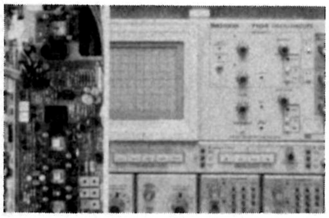

Oscilloscope doubles bandwidth to set new frontier
The pressure for more speed in oscilloscopes has mounted with the soaring speed of logic circuits and data-communications networks, and the ever-upward push of communications frequencies. But the present maximum bandwidth of 500 MHz has resisted breakthrough for five years. Now, however, a new scope finally brings together the essential design elements needed to push the bandwidth barrier aside. Working at 1-GHz and 350-ps rise time, the new unit also shows bright displays of hitherto unviewable single-shot events, without compromising X-Y performance. Two articles tell what new measurement possibilities are promised by the boosted capabilities, and what ingredients are mixed to get the unprecedented speed.

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Plastic fiber-optic assemblies make design a snap
Fiber optics has arrived, but taking advantage of its many performance benefits still costs more than using conventional electronic techniques. However, both fiber-optic components and preassembled data links are coming down in price, particularly for all-plastic designs. Besides offering the best cost effectiveness of any fiber-optic hardware, plastic assemblies are easy to use—and they're specifically intended for high-volume applications. Detector and source assemblies, for example, are available in IC-compatible dual-in-line packages that have pins on standard 0.1-in. centers.

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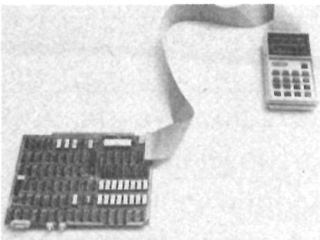

Microcomputers climbing to minicomputer performance
The latest in microcomputers is a new generation of 16-bit systems, many of which can match or exceed the performance of earlier minicomputers. One family of such systems is based on Fairchild's 9440 microprocessor—a bipolar 16-bit chip that can execute Data General's Nova-3 instruction set. The Fairchild systems stand out in the crowd of new 16-bit entries, not only because of their performance, but because the company's marketing people have identified them with a colorful series of names that have fiery connotations—names like Spark, Flame and Glow. Get to know these powerful new processors: You'll find comprehensive descriptions of their capabilities as well as a simple application example.

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Microprogramming struts its advantages in disc control
In many applications, microprogramming with bit-slice chips is clearly better than competing design approaches such as dedicated chips or random logic. Usually the design is more flexible because it can be readily reprogrammed by changing a ROM. In addition, bit slices provide a more compact design than random logic and higher speeds than dedicated MOS chips. The controller for a Shugart SA-4000-series disc drive, described here, clearly demonstrates the power of microprogramming. Using Signetics 2900-series chips, it's fast enough to access a host computer's memory during data transfers, and thus free the host from many routine chores.

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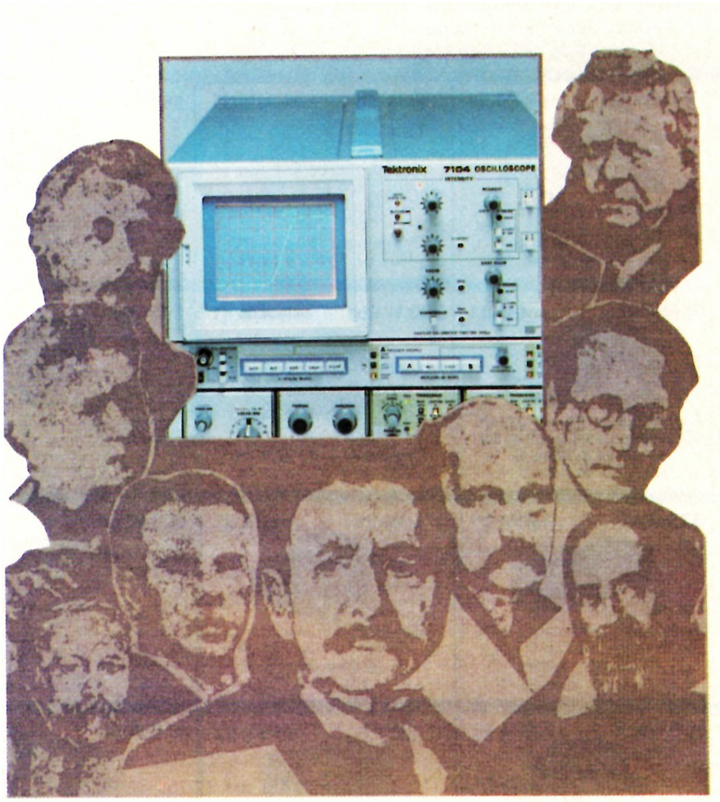
Featured Next Issue

In our February 1 issue:

Special report on data acquisition, from chips to boards...Technique for boosting the bandwidth of fiber-optic receivers...Using multiplier ICs to simplify digital processing of audio signals...Designing reliable systems by predicting relay life accurately.

