Electronics
Resistive Sensors and Bridge Circuits

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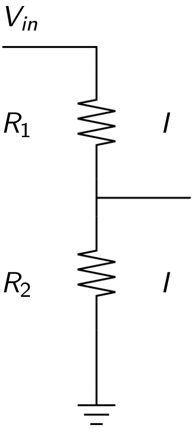
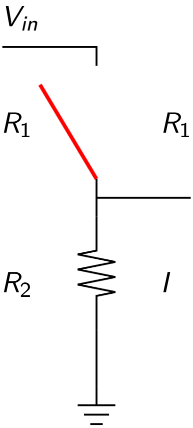
- A switch can be thought of as a resistor which can have a value of either zero or infinity.
- Following is an illustration of a voltage divider where one element is a switch.



$$V_{out} = V_{in}\left(\frac{R_2}{R_1+R_2}\right)$$

True if $I_{out} \equiv 0$



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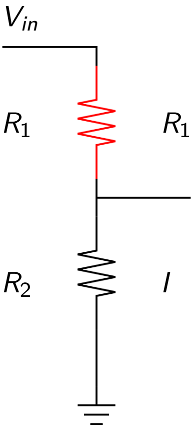

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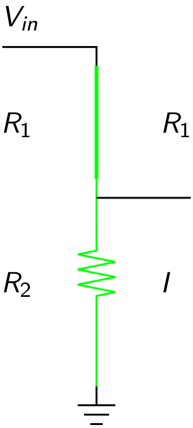

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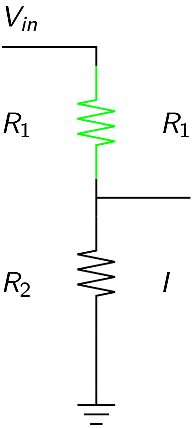

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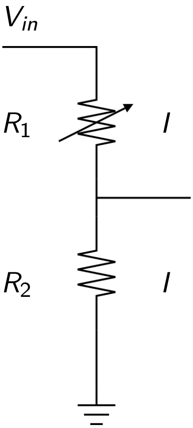
- If either resistor in a voltage divider is *variable*, then a range of output voltages is possible.



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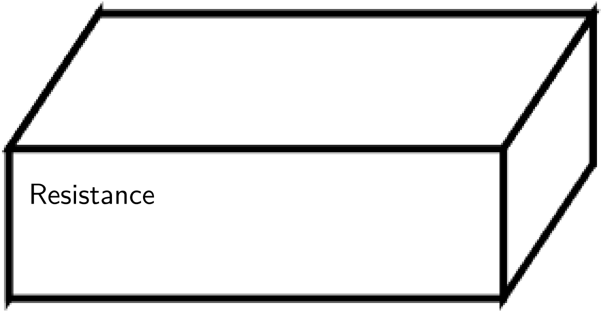
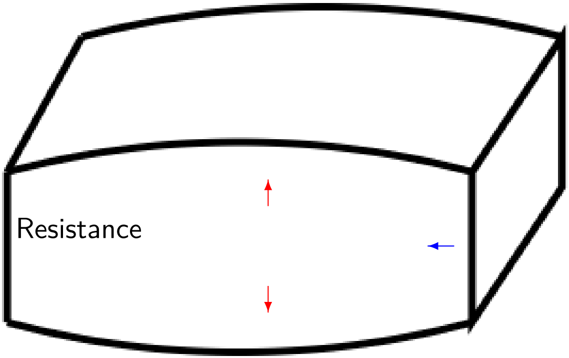
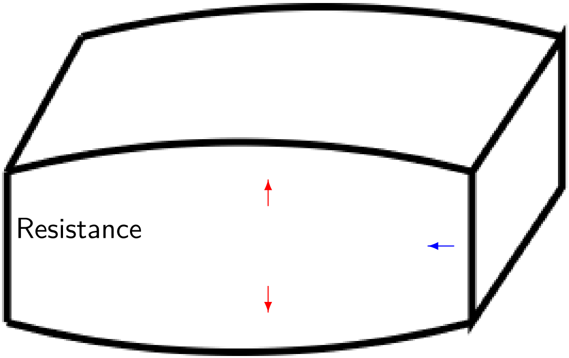
- Force-dependent resistor; the resistance varies with *applied pressure*

Here's an example of how a strain gauge works.

