HEWLETT PACKARD

Simplified Triggering of the HP 71500A Improves Accuracy When Characterizing Lightwave Components

Product Note 70820-4

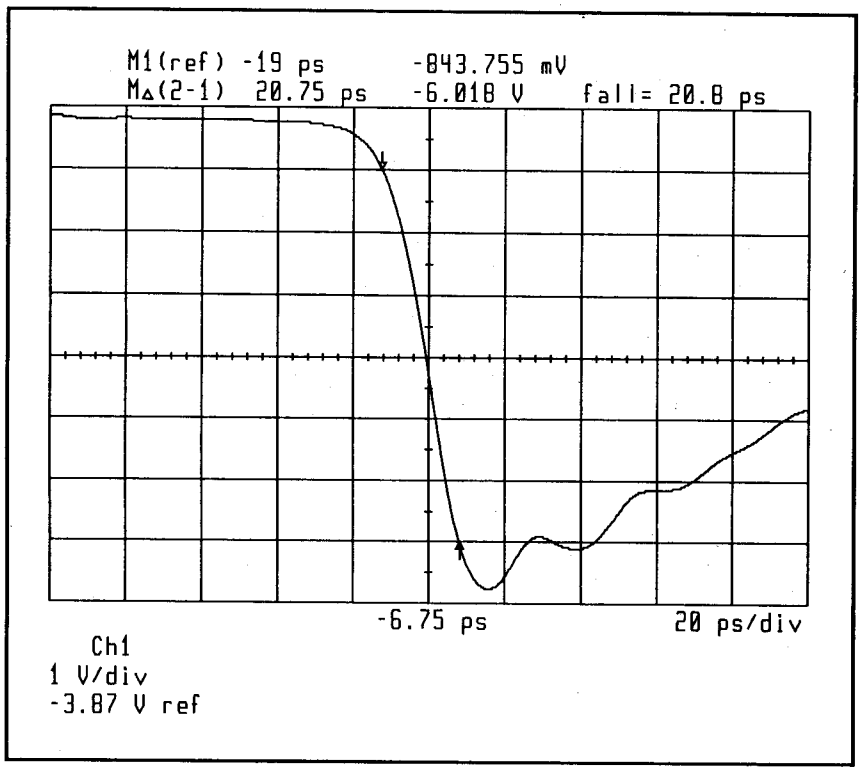

Figure 1. The HP 71500A triggers directly on narrow pulses and shows pre-trigger information, simplifying the triggering task and giving more accurate measurements.

Measuring the fast rise and fall times of laser diodes and O/E converters with a traditional sampling oscilloscope is difficult due to the triggering limitations of these oscilloscopes. Not only can triggering be a nuisance, but some aspects of triggering actually can degrade measurement accuracy.

The HP 71500A microwave transition analyzer (dc - 40 GHz) makes significant contributions toward simplifying the challenge of triggering on fast edges. These contributions include:

- ***Internal triggering on the signal channel to 40 GHz***
- ***Pre-trigger information***
- ***Sensitive triggering, even at 40 GHz***
- ***Phase triggering for noisy signals***

Reduce Jitter, Increase Measurement Bandwidth

Bandwidth, sensitivity, and external-triggering requirements of the sampling oscilloscope often force the user to find a trigger signal that is synchronous with the measured signal. To allow the sampling scope to trigger on it, the trigger signal usually has a wider pulse width and larger amplitude than the measured signal. But a problem arises because timing jitter may exist between the trigger signal and the measured signal. When the measured signal is averaged to clean up the effects of this jitter, some of the high-frequency content of the waveform may be averaged out, reducing the effective bandwidth of the measurement.

The HP 71500A can trigger directly on narrow pulses, removing the need for an external trigger signal. By eliminating this source of jitter, better detail can be seen in the waveform, especially when significant jitter would otherwise exist between the trigger signal and the measured signal. The HP 71500A also makes these measurements much easier to set up.

