For the digital-to-analog conversion (DAC) lab, we need to implement a ramp generator (again). In this document, we review ramp generators each built with a pnp BJT current source.

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## 1 Resistor-Biased Ramp Generator

![Resistor-Biased pnp BJT (e.g., 2N3906) ramp generator (0–8.5 V compliance).](image)

Use $C$ and the desired $v'_\text{out}$ to set $i$. Use $i$ to pick $v_B$ and $R_E$. Use $v_B$ to pick $R_1$ and $R_2$. From Figure 1.1:

- $i = C v'_\text{out}$
- $8.05 \text{ V} < v_B < 9.35 \text{ V}$
- $v_{BE} \approx \frac{9.35 \text{ V} - v_B}{i} = R_E$
- $v_B \approx \frac{R_2}{R_1 + R_2} 10 \text{ V}$

- Due to parasitic resistances, choosing $C$ trades off ramp linearity for reset steepness.
- **MAKE** the $R_1$–$R_2$ divider a **POTENTIOMETER** for tuning.
- **For best results**, use $R_1 \parallel R_2 \ll \beta R_E$ where $\beta \approx 100$ and $R_1 \parallel R_2 \triangleq R_1 R_2 / (R_1 + R_2)$. 

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Abstract

For the digital-to-analog conversion (DAC) lab, we need to implement a ramp generator (again). In this document, we review ramp generators each built with a pnp BJT current source.
2 Diode-Biased Ramp Generator

![Diode-biased pnp BJT (e.g., 2N3906) ramp generator (0–8.65 V compliance).](image)

Use $C$ and the desired $v'_{\text{out}}$ to set $i$. Use $i$ to pick $R_E$. From Figure 2.1:

\[ i = C v'_{\text{out}} \]

\[ \frac{v_{R_E}}{i} = \frac{1.15 \text{ V}}{i} = R_E \]

- Due to parasitic resistances, choosing $C$ trades off ramp linearity for reset steepness.
- MAKE the $R_E$ resistor a **variable resistor** (i.e., two adjacent pins of a potentiometer) for tuning.
A Parts

(a) CD4066 solid-state switch

(b) 2N3906 PNP BJT transistor

(c) 1N914 silicon diode (generic small-signal diode)

Figure A.1: Part pin-outs.