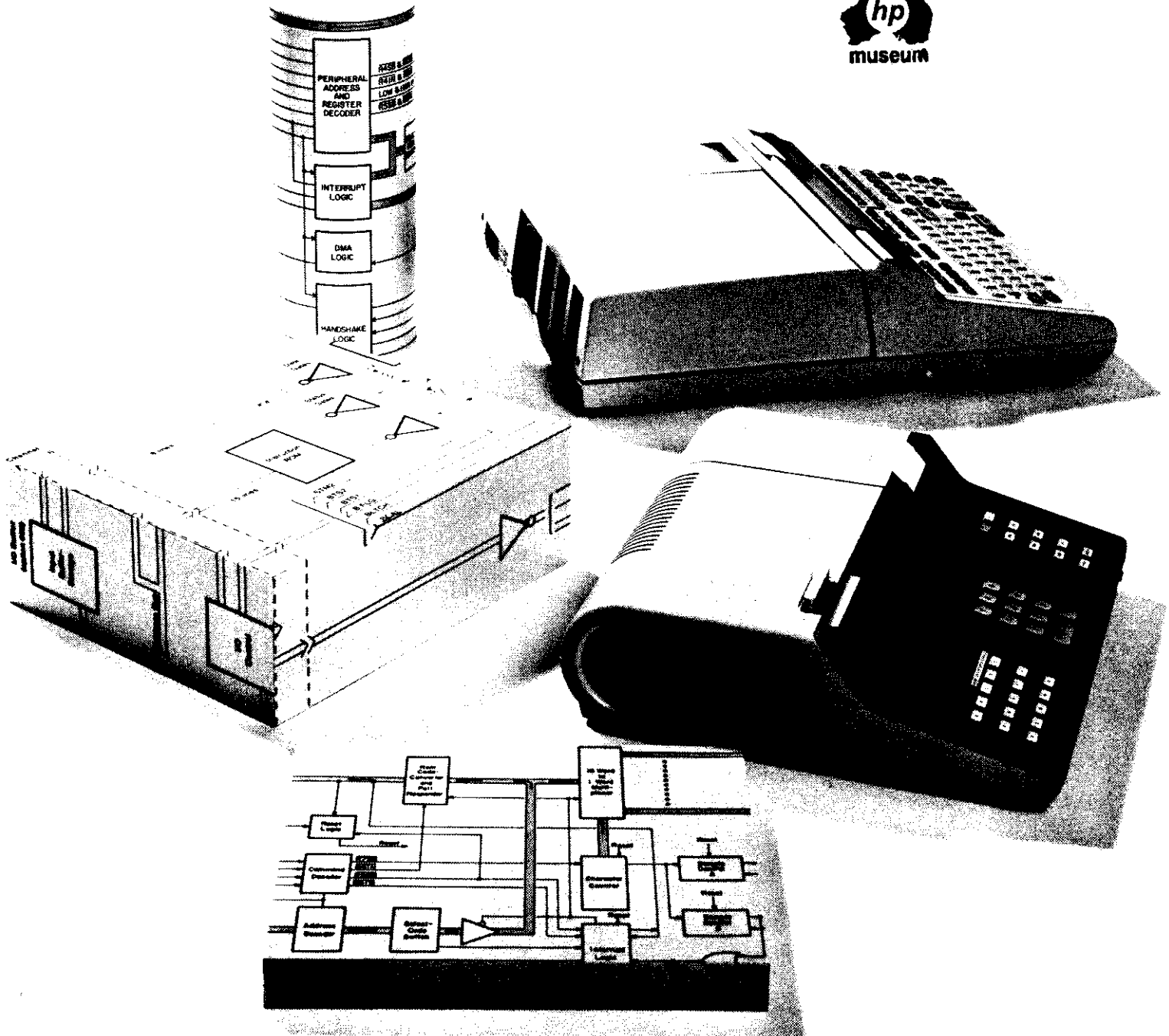


Selecting an

HP computing controller and interface.



How to select the right computing controller

how to select your mainframe



Whether or not you are already experienced at computer instrumentation control, this brochure can help you select an effective, inexpensive HP computing controller. Either the HP 9815 or the HP 9825 can be the heart of an easy-to-use, convenient system that will fit your specific instrument controller needs and save you time and money.

When selecting the HP computing controller that is best for your job, features exclusive to one mainframe may quickly narrow the choice. Comparable performance characteristics such as speed, memory size, and storage capability, with consequent differences in throughput time and ease of use, may dictate one controller over the other. Additional price vs. performance factors such as memory load and record, programming language, keyboard functions, and display capabilities, give you still more parameters to consider.

The table on the facing page summarizes many of the important features of HP's two most popular desktop computing controllers. On the following pages, you will find descriptions of the common interface types and how they are used. Finally, guidelines are suggested for putting the selected apparatus together into a complete system design.

Exclusive Features. If your system requires interrupt, direct memory access, data communications, or automatic data entry at random times, or if you will be working with data bases of more than 100,000 bytes, the 9825 is

probably the controller for your job. If these capabilities are not essential to do your job, consider the HP 9815, a very economical unit having many of the optional characteristics that make it a highly cost-effective small-system controller.

Controller Characteristics.

Speed of computing and data handling is a variable that allows many applications to be handled by either controller, but with a difference in ease and execution time. The HP 9825 can be several times as fast as the HP 9815, depending on the interface used. If you need data logging at a few readings per second, or production monitoring requiring only occasional signals or printouts from the system, the HP 9815 could be the cost-effective controller solution.

Internal memory size options, internal tape data storage, external memory, and the number of I/O slots available are other characteristics you can select to match the needs of the devices that will make up your system. You can easily compare the available controller capabilities with those required by your system instrumentation to help determine your correct selection.

for your job.

Before making a final decision on your mainframe, you should consider the relative merits of the programming language, the controller's keyboard and display, its ability to manipulate data bits, and other characteristics that will help you balance your mainframe's performance against its price.

As an example, the programming language of either controller is simple to learn and use, and either can output programmed instructions to the user in ordinary language. The HP 9815's reverse Polish notation, RPN, is an easy-to-learn language that provides control and editing keys and makes interface programming fast and simple. The HP 9825's high-level programming language, HPL, includes many of the powerful characteristics of BASIC and FORTRAN, and offers powerful interfacing capabilities. The 9815 prints instructions on 16-character lines; the HP 9825 can display instructions in upper- and lower-case letters, print them, and identify programming or operator errors.

