Electronics
Wheatstone Bridge Circuits

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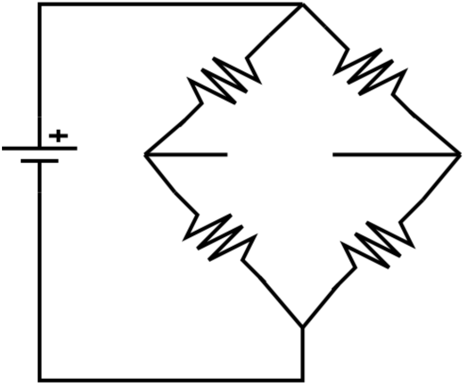
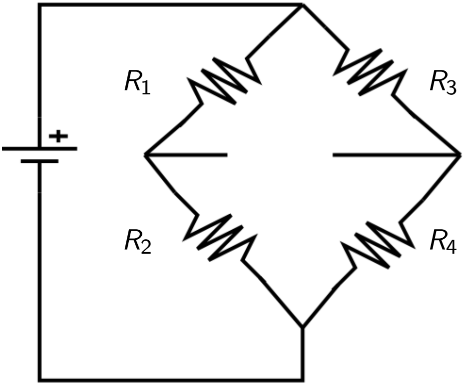
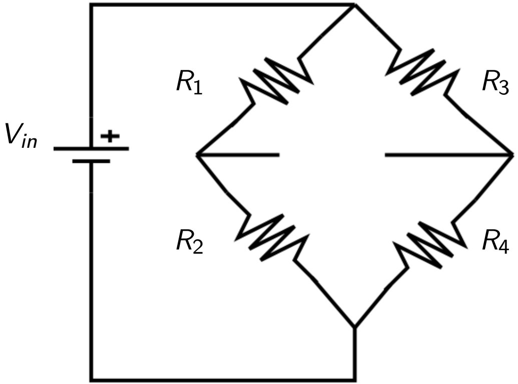
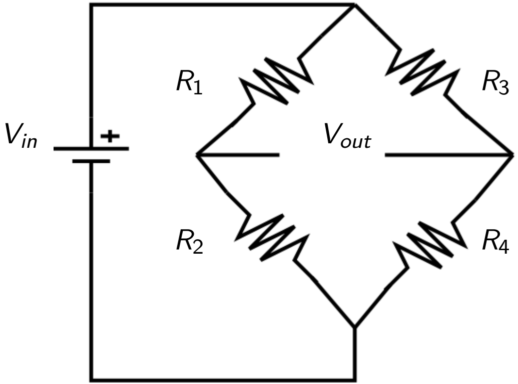
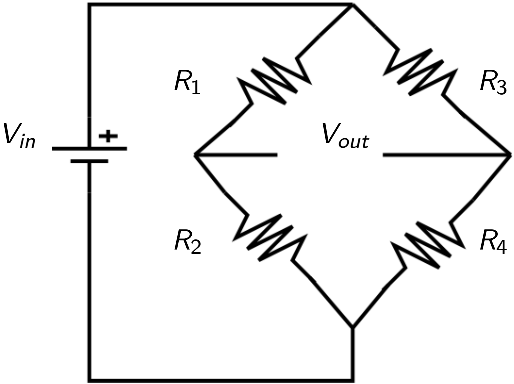
- It's usually operated with the output voltage at or close to zero.



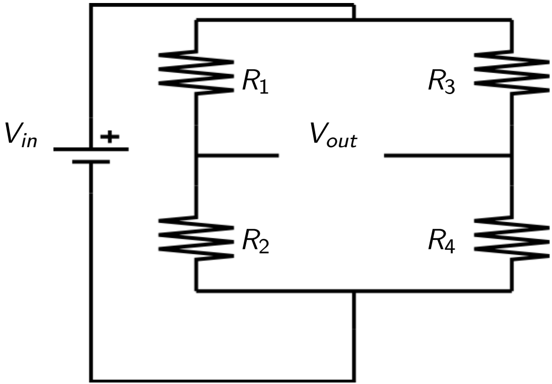

+
R_1
R_3
R_2
R_4


V_{in}
+
R_1
R_3
R_2
R_4

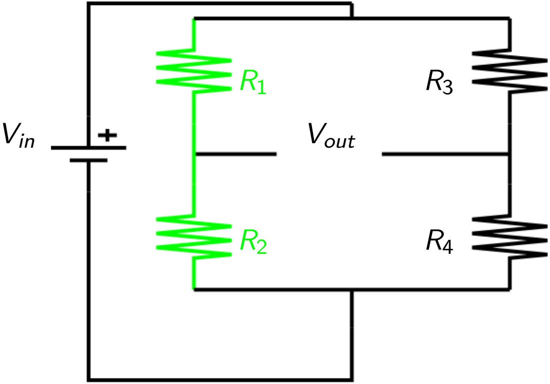

V_{in}
+
R_1
R_3
V_{out}
R_2
R_4



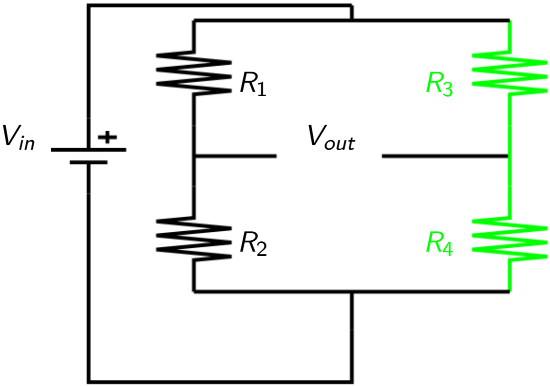
This is a Wheatstone bridge.



