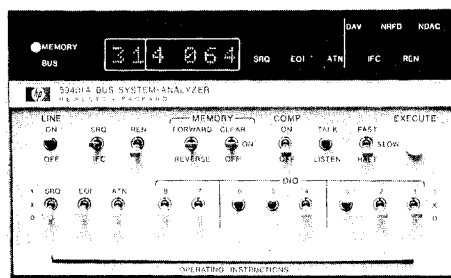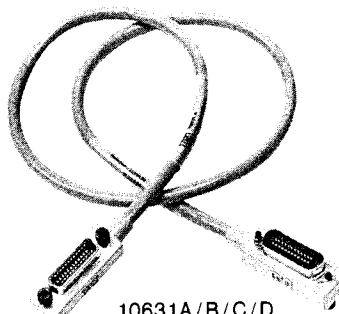# HEWLETT-PACKARD INTERFACE BUS
Versatile interconnect system for instruments and controllers ◀HP-IB▶
Bus system analyzer, cables & accessory modules

59401A

10631A/B/C/D

59401A Bus System Analyzer

The HP-IB (IEEE 488) concept has greatly simplified many of those things which have in the past made instrument interfacing a burdensome task. Even so, software errors can occur if the system designer does not completely understand the bus system or the capabilities of the instruments and other devices being interfaced. Hardware problems can occur if the instruments/devices are not functioning properly, or if they are not completely compatible with the bus standard.

The 59401 Bus System Analyzer is especially useful in design and service work. It simplifies and speeds up the diagnosis of software and hardware problems by allowing the user to see the status of all bus lines, including the actual characters on the bus data lines. Because the 59401A can also drive all bus lines, it can completely exercise another Talker, Listener or Controller—which is especially useful in verifying compatibility of new or user-designed products with the HP-IB.

There are several choices of analyzer operating speed. It may be operated at one character at a time (useful for software debugging), at 2 characters per second, or at regular bus speed. It may also be operated at a variable rate as determined by the external clock input.

The analyzer's 32 character memory can be used to store bus characters in the Listen mode, or to output characters to the bus in the Talk mode. When the analyzer is in the Compare mode, a stream of bus traffic may be stopped on a pre-selected character—and at that time, a trigger pulse is available, which is very useful when analyzing transient or timing problems related to the bus.

59401A Specifications

Display: monitors all bus lines. Represents data lines, any memory location, or DIO front panel switch settings; in octal code and ASCII character.

Listen mode: stores up to 32 characters of bus traffic in memory for real time and repetitive testing. In compare mode, halts bus traffic when a selected character is present, and user can display any one of the previous 31 characters stored in memory.

   Timing: accept <750 ns; ready <750 ns.

Talk mode: bus lines can be driven directly from front panel switches; memory can be loaded from front panel switches for driving bus with a 32 character sequence.

   Timing: (1) data changed >500 ns before DAV pulled low; (2) ATN driven low >1 μs before DAV pulled low; (3) DAV driven high <700 ns after NDAC is false; (4) DAV driven low <700 ns after NRFD is false, if conditions 1 and 2 are met.

Operating speeds: one character at a time, 2 characters per second, regular bus speed, or variable rate determined by external clock input; in either Listen or Talk mode.

External clock input: 1 standard power TTL gate input; ≤10 MHz repetition rate.

Compare output: provides 1 standard power TTL gate output (LOW TRUE) sync pulse when bus character is same as front panel switches.

HP-IB load: 1 bus load (capable of driving 14 other bus devices).

General
Temperature ranges: operating, 0 to 50°C; storage, −40 to +75°C.
Humidity: 95% relative, 0 to 40°C.
Power requirements: 100, 120, 220 or 240 V +5%, −10%; 48 to 66 Hz; ≤42 VA.
Size: 145.5 H, 205.1 W, 495.3 mm D (5.730″ x 8.075″ x 19.500″)
Weight: net, 5.64 kg (12.44 lb).

