New Products

Instruments

Curve tracer shows scale and beta

Features of transistor tester with digital display may foreshadow significant design changes in many other Tektronix products

By Walter Barney

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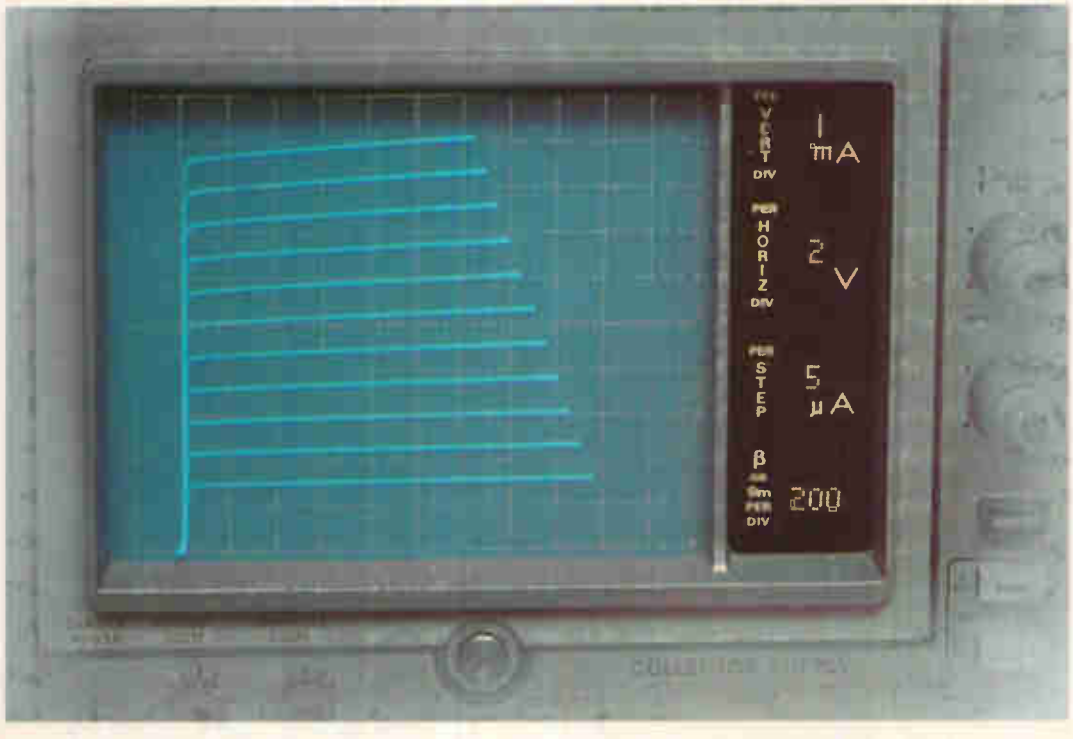
A new generation of transistor curve tracers will be introduced in Boston next week with features that are likely to reappear in most other new offspring of the parent, Tektronix Inc. The instrument company will show the tracer, christened the Type 576, at the Northeast Electronics Research and Engineering Meeting, Nov. 6-8.

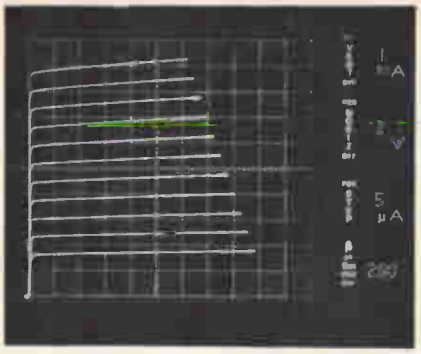
The features of the 576 include:

- A digital display of cathode-ray tube calibration, so the user knows the deflection parameters at a glance.
- Automatic calculation and display of beta per division on the crt.
- Performance of both parameter display and beta calculation by nine Tektronix integrated circuits that do the job of about 60 commercial IC's—but aren't complex circuits in the usual sense.
- Use of a new type of cam switch that replaces the conventional rotary switch and reduces torque requirements by 75%.

