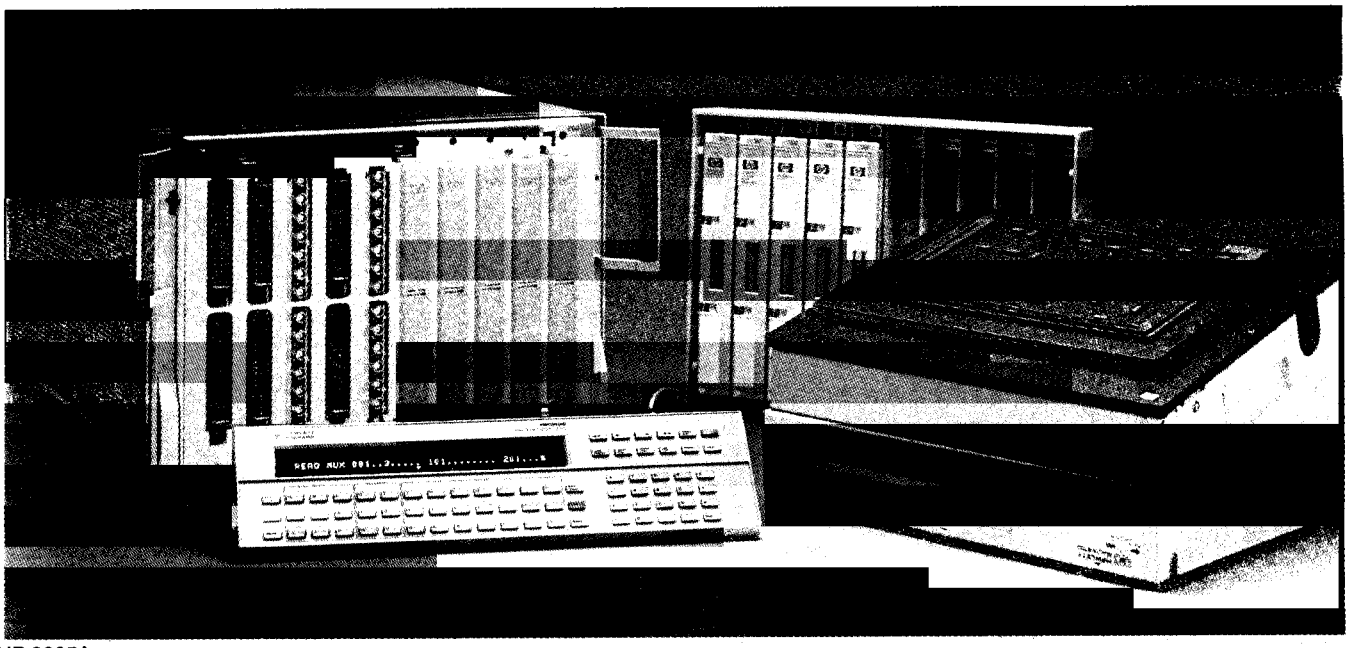
TEST SYSTEM SWITCHES

Signal Routing and Measurement

HP 3235A

- For medium to large systems
- 10-slot, intelligent cardcage
- 20-switch modules for dc to 26.5 GHz signals
- DMM, ac/dc source, 4-channel D/A digital I/O, breadboard modules
- Quick interconnect fixture
- Control panel for debugging

DESIGNED FOR HP-IB SYSTEMS



HP 3235A

HP 3235A Switch/Test Unit

The HP 3235A Switch/Test Unit reduces test development of HP-IB test systems by providing high-performance, off-the-shelf switching and interfacing to a wide variety of devices under test (DUT).

The Switch/Test Unit routes signals between the DUT and source/receiver instruments such as digital multimeters, counters, signal sources, and analyzers.

Speed your test system development with:

- Off-the-shelf tools
- Easy programming
- Reduced cabling

Increase your test system throughput with:

- Local intelligence
- Plug-in digital multimeter module
- Internal bus structure
- Quick Interconnect Fixture

Reconfigurable Architecture

The HP 3235A chassis is a 10-slot cardcage driven by a 16-bit processor backed with 256k of firmware. You control the cardcage over HP-IB using high-level commands for easy programming. Twenty different switch modules in various matrix and multiplexer topologies switch signals up to 10 amperes and from dc to 26.5 GHz. Also available are digital I/O, breadboard, 4-channel D/A, DMM, and ac/dc source modules that are true "instruments on a card."

