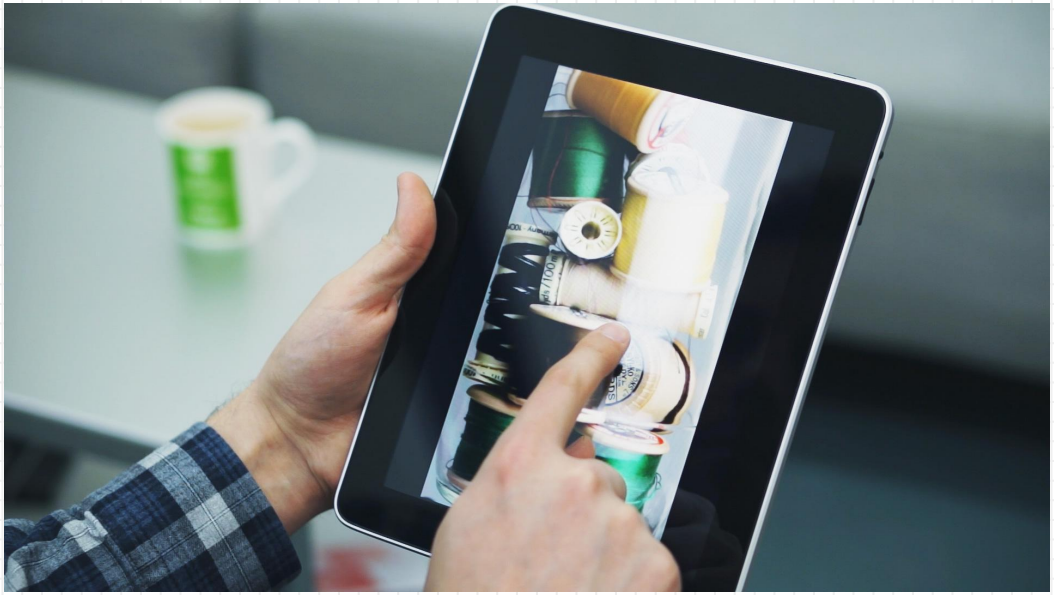
EECS16A Lab: Touchscreen 3

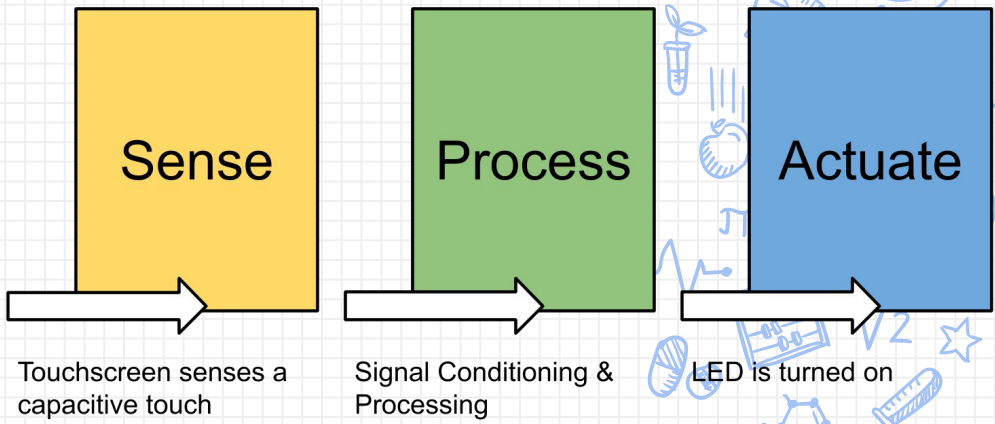
Capacitive Touchscreens



Electronic Systems

Most systems perform 3 tasks:

- ✘ Sense (Physical to Electrical)
- ✘ Process (Signal Conditioning)
- ✘ Actuate (Electrical to Physical)

