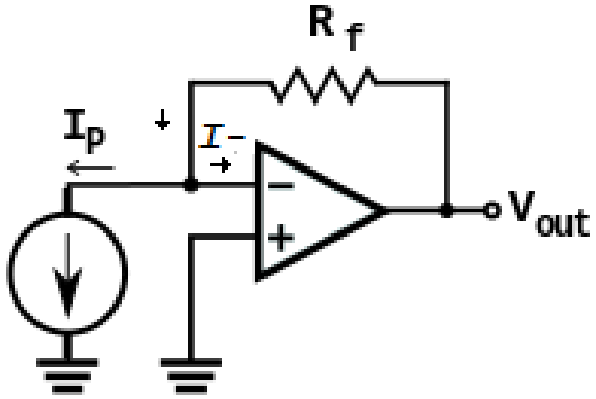
Signal Conversion

I-V Converter

A current to voltage converter will produce a voltage proportional to the given current. This circuit is required if your measuring instrument is capable only of measuring voltages and you need to measure the current output.

If your instrument or data acquisition module (DAQ) has a input impedance that is several orders larger than the converting resistor, a simple resistor circuit can be used to do the conversion. However, if the input impedance of your instrument is low compared to the converting resistor then the following op-amp circuit should be used.



To analyse the current to voltage converter by inspection,

- if we apply KCL to the node at V- (the inverting input) and let the input current to the inverting input be I-, then

$$\frac{V_{out} - V_-}{R_f} = I_p + I_- \qquad (1)$$

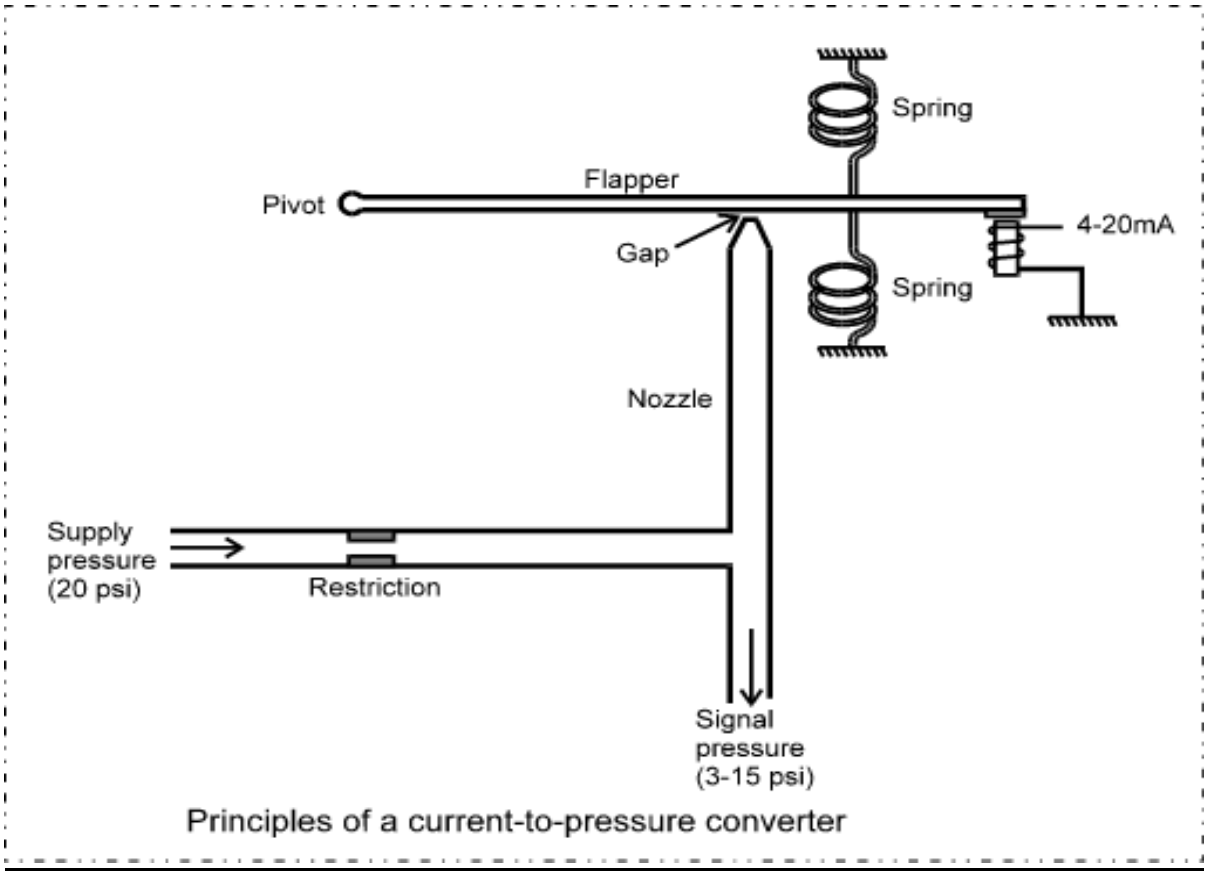
- since the output is connected to V- through R_f, the opamp is in a negative feedback configuration. Thus