For applications demanding numerous switch points, up to seven 10-slot HP 3235E Extenders can be slaved to the HP 3235A mainframe. A total of 20,480 two-wire analog points can be controlled from one HP-IB address.

The Quick Interconnect Fixture allows easy reconfiguration of the test system for different devices. Operator errors are also reduced by minimizing the number of connections to be made before starting a new test.

Four analog and two trigger buses link the switch and instrumentation modules. These internal paths provide a "soft-wired" connection that can be redefined by your test software. Analog signals are routed conveniently from a multiplexer to the digital multimeter (DMM) module during scanning. Or, a trigger generated by the digital I/O module can be routed to the DMM module.

To aid in system setup and debugging, a control panel with a full alphanumeric keypad and electro-luminescent display is available.

Intelligence of a Computer

The powerful firmware of the HP 3235A instructs the plug-in modules with high-level commands from the host computer. Storage and recall of hundreds of HP 3235A setups saves sending command sequences from the computer. HP BASIC language commands in the mainframe, such as IF . . . THEN and FOR . . . NEXT, plus variables and math functions, keep computer-to-switch interactions to a minimum, thereby increasing throughput. You can use up to 480 Kbytes of mainframe memory for downloaded subroutines and stored values. Downloaded programs, including user-defined data conversions or setups, execute rapidly.

Complete Modularity Means In-Rack Service

The HP 3235A is completely serviceable in-rack, so you never need to remove the cardcage. All assemblies, including power supply, controller, and HP-IB, remove easily because of the modular design.

Simple Operational Verification Before Your Test

The HP 3235A offers three levels of internal self-test as well as a fixtured functional test for individual plug-in modules. The fixtured test uses diagnostic terminal blocks that attach to the modules. These diagnostic fixtures, together with the internal DMM module, verify the integrity of the relay contacts in your system.

HP 3235A Plug-In Modules

A full array of functional plug-in modules is available for the HP 3235A 10-slot mainframe or the HP 3235E 10-slot extender.

TEST SYSTEM SWITCHES

Signal Routing and Measurement (cont'd)

HP 3235A

Low-Frequency Relay Multiplexers

These modules can be used either as input or output multiplexers to switch signals to and from a DUT. The multiplexers are 2-wire, switching both High and Low. They have different voltage- and current-switching capabilities, and use different relay types. The HP 34501T/34502T/34507T can also be used with thermocouples.

	HP 34501	HP 34502	HP 34507	HP 34511	HP 34515
Max voltage (ac rms)	250 Vdc 250 Vac	125 Vdc 90 Vac	250 Vdc 250 Vac	130 Vdc 130 Vac	1000 Vdc 1000 Vac
Max current	2 A	25 mA	100 mA	1 A	1 A
No. of channels	32	32	32	64	10
Relay type	Armature	Reed	Mercury	Armature	Reed
Thermal offset	<3 μV	<3 μV	<20 μV	<7 μV	<30 μV

High-Frequency Relay Multiplexers

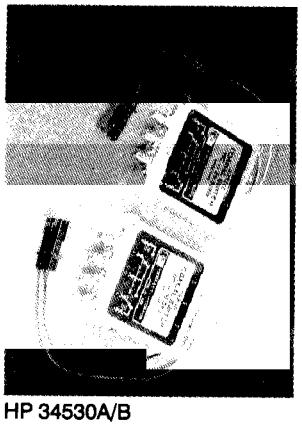
These multiplexers provide broadband switching of high-frequency analog or digital signals. The HP 34504 switches both the center conductor and the shield. In the HP 34505 and HP 34508, the 3 multiplexer banks are isolated from each other and from ground, preventing ground loops.

High-Frequency Relay Multiplexers

	HP 34504	HP 34505	HP 34508
Bandwidth	100 MHz	1.3 GHz	1.3 GHz
Number of channels	Dual 1×6	Two 1×4 One 1×3	Two 1 × 4 One 1×3
Impedance	50 Ω	50 Ω	75 Ω
Max voltage (ac rms)	42 Vdc 30 Vac	42 Vdc 30 Vac	42 Vdc 30 Vac
Max current	1 A	1 A	1 A
Switched shield	Yes	No	No

Microwave Switches

These 50-Ω coaxial switches provide excellent electrical performance from dc to microwave frequencies. The HP 34530A goes to 18 GHz, while the HP 34530B goes to 26.5 GHz. The HP 34531A/B 18 GHz multiplexers are configured as 1×6. The HP 34531B has internal 50-Ω terminations for the open channels, while the HP 34531A does not. All of these microwave switches use SMA connectors. A variety of rack-mounting kits are available. Up to four HP 34530A/B 3-port switches can also be mounted in the HP 34530T terminal block kit.



