Lab 16: Diff and SE Measurements

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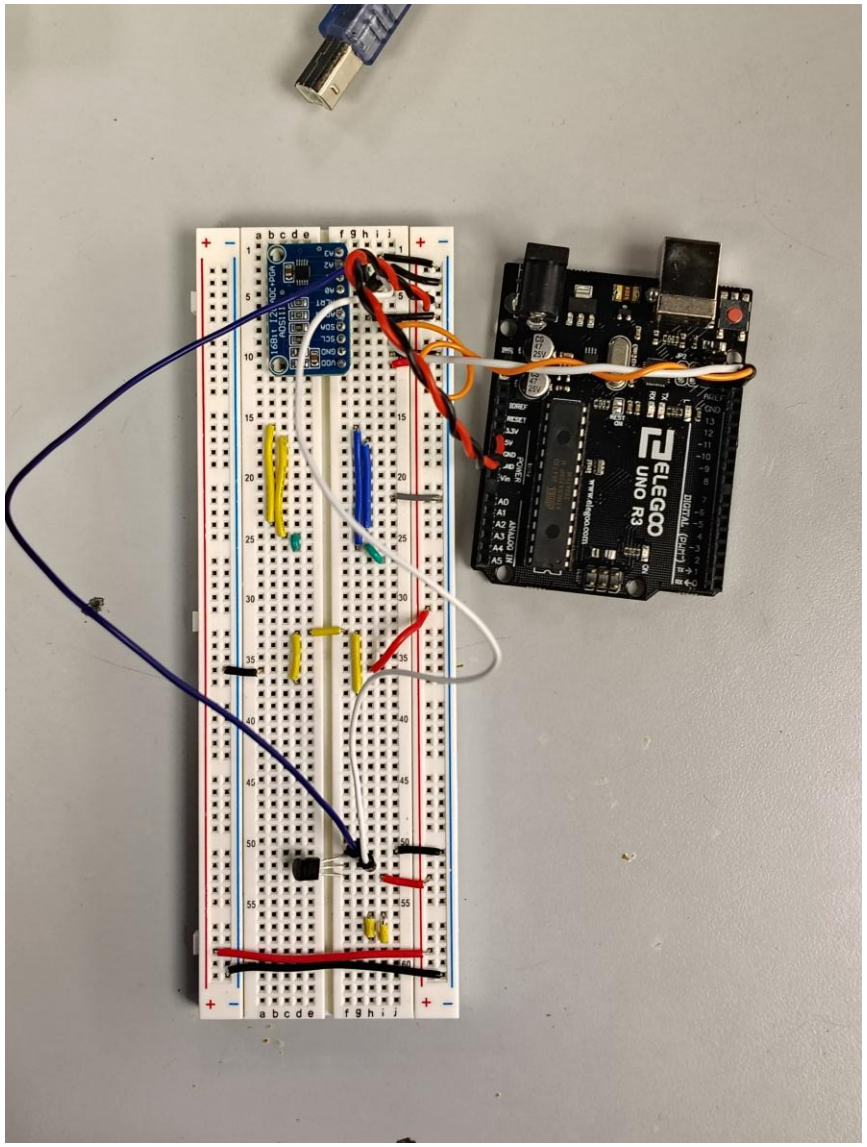

Figure 1: Test setup

Differential Pair vs. Single Ended Test Results

- Large ground currents -> Large impact on temp reading (10V/(0.74V/0.5A)) = 10V/1.5Ω = 6.8A)
- Diff is less impacted (Vpp=2mV, or 0.2°C)
- SE receives full impact (Vpp=64mV, or 6.4°C)
- The read temperature was approximately:

