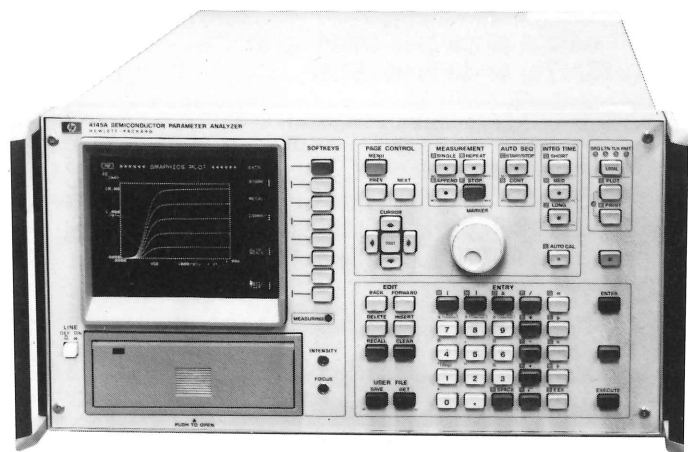
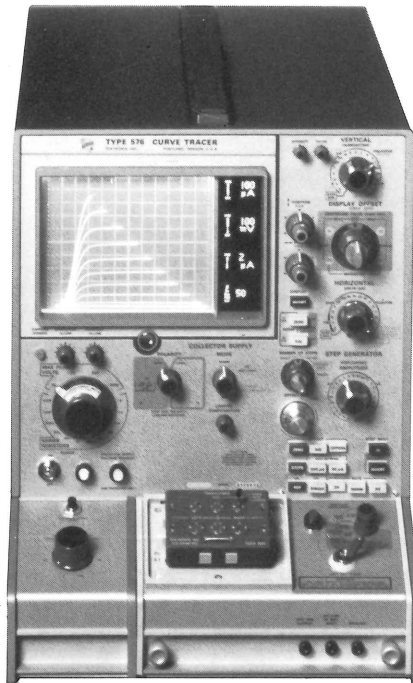
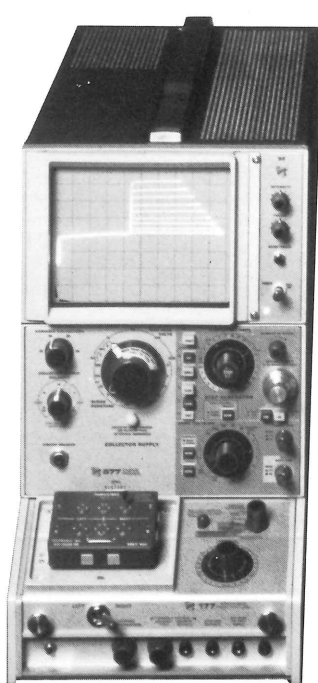


FEATURES COMPARISON OF TEKTRONIX CURVE TRACERS VERSUS HP4145A SEMICONDUCTOR PARAMETER ANALYZER



Introduction

Tektronix has an excellent line of curve tracers developed over the last twenty years. Using mainframes with interchangeable test fixtures, they provide realtime, DC parameter test capability for most semiconductor devices. In 1982 Hewlett-Packard entered the market with their HP4145A Semiconductor Parameter Analyzer, manufactured by Yokogawa-Hewlett-Packard Ltd. in Japan.

A casual look at the HP4145A might make you think that it is a very powerful instrument that will give our 576 and 577 Curve Tracers serious competition. However closer examination, reveals that it has some very serious limitations as a curve tracer. It could be argued that it is not a curve tracer at all. HP calls it a Semiconductor Parameter Analyzer, which is a more accurate description. Let's examine architectural differences.

