

Lab 01

Solenoid and Back-EMF

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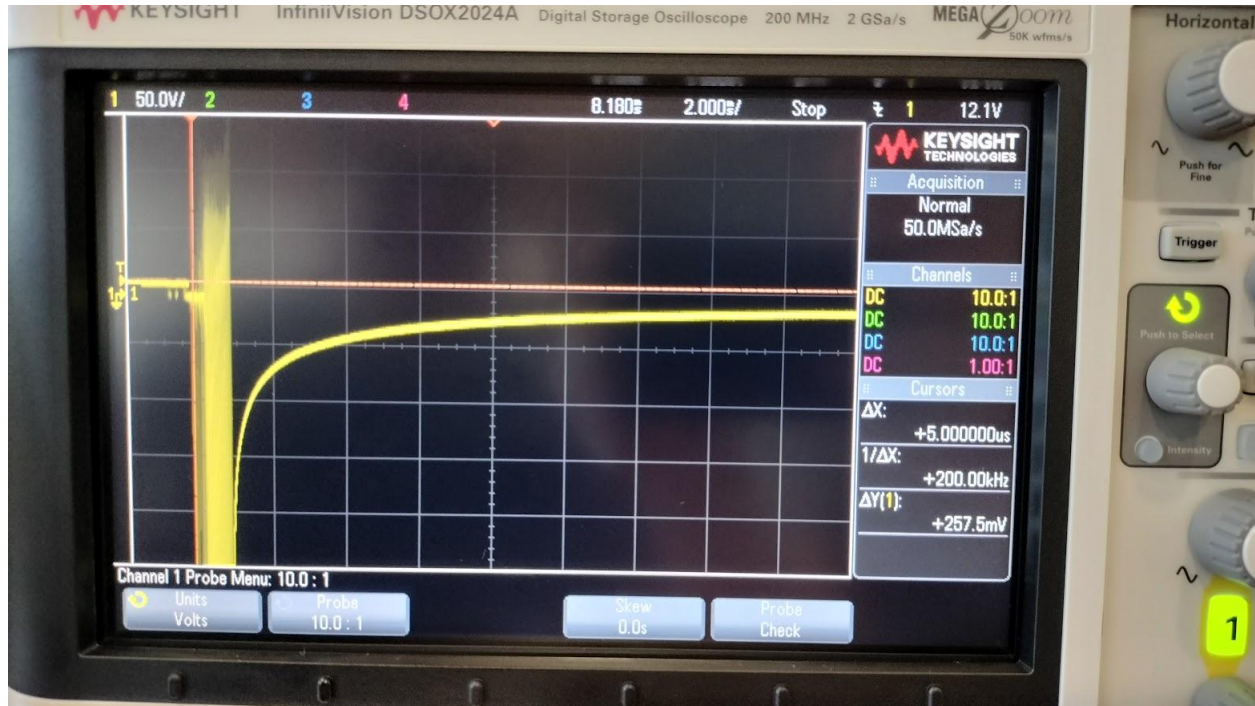
CSE 4355- Section 001