Options and Accessories	Price
5061-0089 front handle kit	$15
10631B 2 m (6.6 ft) bus cable, furnished	N/C
59401A Bus System Analyzer	**$2800**

HP-IB Interconnection Cables

Cables for interconnecting HP-IB devices are available in four different lengths. The connector block at both ends of each HP-IB cable (photo above) has a plug on one side and a matching receptacle on the other, so that several cables may be conveniently connected in parallel, thus simplifying system interconnection. Lock screws provide for secure mounting of each connector block to an HP-IB instrument, or to another cable connector block.

SPECIAL NOTE: HP-IB cables are not *included with individual HP-IB devices, and must be ordered separately (exception: HP-IB computing controller interfaces include cable with connector).*

Ordering Information
	Price
10631A HP-IB Cable, 1 m (3.3 ft)	$60
10631B HP-IB Cable, 2 m (6.6 ft)	$65
10631C HP-IB Cable, 4 m (13.2 ft)	$75
10631D HP-IB Cable, 0.5 m (1.6 ft)	$60

HP-IB Accessory Modules

Modules in the HP 59300, 59400 and 59500-series are ideal building blocks for use with instruments to extend measurement capabilities. Modules listed here can be interconnected via the HP-IB to HP measuring instruments, signal sources and recording devices capable of operating directly on the HP-IB. In addition, these modules frequently serve as useful ways to interconnect with devices which are not themselves capable of direct HP-IB operation.

Instrument requirements differ. Some only output or accept data on the HP-IB. Others can be remotely programmed by ASCII characters sent along the HP-IB. These modules can work with instruments on any of these levels with or without a controller. Each module having controls can be operated stand-alone from its front panel, or it can be placed in automatic operation under program control.

Module provision for stand-alone, local operation also has important system benefits. The operator can set up and check out the system under manual control, avoiding otherwise complex and time consuming error tracing. Each module has status indicator lights that make it easy to monitor operation.
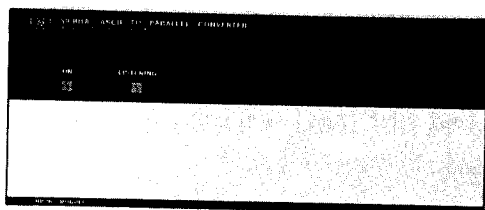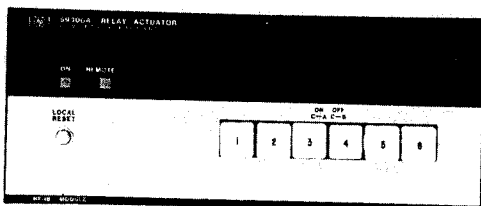
59301A

59306A
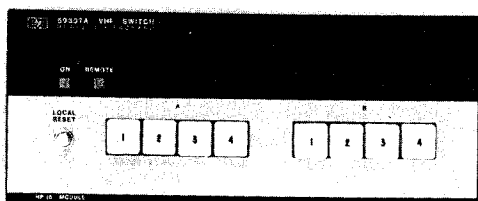
59307A

59308A

59313A

59501A

59309A

59303A

59301A ASCII-to-parallel Converter

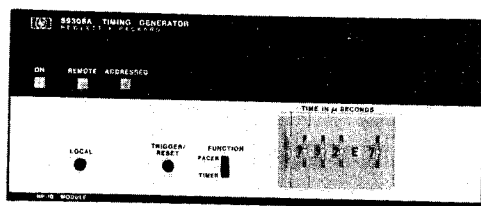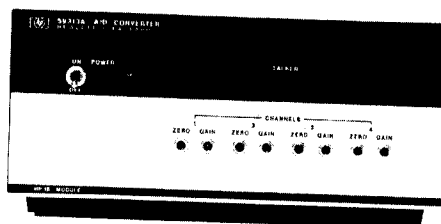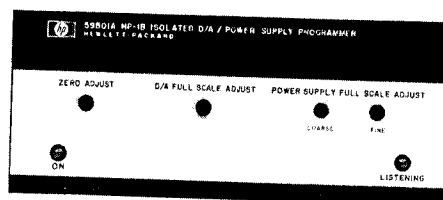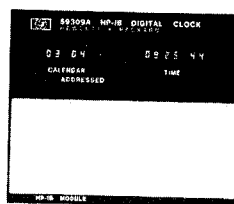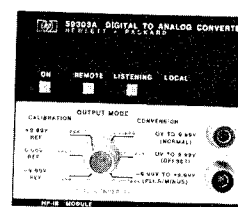Accepts byte-serial ASCII characters from the HP-IB and converts them to parallel output. A string of up to 16 characters terminated by linefeed is converted to 1-2-4-8 BCD and placed on the output lines; the ASCII linefeed character causes a print command (strobe) to be output by the 59301A.

