# Engineering Graphics System/200

## Technical Data, July 1983
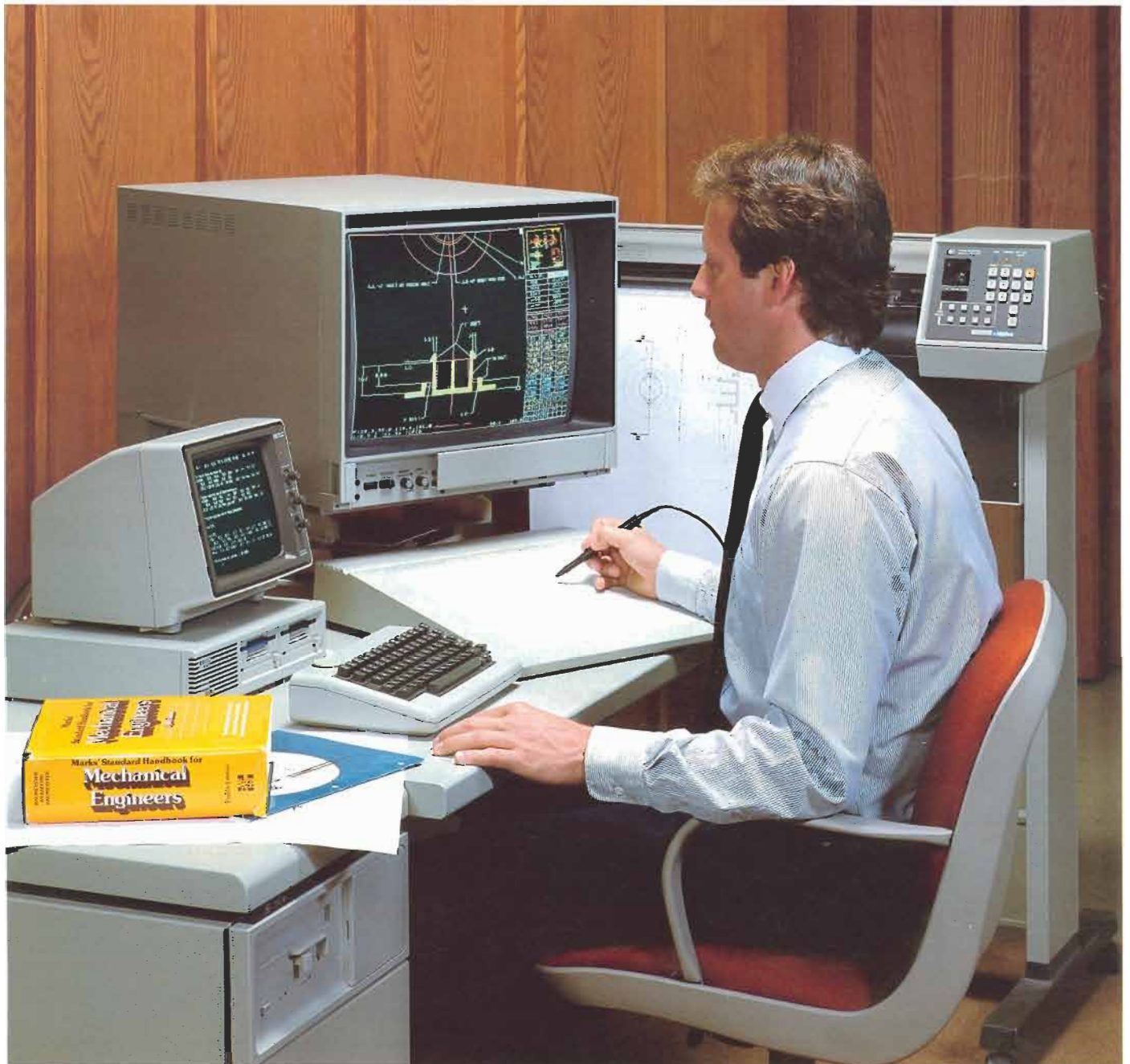
# HP Computer Museum
[www.hpmuseum.net](www.hpmuseum.net)

**For research and education purposes only.**

# Introduction

Hewlett-Packard's Engineering Graphics System/200 (EGS/200) is a software product designed for HP Series 200 computers and peripherals to comprise a complete engineering drawing system. It is ideal for those who have little knowledge of computers, but can also be customized for the more experienced user. EGS/200 allows you to process many commonly used engineering drawings, making it a perfect tool for design teams with diverse drawing needs.

