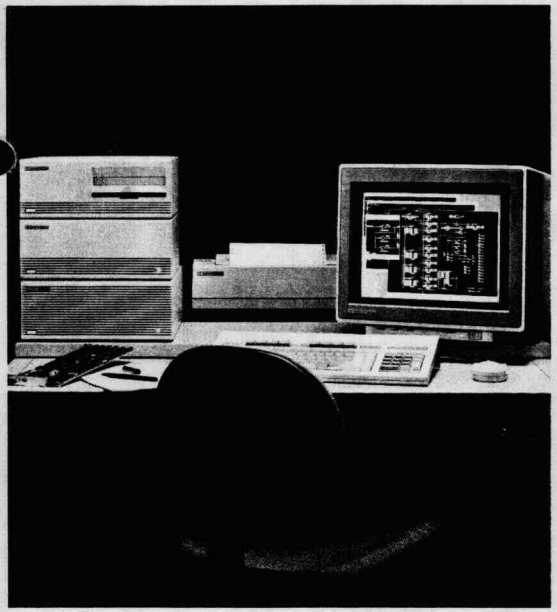
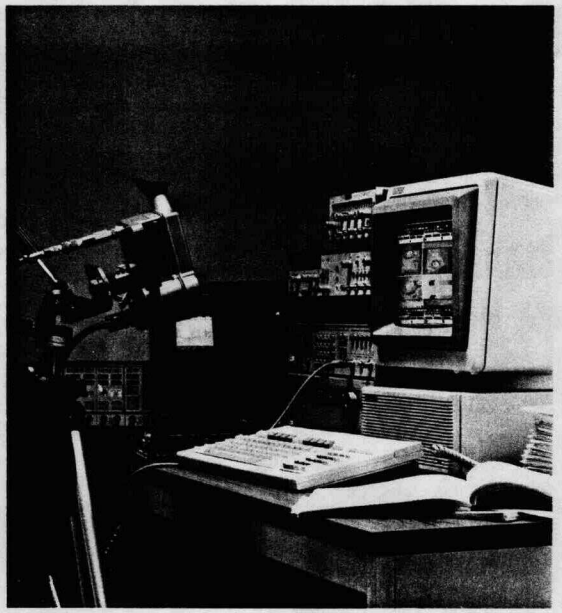
HP 9000 Series 300 Hardware Technical Data

HEWLETT PACKARD

Effective: September l, 1988*





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** Data subject to change without nolice.*

Introduction

The HP 9000 Series 300 family of computing Systems consists of a variety of workstations and network Servers äs well äs modular components. These components include a selection of processors with different performance levels, display Systems, memory boards, interface cards, operating Systems, and peripherals. The pre-configured workstations and network Servers include the components most likely needed for typical applications. Compatibility throughout the Series 300 family is ensured via object-code compatibility. For complete information on system configurations and pricing, consult the HP 9000 Series 300 Pricing Information, Pub. No. 5954-9831D.

1.0 Features Common to all Series 300 Systems

1.1 System Processing Units

The basis for each Series 300 workstation or network server is the System processing unit (SPU). The SPU contains the processor, RAM†, floating point co-processor (where applicable) and system interfaces. While the SPU configurations vary, äs explained further in the SPU section, some features are common to all Series 300 system processing units.

Four Gbytes of virtual memory space (16 Mbytes on the Model 310) is available for very large HP-UX‡ programs and multiple processes, due to a memory management unit that translates virtual memory addresses into main memory physical locations. HP-UX allows up to 84 independent virtual processes to execute simultaneously, but this number can be modified according to the user's particular application requirements.

1.2 Display Systems

The display Systems available for the Series 300 are bit-mapped and capable of supporting the new generation of engineering applications. Series 300's füll ränge of monitors includes a 12-inch monochrome monitor with integral tut and swivel, a 12-inch color monitor with integral tut and swivel, a choice of two 16-inch high-resolution color monitors, a 17-inch high-resolution monochrome monitor, a 19-inch high-resolution monochrome monitor, and a choice of two 19-inch high-resolution color monitors. All monitors operate at 60 Hz non-interlaced to eliminate flicker and so miiiimize operator fatigue. A large variety of terminals can also be connected to HP-UX Systems.

1.3 Input Devices

Complementing the ergonomic displays is the detached keyboard which connects to the Computer by means of the HP-HIL (Hewlett-Packard- Human Interface Link) included with each Series 300 system. The HP-HIL is a serial interface capable of connecting up to seven devices, daisy-chain fashion, to a single interface port on the Computer. Other HP-HIL input devices include a **mouse,** a 32-button box, rotary control knob, control dial box, an A- or B-size **digitizer,** a bar code reader, and the touchscreen **bezel.**

1.4 Keyboards

The Series 3OO employs two keyboards:

- HP46021A
- HP98203C

The **HP46021A** has 107 keys, including eight special function keys. The keyboard features a numeric pad, auto-repeat, and sculptured keycaps with tactile feedback and N-key rollover.

46021A physical sizes are äs follows:

Height .....44 mm (1.6 in.)
Width.....452 mm (17.8 in.)
Depth .....219 mm (8.7 in.)
Net weight .....2.2 kg (4.75 Ib.)
Shipping weight .....2.6 kg (5.75 Ib.)

The following languages are available: Belgian Dutch, Canadian French, Danish, Dutch, European Spanish, Finnish, French, German, Italian, ICON/European **English,** Katakana, Kanji, Latin Spanish, Norwegian, Swedish, Swiss French, Swiss German, U.K. English, and U.S. English.

The HP 98203C features a built-in rotary knob, allowing single-control Cursor movement. The keyboard has 105 keys, including 10 special function keys. Additional features include numeric pad and ergonomic palm rest. HP 98203C keyboard is supported only by Series 300 BASIC 4.03 and Pascal Language Systems 3.12 or later releases.

HP 98203C physical sizes are äs follows:

Height .....62 mm (2.4 in.)
Width .....440 mm (17.3 in.)
Depth .....260 **mm** (10.2 in.)
Net weight .....2.5 kg (5.5 Ib.)
Shipping weight .....2.7 kg (6 Ib.)

The following languages arp available: French, German, Katakana, Spanish. Swedish/Finnish and U.S. English.

1.5 Operating Systems

Series 300 models fully support threc primary operating Systems: HP-UX (multi-tasking, multi-user), BASIC (single-user), and Pascal (single-user) BASIC and Pascal operating Systems are capable of accessing up to 32 Mbytes of physical memory. The HP-UX operating system offers access of up to 32 Mbytes parity checking RAM or 48 Mbytes Error Checking and Correcting (ECC) RAM and also access to virtual memory capabilities.

The Model 318M Supports only the HP-UX operating System. The Model 319 supports the HP-UX operating system and BASIC language system. The PC-305 and PC-308 support the BASIC operating system, äs well äs DOS. DOS also is supported on the Model 310, 330, 35,0, 360 and 370 through the use of the HP Series 300 DOS Coprocessor.

† *All RAM is parity checking unless otherwise stated.*
‡ *HP's implementation of the AT&T* UNIX® *System V.2 Operating System in compliance with the System V Veriftcation Suite U. UNIX is a trademark of AT&T in the U.S. and othcr countrics.*

System Processing Units Hardware Comparison

	PC-305 (dual processors)		PC-308 (dual processors)		Model 310	Model 318M	Model 319	Model 330	Model 350	Model 360	Model 370
Central Processor	MC68000	3086-compatible	MC68000	Intel 80286	MC68010	MC68020	MC68020	MC68020	MC68020	MC68030	MC68030
Clock frequency	8 MHz	7.16 MHz	flMHz	12 MHz	10 MHz	16 7 MHz	16.7 MHz	16.7 MHz	25 MHz	25 MHz	33 MHz
Wait states	0	0	0	1	0 (on-board RAM)	2	2	2 (on-board RAM)	0 (cache)	1.5 (on-board RAM)	0 (cache)
Floating Foint	N/A	Intel 8087	N/A	Intel 80287	Add-on 98635A	MC68881	MC68881	MC68881	MC68881	MC68882	MC68882
Clcck frequency (Standard)	N/A	Dl 172 A, 7.16 MHz	N/A	D1387A, 8 MHz	10 MHz	16.7 MHz	16.7 MHz	16.7 MHz	20 MHz	25 MHz	33 MHz
Accelerator	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Optional 98248A	Optional 98248A	Optional 9824SB	Optional 98248B
Memory Management Unit											
Type	N/A	N/A	N/A	Intel B0286	HP Custom	MC68B51	MC68851	HP 68851	HP Custom	on CPU Chip	on CPU Chip
Virtual meirory [HP-UX only)	N/A	N/A	N/A	N/A	16 Mbytes/ process	4 Gbytes/ process	4 Gbytes/ process	4 Gbytes/ process	4 Gbytes/ process	4 Gbytes/ process	4 Gbytes/ process
Contexts	N/A	NfA	NfA	NIA	84 default, user-settable	84 default, user-settable	84 default, user-settable	84 default, user-settaBle	84 default, user-settaBle	84 default, user-settaBle	84 default, user-settable
Cache Memory											
Type	NIA	N/A	NIA	NIA	N/A	Instruction cache	Instruction cache	Instruction cache	Write through instruction and data (external to MC68020 instruction cache)	Instruction cache and data cache on CPU chip	Write through instruction and data (external to MC68030 on chip Caches)
Size	N/A	N/A	N/A	N/A	N/A	256 bytes	256 bytes	256 bytes	32 Kbytes	512 bytes	64 Kbytes
Average cycle time	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	120 nsec	N/A	60 nsec
Main Memory											
Type	No parity	No parity	No parity	Byte parity error checking	Byte parity error checkirg	Byte parity error checking	Byte parity error checking	Byte parity error checking	Byte parity error checking; optional ECC	Byte parity error checking	Byte parity error checking; optional ECC
RAM	512-Kbytes on-board	640 Kbytes on-board	512 Kbytes on-board	640 Kbytes on-board	1 Mbyte on-board	4 Mbytes on-board	4/6 Mbytes on-board	4 Mbytes on-board	5 MBytes	4 MBytes on-board	8 MBytes
Bus width	24b address, lob data	20b address, 8b data	24b address, lob data	24b address, lob data	24b address, lob data	32b address, 32b data	32b address, 32b data	32b address, 32b data	32b address, 32b data	32b address, 32b data	32b address, 32b data
System RAM access time	500 nsec	560 nsec	500 nsec	375 nsec	540 nsec	240 nsec	240 nsec	240 nsec	180 nsec min. 400 nsec max. 120 nsec cache	30 nsec min. 200 nsec max.	170 nsec min. 390 nsec max 60 nsec cache
Additional Memory	82303A, 82305A	D1174A Opt. 001/002	82303A, 82305A	45944A Opt, 001(002/003	93257A	N/A	98266A; 98266B	98258A	98258A/B/C, 98264A/B(ECC)	98267A/B/C	98258A/B/C; 98264A/B(ECC)
Maxirrum Memory	4 MBytes	640 Kbytes Main; 8 Mbytes Expanded Memory Systems (EMS)	4 MBytes	640 Kbytes Main; 8 Mbytes Expanded Memory Systems (EMS)	7.5 Mbytes	4 Mbytes	16 MBytes	8 MBytes	32 MBytes; 48 MBytes (ECC)	16 Mbytes	32 Mbytes; 48 Mbytes (ECC)

Standard System Interfaces and Features

Interface	DIO Equivalent	PC-305	PC-308	Model 310	Model 318M	Model 319	Model 330/360	Model 350/370
HP-IB	98624A	Yes	Yes	Yes	Yes	Yes	Yes	Yes
RS-232C	98644A	Yes	Yes	Yes	Yes	Yes	Yes	Yes
HP-HIL	—	Optional*	Yes	Yes	Yes	Yes	Yes	Yes
RS-422	98628A	Optional	Optional	Optional	No	No	Optional	Optional
LAN	98643A	Optional	Optional	Optional	Yest	Yest	Yest	Yest
DMA	98620B	No	No	Optional	Yes	Yes	Yes	Yes
High-speed HP-IB disc‡	98625B	No	No	Optional	No	Optional§	Optional**	Yes
System timer	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes
User timer	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Battery-backed real-time clock	—	Yes	Yes	Yes	tt	tt	Yes	Yes
DOS Software compatibility	98286A‡‡	Yes	Yes	Optional	No	No	Optional	Optional

Table 2

* *Not supported in HP BASIC.*
‡ *The built-in LAN interface m Models 318M and 319C+ is a ThinLan with BNC "T" connector and ThinMau. The built-in LAN interface on Models 330, 350, 360 and 370 is either AU1 (which am be usedfor ThickLAN, ThinLAN, or StarLAN JO) or ThinLAN BNC "T" connector and ThinMAU.*
† *The SCSI interface is available äs an Option on the Models 319C+, 330, 350, 360 and 370.*
§ *The optional high-speed HP-IB disc interfacefor the Model 319C+ is available only at initial arder.*
** *The highspeed HPIB Disc Interface is Standard on the Model 36O Turbo SEX.*
TT *The Models 318Mand319 include real-time clock with minimum expected run time of 12 hours, after power loss, without battery backup.*
JJ *Also requires 98531A DOS Coprocessor Software.*

2.0 Series 300 System Processing Units

Overview

The HP Series 300 features the Motorola 68000 processors: the 32-bit MC68020 operating at 16.7 MHz in the Models 318M, 319, and 330; the MC68020 operating at 25 MHz in the Model 350. The MC68030 is available in the Model 360 at 25 MHz and the Model 370 at 33 MHz. All these Systems use a füll 32-bit address and data path for both memory and I/O buses.

The Model 330/350/360/370 SPU is contained in a single, compact Design Plus box containing four System slots that are available to hold the System processor board, graphics board, System interface board, and RAM or accessory boards. All System boards plug into a 6 Mbyte/sec asynrhronous device I/O bus (L)IO II) which features füll 32 bits address and 32 bits data, non-multiplexed. The DIO II bus is fully compatible with a complete line of 16-bit DIO interfaces and accessories, and tan easily be expanded via the 98570A direct-connect DIO II expander or 98568 DIO Expander #132.

2.1 Model 318M

The SPU for the Model 318M is a 2 board System, utilizing the same CPU board äs the Model 330. The system interface board is similar to that of the Models 330 and 350, with one exception. Instead of having provisions to add a high-speed disc interface, it includes the video circuitry for the 1024 x 768 monochromatic display. (This circuitry is electrically identical to the 98544B high-resolution monochrome graphics board.) Standard ThinLAN, RS-232C* with DB25 connector, and HP-IB with DMA interfaces are included. The Model 318M contains no mechanical or electrical provisions for additional DIO II or DIO interface or accessory cards.

2.2 Model 319

Utilizing the same 16.67 MHz CPU äs Model 318M and 330, Model 319 offers cosl effective solutions for many applications with limitcd expandability requirements. The processor board of Model 319 contains the MC68020 CPU; MC68881 floating point coprocessor; Standard ThinLAN; RS-232C* with DB25 connector; HP-IB with DMA, and HP-HIL interfaces; and either four or eight Mbytes RAM.

The Model 319C+ is a two-board color workstation. It uses a graphics board containing high-performance graphics display hardware in addition to optional high-spccd HP-IB or SCSI interfaces. Included is the graphics circuitry for the 1024 x 768 color display.

The Model 319SRX uses the Model 319 SPU with the SRX graphics Subsystem. This system provides a cost effective workstation for 3D wireframe applications and provides the capability to movc to surface and solids applications. In this configuration, the HP-IB high-speed disc interface is Standard The SCSI interface is not available.

* *FJP 9864.4.A RS-232C equivalent.*

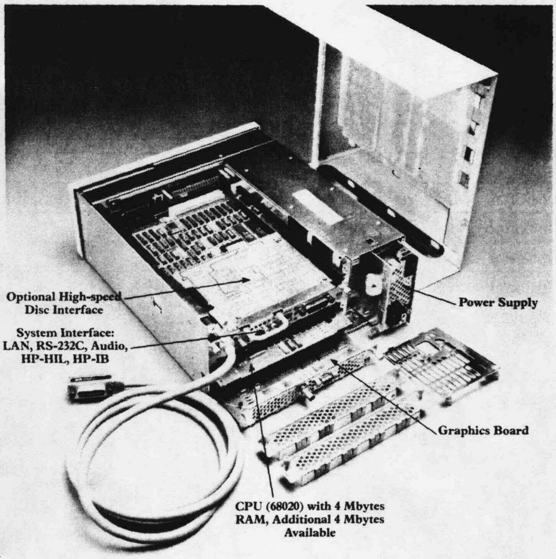

Figure 1: Model 330 SPU Configuration

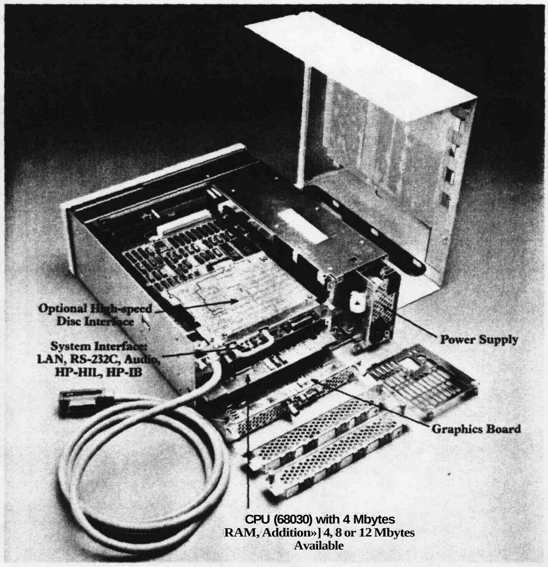

Figure 2: Model 360 SPU Configuration

2.3 Model 330 and Model 360

The architecture of the Model 330 *is* based on 16 MHz VLSI technology from Motorola: MC68020 processor, MC68881 floating point coprocessor, and Motorola 68851 paged memory management unit. Maximum System performance is ensured by operating the four Mbytes of on-board main memory synchronously with the 16.67 MHz MC68020 processor, providing 2 MIPS computational power. This 240 nanosecond (nsec) access time main memory is connected to the processor over a füll 32-bit wide bus.