With the 59301A, instruments with the HP-IB interface can be operated with HP 5050B/5055A Printers (requires two output cables, HP 562-16C, not furnished). Or, the 59301A can be used with HP 6129C thru 6131C and 6140A (Option J99) digitally-controlled power supplies for HP-IB programmable voltage and current. The 59301A can additionally be used to control other functions using its hexadecimal format.

59303A Digital-to-analog Converter

Accepts an ASCII string and converts any three consecutive digits to a dc voltage accurate to 0.1% in 30 μs. Fully programmable via the HP-IB or operates stand-alone from the front panel. Offers three output modes for conversion: normal, offset, or plus-minus (9.99 volts to −9.99 volts) to make it convenient for operating strip chart recorders.

A primary application for the HP 59303A is to present on a logging device the data points being taken during a measurement, such as with the HP 5345A Counter. No controller is required for operation. Compatible logging devices include strip chart recorders, X-Y plotters, and displays.

59306A Relay Actuator

Has six Form-C relays that provide for control of external devices either manually from front panel pushbuttons or remotely from the HP-IB. Relay contacts are specified to switch 24 V dc or 115 V ac @ 0.5 A. Use the 59306A with HP 8761A/B SPDT switches for HP-IB programmable microwave switching dc-18 GHz; use it with HP 8494 thru 8496G/H attenuators for HP-IB programmable attenuation dc-18 GHz (external power supply required).

59307A Dual VHF Switch

This module offers a pair of single throw 4-pole switches (dc to 500 MHz, 50 ohm) optimized for fast risetime (1 ns) pulse waveforms. Switches are independent and bidirectional, and can be operated either from front panel pushbuttons or remotely from the HP-IB.

59308A Timing Generator

Has two modes of operation—a pacing function which provides output at a specified rate, and a timing function which provides a delay with respect to a trigger for a specified period of time. Timed intervals can be selected by thumbwheel switches on the front panel, or can be programmed remotely from the HP-IB. Times from 1 μs to more than a day are available. Trigger inputs are available via HP-IB commands and rear panel connector. Timing outputs are available for both TTL and ECL levels, with switch selection of a squarewave or pulse output positive or negative-going edge. Output pulses are 500 ns ± 100 ns wide, and rise time is <50 ns.

59309A Digital Clock

Displays month, day, hour, minute and seconds, and upon command will output time via the interface bus. Time can be set into the clock by local control, or by remote commands received from the HP-IB. The clock accepts a small internal battery which can provide more than a day's standby during short power interruptions. Alternately, an external source such as the K10-59992 can sustain the clock for up to one year.

59313A Analog-to-Digital Converter

This medium-speed 4-channel unit can accept a full scale input of ± 10 V dc on each channel, individually selectable in four ranges. It also has a program-controlled reverse channel for driving small signal lamps, relays, or TTL circuits. An HP-IB controller can command this unit to perform a single conversion, or initiate a series of internally-paced conversions at one of six selectable rates (up to 200/s on one channel; up to 50/s on each of four channels). Sampling can also be initiated externally by TTL transition or contact closure to ground.

