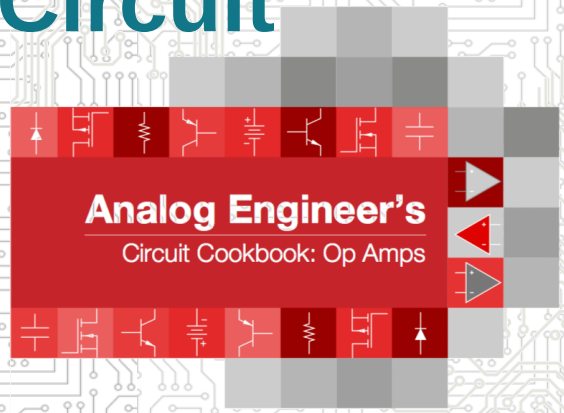
How to Design
Adjustable Reference Voltage Circuit



General Purpose Amplifiers

www.ti.com/general-amps

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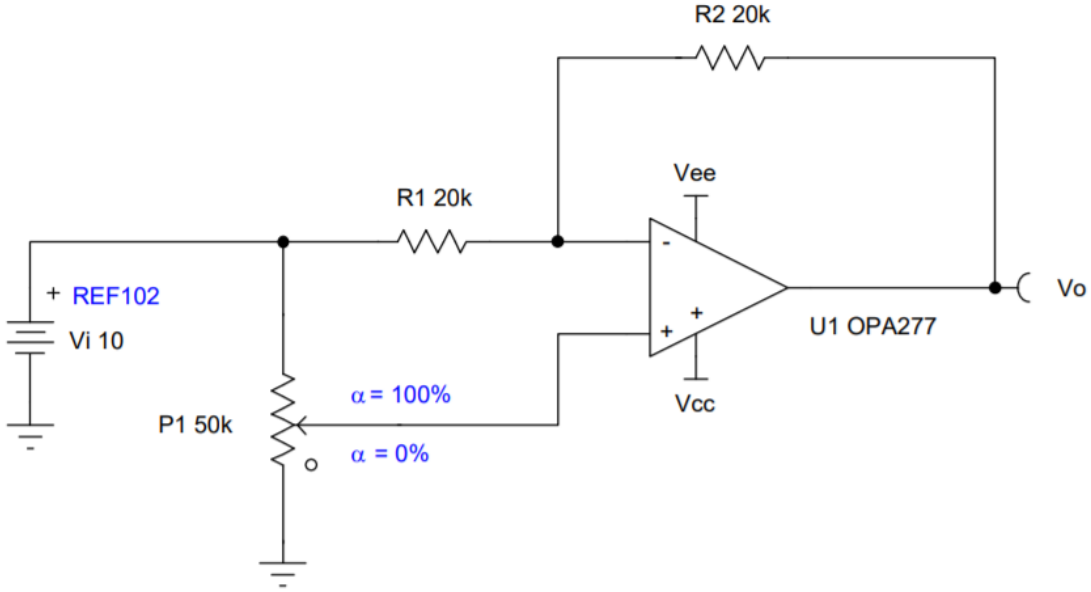
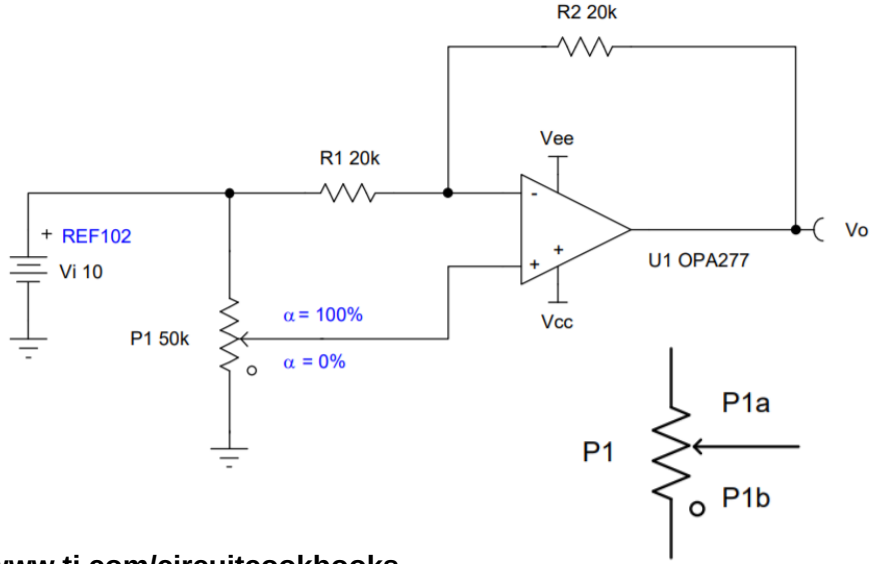
Circuit Description



