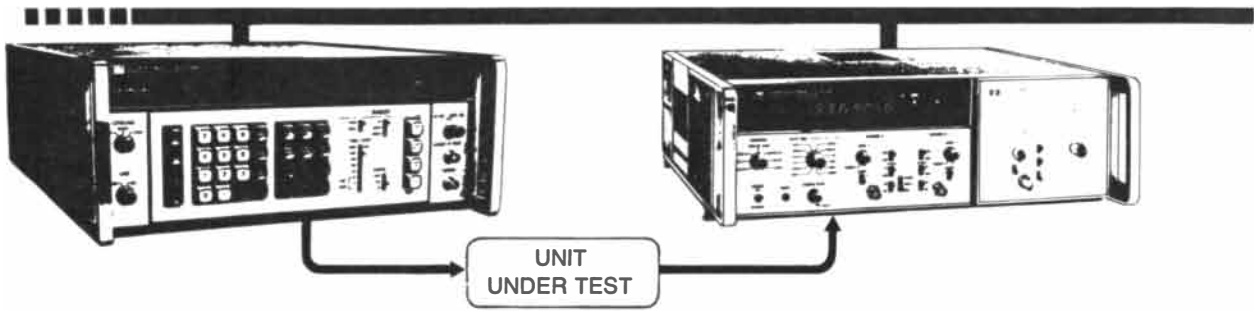


A new standard communications link that facilitates conversation among instruments.

It wasn't long ago that all instruments were, in human terms, totally deaf and dumb. They could not hear instructions so you made them do their job by setting knobs and switches. And when the job was done, they could not tell you the results; the only way to find out was to read, and then analyze, their displays.

Many instruments have since learned to "talk." On command, they can output measurement results and transmit them remotely in code. More and more are being equipped to "listen": send them prearranged signals and they can program their own controls, remotely. Add a control function to such instruments—to tell them when to talk and when to listen—and they can communicate with each other automatically.

This sounds easy, but it hasn't been. Although the three basic elements for automatic instrumentation systems—talkers, listeners, and controllers—are readily available, one who sets out to design and assemble such a system quickly runs into severe frustrations. The different elements are rarely compatible; more often than not, they use different logic, speak a different language, and interconnect with different hardware.

Avoiding this electronic Tower of Babel is what the Hewlett-Packard Interface Bus (HP-IB) is all about. A standard interface system, the HP-IB forms a basic communications link that allows interconnected system components to communicate effectively, in an orderly and unambiguous manner. The interface system involves much more than the standardization of interconnecting cables; it also defines the interface logic capabilities within the system instruments, the scope of the data codes used on the interface, and the timing and control techniques for exchanging messages.

To talk or to listen: never a doubt.

In the HP Interface Bus, all system devices are exposed to all system communications. But a device can neither send nor receive a message unless told to do so by the system *controller*: at any given time, it can be either a *talker* or a *listener*, but not both. Listeners receive programming data from a controller or measurement data from talkers; talkers send measurement data to listeners. There can never be more than one active controller or one talker at the same time, but there can be as many as 14 concurrent listeners.

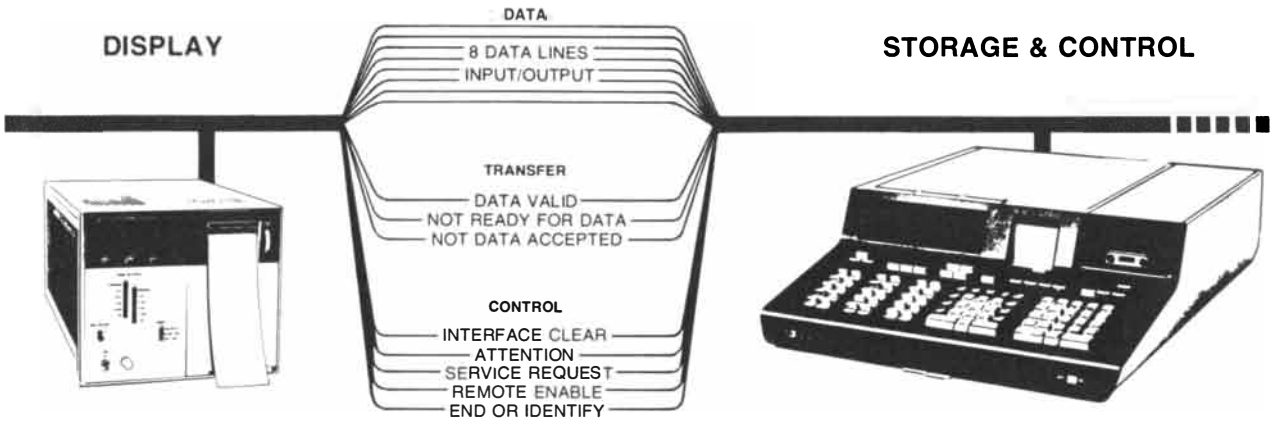
Depending on its capabilities, a device may play more than one role at different times. A calculator or computer, for example, can be talker, listener, or controller; a programmable digital voltmeter alternately talks when it outputs its measurement and listens when it's being programmed; a paper punch can only play the role of listener.

