Adjustable $e^x$ generator colors synthesizer's sounds

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Providing the control signals for voltage-controlled amplifiers, oscillators and filters in order to modulate sound parameters such as loudness, pitch and timbre, this adjustable $e^x$ generator is the indispensable ingredient required to attain superior performance in a music synthesizer. Only four integrated circuits and a few passive components are needed in the inexpensive unit, which costs under $6.

When gated or triggered, the generator produces a waveform that passes through four states:
- An exponential attack.
- An initial decay, or fallback.
- A sustain, or steady dc level.
- A final decay, or release.

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

The waveforms are generated by the sequential charging and discharging of capacitor $C_1$ (see figure). In general operation, $C_1$ is connected to a current source or sink as required, through the 4016 complementary-MOS

Musical tint. Four-state generator provides myriad control waveforms for modulating voltage-controlled amplifiers, oscillators, and filters in a music synthesizer, and thus is useful for coloring loudness, pitch, and timbre. Attack and decay times are variable from 5 to 500 milliseconds; sustain level is adjustable from 0 to 10 volts.

analog switches. These switches are controlled by simple logic set into action by the gate-input pulse. Triggered operation is made possible by adding a monostable multivibrator to the circuit.

In the dormant state (gate input low), analog switch $C$ is on, switches $A$ and $B$ are off and the RS flip-flop formed by two 4001 NOR gates is reset. The onset of a gate pulse turns on switch $A$ and turns $C$ off. Consequently, $C_1$ charges through $R_3$ and $R_4$, producing the attack segment of the waveform. Note that the LM356 buffer protects $C_1$ from excessive loading.

When the voltage across $C_1$ reaches $V_{\text{max}}$ (determined by voltage divider $R_1-R_2$), the LM311 comparator sets the RS flip-flop. This action in turn switches $B$ on and $A$ off. Thus the initial decay segment is generated as $C_1$ discharges through $R_5$ and $R_6$ to reach the sustain voltage, the level of which is determined by the setting of potentiometer $R_2$.

Concurrently, the comparator's output has gone low, but the RS flip-flop remains set until the gate pulse moves to logic 0, at which time switch $C$ turns on. Thus $C_1$ discharges through $R_3$ and $R_4$ to produce the final decay portion of the wave, after which the circuit reverts to its dormant state.