Viewing the unviewable: A 1-GHz scope unveils fleeting events



Those participating in today's ongoing technological struggle for better performance will appreciate the 7104—an oscilloscope that displays events never seen on a scope before. It provides a bright, real-time display of very fast events, and comes across with a spectacular line-up of parameters:

- A voltage-vs-time bandwidth of 1 GHz.
- A rise time of 350 ps—or less.
- An X-Y bandwidth of 350 MHz.
- A trace almost 1000 times brighter than usual for single-shot events.
- A photographic writing speed of 20 cm/ns.
- Full sweep triggering to 1.5 GHz.
- Compatibility with all 7000-series plug-ins.

Where do the differences lie in an oscilloscope with twice the bandwidth of the present speed leader? And who needs a scope that fast? As events materialize that previously were invisible, the answers begin to show themselves too.

The cry for faster and faster data processing continues to push the development of higher and higher-speed logic components. Simultaneously, crowding in the lower end of the electromagnetic spectrum drives users into ever higher frequencies. Today, it's not unusual to see 250-MHz data rates and 900-MHz analog frequencies outside the lab and on the production line.

Naturally, a corresponding need for measuring equipment to depict circuit behavior at those lofty frequencies crops up. The 7104's bandwidth and writing speed do the job when coupled with persistence of vision. This combination lets you see evasive one-shot events—without a scope camera.

Eric Lane, Marketing Program Manager, Tektronix, Inc., P.O. Box 500, Beaverton, OR 97077.

Looking at one-shots

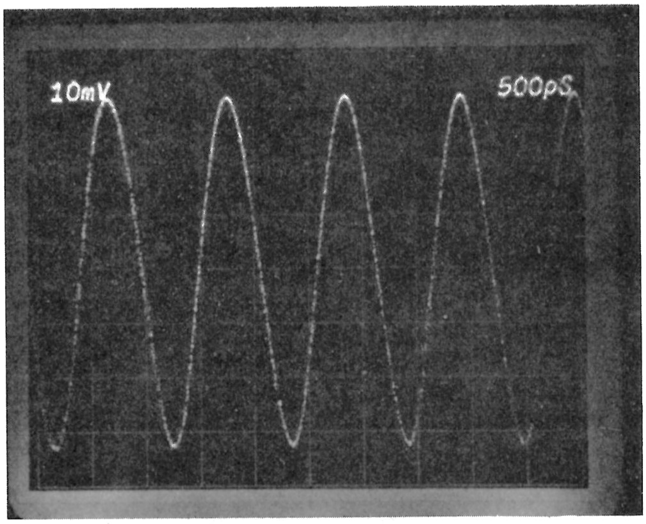
In dealing with fast signals, even an oscilloscope that provides super-wide bandwidth must go further. High writing speed is essential. With its sweep speed set for 200 ps/div, the 7104 has sufficient writing speed to clearly show a single-shot, 350-ps step, six divisions in amplitude—even in normal room light.

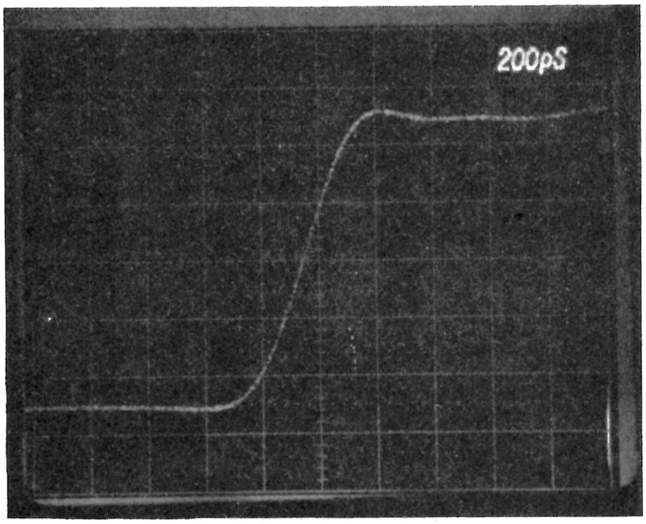
Previous scopes could record steps of that magnitude only if the steps' rise times were slower than 800 ps. Note that word "record." Those scopes could not directly show such fast transients. Sophisticated camera techniques and high-speed film were necessary.