The most striking difference between the 576 and other curve tracers is the panel of parameter readouts at the right of the crt. The top two displays give vertical and hori-



Full disclosure. Transistor performance is spelled out on front panel of curve tracer by digital display of horizontal and vertical scale, increments of input current, and transistor gain, which is calculated by the instrument.



For the record. Engineer gets photo complete with calibrated readout.

zontal deflection per centimeter on the crt face. Because these readouts appear on the user's Polaroid pictures of his transistor curves, they needn't be written down. The readouts use fiber optics designed and built by Tektronix. They are so new that the company does not yet have a camera that will fit the 6.5-inch crt plus the readout. A suitable hood can be jury-rigged, and Tektronix promises a special camera within a year.

The third parameter display is for step-generator current or voltage amplitude. The fourth parameter, beta per division, requires a calculation by the user of conventional instruments.

Logic hodgepodge

All the electronics to display these parameters, including beta calculator and the logic that selects the proper readout, plus lamp drivers and the fiber optics, are on a single circuit card. The nine IC's on this card represent Tektronix's response to what the company calls the indifference of the semiconductor industry. "The big IC manufacturers have kind of given up on us," says Larry Bowman, manager of IC engineering. Tektronix and other instrument makers may want to integrate a circuit whose anticipated volume is as low as 3,000 to 4,000 units a year, but IC makers customarily think in terms of hundreds of thousands of units.

The IC's in the 576 provide digital and analog functions on the same chip, and the digital logic itself is a hodgepodge of logic forms—resistor-transistor, emitter-coupled, transistor-transistor, and some that are peculiar to the chip.

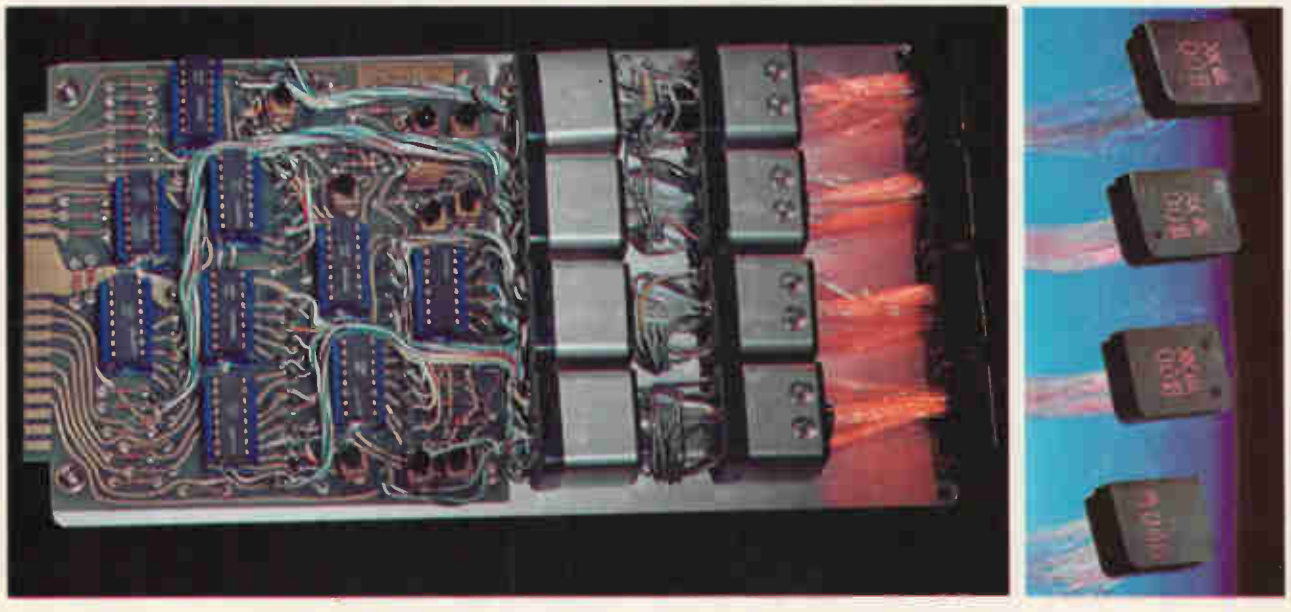
Yet there are only about 500 transistors in the three IC's that make up the beta calculator. And the two types of circuits that generate character readout are also of modest complexity, with about 100 devices on a 60- by 60-mil chip. Designer Michael Metcalf, freed of restrictions of speed and a general-purpose system, was able to mix logic with only the ultimate function in mind. For example, to display a given level of current per vertical division on the crt, Metcalf used a single multiple-emitter transistor to drive three lamps.

