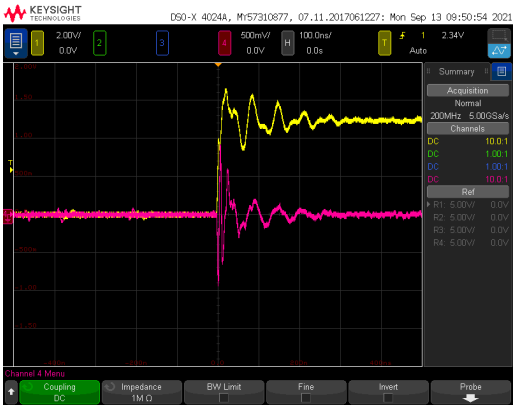
Lab Report 4 - Sam Freed

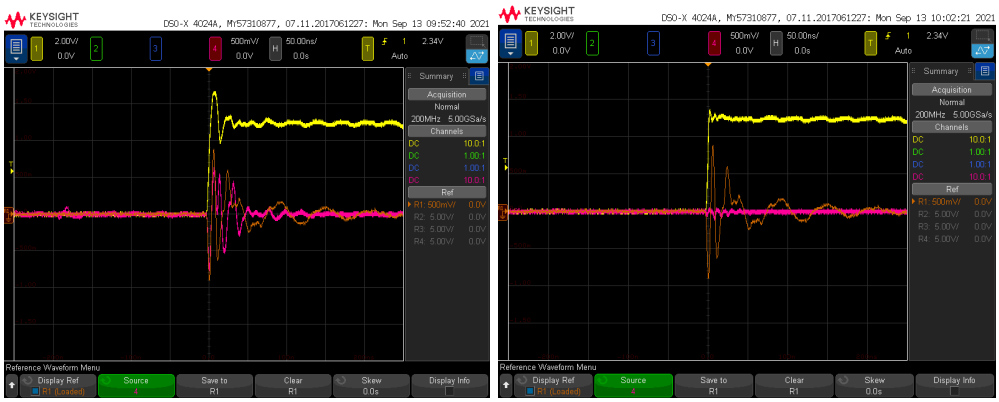
This lab encouraged us to understand the effects that different signal and return path structures have on crosstalk between signals. Overall, as the following comparisons will show, return paths via large planes on separate layers and signal paths that are short will minimize these issues.

Comparison 1: When Crosstalk Occurs



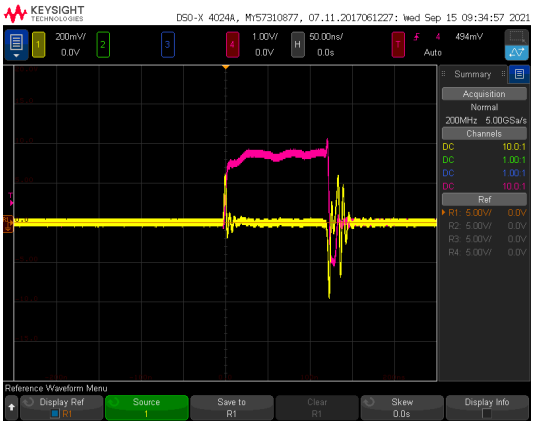
This screenshot shows the initial signal created by the Arduino through the LEDs, with the PIN13 signal shown in yellow and the supposedly grounded signal shown in red, which was created by shorting the probe. Once the signal stabilizes and the current & voltage are not fluctuating, the ground signal also stabilizes and remains close to 0V.

Comparison 2: Probe Connections



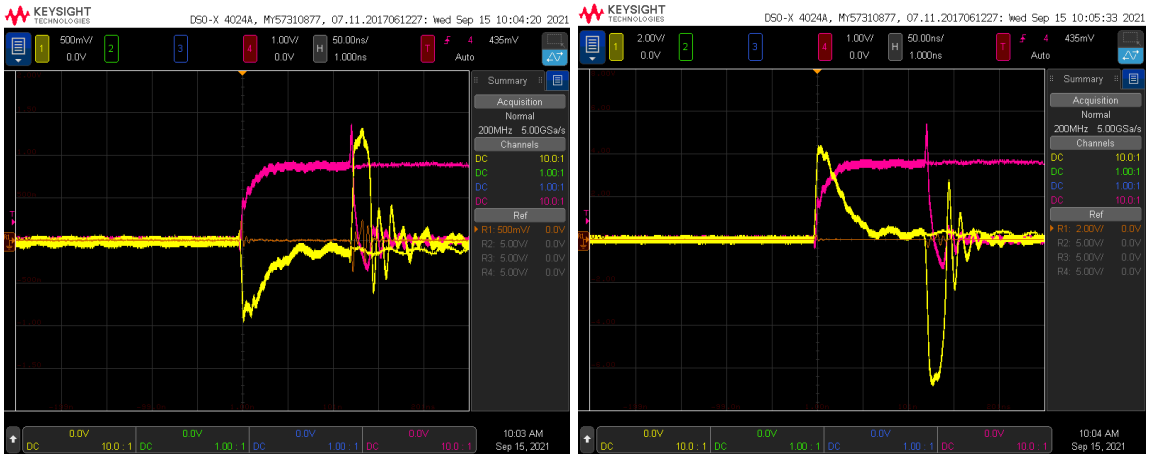
These screenshots show the reading of PIN11, a pin set to LOW according to the Arduino program, with the original, noisy signal in the previous screenshot as a reference. This comparison involved switching the probe connections from longer jumper wires to smaller spring tips, and the noise induced on the measurement is significantly smaller with the smaller loop.

Comparison 3: Continuous Return Plane



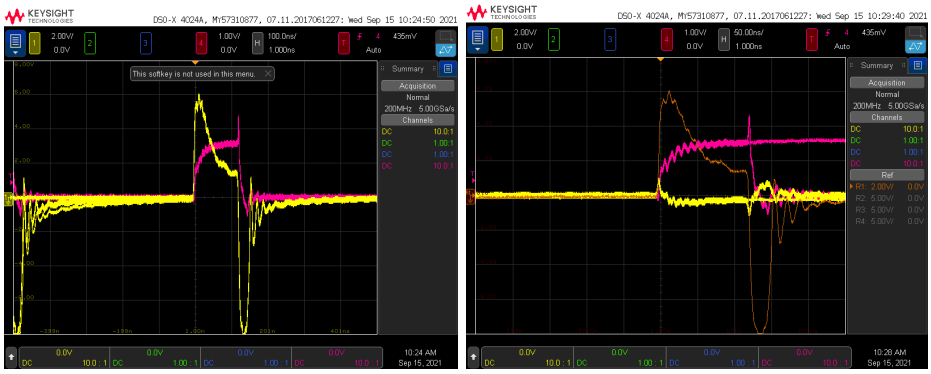
Looking at the scale of the yellow signal in this screenshot emphasizes the importance of a continuous return plane. The noise seen here is at most 400mV from the expected voltage, whereas previous signals with a single return trace had up to a full volt of noise.

Comparison 4: Shared Return Paths



This comparison focuses on the same signal running through two different return paths. With separate return traces, the noise is still impactful, but when two signals have a common return trace, the effect is even stronger. Again, compared to the orange reference return plane, the noise is magnitudes higher.

Comparison 5: Jumper Wires



Finally, both of these signals were captured while using jumper wires instead of the internal traces to transmit the signals. The separate return path structure, shown on the right, is still a better choice overall, but the large loops created by the wires create a lot of inductance and noise of their own.