Here it's redrawn to show the two voltage dividers.



Here's one voltage divider.



Here's the other voltage divider.

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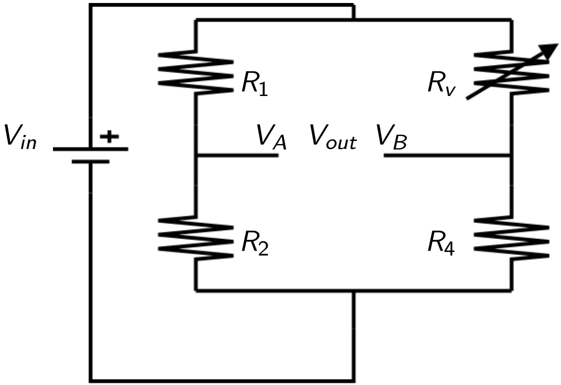
- The circuit is very sensitive to small changes in the variable resistor.



The variable resistor could be in any of the four positions; this is one example.

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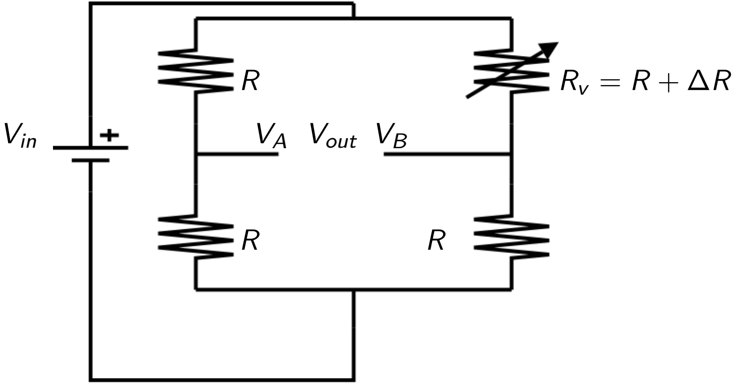
- If R_v increases, V_B will decrease, and vice versa.
- For optimum performance, all resistors should be of the same order of magnitude.
- If using a resistive sensor, use a meter to measure resistance of sensor to get a correct order of magnitude.



If resistors are chosen to be equal, except for R_v, then the output voltage will vary with changes in R_v.

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(This approximation is true as long as $\Delta R << R$)

Wheatstone bridge options

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- Instrumentation amplifiers

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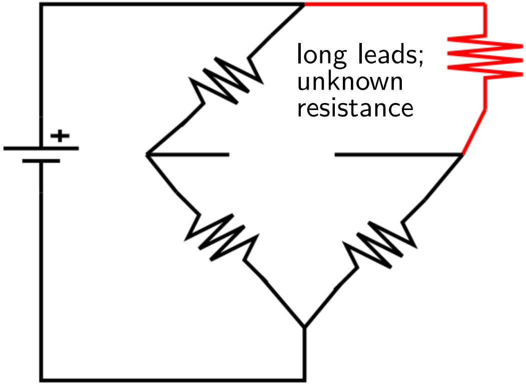
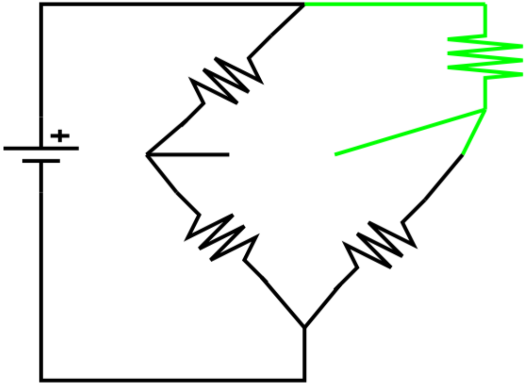
  differential op amp circuit with voltage followers on the inputs

Lead wire compensation



Uncompensated

Lead wire compensation



No current flows in measurement lead; similar resistance in both other leads

Temperature compensation

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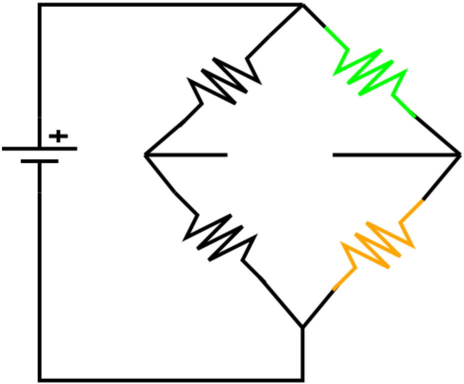

