Elliot Zuercher

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Analog Temperature Sensor Experiment Analysis

Procedure:

Replace the 10K thermistor with a 10K resistor with 1% tolerance so that temperature fluctuations do not impact the experiment.

Write an Arduino sketch to collect 500 data samples from the sensor, with 1ms delay between samples. Example code:

```
for (int i = 0; i < 500; i++) {
  Serial.println(adc.readADC(1, false));
  delay(1);
}
```

MCP3008 10-bit ADC rated at 75 ksps, so this sample rate is well within spec. Note, in reality, the Serial.println() function adds more delay to the loop, so it actually takes more than 500ms (0.5s) for the program to execute.

Use this program to run 5 trials, and store the data collected in each trial in a column in a google spreadsheet. Calculate the standard deviation for each trial, then compute the average of these 5 values to find the actual standard deviation. Compare the standard deviation from the board with a ground plane to the board without a ground plane to see the difference in performance.

Data:

Table plotting the standard deviation for each trial.

Trial	With Ground Plane	Without Ground Plane
1	0.159	0.426
2	0.133	0.434
3	0.176	0.445
4	0.117	0.455
5	0.153	0.462

Table plotting the average values of standard deviation.

	With Ground Plane	Without Ground Plane
Standard Deviation	0.444	0.148

Conclusion:

There is a significant difference in performance between the board with a ground plane and the board without a ground plane. Without the ground plane, the standard deviation is nearly 0.3 more than with a ground plane. The ground plane helps ensure that every component's connection point to ground is at the same potential (as opposed to small voltage differences that may appear as the result of the significant resistance of narrow traces), and also reduces the chance of ground loops or crosstalk.