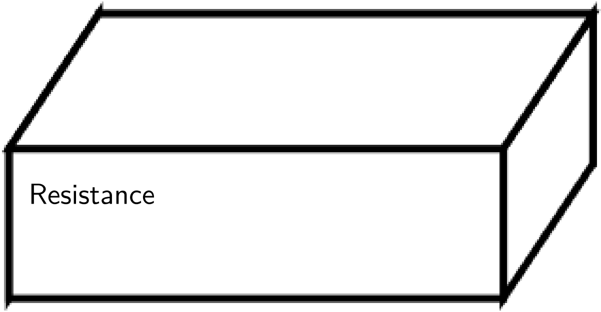


$$R = \rho \frac{L}{A}$$


Resistance



$$R' = \rho \frac{(L - \Delta L)}{(A + \Delta A)} < R$$



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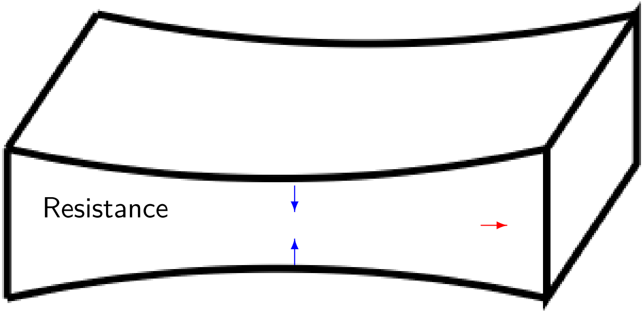
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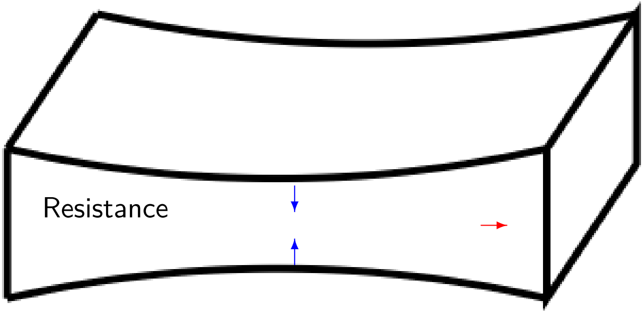

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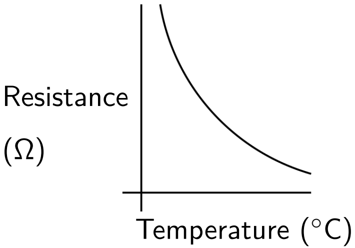
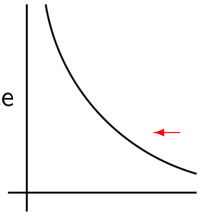


This is the resistance/temperature curve for a thermistor.



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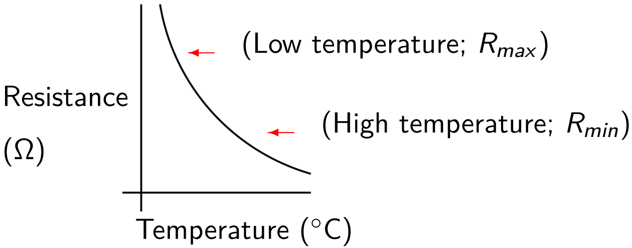

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  $R = \sqrt{R_{min} \times R_{max}}$

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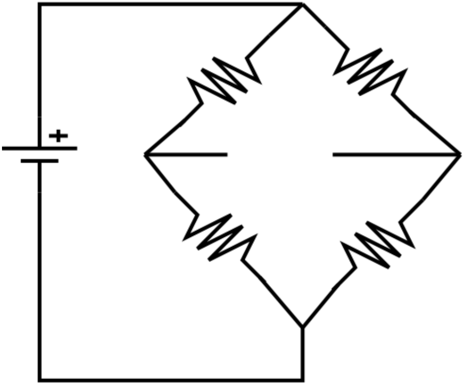
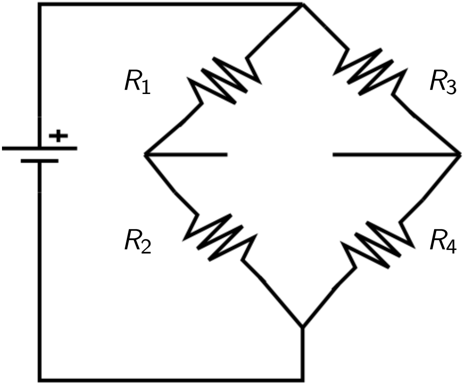
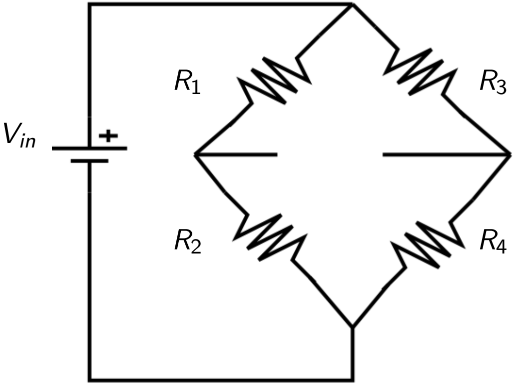
- It's usually operated with the output voltage at or close to zero.