### 59501A Power Supply Programmer (Isolated DAC)

This single-channel digital-to-analog converter can control a wide range of power supplies (output voltage, or current), as well as other analog programmable devices. It may also be used as a low level signal source, depending on the speed of the controller. It has two output ranges (0−1 and 0−10V dc in unipolar mode; −1 to +1 and −10 to +10 V dc in bipolar mode), as well as photo-isolators which electrically separate HP-IB control and data lines from power supply circuitry by up to 600 V dc. (Additional details on page 232.)

9875A Cartridge Tape Unit

Provides a standard for data interchange among HP Series 9800 Desktop Computers via the Hewlett-Packard Interface Bus and also provides remote data acquisition capabilities. Any desktop computer in the series can store data on the 9875 tape unit, which can then read the data into any other desktop computer in the series. The tape unit stores data in HP's Standard Interchange Format.

An internal microprocessor enables the 9875 to become a stand-alone data logger in a simple HP-IB system. In the LISTEN-only mode the 9875 will automatically record data on the bus from another HP-IB device without a controller. When it's in the TALK-only mode, the 9875 will automatically output directly to another HP-IB device without a controller. Using a built-in programmable time interval (1 second to 18 hours) allows automatic delays between successive inputs or outputs.

The 9875 is rack mountable and is available as either a single or double tape drive unit. Each cartridge has 225k byte capacity.
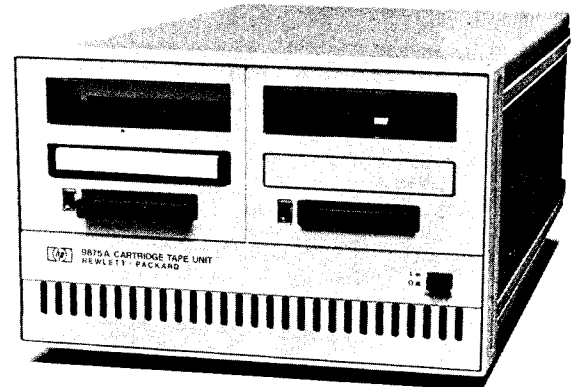
9875A Cartridge Tape Unit

Model	Description	Dimensions—max. height[1] x width x depth mm (inches)	Net Weight kg (lb)	Shipping Weight kg (lb)	Price
59301A	ASCII-to-parallel Converter	101.6 x 212.9 x 294.6 (4 x 8.38 x 11.6)	1.70 (3.78)	2.32 (5.16)	$ 575
59303A	Digital-to-analog Converter	101.6 x 105.9 x 294.6 (4 x 4.17 x 11.6)	2.61 (5.80)	3.17 (7.04)	$ 950
59306A	Relay Actuator	101.6 x 212.9 x 294.6 (4 x 8.38 x 11.6)	2.64 (5.87)	3.23 (7.18)	$ 700
59307A	VHF Switch	101.6 x 212.9 x 294.6 (4 x 8.38 x 11.6)	2.64 (5.87)	3.23 (7.18)	$ 750
59308A	Timing Generator	101.6 x 212.9 x 294.6 (4 x 8.38 x 11.6)	2.10 (4.67)	3.83 (8.51)	$1150
59309A	HP-IB Digital Clock	101.6 x 105.9 x 294.6 (4 x 4.17 x 11.6)	1.70 (3.78)	2.84 (6.31)	$1025
59313A	Analog-to-digital Converter	101.6 x 212.9 x 345.4 (4 x 8.38 x 13.6)	5.45 (12.0)	6.36 (14.0)	$1500
59401A	Bus System Analyzer	145.5 x 205.1 x 495.3 (5.73 x 8.08 x 19.5)	5.64 (12.44)	9.1 (20)	$2800
59403A	HP-IB/Common Carrier Interface	101.6 x 212.9 x 430.0 (4 x 8.38 x 16.9)	4.50 (10.0)	6.10 (13.5)	$1575
59501A	Power Supply Programmer	101.6 x 212.9 x 194.6 (4 x 8.38 x 11.6)	2.61 (5.80)	3.17 (7.04)	$ 550