Tektronix, with an extensive in-house IC effort, has decided that its own designs can give it a cost and function advantage. The company has about 40 special devices in the design or prototype stages, so the 576 is the first of many instruments that will contain Tektronix IC's.

Simple, really

The 576's displays are not quite as complicated as they might look, since they do not have to show all numbers. The controls for the step generator and the vertical and horizontal divisions are calibrated in Tektronix's normal steps of 1, 2, and 5. Therefore, the only characters displayed are those numbers, plus a 0 (either on or blanked) and the letters designating volts or amps, or showing exponential factors in billionths, millionths, or thousandths. The more complex beta-calculator IC's use a matrix of the vertical deflection and step-generator levels. Metcalf says that making the calculator with off-the-shelf components would have taken 30 quad two-input gates, plus 20 lamp-driving transistors. Yet on the chip, that calculation was done by a transistor matrix.

The optics consist of two sets of bulbs (one with number information, the other governing exponents and units), plus optical fibers that

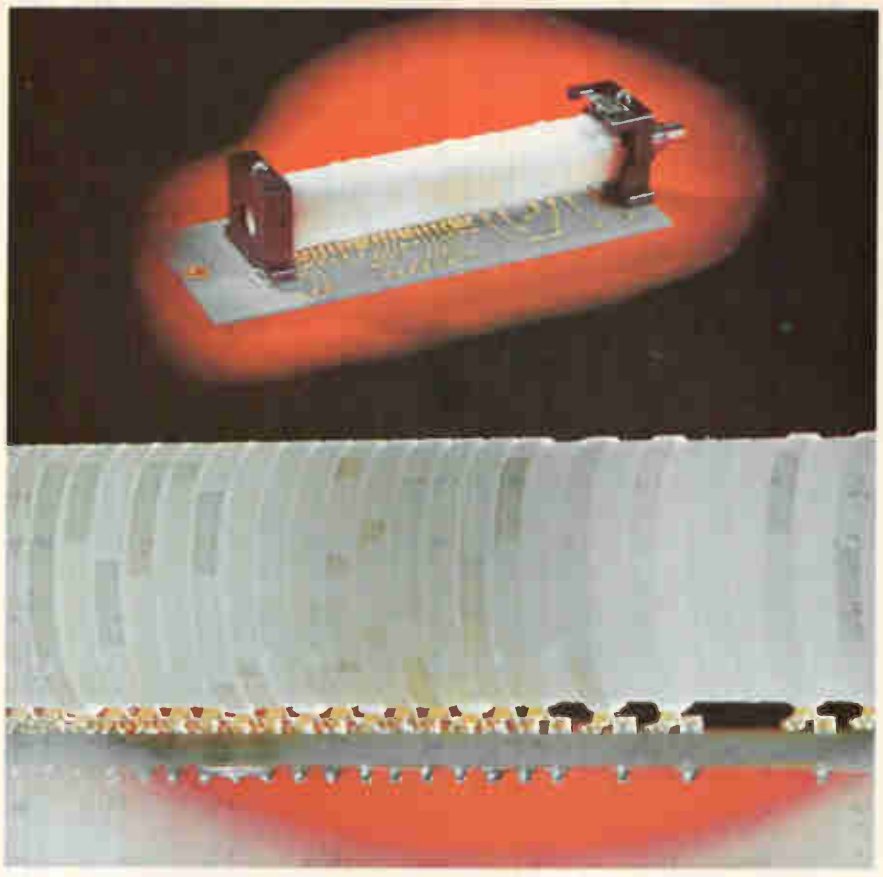


Display electronics. Circuit card contains nine IC's which perform readout logic and calculate beta. It also holds lamp drivers, and the fiber optics which carry light to the character readout sections, right.

end in a plastic faceplate. So simple is the display card that the entire subsystem, including IC's and optics, costs less than $300. The Type 576 will sell for $2,125; it's replacing an 11-year-old tube-type device that costs half as much. Customers not wanting the parameter display will get a reduction of $275; if they decide later to add the display, it will cost them $300.

Anti-squint. Since any oscilloscope measurement requires the user to juggle deflection-factor settings, the parameter displays are almost certain to appear in future Tektronix instruments. Engineers are conditioned to squinting at switch settings, and James H. Knapton, the project manager on the 576, still finds himself doing so even though the numbers are right there on the display.

The Tektronix cam switch works like a music box or player piano. Each contact on the switch is a small spring clip; these are laid out in a row on an etched circuit board. Just above the base rotates a plastic drum with multiple cams. The high points of the cam close the switch, and the low points permit it to spring open. A computer determined where each cam should be high and where low, and a numerically controlled device cut the bumps on the drum.



Bumps and troughs. The 576 uses cam switches, which have lower operating torque than wafer types. Detail, below, shows drum with multiple cams. High points on cams contact clips on etched board to close circuits.