Architecture

The architecture of the HP4145A is quite different from our curve tracers. It has four supplies, each can be a voltage source with a current monitor or a current source with a voltage monitor. These are called Stimulus/ Measurement Units (SMU's). One of these supplies can be swept, and it is typically connected to the collector, drain or anode of a device. The 576 and 577 use a sinewave, a rectified sinewave or a manually swept DC voltage for the collector supply. A second supply in the HP4145A can be stepped and operates much like the Base Step Generator in a 576 or 577 and is normally connected to the base or gate of the device just like the Base Step Generator in the 576 or 577. A third supply in the HP4145A can be used in conjunction with the swept supply to provide offset. Additional

supplies in the HP4145A analyzer can be used to bias other terminals or substrates.

The HP4145A is a micro-processor based digitizing instrument making possible a number of nice features.

These include menu driven operation, storage/recall of test setups and waveform storage on the floppy disk. Once the characteristics have been acquired (digitized), readout of current and voltage of a positioned marker is provided. Some mathematical operations are available using data entry keys, and three stored constants ease computation in some applications.

Tektronix curve tracers have front panel controls. These allow realtime operation — one can immediately see the effects of a change in collector volts for example.

Tektronix Curve Tracers

HP4145A

Collector Peak Power

The standard 576 curve tracer can supply 220 watts, the 577/177 - 100 watts.

Limited to 2 watts maximum.

Collector Voltage and Current

A wide range of voltage and current capability is available. 15V/10A, 1500V/100mA.

Limited to 100V/20mA, 20V/100mA.

Step Generator

Current and voltage steps plus offset up to 20 Amps (576/176) or 40 Volts (576).

Limited to 100mA or 100V.

Note: The curve tracer market for testing power devices is growing rapidly. High power being the highest growth rate portion of the discrete semiconductor market. The HP4145A is very limited in the range of devices it can test because of the available power. It is not possible to fully test power transistors, thyristors, high voltage zeners, diodes or any device requiring current in excess of 100mA, or voltages over 100 Volts. The range of the HP4145A can be extended with HP autoranging DC power supplies. The available current is increased, but additional computation is necessary to obtain the correct scale factors.

Realtime Display

A realtime display is always available. Most customers want to view device behavior as conditions are varied. One can, for example, vary collector volts in the region of breakdown and immediately see the effect.

The digitized waveform is the only one available to view. To vary and view the effect of changing collector volts, one has to change source setup conditions and change scaling for the display. This is done by softkey selection from menus, or by a controller over the interface. For each change the waveform must be reacquired, and displayed. This can be very frustrating to the

COMPARISON CHART HP4145A vs. TEKTRONIX CURVE TRACERS

FEATURE	576	HP4145A	577/177	577/178	576/176	7CT1N/5CT1N
Coll. Sup.						
Peak Power	220W	2W	100W	100W	1000W *	0.5W
Volt/Curr.	15V/10A	20V/100mA	6.5V/10A	Same as 577/177	15V/200A *	7.5V/240mA
	75V/2A	40V/50mA	25V/2.5A		75V/40A	30V/60mA
	350V/0.5A	100V/20mA	100V/0.6A		350V/8A *	75V/24mA
	1500V/100mA		400V/150mA			300V/6mA
			1600V/40mA			
Step Gen.						
Current	5nA-200mA	1pA-100mA	5nA-200mA	5nA-200mA	5nA-20A	1 μ A-1mA
Voltage	5mV-2V	1mV-100V	5mV-2V	5mV-2V		1mV-1V
Measurement						
Vert. (/Div)		Range not "DIV"				
	1 μ A-2A (Ic)	1pA-100mA	0.2nA-2A	5pA-50mA	1 μ A-20A	10nA-20mA
	1nA-2mA (Ie)	1mV-100V		1 μ V-50mV		
Horiz. (/Div)		Range not "Div"				
	5mV-200V (Vc)	1pA-100mA	5mV-200V (Vc)	5mV-200V	5mV-200V (Vc)	0.5V-20V
	5mV-2V (Vb)	1mV-100V	5mV-2V (Vb)		5mV-2V (Vb)	

*Pulsed Operation

Tektronix Curve Tracers

HP4145A

Reliability	
Tektronix curve tracers have a long history of reliability in all user environments. (This has proven to be particularly important to merchant semiconductor manufacturers).	No reports available.
Performance Characteristics	
Valid over an ambient temperature range of +10° C to +40° C.	Valid over +18° C to +28°C, doubles between +10° C and +40° C.
Auxiliary Supplies	
The 577/177 has one auxiliary supply 0 to ±12V. 576 has none.	The HP4145A has two auxiliary supplies of 0 to ±20V.
Pricing	
577/D1/177 = \$7,685 577/D2/177 = \$6,815 576 = \$11,455	HP4145A = \$19,300 (approx.)