Dr. Jason Losh

Fall 2025

Bare Connection

Oscilloscope Capture

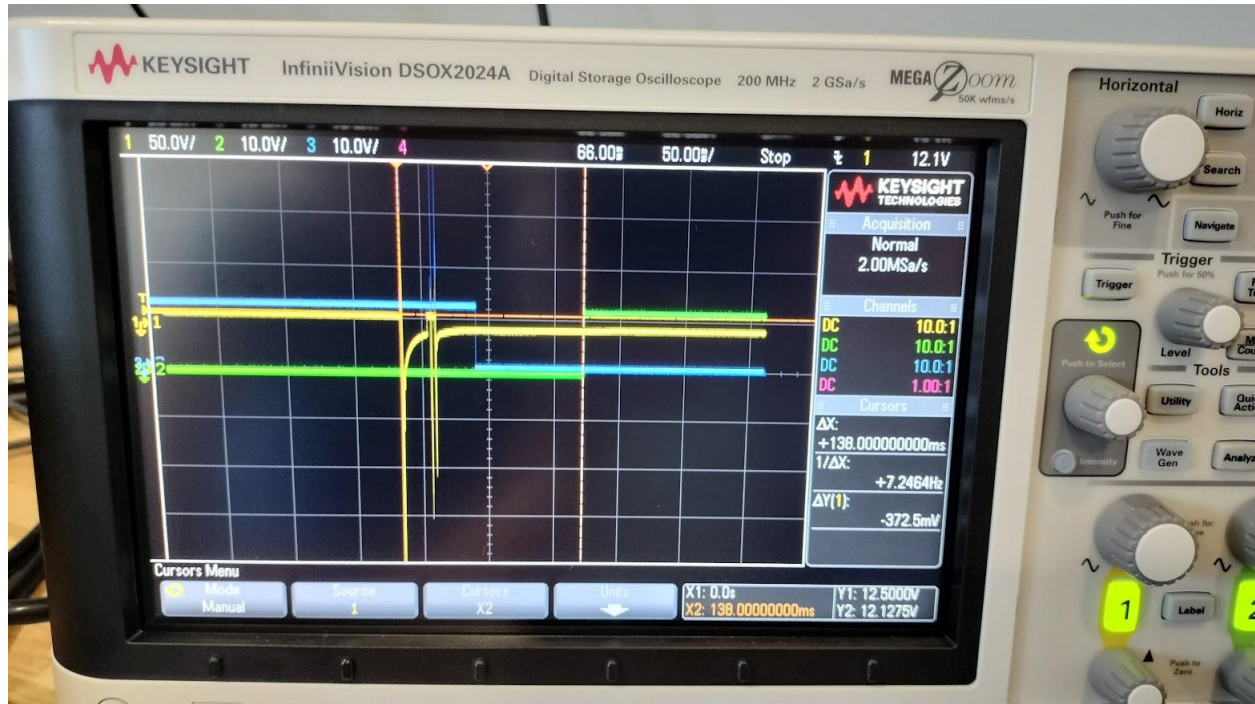


Voltage Spike Amplitude: 250V (At Oscilloscope Limit)

- Voltage spike caused by the coils resistance to the change in current.
- This can cause damage to components in the circuit, especially if the circuit is being driven by a MOSFET (MOSFET is most vulnerable to this voltage spike).
- This can be mitigated by adding a flywheel diode to allow for the coil to more slowly discharge the collapsing magnetic field.