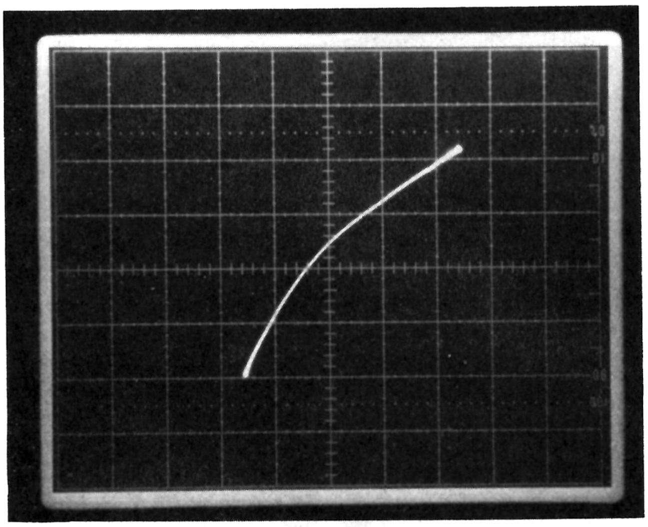
Literally "seeing" one cycle of a single-shot, 1-GHz sine wave is so novel an idea, many engineers react with "You mean you can shoot it on fast film, right?"

No. You can see it with your own eyes. The writing speed gain achieved with a microchannel plate in the CRT (see following article) is so great, no special apparatus is necessary. In terms of scope photography, you can now capture on ordinary films the fastest transients the scope displays—and without special techniques like fogging or reducing the scan.

A chronic "problem signal" for previous scopes has been a pulse that combines a fast rise-time and a low repetition rate. To look at more than one pulse called for a low sweep speed. But to display the pulses clearly at such a low speed, the scopes' beam intensity had to be very high. The resulting display was often a compromise between an overly bright, blooming base line and some rather indistinct pulses. And whatever problems these scopes encountered with direct view-







With double the bandwidth of any existing real-time oscilloscope, the 7104 shows events never before viewable. At the top, a single-swept, 1-GHz sine wave is captured on Polaroid type 107 film. With an f/1.9 lens and image-to-object ratio of 0.85:1, the writing speed is better than 20 cm/ns. The center photo shows a single transient with a rise time of 350 ps. The X-Y mode of the new scope doesn't compromise performance either. With a bandwidth of 350 MHz and advanced Z-axis modulation, uniform displays are possible (bottom).

ing were exaggerated by scope photography.

The 7104 eliminates these problems. The microchannel plate—essentially a secondary-emission device just behind the CRT—effectively limits the waveform brightness as well as tremendously increasing the writing speed. When beam intensity is increased, display brightness increases only to the point at which the plate's electron amplifier becomes saturated. So portions of the 7104's display that might otherwise bloom never get bright enough to do so.

Circuit extends tube life

Microchannel plates have been used in other CRTs, but were very expensive and short-lived devices. Part of the solution to extending tube life in the 7104's plates is a limited-viewing-time feature, a circuit that integrates the screen current and shuts off the beam when a certain value is reached. This lets you set up the scope for whatever brightness is necessary. But don't walk away, since the beam will shut off after several minutes, making it necessary to reset the integrator to start a new viewing cycle. Whenever the screen current gets high enough to actuate the feature, an annunciator light on the front panel flashes.

Most scopes limit the bandwidth for X-Y displays to a few megahertz. The 7104 is conservatively spec'd for 350-MHz, thanks to similar horizontal and vertical amplifiers, and to distributed deflection structures in both CRT axes, rather than in just the vertical. Phase shift is within 2 degrees from dc to 50 MHz and can be compensated for up to 350 MHz with an X-Y option.

In any X-Y display, spot velocity can vary considerably. In conventional scope CRTs, the result is a variation in intensity across the display. The intensity may be turned up high enough to make the trace visible in places where the spot is moving very fast. In that case, it will be too bright where the spot is moving slower. And if the intensity is turned down, the entire figure may not be seen. As with low-repetition-rate signals, the microchannel plate's saturation characteristic helps here, too.

There is, however, an additional uniform-display feature available in the 7104's X-Y mode. With a vertical amplifier plugged into a horizontal compartment, the time base in the other horizontal compartment takes over control of the beam intensity. The beam is then pulse-width-modulated, and the time/division control on the time-base plug-in controls the duty cycle. Triggering is derived from the Y input signal. The final result: a uniform display.

To answer the question, "Who needs a 1-GHz scope?": certainly every engineer or scientist working at the edge of technology and looking for new equipment to get over that edge. That push could come from an instrument that shows what couldn't be seen before. Advanced "instrumentation" providing new perspectives was certainly a key in the successes of men like Galileo, Volta, Lawrence and others. Today's technological successes will be no different.■■