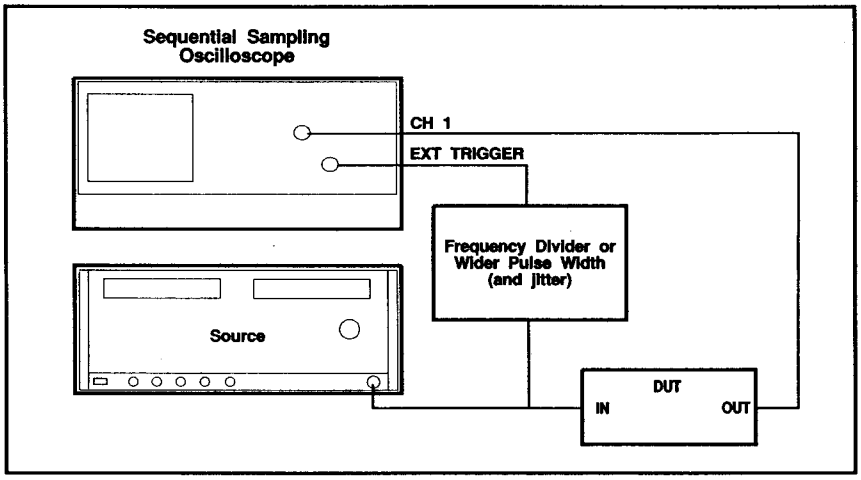

Figure 2. To trigger at high clock rates or on a narrow pulse, with a sequential sampling oscilliscope, an external trigger may need to be found. Extra jitter may be introduced between this trigger and the signal. The external trigger is not needed with the HP 71500A.

Pre-trigger Information Eliminates Need for Delay Line or Delaying to Next Pulse

Sequential sampling oscilloscopes do not easily show the trigger event; typically, they do not show anything until 15-70 ns after the trigger. To show the trigger event, a delay line can be used to delay the measured signal with respect to the trigger signal; however, directing the measured signal through a delay line can significantly

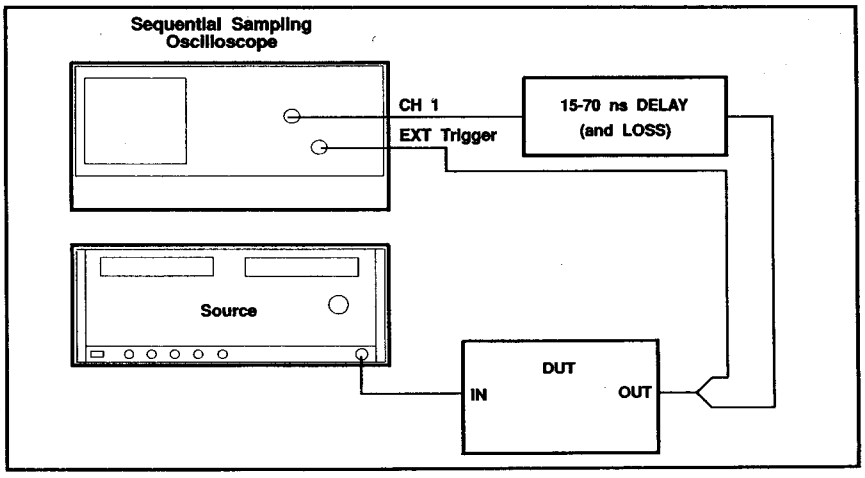

Figure 3. Delay line used with a sequential sampling oscilloscope to view pre-trigger information introduces loss to signal.

degrade the pulse fidelity. Delaying until the next pulse is another common solution, but this introduces jitter, which increases with delay in a sequential sampling oscilloscope.

The HP 71500A can place the trigger event at center screen. The left half of the screen shows information that occurred prior to the trigger event. This allows triggering on the pulse of interest and permits the entire pulse output of the laser diode or O/E converter to be viewed, without the losses introduced by the delay line.