The Model 360 architecture is based on 25 MHz VLSI technology from Motorola which includes the MC68030 processor and MC68882 floating point coprocessor.

System performance of 4.5-5.0 MIPs is ensured by operating up to 16 Mbytes of main memory, synchronously with 25 MHz MC68030 processor. Main memory is connected to the processor over a füll 32-bit wide private-memory bus.

The hardware floating point co-processor is Standard in both the Model 330 and 360 to facilitate the floating point math operations frequently encountered in the technical computing environment. Both single- and double-precision floating point operations conform to the IEEE 754 Standard for floating point formats.

The Model 360 central processing unit (CPU), floating point hardware, memory manager, and memory electronics are contained on the processor board, while all necessary System I/O is located on the System interface board. Two DIO II slots are available for adding a graphics board and a 2-slot DIO backplane for Series 300 accessories such äs HP's DOS Coprocessor, a four-port RS-232C multiplexer card, or any of a host of other interface cards. In either the Model 330 or 360 without a graphics board, the 4-slot DIO backplane may be added to allow insertion of two additional Series 300 I/O cards.

The Standard Configuration for the Model 330 includes 4 Mbytes RAM. One 4 Mbyte parity checking RAM Controller board may be added for a total of 8 Mbytes. HP-IB, RS-232C* and LAN interfaces are also included.

The Standard Configuration for the Model 360 includes 4 Mbytes RAM. One 4, 8, or 12 Mbyte parity checking RAM daughter board may be added for a total of 8, 12 or 16 Mbytes. HP-IB, RS-232C* and LAN interfaces are also included.

* 98644A RS-232C equivalent.

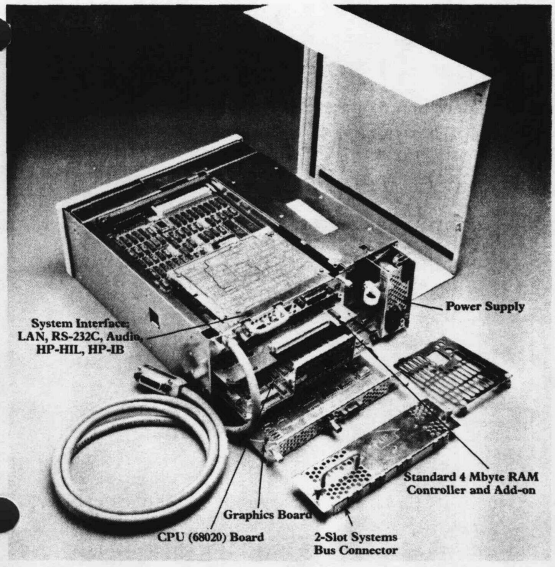

Figure 3: Model 350 SPU Configuration

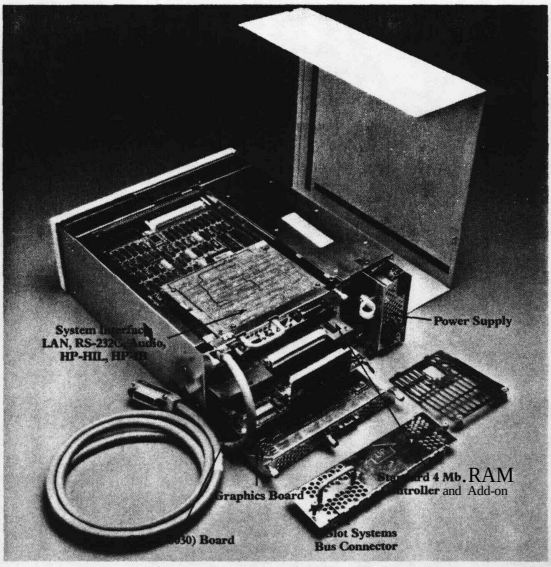

Figure 4: Model 370 SPU Configuration

2.4 Model 350 and Model 370

The Model 350 and Model 370 SPU include three Standard boards:

- The CPU board with processor, memory management unit, floating point hardware and cache
- The system interface board with HP-IB IEEE 488 port, RS-232C* port, HP-HIL, 2-channel DMA Controller, LAN interface, System and user timers, and high-speed disc interface
- 8 Mbyte parity-checking RAM board Standard, or optionally 16 Mbyte parity-checking RAM, 8 Mbytes Error-Checking and Correcting (ECC) RAM, or 16 Mbytes ECC RAM

The SPU on either leaves one slot free for adding either a graphics board, 2-slot DIO adapter, or graphics System Interface board. A 2-slot system bus connector couples the CPU board with the memory board installed in either the Model 350 or Model 370. Up to two additional memory boards can be installed (for a maximum of three) on the system bus via 3-slot and 4-slot system bus connectors. The recommended maximum for parity-checking RAM is 32 Mbytes, while ECC maximum supported memory is 48 Mbytes.

Parity checking is performed on a byte-boundary basis—4 bytes per 32-bit word. ECC RAM generates a checksum on a 32-bit word basis and provides single-bit error correction and double-bit error detection. Both parity and ECC RAM Systems consist of a RAM array and a dual-port Controller that multiplexes accesses from the CPU over the system bus and from bus masters on the DIO or DIO II bus.

The füll potential of the Model 350's 25 MHz MC68020 processor is realized by the use of a 32 Kbyte cache with 32-bit wide entries operating at a 120 nsec cycle time (which yields 4 Mips performance rating). This large cache buffers the 25 MHz processor from the main memory which operates at an average 180 nsec cycle time over a high-speed 32-bit wide system bus. The Model 350's custom memory management unit translates virtual memory addresses into physical memory addresses in parallel with cache-miss detection.

The Model 370's 8 MIPS high performance is realized by the 33 MHz MC68030 processor and 64 Kbyte cache with 32-bit wide entries operating at a 60 nsec cycle time (zero processor wait states). This larger, higher performance cache buffers the 33 MHz processor from the main memory which operates at an average 170 nsec cycle time over a high-speed 32-bit wide system bus. The Model 370's management unit, located on the CPU chip, translates virtual memory addresses into physical memory addresses in parallel with cache-miss detection. This means that maximum throughput is maintained for very large HP-UX programs and multiple concurrent processes.

* HP *98644A RS-232C equivalent.*

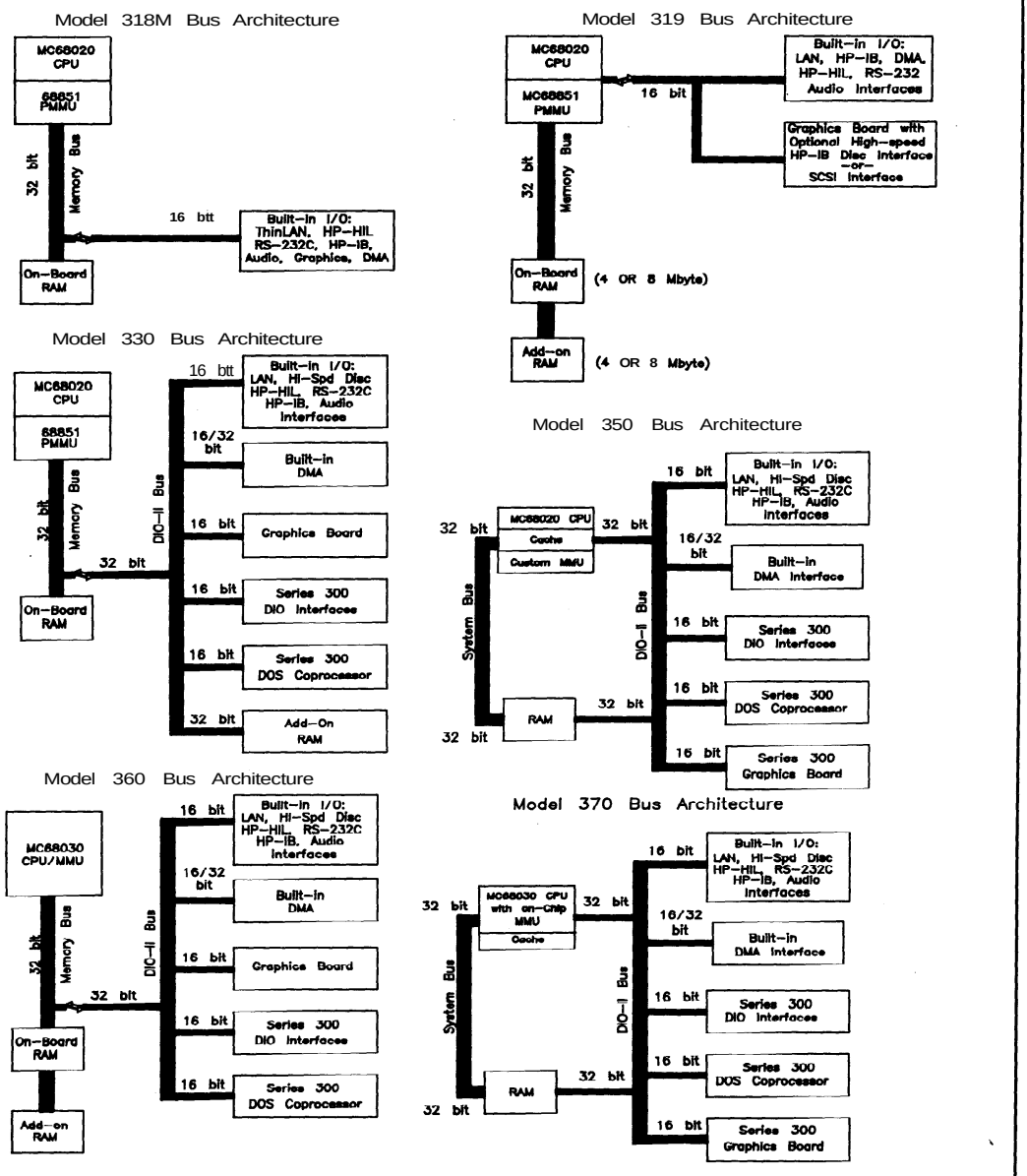

Figure 5: Model 318M. 319, 330, 350, 360 and 370 Bus Architecture

2.5 RAM and RAM Add-on

The Standard configuration for Both the Model 350 and Model 370 includes one 4 MByte RAM Controller Board, which occupies one System slot, and one 4 MByte RAM add-on Board, for a total of 8 MBytes. An optional 12 MByte RAM add-on Board may Be suBstituted for the 4 MByte RAM addon Board. With this arrangement, 8 or 16 MBytes per slot are provided. The maximum amount of parity-checking RAM on the System Bus is restricted to 32 MBytes (2 RAM Board sets). In addition, Error Checking and Correcting (ECC) RAM can Be added via 8 or 16 MByte Boards for a maximum of 48 MBytes.

The Standard configuration for the Model 330 includes 4 MBytes RAM äs discussed aBove. An additional 4 MByte RAM Controller Board may Be added, for a total of 8 MBytes.

The Standard configuration for the Model 360 also includes 4 MBytes of RAM. An additional 4-, 8- or 12-MByte RAM daughter Board may Be added for a total of 8, 12 or 16 MBytes.

The Model 360's DIO II port supports DIO Bus masters allowing it to Be used with Boards such äs the DOS Coprocessor.

The Standard configuration for the Model 319 includes 2 MBytes RAM on the processor Board. 8 MBytes on-Board RAM is optionally availaBle. An additional 4 or 8 MByte RAM add-on Board, which is unique to the Model 319C+, can Be added. The RAM add-on Boards are availaBle optionally at the time of SPU purchase or äs HP 98266A (4 MByte) and HP98266B (8 MByte).

The Standard configuration for the Model 318M includes 4 MBytes RAM on the processor Board. No additional RAM is availaBle.

2.6 Model 310

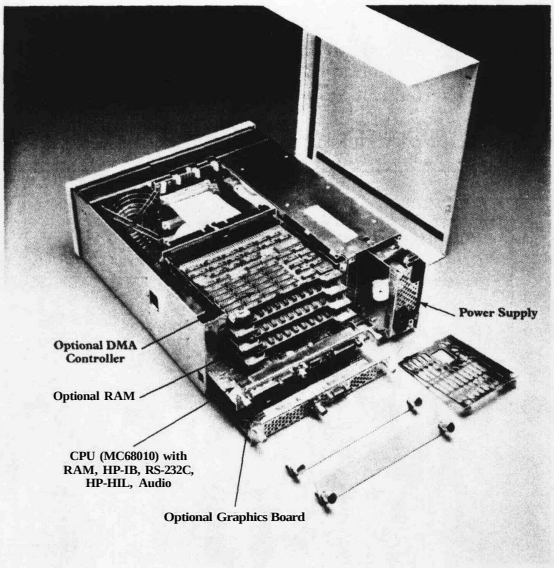

Figure 6: Model 310 SPU Configuration

The Model 310 features a 32-Bit internal architecture and 16-Bit external data/24-Bit address paths.

Architecture of the Model 310 memory, interface, and accessory cards features a 16-Bit Bi-directional data Bus, 24-Bit address Bus and Bus arBitration logic to allow multiple Bus master. The DIO memory and I/O Bus is an asynchronous Bus operating at 8 MHz, with an effective data throughput of 1.5 Mwords (3.0 MBytes) per second transfer rate.

In the Model 310, DIO memory and interface cards plug into the Backplane through a 100-pin edge connector. Each pair of DIO slots in the SPU or expander (see discussion under "System Accessories") can hold either two memory cards or one memory/accessory card (with cover plate). A Model 310 SPU has four accessory slots and thus can hold either four memory cards; two interface cards and two memory cards; or one interface card and three memory cards.

Model 310

The Model 310 processor Board includes an MC68010 processor, operating synchronously with on-board RAM, 512 or 1024 Kbytes RAM, paged memory management unit, medium-resolution bit-mapped video Output, and Standard interFaces. It has no Floating point Hardware built in; the HP 98635A floating point board provides Hardware Floating point performance.

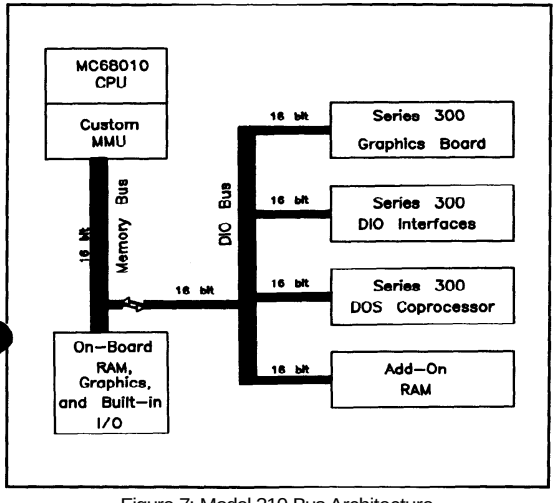

Figure 7: Model 310 Bus Architecture

3.0 SPU Accessories

3.1 I/O Expanders

Scveral expanders are available to increase the I/O capabilities oF the Series 300. A maximum oF one direct-connect and two 9888A expanders is supported with the Model 310. Models 330, 350, 360 and 370 support a maximum oF two direct-connect expanders plus two 9888A expanders.

The 98568A direct-connect 8-slot DIO Expander features eight DIO slots to Hold memory, interFace, and accessory cards. Option 132 (not available äs a stand-alone product) provides additional Features which allow the 9Õ568A to be connected to the DIO II backplane oF the Models 330 and 350.

The 98570A direct-connect DIO II expander adds two DIO II slots and Four DIO slots to a Model 330, 350, 360 OT 370 SPU. Option OO4 deletes the Four DIO slots, making the 98570A a 4-slot DIO D expander.

The 98242B 2-slot DIO backplane can be added to a Model 330, 350, 360 or 37O SPU or to the 98570A Option 004 expander to provide two DIO slots and three DIO II slots. The 98242A 4-slot DIO backplane can be added to a 98570A Option OO4 expander or to a Model 330 or 360 SPU to provide Four DIO slots and two DIO II slots. The 9888A 16-slot DIO expander plugs into one DIO interFace slot and can be used with any oF the Series 30O SPUs.

Because the expanders (with the exception of the 9888A) are electrically passive, no additional wait States are induced when accessing memory or I/O cards installed in the expander. The 9888A is electrically buFFered and induces one extra DIO dock cycle into 9888A accesses. The 9888A should only be used For adding DIO interFace cards, where access time is not a critical Factor.

3.2 PC-305 and PC-308 BASIC Controllers

The PC-305 and the PC 308 are BASIC Controllers based on the Vectra CS PC (8086 compatible) and the Vectra ES/12 PC (Intel 8O286 at 12 MHz), respectively.