The HP 9825's keyboard is typewriter-like in layout and allows simple, convenient instruction entry, while the HP 9815's keyboard performs one function for each keystroke. The HP 9825 keyboard is "live", so you can do manual computations while your computer is busy controlling your system; there is no apparent interruption. Both controllers have numeric and editing keys, plus Special Function keys that can act as typing aids or be programmed to perform special tasks with one keystroke.

If you need to stop your system in the middle of an operation for higher priority applications, the HP 9825's memory load and record feature allows you to transfer the entire memory contents to and from the data cartridge - no need to reload and re-enter all the data manually. You preserve the exact status of the controller and resume operation later at the point where program interruption occurred.

The next step is to choose your interface.

HP COMPUTING CONTROLLER CHARACTERISTICS

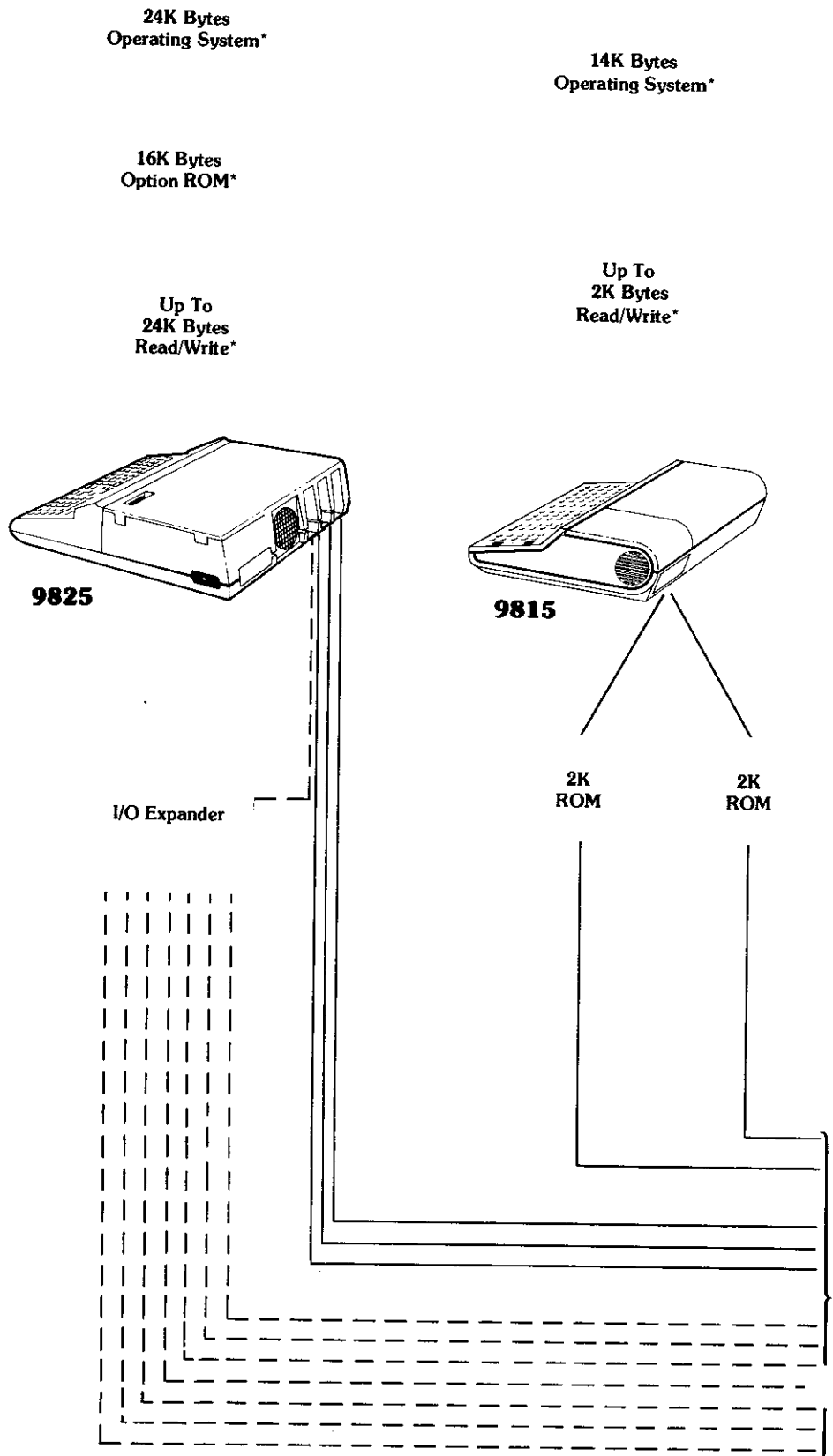
Controller Characteristic	HP 9815	HP 9825
Keyboard	Key per function (SIN, LOAD, etc)	Typewriter-like, upper and lower case alpha and numeric pad
Live keyboard	Not available	Allows manual computation and changing variables while program running
Display	Numeric, 16 characters per line	Full ASCII character set, 32 characters per line
Language	RPN - Reverse Polish notation	HPL - a high-level programming language
Internal memory with I/O compatible options	Up to 2008 bytes	Up to 24,000 bytes
Data storage		
Internal Tape	96,000 bytes/tape	250,000 bytes/tape
External Disk	Not available	480,000 bytes/disk
Memory load and record	Not available	Allows storing complete memory status on tape and reloading later
I/O Channels	2	3 (14 with expanders)
Bit manipulation		
AND	Yes*	Yes†
OR	Yes*	Yes†
ROTATE	Yes, 1-bit right shift*	Yes, 16-bit shift†
Others	None	7 additional
Size	4x13.5x13.6 inches 101,6 x 345,4 x 342,9mm)	5.1 x 15.1 x 19.5 inches (129,5 x 383,5 x 495,3 mm)
Weight	13 lb (5,9 kg)	26 lb (11,8 kg)

*With I/O cards

†With General I/O and Extended I/O ROMs

The Controller Diagram. The HP 9815 and HP 9825 are complete, ROM-driven computer systems in integrated packages, making them extremely attractive compared to other controller alternatives. Each model contains its own high-performance processor, memory, keyboard, thermal printer, display, magnetic tape storage for programs and data, and receptacles to take plug-in interfaces. Input/output software to operate a wide variety of peripherals and instruments is stored in ROMs (read-only memories), which are available as plug-in units that let you tailor your instrumentation system for full capability at the most reasonable cost.

