


HP Series 200 Models 216, 220, 226 and 236 Hardware Technical Data



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Introduction

Hewlett-Packard's Series 200 Personal Technical Computers are based on the MC68000, a powerful 16-bit Motorola microprocessor with 32-bit internal architecture and 8 MHz clock rate. Series 200 is available in four models - Models 216, 220, 226 and 236. Configured 'S' systems are also available for each model. The Series 200 machines feature single-user, single-tasking BASIC, Pascal, and HPL.

The Series 200 computers are also available with higher-performance hardware which can accommodate multi-tasking, multi-user applications. A 12.5 MHz MC68000 is included, as are 16K bytes of high-speed cache memory and memory management hardware. The high-performance hardware is available on Models 220 and 236. Configured 'T' systems are also available for each model. The high-performance Series 200 machines feature the HP-UX operating system, along with C, Pascal, FORTRAN, MC68000 assembly language and a graphics library.

The smallest Series 200 computer, Model 216, fits easily on a desk. It features a 9-inch (229 mm) CRT, small, detached keyboard and memory from 128K to 768K bytes. A variety of disc drives, printers and other peripherals are available to convert it into a stand-alone system; or it can be connected to a Shared Resource Management (SRM) system with other HP computers, using printers and disc drives in common. It features both HP-IB* and RS-232-C built-in interfaces. The Model 216 is a high-performance personal computer.

The Model 220 is a modular, rack-mountable computer that can be separately configured with a keyboard, monitor, disc drive, and an assortment of peripherals. The Model 220 can be configured with up to 3.9 megabytes of memory. With extra interface and memory slots, plus the capability to remove the keyboard and monitor, the Model 220 is well-suited for computer-aided test (CAT) areas such as a factory assembly line or testing, or as the CPU in a multi-user HP-UX system.

The Model 226 features a 7-inch CRT, built-in 5¼-inch flexible disc drive with 264K-byte capacity and up to 2 megabytes memory. Having a larger base and keyboard than the Model 216, it is suited to placing in a rack with



other electronic devices and instrumentation. With built-in HP-IB interface, it finds its ideal application in computer-aided test (CAT) applications where a more integrated system is required.

The Model 236 features a full 12-inch (310 mm) CRT, dual, built-in 5¼-inch flexible disc drives, and up to 2 megabytes of memory. Its larger screen adapts it more to computer-aided engineering (CAE) applications such as engineering design and analysis. Like the Model 226, it features a built-in HP-IB interface.

The Model 236 with color display is the top-of-the-line Series 200 computer, with a full 12-inch (310 mm) color CRT, dual, built-in 5¼-inch flexible drives and up to 2 megabytes of memory. With its color capability, this is the ideal machine for computer-aided engineering (CAE) applications where the additional graphics versatility of color is useful.

Series 200 machines feature graphics, user-definable soft keys, a special "rotary control knob" for easy editing and simulations, memory-mapped I/O, prioritized interrupt, internal system clock and timers, and built-in slots for additional memory or interface cards. In addition, a special backplane expander allows up to an additional 4 megabytes of memory or eight interface cards to any Series 200 computer.

Graphics, keyboard, and monitors are ordered separately on the Model 220.

* HP-IB is Hewlett-Packard's implementation of IEEE Standard 488-1978.

Series 200 Technical Specifications

Processor

Type	Motorola MC68000
Clock frequency	8 MHz or 12.5 MHz
Internal architecture	32-bit data and address registers
Address range	16M bytes
Data bus	16-bit asynchronous
Instruction types	56
Major data types	5
Addressing modes	14
Interrupt levels	One non-maskable and 6 maskable

Model 226/236 Integrated Flexible Disc Mass Storage

Drives in computer	Model 226 - one Model 236 - two
Tracks per disc	35 per side, 70 total
User available tracks	66
Sectors per track	16
Bytes per sector	256
Total capacity	264K bytes
File name size	Up to 10 characters
Rotational speed	300 RPM
Average access time	300 msec
Average transfer rate	16K bytes/s, default interleave, track to track stagger
Media	133 mm (5¼-in.) double-sided, double-density flexible disc
Life	More than 2.5 million revolutions (140 hours rotating) [†]

Models 226/236 Powerfail Option

Provides battery backup for up to one minute for the Models 226 and 236 only without 9888A Bus Expander (Model 236 color CRT not powered), allowing the computer to "ride out" short power lapses or, for longer ones, to store programs and data for later recovery.

On-board real-time clock maintains accurate time so the computer's internal clock can be reset when power is restored.

Battery System

Powerfail backup time	≤1 min. (programmable)
Battery	2 amp hour (23°C), 18 volt, sealed, rechargeable NICAD
Recharge time (computer must be on)	0°C to 25°C - 14 hrs. max. 26°C to 35°C - 24 hrs. max. 36°C to 40°C - 100 hrs. max.