$$0.725V \ * 100 \frac{°C}{V} - 50°C = 22.5°C$$

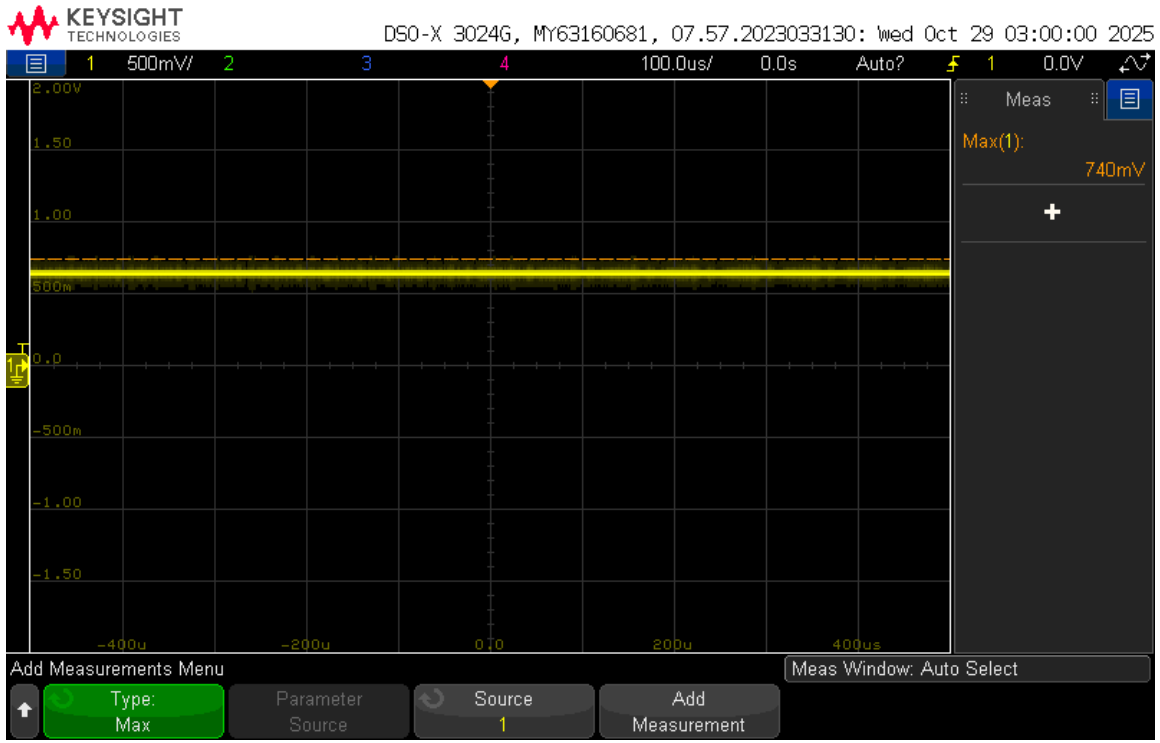

Figure 2: Voltage across a power rail in the long solderless breadboard with 0.5A passing through it.

Differential Pair vs. Single Ended Test Recommendation

- Use Differential Pair if signal integrity matters and there is lots of ground noise (eg O2 sensors)
- Otherwise, use Single Ended (eg door open/closed sensor)
- Route the diff lines close together so that they're impacted equally by EMI.

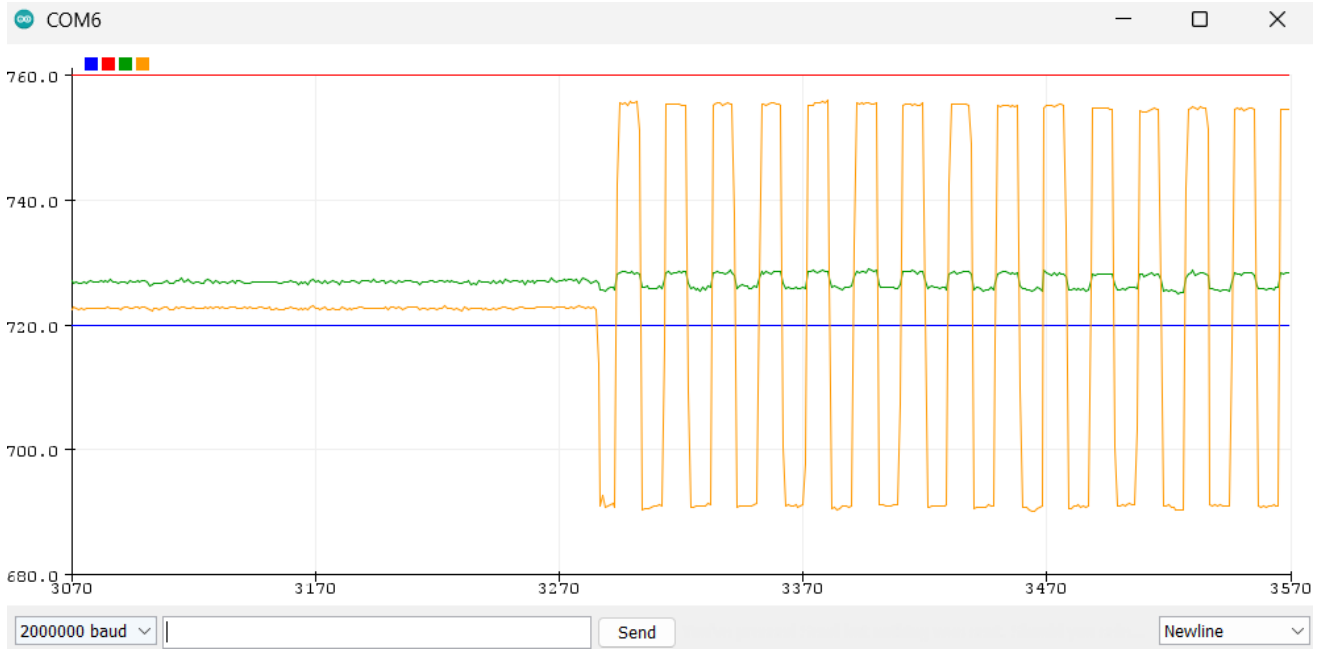

Figure 3: Differential pair (green, 0.726mV avg) and single-ended (yellow, 0.722mV AVG) readings with (right) and without (left) induced ground noise.