[1]Height above includes feet, with feet removed height is 88.1 mm (3.47").
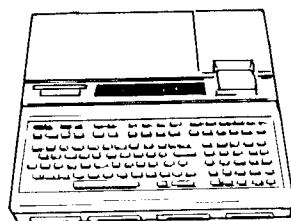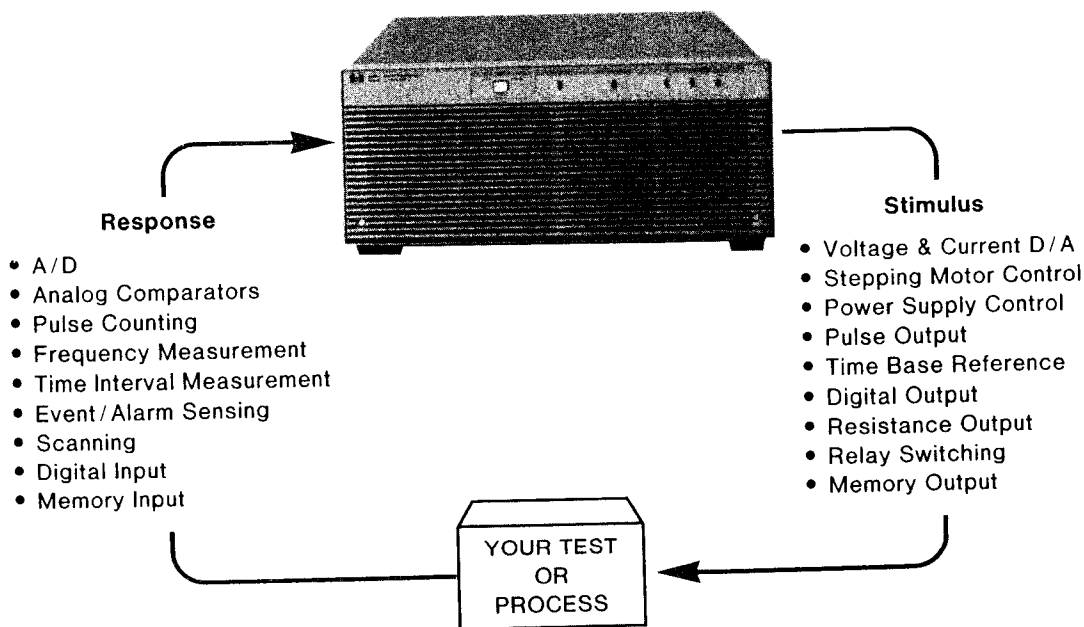
HP-IB

With a Multiprogrammer
Your HP Desktop or Minicomputer Becomes a Reliable
Easy-to-use Automatic Test or Control System

HP-IB

MULTIPROGRAMMER

Response

* A/D
* Analog Comparators
* Pulse Counting
* Frequency Measurement
* Time Interval Measurement
* Event/Alarm Sensing
* Scanning
* Digital Input
* Memory Input

Stimulus

* Voltage & Current D/A
* Stepping Motor Control
* Power Supply Control
* Pulse Output
* Time Base Reference
* Digital Output
* Resistance Output
* Relay Switching
* Memory Output

YOUR TEST OR PROCESS

Benefit from the Multiprogrammer Functional Card System

You can quickly design and implement a control system using the HP-IB and one of the HP Multiprogrammers. Choose from the wide selection of functional plug-in cards and assemble them into a Multiprogrammer mainframe to economically interface your analog and digital input/output signals. The Multiprogrammer provides the interface between your HP-IB controller and the physical world. Thousands of Multiprogrammers are in everyday use as the nucleus of user defined and assembled systems for production testing and control, data acquisition, process monitoring, laboratory experiment control, life testing, quality control, and component evaluation.