Real-time Clock^{‡§}

Accuracy	± 75 sec/30 days
Resolution	20ms
Battery support	≥7 days

Timing Features

- Programmable 0 to 60 sec
- Delay before Powerfail interrupt
- Delay before power-back recognition
- Battery backup time (0 - 60 sec).

Model 220 Custom Keypad Interface Option

The 98201A custom keypad interface allows easy interfacing of a custom keypad to the Model 220. With the 98201A, a designer can access all keycodes of the computer except for alpha keys. This includes keycodes for control keys, special function keys, and numeric keys. Each accessible keycode can be controlled by a simple momentary action switch connected to a specific pin on the 98201A connector. The 98201A takes up one I/O slot on the Model 220.

Rotary Control Knob[§]

Pulse resolution	120 pulses per revolution (nominal)
Pulse count range	-128 to 127 net pulses since last interrupt
Pulse count sign:	
Positive	Net clockwise
Negative	Net counterclockwise
Interrupt generation period01 sec to 2.55 sec

Clock and Timers[§]

Real-time clock:	
Resolution	10 msec
Accuracy	50 ppm (4.3 sec/day)
Power-on reset	Midnight, January 1
Timers:	
Match interrupt	Match on time of day, 0.00 to 84600.00 seconds
Delay interrupt	10 msec to 1.94 days
Cycled interrupt	10 msec to 1.94 days

Beeper[§]

Range (nominal)	81.375 Hz to 5 208 Hz
Resolution	81.375 Hz nominal
Duration01 sec to 2.55 sec

Environmental Range

With disc media (without disc media):	
Operating temperature*	10°C to 40°C (0°C to 55°C)
Humidity	20 to 80% R.H. (5 to 95% R.H.) non-condensing
Maximum wet-bulb temperature	25.5°C (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, and FCC class B standards. (Model 236 with color display and Models 220/236 with 12.5 MHz MC68000 meet FCC class A standard.)

Line transient spike immunity (1 nsec. rise, 800 nsec. duration)	1KV
Additional regulatory compliance	UL, CSA, IEC, SEV, FEI

[†] The internal disc drive is intended for program and data storage with a duty cycle of less than 25%. Greater duty cycles may reduce life.

[‡] Crystal controlled.

[§] Pascal access documented in System Internals Documentation.

* With Powerfail, temperature is 0°C to 40°C.