At the heart oF the PC-305 and PC-308 is the HP BASIC Language Processor which provides the Vectra PC with the capabilities oF a Series 300 Werkstation. Consisting oF a Vectra-size circuit board, this plug-in accessory contains a Motorola 68OOO CPU, 512 Kbytes oF RAM (expandable to 4 Mbytes), HP-IB interFace, DIO interFace bus, BASIC in ROM or optional Pascal soFtware on Flexible discs. With the language processor, the Vectra PC allows programming and execution oF BASIC soFtware. SoFtware and data compatibility with PC-DOS Files is provided.

Two DIO interFaces, GPIO and SRM, have been redesigned to meet the Vectra size and Form specifications. They connect to the Language Processor through a DIO-equivalent bus, thereby achieving maximum perFormance and compatibility. Vectra PC interFaces, such äs serial (RS-232C) and parallel (Centronics), are also supported and emulate their Series 300 counterparts.

The Language Processor includes the ability to operate unattended in the background while the user runs a DOS application. While not true multi-tasking, this capability provides eFFiciency where the BASIC program does not require the attention oF the user or built-in Vectra PC resources.

The I/O transFer rates oF the PC-305 and PC-308 are the same. However, because the PC-3O8 is an IBM PC AT-compatible System, screen graphics perFormance is Faster than that oF the PC-305, an IBM PC XT-compatible System.

The PC-305 and PC 308 Feature HP's VGA video system that oFFers improved Feature beneFits over its previous monochrome and color solutions, Multimode and EGA. These beneFits include higher resolution (up to 640 x 480), larger number oF displayable colors, gray scale, larger color palette, and Faster video perFormance.

All Controllers include an HP Vectra PC with 640 Kbytes oF RAM and a 1.44 Mbyte 3.5 inch Flexible disc drive. The models vary in oonFiguration äs Follows:

Model PC 305M	Vectra CS with Monochrome Video Graphics Display
Model PC-305ML	Vectra CS plus 20 Mbyte hard disc drive, Monochrome Video Graphics Display
Model PC-308ML	Vectra ES/12 plus 20 Mbyte hard disc drive, Monochrome Video Graphics Display
Model PC-308CL	Vectra ES/12 plus 20 Mbyte hard disc drive, Color Video Graphics Display

Note: A PC-308 with 4O Mbyte hard disc drive and color video graphics display will \>e available in August 1988.

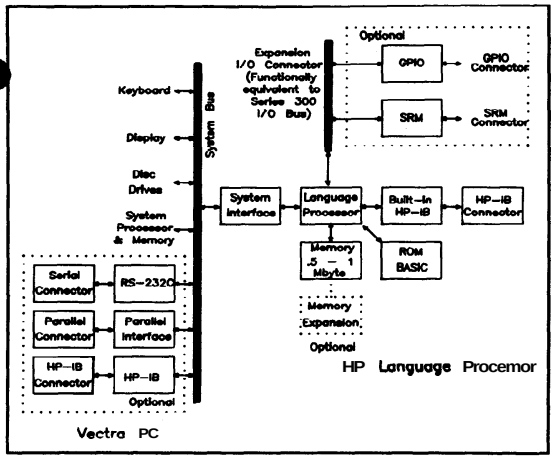

Figure 8: Functional relationship of the HP BASIC Language Processor to the host Vectra PC.

3.3 Network Servers

Models 15NS and 25NS are entry-level and high-performance Design Automation Network Servers based (respectively) on the HP 9000 Model 319 and 35O SPUs. The Servers have a number of capabilities that make them ideally suited for their task:

- 4-MIPS processing power (Model 25NS) and 2 MIPS (Model 15NS) enables dient workstations to of f-load Computer-intensive tasks increasing clients productivity
- I/O expandability (Model 25NS) permits it to be a Communications gateway integrating a multi-vendor environment, supporting industry Standard protocols such äs TCP/IP, SNA, NFS and X.25
- Support of discless nodes, reducing the cost-per-seat for a workcluster by eliminating the need for local discs
- Large, high performance disk and high capacity 1/4-inch tape drive simplifies backup System administration
- Support of **shared,** spooled peripherals reducing peripheral costs for a workduster
- Factory installed hardware and HP-UX operating System makes for fast System Setup

Model 15NS and 25NS are designed for deskside use in an office or lab environment. No special flooring or air conditioning is required.

The Model 25NS has the following System features:

- 4 MIPS HP 9000/350 SPU
- 8 Mbytes of ECC RAM (expandable to 32-Mbytes ECC RAM)
- DIO U I/O Expander
- 571-Mbyte Fixed Disc
- 536-Mbyte 1/4-inch Tape Autochanger
- Factory installed hardware and HP-UX operating System

The Model 15NS has the following system features:

- 2 MIPS HP 9000 Model 319 SPU
- 8 Mbytes of Parity RAM (expandable to 16 Mbytes)
- 304-Mbyte Fixed Disc
- 60-Mbyte 1/4-inch Tape Drive
- Factory installed hardware and HP-UX operating System

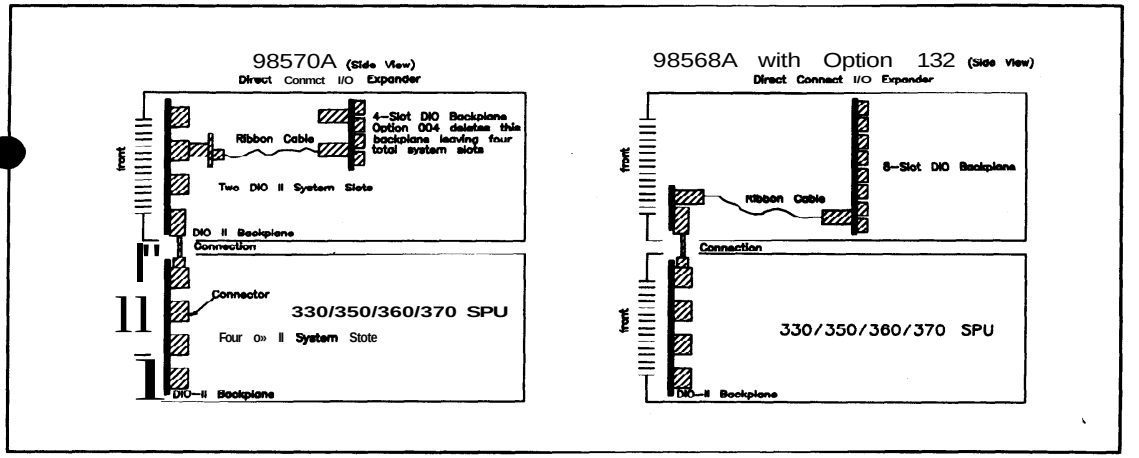

Figure 9: Series 300 Expanders

4.0 Upgrades

4.1 Model 330 to Model 350 Field Upgrade

By using the field installable kit, HP 98244A, a Standard Model 330 can be upgraded to a Standard Model 350. This Upgrade offers the improved power and performance of a 4 MIPS Werkstation and capability to expand to more than eight Mbytes RAM. The Model 350 offers a maximum of 32 Mbytes for parity checking RAM, 48 Mbytes for ECC RAM, twice the CPU power of the Model 330 and object code compatibility with the Model 330. The Model 330 to Model 350 Upgrade kit consists of:

- **Model 350 processor board**
- System bus, 2-high connector (98562-66502)
- 98258A 4 Mbyte RAM Controller
- 98258B 4 Mbyte RAM Add-on
- 98262A High-speed HP-IB Disc Interface

An Option is available which replaces the 2-high system bus with a 3-high system bus, allowing use of the f loating point accelerator in the upgraded **workstation**. The Model 330 processor board must be returned to HP.

4.2 Model 330 to Model 360 Field Upgrade

The Model **330's** performance can be doubled and the maximum RAM increased to 16 Mbytes through the HP 98247A 330 to 360 board Upgrade. This field installable kit consists of the MC68030-based Model 360 processor board which includes four Mbytes of RAM. Four, eight, or 12 Mbytes optional RAM can be ordered for a total of 8, 12 16 Mbytes.

The Model 330 processor board must be returned to Hewlett-Packard. If the upgraded Model 330 was configured with eight Mbyte RAM, an additional credit is given for the return of one four Mbyte RAM.

4.3 Model 350 to Model 37O Field Upgrade

The Model 350's performance can be increased to about 8 Mips through the 98247B 35O to 370 board Upgrade. This field installable kit consists of the MC68O30-based Model 370 processor board. The Model 350 processor board must be returned to Hewlett-Packard.

4.4 Model 310 to Model 330 Trade In Upgrade

A Model 310 SPU can be upgraded to a Model 330 SPU. realizing three to five times higher performance.

4.5 Model 320 Trade-In Upgrade

A Model 320 SPU can be traded in when purchasing either the Model 360 or 350 SPU which provides more than double the performance of the 320 System.

5.0 Updates

5.1 Boot ROM Update to Rev. B (98563-67001)

Use of the discless node feature of HP-UX 6.0 or later revision requires Rev. B Boot ROM or later revision. The following models which were shipped prior to l January 1988 require the Boot ROM update in Order to use the discless node feature.

- Model 310 with a serial number prefix prior to **2751Axxxxx,** 280lGxxxxx, or 2751jxxxxx
- Model 330 with a serial number prefix prior to 2740Axxxxx, 2752Gxxxxx, or 2740jxxxxx
- Model 350 with a serial number prefix prior to 2747Axxxxx, 280lGGxxxxx, or 2747jxxxxx
- **98243A/B Model 310 to Model 320 Field Upgrade, which includes a 98561-66516 processor board**

Installation assistance can be purchased separately.

*Note: **Model** 310 Systems with a serial number less than **2522A02500 require** an additional procedure to allow use of this update. Please contact your local HP service office for more Information.*

5.2 Processor Board Update for Model 330 (98562-69013)

Use of the 98566A 2D Integer-based Graphics Accelerator or SCSI requires the latest revision of the Model 300 processor board. Model 330 Systems with serial number prefixes prior to 2740Axxxxx, 280lGxxxxx, or 2740jxxxxx which were shipped prior to l January 1988 require this Update. The update is a board exchange kit that includes a new system interface board and a new processor board with Rev. Cl Boot ROM revision. This update allows use of the discless node feature of HP-UX 6.0 or later revision and access to the 98566A graphics accelerator. The current CPU board and system interface board must be returned to HP.

5.3 Boot ROM Update Rev. C to Rev. Cl (98562-67001)

Use of the TurboSRX graphics Subsystem or enhanced SCSI error status support requires Boot ROM Rev. Cl. Model 350 Systems with Rev. C* require this update. The Rev. Cl update kit (98562-67001) includes the two Rev. Cl Boot **ROMs,** Installation Notes, and Labeis.

5.4 Processor Board Update for Model 35O (98562-69517)

Use of the 9873OA TurboSRX Graphics Subsystem or the 98556A 2D Integer-based Graphics Accelerator or SCSI requires the latest revision of the Model 350 processor board. Model 350 Systems with a serial number prefix prior to 2747Axxxxx, 2801Gxxxxx, or 2747jxxxxx which were shipped prior to l January 1988 require this update. The board exchange kit includes a new processor board with Rev. C Boot ROM, which allows use of the discless node feature of HP UX 6.0 or later revision and access to the 98556A graphics accelerator. The current CPU board must be returned to HP.

To Jetermine the current Boot ROM revision of your system, simply re-boot your system and read the boot message.

6.0 Standard I/O Specifications

Models 310, 318M, 319, 330, 350, 360 and 370

DIO II Bus:
- Width ..... 32 bits address; 32 bits data
- Bus bandwidth ..... 6 Mb/second

DIO Bus:
- Width ..... 24 bits address; 16 bits data
- Bus bandwidth ..... 3 Mb/sec

ThinLAN Interface (Models 318M, 319, 330, 350, 360 and 370):
- Connector ..... BNC "T" connector
- Required MAU ..... Built-in ThinMAU
- Media ..... ThinLAN coax cable (RG 58U)
- Protocol ..... IEEE 802.3/Ethernet
- Data rate ..... 10 Mbit/sec

AUI LAN Interface (Models 330, 350, 360 and 370):
- Connector ..... AUI (Attachment Unit Interface)
- Required MAU ..... Backbone MAU (HP 30241A) and AUI cable
- Media ..... ThickLAN coax cable
- Protocol ..... IEEE 802.3/Ethernet
- Data Rate ..... 10 Mbit/sec

Parallel Interface:
- Type ..... IEEE 488
- Data rate ..... 350 Kbyte/sec
- Number of connected devices supported ..... 15 per interface

Serial Interface:
- Type ..... RS-232C Standard (98644A equivalent)
- Connector ..... DB9 with cable adapter to DB25 (for 310, 318M and 319, DB25 connector)

Disc Interface (Models 319, 330, 350, 360 and 370):
- Type ..... IEEE 488
- Data rate ..... 1 Mbyte/sec
- Number of connected drives supported ..... 8 per interface (additional disc interfaces are available äs optional accessories)

DMA Interface:
- Number of channels 2

HP-HIL Interface:
- Number of devices supported ..... 7 total

7.0 Physical and Environmental Specifications

SPU Power Specifications

	PC-305/PC-308	Model 318M	Model 319	Model 310	Model 330, 350, 360,370	98568A	98570A
Source Consumption	3.95A @ 115 V 2.12A @ 230V	2.1A @ 11SV 1.2A @ 230V	1.9A @ 120V l.OA Gä> 240V	5.0A @ 90 - 132V, switch selectable 3 OA @ 180 - 250V, switch selectable			
Line Frequency	50-60 Hz	5O-60 Hz	50-60 Hz	48 - 66 Hz			
Power Consumption: Watts maximum BTU/hour Kcal/hour	46SW*	100 340 100	110 374 110	250 853 250			
Power Availability: Power supply maximunv At +5 volts At+ 12 volts At + 12 volts	134W	N/A	N/A	ISO Watts 20Amps 3.6 Amps 1.1 Amps			
DIO Backplane Power: At +5 volts At + 12 volts At -12 volts	N/A	N/A	N/A	** 31 Watts 192 Watts 6 Watts	N/A	** 62 Watts 38.4 Watts 12 Watts	N/A
DIO II Rackplane Power; At -1-5 volts At + 12 volts At - 12 volts	N/A	N/A	N/A	N/A	** 85 Watts 40 Watts 12 Watts	N/A	** 62 Watts 38.4 Watts 12 Watts

* *InfluJes 150 W convenitnce* ***outlet.***
** *Only supported configurutions allowed.*

Table 3

7.1 Physical Dimensions

Models PC-305 and PC-308

	PC-305	PC-308
Height	160 mm (6.3 in.)	160 mm (6.3 in.)
Width	425 mm (16.7 in.)	425 mm (16.7 in.)
Depth	390 mm (15.4 in.) Additional 4 inches in depth should be allowed for interface cables.	390 mm (15.4 in.)
Net weight	13.3 kg (29.4 Ibs.)	13.9 kg (30.5 Ibs.)

Models 310, 330, 350, 360, 370, 98568A/98570A

Height ..... 130 mm (5.12 in.)
Width ..... 325 mm (12.8 in.)
Depth ..... 376 mm (14.8 in.) Additional 4 inches in depth should be allowed for interface cables.
Net weight ..... 11.8 kg (26 Ibs.) maximum
Shipping weight ..... 13.8 kg (30.4 Ibs.)

Model 318M

Height ..... 104 mm (4.10 in.)
Width ..... 325 mm (12.8 in.)
Depth ..... .325 mm (12.8 in.) Additional 4 inches in depth should be allowed for interface cables.
Net weight ..... 4.5 kg (10 Ibs.) maximum
Shipping weight ..... 6.5 kg (14.4 Ibs.)

Model 319

Height ..... 104 mm (4.10 in.)
Width ..... 325 mm (12.8 in.)
Depth ..... 444 mm (17.5 in.) Additional 4 inches in depth should be allowed for interface cables.
Net weight ..... 6.8 kg (15 Ibs.) maximum
Shipping weight ..... 10.0 kg (22 Ibs.)

7.2 SPU Environmental Range

Models PC-305 and PC-308

Operating temperature ..... —5°C to 40°C
Storage temperature ..... —40°C to 70°C
Humidity ..... 5% to 80% R.H. (non-condensing)
Maximum altitude ..... 4,570m (15,000 ft.)
EMI ..... Conducted and radiated interference meets FTZ Level A; FCC Class B

7.3 Environmental Range

Models 310, 318, 319, 330, 350, 360 and

Operating temperature ..... 0°C to + 55°C
Storage temperature ..... —40°C to +71°C
Maximum wet-bulb temperature ..... 40°C
Humidity:
Operating 40°C ..... 15% to 95% R.H.
Non-operating 65°C ..... @ 90% R.H.
Altitude:
Operating ..... 4,570m (15,000 ft.)
Non-operating ..... 15,240m (50,000 f t.)
EMI, Models 310 and 320 .... Conducted and radiated interference meets Fl Level A, FCC Class A
EMI, Models 318M, 319, 330 and 350 ..... Conducted and radiated interference meets FC Class A; VDE 1046/8 (Level B); VCCI Class
Additional Regulatory Compliance ..... UL478, 5th edition; CS/ 22.2 No. 154, M-1983 380, 2nd edition; IEC 2nd edition; (Model 319C-I- only, CSA 22. No. 220-M-1986)

7.4 Clock and Timers

Real-time Clock

Resolution ..... 10 milliseconds
Accuracy ..... + 5 seconds/day
Battery Backup (except Models 318M and 319C-I- ..... Lithium, expected life = 1 year
Expected run time after power loss (Models 318 and 319C+)..... 12 hours

Timers

Match interrupt ..... Match on time of day 0.0 84600.00 sec.
Delay interrupt..... 10 msec. to 1.94 days
Cyclical interrupt ..... 1O msec. to 1.94 days
System timer ..... 4usec. resolution accurate 25 ppm

Audio

Three independent tone generators controllable over 30

Frequency range..... 81.46 Hz to 83.3 KHz
Resolution ..... Capable of approximate chromatic scale over f h octaves
Duration ..... 01 sec. to 2.55 second/ton

8.0 Display Systems

The Series 300 features twelve display Systems: eleven are bit-mapped display Systems which allow user selection of dif ferent text styles and sizes to be intermixed with graphics information on the same screen. Of these eleven, eight fit in a DIO D slot, the ninth is the 98700A Graphic Display Station, and the tenth is the 98720A Solid Rendering Display Controller. The eleventh is the 98730A Solid Rendering Display Controller. The twelfth display System separates alpha and graphics Information for füll compatibility with Series 200 programs written to take advantage of independent control of alpha and graphics.