To help recognize the types of interfaces used between controllers and controlled devices, a short review of the common interface codes and some system terminology is useful.



*1K Byte = 1024 Bytes



how to recognize interfaces

Interface Codes. Because alphabetical and numerical data and control commands must be changed to electrical signals of some kind that can be transmitted along a cable, decoded, and used by a receiving device, several widely used standard interface schemes have evolved. There are four commonly used interface codes: bit-parallel; BCD (binary-coded decimal); bit-serial (per EIA Specification RS-232-C); and HP-IB (Hewlett-Packard Interface Bus), Hewlett-Packard's implementation of IEEE Specification 488-1975. These interface codes are very device dependent because different types of equipment inherently require data words with different numbers of information bits and formats.

If you already own one or more instruments or other devices you want to include in a system, your choice of inter-

face codes is likely limited to one or two types. With appropriate interfaces, the HP 9815 and HP 9825 are compatible with devices using any of the four common interface codes.

System Device Functions. Any device used in an electronically controlled system must be able to function as a controller, a talker, and/or a listener. The HP 9825 and HP 9815 can perform all three tasks. They can send commands to peripheral devices and change ranges and functions of these devices. They can also receive and process data or transmit data.

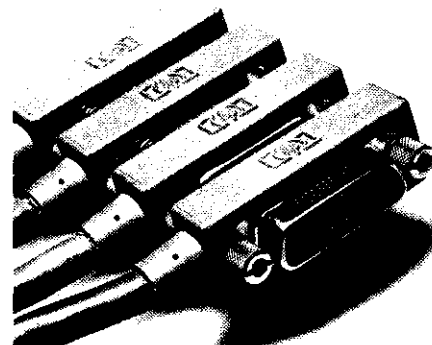
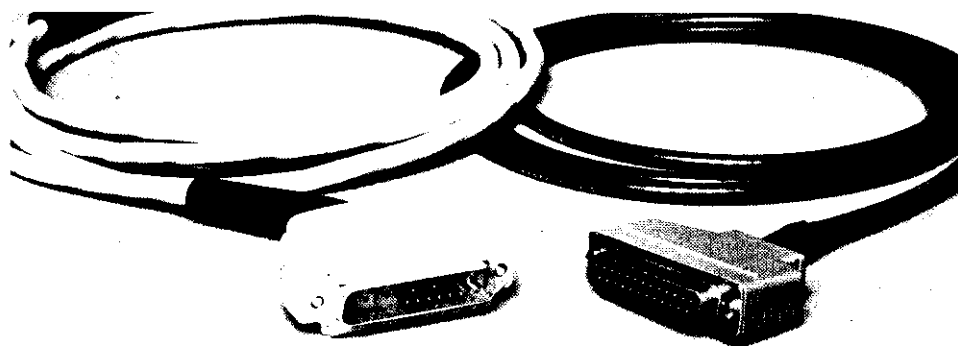
Logic Terminology. TTL (transistor-transistor logic) is a commonly used term in describing the signal level characteristics in a system. Both bit-parallel and BCD (binary-coded decimal) instruments are usually TTL compatible. This logic defines two states

on a particular signal line in the interface system as being true or false: 1 or 0. The logic can be either positive true or negative true, specifying whether the true state is $\geq +2.4$ volts or $\leq +0.7$ volts. The HP controllers and interfaces can be set for either positive-true or negative-true logic, making them usable with a wide range of devices.

Interface Connectors. You can easily recognize two of the common interfaces used with the HP 9815 and HP 9825 controllers because of their unique connectors. These are HP-IB, with connectors according to IEEE Specification 488-1975, and serial, RS-232-C, with EIA 25-pin connectors. You may recognize mating connectors in the instruments' operating manuals.

The standard HP bit-parallel interface cable comes without a terminating connector, or optionally with a connector to plug into specific HP peripherals.

The BCD interface cable is always unterminated, so you can choose an appropriate connector to plug into an instrument designed to your specifications.



Bit-Parallel

Tape reader
Tape punch
Digitizer
Line printer

BCD

Frequency counter
Digital voltmeter
Capacitance bridge

Bit-Serial

Data terminal
Serial printer
Modem

HP-IB

Synthesizer
Sweep generator
Thermal printer
ASCII digital clock

How to select your interface.

bit-parallel — the general purpose interface

Bit-Parallel With the HP 9815.

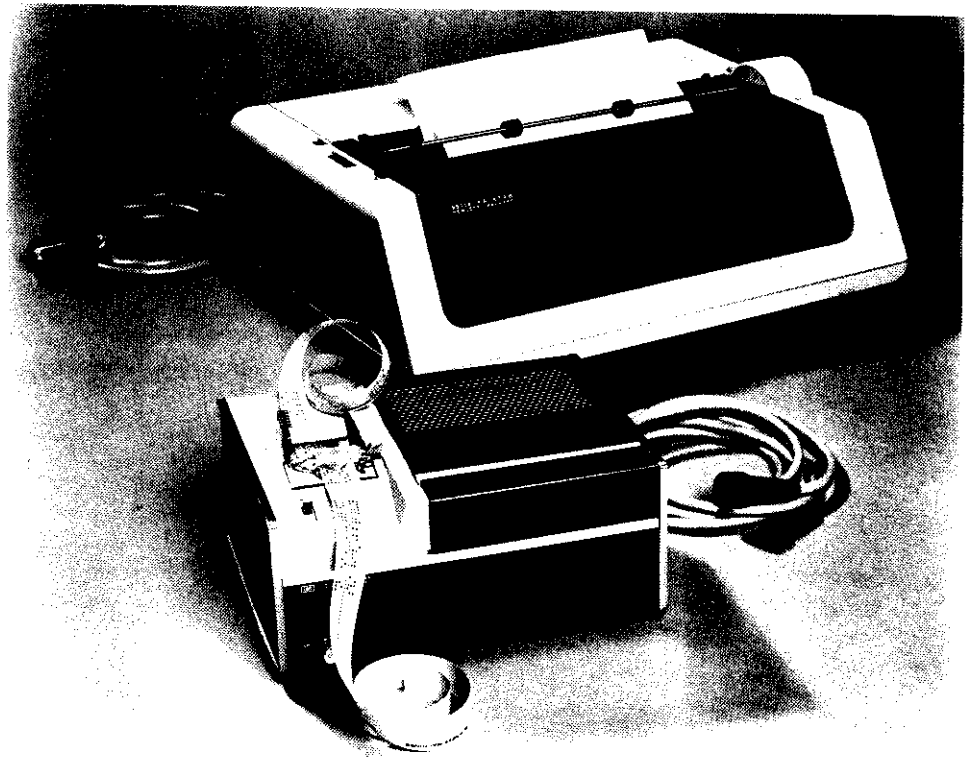
If your instrumentation system includes a tape reader, a tape punch, a digitizer, or a line printer, it probably uses a bit-parallel interface.