The bus: a common interconnection.

All system devices are interconnected on a common set of 16 signal lines. Eight of these lines form the *data bus* which carries all data messages bidirectionally between talkers and listeners, in bit-parallel byte-serial fashion. The *transfer bus* uses three lines to ensure that data is interchanged only from the intended talker to the designated listeners, through an interrogation and reply sequence. The remaining five signal lines constitute the *control bus*, by which the controller directs an orderly flow of information across the interface, sending commands to the devices and receiving service requests from them. Although system control is always delegated (never assumed), it may be shifted from one system device to another.

HP-IB simplifies systems, small or large.

An HP-IB system can consist of one talker, one listener, and *no* controller; for example, a counter and digital printer for semi-automatic data logging. At the other extreme, a completely auto-



matic system may include as many as 15 instruments possessing stimulus, measurement, display, storage, and control capabilities. Whether a calculator, computer, or the processor of a "smart" instrument, the controller operates the entire system through an interface connection (a single I/O card)—an obvious economy compared to non-bus systems that require one I/O card for each instrument.

System configuration: fundamental problems solved.

Although the HP-IB does not provide instant systems, it does solve the fundamental interface problems that have plagued instrumentation system designers and users until now. Designers no longer need to invent custom interfaces for each new product; users no longer need to familiarize themselves with an interface unique to each new product. Cable and connector problems are minimized by the use of a simple, passive cable interconnection system.

HP-IB protocol allows the designer to assign talk and listen addresses to each device to suit his purposes. Each address is set at the device to any desired value, through a switch on a rear panel, jumper wires on a PC board, or other convenient means.

The HP-IB imposes minimal functional restrictions on data transfer between a talker and a listener. For example, data bytes may consist of from one to eight bits. Once a device is addressed, data can be transferred using any coding and format convention appropriate to the application. The most commonly used codes are the printable characters of the ASCII code set, and the number representations are typically FORTRAN compatible.

Minimal timing restrictions are imposed on the data rates by the HP-IB. Data is transferred asynchronously at a rate that suits the devices involved; burst rates of 1 megabyte per second are possible over limited distances. Data may be transferred directly between devices, thus reducing message traffic on the bus.

More than a theory, HP-IB is a reality now.

Within Hewlett-Packard, the common interface concept has already been incorporated into a growing list of more than 25 instruments and accessory products as well as our computers and programmable desk-top calculators. Additionally, the HP-IB is our implementation of new IEEE Standard 488-1975—and it has served as a model for the IEC Recommendation recently released for ballot among member nations. Thus the possibility exists that this concept will become internationally applicable to the interfacing of instruments, without regard to manufacturer or nation of origin.

Obviously an idea whose time has come, the common interface is here now, still another aspect of the new measurement technology that is taking shape at Hewlett-Packard.

For more information, write to us. Hewlett-Packard, 1504 Page Mill Road, Palo Alto, California 94304.

HEWLETT hp PACKARD

Sales and service from 172 offices in 65 countries.
Palo Alto, California 94304

Mail to: Hewlett-Packard, 1504 Page Mill Road, Palo Alto, CA 94304.

Please send me further information on the Hewlett-Packard Interface Bus.

Name _____ Title _____

Company _____

Address _____

City _____ State _____ Zip _____

00544