ICs replace memory scope for pulse measurements

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A 10-megahertz crystal oscillator is the secret ingredient in a circuit for reading out the time interval between two nonrecurring logic pulses or the duration of a single pulse. The circuit is an inexpensive alternative to a memory oscilloscope or a commercial frequency counter for examining the nonrecurring pulses.

By counting oscillator cycles, the circuit provides a digital readout of the nonperiodic time intervals—for example, with proper interfacing circuitry, it can measure the cycle time of a microprocessor function or calibrate test equipment such as a pulse generator. Parts for the complete circuit cost about $50.

As the figure shows, two-input exclusive-OR gates

FUNCTION TABLE FOR EXCLUSIVE-OR GATE (7486)			
Pulse edge to be detected	Inputs		Output
	Control	Probe	
Rising	Low	Low	Low
	Low	High	High
Falling	High	High	Low
	High	Low	High

(7486s) are the first stage in the pulse detection. The output of such a gate provides a high only when the logic levels on its inputs are different (see table). By using one input as a control (switching it to either the supply voltage, V_{CC}, or ground), the user can make the output go high, no matter whether a low or a high logic level is applied to the other input, which is connected to a test probe.

The gates' outputs are connected to a dual monostable multivibrator (74123). When a gate's output goes high, the multivibrator triggers on the rising edge, and an output pulse goes to a set-reset ($\overline{S}$-$\overline{R}$) latch (74279). The latch output, Q, controls a NAND gate, which passes the 10-MHz signal to a series of decade counters when Q is high. Each 10-MHz pulse corresponds to a time interval of 0.1 microsecond.

When a nonrecurring logic pulse occurs at probe input A, a pulse is applied to the $\overline{S}$ input of the latch, setting the latch's output to a high logic level. Probe input B causes a pulse to be applied to the $\overline{R}$ input of the latch, thereby resetting the latch's output to a low level.

The oscillator signal is counted only during the time interval between the set and reset pulses to the latch. The data displayed is the time interval between the rising (or falling) edge at probe input A and the rising (or falling) edge at probe input B. Of course, the input to probe A must always precede the input to probe B.

To measure the time interval between two nonrecurring pulses, connect probe inputs A and B to the circuit under test and switch control inputs A and B to the desired positions, whichever are necessary to detect rising or falling edges.

The duration of a single nonrecurring pulse is measured by connecting probe inputs A and B to the same place in the circuit under test, and setting the control inputs to the proper positions. For example, to measure the duration of a positive pulse, position switch A to ground and switch B to V_{CC}. The rising edge of the pulse will set a high on the latch's output, and the falling edge will reset the output to a low. The system's accuracy depends on the accuracy of the 10-MHz oscillator.

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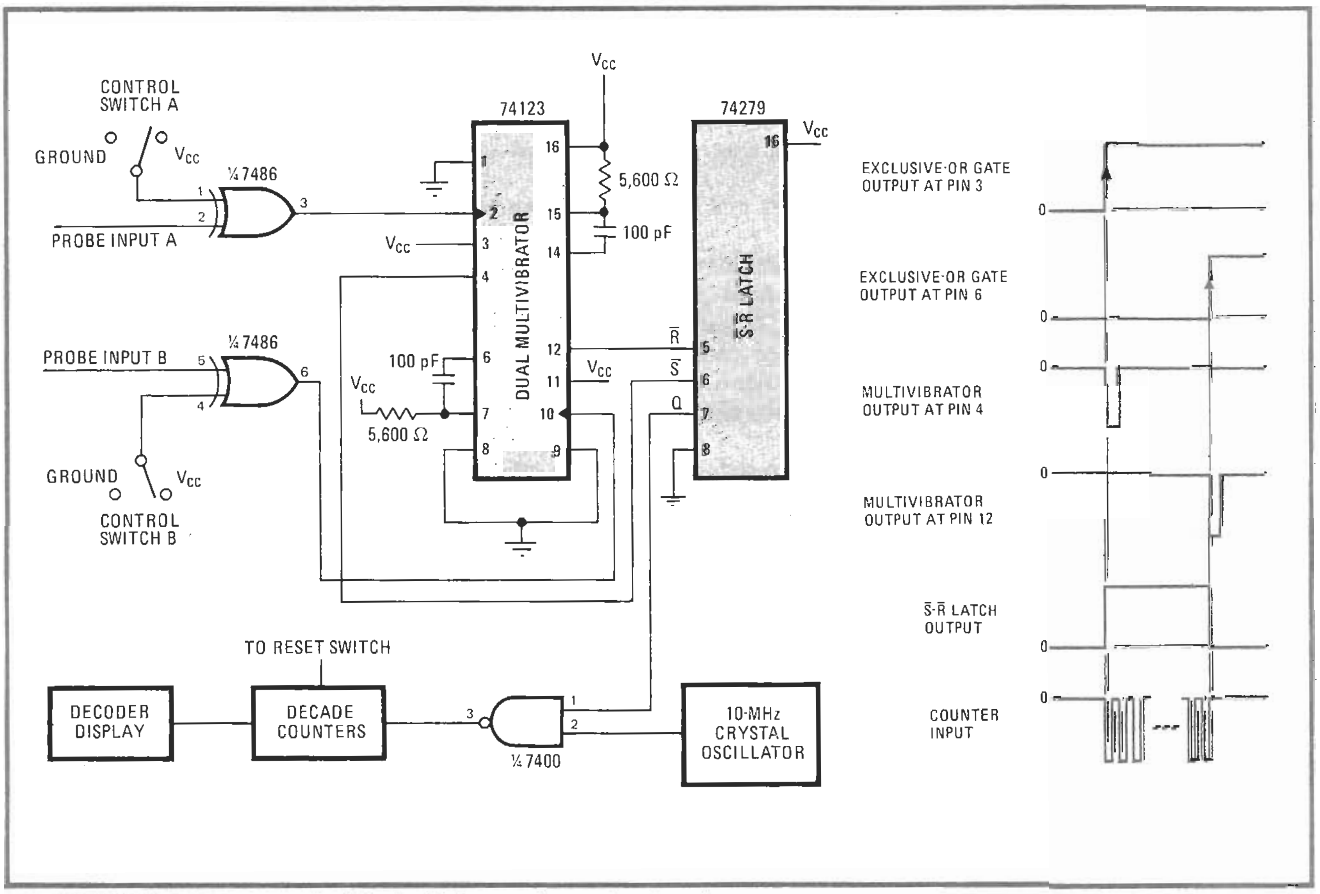

Alternative to memory scope. In this circuit, the spacing or duration of nonrecurring pulses is measured with transistor-transistor-logic detection circuitry that counts cycles of a 10-MHz oscillator. Seven digits can be displayed, giving readings from 0.1 microsecond to 0.9999999 second. This technique can be used in lieu of a memory scope for preserving nonrecurring pulses in digital circuits.