The HP 9815 interface that connects the controller with a bit-parallel instrument is the HP 98134A. This interface transfers data in a half-duplex manner; it can input or output data, but not both at the same time. The interface provides buffered storage for each byte (character) of information for faster operation, and all of the interface lines conform to standard TTL (transistor-transistor logic) levels. The HP 98134 can be used with 6-, 7-, or 8-bit bytes. It will input data to the controller at up to 1200 bytes per second or output up to 2000 bytes per second.

Simple programming allows communicating data with either positive-true or negative-true logic, as required by your peripheral device. Negative-true logic is automatically set by the HP 9815 at turn on. Your instrument's operating manual or specifications will tell which logic level applies.

The HP 9815 has two interface channels available, allowing you to use either two bit-parallel devices or one bit-parallel device and one device with a different interface code, such as BCD. A unique one-digit select code (address) is assigned to each interface to allow controlling the specified instrument at any time.

The HP 98134 interface provides a handshake operating mode, in which the interface checks status of a flag so the controller will not send new data unless the previous data is accepted or an indication is given that new data is ready to be input.



Bit-Parallel With the HP 9825.

If your controller choice is the HP 9825 because of speed, interrupt capability, or the number of devices in your system and one or more devices operate with bit-parallel information, the proper interface is the HP 98032A. It provides either an 8-bit byte or a 16-bit word exchange between the HP 9825 and the peripheral.

For all applications using the HP 98032, the HP 9825 requires the General I/O plug-in ROM (read-only memory). Some applications, including DMA (direct memory access) and interrupt, also require the Extended I/O plug-in ROM.

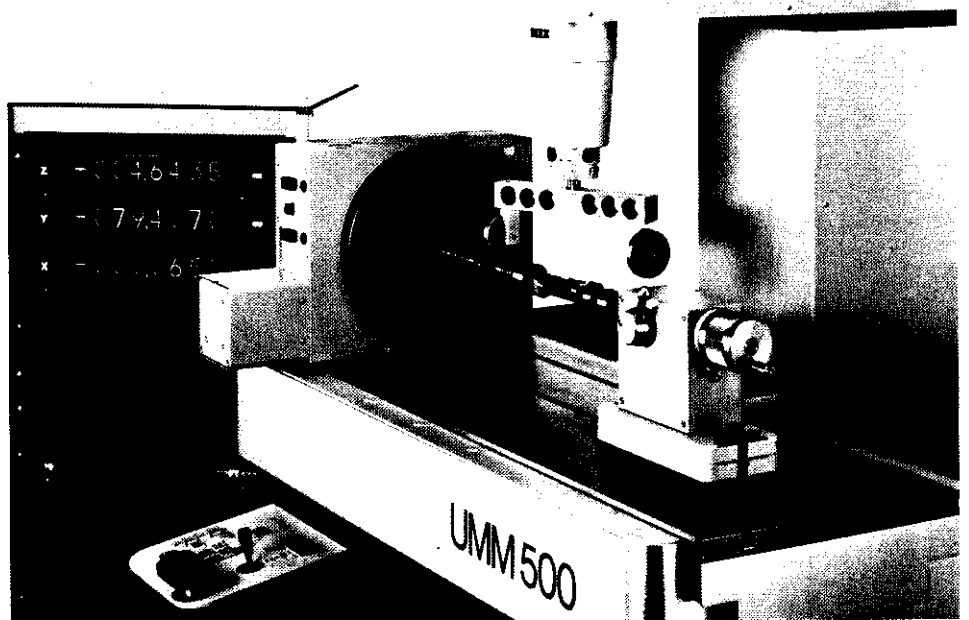
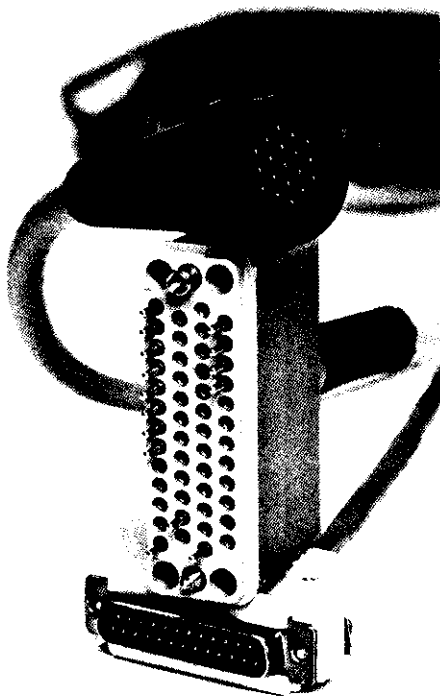
Both the input and output lines, which are TTL compatible, can be set independently to function in either an 8-bit byte mode or a 16-bit word mode. This is accomplished simply by moving jumpers inside the interface. Similarly, the interface can be set for positive-true logic instead of the normal negative-true logic.

Data transfer synchronization between the HP 9825 and the instrument

is accomplished by a handshake, which can be either full or pulsed, depending on the application. Also, for data transmission between two instruments separated by a distance of more than two metres, a delay capacitor can be inserted in the control line to mask any ambiguities in the signals caused by reflections.

