The pulses from the VCO output are quite narrow because the reset time is much smaller than the integration time. Pulse stretching comes quite naturally to a Schmitt trigger. A one-shot or pulse stretcher made with an inverter and Schmitt trigger is shown in *Figure 12*. A positive pulse coming into the inverter causes its output to go low, discharging the capacitor through the diode D1. The capacitor is rapidly discharged, so the Schmitt input is brought low and the output goes positive. Check the size of the capacitor to make sure that inverter can fully discharge the capacitor in the input pulse time, or

$$I_{SINK\ INVERTER} > \frac{C\ \Delta V}{\Delta T} + \frac{\Delta V}{R}$$

where $\Delta V = V_{CC}$ for CMOS, and ΔT is the input pulse width.

For very narrow pulses, under 100 ns, the capacitor can be omitted and a large resistor will charge up the CMOS gate capacitance just like a capacitor.

When the inverter input returns to zero, the blocking diode prevents the inverter from charging the capacitor and the resistor must charge it from its supply. When the input voltage of the Schmitt reaches V_{T+}, the Schmitt output will go low sometime after the input pulse has gone low.

THE SCHMITT SOLUTION

The Schmitt trigger, built from discrete parts, is a careful and sometimes time-consuming design. When introduced in integrated TTL, a few years ago, many circuit designers had renewed interest because it was a building block part. The input characteristics of TTL often make biasing of the trigger input difficult. The outputs don't source as much as they sink, so multivibrators don't have 50% duty cycle, and a limited supply range hampers interfacing with non-5V parts.

The CMOS Schmitt has a very high input impedance with thresholds approximately symmetrical to one half the supply. A high voltage input is available. The outputs sink and source equal currents and pull directly to the supply rails.

A wide threshold range, wide supply range, high noise immunity, low power consumption, and low board space make the CMOS Schmitt a uniquely versatile part.

Use the Schmitt trigger for signal conditioning, restoration of levels, discriminating noisy signals, level detecting with hysteresis, level conversion between logic families, and many other useful functions.

The CMOS Schmitt is one step closer to making design limited only by the imagination of the designer.
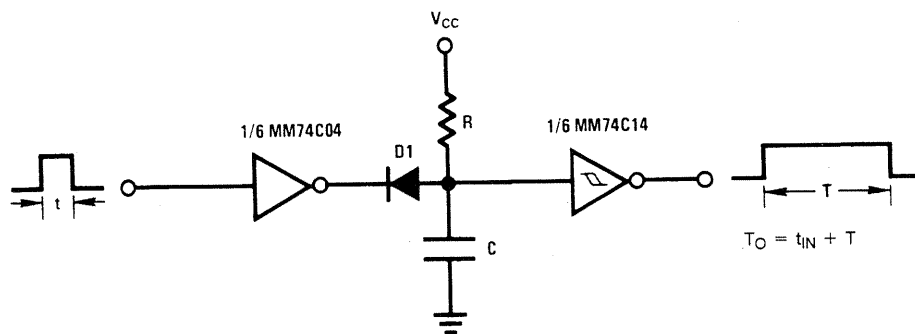
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$$T = RC\ \ell n \left(\frac{V_{CC} - V_{BE}}{V_{CC} - V_{T+}} \right) \quad \text{BE SURE THAT } I_{SINK\ INVERTER} > \frac{C\ V_{CC}}{t} + \frac{V_{CC}}{R}$$

FIGURE 12. Pulse Stretcher. A CMOS inverter discharges a capacitor, a blocking diode allows charging through R only. Schmitt trigger output goes low after the RC delay.