$$V_o = V_i \times \left(-\frac{R_2}{R_1} + \alpha \left(1 + \frac{R_2}{R_1} \right) \right)$$

Design Steps

Input	Output		Supply	
V_i	V_{oMin}	V_{oMax}	V_{dd}	V_{ee}
10V	-10V	10V	15V	-15V



Inverting Gain

$$\frac{V_o}{V_i} = -\frac{R_2}{R_1} + \alpha\left(1 + \frac{R_2}{R_1}\right)$$

Non-Inverting Gain

$$\alpha = \frac{P1b}{P1}$$

$$P1 = P1a + P1b$$

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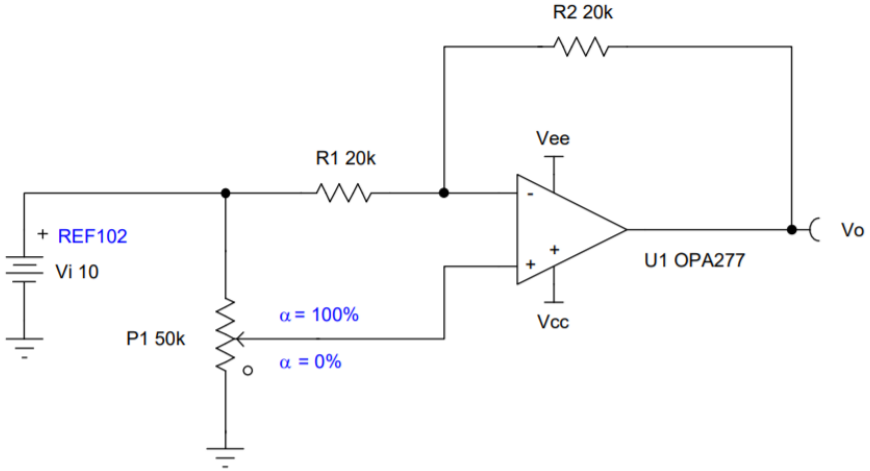
Design Steps

Input	Output		Supply	
V_i	V_{oMin}	V_{oMax}	V_{dd}	V_{ee}
10V	-10V	10V	15V	-15V



$$R_2 = R_1 = 20k\Omega$$

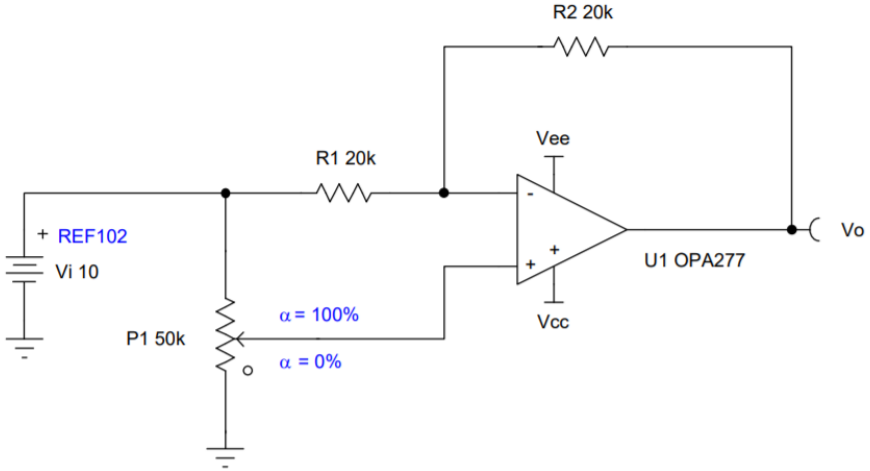
$$V_o = (2 \times \alpha - 1) \times V_i$$

