switches that you set on the EGA to produce the CGA mode.

SAS software for using the CGA, EGA, and compatibles includes TERM5150 and SAS/RTERM® software.

TERM5150 is a program written in BASIC that can be used in conjunction with the IBM Asynchronous Support Package routines to convert an IBM Personal Computer to an ASCII terminal. The IBM5150 device drivers can then be used to produce SAS/GRAPH software output on the PC. REPL5150 is a BASIC program that can be used to replay pictures produced via the TERM5150 program and IBM5150 drivers. TERM5150 and REPL5150 are on the OS and CMS installation tapes and must be downloaded to diskette in order to use them. Minicomputer sites must request copies of TERM5150 and REPL5150 from Technical Support. TERM5150, REPL5150, and the IBM5150 drivers will be given a limited support status with the Version 5 maintenance release for all operating systems.

SAS/RTERM software is terminal emulation software written in C and assembler languages. It allows an IBM PC to emulate a Digital VT100 terminal and a Tektronix 4105 graphics terminal. It was released as an IPP by the Institute in October 1985. SAS/RTERM software can be used 3270-type protocol converters to provide full-screen capabilities.

There are terminal emulating software packages other than SAS/RTERM software you can purchase to work with SAS/GRAPH software. Most of these do Digital VT125, Tektronix 4010, or Tektronix 4105 emulation and the appropriate SAS/GRAPH drivers can be used with them.

Another common question is “What about SAS/GRAPH software for PCs?” As you already know, this is part of Version 6, the SAS System for PCs. Here we have no host connection. Graphs are produced locally, and therefore communications protocol is not an issue. The only worry you have is the type of graphics adapter and here is a partial list of graphics adapters SAS/GRAPH software for PCs will support: CGA, EGA, Vectrix, Hercules monochrome and the APA board for IBM 3270 PCs.

So, now we’ve covered every possible direct way of producing a graphics picture on your PC screen. You may also be wondering, “How do I get hardcopies of my pictures?”

Once again, we must consider communications protocol when using Version 5 of SAS/GRAPH software. If you are communicating synchronously, hardcopies are usually produced one of three ways. The first is a local print screen function that is activated by pressing a key, usually the PRTSC key. The second way is to route the file of graphics commands to a system or batch hard-copy graphics device. And finally, you can download a file of the graphics commands to your PC or plot them locally.

With asynchronous communications, hardcopies can be produced by putting the hardcopy device in eavesdrop mode for plotters or in slave mode for plotters and printers.

In eavesdrop mode, the plotter sits between the PC and the host and eavesdrops or “listens in” on their data communications. When you use the plotter’s SAS/GRAPH software device driver in a OPTIONS DEVICE=; statement, special commands are sent to the plotter to allow it to intercept the data flow and begin plotting. A subsequent command in the graphics data stream tells the plotter to end its interception. When you are using eavesdrop mode, use the SAS/GRAPH software driver for the plotter, such as HP7475 for Hewlett-Packard’s six-pen plotter. Most terminal emulators that you use for your PC use plotters with SAS/GRAPH software in eavesdrop mode. The big disadvantage of eavesdrop mode is that your PC keyboard is unavailable for use until the plotter is finished plotting.

And that brings us to slave mode and SAS/RTERM software. In slave mode, the plotter or printer is attached only to the PC. You can now produce your hardcopies in background so the PC’s keyboard is free while the hardcopy is being produced. SAS/RTERM can also queue up to ten pictures, which can even be produced with human intervention if your hardcopy device does its own paper feeding. SAS/RTERM also has an internal rasterizer to support devices that produce raster data, such as the Tektronix 4695 and 4696 ink jet printer and the Epson/IBM graphics printers.

With SAS/GRAPH software for PCs, you do not worry about communications protocol since your graphs are produced locally. You simply choose the appropriate driver for your device. A partial list of hardcopy device graphics languages that Version 6 of SAS/GRAPH for PCs will support includes HPGL, GML, DMP, QVP, Postscript, and DDL. There will also be a Metagraphics Facility that will allow user-written graphics device drivers.

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