HP 9000 Graphics Hardware Summary

Graphics Subsystem	98542A	98543A	98544B	98546A	98547A	98548A	98549A	98550A*	98720A	98730A
Resolution	512x400	512x400	1024x768	512x400	1024x768	1280x1024	1024x768	1280x1024	1280x1024	1280x1024
Overlay Planes	0	0	0	0	0-2	0	0-2	2	4	4
Color Planes	1	4	1	1	6-4	1	6-4	8	8-24	8-24
Colors"*	Mono-chrome	16	Mono-chrome	Mono-chrome	64-16	Mono-chrome	64-16	256	256-16M	256-16M
Double Buffer Planes	No	No	No	No	No	No	3	4	4, 8, or 12	4, 8, or 12
Monitors/Size	35731A/B 12"	35741A/B 12"	98786A 17"	35731A/B 12"	98751A 19" 98785A 16-	98788A 19"	98751A 19" 98785A 16"	98752A 19" 98789A 19"	98752A 19" 98789A 16"	98752A 19" 98789A 16"
Options										
- 8 planes graphics memory	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	98722A	98722A
- Graphics accelerator	N/A	N/A	N/A	N/A	N/A	N/A	98556A	98556A	98721A	98732A
- Z-buffer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	98722A	ine. with 98732A
Systems Supported - Series 300	All"	All"	All"	All"	All**	330/350/ 360/370	330/350/ 360/370	319/330/ 350/360/ 370	350/ 360/370	350/ 360/370
Operating Systems Supported										
- HP-UX	Yes	Yes	Yes	YPS	Yes	Yes	Yes	Yes	Yes	Yes
- BASIC	Yes	Yes	Yes	Yes	Yes	Yes	Yes-Not 98S56A	Yes-Not 98556A	No	No
- Pascal	Yes	Yes	Yes	Yes	Yes	Yes	Yes-Not 98S56A	Yes-Not 98556A	No	No

** Order the AlOZOH for the Series 800.*
*** Not on the Model 318 or Model 319.*
**** Displayable colors from a Palette of 16 millim. Ihis refers to single hufferedmode.*

Table 4

Series 300 Graphics Boards

Series 300 graphics boards provide a choice of either monochrome or color and medium- or high-resolution formats. The display architecture is urganized on a byte-per-pixel basis. Each f rame buf fer plane in a color System can be manipulated independently of the others, providing flexibility to the system programmer in implementing graphics applications on the Series 300 Computer Systems.

To achieve maximum functional density at lowest cost, each board employs VLSI technology. The graphics board's VLSI chips operate independently from the main CPU, f reeing up the processor to perform other functions while the display System is performing screen blanking, scrolling or window moves, thereby maximizing system throughput.

The technical specifications of Series 300 graphics boards (98542A/43A/44B/47A) are listed in the following table.

Uesrription	Resolution	
	Medium	High
VLSI clock rate	9MHz	16 MHz
Frame buf fer size (pixels/plane)	1024 x 512	1024 x 1024
Displayed buffer size (pixels/plane)	512 x 400*	1024 x 760
Window move speed (pixels/second)	11.2M	20M
Scrolling speed (pixels/second)	16.9M	30M
Pixel write speed, maximum: • Horizontal (pixels/second)	IM	1.9M
• Vertical (pixels/second)	.28M	.SM
Pixel write speed by CPU: • Models 310 (pixels/second)	60,000	60,000
• Model 320 (pixels/second)	120,000	120,000
Screen erase time (msec)	36	40

" These are half-width. reclangular pirels to impnme alpha resoluHon.

Table 5

8.2 98542A - Medium-resolution (512 x 400) Monochrome Graphics Board

This Board provides a high-quality display suitable for desktop or lab bench use. It features both alpha text and graphics capabilities and is supplied with a 2.4 meter cable for use with the HP 35731A 12-inch monochrome monitor with built-in Speaker and integrated tut and swivel. The HP 35731A/B monitor also Supports an optional HP HIL touchscreen bezel and can be rack mounted (Rack Mounting Kit HP *98567 A)* for computer-aided test applications.

8.3 98543A - Medium-resolution (512 x 400) Color Graphics Board

This board features high-quality color text and graphics capability suitable for desktop or lab bench use. Four planes provide 16 simultaneous colors selectable from a color palette of over 16 million hues. The board comes supplied with 2.4 meter RGB cables for use with the HP 35741A 12-inch color monitor with built-in Speaker and integrated tilt and swivel. The 35741A/B monitor also Supports an optional HP-HIL touchscreen bezel and can be rack mounted.

8.4 98544B - High-resolution (1O24 x 768) Monochrome Graphics Board

This board provides a high-resolution display suitable for desktop or CAD System use. It drives the 98786A 17-inch high-resolution monochrome monitor with built-in tilt and swivel. The 98544B graphics board is supplied with a 1.7 meter coax video cable and a 2.5 meter coax audio cable.

8.5 98547A - High-resolution (1024 x 768) Color Graphics Board

This board provides a high-resolution display suitable for CAD System use. It comes with a 3 meter RGB cable for use with the 98751A 19-inch or 98785A 16-inch high-resolution color monitors. The board features six planes of frame buffer to provide 64 simultaneous colors from a color palette of over 16 million hues.

9.0 Serics 300 High-performance Graphics Boards

The Series 300 high-performance graphics boards are a family of graphics Subsystems providing a ränge of resolutions and graphics planes. High performance has been designed into the boards through custom-designed HP VLSI components. The boards feature bit-per-pixel addressing, overlay planes, hardware support of vectors, general polygons and filled geometries for enhanced System interactivity.

9.1 VLSI Implementation

The ctistom VLSI in the Series 300 high-performance graphics boards gives higher reliability and performance at lower cost.

The scan Converter chip takes the end-points of lines or polygons and calculates the position of all pixels within the line or polygon. Since this calculation is done in VLSI rather than Software, the performance is dramatically improved.

The data path chip gives the board the ability to update the frame buffer at a rate of 74 million pixels per second.

The color map Digital to Analog Converter (DAC) provides the 108 MHz video rate needed for a 1280 x 1024 resolution, 60 Hz display. It allows 256 colors to be simultaneously displayed from a palette of over 16 million in the image planes. This chip also provides the special color map hardware for mixing overlay Information with image information.

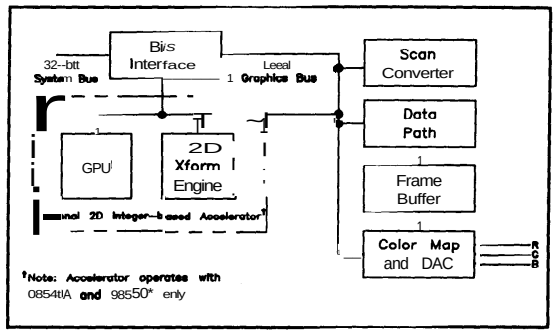

Figure 10: Series 300 High-performance Graphics Board Diagram

9.2 98548A - High-resolution (1280 x 1024) Monochrome Graphics Board

The 98548A monochrome board features the 1280 x 1024 resolution most needed for computer-aided Publishing and Software engineering. In addition to the improved resolution, the 98548A provides bit-per-pixel addressing for fast movement of screen images such äs menus and Windows. The 98548A also provides hardware scan Converter circuits for high-speed vector, polygon and area-fill performance. The 98548A requires the 98788A 19-inch monochrome monitor.

9.3 98549A - High-resolution (1024 x 768) Color Graphics Board

The 98549A color graphics board provides 1024 x 768 resolution and is offered äs an Upgrade Option. The 98549A features the same scan Converter and data path chips äs the 98S50A for high-performance graphics.

The six planes may be Software configured äs six color planes, which allow for 64 colors, or äs four color planes, which allow 16 colors and two overlay planes.

The 98549A also accommodates the 98S56A 2D Integer-based Graphics Accelerator. The 98549A may use the 987S1A 19-inch color monitor or the 98785A 16-inch color monitor.

9.4 98550A - High resolution (1280 x 1024) Color Graphics Board

This graphics board provides the 1280 x 1024 resolution needed for demanding 2D graphics applications. A hardware scan Converter provides high-speed vector, polygon and circle gerteration. High-speed block transfer circuits provide fast BITBLT performance. The 9855OA provides eight color planes which allow 256 colors from a palette of over 16 million. These color planes can also be used äs four planes double-buffered for interactive pan-zoom of 16-color images.

Two additional overlay planes can be used for Cursors, menus, text or temporary storage. The use of these overlay planes can make application writing a much easier task. The 98550A also accommodates the 98556A Integer-based Graphics Accelerator. The 98550A may use the 98752A 19-inch color monitor or the 98788A 16-inch color monitor.

9.5 Model 319 High-resolution (1024 x 768) Color Graphics Board

The graphics Subsystem in the Model 319 provides six color planes which allow 64 colors from a palette of over 16 million. These planes can be configured äs four color planes and two overlay planes.

9.6 Technical Specifications of Series 300 Graphics Boards (98548A/49A/50A and Model 319)

System Graphics Performance†

Polyline Drawing Speed:
- Device coordinates*
  - (50-vector polylines, 20 pixels per vector, 45 degree angle)..... 76,000 vectors per second
- World coordinates†
  - (50-vector polylines, 20 pixels per vector, 45 degree angle)..... 13,500 vectors per second

Filled Polygon Drawing Speed:
- Device coordinates
  - (4-sided oblique polygons, 30 pixels per side) ..... 1,700 polygons per second
- World coordinates
  - (4-sided oblique polygones, 30 pixels per side) ..... 800 polygons per second

Block Transfer:
- Main memory to frame buffer:
  - Bit/pixel - Starbase speed ..... 4 megapixels per second
  - Byte/pixel - Starbase **speed ..... 1.7 megapixels per second**
- Frame buffer to frame buffer - peak

härdware speed:
- Screen clear..... 74 megapixels per second
- SOURCE rule ..... 39 megapixels per second
- XOR rule..... 28 megapixels per second

10.0 Accelerators and Controllers

10.1 HOP 98556A 2D Integer-Based Graphics Accelerator

The HP 98556A 2D Integer-Based Graphics Accelerator further extends the graphics performance of the Model 330 and 350 color graphic workstations which include the HP 98550A or 98549A graphics boards.

Through the use of a dedicated graphics processing unit and 2D integer-based transform engine, the HP 98556A Graphics Accelerator provides the capability to realize "real-time," interactive pan and zoom functions for graphics-intensive 2D integer-based applications.

The 2D Graphics Accelerator provides a 32-bit world coordinate interface directly to the graphics pipeline. This speeds the display process by moving the Software intensive operations of transform calculations and device coordinate scaling directly to the graphics hardware that has been optimized to perform those tasks.

The 2D Graphics Accelerator is supported by the Starbase Graphics Library with optimized integer interface commands for the füll performance of the accelerator. The 2D Graphics Accelerator will operate in multiple, moveable and obscurable Windows and provide window performance improvements through the use of clip list management and context switch support.

Performance of the 2D Graphics Accelerator may be obtained with a simple field add-on board that takes advantage of the existing 98550A or 98549A graphics Subsystem.[5] It connects to the existing graphics board through an interface connector and exists in a "sandwich" configuration.

Additional 2D Graphics Accelerator functions:
- Transformation and clipping of lines, polylines and circles
- Programmable radix point for controlling precision and dynamic ränge of viewing operations
- Peak performance > 300,000 vectors/second
- Attribute management (colors, füll style, ...)
- Primitives including lines, polygons and circles
- **Matrix operations**
- Fast-stroked text
- **Cursors including stroked and raster Cursors and picking**
- Window acceleration

Accelerator vector speed** .... 300,000 vectors per second
Vector performance through
- Starbase Graphics Library..... 225,000 vectors per second

Stroked text ..... 6,000 characters per second
Graphics Processing Unit MC68020
Integer Math Unit ..... Weitek 8137
Interface ..... 32 bit integer

** Information is senl to the graphics boarJ in device coordinates.*
† Starbase transforms world coordinates to dfoice coordinates and sends deoice COordinates to the graphics board.
‡ Performance measured with Model 350 SPU.
§ I he HP 98S56A is supported cm Models 330 and 350 workstations with C+, CH, or CHXgruphics including the HP 98550A or 98549A Graphics boards.
10 pixel vecton, clipped, transformed and drawn.

Power Requirements

Source consumption ..... 3.4A (g) 5 Vdc[f]
Power consumption:
Watts (maximum)..... 33
BUT/hr 112.7
Kcal/hr..... 28.4

Environmental Range

Temperature:
Operating ..... .0°C to 55°C
Non-operating ..... —40°C to + 71°C
Humidity:
Operating 40°C ..... 15% to 95% R.H., non-condensing
Maximum wet-bulb ..... 40°C
Altitude:
Operating ..... .4,57Om (15,000 ft.)
Non-operating ..... 15,240m (50,000 ft.)
EMI ..... PCB int; maintains host system compliance
Additional regulatory compliance ..... PCB; maintains host

10.2 98700A - 3D Display Controller

The HP 98700A is designed to meet your 2D and 3D wireframe needs. When combined with the 98710A Graphics Accelerator, this system provides performance an order of magnitude greater than the HP 98547A High-Resolution Color Graphics Board, and Supports the same monitors.

The subsystem's interface plugs into an I/O slot in the Series 300 and accepts data f rom the SPU at a rate of over 1.5 Mbytes/second. Four planes of frame buffer are Standard, with an additional four planes available for a total of 256 simultaneous colors displayable from a palette of over 16 million hues.

10.3 98710A - Graphics Accelerator

The HP 98710A Graphics Accelerator for the 98700A Display Station contains a bit-slice processor with writable control störe, f loating point add, multiply and divide chips, äs well äs a vector generator chip with associated fast area fill hardware.

A hardware scan Converter and transform engine perform 2D and 3D transformations, polygon clipping and filling, and perspective division—improving performance by more than an order of magnitude over handling these functions in Software.

The following table provides a brief summary of the graphics performance of the 98700A Graphics Display Controller with the HP 98710A Graphics Accelerator installed:

10.4 Technical Specifications - 98700A with 98710A

Accelerator Specifications

Hardware vector generation . . Up to 2.5 megapixels per second
Line types ..... Eight
Hardware area fill ..... Up to 12 megapixels per second with 2x2 and 4x4 support

Performance Specifications

Frame buffer size (pixels per plane) ..... 1024 x 1024
Displayed buffer size (pixels per plane) ..... 1024 x 768
Window move speed (pixels per second) 16M
Scrolling speed (pixels per second)..... 24M
Pixel write speed during Hardware vector generation (pixels per second)..... 2.5M
Vector generation speed (25 pixel vectors per second) 62K
Area fill speed (pixels per second)..... 12M

Power Requirements

Line voltage..... 90 - 125 Vac, 198 - 250 Vac
Line frequency ..... 48 - 66 Hz
Current requirements ..... 2.3A (each) @ 9O - 125 Vac maximum
1.2A (each) @ 198 - 250 Vac maximum
Power consumption (maximum) ..... 130 watts, 45O BTU/hour (each)

Operating Environmental Range

Temperature:
Operating ..... 0°C to 55°C
Non-operating ..... —4O°C to 75°C
Humidity:
Operating 40°C ..... 15% to 95%
Non-operating 65°C ..... @ 90%
Altitude;
Operating ..... 4,570m (15,000 ft.)
Non-operating ..... 15,240m (50,000 ft.)
Electromagnetic Interference (EMI):..... Conducted and radiäted interference meets FCC Class A; FTZ Level A
Regulatory compliance ..... UL 478, 5th Edition; CSA 22.2 No. 154M-1983; IEC 380, 2nd Edition; IEC 435, 2nd Edition

t *The source consumption for the* HP *98556A combined with the gruphics board is 6.6A @ 5 Vdc*
board is 2.4A @ 5 Vdc

Physical Specifications

Height ..... 132 mm (5.2 in.) (each)
Width ..... 325 mm (12.8 in.) (each)
Depth ..... 292 mm (11.5 in.) (each)
Net weight ..... 6.8 kg (15 Ibs.) (each)
Shipping weight ..... 8.1 kg (18 Ibs.) (each)

10.5 98720A - Solid Rendering Display Controller

The 98720A Display Controller provides the resolution and number of displayable colors necessary for 3D solid graphics applications. The 98720A display System can grow f rom a 16-color low-cost system to a high-performance system with 16.7 million colors by simply adding frame buffer memory and a graphics accelerator.