The HP 98032 can be used with instruments produced by any manufacturer as long as they are TTL compatible. It is furnished without a terminating connector, but for ease of use with HP peripherals the following HP 98032 options are available for immediate plug-to-plug connection:

- Opt. 062 9862A Plotter
- Opt. 063 9863A Tape Reader
- Opt. 064 9864A Digitizer
- Opt. 066 9866B Thermal Line Printer
- Opt. 069 9869A Hopper Card Reader
- Opt. 071 9871A Impact Printer
- Opt. 083 9883A Tape Reader
Subsystem
- Opt. 084 9884A Tape Punch



BIT-PARALLEL INTERFACE CHARACTERISTICS

I/O Characteristics	HP 9815/98134A	HP 9825/98032A
Data input lines	8 latched	16 latched
Data output lines	8 latched	16 latched
Control lines to device	2	5
Control lines from device	1	5
Interrupt capability	No	Yes*
Type of data transfers	8-bit bytes	16-bit words or 8-bit bytes
Transfer rates extend to,	Output 2000 bytes/s Input 1200 bytes/s	1000 transfer/s† 90,000 transfers/s*
DMA	None	Input 400,000 transfers/s* Output 225,000 transfers/s*

†With General I/O ROM
*With Extended I/O ROM

BCD — the instrument/measurement interface

BCD With the HP 9815. If your system includes a frequency counter, digital voltmeter, digital multimeter, or capacitance bridge, the appropriate interface is probably BCD. For the HP 9815, this requires an HP 98133A BCD Interface, which is compatible with standard TTL levels. With this interface, the HP 9815 can input and output data.

It provides buffered storage in both directions and allows input of up to 10 digits. Output from the controller can be in either binary or ASCII (American Standard Code for Information Interchange).

Both of the HP 9815's interfacing channels can be used to control BCD devices, or one can be BCD and the

other bit-parallel, bit-serial, or HP-IB. Each channel has a unique select code (address), so the specified peripheral is the only one that responds to a particular command.

The HP 9815/98133 combination allows data transfer with a complete or pulsed handshake mode, or with no handshake, to suit particular applications. When the controller is first turned on, a complete handshake mode is automatically set. Also, the logic sense of the data and handshake is completely programmable.

The HP 9815/98133 normal data input rate is about 200 readings per second. However, data can be packed either as four 4-digit samples or two 8-digit samples per register. Using the packed mode, the data input is about 1000 readings per second. In the burst mode, data blocks of 10 digits each are input and stored in data registers at a rate of 2000 readings per second.

BCD With the HP 9825.

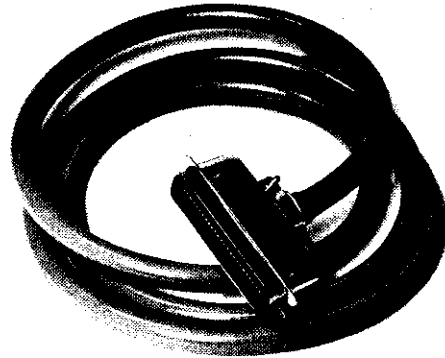
Equipped with an HP 98033A BCD Interface, the HP 9825 is compatible with BCD instruments at standard TTL levels. Operation can be under interrupt control when the General I/O and Extended I/O ROMs are used in the HP 9825.

The HP 9825/98033 combination is capable of receiving, but not outputting, data. Input speeds using the HP 98033 and a General I/O ROM can be up to 250 readings per second. Exact transfer speeds depend on the particular applications, the peripheral speeds, and the amount of controller computation needed between each reading.

Switches inside the HP 98033 Interface allow selection of the logic sense of the control, flag, interface data, and overload lines, thus increasing the interface's compatibility with a wide variety of system instruments.

Both the HP 9815 and the HP 9825 with BCD interfacing can handle two instruments with one interface, providing a cost-effective solution when each controlled instrument outputs a limited number of digits (4 or 5).





BCD INTERFACE CHARACTERISTICS

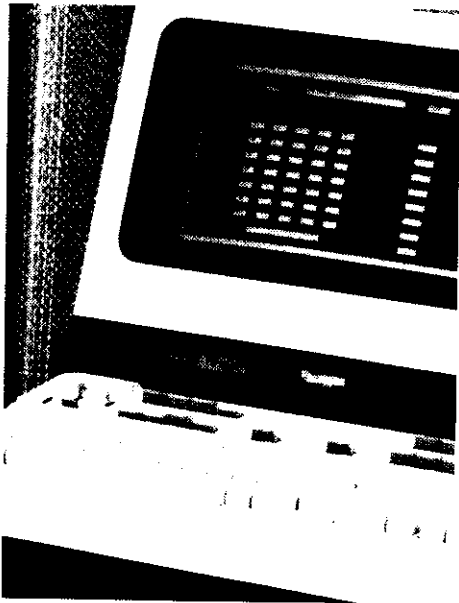
I/O Characteristic	HP 9815/98133A	HP 9825/98033A
Data input lines	40 latched	43 not latched
Data output lines	8 latched	None
Control lines to device	3	2
Control lines from device	2	2
Interrupt capability	No	Yes*
Type of data transfers	Flexible	16-bit character sequence
Transfer rates extend to	200 readings/s 2000 readings/s	250 readings/s† 3100 readings/s*

*With Extended I/O ROM.

†With General I/O ROM.



bit-serial — the communications interface



Bit-Serial Interface With the HP 9815. If your system includes a data terminal, serial printer, or a modem, these devices are normally designed to use a bit-serial interface code complying with EIA Specification RS-232-C. The corresponding serial I/O interface for the HP 9815 is the HP 98136A, which transfers data and other ASCII-coded signals to and from instruments using the RS-232-C code.

With the HP 98136, the HP 9815 sends and receives data as either 7-level ASCII or 8-bit binary bytes. You can also select special combinations of character formats consisting of 5-, 6-, or 7-bit bytes for special non-ASCII applications.

The data transmission rate is defined in bits per second, or baud. The HP 98136 baud rate is set at 110 baud, but by using a screwdriver-adjusted rotary switch you can select discrete rates between 150 and 3600 baud to match the rating of the controlled device.

As with other interfaces, the HP 98136 has a unique select code (address) that allows you to specify which interface should respond to each instruction. You can easily change the select code by moving a plug inside the interface, thus avoiding the possibility of two interfaces having the same select code with the same HP 9815 controller.