CRT Display

	Model 216	Model 220	Model 226	Model 236	Model 236 With Color Display
Size:	229 mm (9 in.) diagonal	304.8 mm (12 in.) diagonal for HP 82913A CRT 228.6 mm (9 in.) diagonal for HP 82912A CRT	178 mm (7 in.) diagonal	310 mm (12.2 in.) diagonal	310 mm (12 in.) diagonal
Alphanumeric capacity On screen: Total scrolling:	25 lines x 80 characters 39 lines x 80 characters, 3 120 characters	25 lines x 80 characters 39 lines x 80 characters, 3 120 characters	25 lines x 50 characters 39 lines x 50 characters, 1 950 characters	25 lines x 80 characters 39 lines x 80 characters, 3 120 characters	25 lines x 80 characters
Character height:	1.2 mm wide x 2.8 mm high (.05 in. x .11 in.) capital letters	2.2 mm wide x 4.2 mm high (.087 in. x .166 in.) capital letters for HP 82913A CRT 1.65 mm wide x 3.1 mm high (0.65 in. x .122 in.) capital letters for HP 82912A CRT	1.51 mm wide x 2.12 mm high (.059 in. x .082 in.) capital letters	1.9 mm wide x 3.8 mm high (.07 in. x .15 in.) capital letters	1.9 mm wide x 3.9 mm high (.08 in. x .16 in.) capital letters
Display enhancements:	Inverse video, underlining, blinking, half bright	None	None	Inverse video, underlining, blinking, half bright	Inverse video, underlining, blinking, eight alpha colors
Graphics capability Resolution: Density: Raster size:	400 dots horizontal x 300 dots vertical 25 dots/cm (63 dots/in.) 160 mm x 120 mm (6.3 in. x 4.72 in.)	400 dots horizontal x 300 dots vertical 19 dots/cm (48.4 dots/in.) for HP 82913A CRT 26.3 dots/cm (66.8 dots/in.) for HP 82912A CRT 210 mm x 158 mm (8.27 in. x 6.2 in.) for HP 82913A CRT 152 mm x 114 mm (5.98 in. x 4.49 in.) for HP 82912A CRT	400 dots horizontal x 300 dots vertical 33 dots/cm (85 dots/in.) 120 mm x 88 mm (4.7 in. x 3.47 in.)	512 dots horizontal x 390 dots vertical 24 dots/cm (60 dots/in.) 210 mm x 160 mm (8.3 in. x 6.3 in.)	512 dots horizontal x 390 dots vertical x 4 bits/pixel 24 dots/cm (60 dots/in.) 217 mm x 163 mm (8.5 in. x 6.4 in.)
Display buffering:	Dedicated 2K byte alpha buffer, 15K byte graphics buffer (can be displayed simultaneously)	Dedicated 3K byte alpha buffer, 16K byte graphics buffer (can be displayed simultaneously)	Dedicated 1.25K byte alpha buffer, 15K byte graphics buffer (can be displayed simultaneously)	Dedicated 4K byte alpha buffer, 25K byte graphics buffer (can be displayed simultaneously)	Dedicated 4K byte alpha buffer, 100K byte graphics buffer (can be displayed simultaneously)
Soft-key labeling:	Up to 10 user-definable soft-key labels, 14 characters per label	Up to 10 user-definable soft-key labels, 14 characters per label	Up to 10 user-definable soft-key labels, 8 characters per label	Up to 10 user-definable soft-key labels, 14 characters per label	Up to 10 user-definable soft-key labels, 14 characters per label
Character set:	256 characters	256 characters	256 characters	256 characters	256 characters
Character font:	7 x 8 dot character matrix in a 10 x 12 character cell	8 x 8 dot character matrix in a 10 x 12 character cell	5 x 7 dot character matrix in a 8 x 12 character cell	7 x 9 dot character matrix in a 9 x 15 character cell	7 x 9 dot character matrix in a 9 x 15 character cell
Intensity (nominal):	Adjustable up to 30 ft-lamberts	Adjustable up to 47 ft-lamberts for HP 82913A CRT Adjustable up to 47 ft-lamberts for HP 82912A CRT	Adjustable up to 30 ft-lamberts	Adjustable up to 15 ft-lamberts (12 ft-lamberts Opt. 801)	Adjustable up to 17 ft-lamberts (14 ft-lamberts Opt. 801)
Refresh rate:	60 Hz standard with 50 Hz user selectable	50 Hz independent of line frequency	60 Hz independent of line frequency	60 Hz standard (50 Hz Opt. 801) independent of line frequency	60 Hz standard (50 Hz Opt. 801) independent of line frequency
Implosion protection:	Tension band	Integral implosion protection for HP 82912A and HP 82913A CRTs	Lexan plastic shield	Tension band and safety glass	Tension band and safety glass
Tube phosphor:	P4	P31ARF for HP 82912A and HP 82913A CRTs	P4	P4	P22
Cursor:	Blinking underline	Blinking underline	Blinking underline	Blinking underline	Blinking underline

Power Requirements

	Model 216	Model 220	Model 226	Model 236	Model 236 With Color Display
Source consumption (A max. @ ~V, switch selectable):	1.5A @ 90 - 125V 0.8A @ 198 - 250V	4.2A @ 90 - 125V 2.4A @ 195 - 250V <i>Note: These do not include CRT power consumption</i>	2.8A @ 90 - 110V 2.4A @ 108 - 132V 1.3A @ 198 - 242V 1.2A @ 216 - 250V	3.5A @ 90 - 110V 3.2A @ 108 - 132V 1.7A @ 198 - 242V 1.6A @ 216 - 250V	5.5A @ 90 - 132V 2.7A @ 198 250V
Line frequency:	48 - 66 Hz	48 - 66 Hz	48 - 66 Hz	48 - 66 Hz	48 - 66 Hz
Power consumption Watts max.:	80W	250W	210W	300W	430W
BTU/hr.:	280	680	720	1 030	1 475

Physical

	Model 216	Model 220	Model 226	Model 236	Model 236 With Color Display
Height:	282 mm (11.10 in.)	190.5 mm (7.5 in.)	184 mm (7.25 in.)	452 mm (17.8 in.)	452 mm (17.8 in.)
Width:	315 mm (12.40 in.)	426 mm (16.8 in.)	432 mm (17 in.)	432 mm (17 in.)	432 mm (17 in.)
Depth:	488 mm (19.21 in.)	377 mm (14.8 in.) Additional 4 inches in depth should be allowed for interface cables.	654 mm (25.75 in.)	654 mm (25.75 in.)	704.8 mm (27.75 in.)
Cube:	.043 m ³ (1.53 ft. ³)	.031 m ³ (1.079 ft. ³)	.052 m ³ (1.84 ft. ³)	.12 m ³ (4.4 ft. ³)	.138 m ³ (4.86 ft. ³)
Net weight:	8.9 kg (19.5 lb.)	9.5 kg (21 lb.)	20.5 kg (45.1 lb.)	35.3 kg (78 lb.)	40.8 kg (90 lb.)
Shipping weight:	11.3 kg (25.0 lb.)	17.2 kg (38 lb.)	24.6 kg (54.0 lb.)	44.3 kg (98.0 lb.)	49.9 kg (110 lb.)

