PROJECT OF THE MONTH

By Forrest M. Mims

Precision CMOS Clock Generator

SEQUENTIAL digital logic circuits require one or more clock pulse generators. Microprocessors often include built-in clock generators. Other sequential circuits may use clocks made from 555 timers, a pair of cross-coupled inverters, or a trio of inverters connected as a ring oscillator.

Intersil makes a general-purpose timer chip which, for a CMOS device, has extraordinary specifications. The chip is the ICM7209, available from some electronics mail order suppliers for about $4.00.

The ICM7209 is guaranteed to oscillate at frequencies up to 10 MHz, and it can directly drive as many as five TTL gates. With a 5-volt power supply, the chip typically consumes 11 milliamperes and will operate with a minimum of three external components—two capacitors and a quartz crystal (Fig.1).

The power dissipation of the ICM7209 is directly related to its oscillation frequency. Since the oscillator portion of the chip consumes much less power than its output buffers, power dissipation can be dramatically reduced when the chip is disabled by making pin 3 low. The oscillator portion will continue to operate, but the output buffers will be disabled, thus reducing their current drain.

The crystal can be any quartz crystal having a frequency of oscillation from 10 kHz to 10 MHz, and the circuit can be powered by a supply of 3 to 6 volts. For best results, the crystal should have a load capacitance of 10 pF rather than the usual 30 pF. When *C1* and *C2* are 18 pF, this provides a typical frequency stability of one part per million (ppm) per one volt change in supply voltage.

Note that the ICM7209 includes two output pins. The divide-by-eight output (pin 6) can be used to obtain many combinations.

While Fig. 1 shows the disable input (pin 3) connected to a switch, disable/enable controls can be easily provided by external logic. Pin 3 can also be connected to either the oscillator IN or OUT pins for some interesting results. For example, when pin 3 is connected to pin 2, each of the divide-by-eight pulses appearing at pin 6 are further divided into four separate pulses. This provides a burst output mode not mentioned in the ICM 7209's data sheet.

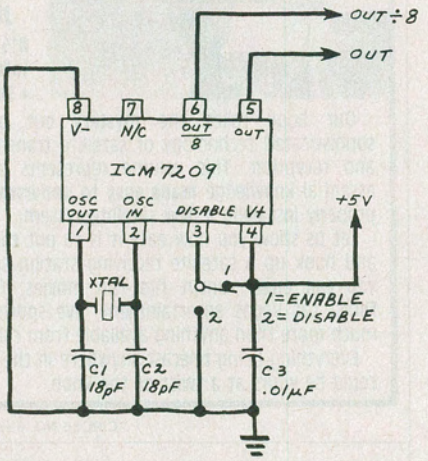

Fig. 1. A clock pulse generator using the ICM7209 chip with just three external components.

Figure 2 illustrates this chip's operation at its maximum guaranteed frequency of 10 MHz. Intersil claims typical rise and fall times of 10 nanoseconds (25 nanoseconds maximum) as measured from the 0.5-to-2.4-volt output points. These represent TTL logic levels.

As you see in Fig. 2, the circuit in Fig. 1 has a risetime better than 8 nanoseconds and a falltime faster than 7.5 nanoseconds. The pulse width is 50 nanoseconds FWHM (full width, half maximum). Figure 2 was taken directly from the screen of a 100-MHz oscilloscope. I assembled the oscillator on a standard plastic, solderless breadboard with short, point-to-point connection wires.

The ICM7209 provides an excellent solution to the need for a precision clock generator. Though the circuit shown in Fig. 1 isn't tunable, the oscillation frequency can be quickly altered by changing the quartz crystal used. ◇

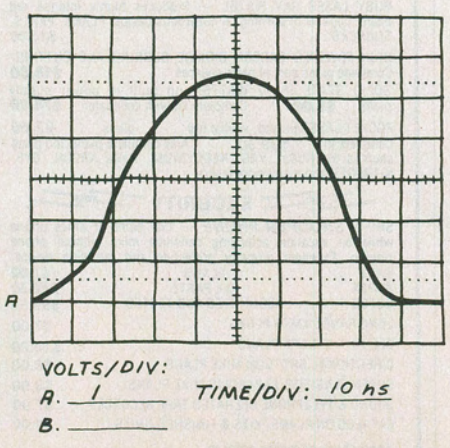

Fig. 2. Output waveform from an ICM7209 with a 10-MHz crystal.