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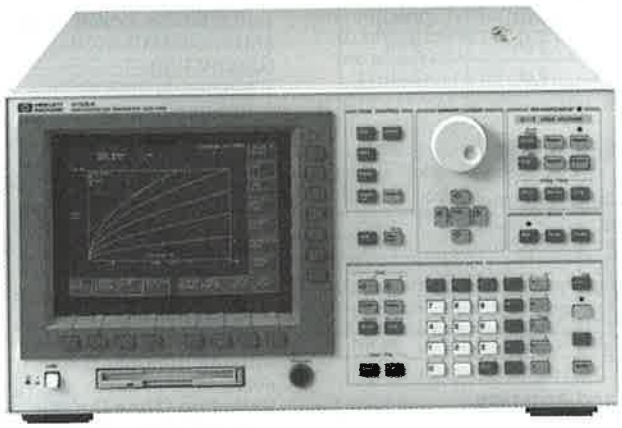
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- High-resolution/accuracy and wide range I: 1 fA-1 A (20 fA offset accuracy), V: 1 μV-200 V
- Fully automated IV sweep measurements with dc or pulse mode, expand up to 6 SMUs.
- Fully automated reliability evaluation: synchronized stress/measure function, two high-voltage pulse generator units (±40 V)
- Time domain measurement: 60 μs-variable intervals, up to 10,001 points
- Easy to use: industry-standard HP 4145B-like operation, knob sweep similar to curve tracer, automatic analysis functions, color graphic display
- Automation: Built-in HP Instrument BASIC, trigger I/O capability
- Windows-based PC software is available for controlling the HP 4155A/56A and analysis.



HP 4155A

HP 4155A Semiconductor Parameter Analyzer HP 4156A Precision Semiconductor Parameter Analyzer

These two analyzers have unique features such as knob sweep, stress function, high-resolution/accuracy measurement capability, and two pulse generator units that contribute to improving small geometry device quality and time-to-market. They have HP 4145B-like easy operation and automatic graphical analysis and are easy to use in a system, which expands areas of application to quality assurance and online monitoring.

Hardware

The four SMUs of the HP 4156A are high-resolution SMUs (HRSMU) capable of measurement down to 1fA/2 μV resolution. The HP 4155A has four medium power SMUs (MPSMU) with resolution of 10 fA/2 μV. HP 4155A and HP 4156A both have two voltage source units (VSU: 20 V, 100 mA) and two voltage monitor units (VMU: 1 μV resolution in differential mode).

The HP 41501A (SMU and pulse generator expander) can expand measuring capability of the HP 4155/56A by installing two high-voltage pulse generator units (PGU: ±40 V, 200 mA), a ground unit (GNDU), and a high-power SMU (HPSMU: 200 V, 1 A) or two MPSMUs (100 V, 100 mA).

Setup and Measurement

HP 4155/56A can perform staircase and pulse sweep measurement, and sampling (time domain) measurement using many measurement units, including units in the HP 41501A, without changing connections. Moreover you can easily perform stress-measure cycling test for reliability evaluation such as hot carrier injection and flash EEPROM test.

Setup and measurement are made by setting up pages and filling in the blanks from front panel keys, keyboard, or HP-IB (SCPI commands). You can also instantly measure and find setup conditions by using knob sweep capability, which is similar to curve tracer operation.

Display and Analysis

The measurement and analysis results are displayed on the color CRT, and you can superimpose stored graphics from four graphic memories for comparison. A number of powerful graphical analysis tools make it easy to analyze and extract many parameters such as hfe and Vth.

Once you find the parameter extraction conditions, you can automatically get the parameter by using the automatic analysis function.

Output and Storage

Setup, measurement, and analysis data can be output via HP-IB or serial interface to a color plotter and printer. You can also save the data onto a 3-inch disk in MS-DOS or LIF format. Graphic (HP-GL or PCL) output file allows you to transfer graphics to desktop publishing software.

Application-Specific Accessories

SMU/pulse generator selector (HP 16440A) can select SMUs or pulse generators up to four channels, which easily enables HP 4155/56A applications such as ac hot carrier injection and flash EEPROM test.

