HP 9000 Series 300
Models 310 and 320
Hardware Technical Data

Introduction[†]

The HP 9000 Series 300 is a modular family of high-performance technical systems designed for instrument control and computer-aided design applications. A variety of processors, monitors, input devices, data storage devices and peripherals are available for you to custom-tailor your system with the right mix of processor power, display capability, and peripheral performance to meet your needs.

Series 300 is descended from and compatible with the HP 9000 Series 200 systems. Architecture, interfaces, memory cards, operating systems, accessories and

peripherals are shared between Series 200 and Series 300. The Series 300 systems differ from Series 200 in that they are completely modular, the display systems are bit-mapped, and components can be flexibly combined.

The architecture of the Series 300 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 masters (such as the 98620B Direct Memory Access (DMA) Controller). The memory and I/O bus is an asynchronous bus operating at eight megahertz, with an effective data throughput of 1.5 Mwords (3.0 Mbytes) per second transfer rate.

Physically, the memory and interface cards plug into the backplane through a 100 pin edge connector. Each pair of slots in the System Processing Unit (SPU) or expander can hold either two memory cards or one

memory/accessory card and one interface card (with cover plate). A Series 300 SPU box 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. The Series 300 I/O Expander has eight slots and can hold twice as many cards, in a fashion similar to that of the SPU box.

The Series 300 systems are based on the Motorola MC68010 (Model 310) and MC68020 (Model 320) microprocessors. Each features a 32-bit internal architecture, with the MC68020 differing from the MC68010 in that it features full 32-bit external data and address paths and operates at a higher clock rate. The MC68010 operates at a 10 MHz clock rate (about 0.6 native MIPS) and can address 16 Mbytes virtual memory per process with HP-UX. The MC68020 operates at a 16.6 MHz clock rate (about 1.4 native MIPS) and can address 4 Gbytes virtual memory per process with HP-UX.

The display systems available for the Series 300 are bit-mapped and capable of supporting the new generation of engineering applications. Series 300's full range of monitors includes a 12-inch monochrome monitor with integral tilt and swivel, a 12-inch color monitor with integral tilt and swivel, a 17-inch high-resolution monochrome monitor, and a 19-inch high-resolution color monitor. All monitors operate at 60 Hz non-interlaced to eliminate flicker and so minimize operator fatigue. Each of the monitors is fully compatible with either the Model 310 or Model 320.

Complementing the ergonomic displays is the detached keyboard which features sculptured keys, an integral numeric keypad and eight special function keys. The keyboard 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 daisy-chain interface capable of connecting up to seven devices, in series, to a single interface port on the computer. Other HP-HIL input devices available 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 touch screen bezel.

Other accessories for the Series 300 include:
- The Series 300 I/O Expander (Part Number 98568A) features eight I/O slots to hold memory, interface and accessory cards. It is physically attached to the SPU box and looks identical to the SPU from the front. Because it is electrically passive, no additional wait states are induced when accessing memory or I/O cards installed in the expander. Any supported combination of cards can be installed in the expander with no concern for power availability. (The 150 watt power supply has plenty of reserve power to handle a fully-loaded cardcage.)
- An Electronic Industries Association (EIA) 19-inch rack-mount adapter kit for the SPU boxes and expanders (Part Number 98569A).
- An EIA 19-inch, rack-mount adapter kit for the 35731A 12-inch monochrome monitor (Part Number 98567A).

Series 300 models fully support three primary operating systems: HP-UX (multi-tasking, multi-user), BASIC (single-user), and Pascal (single-user). Both the BASIC and Pascal operating systems are capable of accessing up to 7.5 Mbytes of physical memory (if installed). The HP-UX Operating System offers access of up to 7.5 Mbytes physical RAM (if installed) and also access to the virtual memory capabilities of both the Model 310 (16 Mbytes virtual memory) and the Model 320 (4 Gigabytes virtual memory).

Series 300 Hardware Specifications

Model 310 Processor
Type . . . . Motorola MC68010
Clock frequency . . . . 10 MHz
Internal architecture . . . . 32-bit data and address registers
Addressable RAM. . . . . 16 Mbytes virtual; 7.5 Mbytes physical
Data bus . . . . 16-bit synchronous to processor board RAM; 16-bit asynchronous backplane
Instruction types 56
Major data types 5
Addressing modes 14
Interrupt levels . . . . One non-maskable; six maskable

This processor board includes the MC68010 16/32-bit CPU, 512 or 1024 Kbytes RAM with parity, 32-bit demand paged Memory Management Unit (4 Kbyte pages), system timers with a maximum of 4 msec resolution, user timers with 10 msec resolution, a battery-backed real time clock, a 3-voice audio controller; HP-IB, RS-232 and HP-HIL interfaces, and a medium-resolution bit-mapped video output that may optionally be deleted if a separate video board is to be used instead. The built-in HP-IB is essentially identical to the 98624A interface except that it adds "interrupt on PPOLL response" capability to enhance HP-UX system performance by reducing processor overhead during disc seeks. The built-in RS-232 interface is essentially identical to the 98644A interface.

The Model 310 processor board features an MC68010 operating synchronously with on-board RAM (no wait states) allowing a twenty percent performance improvement over accesses to RAM boards plugged into I/O slots, in addition to operating at 10 MHz (25% faster than the 8 MHz MC68000). Performance of this MC68010 board (for programs executing in on-board RAM) is thus approximately 50% faster than the Series 200 Models 216 and 217.