Series 200 Interfacing Capabilities

In addition to the built-in HP-IB interface (and built-in Serial interface on the Model 216), there is a choice of external interface cards and internal memory enhancements:

- 2-channel DMA Controller (98620B)
- GPIO (98622A)
- BCD (98623A)
- HP-IB (98624A)
- High-speed Disc (98625A)
- Serial (98626A)
- Color Video (98627A)
- Datacomm (98628A)
- Shared Resource Management (98629A)
- Breadboard Interface (98630A)
- Programmable Datacomm (98691A)
- EPROM Development (98253A)
- EPROM (98255A)
- 128K byte Bubble Memory (98259A)

	Earliest Language Version Required				
	BASIC	BASIC Extensions	Pascal	HPL	HP-UX
98620B	—	2.0	1.0	1.0	2.0
98622A	1.0	—	1.0	1.0	—
98623A	—	2.0	—	1.0	—
98624A	1.0	—	1.0	1.0	2.0
98625A	—	2.1	2.0	—	2.0
98626A	1.0	—	2.0	1.0	2.0
98627A	—	2.0	1.0	2.0	2.0
98628A	2.0	—	1.0	—	2.0
98629A	2.0*	2.0	2.0	—	—
98630A	—	—	2.0	—	—
98253A	—	2.1	—	—	—
98255A	—	2.1	—	—	—
98259A	—	2.1	—	—	—
98691A	2.0	—	1.0	—	—
98695A	†	†	†	†	†

Interface Support Matrix

The following language capabilities are required in order to use the following interfaces. The marked items are the earliest language revision that supports that Interface or Memory device.

* Requires Resource Management Access pack or BASIC Extensions 2.0.

† 98795A Terminal Emulation software recommended (which includes its own operating system).

DMA Controller Card

The 98620B DMA Controller Card enhances the Series 200's interfacing capability by providing two DMA channels for I/O data transfers. This high-speed I/O capability works with the 98622A GPIO, 98624A HP-IB and internal HP-IB interfaces. Although the 98620B can accommodate DMA transfer rates up to memory cycle rates (approx. 1.2M transfers/sec) lower DMA rates can be expected since 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, and for the 98624A HP-IB interface approximately 330K transfers per second.

GPIO Interface

The 98622A GPIO Interface provides 16 bits of latched input and output data for bidirectional 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 also available to permit interfacing to a variety of equipment.

Data Input/Output

There are 16 output data lines and 16 input data lines. The output lines provide high current/voltage drivers, using open-collector buffers. 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.

Electrical Characteristics for Data Output Lines

	Min.	Max.	Units
Output Low Voltage @ 16 mA		0.4	V
Output Low Voltage @ 40 mA		0.7	V
Output High Voltage (open collector)		30.0	V
Output Low Current		40.0	mA
Output High Current @ Output High Voltage		0.25	mA

Electrical Characteristics for Data Input Lines

	Min.	Max.	Units
Input Low Voltage		0.8	V
Input High Voltage	2.0		
Input Current @ Input Low Voltage = 0.4V		-0.8	mA
Input Current @ Input High Voltage = 2.7V		40	μA

Control Lines

Ten lines provide control information between the peripheral and the 98622A GPIO Interface. The outgoing lines are electrically equivalent to the open-collector data output lines. The incoming lines have the following characteristics:

Electrical Characteristics for Control Input Lines

	Min.	Max.	Units
Input Low Voltage		0.6	V
Input High Voltage	1.9		V
Hysteresis	0.4		V
Input Low Current @ Input Low Voltage = 0.4V	-0.4		mA
Input High Current @ Input High Voltage = 2.7V	20		μA

The control lines and their meanings are:

PCTL Peripheral Control – indicates that the computer is ready for input data or that data is ready for output; PCTL is reset by a ready-to-busy transition on PFLG or by an interface reset.

PFLG Peripheral Flag – indicates to the computer that the peripheral has completed the data transfer; also used to request peripheral interrupt when enabled.

PSTS Peripheral Status (optional) – indicates to the computer the readiness of the peripheral; PSTS is sampled by the computer whenever communication with the peripheral is requested.

STI0, STI1 Extended Status (optional) – driven by the peripheral and may be used for any purpose; examined by reading the 98622A peripheral status register.

CTL0, CTL1 Extended Control (optional) – driven by the computer and may be used for any suitable purpose by the user; asserted by writing to the 98622A peripheral control register.

I/O Direction – indicates to the peripheral the direction of the current data transfer.

PRESET Peripheral Reset – used to initialize a peripheral when the computer is turned on, when the RESET key or CLEAR I/O key are pressed or when the 98622A peripheral reset register is written to.

EIR External Interrupt Request – used to generate an interrupt request based on some external event or termination of a DMA buffer transfer.

