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Hardware Calculations

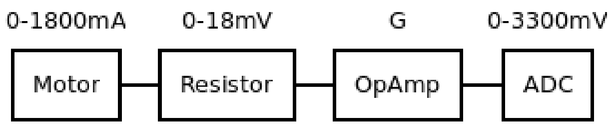
This document's purpose is to explain the current sensor calculations and the temperature sensor's equation.

Current Sensor

Since the board uses a TI DRV8837 motor driver with a 1.8A maximum current, that is the range the LPC11U24's ADC should work in.

To measure the current used by the motor a 10mΩ shunt resistor (R5) is added between the driver's GND pin and the ground plane. From Ohm's Law, for every 1000mA through the resistor there is a 10mV voltage drop, which means an 18mV range.

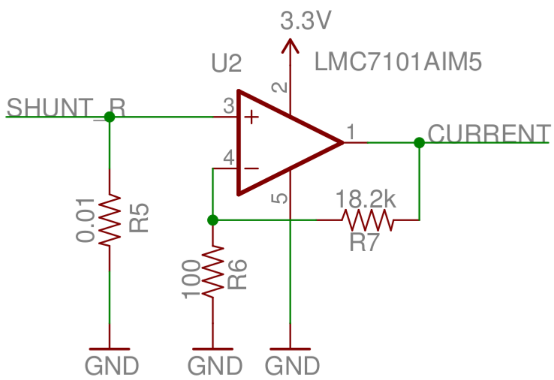
The ADC works between 0 and 3.3V and has a 10-bit resolution, or a 3.23mV/step resolution. With this setup only the first 6 steps of the 1024 would be meaningful, which is a meager 0.6% of the ADC's scale.



To use the ADC's full scale the resistor's voltage range must be transformed to that of the ADC, which is done by multiplying by the operational amplifier's gain G.

$$G = \frac{3300}{18} = 183.33$$

To get such gain the OpAmp is configured as a non-inverting amplifier, as seen in the following image:



$$G = 1 + \frac{R7}{R6}$$
$$G = 1 + \frac{18.2k}{100}$$

The ADC will now use its full scale to read the current, with a theoretical resolution of 1.76mA/step.

Temperature Sensor

The board includes a TMP36 temperature sensor from Analog Devices. From its datasheet:

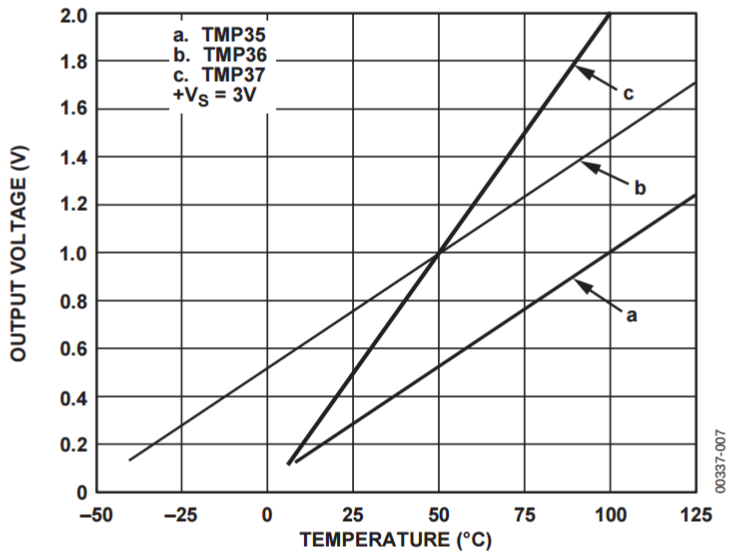


Figure 6. Output Voltage vs. Temperature

and TMP36 Output Voltage when T=25°C is 750mV. Knowing this, the temperature equation is calculated:

$$V(mV) = m \cdot T(°C) + p$$

$$m = \frac{1000-750}{50-25} = 10$$

$$p = V - m \cdot T = 750 - 10 \cdot 25 = 500$$

$$V(mV) = 10 \cdot T(°C) + 500$$

$$\rightarrow T(°C) = (V(mV) - 500)/10$$