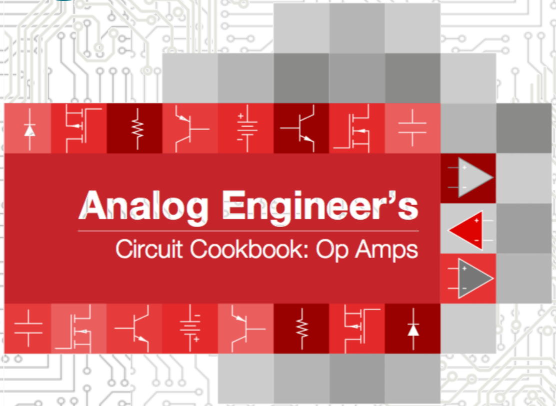
How to Design
Single-supply strain gauge bridge amplifier circuit



General Purpose Amplifiers

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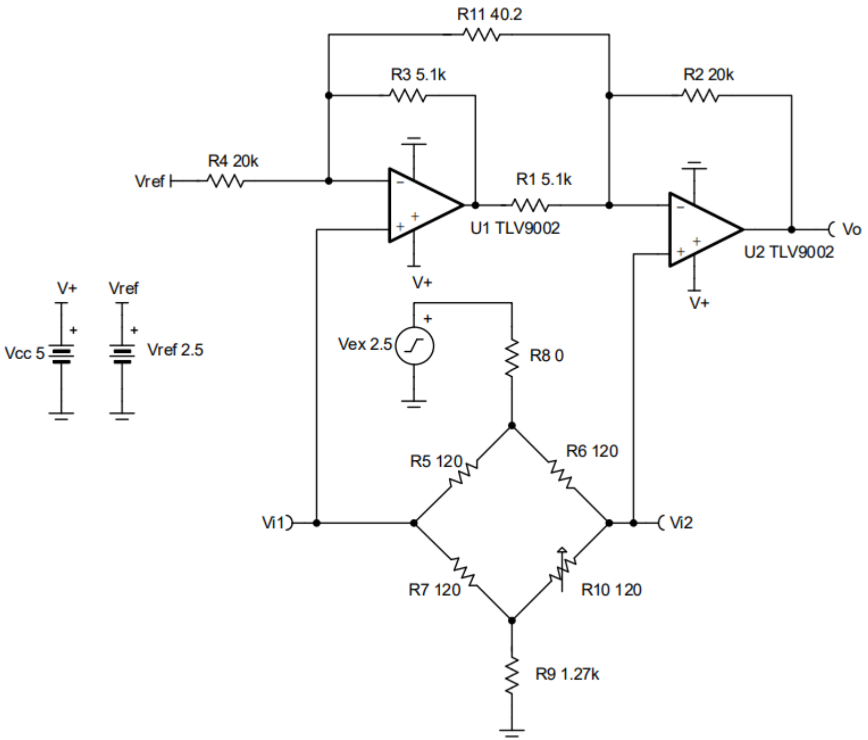
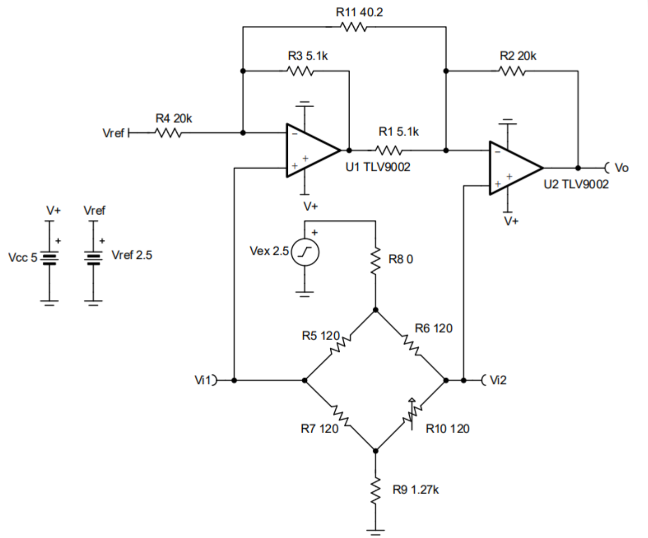
Circuit Description



$$V_O = (I_i \times R_1) \times \left(1 + \frac{R_3}{R_2}\right)$$

Design Steps

Input V_{iDiff} (V_{i2}-V_{i1})		Output		Supply		
V_{iDiff_Min}	V_{iDiff_Max}	V_{oMin}	V_{oMax}	V_{cc}	V_{ee}	V_{ref}
-2.22 mV	2.27 mV	225 mV	4.72 V	5 V	0 V	2.5 V
Strain Gauge Res. Variation (R_{10})		V_{cm}		Gain		
115Ω - 125Ω		2.15 V		1001 V/V		