HP 34530A/B

HP 34531A

Relay Matrix Modules

These matrix cards come in a variety of configurations, densities, and bandwidths. For the highest density, consider the HP 34511M or the HP 34516M/N. If low leakage is a requirement, the HP 34512C features 10 pA/volt leakage, 2 pA/V typical. For higher bandwidth applications, look at the HP 34506 Switched Shield Matrix. Finally, for very high-frequency applications, consider using the HP 34513C or the HP 34514C General Purpose RF relay modules (described in a later section) to build up your own custom high-frequency matrices. Special cable kits allow many of these modules to expand into larger matrix configurations.

Relay Matrix Modules

	HP 34501M	HP 34506	HP 34511M	HP 34512	HP 34516
Crosspoints	32	32	64	32	256
Matrix configuration	4×8	4×8	8×8 4×16	4×8	8×32 4×64
Bandwidth	1 MHz	30 MHz	1 MHz	30 MHz	1 MHz
Max voltage (ac rms)	42 Vdc 30 Vac	42 Vdc 30 Vac	130 Vdc 130 Vac	250 Vdc 170 Vac	42 Vdc 30 Vac
Max current	2 A	1 A	1 A	1 A	1 A
Connectors	2-wire	Coaxial	2-wire	Triaxial	2-wire
Switched shield	No	Yes	No	Yes	No

General Purpose Relay Modules

There are several general-purpose modules available for different applications. The HP 34503 has 16 Form C relays. The HP 34510 has 8, but can switch 10 amps per relay. The HP 34513 and HP 34514 are building blocks, allowing you to build up custom-switching topologies to fit your requirements. These cards contain 32 independently operated double-pole/double-throw high-frequency relays. All contacts are brought out to board-mounted SMB connectors. Interconnections between relays are made via coaxial cables.

General-Purpose Relay Modules

	HP 34503	HP 34510	HP 34513	HP 34514
Number of relays	16	8	32	32
Contact config.	SPDT (Form C)	SPDT (Form C)	DPDT	DPDT
Max voltage (ac rms)	250 Vdc 250 Vac	125 Vdc 250 Vac	42 Vdc 30 Vac	42 Vdc 30 Vac
Max current	3A	10 A	1 A	1 A
Bandwidth	1 MHz	1 MHz	1 GHz	300 MHz
Use	General Purpose	Power Actuator	50 Ω RF Switching	75 Ω RF Switching

Digital I/O Modules

The HP 34509 has a total of 32 open-drain MOS FET outputs, which can switch voltages up to 42 V and currents up to 0.5 A. This card also contains 2 internal power supplies of 15 V and 28 V, making the module ideal for driving relay coils or other devices. This card is also used in conjunction with the HP 34530 and HP 34531 microwave switches.

The HP 34522 is a 32-bit digital I/O module, featuring 32 bi-directional TTL-compatible data lines, 8 edge-triggered interrupt lines, 16 high-power FET outputs, and a read/write rate > 40 kHz. The 32 data lines are configured as four 8-bit ports, each with its own handshake lines. Each port can be operated independently as a read or write port, or can be combined to handle 16- or 32-bit parallel data.

Analog Source Modules

The HP 34521 AC/DC Source Card offers 24-bit (6.5-digit) resolution in the dc voltage mode, highly accurate amplitudes in the ac voltage mode, and versatile high-speed outputs in the arbitrary waveform mode. Maximum voltage output is ±10 volts; maximum frequency is 1 MHz. Standard ac outputs include sine, square, and triangle waveforms, with variable duty cycle on both triangle and square waves. AC outputs are generated by direct digital synthesis, which provides high accuracy and resolution down to 0.001 Hz. Arbitrary waveform memory depth is 2048 bytes. Arbitrary waveforms can be generated at a full 1 MHz bandwidth.

The HP 34524 contains 4 completely independent 14-bit plus sign digital-to-analog converters (DAC). In the voltage mode, each DAC can supply ±10.24 volts. In current mode, each can provide ±20.16 mA. Because the 4 DACs are isolated from each other, they can be connected in series or parallel for greater output voltages or currents.