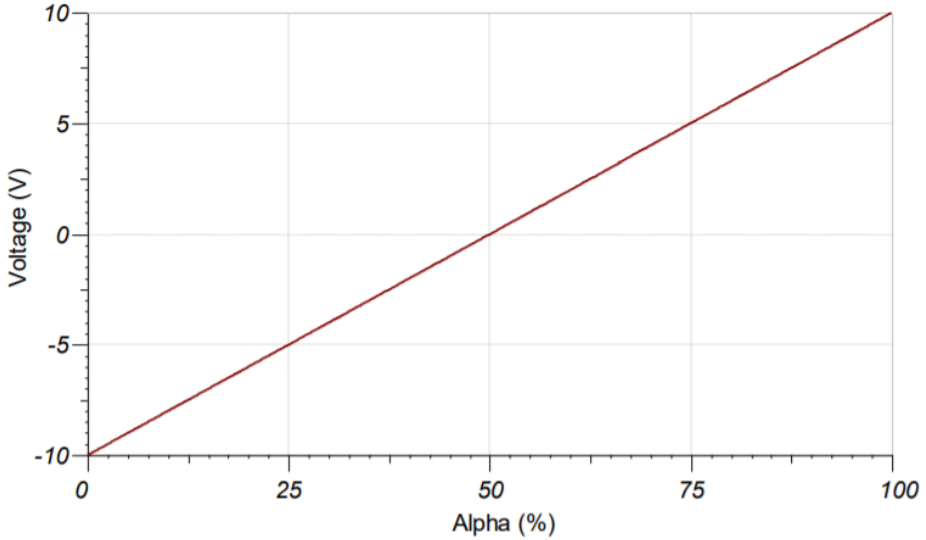
$$\alpha = 0\ ;\ V_o = -V_i$$

$$\alpha = 1\ ;\ V_o = V_i$$

DC Results

Input	Output		Supply	
V_i	V_{oMin}	V_{oMax}	V_{dd}	V_{ee}
10V	-10V	10V	15V	-15V





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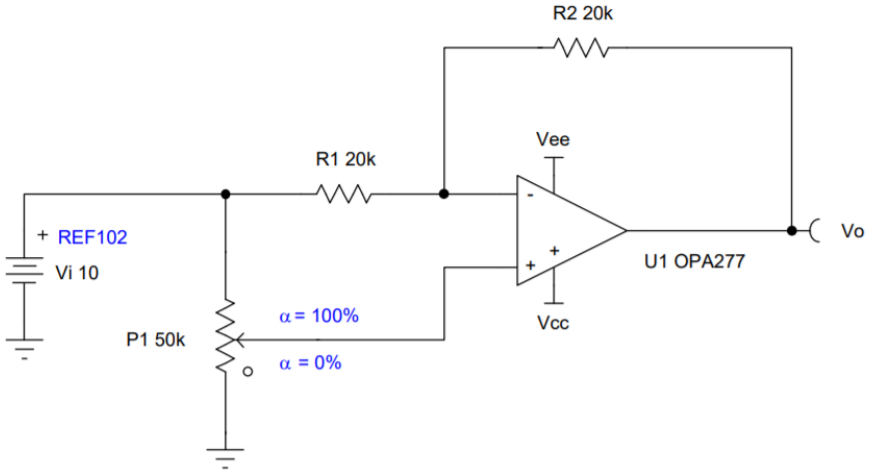
Design Notes

Input	Output		Supply	
V_i	V_{oMin}	V_{oMax}	V_{dd}	V_{ee}
10V	-10V	10V	15V	-15V



Design Notes:

1. Observe the common-mode and output swing limitations of the op amp.
2. Mismatch in R1 and R2 results in a gain error. Therefore, be sure to use precision resistors for high accuracy applications.
3. Select the potentiometer based on the desired resolution of the reference.

Design Resources

EE Cookbook: Op Amp
www.ti.com/circuitcookbooks
Step-by-step circuit design of common op amp building block circuits.

TI Designs
www.TI.com/tidesigns
Ready-to-use reference designs with
theory, calculations, simulations
schematics, PCB files, bench test results

Analog Engineer's Pocket Reference
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PDF, iTunes app and hardcopy available
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