Markets

The HP4145A fits the needs of the semiconductor design engineer who is using it frequently and is familiar with its operation and idiosyncracies. We have found that most have been sold in this market segment. However it is not well suited to the other segments of the market like Q.C., Incoming Inspection, general R & D, and Service, primarily because of its low power, poor human interface and non-real time operation. Tektronix Curve Tracers are much better suited to these segments. They are high power, real time, and users are familiar with their operation.

It's interesting to note that almost all of the HP4145As that we found, when talking to customers, had a Tek Curve Tracer nearby for "quick look" capability.

Summary

Semiconductor sales and the sales of equipment to test semiconductors are growing at a very healthy rate. Our curve tracers sales were up significantly last year and we believe they are going to go up again this year.

The HP4145A is a nice instrument but should not compete effectively in most market segments.

Curve tracers represent a significant sales opportunity for you. While you're selling other products look for opportunities to sell curve tracers and if we in Lab Instruments Marketing can be of any help let us know.

Laurie Lawrence
Applications Marketing
Laboratory Instruments Division
Tektronix, Inc.

The author offers special thanks for the able assistance of Emory Harry and Norb Luersen

Tektronix Curve Tracers

HP4145A

Realtime Display (cont)	beginner or casual user of curve tracers. Many users have found that the buffer memory in which the digitized waveform is stored, was much too small for their needs.
Connections/Fixturing	
<p>A wide range of sockets, adapters and fixtures are available to provide connection to most semiconductor devices.</p> <p>Fixturing is easy to discrete devices, more difficult to wafer probers.</p> <p>Kelvin Sensing</p> <p>Use of Kelvin sensing for greater measurement accuracy when measuring larger currents.</p>	<p>A range of socket boards are available for small signal devices to provide connection from the device under test to the test fixture. Patch connections are used on the test fixture. This can be a time consuming task.</p> <p>Easy connection to wafer probers, more difficult to discrete devices.</p> <p>Driven Guards</p> <p>Use of driven guards for greater measurement accuracy when measuring low current.</p>
Test Setup	
<p>Test setup charts are available on which setups can be recorded. These can be used as an aid when setting up the test again.</p>	<p>The ability to store setup on floppy disk and recall them is a nice feature. However the operating system resides on the disc and leaves less than 40K bytes available as user area for setup and data storage.</p>
Storage/Recall of Waveforms	
<p>577/D1 with its storage capability provides multiple waveform comparison facilities.</p>	<p>The digitized curves can be stored and recalled for comparison.</p>
Display Offset	
<p>This permits more accurate measurements and better resolution of a selected portion of the characteristic curves. (576).</p>	<p>Zoom and window permit graphic plot expansion of a selected portion of the characteristic curve. Resolution can only be improved by changing setups, digitizing, and then regraphing.</p>
 GPIB (HPIB) Interface	
<p>Most customers do not require this feature at the present time, but think that it may be a necessity within a few years.</p>	<p>Allows control/data collection and analysis with an external computer.</p>
Auto-Sequence of Tests	
<p>The 576/172 will provide automatic sequence of the 11 tests of FETS, transistors, or diodes.</p>	<p>Readily available (for the low power devices that the HP4145A is capable of testing) through sequences stored on the floppy disk.</p>
Additional Features Because of Microprocessor	
<p>No microprocessor.</p>	<p>Auto Calibration Self-test Autoscaling Averaging Good Graphics Computation Note: The low sampling rate can result in very long averaging time.</p>
Permanent Records of Characteristic Curves	
<p>Limited to camera only.</p>	<p>By means of an added X-Y plotter or by a camera.</p>

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