R-Box (HP 16441A) adds a selectable series resistor to the SMU output up to two channels.

You can perform V-Ramp, hot carrier injection, flash EEPROM test, and more by sample application software which helps you to easily perform reliability testing with the HP 4155/56A.

Repeating and Automating Tests

The HP Instrument BASIC controller built into the HP 4155/56A can construct an automatic measurement system using external instruments without a controller. HP 4155/56A can be synchronized with external instruments by the versatile trigger I/O functions.

Interactive Characterization Software

Windows-based PC software is available for interactive measurement control and data analysis of the HP 4155A/56A and HP 4142B.

SEMICONDUCTOR TEST SYSTEMS

Semiconductor Parameter Analyzer (cont'd)

HP 4155A, 4156A

HP 4145B Data Compatibility and HP 4145B Syntax Command Set

HP 4155/56A can load measurement setup and data of the HP 4145B, and has a command set that has the same syntax as the HP 4145B commands.

Specifications

Hardware

Configuration

	High resolution SMUs (HRSMU)	Medium power SMUs (MPSMU)	Voltage source unit (VSU)	Voltage monitor unit (VMU)
HP 4155A	0 ch	4 ch	2 ch	2 ch
HP 4156A	4 ch	0 ch	2 ch	2 ch

HP 4156A

SMU Measurement Resolution: 6 digits

HRSMU Voltage Range, Resolution, and Accuracy

Voltage range	Set. reso.	Set. accuracy	Meas. reso.	Meas. accuracy	Max. current
±2 V	100 μV	±(0.02% +400 μV)	2 μV	±(0.01% +200 μV)	100 mA
±20 V	1 mV	±(0.02% +3 mV)	20 μV	±(0.01% +1 mV)	100 mA
±40 V	2 mV	±(0.025% +6 mV)	40 μV	±(0.015% +2 mV)	50 mA
±100 V	5 mV	±(0.03% +15 mV)	100 μV	±(0.02% +5 mV)	20 mA

HRSMU Current Range, Resolution and Accuracy

Current range	Set. reso.	Set. accuracy	Meas. reso.	Meas. accuracy	Max. V
±10 pA	10 fA	±(4% + 400 fA)*1	1 fA	±(4% + 20 fA + 1 fA × Vout/100)*1	100 V
±100 pA	10 fA	±(4% + 400 fA)*1	1 fA	±(4% + 40 fA + 10 fA × Vout/100)*1	100 V
±1 nA	100 fA	±(0.5% + 0.7 pA + 1 fA × Vout)	10 fA	±(0.5% + 0.4 pA + 1 fA × Vout)	100 V
±10 nA	1 pA	±(0.5% + 4 pA + 10 fA × Vout)	10 fA	±(0.5% + 2 pA + 10 fA × Vout)	100 V
±100 nA	10 pA	±(0.12% + 40 pA + 100 fA × Vout)	100 fA	±(0.1% + 20 pA + 100 fA × Vout)	100 V
±1 μA	100 pA	±(0.12% + 400 pA + 1 pA × Vout)	1 pA	±(0.1% + 200 pA + 1 pA × Vout)	100 V
±10 μA	1 nA	±(0.07% + 4 nA + 10 pA × Vout)	10 pA	±(0.05% + 2 nA + 10 pA × Vout)	100 V
±100 μA	10 nA	±(0.07% + 40 nA + 100 pA × Vout)	100 pA	±(0.05% + 20 nA + 100 pA × Vout)	100 V
±1 mA	100 nA	±(0.06% + 400 nA + 1 nA × Vout)	1 nA	±(0.04% + 200 nA + 1 nA × Vout)	100 V
±10 mA	1 μA	±(0.06% + 4 μA + 10 nA × Vout)	10 nA	±(0.04% + 2 μA + 10 nA × Vout)	100 V
±100 mA	10 μA	±(0.12% + 40 μA + 100 nA × Vout)	100 nA	±(0.1% + 20 μA + 100 nA × Vout)	100 V *2

Connection: Kelvin

Accuracy specifications are given as ±% of reading value when measuring or ±% of setting value when sourcing.

