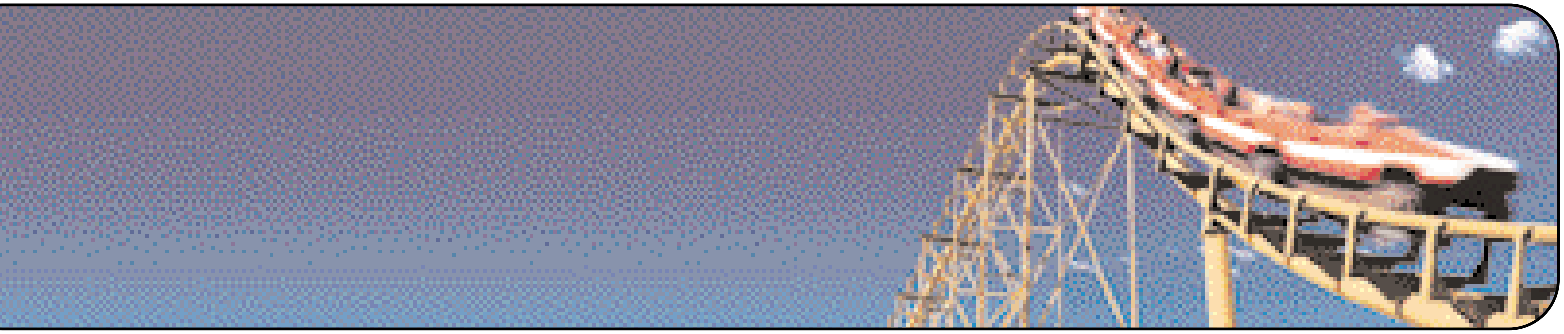
If I could...

...accurately characterize high-speed digital signals...



In Digital Systems, Rise Time Is Paramount

In the digital world, rise time measurements are critical. Your oscilloscope must have sufficient rise time to accurately capture the details of rapid transitions.

To calculate the oscilloscope rise time required for your signal type, use the following equation:

Oscilloscope Rise Time Required = Fastest Rise Time of Measured Signal ÷ 5

Notice that this basis for oscilloscope rise time selection is similar to that for bandwidth. As in the case of bandwidth, achieving this rule of thumb may not always be possible given the extreme speeds of today's signals. Always remember that an oscilloscope with faster rise time will more accurately capture the critical details of fast transitions.

In some applications, you may know only the rise time of a signal. A constant allows you to relate the bandwidth and rise time of the oscilloscope, using the equation:

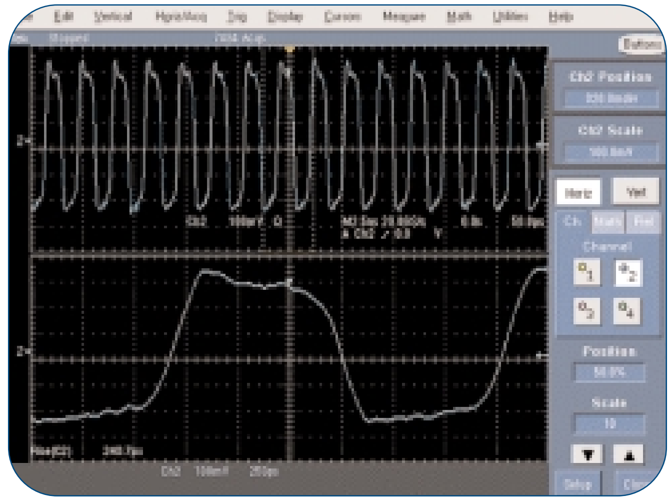
$$\textbf{Bandwidth} = \frac{k}{\textbf{Rise Time}}$$

where *k* is a value between 0.35 and 0.45, depending on the shape of the oscilloscope's frequency response curve and pulse rise time response. Oscilloscopes with a bandwidth of <1 GHz typically have a 0.35 value, while oscilloscopes with a bandwidth >1 GHz usually have a value between 0.40 and 0.45.

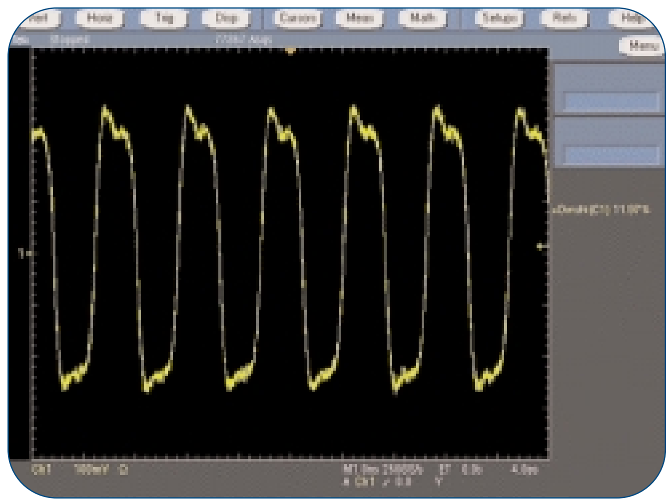
Tektronix offers oscilloscopes with rise times to match applications that range from the slower rise times of TTL logic to today's fastest CMOS, ECL and GaAs logic.

Logic Family	Typical Signal Rise Time	Calculated Signal Bandwidth	Bandwidth Required
TTL	2 ns	175 MHz	875 MHz
CMOS	1.5 ns	230 MHz	1.15 GHz
GTL	1 ns	350 MHz	1.75 GHz
LVDS	400 ps	875 MHz	4.375 GHz
ECL	100 ps	3.5 GHz	17.5 GHz
GaAs	40 ps	8.75 GHz	43.75 GHz

Some logic families produce inherently faster rise times than others, which may prove important in your selection of an oscilloscope.



Rise time characterization of a high-speed digital signal.



Fast edge rates coupled with long board traces can create high-frequency transmission line effects such as undershoot, overshoot and cross-talk. If left undetected, these signal anomalies can seriously degrade the proper functioning of a circuit.