Model 320 Processor
Type . . . . Motorola MC68020
Clock frequency . . . . 16.6 MHz
Internal architecture . . . . 32-bit data and address registers
Address range. . . . . 4 Gbytes virtual; 7.5 Mbytes physical
Data bus . . . . 32-bit synchronous to processor board cache; 16-bit asynchronous backplane
Instruction types 100
Major data types 7
Addressing modes 18
Interrupt levels . . . . One non-maskable; six maskable

The Model 320's processor board includes: the MC68020 32-bit CPU operating at 16.6 MHz; the MC68881 Floating Point Co-processor; a 16 Kbyte write-thru cache (4 Kwords, 32 bits wide); a 32-bit demand paged Memory Management Unit (4 Kbyte pages); and system timers with a maximum of 4 msec resolution.

The MC68020 contains an internal 256 byte instruction cache, which can be turned on and off. Each time the microprocessor goes off chip to fetch from the instruction stream, the cache retains the data. Should the need arise to re-execute a recent instruction sequence, it may be that instruction sequence is valid within the cache. If so, the information is read from the cache without accessing off-chip resources, thus speeding up execution.

The Model 320's processor board contains a 16 Kbyte instruction and data cache that operates with no wait states with the MC68020. This high-speed cache matches a full 32-bit processor with the low cost Series 300 memory and interface cards to provide a very high performance technical workstation at a low system price. The size and design of the on-board instruction and data cache is such that for executing program loops and operating system commands, the "hit rate" (percentage of time the processor fetches information from the cache instead of having to fetch from main memory) is about 90%. A typical program mix of reads and writes (a database program for example) yields a hit rate of 70–80%. Programs are executing in a full 16 MHz, 32-bit computer about 75% of the time, with only about 25% of the program execution time being performed at a slower 8 MHz rate. While the MC68020 is executing from the cache any other bus masters, such as DMA controllers, are free to use the external buses without halting the processor. In fact, performance of the Model 320 is about four times as fast as an 8 MHz 68000 Series 200 system for any computational benchmark.

The MC68881, which provides full IEEE 754 floating-point support, can execute concurrently with the MC68020 and usually overlaps its processing with the MC68020's to achieve higher performance. The MC68881 provides increased performance for floating-point operations, particularly for the evaluation of transcendental functions.

The companion board to this CPU board is the Human Interface Card. This I/O card contains: the system timers with a maximum of 4 msec resolution, the user timers with 10 msec resolution; battery-backed real time clock; HP-IB, RS-232, and HP-HIL Interfaces; and a 3-voice audio controller. The built-in HP-IB is essentially identical to the 98624A interface. The built-in RS-232 interface is essentially identical to the 98644A interface.

Clock and Timers

Battery-backed Real-time Clock
Resolution . . . . 10 milliseconds
Accuracy . . . . ±5 seconds/day
Battery backup . . . . Lithium, expected life = 1 year

Timers
Match interrupt . . . . Match on time of day 0.00 to 84600.00 sec.
Delay interrupt . . . . 10 msec. to 1.94 days
Cyclical interrupt . . . . 10 msec. to 1.94 days
System timer . . . . 4 usec. resolution accurate to 25 ppm

Beeper
Three independent tone generators controllable over 30 db.

Frequency range . . . . 81.46 Hz to 83.3 KHz
Resolution . . . . Capable of approximate chromatic scale over five octaves
Duration .01 sec. to 2.55 sec. per tone

System Processor Unit Specifications

SPU Power Requirements
Source consumption . . . . 5.0A @ 85–129V, switch selectable
3.0A @ 187–250V, switch selectable
Line frequency . . . . 48–66 Hz
Power consumption:
    Watts max. 250
    Btu/hr 853
SPU power supply:
    Total power availability . . . . . 150 Watts
    Current at +5 volts . . . . 20 Amps
    Current at +12 volts . . . . 3.6 Amps
    Current at -12 volts . . . . 1.1 Amps
Power available at backplane:
    SPU:
        Current at +5 volts . . . . 31 Watts
        Current at +12 volts . . . . . . 19.2 Watts
        Current at -12 volts . . . . . . 6 Watts
    Bus Expander:
        Current at +5 volts . . . . 62 Watts
        Current at +12 volts . . . . . . 38.4 Watts
        Current at -12 volts . . . . . . 12 Watts

Physical Dimensions (SPU or Bus Expander Box)
Height . . . . 127 mm (5.0 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 . . . . 10 kg (22 lbs.)
Shipping weight . . . . 12 kg (26.4 lbs.)

Environmental Range
Operating temperature . . . . 0° to +55°C
Humidity . . . . 5 to 95% R.H. non-condensing
Maximum wet-bulb
    temperature . . . . 40°C
Storage environment . . . . -40°C to +75°C
Maximum altitude . . . . 4572m (15,000 ft.)
EMI . . . . Conducted and radiated interference meets VDE 0730, CISPR publication 11

Line transient spike immunity
(1 nsec rise, 800 nsec
duration) . . . . 1 KV
Electrostatic discharge
immunity (no adverse
operational effects) . . . . 15 KV discharged thru 300 pf
and 500 ohms
Additional regulatory
compliance . . . . UL, CSA, IEC, SEV, FEI

Keyboards
The Series 300 employs two keyboards:
- HP 46021A
- HP 98203C

The **HP 46021A** 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 a follows:

Height . . . . 40 cm (1.6 in.)
Width . . . . 452 mm (17.8 in.)
Depth . . . . 219 mm (8.7 in.)
Net weight . . . . 2.2 kg (4.75 lb.)
Shipping weight . . . . 2.6 kg (5.75 lb.)