Start building your system with one of the HP Multiprogrammers combined via the HP-IB with a computing controller. To help you,

HP offers a variety of proven design aids. These include the *Multiprogrammer Technical Brochures* complete with capabilities, typical system layouts, specifications, and more; ...A *User's Guide* that gives you sample programs, test routines, and I/O interface data for all 38 Multiprogrammer plug-in cards... There is also a *Utility Cartridge* with a recorded program ready to use in the HP 9825A, 9835A and 9845A computing controllers, to aid in writing your own application ... and a *System Throughput Analysis* that allows you to accurately determine the measurement and control speed you can expect before you build your system.

Refer to pages 658 and 662 for more details on the HP 6940B and 6942A Multiprogrammers and how they are used with the HP-IB.

HEWLETT-PACKARD INTERFACE BUS
Versatile interconnect system for instruments and controllers
HP-IB Over Longer Distances

59403A

HP-IB ➤ | 59403A | FULL DUPLEX BIT SERIAL | 59403A | ◀ HP-IB
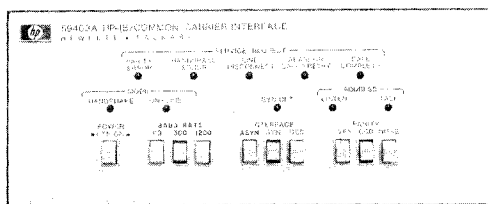
The distance between HP-IB devices may be extended by up to 1000 metres, using two 59403A's; even further with modems.

The total transmission path length for the HP-IB is specified as 20 metres. To extend this, HP has developed these techniques:

Product	59403A Common Carrier Interface	37201A HP-IB Extender	12050A Fiber Optic Link
Application	Gen Purpose Inter-Intra Facility	Gen Purpose Inter/Intra Facility	Fast Intra Facility
Transmission medium	Dual Twisted Pair or Modem Link	Dual Twisted Pair or Modem Link	Dual Fiber Optic Cable
Operating range	Twisted Pair: 1000 metres Modem Link: Unlimited	Twisted Pair 1000 metres Modem Link: Unlimited	100 metres
Modem data rates	Asynchronous: 110/300/1200 bits/s	Asynchronous: 150/300/600/1200 bits/s Synchronous: Up to 19,200 bits/s	—
Hardwired speed	1760 Bytes/s	775 Bytes/s	20,000 Bytes/s
Error Checking	Parity Only No Retransmission	Block Check With Auto Retransmission	Checksum Byte with Auto Retransmission
Electrical Noise Isolation	—	Balanced Coupling on Hardwired Links	Optical
Programming Transparency	No	Yes, except Parallel Poll and Pass Control	Yes, except Parallel Poll and Pass Control

59403A HP-IB/Common Carrier Interface

Provides a way to extend the separation of component parts in an HP-IB system by more than the 20 metre maximum transmission path length specified in various interface standards, and it is especially useful for production or remote site applications. Distances up to 1000 metres are possible by using two 59403A modules (one at each location) interconnected by a dedicated and shielded two-twisted-pair cable. And even longer distances can be achieved by using a telephone line (with appropriate modems) instead of the dedicated cable.

Each 59403A module converts HP-IB data and control lines to a serial bit stream of digital information for transmission over the dedicated or telephone lines, and vice versa in the reverse direction. In both cases, operation is full duplex, so that (for example) one HP-IB device at a remote location can request service from the controller at the same time the controller is sending data to another HP-IB device at the remote location.

The recommended dedicated cable is available from HP as Part Number 8120-1197 (Belden type 8723). The 59403A is designed to operate with 110, 300, and 1200 baud asynchronous or synchronous full duplex modems which are EIA RS 232C or CCITT V.24 compatible. In the U.S., Bell 103A modems with "soft carrier turn-off" are recommended for the direct dial (DDD) network. (Check your local telephone authorities regarding data communication regulations.)
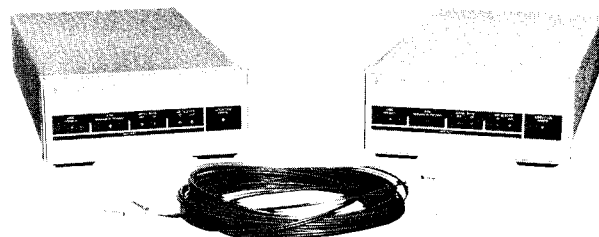
59403A HP-IB/Common Carrier Interface $1579