The display System is particularly optimized for fast rendering of fully-shaded objects with hidden surfaces removed. This combination of speed and feature set provides an excellent graphics platform for solid modelling applications. The key features which provide this performance are:

- 3D polygons with shading, hidden-surface removal, and light source generation in hardware and microcode.
- B-spline capability, implemented in microcode, allowing generation of curved lines, meshes, and surfaces.
- Overlay planes for windowing, alpha, Cursors, and menus.

To obtain interactive graphics performance, the traditional four-stage graphics pipeline has been modified:

- Dual-ported memory has been added between each stage of the graphics pipeline, allowing each stage to operate independently, increasing the throughput of the pipeline.
- VLSI was used to eliminate pipeline bottlenecks.

The displayable resolution supported by the Display Controller is 1280 x 1024. The choice of monitor is 16-inch (98789A) or 19-inch (98752A). In its minimum configuration, four planes of graphics memory is available. Frame buffer memory can be addcd in increments of 8 planes to a maximum of 32 planes plus 4 overlay planes.

Overlay planes provide the capability to do windowing, Cursors, menus and alpha independently of the graphics images, and with 8 simultaneous colors.

Each frame buffer board supplies 2048 x 1024 bytes of graphics memory; the non-display portion is used for hidden surface removal (HSR). With a maximum 32-plane system, 24 planes (and 16.7 million simultaneous colors) are available for the graphics image; 8 planes plus "off screen" graphics memory provides a full-screen 16-bit Z-buffer for HSR. With less than 32 planes, Z-buffering is also available. For example, in a 24-plane system, it is possible to allocate 16 planes of the frame buffer for image (256 colors double-buffered) and 8 planes for HSR Alternately, all 24 planes may be used for image with non-displayable memory used for strip-mode HSR.

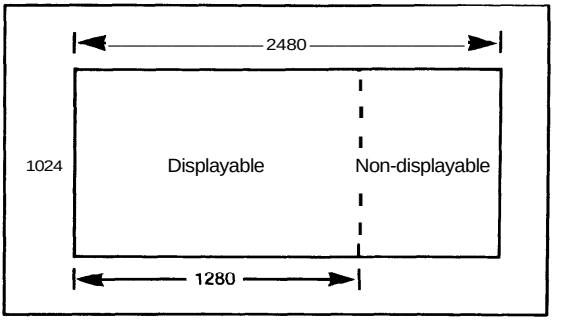

Figure 11: 98720A Frame Buffer Memory

10.6 98721A - Solid Rendering Graphics Accelerator

The 98721A 3D Solid Rendering Graphics Accelerator contains a bit-slice processor with writable control störe, floating point integrated circuits for add, multiply and divide functions, and high-speed 6-axis scan Converter. This provides the hardware and microcode implementation of the routines required by 3D applications, such äs:

- Lights (up to 8 sources, color and intensity adjustable) - directional, ambient, positional, Spotlight, colored
- Dithering
- Shading
- Hidden-surface removal
- Fourth-order non-uniform rational B-splines with trimming curves
- Specular highlighting

Hidden-surface removal requires frame buffer memory (HP 98720A Option 722 or HP 98722A Upgrade). The non-displayable portion of the frame buffer can be used if a low-cost, strip-Z-buffer system is needed. However, adding an extra frame buffer board to the system allows hidden-surface removal performance to increase by three timcs using füll 16-bit Z-buffer.

10.7 Technical Specifications - 98720A with 98721A*

Graphics Data

Frame buffer size 2048 x1024
Frame buffer planes ..... 4, 8, 16, 24, or 32 (maximum 1280 x 1024 displayable, 24-bit image planes, additional 8 planes and non-displayable portions of video RAM provide füll 16-bit Z-buffering)

* *Specifications listed are for a füll system induding u Graphits Accelerator, 32-plane frame buffer memory and four onerlay planes.*

Overlay planes ..... 0 (4-plane System) 4 (8,16, 24, or 32-plane System)
Video Signals.....RS-343
Color palette ..... 16.7 million
Mathematical representation..... 32-bit floating point
Z-buf fer ..... Hardware, 16-bit füll or strip
Control memory..... Writable control störe
Double buffering ..... 4, 8, or 12 planes

System Capabilities

Primitives:
- Vectors
- Polylines
- Circles
- Ares
- Polygons
  - n-sided, concave, convex, crossing, doughnut, wireframe
- B-spline (fourth-order non-uniform rational, with trimming)
  - curved lines, meshes, surfaces

Image Rendering:
- Depth cueing
- Hidden-surface removal
- Fiat shading
- Gouraud shading
- Phong lighting model
  - specular and diffuse reflections
- Lights (up to 8 sources, color and intensity adjustable)
  - directional, ambient, positional, Spotlight, colored
- Transparency
- Perspective projection

Software:
- CGI-based
- 3D hierarchical PHIGS-based display list
  - System memory or virtual memory, giving nearly unlimited size
- Hierarchical segments
  - segment contents editable
  - picking supported

Dimensional Capabilities:
- Geometrie transformations
  - scale, rotate, translate, perspective
  - concatenation of transformations
  - light source and perspective
- 32-bit IEEE f loating point
- 2D and 3D coordinates
- 6-plane clipping

Peak Performance

Display list traversal
Model 319 ..... 175,000 vectors per second
Model 350 ..... 190,000 vectors per second
Graphics accelerator..... 180,000 coordinates per second
Scan conversion ..... 16 million pixels per second
Raster operations ..... 125 million pixels per second using rectangular area fill
Window move speed ..... 17 million pixels per second
Area fill speed..... 124 million pixels per second

Power Requirements

Line voltage.....90 - 125 Vac, 198 - 250 Vac
Line frequency ..... 48 - 66 Hz
Current requirements:
Main supply ..... 6.2A (each) @ 90-125 Vac Maximum; 4.4A @ 198-250 Vac maximum
Auxiliary supply..... 3.8A (each) @ 90-125 Vac maximum 2.7A (each) @ 198-250 Vac maximum
Power consumption (maximum) ..... 130 Watts, 450 BTU per hour (each)
Main supply ..... 380 Watts, 1262 BTU per hour
Auxiliary supply..... 250 Watts, 818 BTU per hour

Environmental Range

Temperature:
Operating .....0°C to 55°C
Non-operating ..... 40°C to 71°C
Humidity:
Operating 40°C ..... 15% to 95%
Non-operating 65°C ..... @ 90%
Altitude:
Operating .....4,570m (15,000 ft.)
Non-operating ..... 15,240m (50,000 ft.)
EMI .....Conducted and radiated interference meets FCC Class A; VCCI Class 1; VDE 1046/84 Level B
Regulatory compliance ..... UL 478, 5th Edition; CSA 22.2 No. 154M-1983; IEC 380, 2nd Edition; IEC 435, 2nd Edition

Physical Specifications

Height .....235 mm (9.3 in.)
Width.....325 mm (12.8 in.)
Depth .....550 mm (21.7 in.)
Net weight .....23.2 kg (51 Ibs.)

10.8 98730A - Solid Rendering Display Controller

The 98730A Display Controller is a high-performance solid-rendering Subsystem that extends the performance of the 98720A. The 98730A provides the most advanced and extensive 3D solid rendering feature set available in the industry. These features dramatically increase the user's competitiveness by maximizing graphics interactivity and displaying photorealistic images.

For customers with imaging applications, the System can be configured without the graphics accelerator and Z-buf fer. This system provides the user with frame buf fer memory, overlay planes, pixel pan and zoom and blending Capabilities.

The 98720A remains an excellent platform for solid modeling at a significantly lower price than the 98730A.

10.9 98732A - Solid Rendering Graphics Accelerator & FuD 16-Bit Z-buffer

The design of the 98732A graphics accelerator is based upon the industry-leading 98721A accelerator. The 98721A graphics accelerator was integrated into a custom VLSI microprogrammable CPU using HP's 1-micron NMOS-III technology, which allows the graphics System to be configured with up to three transform engines running in parallel. This integration provides three to ten times the performance of the 98721A.

Additional enhancements include a more extensive feature set, new geometric primitives, füll speed Z-buf fer and improved communication links between all the Subsystems. The result is a System offering a consistently higher level of performance than ever before attainable for markets that require interactivity and photorealistic images.

10.10 Technical Specifications - 98730A with 98732A*

Graphics Data

Frame buffer size ..... 2048 x 1024
Frame buffer planes ..... 8,16, or 24 (maximum 1280 x 1024 displayable; nondisplayable portions are used for fonts, etc.)
Overlay planes 4
Video Signals..... RS-343
Color palette 16.7M
Mathematical representation..... 32-bit floating point
Z-buf fer ..... Hardware, 16-bit füll
Control memory..... Writable control störe
Double buffering ..... 4, 8, or 12 planes

System Capabilities

The 98730A/32A supports the complete 98720A/21A feature set and is fully object code and source code compatible. The 98730A Subsystem has the following additional capabilities:

Primitives:
- Triangle Strips
- Quadrilateral mesh
- Polymarkers
- Text
- Annotation matrix
- Culling
- Hardware Cursor tracking
- Pixel pan and zoom
- Image blending
- Gamma correction
- Sixth order non-uniform rational B-splines with trimming

Image Rendering:
- Enhanced depth cueing model
- Phigs -l- backface model
- Phigs + lighting model
- Füll performance when using:
  - Dithering
  - Transparency
  - Z-buffering
- light sources

Software:
- Ray tracing†
- Radiosityt
- **CGM**
- X Window System™
- Local 3D MOMA Windows (Multiple Obscurable Movable Accelerated Windows)

System Performance*

Polylines ..... 240K (3D) vectors per second
270K (2D) vectors per second
Triangle strip*..... 38K (3D) triangles per second
50K (2D) triangles per second
Quadrilateral mesh*..... 35K (3D) quads per second
45K (2D) quads per second

Peak Performance*

Display list traversal ..... 250K (3D) vectors per second
333K (2D) vectors per second
Graphics accelerator (using the 3 parallel accelerators) ..... 900K (3D) coordinates per second
2.2M (2D) coordinates per second
Scan conversion ..... 16M pixels per second
Raster operations ..... 15M pixels per second
Window move speed ..... 19M pixels per second
Area f ill speed..... 125M pixels per second

Power Requirements

Line voltage..... 90-125 Vac
198-250 Vac
Line frequency ..... 48-66 Hz
Current requirements:
Main supply ..... 5.5A @ 90-125 Vac
3.0A @ 198-250 Vac
Auxiliary supply..... 5.5A @ 90-125 Vac
3.0A @ 198-250 Vac
Power consumption (max.) ... 600 Watts
Main supply ..... 300 Watts
Auxiliary supply..... 300 Watts

** Specifications listed are for a füll syslem including ihe Graphics Accelerator, füll 16-bit Z-buf fer, and 24 planes offrame buffer memory.*

t HP *anticipates shipping this product at the end of 1989 but reserves the right to make changes to the product and introduction date.*

‡ *with light sources andshading*

X *Window System is a trademark of Massachusetts Institute of Technology.*

Environmental Range

Temperature:

Operating .....0°C to 55°C
Non-operating .....-40°C to 71°C

Humidity:

Operating 40°C ..... 15% to 95%
Non-operating 65°C ..... @90%

Altitude:

Operating .....4,570m (15,000 ft.)
Non-operating ..... 15,240m (50,000 ft.)

EMI .....Conducted and radiated interference meets FCC Class A; VCCI Class 1; VDE 1046/84 Level B

Regulatory compliance .....UL 478, 5th Edition; CSA 22.2 No. 220, M-1986; IEC 380, 3rd Edition; IEC 435 2nd Edition

Physical Specif ications

Height .....312 mm (12.3 in.)
Width.....325 mm (12.8 in.)
Depth .....570 mm (22.4 in.)
Net weight .....27 kg (59 lb.) maximum configuration
20 kg (43 lb.) minimum configuration

10.11 Hard Copy Output for 98720A/30A

Versatec Hardcopy Support (HP 98053A) allows users to make color graphics dumps of the 98720A or 98730A displays on paper or transparencies. The Versatec-support product consists of Software, interface cable, and documentation. The GPIO Interface (HP 98622A) must be purchased separately. Supported plotters are available from Versatec.

10.12 Series 200 Display Compatibility Interface

The 98546A Display Compatibility Interface provides separate alpha and graphics planes and is completely compatiWe with Series 200 Models 236 and 217 displays in both functionality and resolution. The graphics aspect ratio of 1.33:1 is compatible with all Series 200 graphics displays äs well. Graphics resolution is 512 x 390; alpha format is 25 lines of 80 characters per line.

The 98546A is a pair of I/O cards that is intended for use in conjunction with a medium-resolution bit-mapped display. It is capable of driving either the HP35731A 12-inch monochrome monitor or the HP 35741A 12-inch color monitor (connected to the "green" monitor input). A relay on the 98546A allows you to switch between the 98546A alpha/graphics display or a 98542A monochrome bit-mapped display by means of simple keyboard and program commands. (When connected to a 98543A color bit-mapped video board, the 98546A interface will display only green text and graphics in the Compatibility mode. User Software selects between bit-mapped color display or green alpha/graphics display.)

The 98546A would normally be connected to the HP 35731A 12-inch monochrome monitor. Either of the Series 300 high-resolution video boards can be used in the same system äs the **98546A,** but the resulting System will be a two-monitor system—one a high-resolution bit-mapped display, the other a monochrome alpha/graphics display. The two display Systems are independent of one another.

Monitor Specifications

	35731A/B Monochrome	35741A/B Color	98785A Color	98751A Color	98789A Color	98752A Color	98786A Monochrome	98788A Monochrome
Size (measured diagonally)	310 mm (12 in.)	310 mm (12 in.)	406 mm (16 in.)	480 mm (19 in.)	406 mm (16 in.)	480 mm (19 in.)	432 mm (17 in.)	480 mm (19 in.)
Alphanumeric capacity (default fönt)	80 characters, 26 lines	80 characters, 26 lines	128 characters, 48 lines	128 characters, 48 lines	128 characters, 48 lines	128 characters, 48 lines	128 characters, 48 lines	128 characters, 48 lines
Character height and width	3.7 mm wide 4.9 mm tall	3.7 mm wide, 4.9 mm tall	2 mm wide 2.9 mm tall	2.5 mm wide 3.2 mm tall	2.3 mm wide 3.2 mm tall	2.7 mm wide 3.8 mm tall	1.8 mm wide 3.0 mm tall	2.7 mm wide 3.8 mm tall
Graphics capability: Resolution	512 dots horizontal, 400 dots vertical	512 dots horizontal, 400 dots vertical	1024 dots horizontal, 768 dots vertical	1024 dots horizontal, 768 dots vertical	1280 dots horizontal, 1024 dots vertical	1280 dots Korizontal, 1024 dots vertical	1024 dots horizontal, 768 dots vertical	1280 dots horizontal, 1024 dots vertical
Raster size	210 mm x 164 mm	210 mm x 164 mm	297 mm x 238 mm	360 mm x 270 mm	295 mm x 236 mm	343 mm x 274 mm	304 mm x 234mm	343 mm x 274 mm
ROM character set	256 characters	256 characters	276 characters	276 characters	276 characters	276 characters	276 characters	276 characters
Character fönt	9 x 12 character in a 12 x 15 cell*	9 x 12 character in a 12 x 15 cell*	7 x 10 character in an 8 x 16 cell†	7 x 10 character in an 8 x 16 cell	10 x 15 character in a 10 x 21 cell	10 x 15 character in a 10 x 21 cell	7 x 10 character in an 8 x 16 cell†	10 x 15 character in a 10 x 21 cell
Intensity adjustable up to	50 FL	36 FL	35 FL	30 FL	35 FL	27 FL	35 FL	27 FL
Refresh rate	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
Scan rate	24.9 - 25.5 KHz	24.9 - 25.5 KHz	47.7 KHz	47.7 KHz	63.3 KHz	63.3 KHz	47.7 KHz	63.3 KHz
Implosion protection	Tension band	Tension band	Safety glass with anti-glare coating	Safety glass, bonded panel with thin-film, anti-glare coating	Safety glass, bonded panel with silica, anti-glare coating	Safety glass, bonded panel with thin-film, anti-glare coating	Safety glass, bonded panel with thin-film, anti-glare coating	Safety glass, bonded panel with thin-film, anti-glare coating
Tube phosphor	p 31	p 22	p 22	p 22	p 22	p 22	p 40	p 40
Chromaticity coordinates	N/A	X Y Red 0.63 0.35 Green 0.30 0.60 Blue 0.15 0.06	X Y Red 0.62 0.34 Green 0.28 0.60 Blue 0.16 0.07	X Y Red 0.63 0.34 Green 0.28 0.60 Blue 0.16 0.07	X Y Red 0.62 0.34 Green 0.28 0.60 Blue 0.16 0.07	X Y Red 0.63 0.34 Green 0.28 0.60 Blue 0.16 0.07	X Y 0.26 0.32	X Y 0.26 0.32
Physical dimensions:								
Height	332 mm (13.7 in.)	345 mm (13.6 in.)	380 mm (15 in.)	436 mm (17.1 in.)	380 mm (15 in.)	436 mm (17.1 in.)	422 mm (16.6 in.)	420 mm (16.5 in.)
Width	340 mm (13.4 in.)	328 mm (12.9 in.)	406 mm (16 in.)	408 mm (16.1 in.)	406 mm (16 in.)	408 mm (16.1 in.)	435 mm (17.1 in.)	480 mm (18.9 in.)
Depth‡	240 mm (9.5 in.)	390 mm (15.4 in.)	450 mm (17.7 in.)	535 mm (21.0 in.)	450 mm (17.7 in.)	535 mm (21.0 in.)	370 mm (14.6 in.)	407 mm (16 in.)
Net weight	10 kg (22 Ibs.)	13.9 kg (30.6 Ibs.)	26 kg (57 Ibs.)	35 kg (77 Ibs.)	26.5 kg (58.3 Ibs.)	35 kg (77 Ibs.)	20.0 kg (44 Ibs.)	21.8 kg (48 Ibs.)
Shipping weight	12 kg (26.4 Ibs.)	15.9 kg (35 Ibs.)	28 kg (62 Ibs.)	40 kg (88 Ibs.)	28 kg (62 Ibs.)	40 kg (88 Ibs.)	27.0 kg (59 Ibs.)	27 kg (59.4 Ibs.)
Compatible interfaces	98542A, 98546A	98543A, 98546A	98547A, 98549 A, 98700A	98547A, 98549A, 98700A	98550A, 98720A, 98730A	98550A, 98720A, 98730A	98544B	98548A