EGS/200 uses a central Graphics Editor plus four distinct 'personalities' geared to particular types of drawings (Figure 1). These personalities are General Drawing, for the novice user in preparing artwork; Technical Drawing, for generating 2-D mechanical drawings; Electrical Schematic, for drawing circuit schematics; and Printed Circuit Board, for preparing artwork for printed circuit boards. The EGS/200 system can also output material lists or connection lists from a drawing.

In addition to stand-alone configurations, EGS/200 can be used in a Shared Resource Management (SRM) system, allowing a design team to share commonly used data. SRM also allows several computers to share discs, printers and plotters, thus making a considerable cost savings. ·
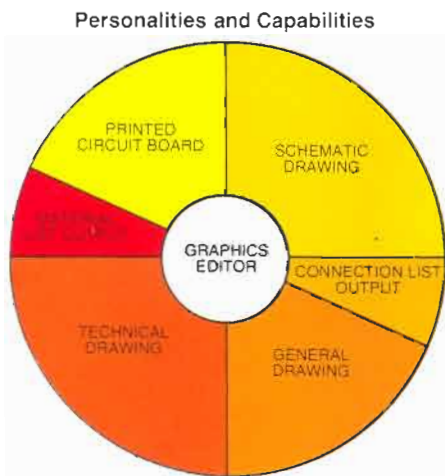
## Personalities and Capabilities



Figure 1

# Graphics Editor

The Graphics Editor, the heart of the EGS/200 system, is used to generate drawings on the screen. It makes use of three types of files — menu, process and macro — to define the user interface to EGS/200; they are collectively termed 'personality files'. HP supplies these files for all personalities shown in Figure 1, plus the tools to customize or build entirely new personalities. These files are further explained below.

EGS/200 contains two types of menus — screen menus and graphics tablet menus. Screen menus contain commands, library part names and any other text needed to create drawing commands. Tablet menus contain graphic images as well as textual messages. For instance, a screen menu may have a part labeled "CAP" for capacitor. The tablet menu might contain a picture of the capacitor.
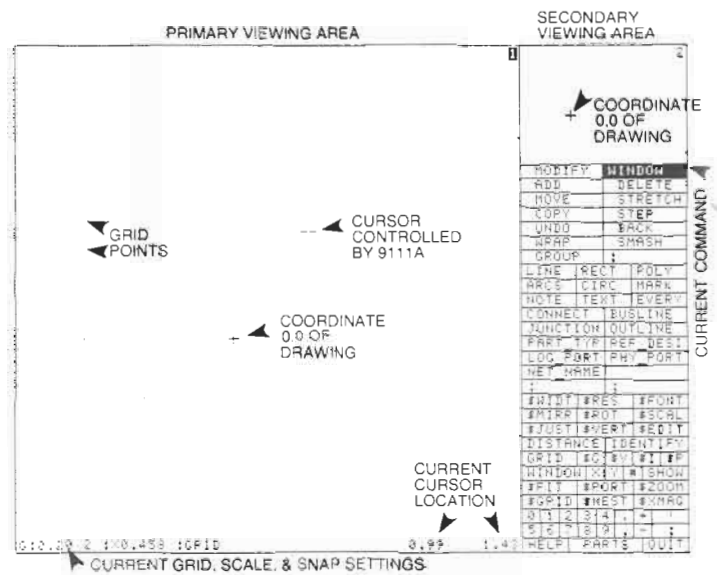


Figure 2

Process files are used to describe the drawing layers within EGS/200. There are 255 layers, all of which can be thought of as individual clear sheets that can be stacked and manipulated so that any combination of layers can be viewed. For each layer, the process file contains a layer label, a layer type, the linetype and color used when displaying the drawing, and the pen number used when a plot is made. You may choose between eight different line types: solid, dashed, long dashed, dotted center, dashed center, phantom, long dotted and dotted. Color can be defined as blue, cyan, green, magenta, red, yellow, or white when you use a color monitor or a Series 200 Model 36C desktop computer (the Model 36C also has eight additional pastel colors). Units of measure for the drawing can be micrometers, millimeters, centimeters, meters, kilometers, micro-inches, mils, inches, feet, yards or miles.