The following languages are available: Belgian Dutch, Canadian English, Canadian French, Danish, Dutch, Finnish, French AXERTY, German, Italian, JASCII/Katakana, Katakana, Latin Spanish, Norwegian, Spanish, Swedish, Swiss French, Swiss German and U.S. ASCII.

The **HP 98203C** features a built-in rotary knob, allowing cingle-control cursor movement. The keyboard has 105 keys, including 10 special function keys. Additional features include numeric pad and ergonomic palm rest. The 98203C key layout is identical to that found on the Models 226 and 236 keyboards. 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 as 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 lb.)
Shipping weight . . . . 2.7 kg (6 lb.)

The following langauges are available: French, German, Katakana, Spanish, Swedish/Finnish and US ASCII.

Display Systems
The Series 300 features six display systems: five are bit-mapped display systems which allow user selection of different text styles and sizes to be intermixed with graphics information on the same screen. Of these five, four fit in an SPU system slot, the fifth is the 98700H Graphic Display Station. The sixth display system separates alpha and graphics information for full compatibility with Series 200 programs written to take advantage of independent control of alpha and graphics.

Bit-mapped Video Boards
Series 300 video boards provide a choice of either monochromatic or color in medium- or high-resolution formats. The display architecture is organized on a byte-per-pixel basis. allowing a maximum of up to 256 colors to be displayed from a color palette of over 16 million color hues. (The 98547A video board provides six planes or 64 colors.) Each plane in a color system can be manipulated independently of the others, providing flexibility to the systems' programmer in implementing graphics applications on the Series 300 computer systems.

To achieve maximum integration at lowest cost, each video board employs a high-performance VLSI chip to supply video timing signals and high-speed pixel moving capabilities to support windowing and text management in a bit-mapped environment. Sixteen replacement rules are available for pixel generation and for window moving. The video board's VLSI chip operates independently from the main CPU, freeing up the processor to perform other functions while the display system is performing screen blanking, text scrolling or window moves, thereby maximizing system throughput.

Description	Resolution	
	Medium	High
VLSI clock rate	9 MHz	16 MHz
Frame buffer size (pixels per plane)	1024 x 512	1024 x 1024
Displayed buffer size (pixels per plane)	1024 x 400*	1024 x 768
Window move speed (pixels/sec.)	11.2M	20M
Scrolling speed (pixels/sec.)	16.9M	30M
Pixel write speed, maximum: • Horizontal (pixels/sec.)	1M	1.9M
• Vertical (pixels/sec.)	.28M	.5M
Pixel write speed by CPU: • Model 310 (pixels/sec.)	60K	60K
• Model 320 (pixels/sec.)	120K	120K
Screen erase time (msec)	36	40

* These are half-width, rectangular pixels to improve alpha resolution.

98542A – Medium-resolution Monochrome Video 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 video cable for use with the HP 35731A 12-inch monochrome monitor with built-in speaker and integrated tilt and swivel. The HP 35731A monitor also supports an optional HP-HIL touchscreen bezel and can be rack mounted (Part Number HP 98567A) for computer-aided test applications.

98543A – Medium-resolution Color Video 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 monitor also supports an optional HP-HIL touchscreen bezel and can be rack mounted (Part No. HP 98567B).

98544B – High-resolution Monochrome Video Board

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

98547A – High-resolution Color Video Board

This board provides a high-resolution display suitable for CAD system use. It comes supplied with a 3 meter RGB cable for use with the 98782A 19-inch or 98785A 16-inch high-resolution color monitor. The board features six planes of frame buffer to provide 64 simultaneous colors from a color palette of over 16 million hues.

Graphics Display Stations

The **HP 98700A** is designed to meet your 2-D and 3-D wireframe needs. The graphics subsystem provides performance an order of magnitude greater than the HP 98547A High-Resolution Color Video Board.

The subsystem's interface plugs into an I/O slot in the Series 300 and accepts data from 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. An optional graphics accelerator with bit slice processor and writable control store provides high-performance vector generation, area fill, 2-D and 3-D tramsformations, polygon clipping and filling plus perspective division. The following table provides a brief summary of the graphics performance of the 98700A Graphics Display Station Controller with the HP 98710A Graphics Accelerator installed:

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

The **HP 98720A** provides the highest performance display system for the Series 300. Coupled with the optional graphics accelerator, this system is designed to meet the needs of 3-D solid rendering applications such as solid modeling, molecular modeling, mapping, architectural engineering and construction.

Features such as hidden-surface removal, B-splines*, shading and light sources are implemented in hardware and microcode to minimize response time. B-splines allow definition of curved lines, meshes and surfaces using control points and knot vectors – reducing the amount of data and increasing rendering speed. To maximize the throughput of the system, the implementation uses HP-custom VLSI technology – providing interactive 3-D solid modeling capabilities.