$$V_- = V_+ = 0 \qquad (2)$$

- and assuming that I- is 0 and simplifying,

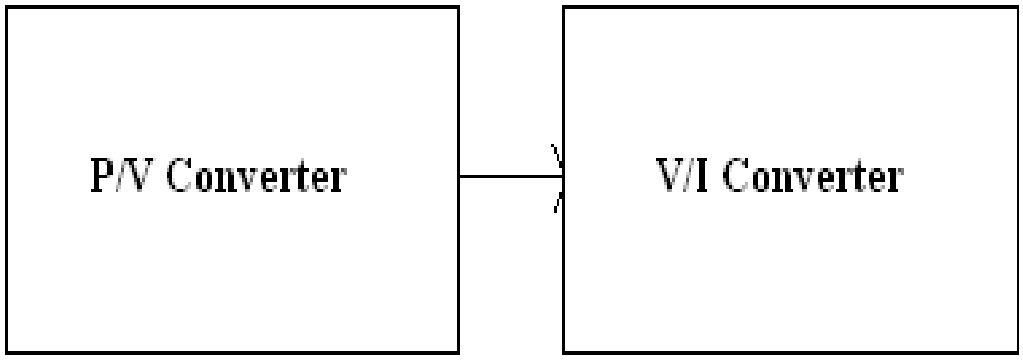
$$V_{out} = I_p R_f \qquad (3)$$

I-P Converter

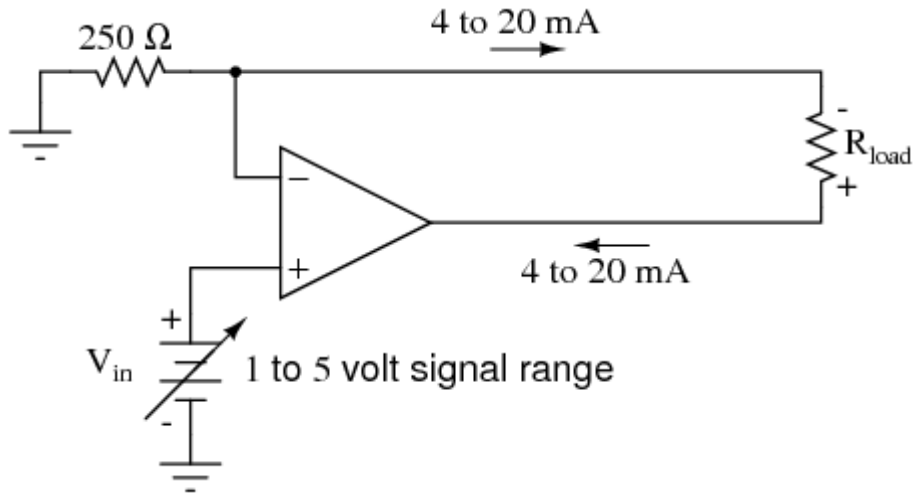


Principles of a current-to-pressure converter

P-I Converter



V-I Converter



The input voltage to this circuit is assumed to be coming from some type of physical transducer/amplifier arrangement, calibrated to produce 1 volt at 0 percent of physical measurement, and 5 volts at 100 percent of physical measurement. The standard analog current signal range is 4 mA to 20 mA, signifying 0% to 100% of measurement range, respectively. At 5 volts input, the 250 Ω (precision) resistor will have 5 volts applied across it, resulting in 20 mA of current in the large loop circuit (with R_{load}). It does not matter what resistance value R_{load} is, or how much wire resistance is present in that large loop, so long as the op-amp has a high enough power supply voltage to output the voltage necessary to get 20 mA flowing through R_{load}. The 250 Ω resistor establishes the relationship between input voltage and output current, in this case creating the equivalence of 1-5 V in / 4-20 mA out. If we are convert the 1-5 volt input signal to a 10-50 mA output signal (an older, obsolete instrumentation standard for industry), we have to use a 100 Ω precision resistor instead.