Vout is SMU output voltage in volts.

*1: The value when offset cancel is performed.

*2: 100 V (|I0| <=20 mA), 40 V (20 mA < |I0| <=50 mA), 20 V (50 mA < |I0|) (I0: output current)

Voltage Source Unit (VSU) Characteristics

Number of sources: 2
Maximum voltage: 20 V
Maximum current: 100 mA

Voltage Monitor Unit (VMU) Characteristics

Number of monitors: 2
Voltage range: 0.2, 2, 20
Measurement resolution:
Normal mode: 2 μV
Differential measurement mode: 1 μV

HP 4155A

Four medium-power SMUs (MPSMUs)
Connection: Non-Kelvin
Range of Operation: 2 μV to 100 V, 10 fA to 100 mA
Accuracy: Set and measurement accuracies are different from the HP 4156A.

HP 41501A

Two Pulse Generator Units (PGUs)

Amplitude: 0 Vp-p to 40 Vp-p
Window: −40.0 V to +40.0 V
Maximum current: ±200 mA (Pulse Width: <=1 ms, average current ≤100 mA)
Pulse width: 1.0 μs to 9.99 s, 100 ns resolution
Pulse period: 2.0 μs to 10.0 s, 100 ns resolution
Transition time: 100 ns to 10 ms, 1 ns resolution
Source impedance: 50 Ω or Low Z (1 Ω max) is selectable.

High-Power SMU (HPSMU)

Range of operation: 2 μV to 200 V, 10 fA to 1 A
Connection: Kelvin

Two Medium-Power SMUs (MPSMUs): Same specifications as SMU of the HP 4155A.

Ground Unit

Maximum sink current: 1.6A
Connection: Kelvin

Measurement

Synchronized Voltage/Current Sweep Characteristics

Linear or logarithmic sweep
Staircase or pulsed sweep
Single staircase or double staircase

Pulse Measurement

Pulse width: 500 μs to 100 ms, 100 μs resolution
Pulse period: 5 ms to 1 s, 100 μs resolution

Knob Sweep: In the knob sweep mode, sweep range is controlled with the front-panel rotary knob. Only the channel definition page needs to be defined.

Sampling (Time Domain) Measurement

Sampling mode: Linear or log
Measurement interval: 60 μs to 65.535 s
Maximum number of sample points: 10001
Thinned-out function: Enables HP 4155A and 4156A to measure until the sampling completion condition is satisfied.

Stress Force Function: Stress function can control period of dc or ac outputs or number of pulse counts. Combining stress force function and measurement function, you can easily perform reliability test.

Voltage/Current/Power Compliance: All SMUs can limit output voltage or current to prevent damage to device under test.

Display and Analysis

Display Mode: Graphics, List, and Sampling (Time Domain)

Analysis Functions:

- 18 arithmetic operators and three physical constants.
- 6 user functions can set up user-defined arithmetic expression.
- Overlay graph comparison (memory for four graphs), Marker, Cursor, Line, Interpolation, Auto scale, Zoom, Data variable display, Automatic Analysis Function

General Specifications

Operating Temperature Range: 10° C to 40° C
Operating Humidity Range: 15% to 80% RH at 40° C (no condensation)
Power: 100/120/220/240 V ±10%, 47 to 63 Hz, HP 4155/56A: 600 VA max, HP 41501A: 450 VA max

Size

HP 4155/56A: 235 mm H × 426 mm W × 600 mm D
HP 41501A: 190 mm H × 426 mm W × 600 mm D

Weight (approximate)

HP 4155/56A: 25 kg
HP 41501A: 15 kg

Ordering Information

	Price
HP 4155A Semiconductor Parameter Analyzer	$29,600
HP 4156A Precision Semiconductor Parameter Analyzer	$36,150
HP 41501A SMU and Pulse Generator Expander	$13,500–$23,350
HP 16440A SMU/Pulse Generator Selector	$1,155
HP 16441A R-Box	$2,435
HP 16442A Test Fixture	$4,930
HP E5230A Interactive Characterization Software	$2,000
HP E5231A I-V Parametric Driver Library	$1,000

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