12050A   12050A

39200 series Fiber Optic Cable

HP 12050A Fiber Optic HP-IB Link With 39200 Series Cable
* Extends HP-IB Length Up to 100 Metres Via Fiber Optic Cable
* 20 KBytes/s Data Rate
* Excellent Electromagnetic Noise Immunity
* Electrical Isolation Between Distant Sites
* Built-in Self Test and Error Correction

A single point-to-point Fiber Optic HP-IB Link consists of two HP 12050A Fiber Optic HP-IB Link units, one at the local controller site and the other at the remote instrumentation site. The 12050A units are connected using a single length of 39200 Series Fiber Optic Duplex Cable or two Simplex Cables. Data transfer rate is up to 20 KBytes/s regardless of cable length. If a remote device requests service, the service request (SRQ) will be asserted at the local end of the Link typically within 100 μs of its occurrence. Thus for many HP-IB applications, no system performance degradation will be observed when extending the bus length with the Fiber Optic HP-IB link. HP-IB devices communicate programmatically via the 12050A units just as they would in local operation. Since information is transmitted using light pulses rather than electrical signals, it is impossible for large electromagnetic fields to interfere with data being sent over the Fiber Optic Cable.

Specifications
HP 12050A Fiber Optic HP-IB Link
Power Requirements: 86 to 127 V ac; 172 to 254 V ac. 48 to 66 Hz. 15 W.
Operating Temperature/Humidity: 0 to 55°C. 10 to 95% RH; non-condensing at 40°C
Size: 9 H x 21 W x 44 cm D (3.5″ x 8.4″ x 17.4″)
Weight: 2.75 kg (6 lb. 1 oz.)

39200 Series Fiber Optic Cables
Operating temperature: 0 to 70°C.
Storage temperature: − 40 to 85°C.
Relative Humidity: 95% at 70°C.
Max. tensile force on Cable: 60 kg (132 lbs.).
Max. tensile force on Connector/Cable: 5 kg (11 lbs.).
Min bend radius: 7 mm (0.3 in.)
Flexing: 50000 cycles (180° bending at minimum bend radius).
Crush load: 20 kg (44 lbs.)

Ordering Information
39200 Series Fiber Optic Cables

Length	Simplex (2 req'd/system)	Duplex (1 req'd/system)
10 m	39201A	39201B
25 m	39202A	29302B
50 m	39203A	39203B
75 m	39204A	39204B
100 m	39205A	39205B

12050A Fiber Optic HP-IB Link $1950 ea
(Two required per system)

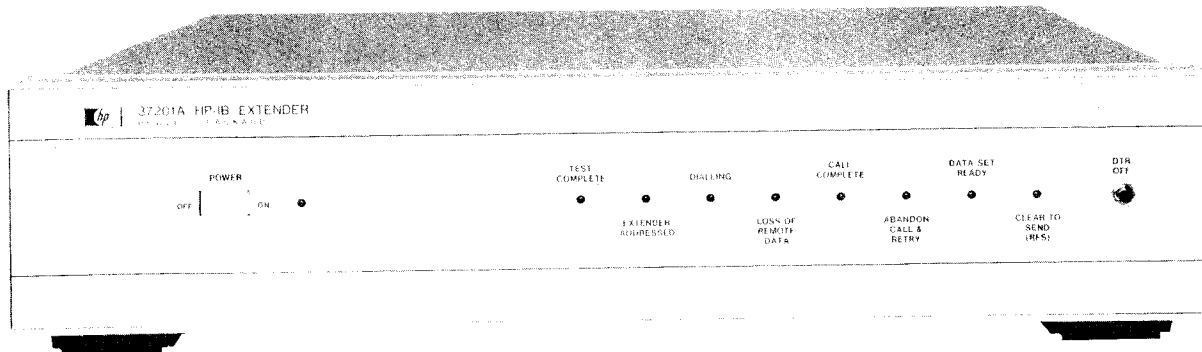## Versatile interconnect system for instruments and controllers
Model 37201A