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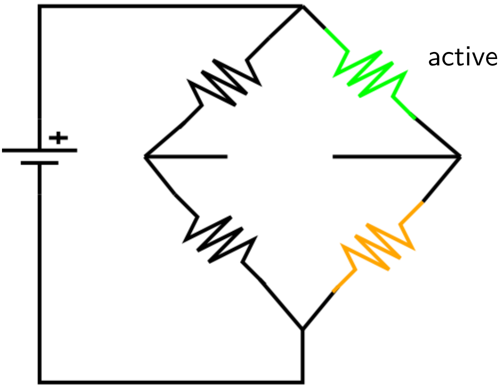

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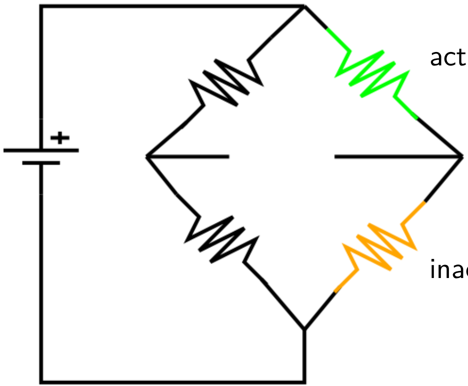

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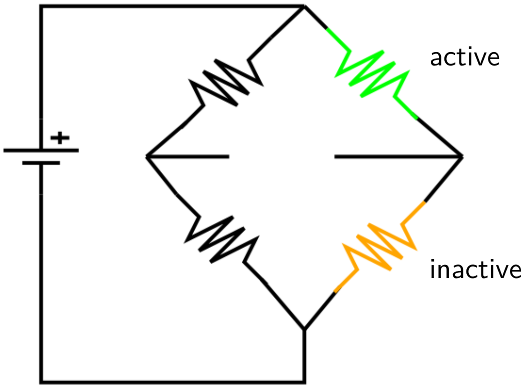

Temperature response of non-active sensor similar to active sensor

Doubling sensitivity

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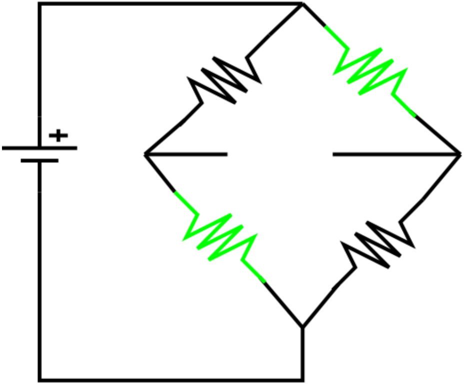
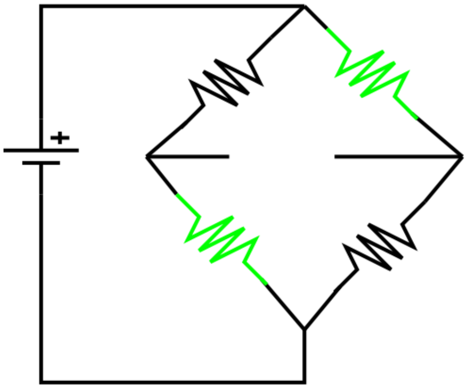


Doubling sensitivity



Sensors in diagonal positions produce opposite responses.

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  thus current controlled by R_s (fixed) rather than R_t (variable).

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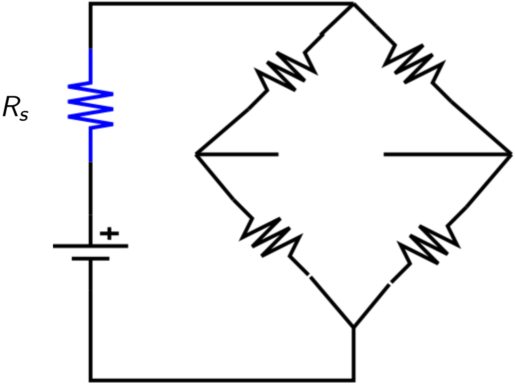

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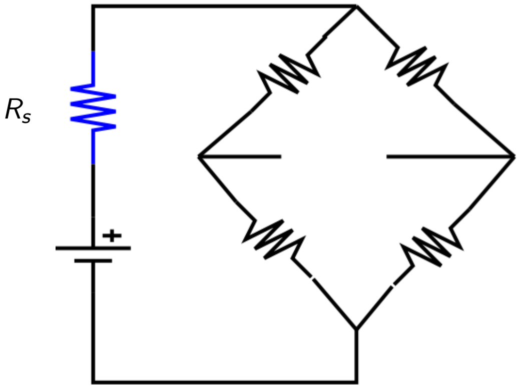

This is useful if the voltage supply is fixed.