** Character width is measured in half-pixels on medium-resolution, bit-mapped display Systems.*

† User *settable in HP-UX.*

‡ *Additional 4 inches in depth should be allowed for interface cables, and 2.5 inches on the left sidefor Ventilation.*

Table 6

Monitor Environmental Range and Regulatory Compliance

P	35731A/B	35741A/B	98785A, 98789A, 98751A, 98752A	98786A, 98788A
Temperature: Operating Non-operating	0° to 55°C -40°to75°C	0° to 55°C -40°to65°C	10° to 40°C -40°to65°C	0° to 55°C -40°to71°C
Humidity: Operating 40°C	5% to 95%C	5% to 95%C	10% to 80%C	15% to 95%C
Altitude (meters): Operating Non-operating	0 to 4,570 0 to 15,240	0 to 4,570 0 to 15,240	0 to 3,352 0 to 15,240	0 to 4,570 0 to 15,240
Regulatory Compliance for EMI	VDE"B",FCC"B"in typical system	VDE"B",FCC"B"in typical System	VDE"B",FCC"A"in typical System	VDE"B",FCC"A"in typical system
Regulatory compliance for product safety	UL, CSA, IEC, NEMKO*, SEV*, FEI*	UL, CSA, IEC, NEMKO*, SEV*, FEI*	UL, CSA, IEC, SEV†, FEIt	UL, CSA, IEC, SEV t, FEI†

** 'A Version does not have these.*
t *Designed for compliance; certification for i*monitors *in technical workstations unnecessary.*

Table 7

10.13 Graphics Upgrades

Graphics boards, graphics accelerators, display Controllers, and monitors can be returned for credit toward similar components with higher performance, higher resolution, color, or 3D.

Return credit for a graphics accelerator is allowed only when an accelerator is ordered. There is generally a limit of one return credit for one destination product ordered. Ask your HP sales representative for specific details on the Upgrade program.

11.0 Series 300 Human Interface Access

The following table summarizes the HP-HIL devices available for Series 300 Computers. HP-HIL (Hewlett-Packard - Human Interface Link) devices provide low-cost input to Series 300 Computer Systems. They are connected in a "daisy-chain" fashion with up to seven devices supported on a single HP-HIL (or HIL for short) interface.

HP-IB or RS-232C input devices are also available, äs shown in the following table.

Product No.	Description	Interface Required	Cable Included
	Graphics Input/Picking Devices		
35723A	HP-Touchscreen bezel for 35731/41 Monitors	HP-HIL	—
46021A	Keyboard	HP-HIL	—
46060A	HP Mouse (2-button)	HP-HIL	1.4m
46060B	HP Mouse (3-button)	HP-HIL	—
46083A	Knob	HP-HIL	0.5m
46084A	ID Module	HP-HIL	0.5m
46085A	Control Dial Box	HP-HIL	0.8 ... 3m
46086A	32-button Box	HP-HIL	0.8 ... 3m
46087A	ANSI A/ISO A4-size Digitizer	HP-HIL	0.8 ... 3m
46088A	ANSI B/ISO A3-size Digitizer	HP-HIL	0.8 ... 3m
46089A	4-button Cursor for 46087/88A (orderable äs Opt. 001 on either digitizer)	46087/88A	Included
46094A	Quadrature Port	HP-HIL	0.5m
46095A	3-button Mouse	46094	1.2m
	Bar Code Readers		
39800/01A	Bar Code Reader	RS-232C	None
92916A	Bar Code Reader	HP-HIL	.7 ... 1.83m
	HP-HIL Extensions		
46080A	2.4m Extension (no audio)	HP-HIL	2.4m
46081A	2.4m Extension (with audio)	HP-HIL	2.4m
46082A	15m HP-HIL Remote Extension (with audio and RGB video)	HP-HIL	15m, 0.5m
46082B	30m HP-HIL Remote Extension (with audio and RGB video)	HP-HIL	30m, 0.5m

Table 8

12.0 Seines 300 Local Area Networking

12.1 NS-ARPA Services/300 Local Area Networking (LAN)

NS-ARPA Services/300 Supports the File Transfer Protocol (FTP), Telnet, and Simple Mail Transfer Protocol (SMTP), ARPA Services, and the rcp, rlogin, and remsh Berkeley Systems Distribution (BSD) 4.2 networking Services. In addition, the BSD 4.2 socket interface is supported. These Services use the Department of Defense Advanced Research Projects Agency (ARFA) Standard Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) transports.

Network Services-ARPA Services/300 provides transparent Remote File Access (RFA) between HP-UX Systems. It provides file transfer (NFT) between Series 300, Series 800, HP 3000, HP 1000 A-Series and DEC VAX/VMS Computers.

Line-level access capability is provided for customers who have the expertise to write higher performance networked applications.

NS-ARPA Services/300 and the 98643A LAN/300 Link combine to provide high-speed local area network communication supporting either IEEE-802.3, Ethernet, or StarLAN 10 networks.

12.2 Network Füe System (NFS) Services/300

NFS permits Computers to share file Systems over a local area network. Computers running NFS may access remote databases containing drawings, schematics, netlists, graphics or source code. Most user level commands (e.g., list, remove, copy,...) operating locally, will work on a remote file, in most cases, without any noticeable change in response time.

NFS distinguishes itself f rom competing products by operating on Computers and operating Systems from different manufacturers. **Thus,** NFS provides multi-vendor file sharing and has become the de facto industry Standard for file sharing. HP's version of NFS contains the major components of NFS Revision 3.0:

- Capabilities to mount remote file Systems and transparently access f iles on remote machines
- External Data Representation (XDR) specifies alignment and size of data types in a machine-independent manner
- Remote Procedure Call (RPC) allows programmers to execute routines on remote machines and upon completion receive the results. RPC allows network programmers to write customized networking applications
- Yellow Pages (YP) gives the user centrally administered data look up Service, includes Utilities for global System administration and the associated user level commands
- Virtual Home Environment (VHE) allows the user to configure a login environment on remote nodes to mirror the login environment on your home node.
- Async Option provides high-speed write throughputs from clients to Servers.

To run NFS, the NS-ARPA Services/300 product must be installed.

12.3 HP-UX Asynchronous Data Communications

HP-UX and most UNIX operating System and UNIX-like Systems can communicate using uucp protocol over hardwired, leased, dial-up and X.25 lines. File transfer, remote command execution (uux) and virtual terminal (cu) capabilities are provided. HP-UX electronic mail uses the uucp facility.

Uucp connections (except hardwired) are generally not dedicated. Systems communicate on demand. Your System can simultaneously communicate with äs many Systems äs you have available ports (subject to single- and multi-user license limits). There is no limit to the number of Systems with which you can potentially communicate in turn.

Any RS-232C interface is sufficient for hardwired Operation, although the direct-connect ports of the 98642A Multiplexer are not recommended. All other connections require a modem-compatible interface and cable. An X.25 connection requires a modern port of an HP 2334A Option 123 Multi-MUX X.25 düster Controller.

The virtual terminal capability of cu makes your terminal (through your System) appear to be a terminal connected to a remote System. Cu can communicate with most Systems that are compatible with 7- or 8-bit asynchronous ASCII terminals. In general, cu works with any System with which HP terminals work, except for block-mode applications.

12.4 HP 2392A and VTlOO Terminal Emulation

The 98791B Terminal Emulation package is a stand-alone Pascal 3.1 (execute-only based) application that makes your Series 300 Computer emulate an HP 2392A terminal (including block mode), or DEC's VTlOO Terminal Emulator (requires 46084A ID Module).

12.5 Shared Resource Management (SRM)

An SRM network consists of one or more SRM Servers and up to 63 workstations. The Server provides a shared hierarchical file System and spooled printer and plotter support. Workstations communicate only with Servers. Workstation-to-workstation and server-to-server communication is not supported.

BASIC and Pascal workstations can be discless using the server's file system äs their sole file System (including System boot). HP-UX workstations may be included in the SRM network. HP-UX workstations transfer f iles to and from the SRM Server and submit data for spooling to a printer and plotter by merely writing to a file in one of the server's spool directories.

Series 300 Networking

Feature	Local Area Network (LAN)	**uucp,** uux, 01	2392A/VT100 Emulator	Shared Resource Management (SRM)
Operating System required	HP-UX	HP-UX	Stand-alone or Pascal	BASIC, HP-UX or Pascal
Network Services provided	NFS, RFA, NFT, LLA, FTP, Telnet, SMTP, rcp, rlogin, remsh, BSD sockets, Net 1PC	File Transfers, Remote Execution, Terminal Access	Terminal Access, File Transfer	NFT (HP-UX), RFA (BASIC and Pascal)
Other Systems on network	Series 200, 500, 800, HP 1000 'A' Series, HP3000, VAX/VMS, ARPA/BSC4.2 **Systems†,** HP Vectra	Any HP-UX, most async hosts	Any HP, DEC, most async hosts	Series 200, 300, 500, PC-308
Bit rate	10Mbps	9.6 Kbps	9.6 Kbps	700 Kbps
Maximum distance	1500m	Unlimited	Unlimited	1000m
Maximum nodes	1024	Unlimited	Unlimited	63
Connect method	Ethernet/802.3, Coax	RS-232C, X.25	RS-232C	Coax

Key: NFT - Net File Transfer RFA - Remote File and Directory Access VT - Terminal Access RCX - Remote Command Execution LLA - Une Level Access

t *Check with your local HP sales office for Systems which HP supports.* Table 9

3.0 Series 300 Data Storage

Hewlett-Packard offers a wide ränge of discs from low-cost floppy discs to high-performance hard discs. The following table summarizes the discs available for the Series 300 Computer Systems and the relative performance levels of each. (Performance levels are presented here äs **"I/Os/sec",** or input-outputs per second.)

High-speed discs have an instantaneous transfer rate in excess of 300 Kbytes/sec and deliver their listed performance only when connected to a high-speed disc interface (HP 98625B or Model 330/350 built-in) in a System which has a DMA Controller. The built-in HP-IB and 98624A interfaces support only Standard speed mode. *Note: The built-in HP-IB of the Models 310, 330, and 350 Computers has less overhead than the 98624A. If you do not plan to purchase a high-speed disc interface, plan to use the built-in HP-IB for your System disc and add a 98624A HP-IB for* ***peripherals.***

Series 300 Data Storage (in order of increasing capacity)

Product No.	Capacity (bytes)	Performance I/O/sec	Transfer Rate	Media Type	Rack Mount Kits
9122C	2M (1.42 formatted)	—	Standard	3Vi-inch microfloppy disc	19500B for **19"** EIA cabinet
9127A	270K, **360K,** 380K	—	Standard	**5¼-inch** floppy disc	—
9153C	10/20/40M	—	Standard	Fixed with optional 3Vi-inch microfloppy disc (1.42M formatted)	—
7907A	20.5M + 20.5M	20	High	Fixed, removable	19507A for **19"** EIA cabinet
7957A/58A	81/130M	24.1	High	Fixed	19500B* for **19"** EIA cabinet
7933H	404M	23	High	Fixed	—
7935H	404M	23	High	Removable	—
7935HR	404M	23	High	Removable (remarketed from FRD)	—
7936H/37H	307/571M	32.5	High	Fixed	19511A/191512A/191514A 2/4/8 discs
7957B/58B/59B	81/152/304M	35.3	High	Fixed	19500B Rack Mount Kit or 9211R Mini-Cabinet
7962B/63B	152/304M	35.3	High	Fixed with space for address mechanism	19560B** for **19"** EIA cabinet
7957S/58S/59S	107/161/323M	35.3	High	Fixed	19500B Rack Mount Kit or 9221R Mini-Cabinet

*'*92111 Series Mini-Cabinet*
***'*RequiresHP 12679 raus*

Table 10

Series 300 Magnetic Tape Drives

Product No./Description	Density (cpi)	Tape **Capacity** in Mbytes	Read After Write	Performance in Mb/min.	Separate Controller Option
i/4-inch Cartridge Tape Drives 9144A, stand-alone drive	10,000	67	Standard	2	Standard
35401A, stand-alone	10,000	8x67	Standard	2	Standard
Vi-inch 9-track Tape Drives 7979A, stand-alone drive	1,600	45	Standard	10	Standard
½-inch 9-track Tape Drives **7980A,** stand-alone drive	1,600/6,250	45/180	Standard	25	Standard
Opt. 800, available on 7979A/7980A	800	22	Standard	4	Standard
½-inch 9-track Tape Drives **7980XC,** stand-alone drive	1,600/6,250/6250XC	45/180/450	Standard	30	Standard

Table 11

Discussion of Terms

- Density - The number of characters per inch (cpi) that can be stored on the tape. The **¼-inch** f igure is based on the 600-ft. tape (88140LC). The VS-inch figure is based on a 2400-ft. tape with a 16384 byte record size.
- Capacity - The maximum number of bytes that can be stored on one tape. The assumptions are the same äs for density.
- Read-af ter-write - When writing to the tape, the drive itself is verifying the data (reading the written data and comparing it).
- Performance - The figures account for just the magnetic tape I/O. Normal backup operations are slower due to the time required to locate and read the files being saved.
- Separate Controller - The tape drive has its own Controller electronics, HP-IB connector and HP-IB address. Disc operations are unaffected if the tape is on a separate HP-IB interface. This is the recommended configuration if you have a separate HP-IB interface for the tape drive (usually the same bus used for other non-disc devices).

14.0 Series 300 Terminals

Product	Alpha Thruput	Phosphors Available	Graphics Size	Diagonal Size	Alpha Resolution	Features
HP 700/92	38,400	P31, P188, P194	N/A	14-inch	27 x 80/132	PP,SS
HP 700/22	38,400	P31, P188, P194	N/A	14-inch	27 x 132	PP,SS
HP 700/41	38,400	P31, P194	N/A	14-inch	27x80	PP,SS
HP 700/43	38,400	P31, P188, P194	N/A	14-inch	27 x 80/132	**PP, SS**
2393A	19,200	P31	512 x 390	12-inch	27x80	**HP-HIL, PP, SS**
2397A	19,200	P22	512 x 390	12-inch	27x80	HP-HIL, PP, SS
Portable Plus (45711)	4,800	LCD	480 x 128	9-inch	16x80	DP, IM, PC, PP
HP 150-n (45850)	19,200	P31	512 x 390	12-inch	26x80	HP-HIL, DP, IM, PC, PP, SS
9807A *Integral*	1,800	EL	512 x 255*	9-inch	24x80	HP-HIL, IM, IP, PC
Vectra	9,600	P22, P31	512 x 390*	12-inch	25x80	HP-HIL, IM, PC, PP, SS

** These terminals are not supported äs graphics **devices** by HP-UX.*

Table 12

Discussion of Terms

- Features - A quick summary of the major distinguishing features of the terminals. If the feature is **uppercase,** it is Standard; **lowercase,** it is optional.

  DP - Dual Port - can connect to two hosts
  HP-HIL - HP-HIL input devices are supported
  IM - An Internal Model is available
  IP - An Internal Printer is available
  PC - Terminal is also a Personal Computer
  PP - Printer Port is available
  SS - Has Smooth Scrolling capability

The phosphors are:

EL - Electroluminescent (black or amber)
LCD - Liquid Crystal (black on white)
P22 -FullColor
P31 - Green
P188 - White
P194 - Amber

- Alpha Resolution - listed in lines x columns. Terminals with more than 24 lines use the additional lines for softkey labels and/or terminal Status messages. All terminals (except the Portable and Integral) display characters at an effective resolution of 9 x 14 or better (7 x 11 with half-dot shifting).