Macro files contain macro commands, which are combinations of commands used in the Graphics Editor. By grouping these frequently-used commands, you can save typing time and make your drawing job easier.

Figure 2 shows the Graphics Editor screen for the Schematic Drawing personality. You'll notice three major screen divisions — the main viewing area, the secondary viewing area and the menu area. The cursor, which is controlled by the stylus on the graphics tablet, can access any part of the screen; menu items are also selected using the stylus.

You interact with your drawing through the primary and secondary viewing areas of the screen. Commands allow you to zoom in and out of the viewing area, as well as pan across. Commands operate in either area or between areas. For example, the secondary area can be used to show a global view of your drawing, while the primary area can zoom in on a paricular location. As you make modifications, the secondary area shows their relationship to the overall drawing. The cursor coordinates, expressed in the units of measure you specify, constantly change as you move the cursor around the viewing area. EGS/200 has an extremely fine grid resolution for drawing very large, accurate drawings. In fact, a drawing accurate to .0001 inch can be made as large as 3 miles on a side!

## Entering Commands

All EGS/200 commands can be entered from the keyboard as well as from the menu areas.

Commands can be single words (such as DUMP) or simple operations chained to form a complete command. For example, to add a line 20 mils wide between two points in layer 5, you would enter the following from the screen menu:

ADD
LINE
5
$WIDTH
20

. . . then select two points from the drawing area. This can also be done by typing the command:

ADD L5 :W20 0,0,110,240;

## Drawing Elements

Figure 3 illustrates the 10 primitive drawing elements within the Graphics Editor. These can be combined to form higher-level elements (or library parts). Library parts can also be combined to create other library parts, forming a hierarchical data structure. This is very useful when changes are made in a lower-level part and need to be reflected into all parts built on it.

Each primitive can be specified in several different ways. For example, in adding a circle to your drawing, you may specify the width of the line and whether or not the circle is to be filled. Further, EGS/200 gives you five modes in which to describe the circle:

- X/Y center point and X/Y point on circumference
- numeric radius and X/Y center point
- X/Y end-points for the diameter
- numeric radius and one or two X/Y tangent points
- X/Y center point and X/Y tangent point.

This flexibility in switches and modes applies to all EGS/200 primitives.

In addition to primitive drawing elements, EGS/200 contains three different parts libraries. You can expand or change these libraries to fit the needs of your application. Each part is constructed to match its corresponding process file in each personality.

## Associated Text

In addition to annotating your drawing, text can also be associated with primitive elements or library parts. The text then 'tracks' with the part as it is moved, rotated or changed. The material and connection lists have four types of text for post-processing: 1) reference designators, a name you give to any part to make a use of the part different from other uses; 2) bus/net name, a name given to connection lines (nets) or bus lines (collections of nets); 3) port names, names for locations on the part where

connections can be made; 4) and part type, a name you assign to classes of parts. As an EGS/200 user, you can use associated text to make your drawing more self-explanatory, or use them in a post-processing module.

## Graphics Editor Commands

EGS/200 has extensive commands in four major categories. Here are some of the more frequently used:

### Drawing Creation and Editing Commands

**ADD** – places a component on the drawing. Components are either primitive drawing elements or predefined library parts. The ADD command has a number of switches to specify options like line width, area fill, etc., as well as many modes to specify how the component is to be added.