Breadboard Module (HP 34523)

The breadboard module is a convenient way to incorporate special-purpose circuits into your test system. This module lets you interface directly to the HP 3235A's backplane control signals and backplane analog and trigger buses.

6.5-Digit Multimeter Module (HP 34520)

With the DMM module, you can integrate a high-performance system multimeter into your test system without extensive cabling and software programming. The DMM module offers 7 functions:

dc Voltage (90-day, Tcal ±5° C)

Range	Best 6.5-digit accuracy[1] ± (% of reading + volts)	Input resistance
30 mV	0.0053% + 5.40 μV	>10 GΩ
300 mV	0.0038% + 5.7 μV	>10 GΩ
3.0 V	0.003% + 8 μV	>10 GΩ
30 V	0.0048% + 220 μV	10 MΩ ± 1%
250 V	0.0063% + 70 μV	10 MΩ ± 1%

dc Current (90-day, Tcal ±5° C)

Range	Best 6.5-digit accuracy[1] ± (% of reading + amps)	Max. burden voltage at full scale
300 μA	0.025% + 15.4 nA	0.35 V
3 mA	0.025% + 15.4 nA	0.35 V
30 mA	0.025% + 1.54 μA	0.35 V
300 mA	0.088% + 25.4 μA	0.6 V
1.5 A	0.088% + 654 μA	1 V

Resistance (2- and 4-wire Ω)[2] (90-day, Tcal ±5° C)

Range	Best 6.5-digit accuracy[1] ± (% of reading + Ω)	Current output
30 Ω	0.0078% + 5.4 mΩ	1 mA
300 Ω	0.0058% + 5.7 mΩ	1 mA
3 kΩ	0.0048% + 9 mΩ	1 mA
30 kΩ	0.0048% + 90 mΩ	100 μA
300 kΩ	0.006% + 1 Ω	10 μA
3 MΩ	0.008% + 15 Ω	1 μA
30 MΩ	0.032% + 830 Ω	100 nA
300 MΩ[3]	2.5% + 100 kΩ	100 nA
3 GΩ[3]	25% + 1 MΩ	100 nA

[1] After 1-hour warmup, integration time 100 PLC. Tcal is the temperature of the calibration environment between 18 and 28° C.
[2] For 2-wire Ω, add 200 MΩ to count error specifications.
[3] For 2-wire Ω, only accuracy is specified following auto-cal (ACAL), under stable conditions (±1° C).

ac Voltage (RMS ac and RMS ac + dc)

acV Bandwidth: 20 Hz to 1 MHz
Crest Factor: 3.5 to 1 at fullscale
Common Mode Rejection: With 1 kΩ imbalance in the low lead, dc to 60 Hz
Guarded: >86dB
Non-Guarded: >66dB

ac Volts (90 day, Tcal ±5° C)

Range	(100 Hz to 20 kHz) Best 5½-digit accuracy[4] ± (% of reading + % of range)		Input impedance
	ac coupled	dc coupled	
30 mV	0.15% + 0.0441%	0.19% + 0.169%	1 MΩ ±1% shunted by >90 pF
300 mV	0.15% + 0.0441%	0.19% + 0.169%	
3.0 V	0.15% + 0.0441%	0.19% + 0.169%	
30 V	0.15% + 0.0441%	0.19% + 0.169%	
300 V	0.21% + 0.053%	0.25% + 0.203%	

[4] Accuracy specified for sine wave inputs, >10% of range. dc component <10% of ac component after one-hour warmup and within one week of ACAL. ac band set to <400 Hz.

ac Current (RMS ac and RMS ac + dc)

acI Bandwidth: 20 Hz to 100 kHz
Crest Factor: 3.5 to 1 at full scale

Frequency and Period

Measures the frequency or period of the ac component of the ac or dc coupled voltage or current input. The counter uses a reciprocal counting technique to give constant resolution independent of input frequency.

Frequency Range: 10 Hz to 1.5 MHz (voltage input)
10 Hz to 100 kHz (current input)
Period Range: 0.1 s to 667 ns (voltage input)
0.1 s to 3.33 us (current input)
Sensitivity: 10 mV rms or 100 μA rms (sinewave)
Triggering: Triggers and counts on zero crossings

SimPlate Board Test Fixture (HP 34597A)

The HP 34597A SimPlate Board Test Fixture is a vacuum-actuated bed-of-nails test fixture kit for the HP 3235A Switch/Test Unit. SimPlate and the HP 3235A are tools developed for your "rack-and-stack" functional test systems. Unlike an edge connector test, SimPlate gives you access to all component leads to provide more functional test flexibility and improved fault isolation. Because of its unique single-plate design, SimPlate can provide the close-tolerance probing required for interfacing to Surface-mount technology (SMT) boards.

