Counter indicates when its probe is compensated

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Using a scope probe with a counter or other measuring instrument has a number of well-known benefits—namely, it ensures minimal source loading, physical ease of circuit connection, and minimum distortion of high-frequency signal components. Still, matching the probe to the counter's input impedance to secure wideband response can be troublesome, especially if the elements needed to perform the standard compensation procedure (a scope and a source of square waves) are not available and the input impedance of the scope and counter are not identical. Fortunately, the counter's own input-trigger circuit may be employed as a peak detector to indicate that proper probe compenstion has been achieved.

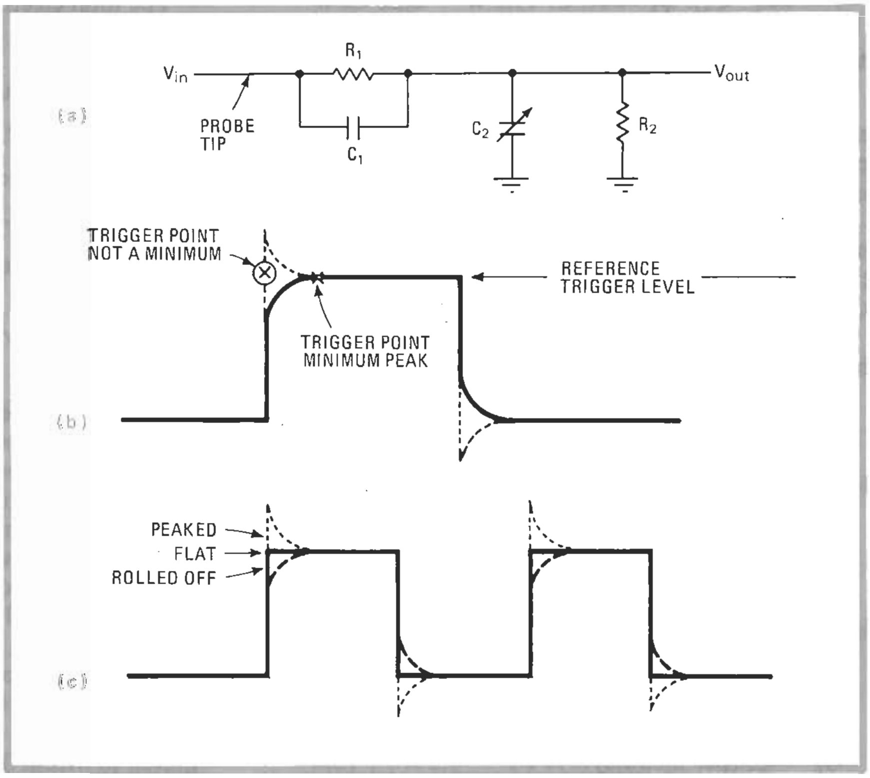
The equivalent input circuit of the typical 5× and 10× (attenuating) probe appears as in (a), where C_1 is the ac coupling capacitor and C_2 represents the probe's compensating capacitance, cable capacitance, and the input capacitance of the measuring instrument. R_1 is the dc coupling resistance. R_2 is the instrument's input resistance. For flat response, the product of R_1 and C_1 should be equal to the product of R_2 and C_2.

Compensation is achieved by applying to the probe/counter a 1-kilohertz square-wave signal having a rise time of less than 100 microseconds. The amplitude of the square wave should be as large as the counter's dynamic range will allow. The counter should be set to trigger on the low-frequency components of the square wave so that a reference level is established. Then the probe's compensating capacitor is adjusted so that the counter will trigger on the highest-frequency components of the signal.

Specifically, the counter should be set to the 1× position. The counter's function control is then set to the frequency, period, or event position, so that the counter's display or input-trigger LED will indicate triggering when the square wave is applied.

To establish the reference level, the probe is adjusted so that triggering occurs in the waveform's so-called roll-off region. This is done by setting C_2 and the trigger level in turn so that triggering occurs at the peak of the acquired signal and at the minimum level required to ensure consistent operation. The point at which this occurs for a given trigger level is reached when an increase or decrease in C_2 does not stop triggering. If the acquired signal could be observed, it would appear as in the illustration in (b).

For compensation at the high frequencies, the response of the probe must be flattened (c). This is achieved by setting the trigger level to a position where triggering just stops or is erratic. C_2 is then adjusted to



Match. Universal counter's display or trigger LED is used to indicate that probe/circuit's elements $R_1C_1C_2$ (a) are matched to input impedance (R_2) of measuring device. Procedure used is to first position triggering region on roll-off of input-signal curve (b) with C_2 and counter's trigger-level control. Probe will be compensated over a wide band after C_2 is peaked (c) to detect high-frequency components of square wave.