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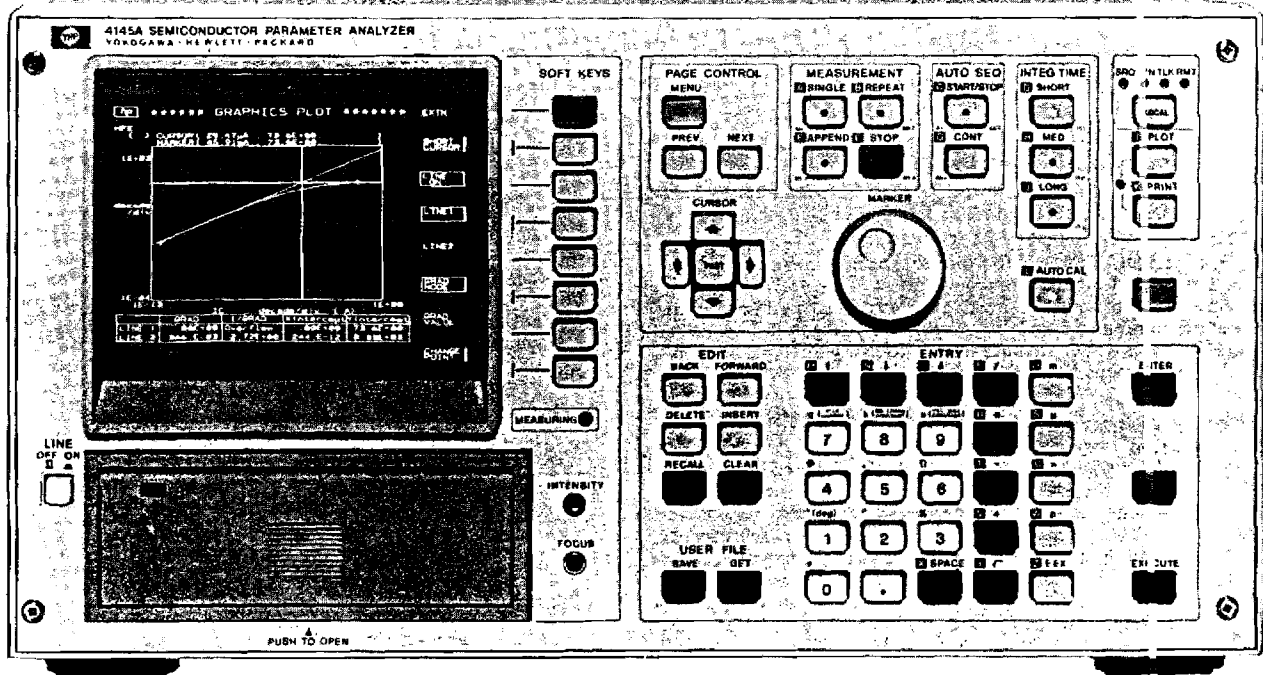


## COMPONENT & SEMICONDUCTOR MEASUREMENT

### Semiconductor Parameter Analyzer

Model 4145A

- Fully automatic, high speed dc characterization of semiconductor devices and materials
- Four programmable stimulus/measurement units capable of high resolution, wide range sourcing and sensing ... I: 1 pA~100 mA, V: 1 mV~100 V
- Built-in graphics analysis functions
  - marker and cursor provide direct numeric readouts
  - line function for automatic calculation of line gradient and X,Y axes intercept values
- Built-in flexible disc drive for permanent storage of user programs and measurement results



HP 4145A



### Description

Designed for production line and laboratory use, the HP 4145A is the electronics industry's first stand-alone instrument capable of complete dc characterization of semiconductor devices and materials. It stimulates voltage and current sensitive devices, measures the resulting current and voltage responses, and displays the results in a user-selectable format (graph, list, matrix or schmoos) on a built-in CRT display. An on-board programmable calculator provides real-time calculation of voltage/current dependent parameters, such as the current gain ( $h_{FE}$ ) and transconductance ( $g_m$ ) of transistors, which also can be displayed on the CRT. A number of powerful graphic analysis tools—marker, cursor, line function, interpolation—enhance the HP 4145A's basic capabilities and provide fast, accurate analysis of semiconductor devices, leading to increased production yields and improved device quality.