Four frame buffer planes are standard (expandable to 32 + 4 overlay planes in increments of eight). In a 32-plane system, 24 frame buffer planes supply 16.7 million simultaneously displayable colors while eight planes are available for hidden-surface removal. The 98720A requires the use of the HP 98784A monitor and HP 98724A interface. The following table provides a brief technical specification overview for the 98720A display station:

Frame buffer size (pixels per
　plane) . . . . 2048 x 1024
Frame buffer planes . . . . 4, 8, 16, 24, or 32
　　　　　　　　　(maximum 24 displayable, additional eight
　　　　　　　　　planes and non-displayable portions of Video
　　　　　　　　　RAM provide full 16-bit Z-buffering)
Overlay planes . . . . 0 (4-plane system)
　　　　　　　　　4 (8, 16, 24, or 32-plane
　　　　　　　　　system
Video signals RS-343
Mathematical representation . . . 32-bit floating point
Z-buffer . . . . 16-bit full or strip
Control memory . . . . Writeable control store
Double buffering . . . . 4, 8, or 12 planes

Series 200 Display Compatibility Interface

The 98546A Display Compatibility Interface provides separate alpha and graphics planes and is completely compatible 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 as 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 HP 35731A 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 as the 98546A, but the resulting system will be a two-monitor system; one a high-resolution bit-mapped display, the second is the monochrome alpha/graphics display. The two display systems are independent of one another.

B-spline capabilities available early 1987.

Monitor Specifications

	35731A Monochrome	35741A Color	98782A Color	98785A Color	98786A Monochrome
Size (measured diagonally)	310 mm (12 in.)	310 mm (12 in.)	480 mm (19 in.)	406 mm (16 in.)	432 mm (17 in.)
Alphanumeric capacity (default font)	80 characters, 26 lines		128 characters, 48 lines		
Character height and width	3.7 mm wide, 4.9 mm tall		1.8 mm wide, 3.2 mm tall	2 mm wide, 2.9 mm tall	1.8 mm wide, 3.0 mm tall
Graphics capability: Resolution	512 dots horizontal, 400 dots vertical		1024 dots horizontal, 768 dots vertical		
Raster size	210 mm x 164 mm		360 mm x 270 mm	297 mm x 238 mm	304 mm x 234 mm
ROM character set	256 characters		256 characters		
Character font	9 x 12 character in a 12 x 15 cell†		7 x 10 character in an 8 x 16 cell‡		
Intensity adjustable up to	50 FL	36 FL	27 FL	35 FL	35 FL
Refresh rate	60 Hz	60 Hz	60 Hz	60 Hz	60 Hz
Implosion protection	Tension band		Safety glass, bonded panel with thin-film, anti-glare coating		
Tube phosphor	p 31	p 22	p 22	p 22	p 40
Chromaticity coordinates	N/A	Red X 0.63 Y 0.35 Green X 0.30 Y 0.60 Blue X 0.15 Y 0.06	Red X 0.64 Y 0.33 Green X 0.29 Y 0.60 Blue X 0.15 Y 0.06	Red X 0.62 Y 0.34 Green X 0.28 Y 0.60 Blue X 0.16 Y 0.07	N/A
Physical dimensions: Height Width Depth§ Net weight Shipping weight	332 mm (13.7 in.) 340 mm (13.4 in.) 240 mm (9.5 in.) 10 kg (22 lbs.) 12 kg (26.4 lbs.)	345 mm (13.6 in.) 328 mm (12.9 in.) 390 mm (15.4 in.) 13.9 kg (30.6 lbs.) 15.9 kg (35 lbs.)	449 mm (17.7 in.) 496 mm (19.5 in.) 596 mm (23.5 in.) 40.7 kg (90 lbs.) 47.5 kg (105 lbs.)	380 mm (15 in.) 406 mm (16 in.) 450 mm (17.7 in.) 26 kg (57 lbs.) 28 kg (62 lbs.)	422 mm (16.6 in.) 435 mm (17.1 in.) 370 mm (14.6 in.) 20.0 kg (44 lbs.) 27.0 kg (59 lbs.)

† *Character width is measured in half-pixels on medium-resolution, bit-mapped display systems.*
‡ *User setable in HP-UX.*

§ *Additional 4 inches in depth should be allowed for interface cables, and 2.5 inches on the left side for ventilation.*

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-232 input devices are also available, as 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	HP-HIL	1.4m
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	A-size Digitizer	HP-HIL	0.8 ... 3m
46088A	B-size Digitizer	HP-HIL	0.8 ... 3m
46089A	4-button Cursor for 46087/88A	46087/88A	Included
46094A	Quadrature Port	HP-HIL	0.5m
46095A	3-button Mouse	46094	1.2m
9111A	A-size Tablet	HP-IB	None
	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 and RGB Coax Extension (with audio)	HP-HIL	15m, 0.5m
46082B	30m HP-HIL and RGB Coax Extension (with audio)	HP-HIL	30m, 0.5m

Series 300 Networking

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

Network Services-ARPA Services/300 provides transparent Remote File Access (RFA) between HP-UX systems. It also provides file transfer (NFT) between Series 300 and the HP 3000 and DEC VAX/VMS computers which support HP AdvanceNet protocol.

Link-level access capability is provided for customers who have the expertise to write inter-vendor software.

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 Advanced Research Projects Agency (ARPA) standard Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) transports.

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

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 as many systems as 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 Mux are not recommended. All other connections require a modem-compatible interface and cable. An X.25 connection requires a modem port of an HP 2334A Option 123 Multi-MUX X.25 cluster 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.