Connection w/ Limit Switches

Oscilloscope Capture



De-engage to Blue = Off: 56ms

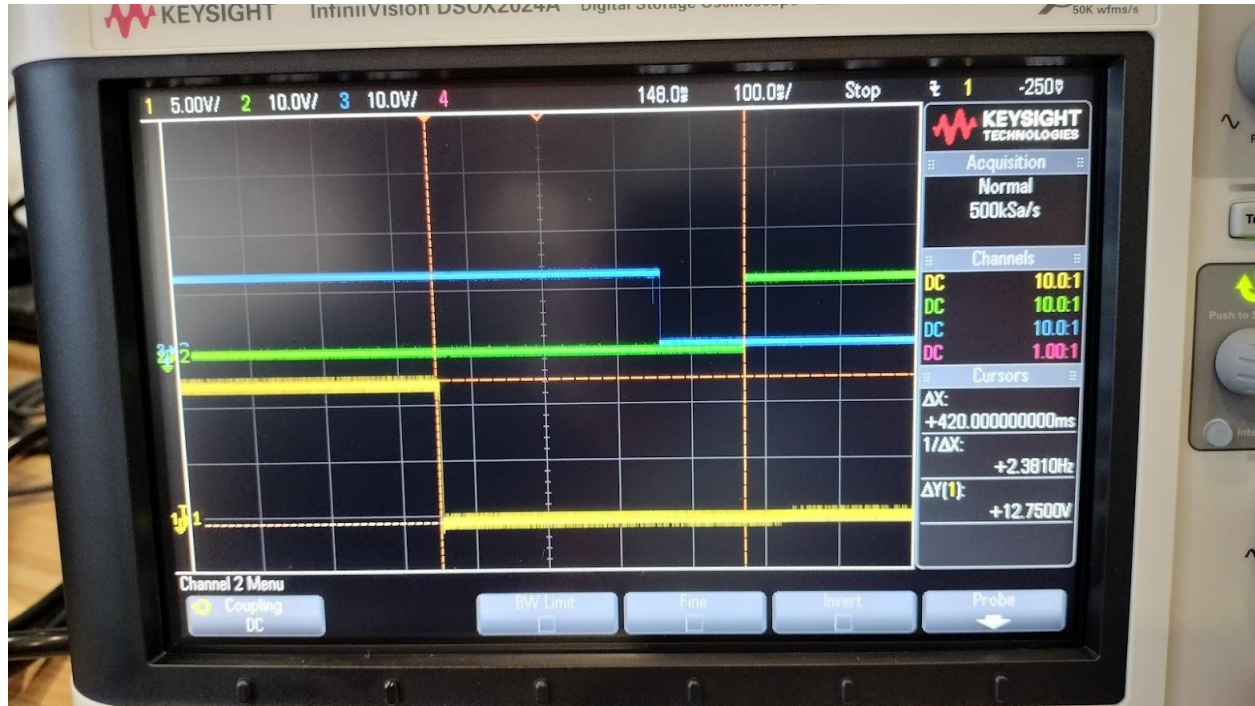
Transient time (Green & Blue = Off): 82ms

Total Transition Time (Blue = Off, Green = On): 138ms

Voltage Spike Amplitude: 250V (At Oscilloscope Limit)

Connection w/ 1N5819

Oscilloscope Capture



De-engage to Blue = Off: 306ms

Transient time (Green & Blue = Off): 112ms

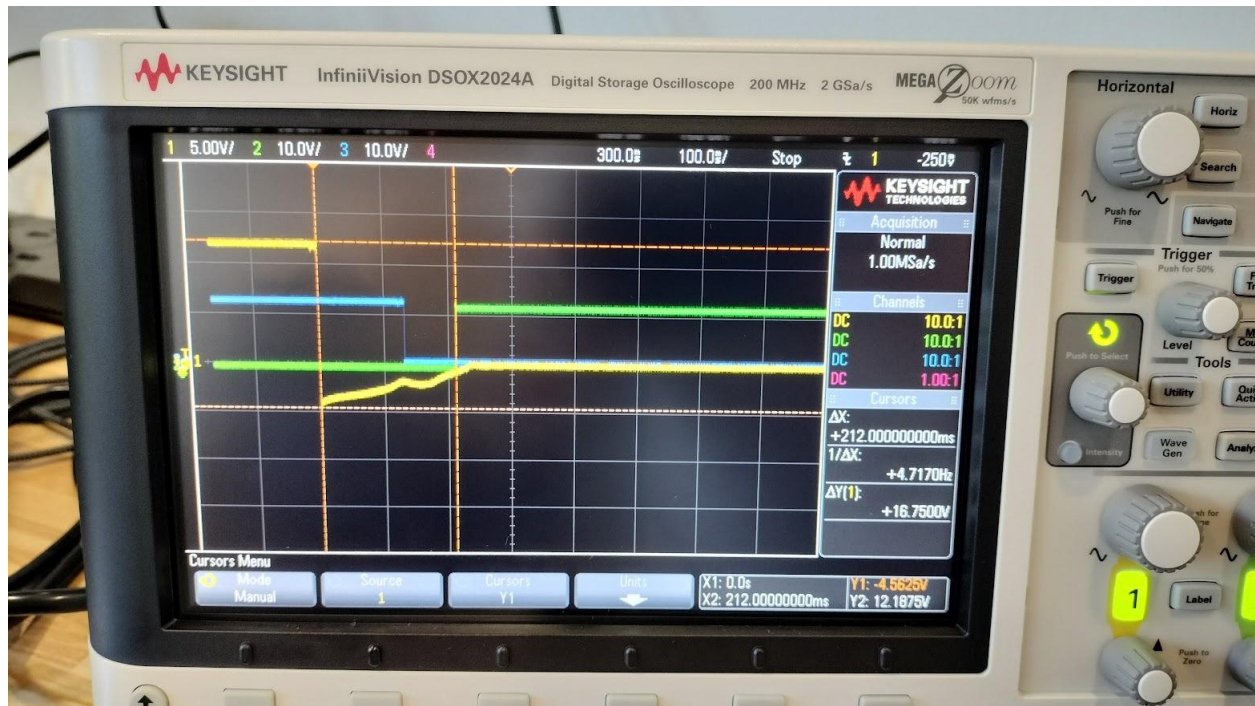
Total Transition Time (Blue = Off, Green = On): 420ms