Interrupt Capability

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

- PCTL clear
- PCTL clear & PFLG ready
- EIR asserted

DMA Capability

The 98622A is capable of carrying out DMA transfers via the optional two channel 98620B DMA Controller Card. The following DMA capabilities are supported by the 98622A:

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



Switch Configuration

The following switches can be configured on the interface card:

Select Code – the factory select code setting for the 98622A card is 12; the select codes available for interface cards are language dependent.

Interrupt Level – the factory interrupt priority level setting for the 98622A card is three; the 98622A card can have an interrupt level setting from three to six.

Output Data Line Sense – a 1-bit switch allows the output data lines to use either positive-true or negative-true logic even with fast read/write and DMA transfers.

Input Data Line Sense – a 1-bit switch allows the input data lines to use either positive-true or negative-true logic even with fast read/write and DMA transfers.

PFLG Line Sense – a 1-bit switch allows the peripheral flag line to use either positive-true or negative-true logic.

PCTL Line Sense – a 1-bit switch allows the peripheral control line to use either positive-true or negative-true logic.

PSTS Line Sense – a 1-bit switch allows the peripheral status line to use either positive-true or negative-true logic.

Handshake Mode – a 1-bit switch allows selection of full or pulsed handshake mode.

Data In Clock Source – a 6-bit switch allows selection of when input data is to be clocked into the 98622A input latches. The upper and lower input bytes can have separate clock sources chosen from PFLG ready to busy transition, or busy to ready; or when the computer reads the input latch.

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.

Data Input/Output

The 98623A BCD interface provides 43 data input lines (eight BCD digits, mantissa sign, exponent sign, exponent digit, and an overload bit) for BCD data entry or five bytes of bit-parallel data entry. Eight data output lines are also provided for general purpose data output or control. The data input and output lines have low-power Schottky TTL receivers and drivers.

Electrical Characteristics for Output Data Lines

	Min.	Max.	Units
Output Low Voltage @ 12 mA		0.4	V
Output Low Voltage @ 24 mA		0.5	V
Output High Voltage	3.4		V
Output Low Current		24	mA
Output High Current		-15	mA

Electrical Characteristics for Input Data Lines

	Min.	Max.	Units
Input Low Voltage		0.8	V
Input High Voltage	2.0		V
Input Low Current @ Input Low Voltage = 0.4V		-0.4	mA
Input High Current @ Input High Voltage = 2.7V		20	μA

Control Lines

Five control lines provide control information between the peripheral(s) and the 98263A BCD Interface. The incoming and outgoing control lines use open collector receivers and drivers with the following electrical characteristics:

Electrical Characteristics for Control Input Lines

	Min.	Max.	Units
Input Low Voltage		0.5	V
Input High Voltage	1.9		V
Hysteresis	0.4		V
Input Low Current @ Input Low Voltage = 0.4V		-0.4	mA
Input High Current @ Input High Voltage = 2.7V		20	μA

Electrical Characteristics for Control Output Lines

	Min.	Max.	Units
Output Low Voltage @ 16 mA		0.4	V
Output Low Voltage @ 40 mA		0.7	V
Output High Voltage (open collector)		30	V
Output Low Current		40	mA
Output High Current @ Output High Voltage		0.25	mA

The control lines and their meanings are:

CTLA, CTLB Peripheral Control A and B – indicates that the computer is requesting input data or that data is ready for output; CTLA(B) can be reset by a ready-to-busy or busy-to-ready transition on FLGA(B) or by an interface reset.

FLGA, FLGB Peripheral Flag A and B – indicates to the computer that the peripheral has completed the data transfer; also used to request peripheral interrupt when enabled.

PRESET Peripheral Reset – used to initialize a peripheral when the computer is turned on, when the RESET key or CLEAR I/O key are pressed or when writing to the 98623A reset register.

Data Formats

Two BCD data input formats are supported by the 98623A which are switch selectable on the interface card. This switch status can then be interrogated by the language system to insure that the incoming data is being formatted correctly.

Standard – Up to 8-BCD-digit signed mantissa, 1-BCD-digit signed exponent, 1-digit function code and overload indication.

Optional – Up to 4-BCD-digit signed mantissa from one device. Up to 5-BCD-digit signed mantissa with positive exponent from a second device.

Data Codes – 8421 binary-coded decimal weighting with codes 0-9 representing digits 0-9 and other codes as follows:

1010	(LF)	line feed
1011	(+)	plus
1100	(,)	comma
1101	(-)	minus
1110	(E)	exponent
1111	(.)	decimal point

Additional Input Information

Exponent, Function Code: 8421 binary-coded decimal weighting (codes 0 – 9 only), Mantissa sign, Exponent sign, Overload: 1 binary bit.

Interrupt Capability

The 98263A BCD Interface is capable of generating interrupts to the computer under the following condition:

FLGA ready & FLGB ready

Switch Configuration

The following switches can be configured on the interface card:

Select Code – the factory select code setting for the 98623A card is 11; the select codes available for interface cards are language dependent.

