Ramp generator has separate slope and frequency controls

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Isolating with four analog switches the frequency-determining portion of the circuit from that controlling the charging and discharging of its RC integrator, this ramp generator achieves independent selection of slope ratio and repetition rate. Such a unit is useful in a music synthesizer, where timbre must be changed without affecting a note's fundamental frequency.

Analog gates $T_1$ and $T_2$ are initially switched on, and therefore $V_c$ is applied via operational amplifier $A_1$ to the integrator built around $A_2$ (see figure). Thus, $-V_c$ appears at the inverting input of $A_2$, and its positive-going output reaches voltage $V_H$ in $T_1 = 2V_H C (R_i + R_d)/V_c$ seconds, where $V_H = V_{oc} R_3/R_6$.

At this time, $A_3$ switches on and $A_4$ goes off. $T_1$ and $T_2$ are thus disabled, and $T_3$ and $T_4$ are brought high so that $+V_c$ is applied to the integrator. The output at $A_2$ thus falls linearly toward $-V_H$, where time $T_2 = 2V_H C (R_3 + R_d)/V_c$.

The frequency of the ramp is given by:

$$f = 1/(T_1 + T_2) = R_4 V_{oc}/[2C R_i V_{oc} (R_1 + R_2 + R_3 + R_4)] = k V_c$$

where $k$ is a constant (in the approximate range of 1 kHz/\nu) that can be adjusted with potentiometer $P_3$. Because $R_1 + R_3$ is a constant, it is seen that an adjustment in potentiometer $P_3$ will affect the slope ratio, but not the frequency. With the values shown, the slope ratio can be selected from 1/11 to 11. The slope ratio is given by $T_1/T_2 = (R_1 + R_2)/(R_3 + R_4)$.

Separation. Transmission gates $T_1 - T_2$ separate the portion of the ramp generator that determines the frequency from the circuitry that sets the charge and discharge times of its integrator, so that the up/down slope ratio and frequency can be independently selected. The inexpensive circuit, which costs less than $10 and works in the audio range, is a useful timbre control in music synthesizers.