I2C Pull-up Resistor

- Necessary because I2C devices only require having sink capabilities.
- Pull-up resistor allows the line to reset to high value
- Large resistor -> Less power
- Small resistor -> Faster rise time
- I will use a ~5.1kΩ resistor on my Golden Arduino because it’s in the middle ground.

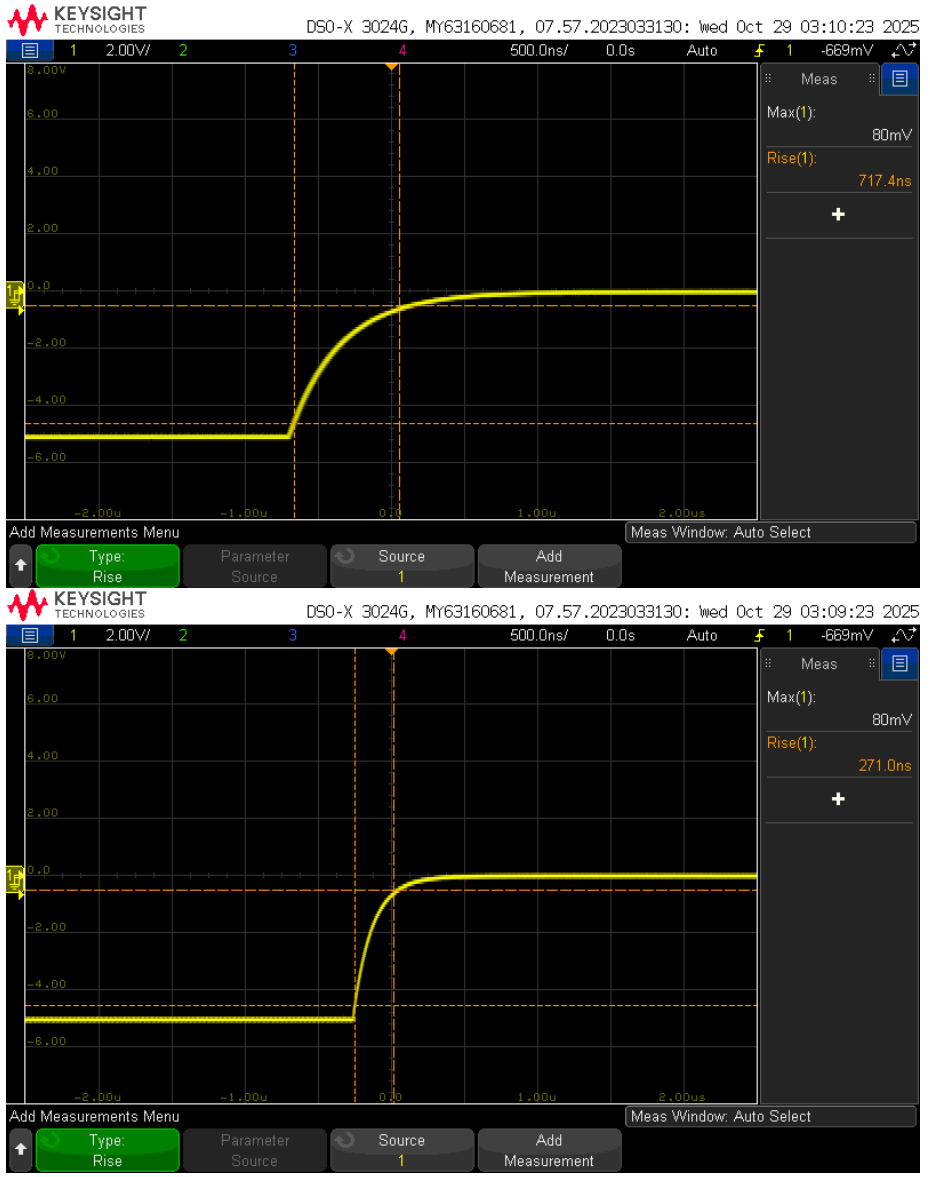

Figure 4: Rise times of SCL without an external pull-up (top) and with an 4.7kΩ external pull-up (bottom).