Four built-in stimulus/measurement units (SMUs) are the heart of the HP 4145A. Each SMU can be independently programmed to function as either a voltage source/current monitor or a current source/voltage monitor. Thus, a bipolar transistor, for example, can be completely characterized in common-base, common-emitter, and common-collector configurations without changing connections—only changing the SMUs' operating modes is required. The HP 4145A is also equipped with two voltage sources and two voltage monitors for measurements on devices having more than four terminals, such as ICs.

The HP 4145A can be controlled from the front panel, via the HP-IB (standard), or by measurement setups stored on flexible discs.

Displayed information—measurement setups, auto-sequence programs, measurement results—can be dumped directly onto an external digital printer/plotter to obtain publication quality hard copies. Also, measurement results can be sent via the HP-IB to a computer for further processing.

### Auto Sequence Programs

Measurement programs stored on a HP 4145A flexible disc can be linked by an auto sequence program, making it possible to perform a series of measurements with just one keystroke.

### Four User-Selectable Display Formats to Suit the Evaluation

Measurement results can be displayed in one of four display formats: GRAPHICS, LIST, MATRIX or SCHMOOS. After measurement has been made and the results displayed, the softkeys can be used to access various analysis functions for complete device evaluation. These functions include MARKER for numeric readout of measured value at any point along a plotted curve, CURSOR for numeric readout of value at any graphic point and for line positioning, STORE/RECALL for overlay comparisons, AUTO SCALE for optimum graphic scaling, and LINE FUNCTION for direct readout of line gradient and X-Y axes intercept values.

# COMPONENT & SEMICONDUCTOR MEASUREMENT

Switching Matrix  
Models 4145A, 4085M



## HP 4145A Specifications

**Stimulus measurement unit (SMU):** four SMUs are built into the HP 4145A. Each SMU can be programmed to source voltage and monitor current, or conversely to source current and monitor voltage.

**Output/measurement resolution:** voltage, 4 1/2 digits; current, 4 digits

**Maximum capacitive load:** 1000 pF

### SMU Range, Resolution and Accuracy

Voltage Range	Resolution	Accuracy <sup>1,2</sup>	Max. Current
±20 V	1 mV	±(0.1% of reading + 0.05% of range + 0.4 Ω × I <sub>out</sub> )	100 mA
±40 V	2 mV		50 mA
±100 V	5 mV		20 mA

Current Range	Resolution	Accuracy <sup>1,2</sup>	Max. Voltage
±100 mA	100 μA	±[0.3% + (0.1 + 0.2 × V <sub>out</sub> /100)%]	20 V (I > 50 mA)
±10 mA	10 μA		40 V (20 mA < I ≤ 50 mA)
±1000 μA	1 μA		100 V (I ≤ 20 mA)
±100 μA	100 nA	±[0.5% + (0.1 + 0.2 × V <sub>out</sub> /100)%]	100 V
±10 μA	10 nA		
±1000 nA	1 nA	±[1% + (0.1 + 0.2 × V <sub>out</sub> /100)% + 5 pA]	100 V
±100 nA	100 pA		
±10 nA	10 pA		
±1000 pA	1 pA*		

I<sub>out</sub> is SMU output current in amps.

V<sub>out</sub> is SMU output voltage in volts.

\*50 fA resolution in current monitor mode.

- Accuracy specifications are given as ±% of reading or setting value ±% of range.
- Accuracy tolerances are specified at 25°C ±5°C, after a 40 minute warm-up time, with AUTO CAL on, and specified at the rear panel connector terminals referenced to SMU common. Tolerances are doubled for the extended temperature range of 10°C to 40°C.

### Voltage Sources (Vs) Characteristics: 2 units

#### Voltage Output Range, Resolution and Accuracy

Output Voltage Range	Resolution	Accuracy	Max. Output Current
±20 V	1 mV	±(0.5% of setting + 10 mV)	10 mA

### Voltage Monitors (Vm) Characteristics: 2 units

#### Voltage Measurement Range, Resolution and Accuracy

Measurement Voltage Range	Resolution	Accuracy
±2 V	100 μV	±(0.5% of reading + 10 mV)
±20 V	1 mV	±(0.2% of reading + 10 mV)

**No. of Measurement Steps:** 512 for a single VAR 1 sweep.  
Max. 570 for a multiple sweep

### Analysis

**Calculation:** two user functions can be input and keyboard calculations can be done using the following 11 operators: +, -, \*, /, √, EXP, LOG, LN, \*\* (power), ABS (absolute) and Δ (differential).