Series 300 Printers

Product No.	Speed*	Technology	Character Resolution	Paper Size	Graphics Resolution
2225A/D *Thinkjet* printer	150 cps	InkJet	11x12	8.5	96x96
%.227A *Quietjet Plus* printer (RS-232C)	160/40 cps	InkJet	19 x 32 Near Letter Quality	8.5/15	96 x 96, 192 x 192
2227B *Quietjet Plus* printer (HP-IB)	160/40 cps	InkJet	19 x 32 Near Letter Quality	8.5/15	96 x 96, 192 x 192
2228A *Quietjet* printer	160/40 cps	InkJet	19 x 32 Near Letter Quality	8.5/11	96 x 96, 192 x 192
2235B *RuggedWriter 480* printer	240/480 cps	DMI	36 x 24 Letter Quality	8.5/15	90 x 90, 180 x 180
2276A *DeskJet* printer	120/240 cps	InkJet	300 dpi	8.5/11 8.5/14, A4	75 - 300 dpi
2563B	300 lpm	LIDM	5 of 13 x 7	16.7	70 x 72, 140 x 144
2564B	600 lpm	LIDM	5 of 13 x 7	16.7	70 x 72, 140 x 144
2566B	900 lpm	LIDM	5 of 13 x 7	18.0	70 x 72, 140 x 144
2603A	45 cps	FCI	Füll	16.4	N/A
2684A/D/P *LaserJet 2000* printer	20 ppm	Laser	300dpi	8.5/11	75 - 300 dpi
33440A *LaserJet Series U* printer	8 ppm	Laser	300dpi	8.5	75 - 300 dpi
2932A	200 cps	DMI	9x12	15	90x90
2934A	200 cps	DMI	9 x 12, 36 x 24	15	90x90
3630A *PaintJet* color graphics printer	167 cps	InkJet	30x15	8.5	180 x 180

** Speed Key cps - characters per second dpi - dots per inch UDM - Urne Impact Dot Matrix lpm - lines per minute ppm - pages per minute*

Table 13

15.0 Series 300 Printers

A wide range of printers is available for Series 300 Computer Systems, varying in price, performance,and print technology used. The following table summarizes these supported printers.

The Series 300 operating Systems do not require a printer. The selection of a printer depends entirely on your intended use. There are several criteria you may wish to use.

- Speed - Expressed in characters per second (cps), lines per minute (lpm) or pages per minute (ppm) depending on the print technology employed. For program development, where the typical program listing is 60 lines per page with an average of 60 characters per line, cps approximately equals lpm, and you can convert ppm to lpm by multiplying ppm by 60. For 132 column reports, convert cps to lpm by multiplying cps by 0.45 (the lpm/ppm relationship is unchanged).
- Technology - The choice of impact vs non-impact printing technology affects other criteria, primarily multiple part printing (possible only with impact) and noise (non-impact is quieter). The abbreviations used are:

  DMI - Dot Matrix Impact
  FCI - Füll Character Impact (e.g., Daisywheel)
  InkJet - Thinkjet non-impact dot-matrix
  Laser - Laser PagePrinting, non-impact

- Character Resolution - This is the number of horizontal X vertical dots used in the character cell. The 2560 series printers use half-dot shifting and can place the horizontal dots at about twice as many locations for higher apparent resolution. Those printers which list two resolutions have a "high density" mode (at lower speed).
- Paper Size - HP printers handle 8½-inch wide or 14-inch wide paper. Most can handle paper narrower than their maximum size. Refer to separate printer data sheets for more information.
- Graphics - Most HP printers can print monochromatic single-level grey scale graphics images. The *HP PaintJet* color graphics printer is capable of producing thousands of colors through Software controls. Where the printer has graphics, the resolution in dots per inch (dpi) is given. A range of resolutions is given for printers which can scale their graphics.
- Fonts - All HP printers have at least one built-in printing font. Most offer additional fonts in one of the following forms:

  Disc - Interchangeable printwheel
  Cartridge - Plug-in ROM cartridge
  ROM - Fixed selection of ROM fonts
  Soft - Downloadable Software

16.0 Series 300 Graphics Plotters

The Series 300 Computer Systems support several graphics plotters. Many printers can generate a hardcopy of a displayed CRT image. However, plotters offer higher resolution, whereas printer CRT images may be limited to the resolution of the monitor. Plotters also offer color hardcopy on a wider variety of media types (paper, vellum, mylar) and sizes (A/A4-E/AO). The selection of a plotter depends upon your application. There are several criteria you may wish to use:

- Speed - Plotting time for a pen plotter is highly dependent on the complexity of (number of vectors in) the drawing. In contrast, electrostatic plotters have a constant print speed. Typical drawings require 1-2 minutes of actual plot time on a monochrome electrostatic plotter. A pen plotter can produce a simple drawing in a short time. A complex drawing, like a printed circuit Board layout, may have over one million vectors. It might take the pen plotter several hours to draw a plot that complex, while an electrostatic could Output the layout in a couple of minutes. Electrostatic plotters fit best in environments producing high volumes of complex drawings.
- Resolution - Resolution specif ications for pen plotters and electrostatic plotters cannot be directly compared due to differences in technology. Both pen plotters and 400 dpi electrostatic plotters produce final-quality drawings that can be used for **reproduction,** client drawings, or reference drawings. Electrostatic plotters with 200 dpi will not meet the final-quality needs of most users.
- Cost - Pen plotters are significantly less expensive than electrostatic plotters. However, electrostatic plotters offer higher throughput and can serve more users per unit than pen plotters.
- Media Size - Pen plotters offer more options on media sizes than electrostatic plotters. High-end plotters typically handle A/A4 through E/AO size media, while electrostatic plotters handle only one media width per model. Electrostatic plotters can produce smaller drawings, but this requires the user to scale the drawing to one corner of the larger media and then trim the media to the desired size.

Electrostatic Plotters

Product No.	Media Sizes	Resolution (dots/in)	Print Speed (in/sec)	Comments
C1600A - 7600 Series Model 240D	D	406	0.64	Monochrome only
C1601A - 7600 Series Model 240E	E	406	0.86	Monochrome only

Table 14

Pen Plotters

Product No.	Media Sizes	Mechanical Resolution (mm)	Pen Speed (cm/sec)	Pen Accel. (g)	Number of Pens	Media Feed	Pen Types
7440A - ColorPro	A	0.025	40	1.2	8	Manual	P, T
7475A	A, B	0.025	38	2.0	6	Manual	P, T
7550A	A, B	0.00625	80	6.0	8	Sheet	D, P, R, T
7570A - DraftPro	CD	0.013	40	2.8	8	Manual	D, P
7595A - DraftMaster I	A-E	0.00625	60	5.7	8	Manual	D, P, R, T
7596A - DraftMaster ü*	A-E	0.00625	60	5.7	8	Roll	D, P, R, T

** Pen Types Key: D - Drafting P - Fiber-Hp Füper R - Roller Ball T - Fiber-Hp Transparency*

Table 15

17.0 Series 300 Cabinets and Racks

There are several cabinets, Werkstation tables, and EIA racks available. The Computer User's Catalog (Part Number 5953-2450) lists accessories for your Computer System. The HP Catalog (Part Number 5954-0168) lists EIA rack mount accessories available, and the following table lists Series 300 adaptors available for mounting into a 19-inch EIA rack.

19-inch EIA rack-mount adapters have the following vertical height specifications:

Product No. **Height**

98569A:
SPU only ..... .178 mm (7 inches)
SPU and expander ..... 312 mm (12.25 inches)
98567A/B ..... .400 mm (15.75 inches)
19500B ..... 132.6 mm (5.25 inches)
19512A ..... 269.24 mm (10.6 inches)
35490A ..... .279.4 mm (11 inches)

The 92211L/M/R Design Plus cabinets accept 325 mm-wide HP Computers and peripherals. Wider Computers and peripherals (such äs the 9888A Bus Expander) mäy be placed on top of the 92211L/M cabinets or in the bays of the 97064A table or 9221OR storage module.

All cabinets are open front. A 92211T filier panel kit is available for the 92211R cabinet. None of the cabinets include a power tap.

The height of Design Plus devices may be expressed in Design Plus units. Each unit is 26 mm. The 92211 cabinet rails may be installed at vertical intervals of one unit. All devices in the cabinet may Stack on a single rail set. The 9706A table has one moveable shelf in each of its two equipment bays.

19-inch EIA Rack-mount Adaptors

fcroduct No.	Description
98569A	For 5-unit high 325 mm-wide, 376 mm-deep devices (füll support for Series 300 SPU and Expander)
19500B	For one or two 78 mm, 104 mm, or 130 mm-high, 325 mm-wide, 285 mm-deep devices (no support for Series 300 SPU or Expander)
19512A	For 7936/37 (307/571 Mbyte) disc drives
35490A	For 3540 **¼-inch** tape autochanger
98567A	For 35731A/B monitors
98567B	For 35741A/B monitors
12131A	For Keyboard Rack Mount

Table 16

Series 300 Cabinets (interior dimensions)

Cabinet Model	Description	Depth(mm)	Height (mm)	Height in Design Plus Units (1 unit = 26 mm)	Rails or Shelf
92211M	Roll-around rack	375	341	13	Included
92211L	Roll-around rack	474	523	20	Included
—11R	Roll-around rack	705	575	22	92211S
98787B	Tilt and swivel unit for the 98751A, 98752A, 98785A or 98789A monitors	330	76	3	N/A
92213B	CAD mini-workstation table with pull-out work surface, keyboard drawer and monitor platform	711-914	Table: 720 Monitor Platform: 749	N/A	N/A
92213D	"C"-size drawing holder with extension arm. Attaches to 92213B table.	N/A	N/A	N/A	N/A
19511A	Roll-around rack for 7936/37 disc drives	705	575	22	Included

Table 17

18.0 Series 300 Interfacing Capabilities and Enhancements

In addition to built-in HP-IB, HP-HIL and RS-232C interfaces, Series 300 offers a choice of plug-in interface enhancements*:

- Series 300 DOS Coprocessor System (98286S)
- LAN/300 Link (98643A)
- Shared Resource Management Interface (50962A)
- Datacomm Interface (98628A)
- Programmable Datacomm Interface (98690A, 98691A)
- 4-channel RS-232C Multiplexer (98642A)
- Serial Interface (98626A, 98644A)
- Floating Point Accelerator (98248A)
- Floating Point Math Card (98635A)
- 2-channel DMA Controller (98620B)
- High-speed HP-IB Disc Interface (98625B)
- SCSI Single-ended Board (98265A)
- 128 Kbyte Bubble Memory Card (98259A)
- 256 Kbyte EPROM Card (98255A)
- Breadboard Card (98630A)
- GPIO Interface (98622A)
- [illegible]-IB Interface (98624A)
- [illegible]44A Multiprogrammer Interface (98633A)
- VMEbus Expander (98577A)
- VMEbus Interface (98646A, 98385A/R)
- BCD Interface (98623A)
- 7-channel Analog-to-Digital Interface (98640A)
- EPROM Programmer System (98253A)
- 256 Kbyte RAM Card with Parity (98256A)
- 1 Mbyte RAM Card with Parity (98257A)
- Color Video Interface (98627A)

For more information on the interfaces or language support, refer to the applicable section(s) below and on the following pages, or consult the *Series 300 Configuration Reference Manual*, Part Number 98561-90020.

18.1 Series 300 DOS Coprocessor

The 98286S DOS Coprocessor System provides IBM PC AT Software compatibility for the Series 300. The addition of the DOS Coprocessor provides access to thousands of compatible MS®-DOS based programs for use on the Series 300, including such populär applications äs Lotus 1-2-3®, Vordperfect®, and R:BASE® System V. Due to innovative design and unique operating characteristics, this second generation System typically provides superior interactive UNIX/DOS performance uncharacteristic of Systems of this type.

The System is comprised of an 80286-based Coprocessor DIOI card (with socket for an optional 80287 Numeric Coprocessor, product number D1387A) and associated emulation Software. The System requires the latest revision of HP-UX, minimum Application Execution Environment (AXE), and works with either the Models 310, 320, 330† or. 350† SPUs using a variety of supported display Systems. In order to provide compatibility with "off-the-shelf" PC AT Software, the 9127A 5¼-inch 360K flexible disc drive is available. To provide international support, emulation is provided for 17 different localized keyboards (across North America and Europe).

A high level of DOS and UNIX integration is provided, allowing DOS to run äs an HP-UX task within or separate from the HP Windows/9000 System. Capabilities are provided that allow the DOS user to transparently access and share the HP-UX file System through a Standard logical DOS drive letter identifier (D:). In addition, filters are provided that allow easy translation of ASCII files between DOS and HP-UX format. Users of HP 110s, HP 150s, or 720K 3½-inch disc PC-compatible machines can also transfer DOS files between the Systems using special HP-UX file interchange capabilities via 3½-inch media and associated drives.

The System emulates many populär IBM PC accessory cards using specialized Software and existing Series 300 hardware resources. While it depends upon the actual Series 300 configuration, this results in the emulation of a powerful PC AT System including expanded memory (over 4 Mbytes can be supported), printers, plotters, and even the System mouse (allowing the HP-HIL mouse to emulate the MS mouse). A variety of PC I/O emulation/redirection is provided to allow Standard HP connected devices (i.e., RS-232C or HP-IB) to be used transparently äs DOS devices via emulation of Standard PC interfaces (RS-232C and Centronics).

While a minimum of the AXE portion of the HP-UX operating System is required, the System can easily be used in a typical BASIC/Pascal environment. The System can be configured in the "auto-boot" mode that allows a DOS session to be started and ended with no HP-UX interaction. When used in this configuration, very little HP-UX knowledge is required. A user-friendly Installation procedure allows the user, even if he or she has virtually no HP-UX or DOS knowledge, to completely install a *DOS* Coprocessor System in under 15 minutes. Please refer to the HP *9000 Series 300 DOS Coprocessor Technical Supplement* (Pub. No. 5954-9390) for more detailed technical, ordering and support Service information.

Not all interfaces work with all operating Systems. Please check the appropriate operating System technical dato for support information.
Models 330 and 350 require an available DIO slot.
ytus 1-2-3 is a registered trademark of Lotus Development Corporation.
Vordperfect is a registered trademark of Wordperfect Corporation.
:R[illegible]E System V is a registered trademark of Microrim.
f[illegible] registered trademark of MicroSoft Corporation.

18.2 LAN/300 Link

The LAN/300 Link interface card provides both protocol management (Ethernet or IEEE 802.3) and electrical levels of communications on the 10 megabit/second local area network. The LAN/300 Link is used by both Series 200 and Series 300 Systems, utilizing the NS/200 and NS-ARPA Services/300 Software. The LAN/300 Link Interface can be attached to either a thin cabled LAN (RG58) or thicker cabled LAN.

18.3 Shared Resource Management Coax Interface

The 50962A SRM interface is part of the connection between the Computer and an SRM Server. The SRM System (HP 50960A) is a dedicated file and printer/plotter Server for HP 9000 workstations. It provides the capability to share resources such äs discs, printers and plotters among a local cluster of workstations including the Series 200, 300, 500 and Vectra with the BASIC or Pascal Language Processor installed.

The hardware link between the Werkstation and the server is provided by a coax network. The coax network features a thin coaxial cable connected in daisy-chain fashion from node to node. Up to 25 nodes can be connected for up to a total length of 1000 meters on a single network. Multiple coax networks may be connected to a single Server or Werkstation äs long äs sufficient interface slots are available. The 92227X Coax Cables are available in a variety of lengths.

18.4 RS-423/RS-232C Data Communications Interface

The 98628A Data Communications Interface provides buffered data transfer, protocol management and appropriate electrical levels for asynchronous serial Communications. This card also Supports the Distributed System Network/Data Link (DSN/DL) protocol for Communications to an HP 1000 minicomputer. A terminal emulation program, which takes advantage of this card for communication to other Computers, is available. Programs written in BASIC or Pascal can communicate through this interface. HP-UX offers drivers compatible with this card as well.

Electrical Interface Capabilities

- RS-232C, V.24/V.28
- RS-449
- RS-423, V. 10

Data Rates and Formats

All Signals present at the 98628A interface card's connector conform electrically to EIA RS-232C and CQTT V.28/V.24 specifications. Data formats include 5, 6, 7 or 8 bits/character and l, 1.5 or 2 stop bits. Odd, even or no parity is selectable and fixing the parity bit to 0 or l is also selectable.

Standard data rates available with internal clocking: 50, 75, 110, 134.5, 150, 200, 300, 600, 1200,1800, 2400, 3600, 4800, 7200, 9600, 19,200.

Interrupt Capability

The 98628A Serial Interface Card is capable of generating interrupts to the Computer. The interface can be programmed to interrupt on the following conditions:

ASYNC

- Data or control block available
- Prompt received
- Framing and/or parity error
- Modem line change (DSR, DCD, CTS, RI)
- No activity timeout
- Lost carrier or connection timeout
- End-of-line received
- Break received

18.5 Programmable Datacomm Interface

The Programmable Datacomm Interface product provides a spectrum of capabilities that can be tailored to meet special datacomm and/or serial interfacing needs. The product consists of two pieces — the Development Package (98690A) and the interface card (98691A). The 98690A Development Package contains the essential information and tools required by a sophisticated user to do firmware programming of the 98691A Programmable Datacomm Interface. The 98691A is a microprogrammable interface which is intended to be a foundation for designing application-oriented Communications products. It is based on the Z-80 CPU, Counter Timer Chip and Serial I/O chip.

Data Rates and Formats

The Z-80A Counter Timer Chip provides one System timer, and a programmable baud rate for the SIO channel. Available speeds follow:

- Synchronous: maximum 460 Kbaud; minimum 50 baud.
- Asynchronous: maximum 57 Kbaud; minimum 50 baud.
- The maximum speed with an external clock is 736 Kbaud for synchronous Communications.

Data formats provided by the Z-80 SIO chip are 5, 6, 7 or 8 bits/character and l, 1.5 or 2 stop bits, odd, even or no parity for asynchronous Communications. The SIO chip supports CRC-16 or CCITT block f rame check for synchronous operations.