Interrupt Level – the factory interrupt priority level setting for the 98623A card is 3; the 98623A card can have an interrupt level setting from 3 to 6.

Input Data Line Sense – a 1-bit switch allows the input data lines to use either positive-true or negative-true logic.

CTLA(B) Line Sense – a 1-bit (ea.) switch allows the peripheral control line to use either positive-true or negative-true logic.

DFLGA(B) Line Sense – a 1-bit (ea.) switch allows the peripheral flag line to use either positive-true or negative-true logic.

CTLA(B)-2 – a 4-bit (ea.) switch allows selection of full or pulsed mode handshake.

Option Format – a 1-bit switch selects standard (one device) or optional (two devices) data format.

SIGN1(2) Line Sense – a 1-bit (ea.) switch allows the mantissa and/or exponent sign lines to use either positive-true or negative-true logic.

OVL D Line Sense – a 1-bit switch allows the overload line to use either positive-true or negative-true logic.

Disc Interface

The 98625A High-Speed Disc Interface provides an interface to the Command Set 80 discs (7908/11/12/14) that offer the maximum transfer rate available. The 98625A, when used with the 98620B DMA card allows buffered DMA data transfers between the Series 200 computer and the Command Set 80 disc. The 98625A 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 98625A, as little performance improvement is seen over a 98624A unless a DMA card is installed.

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.

Data Input/Output

Eight bi-directional data lines provide data input/output.

Control Lines

DAV
NRFD provide handshake
NDAC

Interface Management

IFC
ATN
SRQ provide control of the interface system
REN
EOI

Interface Functions

The chart below specifies the level of implementation in terms of IEEE 488-1978 mnemonics. The Device Trigger, Device Clear and Remote/Local state responses are achieved by programming the computer for end-of-line interrupts on those conditions. Please note in

HPL there is a slight difference in the 'wti' and 'rdi' operations with the 98624A and internal HP-IB interfaces as compared to the 98034 interface (used with the 9825B/T).

- Source Handshake SH1
- Acceptor Handshake AH1
- Talker T6
- Listener L4
- Service Request SR1
- Remote/Local RL1
- Parallel Poll PP1
- Device Clear DC1
- Device Trigger DT1
- Controller:
- System control C1
- IFC & Take charge C2
- REN C3
- Respond SRQ C4
- Miscellaneous control C5
- Drivers E2

Interrupt Capability

The internal and 98624A HP-IB interface are capable of generating interrupts under the following conditions: (Capabilities differ in HPL and BASIC. Pascal has no standard interrupt capability. Non-standard interrupt capabilities for Pascal are documented in the System Designer's Guide.)

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

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)

Switch Configuration

The following switches can be configured on the interface card.

Select Code – the factory select code setting for the 98624A card is 8 (select code is fixed at 7 for the internal HP-IB); select codes available for interface cards are language dependent.

Interrupt Level – the factory interrupt priority level for the 98624A card is 3 (internal HP-IB level is fixed at 3); the 98624A card can have an interrupt level setting from 3 to 6.

Interface Bus Address – 5-bit talker/listener address. The factory-set bus address for the 98624A is 21 decimal (21 for internal HP-IB; if the computer is not system controller the internal HP-IB default bus address will become 20); the 98624A card can have a bus address setting from 0 to 30.

System Controller – 1-bit switch allows the 98624A interface to act as a system controller or non-system controller. The factory setting is system controller. Internal HP-IB has a jumper or a switch.

Serial Interface

The 98626A Serial Interface provides bit-serial communication between the computer and asynchronous EIA RS-232-C (CCITT V.28/V.24) devices. This interface is built into the Model 216. Data rates range from 50 to 19,200 baud (bits/sec). A variety of cabling options allow for terminal connections. Series 200 terminal emulation software takes advantage of this card for connecting to other computers.

Transfer Rates

The maximum data rates for the 98626A Serial Interface are as follows:

	Input	Output
Handshake	19,200 baud	19,200 baud

Data Rates and Formats

All signals present at the 98626A interface card's connector conform electrically to EIA RS-232-C 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 fixing the parity bit to 0 or 1 is also selectable.

Standard switch selectable 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 Serial Interface is capable of generating interrupts under the following conditions: (Capabilities differ in HPL and BASIC. Pascal has no built-in interrupt capability.)

	HPL	BASIC
● Receiver buffer full	X	X
● Transmitter buffer empty	X	X
● Receiver buffer overrun error		X
● Received character parity error		X
● Received character framing error		X
● Received break indication		X
● Carrier detect line change		X
● Clear-to-send line change		X
● Data-set-ready line change		X
● Ring indicator change from on to off		X

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.

Switch Configuration

The following switches can be configured on the interface card.

Select Code – the factory select code setting for the 98626A card is 9 (Model 216 internal Serial Interface is fixed at 9); the select codes available for interface cards are language dependent.