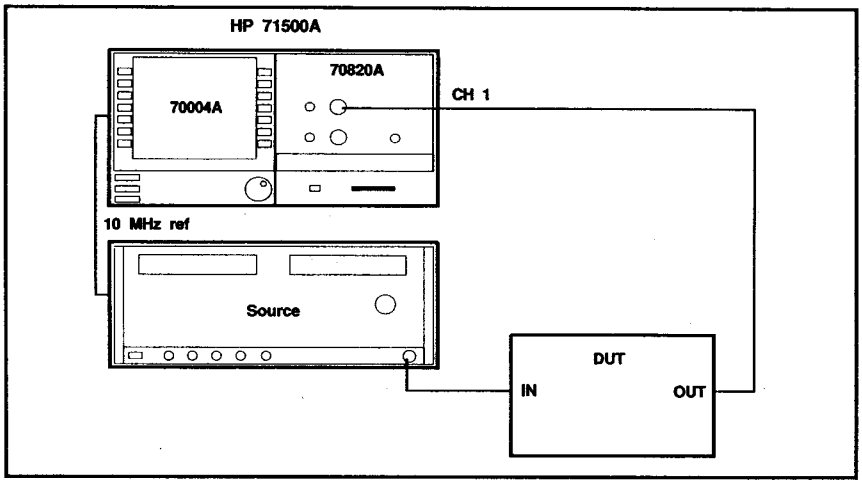

Figure 4. The HP 71500A, with its internal trigger and pre-trigger informatioin, eliminates the need for the external trigger and delay line.

Noise Filter Helps to Trigger on Small Signals

Most high-frequency trigger circuits require signals with amplitudes ranging from tens to hundreds of millivolts. Smaller signals require using an external trigger signal, which may introduce jitter. Two problems are encountered when triggering on small signals with the traditional sampling oscilloscope: the size of the signal itself and the noise accompanying the signal.

Triggering in the HP 71500A occurs after up to 60 dB of amplification. The analyzer's noise filter then reduces the noise on the signal before triggering on it. The unique noise-filter function preserves the fundamental and harmonic components of your signal but filters out the noise between these spectral components. The trigger occurs after this filtering, resulting in reliable triggering on very small signals.

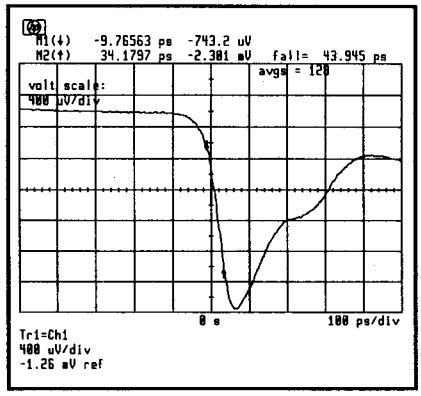

Figure 5. A 2.6 mV pulse was triggered on internally by the HP 71500A and displayed with pre-trigger information at 400 μV/div.

Phase Trigger Locks onto Noisy Signals

Edge triggering on signals having significant noise can result in a mistrigger. Mistriggering can ruin a measurement.

Phase triggering with the HP 71500A provides reliable triggering on noisy signals. The phase trigger uses an FFT of the time-domain waveform. The FFT provides noise-processing gain. So even when the noise is roughly equal to the signal in the time domain, a spectral line in the frequency domain may extend above the noise by 20 dB. The phase of the fundamental spectral line can be identified with the FFT. When transformed back to the time domain, the 0° point (based on a cosine definition) can be lined up with center screen. The result is effective triggering, even on signals having signal-to-noise ratios less than 1.

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About the HP 71500A:

The HP 71500A is part of the HP 70000 Modular Measurement System (MMS). The HP 71500A consists of the HP 70820A microwave transition analyzer module and the HP 70004A color display.

The HP 71500A requires a stable signal of known frequency. This is normally accomplished by driving your circuits with a synthesized source, usually under control of the HP 71500A over HP-IB. Locking the frequency reference of the synthesized source to the frequency reference of the HP 70820A ensures that the signal frequency is known and does not drift. Sources without a frequency reference may drift with respect to the HP 71500A's reference, preventing the noise filter from functioning correctly*. Also, choose a source with good phase noise performance for minimal jitter in your measurements.

There's even more to find out about than the triggering advantages. The HP 71500A includes 1 ps time scale accuracy, frequency response corrections, FFT, and 100 μV/div sensitivity.

Contact your HP sales representative and see how the HP 71500A gives you the measurement edge.

Video:

Microwave Design in Radar and Communications	90454T

Color Brochure:

"HP 71500A Microwave Transition Analyzer"	5091-0791E

Product Notes:

*"The Microwave Transition Analyzer: Picosecond Delta Time Accuracy"	5952-2545E
"Improve Delta Time Accuracies in Semiconductor Device Modeling and Characterization with the HP 71500A"	5952-2544E

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