Voltage Spike Amplitude: 12.75V (At Oscilloscope Limit)

- The zener diode only allows for a certain amount of voltage spike before limiting how fast the magnetic field can collapse (seen in the yellow line hitting the max allowable for the diode).

Connection w/ 1N5819 & 1N5913 (3.3V)

Oscilloscope Capture



De-energize to Blue = Off: 132ms

Transient time (Green & Blue = Off): 80ms

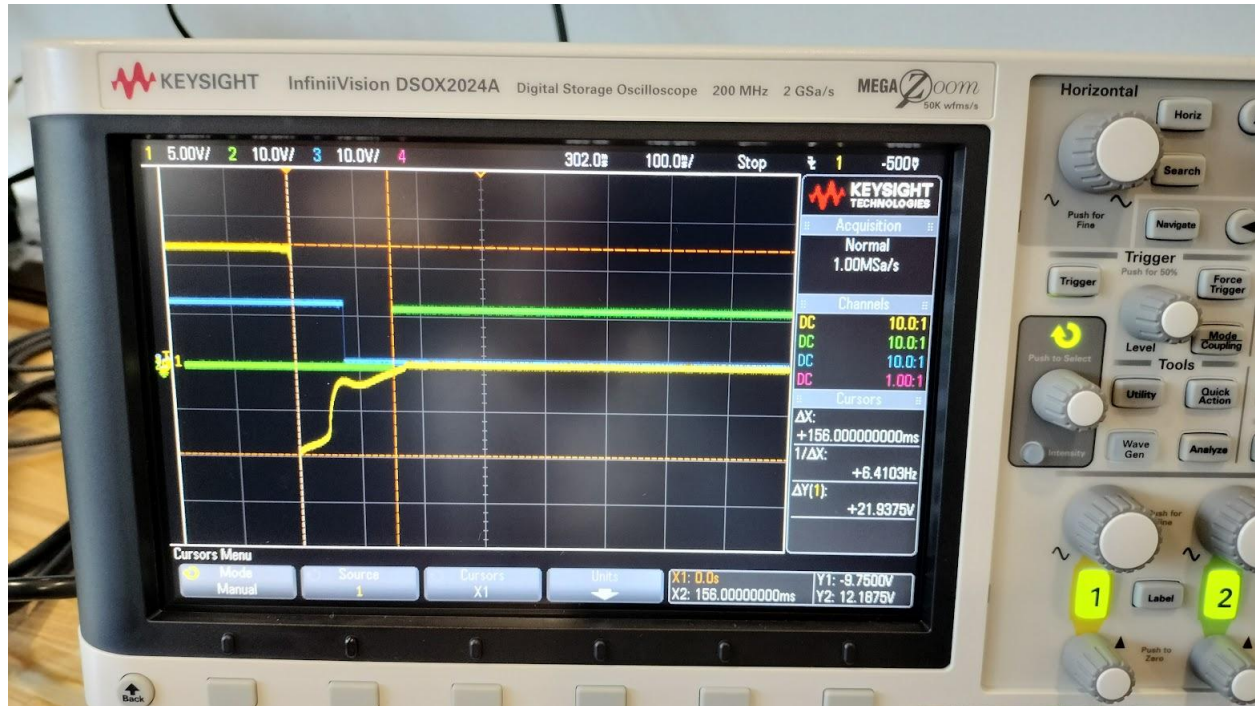
Total Transition Time (Blue = Off, Green = On): 212ms

Voltage Spike Amplitude: 16.75V

- Two zener diodes in this configuration allow for a larger voltage spike while still being controlled.
- This allows the coil to return to the deenergized state more quickly (noted in the reduced Total Transition Time).