**MOVE** – moves a component to another position on the drawing.

**COPY** – makes a copy of a component on the drawing and allows it to be placed anywhere.

**MODIFY** – allows a component to be changed after it is initially drawn.

**STEP** – similiar to COPY, but makes multiple copies in the X and/or Y direction (step and repeat).

**DELETE** – deletes components from the drawing.

**STRETCH** – moves or adds vertices to primitive drawing elements.

**WRAP** – creates a new component out of an encircled set of components. Library parts can be created in this manner and an eight-character drawing named assigned.

**GROUP** – similar to wrap, but allows you to select individual components from anywhere on the drawing.

**SMASH** – opposite to WRAP and GROUP, this command 'smashes' a component down into the next level of components. When completely smashed, it consists only of primitive elements.

### Drawing Information and Environment Commands

**HELP** – gives complete syntax for any command or macro on the screen. Additional explanation for using commands is also available.

**WINDOW** – pans and zooms within the viewing area. This command can be used in either viewport.

**SHOW** – selectively turns display of layers or primitives on or off. Allows you to unclutter drawings with data on many layers. Also allows you to make certain parts of your drawing viewable but not changeable.

**GRID** – sets the snapping resolution. Many 'snapping modes' can be used. For instance, line end-points can snap to the grid, to the the closest primitive, to vertices of the closest primitive, or to intersections of any two primitives.
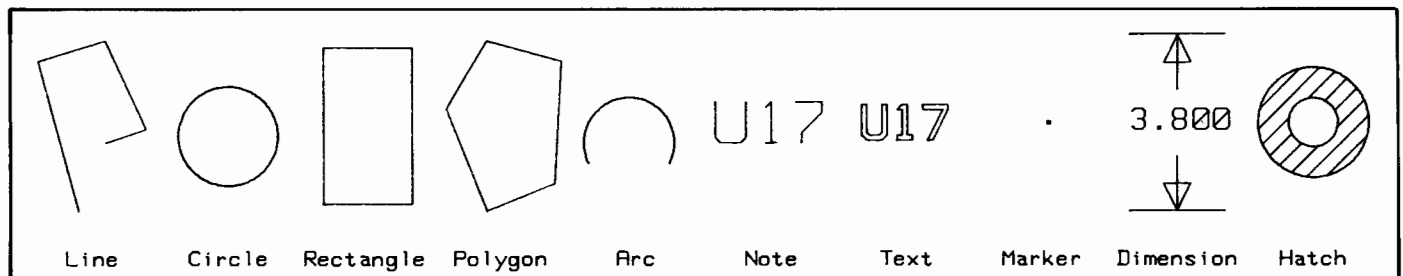


| Line | Circle | Rectangle | Polygon | Arc | Note | Text | Marker | Dimension | Hatch |

**Figure 3**

**DEFINE** – allows new macro definitions to be added to the system.

**EQUATE** – sets up the EGS/200 process file attributes for each drawing layer.

**DISTANCE** – shows the distance between any two points in actual units of measure.

**AREA** – calculates the area within any component on the drawing and prints the result on the screen.

**EVALUATE** – allows simple arithmetic calculations to be done from the keyboard.

**SEARCH** – allows you to specify which volumes are to be scanned when the system is searching for library parts and drawings.

### Drawing Storage and Retrieval Commands

**ARCHIVE/RETRIEVE** – saves and restores the drawing in an ASCII file, with everthing needed to re-create the drawing (including the definition of all library parts used).

**GENERATE/INPUT** – saves and restores the drawing in an ASCII file, but all library parts are reduced to primitive elements.

**SAVE/EDIT** – saves and restores the drawing in a binary file, with pointers to the parts library.

### Output Commands

**PLOT** – plots the current drawing to an external plotter. Note: layers or primitives turned off by the SHOW command will not be plotted.

**DUMP** – dumps the CRT image to an external printer (if it has graphics dump capability).

**CATALOG** – outputs the directory of a mass storage volume.

**VOLUMES** – outputs the names of all on-line volumes recognized by the system.

### EGS/45 Compatibility

Drawings from Hewlett-Packard's Engineering Graphics System/45 (EGS/45) are compatible with EGS/200. Switchover is made via the ARCHIVE file format. User parts libraries can also be moved into EGS/200 with the same procedure.

