

# SEMICONDUCTOR TEST EQUIPMENT

## pA Meter/DC Voltage Source

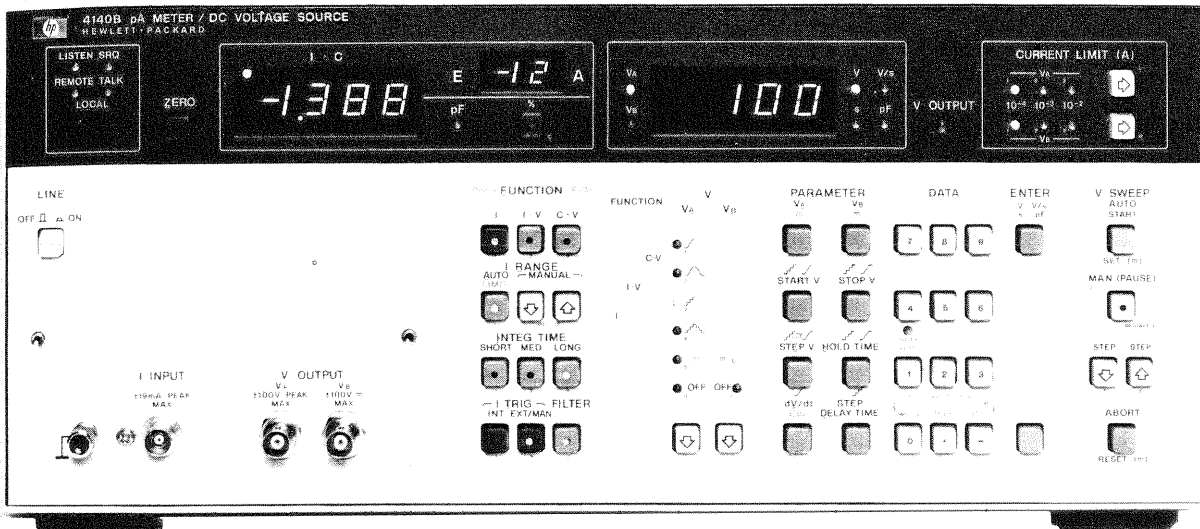
249



Model 4140B

- 3 basic semiconductor measurements: I, I-V and quasi-static C-V
- Two programmable voltage sources

- Basic accuracy: 0.5%
- High resolution:  $0.001 \times 10^{-12}$
- HP-IB standard



HP 4140B



### Description

The HP 4140B pA Meter/DC Voltage Source is another in Hewlett-Packard's new generation of Component Measurement instrumentation. It consists of an extremely stable picoampere meter and two programmable dc voltage sources, one of which operates as a ramp and staircase generator as well as a dc source. These features make the HP 4140B ideal for making dc characteristic measurements such as leakage current, current-voltage characteristics and quasi-static C-V measurements required by the semiconductor industry for new product development and for improving production yields. It is equally useful in measurements of electronic components and materials to determine leakage currents or insulation resistances.

The HP 4140B can contribute to the development, production and quality control of semiconductor devices and to the improvement in the reliability of electronic components and equipment.

### Stable pA Measurements

Stable picoampere measurements can be made with the HP 4140B with a maximum resolution of  $10^{-15}$  A. This is made possible by a new measurement technique in conjunction with an offset current capability, low noise test leads, and an electrostatic and light shielded test fixture. These features provide both stable and fast picoampere measurements.

This measurement technique is very useful in making small leakage current measurements and determining dc parameters of semiconductor devices or measuring the insulation resistance and leakage current for dielectric absorption measurements necessary in the analysis of capacitors or insulation materials.

### Synchronized I-V Measurements

The HP 4140B makes automatic, synchronized current-voltage measurements that have required a large instrumentation system in the past.

The two voltage sources in the HP 4140B operate over a range of -100 V to +100 V with a maximum resolution of 10 mV. One operates only as a stable dc source while the other generates a staircase voltage, a precise ramp or a stable dc level.

By adding precise, programmable timing capability, we can now make fast, accurate I-V and C-V measurements. Device stabilization times, (time between the applied voltage and the subsequent current

measurement) can now be programmed from the front panel of the HP 4140B or via the HP-IB bus.

### Quasi-Static C-V Measurements

Automatic quasi-static C-V measurements are easily accomplished by the ramp voltage capability of the HP 4140B. This measurement is highly significant in evaluating basic semiconductor characteristics.

The HP 4140B operates over a capacitance range of 0.1 pF to 1999 pF with a dc voltage ramp rate of 1 mV/s to 1 V/s in 1 mV/s increments. Capacitance, which is calculated from the measured current divided by the ramp rate, can also be provided as a percent of the capacitance of the oxide film ( $C_{ox}$ ) over a range of 0.0 to 199.9%. By providing the output voltage at each capacitance measurement point, we have the dc (quasi-static) C-V characteristics of the device under test.

### HP-IB Capability

Interfacing the HP 4140B to an HP-IB system improves measurement efficiency and takes advantage of its high speed (approx 5 ms) measurement rate. Such a system will minimize measurement time of dc parameters of semiconductors and the insulation resistance and leakage current of electric components and materials. This allows rapid feedback to production for fast evaluation of a new device in the development stage.

### Specifications

**Measurement functions:** I, I-V and C-V

**Voltage sources:** two separate sources ( $V_A$  and  $V_B$ )

$V_A$ :  $\pm 100$  V programmable source/function generator

$V_B$ :  $\pm 100$  V programmable dc voltage source

### Measurement Function/Source Selection

Function	$V_A$	$V_B$
I		--- (DC)
I-V		--- (DC)
C-V		--- (DC)