Interrupt Level – the factory interrupt priority level for the 98626A card is three (Model 216 internal Serial Interface level is fixed at 4); the 98626A card can have an interrupt level setting from three to six.

Parity – a 3-bit switch to enable or disable parity, even or odd parity, or fixed '1' or fixed '0' parity bit.

Character Length – a 2-bit switch selects between five, six, seven or eight bits per character length.

Stop Bits – a 1-bit switch selects between one stop bit per character or 1.5 stop bits per character if the character length is five bits per character. If the number of bits per character is six, seven, or eight then the stop bits switch selects between one stop bit per character or two stop bits per character.

Modem Status Line Disconnect – a 4-bit switch allowing the Ring Indicator, Data Set Ready, Clear To Send and/or Carrier Detect lines to be disconnected and tied high. Not available on Model 216 internal Serial Interface.

Baud Rate Select – allows power up/reset selection for the baud rate. Refer above to the baud rates available for switch selection.

Remote/local jumper – allows an external device to be used as a remote keyboard to the HPL system.

Color Video Interface

The 98627A Color Video Interface provides the interconnection to an external color monitor. This interface connects to a high-performance, high-resolution color monitor via three outputs – Red, Green/sync and Blue (RGB). The capabilities provided by this interface make it appear as a "soft plotter".

This interface, when connected to an external monitor, does *not* replace the internal CRT for all applications (e.g., program editing). It provides an enhanced soft graphics output capability.

Colors Eight – magenta, blue, cyan, green, yellow, red, white, black.

Resolution Selectable to allow a wide variety of monitors to be used in worldwide applications.

U.S. preferred (No flicker) – 512 x 390 at 60Hz non-interlaced vertical scan rate.

European preferred .. (No flicker) – 512 x 390 at 50Hz non-interlaced vertical scan rate.

High resolution (Some flicker) – 512 x 512 at 46.5Hz non-interlaced vertical scan rate.

Cables Four 5-ft. (1.52m) cables supplied with BNC termination.

Cable type 75 ohm, coaxial RG-59/U – similar to Belden 9259.

Note: Longer cables may not meet environmental requirements.

Recommended monitor HP 13279B 19-in. monitor (order Opt. 065 for use with 512 x 512 resolution)

Data Communications Interface

The 98628A Data Communications Interface provides both protocol management and 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 series minicomputer. A terminal emulation program, which takes advantage of this card for communication to other computers, is also available.

Data Rates and Formats

All signals present at the 98628A interface card's connector conform electrically to EIA RS-232-C 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.

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 following information applies to the BASIC language system. (Pascal has no standard interrupt capability.

Non-standard interrupt capabilities for Pascal are documented in the System Designer's Guide.) 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

DATA LINK

- Data block available
- Space available for new transmission block
- Receive or transmit error
- Modem line change (DSR, DCD, DTS, RI)
- No activity timeout
- Lost carrier or connection timeout

Switch Configuration

The following switches can be configured on the interface cards:

ASYNC/DATA LINK

Select Code – the factory select code setting for the 98628 card is 20; valid select codes are 8 – 31.

Interrupt Level – the factory interrupt priority level setting for the 98628 card is 3; valid interrupt level settings are 3 – 6.

Async/Data Link – selects between Async or Data Link personality.

The settings listed below are not all switch selectable; however, all values are selectable through the CONTROL statement. Values selected through the CONTROL statement override the switch settings.

ASYNC

These settings are active when the ASYNC/DATA LINK switch is set to its ASYNC position.

Parity – Bits/Char – a two-bit switch which selects between the following Parity – Bits/Char combinations:

None – 8, None – 7, Odd – 7, Even – 7.

Hardware Handshake – a 2-bit switch which selects Handshake Off, Non-modem connection; Full Duplex, Modem connection; Half Duplex, Modem connection; and Handshake On, Non-modem connection.

Baud Rate – Stop Bit – a 3-bit switch which selects between the following combinations of baud rates/stop bit settings: 110 – 2, 150 – 2, 300 – 1, 600 – 1, 1200 – 1, 2400 – 1, 4800 – 1, 9600 – 1.

DATA LINK

These settings are active when the ASYNC/DATA LINK switch is set to its DATA LINK position.

DID – a 3-bit switch which selects the following value for the 98628's device address: @, A, B, C, D, E, F or G.

Baud Rate – a 2-bit switch which selects the following baud rates: 300, 1200, 9600 or 19,200.

Hardware Handshake – a 2-bit switch which selects between Handshake Off, Non-modem connection; Full Duplex, Modem connection; Half Duplex, Modem connection; and Handshake On, Non-modem connection.