### User Customization of EGS/200

EGS/200 was designed to be extensible. There are five ways to make it better fit your specific requirements:

- Custom menus can be created on the screen at top, bottom, left or right. You can define your own menus or modify those provided with the system. Menu items can also be changed, if other prompts are desired.
- The MACRO definition facility allows you to build high-level commands out of basic ones. This helps streamline repetitive operations.
- The PROCESS file definition lets you create your own layer structure. For instance, if EGS/200 is used to lay out a computer room, you could define layer 1 as the floor plan, layer 2 as cable troughs, layer 3 as electrical service, layer 4 as terminal cables, and so on. You could make plots of various layers for individuals involved in different phases of the installation.
- Parts libraries can be expanded or new ones built for applications not covered by EGS/200 personalities.

- You can write your own post-processing or custom output modules. For example, you could write a routine to output drill patterns from your PC board layout directly to numerical control drilling machines, or a routine to convert the connect list into a form ready for circuit simulation on another system.

# General Drawing Personality

The General Drawing Personality is designed for the first-time or casual user. As you select Graphics Editor commands, a special MACRO file prompts you to specify various parameters. This makes General Drawing an excellent learning tool, much more forgiving than the other drawing personalities, which were written to speed the drawing process for persons more familiar with EGS/200. The General Drawing Personality is ideal for generating overhead slides, block diagrams for designs, or any other type of general artwork.

Once you are familiar with the system, this 'friendly' interface can be turned off in favor of the more sophisticated personalities.

# Technical Drawing Personality

This personality is designed to assist engineers and draftsmen in preparing 2-D mechanical drawings. Some of its features are as follows:

- You can use construction geometry techniques to create drawings. For example, lines can be added horizontal/vertical, perpendicular, parallel, tangential or angular to other components.
- You can use construction lines (lines of infinite length) while creating the drawing.
- Components on a drawing may be cross-hatched or filled.
- Fillets may be constructed at line intersections.
- Symmetric parts can easily be drawn using the system's MIRRORing facility.
- You may dimension lines, angles, radii and diameters in the units and resolution you select.
- You can make section views by WRAPing components, COPYing them to another location, and replotting them with an increased scale factor. Annotations can be added for clear documentation.
- Components placed on a drawing can 'snap' to the system grid, other components, vertices and intersections.
- Drawings can be easily annotated using block or stick letter fonts.
- You can build assembly drawings since EGS/200 can place many components on one drawing. These components can even be other complete drawings.

### Technical Parts Library

The library for this personality has three major sections, all based on ANSI standard specifications:

- Drawing Paper Templates – A-E size drawing paper that specifies standard borders, title blocks, and revision blocks. Users may place company name and logo within the title block.

- Geometric Tolerancing Symbols — 18 symbols for things like parallelism, symmetry, diameter specification, concentricity, etc.
- Surface Texture Symbols — five symbols specifying surface finishes.
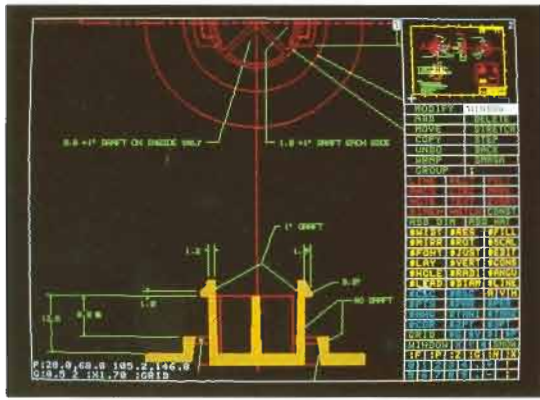


## Graphics Tablet Menu

An extensive graphics tablet menu is included in the Technical Drawing Personality. This menu lets you use the entire screen for the actual drawing. It also provides macros to assist in drawing, annotation, access to library parts, and construction and geometry drawing techniques.