HP 2392A and VT100 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 VT100 Terminal Emulator. Requires 46084A ID Module.

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 as their sole file system (including system boot). HP-UX workstations may be included in the SRM network. HP-UX workstations transfer files 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.

UNIX is a trademark of AT&T.

Series 300 Networking

Feature	Local Area Network (LAN)	uucp, uux, cu	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	RFA, NFT, LLA, FTP, Telnet, SMTP, rcp, rlogin, remsh, BSD sockets	NFT, RCX, VT	VT, NFT	NFT (HP-UX), RFA (BASIC and Pascal)
Other systems on network	Series 200, 500, HP 3000, VAX/VMS, ARPA/BSD 4.2 Systems†	Any HP-UX, most async hosts	Any HP, DEC, most async hosts	Series 200, 500
Bit rate	10 Mbps	9.6 Kbps	9.6 Kbps	750 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 – Line Level Access
† *Check with your local HP sales office for systems HP supports.*

Series 300 Data Storage

Hewlett-Packard offers a wide range 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 as "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 an HP 98625B interface in a system which has a 98620B DMA card. The built-in HP-IB and 98624A interfaces support only standard speed mode. Note: The built-in HP-IB of the Model 310 computer has less overhead than the 98624A. If you do not plan to have a 98625B interface, plan to use the built-in HP-IB for your system disc. Note that a maximum of one 98625B is presently supported.

Series 300 Data Storage (in order of increasing capacity)

Product No.	Capacity (bytes)	Performance I/Os/sec.	Transfer Rate	Media Type
9127A	270K, 360K, 380K	4	Standard	5¼-inch flexible disc
9122S	631K, 710K, 788K	2	Standard	3½-inch microfloppy disc
9122D	631K, 710K, 788K	2	Standard	3½-inch microfloppy disc
9154A	10.0M	10	Standard	Fixed
9153A	10.0M, 631–788K	10	Standard	Fixed, 3½-inch microfloppy disc
9134H	19.9–22.3M	11	Standard	Fixed
9133H	19.9–22.3M	11	Standard	Fixed, 3½-inch microfloppy disc
7941A	23.8M	18	Standard	Fixed
7942A	23.8M	18	Standard	Fixed, ¼-inch cartridge
9133L	39.9–44.8M, 631K, 710K, 788K	16	Standard	Fixed, 3½-inch microfloppy disc
9134L	39.9–44.8M	16	Standard	Fixed
7907A	20.5M + 20.5M	20	Standard	Fixed, removable
7945A	55.5M	18	Standard	Fixed
7946A	55.5M	18	Standard	Fixed, ¼-inch cartridge
7914CT/P/R	132M	23	High	Fixed, ¼-inch cartridge
7933H	404M	23	High	Fixed
7935H	404M	23	High	Removable

Series 300 Magnetic Tape Drives

Product No./Description	Density (cpi)	Tape Capacity in Mbytes	Read After Write	Performance in Mb/min.	Shared Controller Option	Separate Controller Option
¼-inch Cartridge Tape Drives 7914CT, built-in 9144	10,000	67	Standard	2	N/A	Standard
7914P/R, built-in 88140	10,000	67	N/A	2	Standard	001
7942A, built-in 9144	10,000	67	Standard	2	Standard	N/A
7946A, built-in 9144	10,000	67	Standard	2	Standard	N/A
9144A, stand-alone drive	10,000	67	Standard	2	N/A	Standard
35401A, stand-alone	10,000	8 x 67	Standard	2	N/A	Standard
½-inch 9-track Tape Drives 7974A, stand-alone drive	1,600	45	Standard	8	N/A	Standard
Opt. 800, adds	800	22	Standard	4	N/A	Standard
7978B, stand-alone drive	1,600 6,250	45 140	Standard Standard	8 16	N/A N/A	Standard Standard

Discussion of Terms

In the preceding table, "88140" refers to the built-in tape drive of the 7908/11/12/14 discs. It cannot be ordered separately. (All of the ¼-in. drives listed use the 88140 tape format.)

Interface – All of the tape drives are interfaced via HP-IB. A 98620B DMA card is required for the 7978B ½-in.

9-track tape drive; it is recommended for the 7974A. A 98625B high-speed HP-IB interface is also recommended for the 7978B.

Density – the number of characters (bytes) per inch (cpi) that can be stored on the tape. The ¼-in. figure is based on the 600-ft. tape (88140LC). The ½-in. 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 as for density.

Read-after-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 mag tape I/O. Normal backup operations are slower due to the time required to locate and read the files being saved.

Shared Controller – The tape drive shares the disc controller electronics, HP-IB connector and HP-IB address. Disc access is deferred (slowed) while tape operations are in progress.

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).