SimPlate is delivered as a kit that you must drill, wire, and assemble. Its components are designed to probe printed circuit boards from a single side, with test pads as small as 0.030-inch diameter on 0.050-inch centers. Probes, receptacles, and additional HP 3235A terminal blocks are ordered separately.

General

Environmental
Operating temperature: 0° to 55° C (32° to 130° F)
Storage temperature: −40° −75° C (−40° −165° F)
Humidity range: 95% R.H., 0° to 40° C (32° − 10° F)
Power Line Voltage: 90 to 132 V (115 V) or 192 to 264 (230 V) switch-selectable 47 to 66 Hz. Fused at 5A (115 V) or 2.5 A (230 V).
Size
HP 3235 Cardcage: 310 mm H (without feet) × 426 mm W × 594 mm D (12.2 in × 16.8 in × 23.4 in)
Height with feet: 325 mm (12.8 in)
Depth with terminal blocks: 693 mm (27.3 in)

Weight	Net	Shipping
HP 3235 Cardcage (max.)	21 kg (46 lb)	28 kg (62 lb)
Each module (max.)	5.5 kg (12 lb)	6.6 kg (14.6 lb)

Ordering Information

	Price
HP 3235A Switch/Test Unit	$6,550
Opt 560 Add System Expansion Card	$520
Opt 580 HP-IB Controller	+$830
Opt 590 Add Quick Interconnect Fixture	+$1,090
Opt 908 Rack Mount Kit (HP p/n 03235-80908)	+$140
HP 3235E Switch/Test Unit Extender	$5,460
HP 34550A Control Panel	$870
HP 34551A Control Panel Rack Mount Kit	$80

Plug-In Accessories are supplied with your choice of terminal blocks. "A" suffix designates solder lugs, "B" designates screw terminals, "C" deletes the terminal block, "M" and "N" designate matrices, and "T" measures thermocouples. Prices below are for the "B" suffix.

HP 34501A/B/M/T 32-Channel Armature Relay Mux/Matrix	$1,800 – 2,250
HP 34502A/B/M/T 32-Channel Reed Relay Mux/Matrix	$1,800 – 2,250
HP 34503A/B General-Purpose Relay Module	$1,220 – 1,400
HP 34504A/B/C Switched-Shield Coax Mux	$2,220 – 2,400
HP 34505A/B/C 50-Ω RF Mux	$1,940 – 2,120
HP 34506A Switched-Shield Coax Matrix	$2,490
HP 34506B Switched-Shield Coax Matrix	$2,720
HP 34506C Switched-Shield Coax Matrix	$2,250
HP 34507A/B/M/T 32-Channel Mercury Relay Mux/Matrix	$2,070 – 2,550
HP 34508A/B/C 75-Ω RF Mux	$2,300 – 2,370
HP 34509A/B/C 32-Channel Relay Driver Module	$1,300 – 1,600
HP 34510B 10-amp, 8-Channel Power Actuator	$1,080
HP 34511B 64-Channel Relay Mux/Matrix	$3,120
HP 34511M 64-Channel Relay Mux/Matrix	$3,260
HP 34512C Switched-Shield Triaxial Matrix	$3,620
HP 34513C General-Purpose 50-Ω RF Module	$3,620
HP 34514C General-Purpose 75-Ω RF Module	$3,990
HP 34515B 10-Channel 1000-Volt Mux	$2,620
HP 34516M/N 256-Crosspoint Matrix	$6,080
HP 34520A 6.5-Digit Multimeter Module	$3,590
HP 34520B 6.5-Digit Multimeter Module	$3,820
HP 34521A ac/dc Source Module	$3,530
HP 34521B ac/dc Source Module	$3,700
HP 34522A 32-Bit Digital I/O Module	$1,640
HP 34522B 32-Bit Digital I/O Module	$1,860
HP 34523A/B Breadboard Module	$550 – 750
HP 34524A/B 4-Channel D/A Converter Module	$2,300 – 2,490
HP 34530A/B Microwave Switch	$790 – 900
HP 34531A/B 1×6 Microwave Switch	$1,570 – 1,870

For the most current prices and product information, contact your local Hewlett-Packard sales office—see page 654.