Connection w/ 1N5819 & 1N5919 (5.6V) & 1N5913 (3.3V)

Oscilloscope Capture



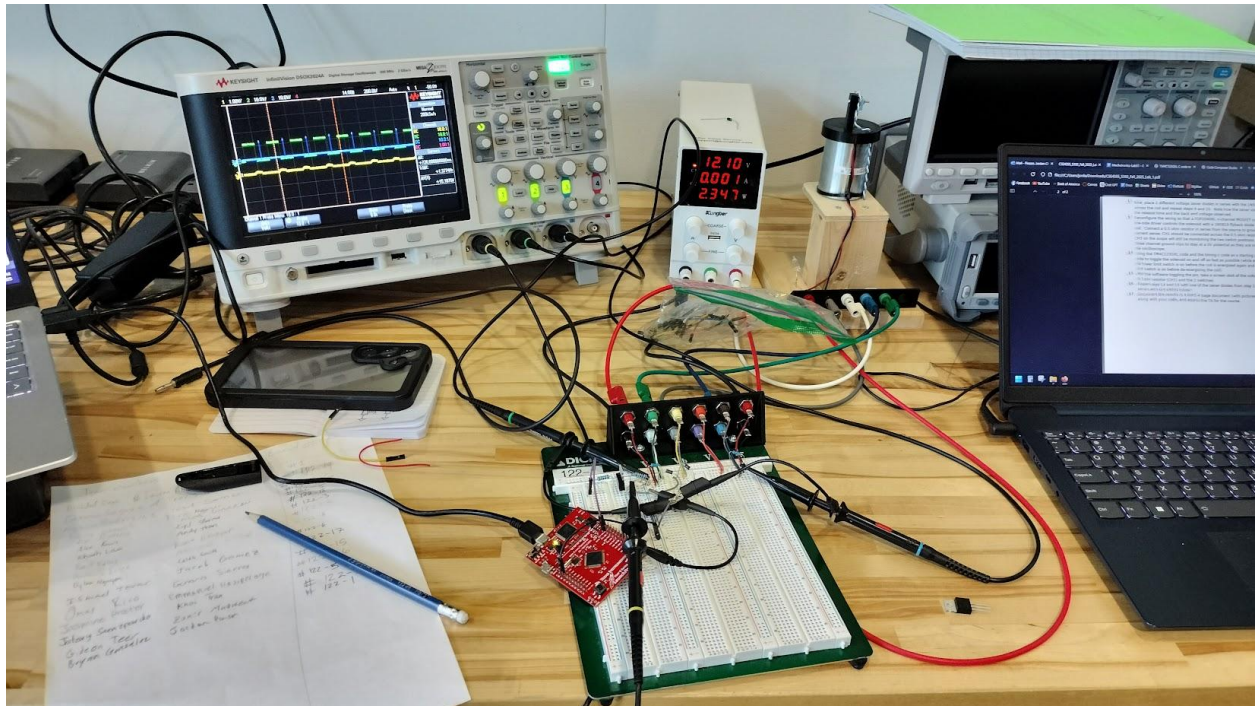
De-engage to Blue = Off: 82ms

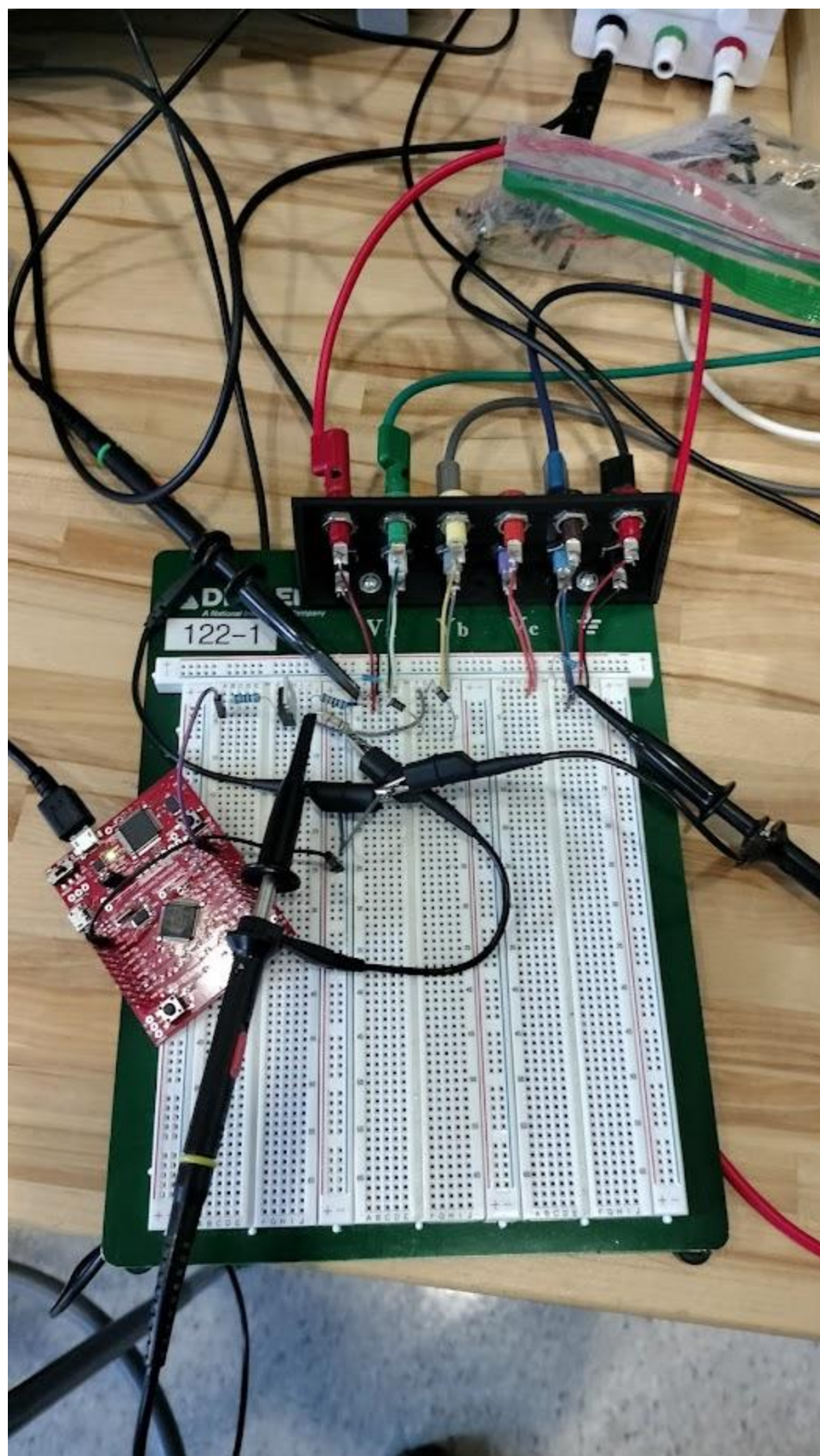
Transient time (Green & Blue = Off): 74ms

Total Transition Time (Blue = Off, Green = On): 156ms

Voltage Spike Amplitude: 21.93V (At Oscilloscope Limit)

Connection w/ TM4C Driving MOSFET





Fastest Green Delay Achieved: 65ms

Fastest Blue Delay Achieved: 156 ms

Fastest Total Transition Time: 221 ms