DESIGNERS NOTEBOOK

Pulse-width counter sorts 16 pulse-width ranges

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Highly precise pulse-width discrimination and demodulation is possible with this perpetual pulse-width counter. Unlike conventional pulse-width counters, this design has a very short dead time, enabling it to detect pulses with very small spacings. Moreover, it can be realized as a 28-pin integrated circuit that can sort 16 ranges.

A perpetual pulse-width counter works by comparing the duration of an input pulse width to a time interval developed by a precision oscillator in combination with a counter. An input signal arrives simultaneously at the enabled input of oscillator O and at monovibrator M_1 (Fig. 1a). The input signal enables a train of clock pulses from O to be applied to counter C. At time $t = t_2$ (Fig. 1b), a negative-going transition of an input pulse causes M_1 to produce a very short pulse. M_1 generates a pulse with the shortest possible duration in order to maximize the accuracy of the pulse-width counter.

For example, if an SN74123 serves as monovibrator M_1, the dead time can be calculated as follows:

$$T_d = T_{phl} + T_w(out)$$

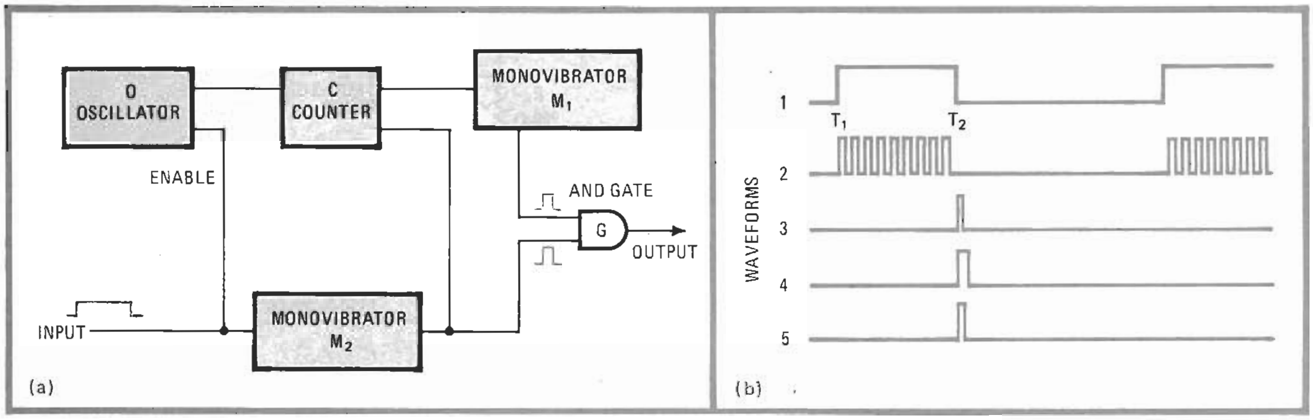
where T_{phl} is the propagation delay time, high-to-low output, and equals 36 ns; $T_w(out)$ is the width of the pulse at M_1's output Q and is 65 ns.

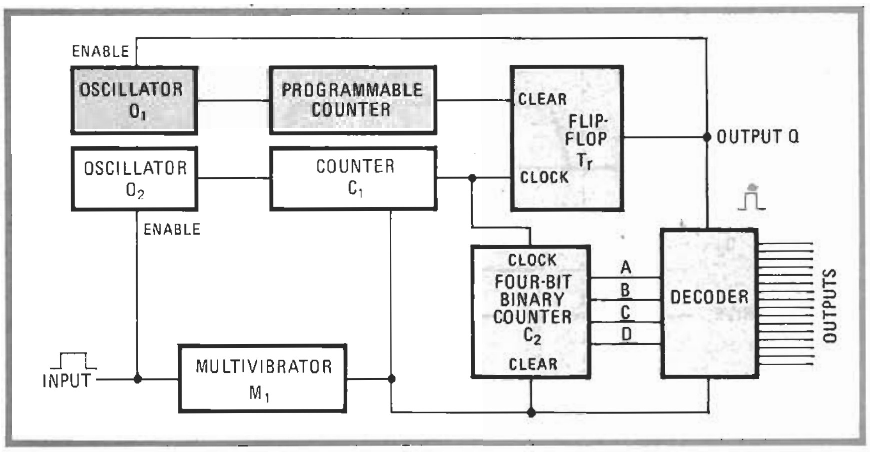
If the above choice was made, the pulse-width counter would adequately react to every input signal, so long as the pause between pulses is greater than 101 ns. For higher-frequency applications, a monovibrator circuit solution should be chosen appropriately.

Counter C in Fig. 1a counts a predetermined number of precisely spaced pulses from the crystal oscillator for a duration of the unknown input signal. Its ripple clock output produces an output pulse only when an input signal is of sufficient duration; that is, when the number of the clock pulses passed to the counter must be greater than or equal to the number set by counter C. If each oscillator cycle is 10 ns and the counter is set to 10, the the input signal's duration has to be at least 100 ns to enable a ripple clock output of the counter. Input signals with a width of less than 100 ns will be neglected.

The counter pulse initiates monovibrator M_2. The output pulse duration of this monovibrator can be adjusted for the appropriate bandwidth. The adjustment has one limitation in that the duration of the M_2 output pulse must be smaller than the pause between pulses. An input signal is detected only when both pulses from M_1 and M_2 coincide at AND gate G.

As shown in Fig. 1b, the pulse on the output of the pulse-width counter (line 5) will exist only when the output pulses from M_2 (line 3) and M_1 (line 4) coincide. This results from the matching of the input-signal duration (line 1) with the interval developed by the clock pulses (line 2) in combination with the counter (line 3). In addition, the output pulse from M_1 is used to reset





1. Interval matching. Simplified block diagram of the perpetual pulse-width counter (1a), which generates an output pulse only if the output pulses of M_1 and M_2 coincide in the AND gate G. The pulse chart (1b) shows the case when the duration of the input signal is equal to the developed interval.

2. Programmable tolerance. Oscillator O2, the programmable counter, and the flip-flop circuit replace the monovibrator M2 in the block diagram of Fig. 1 to ease adjustment of bandwidth and tolerance of windows. The counter generates an output pulse when a number of pulses reach a preset value.