+
R1
R3
R2
R4


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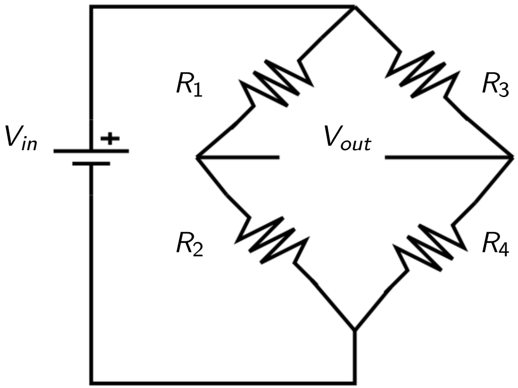
V_{in}
+
R_1
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V_{out}
R_2
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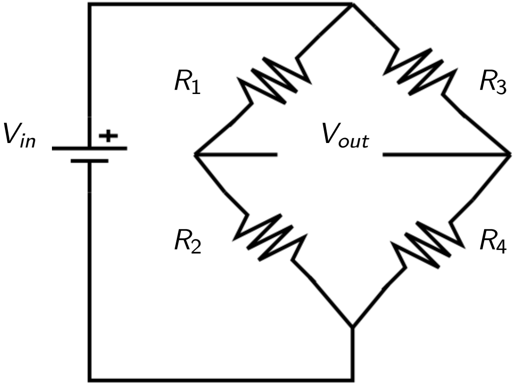
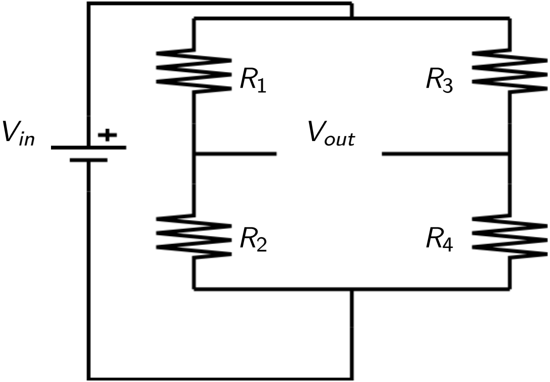
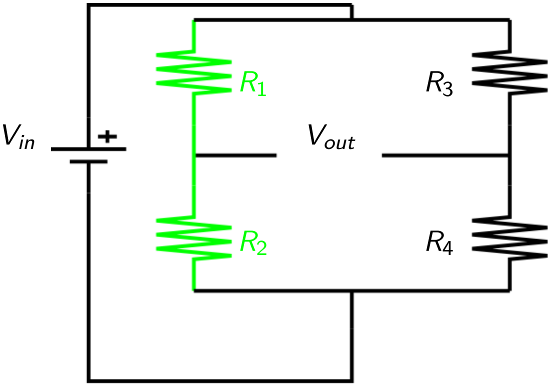


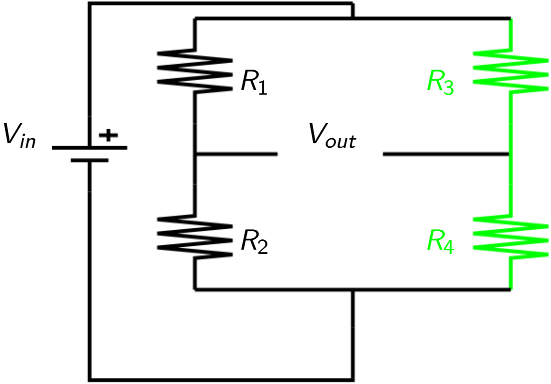
This is a Wheatstone bridge.



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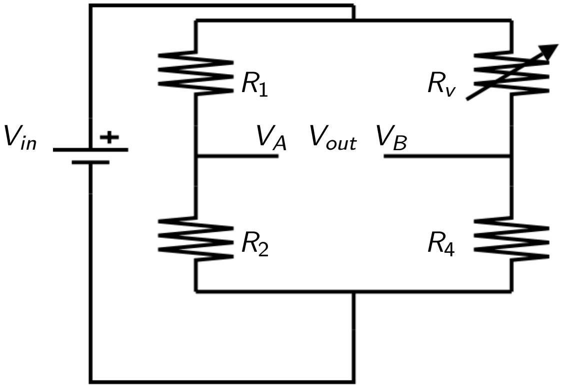
- The circuit is very sensitive to small changes in the variable resistor.



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

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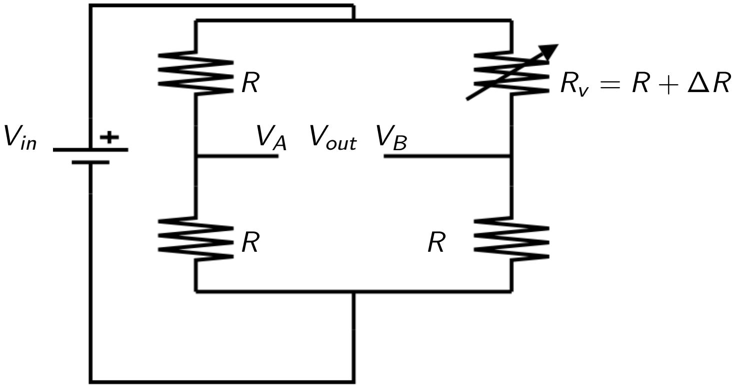
- If using a resistive sensor, use a meter to measure resistance of sensor to get a correct order of magnitude.



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 $\Delta R << R$)