Resource Management Interface

The 98629A Resource Management Interface provides both protocol management and electrical levels for communications between the computer and the Shared Resource Management (SRM) system. The SRM system allows Series 200 computers as well as the 9835, 9845 and Series 500 computers to share common discs and printers and plotters in non-HP-UX environments. The 98629A interface is also used by the SRM system to interface the SRM controller to the 98028A Multiplexer card. The Multiplexer card provides the connection to all workstations that can share common disc and printer resources on the SRM system. Cabling options are available in 10, 25, or 60 metre lengths depending on the distance between the Series 200 Workstation and the SRM controller. The 98629A requires the Shared Resource Management Binary in BASIC Extensions 2.1.

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 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.

128K Byte Bubble Memory Card

The 98259A Magnetic Bubble Memory Card features 128K bytes of non-volatile mass storage. The 98259A provides increased reliability and durability over flexible disc storage.

Note: Due to power supply restrictions, the following are the maximum number of bubble memory cards allowed in one Series 200 machine.

Model 216	1 card maximum
Model 220	4 cards maximum
Models 226/236	2 cards maximum

Access Times and Data Transfer Rates

Access time:

Average	42 milliseconds
Worst case	90 milliseconds

Average transfer rate:

Input	8K bytes/sec.
Output	8K bytes/sec.

Electrical Specifications

Card power consumption: +5V at 715mA typical
+12V at 37mA typical
-12V at 60mA typical

Pod power consumption
(supplied by computer):

	+5V typical	+12V typical	-12V typical
300 baud modem (13265A)	100mA	45mA	45mA
Data link adapter (13264A)	30mA	160mA	23mA

Electrical interface capabilities:

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

EPROM Card

The 98255A EPROM Card contains 16 sockets for EPROMs to allow up to 256K bytes of storage using Intel 27128A EPROMs or equivalent. 128K bytes 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.

EPROM Development Kit

The 98253A EPROM Development Kit consists of one EPROM programmer card and one 98255A EPROM Card. The EPROM Development Kit allows memory volumes to be created in EPROM. To program EPROMs, the programmer card is connected via a ribbon cable to the 98255A EPROM card. Both cards are inserted into adjacent slots of the computer. The Programmer card can be set to program EPROMs at either 52.5 milliseconds or 13.1 milliseconds per word.

The HP Model 216 does not support the 98253A EPROM Development Kit.

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 Timer Chip provides one system timer, and a programmable baud rate for the SIO channel. Available speeds follow:

- Synchronous: max. 460K baud; min 50 baud
- Asynchronous: max. 57K baud; min. 50 baud
- The maximum speed with an external clock is 736K baud for synchronous communications

Data formats provided by the Z-80A SIO chip are 5, 6, 7 or 8 bits/characters 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 98691A interrupt capability is determined by the capabilities programmed into the custom personality ROM.

Electrical Specifications

Card power consumption: +5V 720mA typical
+12V 37mA typical
-12V 60mA typical

Accessory power consumption
(supplied by the computer):

	+5V typical	+12V typical	-12V typical
HP 13264A Data Link Adapter	200mA	90mA	80mA
HP 13265A 300 Baud Modem	100mA	45mA	45mA
HP 13266A Current Loop Pod	30mA	160mA	23mA

(If these pods are used, care must be taken not to exceed the power specifications of the computer's I/O backplane.)

Electrical interface compatibility:

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

3270 Coax Interface*

The 98695A allows the user to connect a Series 200 computer to an IBM 3270 controller over a Type A coax. It contains a high-speed micro-processor and 8K byte buffer and can respond to the 3270 controller as either a 3278 or 3279 Display Station. Operation with the following 3270 controllers is guaranteed.

3270 Controller	Model Number
3274 with Type A Coax	21C, 31D, 331C, 41A, 41C, 41D, 51C, 1A, 1C, 1D
3276 with Type A Coax	01, 02, 03, 04, 11, 12, 13, 14
IBM Integral Controller with Type A Coax	Controller for IBM Models 4331 and 4341 CPU's
Memorex Controller with Type A Coax	Model 2076

The card works in conjunction with the 98795A Series 200 Display Station Emulator. The 98795A identically emulates a 3278-2, or 3279 base color (no graphics) display station and functionally emulates a 3278-3 or 3278-4 display station. Functional emulation of the 3278-3 and 3278-4 is provided through vertical scrolling.

* Supported on Models 216 and 236 only.



Programmatic access to the 98695A's registers and buffers is also supported to allow custom emulators to be written. The following register level commands to the 98695A interface are supported.

- Read one byte from the card buffer
- Write one byte to the card buffer
- Read status and cursor position
- Clear main status bits
- Send keystroke
- Selector pen location
- Power-on reset

- Load trigger and mask
- Load trigger address
- Set terminal type
- Read revision ID

The 98695A is a high-powered card with the following power consumption:

- +5V at 1.43A typical
- +12V - N/A
- 12V - N/A

Care must be taken not to exceed the Series 200 5-volt power supply when using this card in a system with other I/O interfaces.