- Transparent extension of HP-IB systems
- Operation over twin-pair cable or modems
- Automatic error detection and correction

- High immunity to electrical interference
- Multi-point (multi-drop) capability
- Auto-dialler interface

The 37201A HP-IB Extender overcomes the limited range available with direct HP-IB cable interconnections. Each 37201A converts parallel data from the interface bus into a serial bit stream, suitable for transmission to a remote site, and reconverts incoming serial data to bit-parallel HP-IB format. An HP-IB system can therefore be split into two or more discrete parts separated by HP-IB Extenders and a serial data link. A range of 1000 metres is obtainable if twin-pair cable is used for the transmission path, and virtually unlimited range is available if a modem link is used. Communication between Extenders is full duplex, allowing information to flow in both directions simultaneously.

Point-to-point connection using twin twisted pair cable or full duplex modem link.

A pair of HP-IB Extenders provides a transparent interface between local and remote HP-IB devices. Program control of the 37201A is seldom necessary. Consequently, HP-IB Extenders can be added to an HP-IB system usually without any modification of software and without writing special routines to control the Extenders.

Integrity of HP-IB data and control signals is assured by an automatic error-checking protocol, which retransmits any data corrupted in transmission.

Twin-Pair Cable Operation

Twin twisted-pair cable provides a simple inexpensive transmission medium for distances up to 1000 metres. The serial data rate is nominally 20 kbit/s. Suitable cable is available as an accessory (HP Part Number 8120-1187). Transformer coupling within the 37201A gives a high degree of immunity from the effects of common mode signals. This, combined with the automatic error correction capability, makes the 37201A suitable for use in an electrically hostile environment.

Modem Link Operation

The 37201A is designed to operate with a wide range of synchronous and asynchronous modems over private lines, leased lines, or the public switched (dial-up) telephone network. The data interface is compatible with EIA RS-232C and CCITT V.24 and V.28 standards. Asynchronous data rates provided are: 150, 300, 600, and 1200 bit/s. For synchronous modems, operation at any bit rate up to 19.2 kbit/s is possible. Besides operating in point-to-point mode, the 37201A can be used with modems in a multi-point (multi-drop) leased line configuration involving up to 31 remote sites. When operating over the public switched telephone network, connections may be dialled manually. Alternatively, an external auto-dialler may be used to make connections under program control. The 37201A has an RS-366/V.25 interface to permit operation with an auto-dialler.
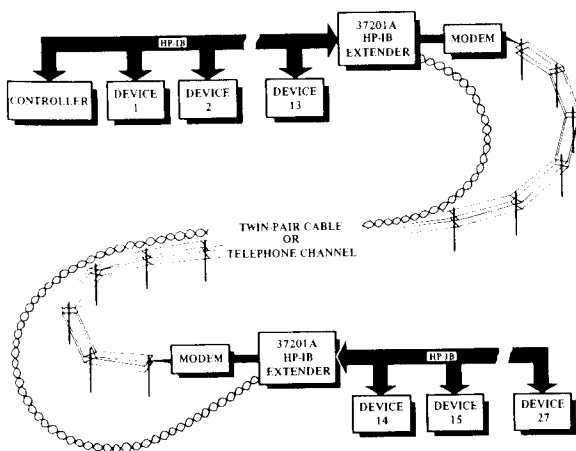
The error checking/correcting communications protocol used in the 37201A protects against errors introduced by poor quality data circuits. It even provides immunity to major interruptions in the data link, such as dropouts, line breaks and modem sync loss, and recovers automatically without loss of data.

The 37201A is in general compliance with each of the following standards and supports their major capabilities:
- IEEE Standard 488-1978
- ANSI Standard MC1.1
- IEC Standard 625-1

37201A HP-IB Extender   **$1840**