Logic levels are also optional to conform to the controlled device's needs. Although the HP 9815 sets the interface to respond to negative-true logic at turn

on, you can change this with a few program instructions or by executing a simple keyboard sequence.

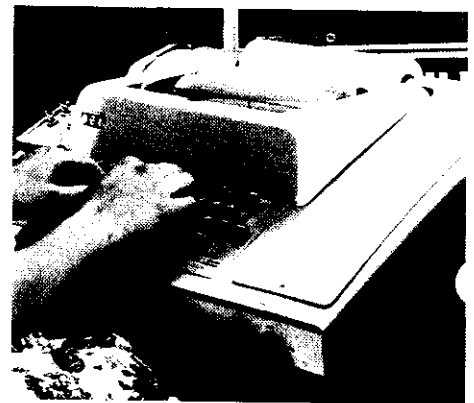
If you need binary-bit manipulation as part of your system operation, the capability is provided. Commands are AND, OR, and ROTATE. ROTATE gives you a single-place right rotation of an 8-bit binary equivalent of the x-register contents.

Bit-Serial Interface With the HP 9825. If you need a bit-serial interface with the HP 9825, the HP 98036A Serial I/O Interface is the solution. This interface receives and sends information in either the EIA RS-232-C voltage configuration or a 20-mA current loop configuration for greater flexibility.

With the HP 98036, you can select discrete data rates between 75 and 9600 baud using an externally accessible rotary switch to best match capabilities of the system's bit-serial device. Also, your system can detect situations where data are sent too fast, causing overrun errors. The HP 9825 can also be programmed to reduce the interface's switch-selected data rate to half its nominal value for greater noise immunity.

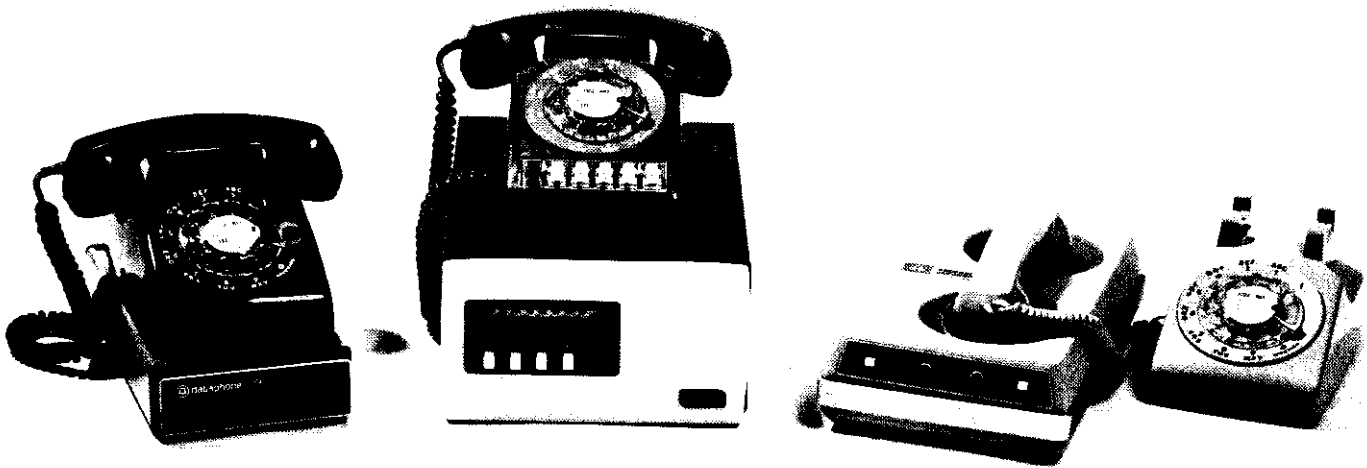
The HP 98036 operates asynchronously using 5-, 6-, 7-, or 8-bit data formatting. Also, the interface will detect several types of errors, including framing (invalid stop bit), parity, and overrun, which the HP 9825 will indicate in a program-testable status word.

Faster data transfer speed can be attained with the HP 9825/98036 combi-



nation and the Extended I/O ROM. This is because the HP 9825 can program the interface to interrupt whenever the input buffer is full or the output buffer is empty. Full duplex operation is thus available, meaning information can be input under interrupt control while information is being output by standard HP 9825 commands.

You can choose one of 14 possible select codes using an externally accessible rotary switch. Select codes 2 through 7 have low interrupt priority, while select codes 8 through 15 have high priority. This maximizes system data throughput by allowing logical interrupt sequence by slow- and fast-responding instruments.



BIT-SERIAL INTERFACE CHARACTERISTICS

I/O Characteristic	HP9815/98136A	HP 9825/98036A†
Data input lines	1	1 bidirectional
Data output lines	1	1 bidirectional
Control lines to device	2	6
Control lines from device	1	6
Interrupt capability	No	Yes*
Type of data transfers	Bit serial	5- to 8-bit bytes
Transfer rates	Selectable 110 to 3600 baud	Selectable 75 to 9600 baud

†With General I/O or Extended I/O ROM.

*With Extended I/O ROM.

HP-IB implements the IEEE standard

What is HP-IB? In recent years, an increasing demand for a truly standard interface has led to establishment of IEEE Specification 488-1975. HP-IB, Hewlett-Packard's implementation of that specification, is helping to simplify and reduce costs normally associated with designing instrumentation systems that include controllers such as the HP 9815 or the HP 9825.

The HP-IB interfacing scheme adheres to the following rationale. All system components are connected with a multilane passive cable. Each device is assigned a unique address or select code so it alone will obey specific commands. And each device is designed to be compatible with standard TTL levels and communicate with a standard bit-parallel, byte-serial code, such as ASCII.