**Analysis functions:** overlay comparison with STORE/RECALL, Marker, Interpolate, Cursor, Auto scale, Zoom function (←→, →←, ||, ||), Line and Move Window.

### General Specifications

**Operating temperature range:** +10°C to +40°C; ≤70% RH at 40°C, permissible temperature change ≤1°C/5 min.

**Power requirements:** 100/120/220 V ±10%; 240 V - 10% + 5%; 48 to 66 Hz; 270 VA max.

**Dimensions:** 426 mm W x 235 mm H x 612 mm D (16.75" x 9.06" x 24.1").

**Weight:** 27 kg (59 lb) approximately.

### Accessories Furnished

- HP 16058A Test Fixture
- HP 04145-61501 Disc Set
- HP 04145-60001 Connector Plate
- HP 04145-61622 Triaxial Cable (3m), 4 ea.
- HP 04145-61630 BNC Cable (3m), 4 ea.
- HP 04145-61623 Shorting Connector

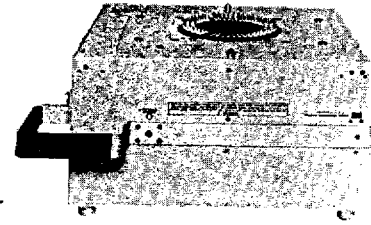
### Ordering Information

HP 4145A Semiconductor Parameter Analyzer

Opt. 050/060: 50Hz/60Hz Line Frequency



Switching Matrix Controller



Switching Matrix

HP 4085M

## HP 4085M Description

Combining the HP 4085M switching matrix with the HP 4145A Semiconductor Parameter Analyzer produces a 1 pA, 1 mV switching system capable of 48-pin high resolution semiconductor testing.

A design which minimizes both noise and leakage current mean exceptional built-in dc measurement capabilities and the realization of 1 pA resolution measurements at any one of the 48 pins.

The software included with the system makes it possible to freely switch any one of the eight instrument ports to any one of the test pins from the system controller. A number of fixtures are available for wafer and various packaged device measurements. The HP 4085M retains the HP 4145B's full measurement capabilities to obtain highly reliable wide range dc parameter measurements.

## Specifications

### Switching Matrix

**DUT Pins:** From 12 to 48 pins can be installed.

**Instrument Ports:**\* Eight instrument ports are included.

**Low Leakage SMU Port:** 1 ea. (Port 1)

**SMU Ports:** 3 ea. (Port 2 - 4)

**Vs Ports:** 2 ea. (Vs Port 1 and 2)

**Vm Ports:** 2 ea. (Vm Port 1 and 2)

\*SMU: Stimulus Measurement Unit

Vs : Voltage Source

Vm : Voltage Monitor

**Maximum Voltage between Instrument Ports:** ±220 Vdc

**Maximum Current at each DUT Pin:** ±500 mA dc

### General Specifications

**Power Requirement:** 100/120/220 V ±10%, 240 V + 5% - 10%, 48 - 66 Hz, 130 VA max.

**Dimensions:** 426 (W) x 134 (H) x 432 (D) mm (Switching Matrix Controller),

406 (W) x 210 (H) x 380 (D) mm (Switching Matrix)

**Weight:** Approx. 25.3 kg (56 lbs) (Switching Matrix Controller),  
Approx. 8 kg (18 lbs) (Switching Matrix)

### System Controller

**Required Controller:** HP 9000 Series 200 Desktop Computer (model 216S or 236A/S).

**Required Memory Size:** >320 KByte.

**Language System:** BASIC 2.0 or later version

### Ordering Information

HP 4085M Switching Matrix (does not include controller)

Opt. 001: 12-pin system

Opt. 002: 24-pin system

Opt. 003: 36-pin system

Opt. 004: Add one pin

Opt. 016:\* 3 1/2" system software disc

Opt. 036:\* 5 1/4" system software disc

\* Must order either OPT. 016 or OPT. 036

Refer to the 4085M data sheet for details.