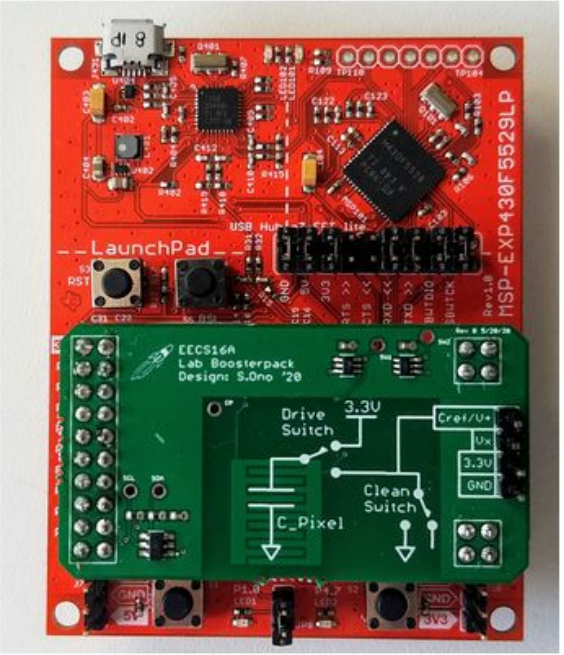


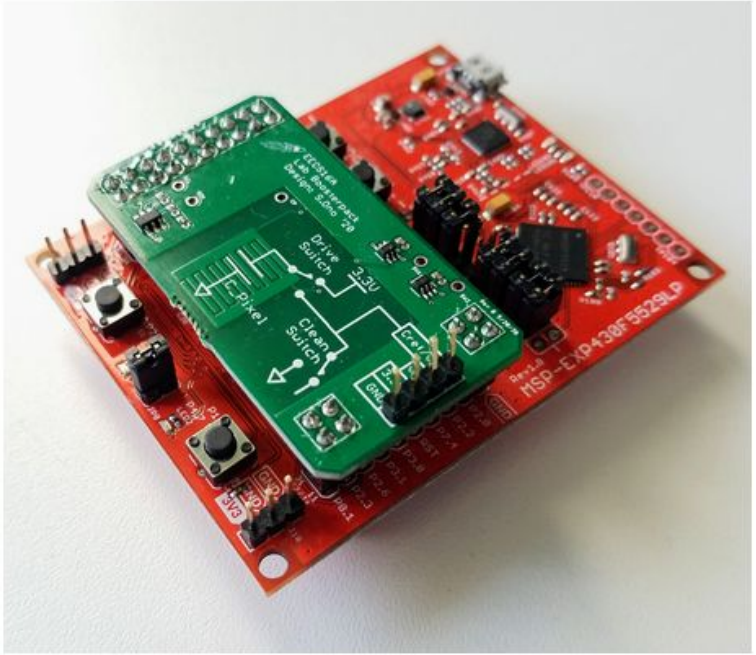
Goals: Touch 3

- ✘ Understand charge-sharing circuit for a capacitive touch sensor
- ✘ Understand comparators
- ✘ Build a functioning Touch Pixel

New Tools

Introducing: EECS16A Lab Boosterpack





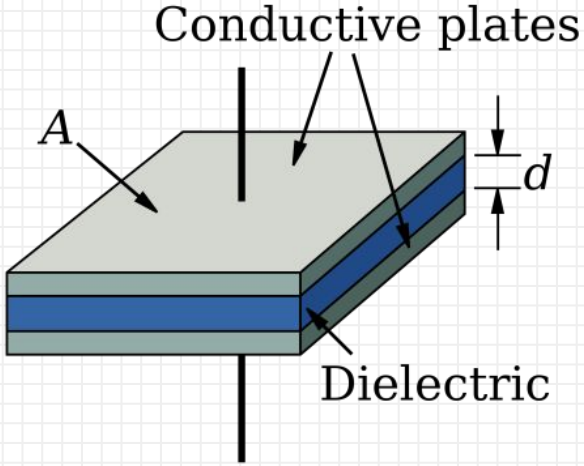
Capacitive Touchscreen

- ✘ Exploits capacitive properties of finger/body
- ✘ Touching the screen changes the capacitance
- ✘ No moving parts
- ✘ Multi-touch is possible
- ✘ More sensitive

How to measure capacitance?

Capacitance and the touchpad

What is a capacitor and how does it work?