## Process File

A simple process file helps separate various components. For example, all construction lines are on one layer, so you do not have to remove them once the drawing is done; you merely turn off that layer with the SHOW command. Other layers contain the annotations and dimensions; these can also be turned off if plots of just the drawing are needed.

# Schematic Drawing Personality

This personality assists you in creating schematics of electronic designs. It does so up to twice as fast as manual methods; additional time can be saved when changes are made. It is not necessary to put off re-drawing the schematic — EGS/200 is fast enough that you can always work with a current drawing. A macro file, menu file, parts library and process help make this personality more suitable to schematic drawing.

## Schematic Parts Library

The schematic parts library consists of over 50 commonly used electronic parts:

**Active Devices** — transistors, diodes, opamps, etc.
**Passive Devices** — resistors, capacitors, inductors.
**Digital Devices** — NAND/NOR gates, inverters, latches, flip-flops, buffers, etc.
**Complete Chips** — 4-bit decade counters, decoders, octal bus buffer/drivers, etc.
**Drawing Elements** — system ground, chassis ground, edge connnectors, page connector, etc.

This library contains text consisting of names for the part's logical ports as well as the part type. This text is used in generating material and connection lists for schematics. You can add reference designators as well as change port names.

## Command Macros

Hewlett-Packard has added command macros that make drawing schematics much easier. These assist you in drawing buses, reference designators, assigning physical and logical port names, etc.
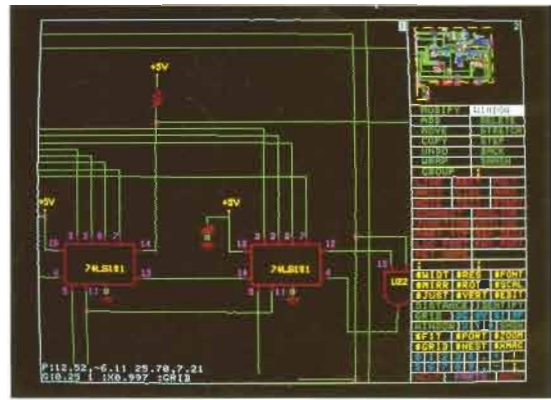


## Process File

The process file lets your drawings be divided so that post-processing is easier. Layer 1 is used for the parts themselves. Layers 2 and 6 are used for notes on the parts. Layer 3 holds the connections between parts. Layer 4 contains the bus lines. Reference designators and physical pin-outs are in yet another layer. You can modify this file to better fit your documentation needs.

# PC Board Layout Personality

This is the final EGS/200 personality. It allows you to create printed circuit board artwork for your electronic designs. Artwork can be output directly to an HP plotter to produce masters.

The Graphics Editor has features that make EGS/200 PC board design much easier: lines can have width (thus making traces); the STEP command allows IC DIP patterns to be placed on the board very rapidly; traces may be rerouted easily by STRETCH and MODIFY commands; and the WRAP command allows an entire portion of the board to be moved.
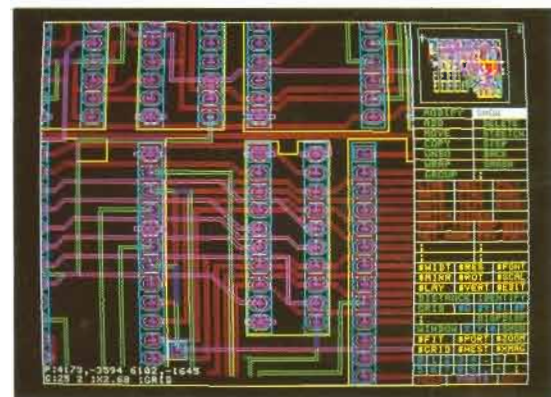


## PC Board Parts Library

This library of over 40 parts can be divided into seven categories:

**Reference Parts** — used to align the layers of the PC board, much like shear or registration marks.
**Primitive Pads** — parts that define the copper and solder resist keepout areas on the PC board.