Differential Input Voltage

Reference Voltage

$$Vo = (Vi2 - Vi1) \times \left(1 + \frac{R4}{R3} + \frac{2 \times R2}{R11}\right) + Vref$$

Gain

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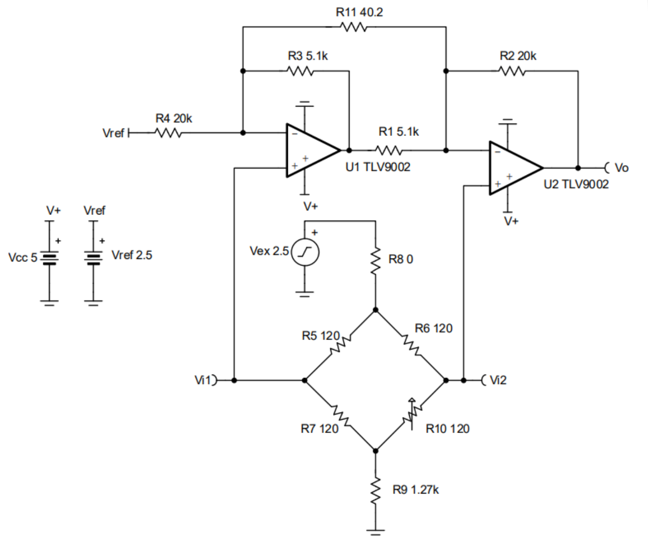

R5 = R6 = R7 = 120 Ω

$$Vcm = \frac{\frac{Rbridge}{2} + R5}{Rbridge + R8 + R9} \times Vex$$

R8 = 0 Ω

R9 = 1.23 kΩ ≈ 1.27 kΩ

Design Steps

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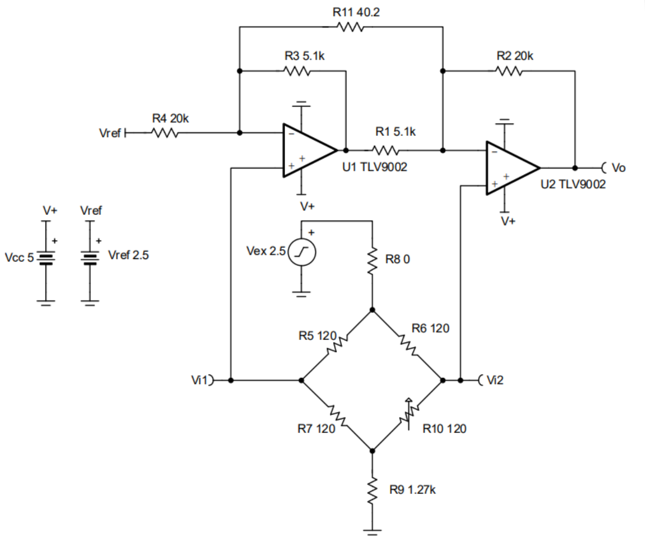