Series 300 Terminals

Product	Alpha Thruput	Phosphors Available	Graphics Size	Diagonal Size	Alpha Resolution	Features
2392A	19,200	P31	N/A	12-inch	26 x 80	pp, SS
2393A	19,200	P4	512 x 390	12-inch	26 x 80	HP-HIL, pp, SS
2397A	19,200	P22	512 x 390	12-inch	26 x 80	HP-HIL, pp, SS
2623A	7,200	P4, P31, P134	512 x 390	12-inch	26 x 80	gt, ip, PP
Portable Plus (45711)	4,800	LCD	480 x 128	9-inch	16 x 80	DP, IM, PC, PP
HP 150 (45610)	19,200	P31	512 x 390	10-inch	26 x 80	DP, im, ip, PC, PP, SS
HP 150-II (45850)	19,200	P31	512 x 390	12-inch	26 x 80	HP-HIL, DP, im, PC, pp, SS
9807A INTEGRAL	1,800	EL	512 x 255*	9-inch	24 x 80	HP-HIL, im, IP, PC
Vectra (724 x 5K)	9,600	P22, P31	512 x 390*	12-inch	25 x 80	HP-HIL, im, PC, PP, SS

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

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
GT	– 17623A Graphics Tablet supported
HP-HIL	– HP-HIL input devices are supported
IM	– An Internal Modem 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)
P4	– White
P22	– Full Color
P31	– Green
P134	– 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

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.

Product No.	Speed*	Technology	Character Resolution	Paper Size	Graphics Resolution
2225A ThinkJet	150 cps	Inkjet	11 x 12	8.5	96 x 96
2563A	300 lpm	DMI	5 x 9, 7 x 18	16.7	70 x 72
2564B	600 lpm	DMI	5 x 9, 7 x 18	18.0	70 x 72
2566B	900 lpm	DMI	5 x 9, 7 x 18	18.0	70 x 72
2567B	1200 lpm	DMI	5 x 9, 7 x 18	18.0	70 x 72
2603A	45 cps	FCI	Full	16.7	N/A
2686A	8 ppm	Laser	30 x 53	8.5	72–300
2671A	120 cps	Thermal	7 x 11	8.5	N/A
2671G	120 cps	Thermal	7 x 11	8.5	90 x 90
2673G	120 cps	Thermal	7 x 11	8.5	90 x 90
2932A	200 cps	DMI	9 x 12	14	90 x 90
2934A	200 cps	DMI	9 x 12, 36 x 24	14	90 x 90
Key *cps – characters per second*		*lpm – lines per minute*	*ppm – pages per minute*		

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). Thermal printers also require special paper which is typically more expensive than impact paper. The abbreviations used are:

DMI   – Dot Matrix Impact
FCI   – Full Character Impact (e.g. Daisywheel)
Inkjet – Thinkjet non-impact dot-matrix
Laser   – Laser Page Printing, non-impact
Thermal – Thermal non-impact dot-matrix

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-in. wide or 14-in. wide paper. Most can handle paper narrower than their maximum size. Refer to (separate) printer data sheet(s) for more information.

Graphics – Most HP printers can print monochromatic single-level grey scale graphics images. 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

Series 300 Graphics Plotters

The Series 300 computer systems support several graphics plotters as well as the ability to direct a screen image to a dot-matrix printer for hardcopy.

Many printers can generate a hardcopy of a displayed CRT image. This method is faster than plotting, but is limited to a single color.

Product No.	Media Sizes	Mechanical Resolution	Pen Speed	Pen Acceleration	Number of Pens	Media Feed	Pen Types*
7440A Opt. 002	A	0.025	54	2g	8	Manual	P, T
7470A Opt. 002	A	0.025	54	2g	2	Manual	P, T
7475A Opt. 002	A, B	0.025	54	2g	6	Manual	P, T
7550A	A, B	0.025	80	6g	8	Sheet	D, P, R, T
7580B Opt. 051	A – D	0.003	60	4g	8	Manual	D, P, R, T
7585B Opt. 051	A – E	0.003	60	4g	8	Manual	D, P, R, T
7586B Opt. 051	A – E	0.003	60	4g	8	Roll	D, P, R, T
*Key: D – Drafting P – fiber-tip Paper R – Roller ball T – fiber-tip Transparency							

Plotters provide high-resolution multiple-color hardcopy of graphics. This requires re-executing the program which generated the CRT image and directing its output to the plotter.

Media Size – shown per ANSI nomenclature. ANSI/ISO sizes are A/A4, B/A3, C/A2, D/A1 and E/A0.

Mechanical Resolution – shown in mm. The addressable resolution typically is different.

Pen Speed – shown in cm/sec.

Series 300 Cabinets and Racks

There are several cabinets, workstation 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
SPU and expander	312 mm
98567A/B	400 mm
19500B	132.6 mm
19501A	208 mm
19507A	180 mm

19-inch EIA Rack-mount Adaptors

Product No.	Description
98569A	For 5-unit high 325 mm-wide, 376 mm-deep devices (full support for Series 300 SPU and Expander)
19500B	For 78 mm, 104 mm, or 130 mm-high, 325 mm-wide, 285 mm-deep devices (no support for Series 300 SPU or Expander)
19501A	For 8-unit high 325 mm-wide devices (not 7907A)
19507A	For 6.5-unit high 325 mm-wide devices (e.g. 7907A)
98567A	For HP 35731A/B Monitors
985678	For HP 35741A/B Monitors

Series 300 Cabinets (interior dimensions)

Cabinet Model	Description	Depth (mm)	Height (mm)	Height in Design Plus Units (1 unit = 26 mm)	Rails or Shelf
92211R*	Suspended storage module for 92211A/B/C/D tables	671	432	16	Included
92211M	Roll-around rack	375	341	13	Included
92211L	Roll-around rack	474	523	20	Included
92211R	Roll-around rack	705	575	22	92211S
97064A†	CAD table, 68–66 Hz, 120 Vac, supports 13279B or 98782A	635	400 x 2	15 x 2	Included
98783A	Tilt and swivel unit for the 98782A monitor	330	76	3	N/A

