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Lab 1 Report Questions

**Questions**

1. Using the rule above, show that the resistor Rin should be selected as 900Ω given the selected values for Rf and R1.

$$R_f = 9\ k\Omega$$
$$R_1 = 1\ k\Omega$$
$$R_{in} = \left(\frac{1}{R_f} + \frac{1}{R_1}\right)^{-1} = \left(\frac{1}{9\ k\Omega} + \frac{1}{1\ k\Omega}\right)^{-1}$$
$$\boldsymbol{R_{in} = 900\ \Omega}$$

2. What resistor values should be used for the voltage divider to get 6.67V provided to the sensor if a 10V supply is used?

$$V_{out} = \left(\frac{R_2}{R_1 + R_2}\right) V_{in}$$
$$6.67\text{ V} = \left(\frac{R_2}{R_1 + R_2}\right)(10\text{ V})$$
$$\left(\frac{R_2}{R_1 + R_2}\right) = 0.667\text{ V} \approx \frac{2}{3}$$

**Therefore, in order to satisfy this ratio, $R_1$ could be selected to be 5 kΩ while $R_2$ could be selected to be 10 kΩ.**

3. Find a voltage regulator through Digikey, or another electronics supplier, which can take an input of 12VDC and supply the required 8VDC output. Provide the part name and manufacturer of the regulator. What is the maximum current output of the regulator?

The voltage regulator chosen that can take an input of 12V DC and supply the required 8V DC output is the PST-DCZ0803 regulator from PowerStream. Specifically, this regulator is capable of taking an input voltage in the range of 10 V – 34 V and supplying an output voltage of 8 V. The maximum current output of this regulator is 3 A.

Link: https://www.powerstream.com/dc-dcz0803.htm

4. Calculate the resistor values to set the gain of the non-inverting amplifier at 8 for the same range of temperatures.

$$G = \left(1 + \frac{R_f}{R_1}\right)$$
$$8 = \left(1 + \frac{R_f}{R_1}\right)$$
$$\frac{R_f}{R_1} = 7$$

**Therefore, in order to satisfy the above ratio, $R_f$ could be chosen to be 7 kΩ while $R_1$ could be chosen to be 1 kΩ.**

5. What gain should you use if you want the output of the amplifier to be 0.4V when measuring a temperature of 10°F? When using this gain, what range of temperatures can be measured if your microcontroller can only read voltages between 500mV and 4.5V?

$$G_{sensor} = 10\,\frac{\mathrm{mV}}{°\mathrm{F}} = 0.01\,\frac{\mathrm{V}}{°\mathrm{F}}$$
$$V_{out} = (G_{amp})(G_{sensor})(T)$$
$$0.4\ \mathrm{V} = (G_{amp})\left(0.01\,\frac{\mathrm{V}}{°\mathrm{F}}\right)(10\ °\mathrm{F})$$
$$\boldsymbol{G_{amp} = 4\ \frac{\mathbf{V}}{\mathbf{V}}}$$

$$T = \frac{V_{out}}{G_{amp} * G_{sensor}} = \frac{V_{out}}{4\,\frac{\mathrm{V}}{\mathrm{V}} * 0.01\,\frac{\mathrm{V}}{°\mathrm{F}}} = \left(25\,\frac{°\mathrm{F}}{\mathrm{V}}\right) V_{out}$$
$$T_{lowest} = \left(25\,\frac{°\mathrm{F}}{\mathrm{V}}\right)(0.5\ \mathrm{V}) = 12.5\ °\mathrm{F}$$
$$T_{highest} = \left(25\,\frac{°\mathrm{F}}{\mathrm{V}}\right)(4.5\ \mathrm{V}) = 112.5\ °\mathrm{F}$$

Therefore, using the amplifier gain of 4 V/V, the range of temperatures that can be measured if my microcontroller can only read voltages between 500 mV and 4.5 V is as follows:

$$\boldsymbol{Temperature\ Range = 12.5}\ °\mathrm{F} < \boldsymbol{T} < \boldsymbol{112.5}\ °\mathrm{F}$$