**Primary Pads** − parts that define components for plated-through holes.

**Inner Layer Pads** − parts that define components for connecting plated-through holes on the inner layers.

**IC DIP patterns** − parts that define components for Integrated Circuit Dual In-line Packages (pads and keepout areas) as well as an outline for the entire component in case you want to make a drawing of the PC board that only shows component placement and part numbering.

**Edge Connectors** −, a variety of edge connectors, showing connector fingers as well as board outline.

**Analog Parts** − resistors and capacitors needed on PC boards.

## PC Board Process File

Within the PC Board Layout Personality is the PC Board Process File, for help in designing PC boards with up to six layers (more can be added). Different PC board shops have different fabrication guidelines, so the file can be modified. It is coordinated with the parts library so it can be used soon as you learn the basics of the Graphics Editor. The Process File preserves the relationship between logical layers and the physical PC board. Here is a sample of how this feature is used:

> Layer 2 contains the outline of the PC board plus some reference designators. Layer 1 contains drill holes (circles). Layers 5 and 6 hold traces for the component and circuit side of the board, respectively. Layer 8 is the inner-layer ground plane. Layer 9 is inner-layer power plane and layers 11 − 14 can be used for inner-layers A-D. Layer 26 contains the outlines for all parts so an assembly drawing or silkscreen pattern can be made.

The Process File can be used with the SHOW command to turn on just the layers you want to see or to plot each layer's components individually.

# Connection List Output

In some engineering drawings, it is important to know where objects are connected on the drawing − you may wish to drive a simulator, to transfer data to a large CAD system, or to do simple analysis of the design. A few simple conventions will allow you to derive connect lists from your drawings.

EGS/200 can process two types of connections − logical and physical.

Logical connections are those between two parts or primitives on a drawing. For example, two lines may cross on the CRT, but not be connected. You can place a MARKER primitive at the intersection if a logical connection is to be made. This is very useful when doing schematics, for instance. There are also physical connections like those found on a PC board. Any two lines on one layer that intersect are, in fact, connected.

For your connection list to make sense, you should name the parts, their ports and the nets within the drawing. Ports are the connections to a part or, in the case of an electrical schematic, the input and output pins. Nets are common ports within a set of parts; for instance, the clock signal would be a net. A group of nets is collectively referred to as a bus; EGS/200 will allow you to specify the bus name. EGS/200 also lets you associate text with parts, ports and nets while the drawing is made. When the connection list is made, the connections will be referenced to this text for convenience and clarity.

Connection lists are output to an ASCII file in the following general form:

<Net#> and <Net Name>

| part name | reference designator | port names | part type | tag text | tag text | tag text |
|---|---|---|---|---|---|---|

Each field is separated by a user-definable character and each net is separated by a blank line. Here is a sample connection list generated from an electrical schematic:

```
1   CLOCK
        inv  U1  pin11 74LS04
        nand2 U2 pin1  74LS00
        nand2 U2 pin2  74LS00
        nand2 U2 pin4  74LS00
        nand3 U3 pin1  74LS10

2   RESET
        nand3 U3 pin6  74LS10
        jkff  U4 pin2  74LS112

3   DATA[1]
        jkff  U4 pin5  74LS112
        nand3 U3 pin2  74LS10
        nand2 U2 pin5  74LS00
        nand3 U3 pin3  74LS10

4   DATA[2]
        jkff  U4 pin9  74LS112
        nand3 U3 pin13 74LS10
        nand3 U3 pin4  74LS10

5   DATA[3]
        jkff  U5 pin5  74LS112
        nand3 U3 pin5  74LS10
```