* The interior width of the module is 493 mm.   † The width of each equipment bay in the 97064A is 595 mm.
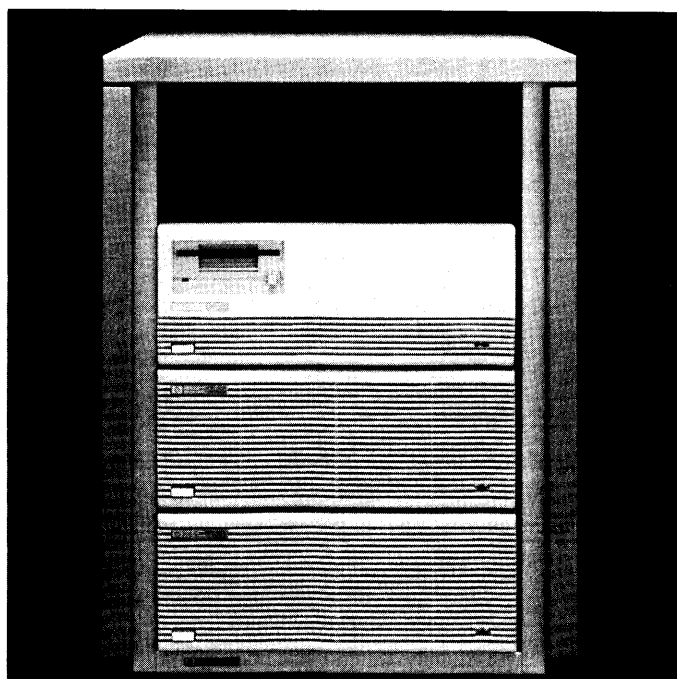
The 92211L/M/R Design Plus cabinets accept 325mm-wide HP computers and peripherals. Wider computers and peripherals (such as the 9888A Bus Expander) may be placed on top of the 92211L/M cabinets or in the bays of the 97064A table or 92210R storage module.

All cabinets are open front. A 92211T filler 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 97064A table has one moveable shelf in each of its two equipment bays.

Series 300 Interfacing Capabilities and Enhancements

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

- EPROM Programmer System (98253A)
- 256 Kbyte EPROM Card (98255A)
- 256 Kbyte RAM Card (98256A)
- 1 Mbyte RAM Card with Parity (98257A)
- 128 Kbyte Bubble Memory Card (98259A)
- Series 300 DOS Coprocessor (98286A)
- 2-channel DMA Controller (98620B)
- Parallel Interface (98622A)
- BCD Interface (98623A)
- HP-IB Interface (98624A)
- High-speed Disc Interface (98625B)
- Serial Interface (98626A, 98644A)
- Color Video Interface (98627A)
- Datacomm Interface (98628A)
- Shared Resource Management Interface (50962A)
- Breadboard Card (98630A)
- Floating Point Math Card (98635A)
- 7-channel Analog-to-Digital Interface (98640A)
- 4-channel RS-232C MUX (98642A)
- LAN/300 Link (98643A)
- VMEbus Interface (98646A)
- Programmable Datacomm Interface (98691A)

For more information on the interfaces or language support, refer to Series 300 Compatible Interface section of this document or consult the Series 300 Configuration Reference Manual, Part Number 98561-90020.

Series 300 DOS Coprocessor

The 98286S DOS Coprocessor System provides IBM PC-AT software compatibility for the Series 300. The system is comprised of a 80286 co-processor DIO card (with socket for 80287) and associated emulation software. The system requires HP-UX 5.1, minimum 98515A, and works with either the Model 310 or 320 processor using any of the four standard displays with one of the following display adapters – 98542A, 98543A, 98544A, and 98547A. In order to provide compatibility with 'off-the-shelf' PC-AT software, the 9127A 5¼-inch, 360K double-sided, double-density disc drive is available. The system provides compatibility with literally thousands of readily available MS-DOS® software applications.

The co-processor system uses many system resources shared between HP-UX and MS-DOS (memory, displays, keyboard, peripherals, file system, etc.) and provides true UNIX/MS-DOS integration. Many unique features are provided such as; operation of MS-DOS as a task in the multi-tasking windowing HP-UX environment, ASCII file transfer capability between HP-UX, MS-DOS, and the BASIC or Pascal operating systems, multiple PC-supported display adapter emulation (MDA, CGA, and Hercules) with greatly improved alpha fonts, and software emulation of the Lotus/Intel/Microsoft Expanded Memory Specificaiton (EMS).

LAN/300 Link

The LAN/300 Link Interface Card provides both protocol management (Ethernet or IEEE 802.3) and electrical levels for 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.

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 as discs, printers and plotters among a local cluster of workstations including the Series 200, 300, and 500.

The hardware link between the workstation 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 workstation as long as sufficient interface slots are available. The 92227X Coax Cables are available in a variety of lengths.

RS-423/RS-232 Data Communication 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 Series 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 CCITT V.28/V.24 specifications. Data formats include 5, 6, 7 or 8 bits/character and 1, 1.5 or 2 stop bits. Odd, even or no parity is selectable and fixing the parity bit to 0 or 1 is also selectable.

Not all interfaces work with all operating systems. Please check the appropriate operating system technical data for support information. MS-DOS® is a U.S. registered trademark of Microsoft Corporation.