HP-IB allows you to connect up to 14 instruments on one I/O channel with minimum complexity and cost. HP and many other electronic instrument manufacturers now design units that comply with IEEE 488-1975, so you can assemble your own system quickly and easily. HP-IB instruments are plug-to-plug compatible; there is no need to worry about soldering connectors, because they are already there. Nor do you have to be concerned about handshake and control logic, because with HP-IB this is automatic. If you do not already have devices for your system, you may find it convenient to choose HP-IB as the most desirable interface code and select all HP-IB-compatible instruments. Some of Hewlett-Packard's HP-IB-compatible products are :

Representative List of HP-IB Compatible Instruments

HP 3320A	Synthesizer
HP 3330A/B	Synthesizer
HP 3490A	Digital Multimeter
HP 3495A	Scanner
HP 436A	Digital Power Meter
HP 5150A	Thermal Printer
HP 5328A	Frequency Counter
HP 5345A	Frequency Counter
HP 59301A	ASCII to Parallel Converter
HP 59303A	Digital to Analog Converter
HP 59306A	Relay Actuator
HP 59307A	VHF Switch
HP 59308A	Timing Generator
HP 59309A	ASCII Digital Clock
HP 59403A	Common Carrier Interface
HP 59500A	Multiprogrammer Interface
HP 8016A	Word Generator
HP 8620C	Microwave Sweep Oscillator
HP 9871A	Character Impact Printer

HP-IB INTERFACE CHARACTERISTICS

I/O Characteristic	HP 9815/98135A	HP 9825/98034A
Data input lines	8 bidirectional	8 bidirectional
Data output lines		
Control lines to device	8 bidirectional	8 bidirectional
Control lines from device		
Interrupt capability	No	Yes*
Type of data transfers	8-bit bytes	8-bit bytes
Transfer rates extend to	2500 bytes/s	1000 bytes/s† 45,000 bytes/s*

*With Extended I/O ROM.

†With General I/O ROM.

HP-IB With the HP 9815. If you choose an HP 9815 as the controller and HP-IB as the interface code, your interface will be the HP 98135A. It allows the HP 9815 to control up to 14 peripheral devices with one interface channel. The total system connecting cable length should not exceed 20 metres, or 2 metres times the number of devices, whichever is less. The interface is counted as one device.

The system can have only one talker (transmitter) active at any time but as many listeners as required. Data can be transferred at up to 2500 eight-bit bytes per second, depending on the devices active on the line. The slowest device always determines the actual data rate. Slow devices do not affect the bus transfer speed unless they are addressed.

Information is transmitted on the bus bidirectionally and asynchronously. Of the 16 lines in the system, eight are data lines, three are handshake (control) lines, and five are for interface man-



agement. You can use more than one controller on a bus, although only one can be active at any time. Messages can be transferred between devices, between controllers, or between a controller and one or more devices.

Instruments with HP-IB capability are assigned unique 5-bit addresses. Each address can be converted to a single decimal value between 1 and 30 for convenience.

Binary bit testing is possible with the HP 9815/98135 without ROTATE capability.

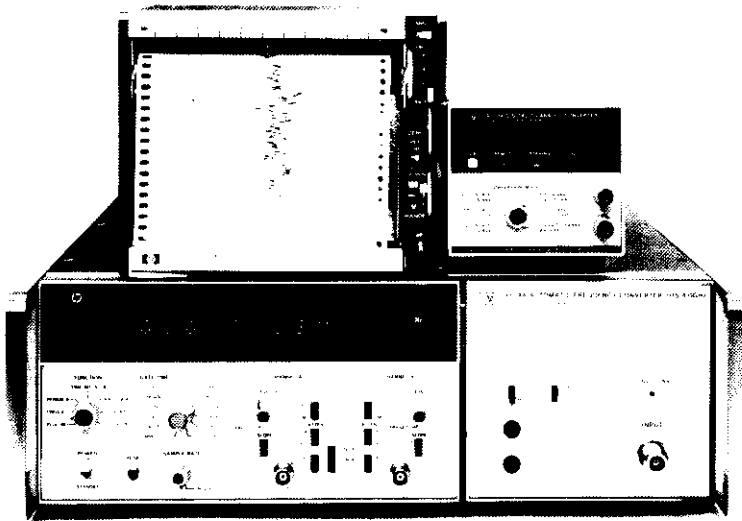
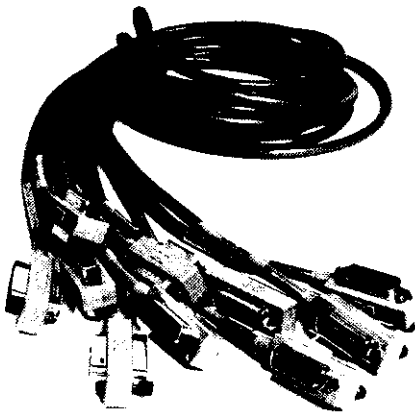
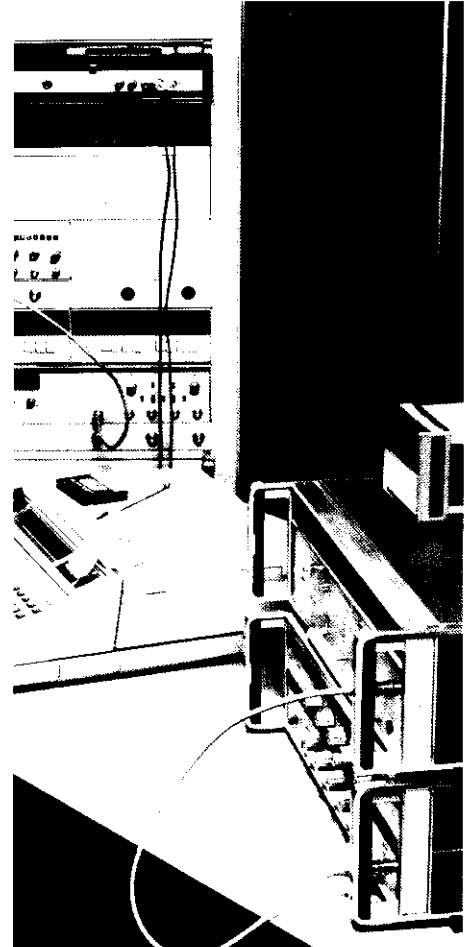
HP-IB With the HP 9825. The HP 9825, equipped with an HP 98034A HP-IB Interface and the General I/O and Extended I/O ROMs, is fully compatible with all HP-IB devices. Because of its larger memory, the HP 9825 can conveniently control more devices than the HP 9815; up to 14 devices per interface are possible for each of the HP 9825's three channels.

If you require fast data transfer speed, the HP 9825 will allow transfer rates up to 45,000 bytes per second, depending on the speed of the peripheral devices involved.