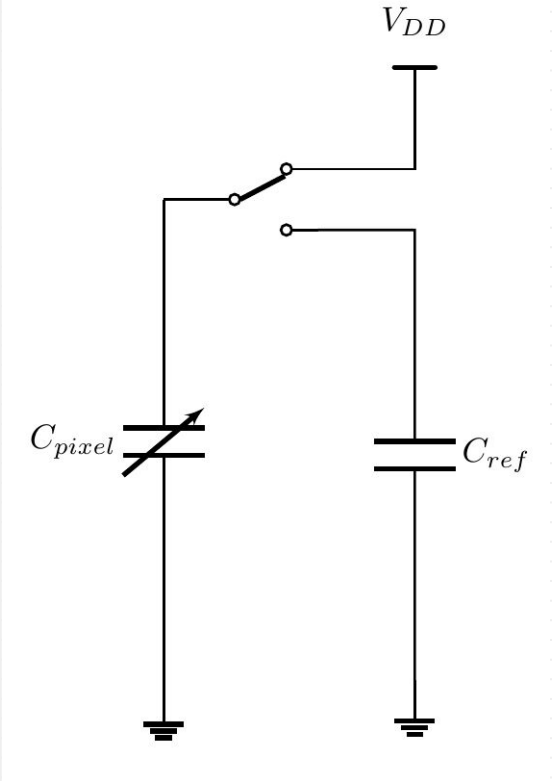


Capacitive Touch Sensor

- ✘ Screen + finger = unknown capacitance
- ✘ In parallel with known capacitance

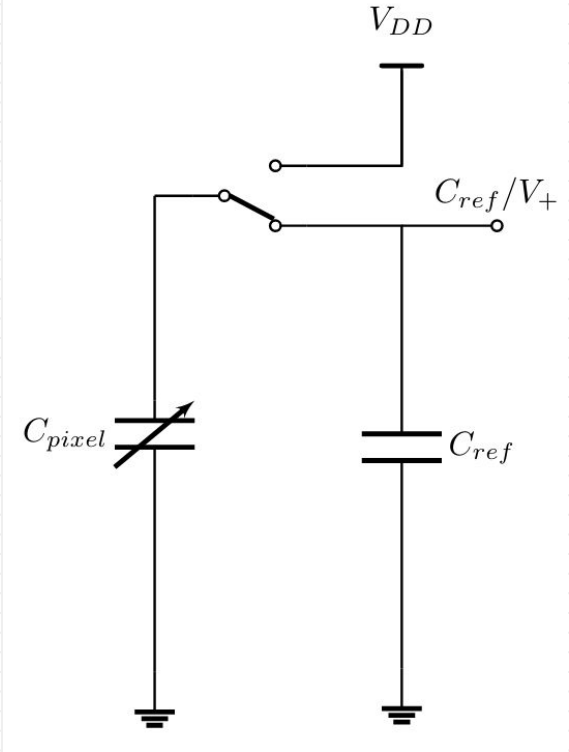
Let’s try to figure out a way to detect this increase in capacitance!

Measuring Capacitance



Start by charging our capacitor touch sensor

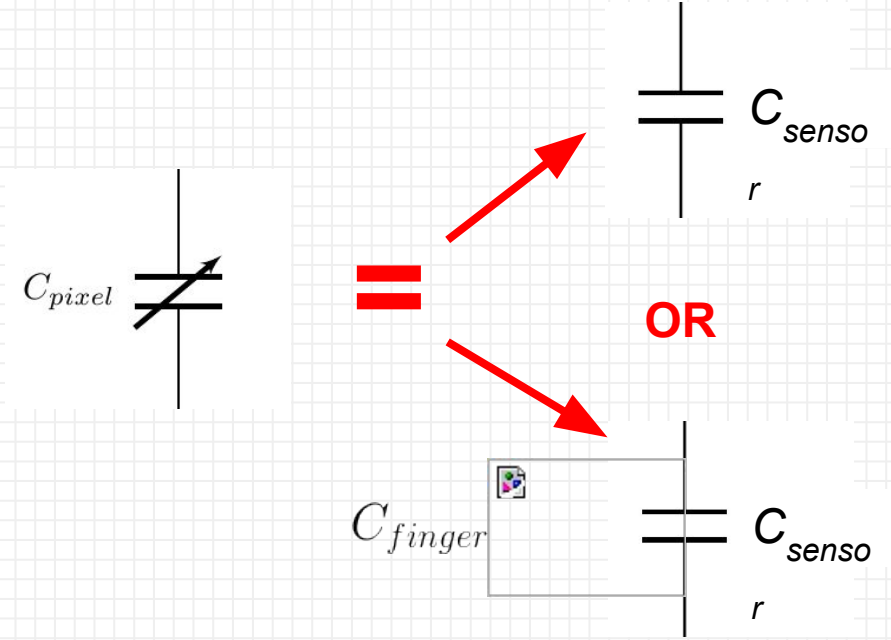
Measuring Capacitance



Charge-sharing invariant: $Q = CV$

- ✘ Q remains constant
- ✘ What happens to capacitors in parallel?