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

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 Programmable Serial Interface Card 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 TimerChip provides one system timer, and a programmable baud rate for the SIO channel. Available speeds follow:

- Synchronous: max. 460 Kbaud; min. 50 baud.
- Asynchronous: max. 57 Kbaud; min. 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 1, 1.5 or 2 stop bits, odd, even or no parity for asynchronous communications. The SIO chip supports CRC-16 or CCITT block frame check for Synchronous operations.

Interrupt Capability

The 98691 interrupt capability is determined by the capabilities programmed into the custom personality ROM.

Electrical interface compatibility:
- RS-232C, V.24/V.28
- RS-449
- RS-423, V.10
- RS-422, V.11 (with user-built cable)

4-Channel Asynchronous Multiplexer

The HP 98642A Multiplexer provides four asynchronous RS-232-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-232-C-compatible modems. A wide range of selectable transmission modes and formats permits three hardwired and one remote connection of various terminals, printers, plotters and other asynchronous devices.

Features
- Four full duplex asynchronous serial I/O ports
- One port with 10-wire full duplex modem control capability
- EIA RS-232-C, CCITT V.28 compatibility
- Programmable data rates for each port up to 19.2 Kbaud
- Programmable character size: 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 text helps assure interface integrity
- On-board buffering: eight circular FIFO data buffers; 4 (128 character) receive buffers and 4 (16 character) transmit buffers (one for each port).
- Programmable interrupt interval
- Special character recognition
- System console support

RS-232 Serial Interfaces

The 98626A and 98644A Serial Interfaces provide bit-serial communication between the computer and asynchronous EIA RS-232C (CCITT V.28/V.24) devices. Data rates range 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-232 devices using this interface.

Transfer Rates

The maximum data rates for the 98626A/98644A Serial Interfaces are as follows:

	Input	Output
Handshake	19,200 baud	19,200 baud

Data Rates and Formats

All signals present at the 98626A/98644A interface cards' connectors conform electrically to EIA RS-232C and CCITT V.28 specifications. Data formats include 5,6,7 or 8 bits/character and 1, 1.5 or 2 stop bits. Odd, even or no parity is selectable and setting the parity bit to 0 or 1 is also selectable.

Standard switch selectable or programmable* data rates available are:

50	75	110	134.5
150	200	300	600
1200	1800	2400	3600
4800	7200	9600	19,200

Interrupt Capability

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

- Receiver buffer full
- Transmitter buffer empty
- Receiver 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
- Ring indicator change from on to off

This interrupt capability allows the interface to operate in a full duplex fashion when information is input under interrupt control while information is output by standard write commands.

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.

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.

Disc Interface

The 98625B High-speed Disc Interface provides an interface to the Command Set 80 discs (79XX) that offer the maximum transfer rate available. The 98625B, when used with the 98620B DMA card, allows buffered DMA data transfers between the Series 300 system and the Command Set 80 disc. The 98625B allows up to four discs to be connected to one interface card. It is recommended that a 98620B DMA card be included in any machine using a 98625B, as little performance improvement is seen over a 98624A unless a DMA card is installed.

DMA Capability
- Burst mode DMA transfer

RAM Cards

There are two RAM cards available for the Series 300 computers: the 256 Kbyte RAM card (98256A), and the 1 Mbyte RAM card with parity check (98257A).

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

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 as pairs (2, 4, ...16). The EPROM card acts as a mass storage device.

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 on 100 mil centers.

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 .nformation. 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 via the optional two-channel 98620B DMA Control Card. The following DMA capabilities are supported by the 98622A:

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

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 as many as 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
- Regular DMA transfer (no burst DMA)

PC Instrument Bus (PCIB) Interface

The 98647A PCIB Interface provides a connection to HP PC Instrument modules. The interface uses BASIC System Software to perform very easy-to-use instrumentation tasks. Two modes of operation are provided:

- Manual Mode – allowing interactive instrument set-up centrally operated from your computer
- Program Mode – automates a wide range of test and measurement applications by using the powerful BASIC Language command set

VMEbus Interface

The VMEbus Interface provides bi-directional data transfer capabilities between the Series 300 and the VMEbus (IEEE P1014), perimtting 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 to 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 Capibility

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.

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 as five input bytes of pure binary information. Eight data output lines are also provided for use as 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.

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. Programmatically it looks like interface registers to the computer. Communication 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 differential 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

Aperture 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 full scale
Input resistance (on each
    channel) . . . . 100 megohms

Warranty Information

In the U.S.A. and Canada, your Series 300 product is warranted by Hewlett-Packard against defects in materials and workmanship from the date of shipment.* The standard warranty requires the product to be returned to a service facility designated by HP and is in effect for one year from the date of shipment. An optional 90 day, on-site repair warranty is also available.

The duration of your HP warranty is based upon the conditions under which your Series 300 product and its associated peripherals were purchased. Contact your local Sales and Service Office for further information.

Hewlett-Packard will, at its option, repair or replace equipment which proves to be defective during the warranty period. Repairs necessitated by misuse of the equipment, or by use of hardware, software, or interfacing not provided by Hewlett-Packard are not covered by this warranty. HP warrants that the software and firmware designated by HP for use with a CPU will execute it programming instructions when properly installed on that CPU. HP does not warrant the operations of the CPU, software or firmware to be uninterrupted or error free.

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