R1 = R3 = 5.1 kΩ

R2 = R4 = 20 kΩ

$$Gain = 1 + \frac{R4}{R3} + \frac{2 \times R2}{R11} = 1001 \frac{V}{V}$$

$$R11 = 40.15\ \Omega \approx 40.2\ \Omega$$

DC Results

Input V_{iDiff} (V_{i2}-V_{i1})		Output		Supply		
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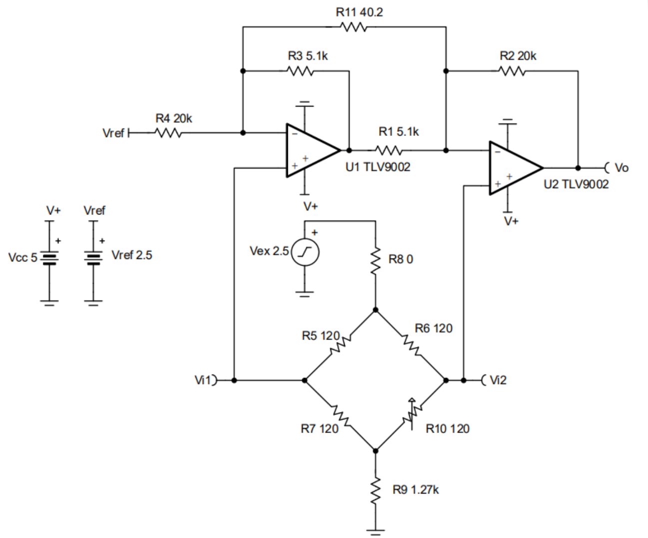

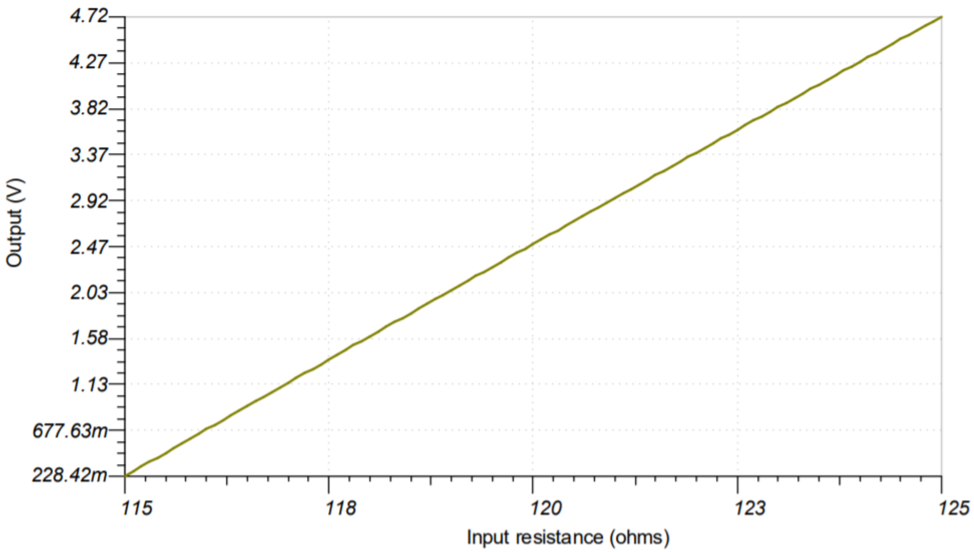

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Design Notes

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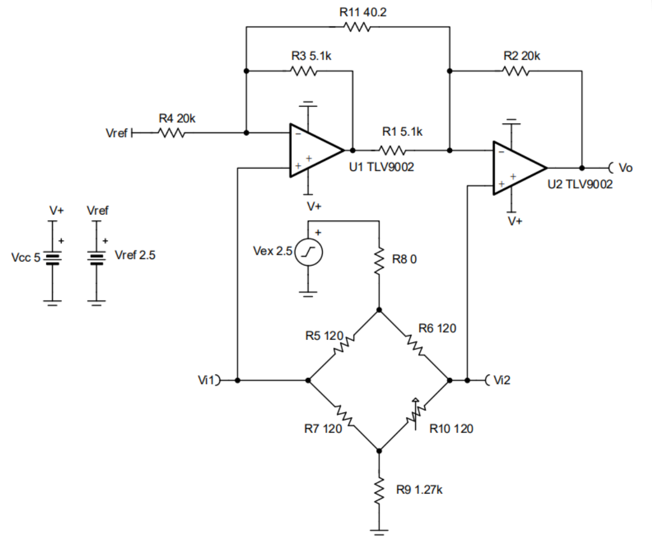

Design Notes:

1. For single-supply strain gauge bridge amplifier circuits, resistors R5, R6, and R7 of the Wheatstone bridge must match the strain gauge nominal resistance and be equal to avoid creating a bridge offset voltage.

2. Vref biases the output voltage to mid–supply to allow differential measurements in the positive and negative directions.

3. Low tolerance resistors must be used to minimize the offset and gain errors due to the bridge resistors.

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
www.TI.com/analogrefguide
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