# Material List Output

The EGS/200 Material List Module uses a data base of parts, along with some of the text associated with the parts. The data base contains a description and stock number for each part type. An editor lets you modify the data base to fit your parts library. The Material List program scans your drawing and the data base, then prints out material lists in one of two formats: by reference designator or by stock number (Figure 4).

```
                         Material List

Board1
                                            5-May-1983   Page 1

STOCK NO   QTY    DESCRIPTION                  REFERENCE
----------------------------------------------------------------
0180-0100   11    4.7uF 35V Capacitor         C1,C10,C11,C12,C14,C15,C2,
                                              C3,C4,C5,C9
0180-2803   3     100uF 50V Capacitor         C6,C7,C13
0683-1035   1     10K Resistor                R5
0683-3025   2     3K Resistor                 R1,R4
0698-6943   1     20K Resistor                R2
0764-0018   2     4.7K Resistor Package       RP1,RP2
1820-0904   1     74LS112 J-K flip flop       U4
1820-1195   2     74LS175 Quad D-type flip flop U10,U11
1820-2833   1     74LS160 4-bit decade counter U19
1820-1112   2     74LS54 4-wide AND or invert  U13,U9
```

**Figure 4**

Although generally associated with electrical schematics, material lists are also useful for other types of drawings. For example, floor layouts could have lists of desks, bookcases, phone jacks and electrical outlets; or piping diagrams might list valves, pipe sections, elbows, etc. The Material List Output Module is useful any time items on a drawing need to be 'counted'.

# Configuration Information

EGS/200 was designed to run on Series 200 desktop computers. The following equipment is required to use EGS/200:

- Model 26A, 36A, 36C or 20A Computers
- 1.4M bytes of memory
- At least 10M bytes of on-line mass storage
- 9111A Graphics Tablet
- Pascal 2.1 Language System (98615A)

The system also supports external color monitors, plotters and printers, additional memory or mass storage, Shared Resource Management, and international keyboards. In general, these items are the same ones supported by the Pascal 2.1 Language System.

The following two configurations are recommended for EGS/200:

## Workstation Configuration

- Model 36CS Color Computer (640K bytes memory std.)
- *Three 256K byte memory boards (98256A)
- 9111A Graphics Tablet
- 7908A Disc Drive (16Mbyte) or 9134B Mini-winchester Disc Drive (10M byte), or Shared Resource Management (SRM) system

## Optional:

- 7580B Plotter (D-size) or 7585B Plotter (E-size)
- 2671G Printer (thermal) or 2631G Dot-Matrix Printer (impact)

## Large Display Configuration

- Model 20S Modular Computer (640K bytes memory and keyboard std.)
- 82913A (12") or 82912A (9") system monitor
- *Three 256K byte memory boards (98256A)
- 9111A Graphics Tablet
- 98627A Color Video Interface
- External Color Monitor (up to 19")
- 7908A Disc Drive and 9121S floppy disc drive or 9133B Mini-winchester disc (10M byte) with 3.5" floppy drive, or Shared Resource Management (SRM) system

## Optional:

- 7580B Plotter (D-size) or 7585B Plotter (E-size)
- 2671G Printer (thermal) or 2631G Dot-Matrix Printer (impact)

* Minimum memory required.



EGS/200 runs on HP's Shared Resource Manangement (SRM) system; shown is a typical workstation configuration (left) and a typical large-display configuration (right).

# Ordering Information

Engineering Graphics System/200 can be ordered as follows:

## 98305A EGS/200 System

The EGS/200 System will operate on only one particular Series 200 computer. This is achieved through the use of a unique code word based in part on the computer's serial number. The 98305A product consists of the media containing the EGS/200 code, one (1) manual set, three (3) graphics tablet menus and the code word. Please specify a media option with the 98305A: Option 630 (3½-in. flexible disc) or Option 655 (5¼-in. flexible disc).

Series 200 Model 26A desktop computers with serial number prefixes less than 2313A and Model 36A computers with prefixes less than 2314A require a CPU Upgrade Kit in order for EGS/200 to operate. The part number for the Upgrade Kit is 98143A.

## 98305M EGS/200 Right-to-Copy

Confers the right to make one (1) copy of the original 98305A media. Also provides one (1) additional manual set, three (3) tablet menus and a code word for an additional desktop computer.

## 98305R EGS/200 Right-to-Copy and Sublicense

For OEM's (original equipment manufacturers), this product is identical to the 98305M product but confers the additional right to sublicense the system.

## After-Sale Support

Like all HP products, EGS/200 has customer training and consulting services available, as well as a variety of software support services. Please contact your local HP sales representative for complete details.