

Precision Ramp Generator

by James Wong

Precision ramps with well-controlled repetition rate and amplitude are generated by this circuit. Repetition rate is controlled by a DC input voltage (V_1). This circuit can also be used as a simple voltage-to-frequency converter over a limited input range.

Just after resetting, the A1 op amp generates a negative ramp with a slope proportional to I_1 , which is $(V_1 - V_{D2})/R_1$. The slope is $-C_1 dV_R/dt$ and the A2 output is sitting at the positive limit. When the A1 output reaches $-10V$, the output of A2 flips to the negative limit. This transition is given regenerative action through capacitor C_2 . The negative pulse from A2 discharges C_1 through diode D3 and drives it positive until diode D1 conducts. Since D2 sets the A1 inputs to $-0.6V$ and D1 has an equal drop when it conducts, the integrator will be reset to zero volts. After the integrator reaches zero volts and C_2 has discharged, amplifier A2 flips back to positive saturation and D3 is again back-biased. A key feature of this circuit is the amplitude stability; the REF-01 output of $+10V$ is very stable and the reset zero is temperature compensated by the matching of D1 and D2. Thus the ramp amplitude of $10V$ is

very accurate and stable over a wide range of operating conditions.

Exact circuit values and op amp choices depend on the desired operating range. For a range of $10Hz$ to $1kHz$, the OP-215 can be used with the following values:

- $R_1 = 1M\Omega$
- $C_1 = 1200pF$
- $R_2 = 10k\Omega$
- $R_3 = 2.0k\Omega$
- $C_2 = 200pF$

With these component values and using the OP-215 dual, we will have a reset time interval of approximately $5\mu s$. The minimum ramp interval, assuming a maximum input voltage of $11.4V$ and $0.6V$ diode drop, is $1200pF \times 10V / 12\mu A = 1msec$ which corresponds to a $1kHz$ repetition rate. The ramp amplitude of zero to $-10V$ is very accurate and stable over a range of $10Hz$ to $1kHz$. The output of A2 is a $5\mu s$ pulse of approximately $\pm 13V$ amplitude.