Electrical Interface Compatibility:

- RS-232CV.24/V.28
- RS-449
- RS-423, V. 10
- RS-422, V. 11 (with user-built cable)

18.6 4-Channel Asynchronous Multiplexer

The HP 98642A Multiplexer provides four asynchronous RS-232C-compatible ports on a single interface. Three ports are intended for local or direct connection. The fourth port can be used either locally or to interface to RS-232C-comptaible modems. A wide ränge of selectable transmission modes and formats permits three hardwired and one remote connection of various terminals, printers, plotters and other asynchronous devices.

Features

- Four füll duplex asynchronous serial I/O ports
- One port with 10-wire füll duplex modern control capability
- EIA RS-232C, CCITT V. 28 compatibility
- Programmable data rates for each port up to 19.2 Kbaud
- Programmable character size: 5, *6,7 or 8* bits/character
- Programmable parity: odd, **even,** none
- Programmable number of stop bits: 1 or 2
- Parity, overrun, framing error check detects transmission faults
- Firmware-based self-help text helps assure interface integrity
- On-board buffering: eight circular FIFO data buffers; four (128 character) receive buffers and four (16 character) transmit buffers (one for each port).
- Programmable Interrupt interval
- Special character recognition
- System console support

18.7 RS-232C Serial Interfaces

The 98626A and 98644A Serial Interfaces provide **[illegible]-serial** communication between the Computer and **[illegible]synchronous** EIA RS-232C (CCITT V.28/V.24) devices. Data rates ränge from 50 to 19,200 baud (bits/second). A variety of cabling options allow for terminal and peripheral connections. Terminal emulation Software, BASIC and Pascal programs, and the HP-UX operating System can communicate with other RS-232C devices using this interface.

Interrupt Capability

The 98626A/98644A Serial Interfaces are capable of generating **interrupts** under the following conditions:

- Receive buf fer füll
- Transmitter buffer empty
- Receive buffer overrun error
- Received character parity error
- Received character framing error
- Received break indication
- Carrier detect line change
- Clear-to-send line change
- Data-set-ready line change
- **[illegible]**rig indicator change from on to off

This **interrupt** capability allows the interface to operate in a füll duplex fashion when information is input under **interrupt** control while information is Output by Standard write commands.

18.8 Floating Point Accelerator for Models 330 and 350

Two Floating Point Accelerator (FPA) products are now available for the Series 300 workstations: the 98248A is supported on the Model 350, and the 98248B is supported on Models 330, 360, and 370. Performance with the optional FPA increases the floating point performance by up to three times over that of the Standard Motorola 6888X FPA included with these workstations.

The 98248A is configured äs a two-board assembly which occupies one DIO II slot of the Model 350 SPU. The 98248B is a single-board assembly which **[illegible]**xcupies one DIO II slot of the Model 330, 360, or 370 **[illegible]**. Either assembly contains specialized floating point math chips and control circuitry which perform the operations of addition, subtraction, multiplication and division. In the case of the Models 350 and 370, the FPA connects to the CPU via a high-speed bus. This high-speed communication link between the CPU, RAM and FPA allows maximum performance of the FPA when used with the Model 350 or 370.

18.9 Floating Point Math Card

The 98635A Floating Point Math Board enhances the performance of the Model 310 Systems and Supports the proposed IEEE Standard for binary floating point numbers. With this board, the computational performance can be increased up to three times. Performance, however, is highly dependent on the application, language and operating system.

18.10 DMA Controller Card

The 98620B DMA Controller Card enhances the Series 300's interfacing capability by providing two DMA channels for I/O data transfer. This high-speed I/O capability works with the 98622A GPIO, 98624A HP-IB and internal HP-IB interfaces and the 98625B disc interface. Although the 98620B can accommodate DMA transfer rates up to the memory cycle rate (approx. 1.2M transfers/sec), lower DMA rates can be expected because actual rates are dependent on a number of factors. The typical maximum transfer rate for the 98622A GPIO Interface is approximately 750K transfers per second; for the 98624A and internal HP-IB interfaces approximately 330K transfers per second; and for the 98625B Disc Interface approximately 750 Kbytes per second.

18.11 Disc Interface

The 98625B (for Models 310 and 320) and 98262A (for Models 330 and 350) High-speed HP-IB Disc Interfaces provide an interface to the Command Set 80 discs (79XX) that offer the maximum transfer rate available. The interfaces, when used with the 98620B DMA card in Models 310 and 320 (built-in DMA in Models 330 and 350), allow buffered DMA data transfers between the Series 300 system and the Command Set 80 disc. The interfaces allow up to eight discs to be connected to one interface card. It is recommended that a 98620B DMA card be included in any Model 310 or 320 using a 98625B, äs little performance improvement is seen over a 98624A unless a DMA card is installed.

DMA Capability

- Burst Mode DMA transfer (Word Mode)

18.12 SCSI Interface

Two single card implementations of the SCSI protocol are available. One card is designed for the Models 330, 350, 360 and 370 and is available both äs an SPU Option (Opt. 011) and äs a customer-installable product (98265A). The other card is for the Model 319 and is only available äs an SPU Option (Opt. 011). Both interface cards conform to the industry Standard defined by the document ANSI X3.131-1986.

These cards are installed in the SPU without consuming any I/O slots. A 98265B external HP-IB disc interface may be used concurrently with SCSI. For more Information on SCSI I/F cards, please see the HP *9000 Series 300 SCSI Cards Hardware Data sheet,* Pub. No. 5951-6800.

18.13 128 Kbyte Bubble Memory Card

The 98259A Magnetic Bubble Memory Card features 128 Kbytes of non-volatile data storage. The 98259A provides increased reliability and durability over flexible disc storage in adverse environmental conditions.

Access Times and Data Transfer Rates

Access time:
Average .....42 milliseconds
Worst case .....90 milliseconds
Average transfer rate:
Input .....8 Kbytes/second
Output.....8 Kbytes/second

18.14 EPROM Card

The 98255A EPROM Card contains 16 sockets for EPROMs to allow up to 256 Kbytes of storage using Intel 27128 EPROMs or equivalent. 128 Kbytes of storage are available using Intel 2764 EPROMs or equivalent. EPROM integrated circuits must exhibit access times of 250 nanoseconds or less. EPROM integrated circuits must be used äs pairs (2, 4,... 16). The EPROM cards act äs a mass storage device.

18.15 Breadboard Card

The 98630A Breadboard Interface allows experienced hardware designers to design their own custom interface to the Computer when none of the interface cards provided by HP will fit a particular requirement. The interface consists of a printed circuit board with the necessary buffering to properly interface to the Series 200 or 300 backplane. Most of the space on the board contains tinned holes on Standard centers to allow a prototyping area for custom interface design.

Board space for prototyping: 96 square cm (15 square inches). Hole patterns are on 100 mil centers.

18.16 GPIO Interface

The 98622A GPIO Interface provides 16 bits of latched input or 16 bits of latched Output data with handshake control lines for bi-directional transfer of Information. Extended control and Status lines are available for applications that require more than one signal from the Computer. Several handshake modes are user-selectable to permit interfacing to a variety of equipment.

Data Input/Output and Handshake Control Signals

There are 16 input data lines and 16 Output data lines. The input data lines are terminated by a resistive divider of 3K Ohms to + 5V and 6.2K Ohms to ground accepting Standard TTL Signals. The Output lines provide high current/voltage drivers, using open-collector buffers.

Interrupt Capability

The 98622A is capable of generating interrupts to the Computer under the following conditions:

- Handshake complete
- Device ready
- Transfer complete

DMA Capability

The 98622A is capable of carrying out DMA transfers. The following DMA capabilities are supported by the 98622A:

- Word or Byte Mode DMA
- Regulär or Burst DMA transfer

18.17 HP-IB Interface

In addition to the Standard built-in HP-IB interface, there is an optional external 98624A HP-IB Interface Card. Both interfaces implement the IEEE 488-1978 Standard Digital Interface for Programmable Instrumentation. Both interfaces can communicate with äs many äs 14 HP-IB compatible Instruments, connected with a maximum of 20 meters (65.6 ft.) of cable.

Interrupt Capability

The internal and 98624A HP-IB interfaces are capable of generating interrupts under the following conditions:

- Controller addressed
- Talker addressed
- Listener addressed
- Service Request (SRQ) detected
- Parallel Poll configuration change
- EOI received
- Serial Poll active
- Remote/Local configuration change
- MY address mode change
- Group Execute Trigger received
- Source handshake error
- Unrecognized universal command
- Unrecognized address command
- Secondary command received
- Device Clear received
- Interface Clear detected

DMA Capability

The internal and 98624A HP-IB interfaces are capable of carrying out DMA transfers via the optional two-channel 98620B DMA Controller Card. The following DMA capabilities are supported:

- Byte Mode DMA
- Regulär DMA transfer (no burst DMA)

1818 HP 6944A Multiprogrammer Interface

The HP 98633A Interface connects the Computer to the HP 6944A Multiprogrammer, a 16-slot Instrument cardcage, which can be customized to a wide variety of applications. A family of over 30 plug-in cards provide simultaneous buffered A/D measurements to 500 kHz, l Megaword memory buffer, D/A, counter, digital I/O, relay, and power supply control capabilities. Continuous data transfer to disc at speeds of up to 200 kHz are also available. The HP 14753A Computer-Aided Test Software package is required.

1819 VMEbus Expander

The HP *98577A* VMEbus Expander connects directly to the HP Model 330 and 350 workstations to provide highly transparent access to the industry-standard VMEbus revision C.l. The expander provides four available slots for Installation of revision C.l-compatible VMEbus cards. A fifth slot is occupied by the interface and System Controller card. The HP *98577A* VMEbus Expander housing is the same size äs Models 330, 350 and the HP 98570A DIO II Expander.

Supported configurations include:

- Model 330* or 350 with one HP 98577A VMEbus Expander and HP-UX 6.0 or later revision
- Model 330* or 350, one HP 98570A DIO II expander, and one HP 98577A VMEbus Expander and HP-UX 6.0 or later revision

Porting existing "kernel-level" drivers or writing new drivers for third-party VMEbus cards is made easier by the Series 300 HP-UX Driver Development Guide supplied with each VMEbus Expander. Use this documentation to customize existing C language drivers or to write entirely new drivers. Drivers written expressly for the HP 98646A VMEbus Adapter must be re-written to take advantage of the kernel-level access.

VMEbus Expander Features

- Supports both DIO II and VMEbus masters
- Supports all VMEbus arbitration levels
- Supports VMEbus hardware vectored interrupts
- Peak hardware data transfer rate of 5 Mbytes per second
- Total solutions - VMEbus card cage, power supply, System Controller, bus Converter and documentation

VME Technical Specifications

Design Specifications

Design reference ..... VME Specification Revision C.l, HP DIO II bus specification
VME Slot l functions:
  Bus arbiter ..... Priority, round-robin (software selectable)
  Interrupts ..... IACK daisy-chain driver
  System clock ..... 16 MHz
VMS bus ..... Not supported
VMS clock..... Not supported
Bi-directional DMA ..... Supported in A32 mode only
Maximum hardware
  transfer rate ..... 5 Mbytes per second
Address translation width:
  DIO II to VME ..... 16-bit, 24-bit, 32-bit addresses
  VME to DIO H ..... 24-bit, 32-bit addresses
Data translation width:
  DIO II to VME ..... 8-bit (even, odd), 16-bit, 32-bit
  VME to DIO n ..... 8-bit (even, odd), 16-bit, 32-bit
Address translation ränge .... 4 Mbyte to 4 Gbyte
VME address modifiers (in hex):
  Generates ..... 29, 39, 09 (short, Standard and extended non-privileged data access)
  Receives..... 39, 3a, 3d, 3e (std, non-block tf r) 09, Oa, Öd, Oe (ext, non-block tf r)
  Bus daisy chains ..... IACK, BG3, BG2, BGl, BGO
DIO bus arbitration
  positions ..... xbgl, bg, bgl, bg2 (switch selectable)
Bus grant/Acknowledge..... RWD (Release When Done), ROR (Release On Request)
Incremental cycle
  translation time
  Best case ..... 125 nsec
  Worst case ..... 400 nsec
  Typical ..... 250 nsec
Protocols:
  Block transfer..... Not supported
  Read-modify-write..... Supported
  Unaligned transfers ..... Supported on Model 350 only
  Address pipelining ..... Supported on VME master to DIO slave transactions

** Model 330 Systems sold prior to January 1988 may require replacement of the processor board. Contact your local HP service office for Service Note 62A-1.*

Vatchdog timers:
Bus error ..... 4 µsec via DIO processor board
Interrupt acknowledge..... 4/xsec via DIO processor board
Bus arbitration ..... None
nterrupt levels:
DIO to VME..... None
VME to DIO..... Levels 7 through l, maskablet
Signals:
STSRESET ..... Supported
Booting from VMEbus interfaces..... Not supported
Optional Signals:
ACFAIL, SYSFAIL, +5STANDBY and SERDAT ..... Not supported

Power Specifications
Input voltages ..... 90-132 Vac or 180-264 Vac (switch selectable)
Line frequency ..... 50-60 Hz
Power consumption:
Watts (maximum)..... 175
BTU/hr 595
Total power available from VMEbus slots:
Power at +5V ..... 36.4 Watts
Power at + 12V ..... 24.0 Watts
Power at -12V ..... 24.0 Watts

Physical Dimensions
Height ..... 130 mm (5.12 in.)
Width..... 325 mm (12.8 in.)
Depth ..... 376 mm (14.8 in.) Allow an additional four inches for interface cables.
Net weight ..... 10 kg (22 Ibs.)

Environmental Range
Operating temperature ..... 0° to 4- 55°C
Humidity..... 5% to 95% relative, non-condensing
Maximum wet-bulb temperature ..... 40°C
Storage environment ..... —40° to + 71°C
Maximum operating altitude ..... 4,572m (15,000 ft.)
Maximum survival altitude... 15,240m (50,000 ft.)
EMI ..... Conducted and radiated interference meets FCC Class A; VDE 1046/84 LevelB; VCCI Classl
Additional regulatory compliance ..... UI 478, 5th Edition; CSA 22.2 No. 220, M-1986; IEC 380, 2nd Edition; IEC 435, 2nd Edition

18.20 VMEbus Interface

The VMEbus Interface provides bi-directional data transfer capabilities between the Series 300 and the VMEbus (IEEE P1014), permitting configurations of both HP-IB and VME Systems. The package consists of the HP 98646A VMEbus Interface hardware and HP 98385A/R VMEbus Driver Software. The hardware consists of two cards connected by two shielded flat cables. The DIO card fits into the backplane of the Series 300. Select code and DIO interrupt level are configurable on the card. The VME master module fits into any Standard double height VMEbus Rack. The VME arbitration channel is configurable on the card, allowing Communications between VME Arbiter and Masters. The 98385A/R drivers are supplied for all three operating Systems: BASIC, Pascal, and HP-UX.

Data Rates and Formats

The 98646A provides 24-bit addressing and either 8- or 16-bit data transfers. Data transfer rates are shown below:

16.6 MHz 68020	Output	Input
BASIC/Pascal	1.3 Mbytes/sec	1.3 Mbytes/sec
HP-UX	950 Kbytes/sec	959 Kbytes/sec

Interrupt Capability

The 98646A and 98385A/R support all seven VMEbus interrupt levels. The Interrupt priority of the DIO to the Series 300 Computer and the Bus Request (BR) and Bus Grant (BGIN/BGOUT) channels of the VMEbus are switch-selectable. The arbitration function is not built into the 98646A, but the set of lines used for arbitration are switch-selectable on the VMEbus card.

DMA Capability

- DMA capability is not currently supported.

18.21 BCD Interface

The 98623A BCD Interface connects the Computer with bit-parallel, digit-parallel, binary-coded decimal devices for data input. Up to eight significant BCD digits, two sign bits (mantissa and exponent), exponent digit, function code digit, and an overload bit can be read. Input format is selectable, allowing two independent instruments to be read from one 98623A Interface Card. Data can also be accepted äs five input bytes of pure binary information. Eight data Output lines are also provided for use äs general purpose control and/or data Output lines.

Interrupt Capability

The 98623A BCD Interface is capable of generating interrupts to the Computer under a peripheral ready condition.

Multiple-handler Systems and distributed Systems are supported and interrupts are automatically handled by the Werkstation processor.

18.22 Analog Input Interface

The 98640A Analog Input Interface is an analog to digital Converter for Series 300 Systems. It provides a low cost, easy-to-use data acquisition solution for low point count applications. Communication to the interface involves reading or writing to appropriate locations on the card or calling subroutines in the 98645A Measurement Library from BASIC or Pascal environments. The 98640A provides the following features:

- Seven dif ferential input channels plus one channel for . referencing
- 55,000 samples per second to System memory
- 13-bit resolution (includes sign bit)
- Four programmable input ranges
- Input overvoltage protection
- 90 dB common mode rejection at 60 Hz
- Internal and external pacing/triggering
- Successive approximation analog to digital Converter
- On-board crystal-controlled clock

Aperature time of sample and hold..... 25 nanoseconds
Temperature coefficient for voltage offset ..... 10 microvolts per degree C
Time from first read to hold at 55 KHz ..... 7 microseconds
Linearity .....02% of füll scale
Input resistance (on each channel)..... 100 megohms

Warranties

The warranty covering a specific System is determined by the HP WARRANTY AND INSTALLATION TERMS in effect at the time of purchase. These terms are specified in HP Pub. No. 5954-1617(D) for the United States and in similar documents for other countries.