Almost upstaged

The display innovations in the 576 tend to overshadow the curve tracing, which has some important features of its own:

- The collector-voltage range selector and the series resistance selector are combined in concentric switches so maximum available power can be read out directly. This protects the device under test by preventing overheating. The operator can preselect the maximum available power in six positions from 0.1 watt to 220 watts; the switch is designed so that as the voltage range is changed, the appropriate resistors are switched.
- A new display amplifier, with a pair of low-impedance current-summing inputs as well as the customary high-impedance voltage inputs, permits the zero point to be set far off screen and consequently increases resolution. A 21-position display-offset switch provides equal increments of positioning from 0 to 10 divisions, unmagnified, or from 0 to 100 divisions when the 10-power magnifier is turned on.
- A continuously variable step-offset voltage of selectable polarity aids in checking FET's and voltage-driven transistor bases. FET's are difficult to test because they require large voltages and sometimes operate in a combination enhancement-depletion mode, making two setups necessary to complete one family of curves. The 576 has the higher voltage—40 volts maximum—needed for testing FET devices.

The step-offset voltage shifts the range of the step generator so it steps on both sides of zero in a single family of curves. In addition, it allows the starting point of the steps to be set far off screen. This helps in measuring curves for voltage-driven transistor bases, which require more voltage to turn the device on than to scan the operating range.

A single switch changes both collector and step-generator polarity, and positions the trace at the proper starting point, so that the instrument can be changed from the pnp to the npn mode easily. On some previous instruments, it took four switches to do this. The 576 also has an invert switch so that the pnp and npn curves can both be displayed in the same quadrant.

Measurements on power transistors sometimes show loops instead of clean curves because the change in collector voltage changes collector-base capacitance. The 576 has a d-c mode in which filter capacitors are switched into the supply output, and the display consists only of a dot at the end of the curve. As the variable supply is turned down manually, the filter capacitors slowly discharge, and the dot moves along the scope. It traces successive end points that show the full curve, and a photograph taken during the whole sweep would show the curve.

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