The HP 98034, used with the Extended I/O ROM, is capable of responding to any of the following interrupt conditions, thus adding to the speed and convenience of the HP-IB system:

- take active controller status,
- take active talker status,
- take active listener status,
- input buffer full,
- output buffer empty,
- service requests.

You can set each interface card to one of 14 possible select codes with an externally accessible switch. The specified device on a particular bus is then selected by its unique address.



How to put your system together.

reviewing the requirements

Now that you have the information to select a computing controller and interface code for your system, a review of your controller needs for today and the future may be useful. Your system may already be defined by the exclusive features of one particular controller, but you should consider how your needs may grow in terms of:

- productivity,
- capability,
- convenience,
- programming.

Productivity. When you are assembling a system to automate data acquisition and processing, control a production process, or monitor quality limits, an engineering evaluation should show how the benefits outweigh the investment cost. Since a system is not subject to operator fatigue, you save by getting more consistent measurement results. You get greater throughput because a system is faster than a human operator and can measure more parameters in a shorter time. A system can automatically process and convert raw data into results in meaningful engineering or statistical terms.

In most cases you can quantify savings a system will produce. For example, at HP's Calculator Products Division, Loveland, Colorado, an HP 9825 system is used to program numerical control machines, including a turret lathe and a milling machine, and optimize operations before punching a tape with the final sequence. Editing the program in HP 9825's memory allows selection of the fastest safe machine speeds and choice of optimum operation sequences without the need to punch and repunch tapes whenever changes are made. After optimization, the program is converted to a permanent punch tape for production use. The shop manager states, "We've saved at least \$20,000 in costs annually

on one machine's operations alone; and at \$25 a roll, we've saved significantly on paper tape costs too."

You may be able to predict similar savings in your operation to justify initial system cost.

Capability. Either of HP's computing controllers can be tailored to fit a wide variety of requirements. The HP 9815 is available with two I/O channels; with one channel you can use any combination of two of the four I/O codes, such as BCD and HP-IB. If your system is small and your requirements include data logging and processing or instrument control, the HP 9815 is clearly the most economical controller choice.

The HP 9825 offers additional highly sophisticated capabilities. With two levels of priority interrupt, you get maximum data throughput while monitoring and acquiring readings from both fast and slow instruments. Also, the 9825 is compatible with the HP 9885M/S Flexible Disk Drive when you require larger data storage. If you need these capabilities, or if your system will include three or more instruments, the HP 9825 is your cost-effective choice.

Convenience. Operator convenience is enhanced by the HP 9815's AUTO START feature, which automatically loads and executes a program from a data cartridge at turn on and asks the operator for initial input data. AUTO START also provides automatic resumption of system operation after a power failure. Your operator can initiate one of up to 15 routines by pressing a single preprogrammed Special Function key, labeled with an overlay that identifies the key functions.

The HP 9825's typewriter-like keyboard is convenient because it is fast to learn and operate. In addition, its live keyboard lets you perform manual computations while the 9825 is busy controlling the system. Live keyboard also makes possible monitoring or changing program variables while the program is running. If you need to stop a program before it is complete, you can record the entire HP 9825 memory status, including programs, data, and pointers, on a data cartridge for later reloading and completion. This enables you to run higher priority programs at any time.





Twelve Special Function keys with shift allow you to initiate up to 24 pre-programmed routines with single key-strokes. AUTO START is also available in the HP 9825.

Programming. Writing and editing programs in the HP 9815's RPN language is a simple, step-at-a-time procedure. A program can be printed out while you are writing it. This facilitates editing, which is done easily by writing over an incorrect step or by inserting or deleting steps. The HP 9815 automatically renumbers affected steps when you insert or delete, including changing any branching addresses. And you can program operator instructions and labels for results to be printed out, so operator learning time is shortened and answers are clearly identified.

HPL, the HP 9825's high-level programming language, allows you to key in algebraic expressions and solve them just the way you do on paper. Programs are displayed a line at a time while they are being written or edited. A flashing cursor on the display shows where an error is located, allowing fast correction by keying in the proper character. Eight editing keys speed editing; single characters or entire lines can be added or deleted using the INSERT or DELETE keys. Insertion or deletion of a program line results in appropriate line renumbering and branching changes. Operator instructions can be displayed, printed, or both.

Putting Your System Together.

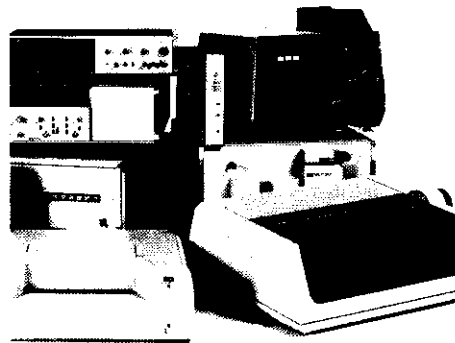
After reviewing your present and future system requirements, you may have a very definite idea of how to assemble a system to take care of all your computing needs. Or, you may still be questioning some interfacing considerations or storage problems that cannot be fully covered in a brochure of this size.

If you find your system requirements are even larger than can be met by either of the controllers described in this brochure, we can still help meet your requirements from a broad line of competitively priced computers, peripherals, and software products. With Hewlett-Packard, you can select a cost-effective solution to your particular system's automation needs and enjoy an orderly and logical upward growth path as your

requirements increase—all from one responsible and responsive source.

Hewlett-Packard's low-cost but powerful 21MX series of small, general-purpose computers is available both in component form and as complete, ready-to-apply processors. Or you can choose from three families of HP computer systems.

At the economy end of the scale, the HP 1000 computer systems offers a choice of program languages and a range of high-speed peripherals. The HP 2000 series allows smooth operation of up to 32 terminals. The powerful HP 3000 Series II systems bring big computer capabilities within the budgetary reach of many small and medium-sized organizations.



Let HP help you get started NOW

Whether you have selected the HP 9815 or the HP 9825 as the solution to your system needs or have decided your requirements are even larger than these small but powerful controllers can handle, the next step is to contact one of HP's field engineers at the nearest Hewlett-Packard Sales Office. Our professionally trained engineers can answer your questions and help you select a controller and interface, either for your own system or for products you manufacture. HP is ready to help you put together a cost-effective, convenient system to automate your measurement/computation problems. From computers-on-a-board to general purpose systems, HP can meet your interfacing needs.



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