Two-chip generator shapes synthesizer's sounds

by Jonathan Jacky
Seattle, Wash.

Generating the same adjustable modulating waveforms or a music synthesizer as the circuit proposed by Kirschman, but using only two integrated circuits, this generator also works from a single supply. It has, in addition, separate gate and trigger inputs for providing a more realistic keyboard response.

When gated or triggered, the generator, which is built around Intersil Inc.'s CMOS 7555 timer, produces a waveform that passes through four states:

1. An exponential attack.
2. An initial decay, or fallback.
3. A sustain, or steady dc level.
4. A final decay, or release.

Each of these four parameters is continuously variable, so that waveforms having a wide variety of shapes can be generated.

The waveforms are generated by the sequential charging and discharging of capacitor $C_1$. Here, the 7555 controls the sequencing while diodes switch the currents, unlike Kirschman's circuit where comparators and flip-flops control the stepping and analog switches steer the currents. Furthermore, the 7555 is well suited for handling the two logic signals provided by most synthesizer keyboards—the gate, which is high as long as any key is depressed, and the trigger, which provides a negative pulse as each key is struck. The gate and trigger features eliminate the need to release each key before striking the next to initiate an attack phase.

In the dormant state (the gate input at pin 4 of the 7555 is low), capacitor $C_1$ is discharged. When the gate goes high and a trigger pulse appears at pin 2, the 7555 output (pin 3) goes high and charges $C_1$ through $R_1$, $R_2$, and $D_1$, producing the attack segment of the waveform. Note that diode $D_2$ is reverse-biased because pin 7 of the 7555 is high and that diode $D_3$ is back-biased by logic 1 signal applied to the gate input.

When the voltage across $C_1$ reaches 10 volts, pin 3 of the 7555 goes low and pin 7 is grounded, terminating the attack phase. $D_1$ and $D_3$ are now reverse-biased and $C_1$ discharges through $D_2$, $R_3$, and $R_4$ to produce the initial decay. The sustain level reached is determined by the voltage divider formed by resistor $R_4$ and potentiometer $R_5$. During this phase, a second attack can be obtained by striking another key (see timing diagram). When the last key is released, the gate goes low and $C_1$ will discharge through $D_3$, $R_7$, and $R_8$ to produce the final decay. The CA3130 operational amplifier serves as a buffer to protect $C_1$ from excessive loading.

In tune. Four-state generator provides control waveforms for modulating voltage-controlled amplifiers, oscillators, and filters in a music synthesizer and thus is useful for coloring loudness, timbre, and pitch. Circuit can be retriggered during its decay/sustain phases. Attack time is variable from 5 milliseconds to 2 seconds. Initial and final decay times can range from 5 ms to 5 s. The sustain level has a dynamic range of 0 to 10.

References