Measuring Capacitance

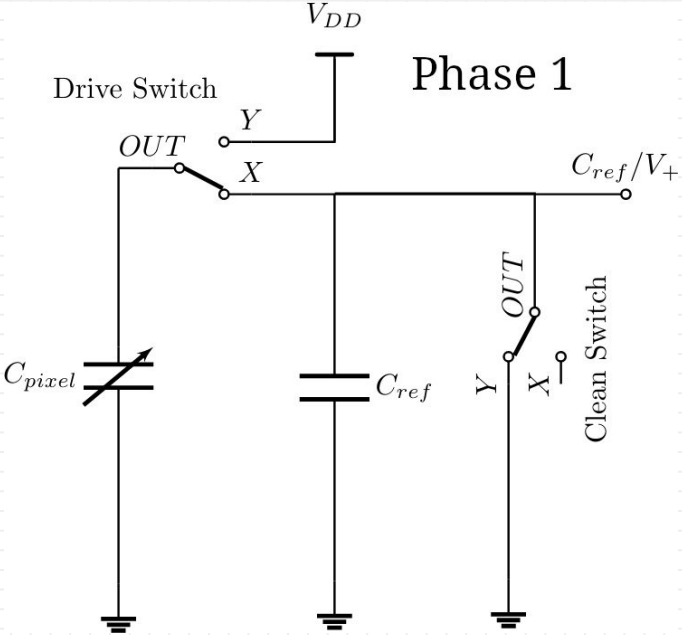


C_pixel is a variable value – may contain our finger or not

- ✘ Model finger as another capacitor in parallel with our capacitive touch sensor
- ✘ How does the capacitance of what we're charging change?

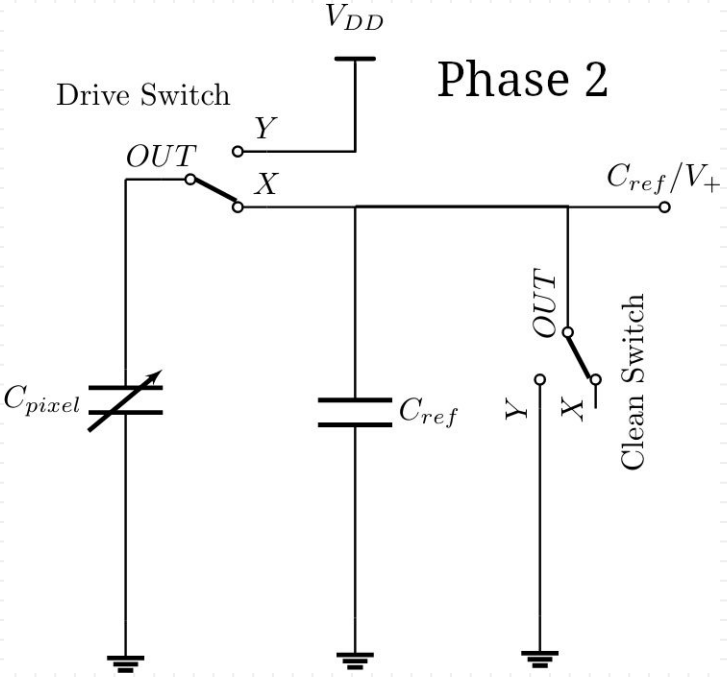
Measuring Capacitance: Full Cycle

1. Connect capacitors to ground to discharge fully



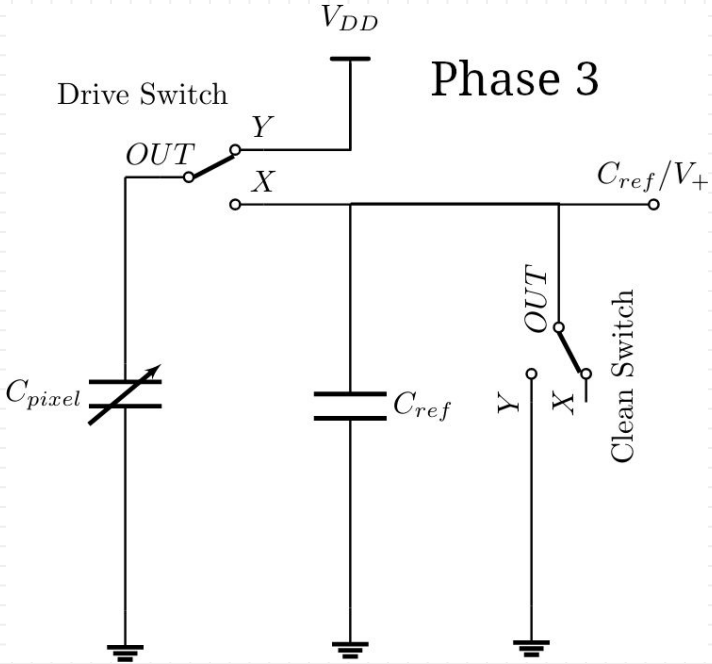
Measuring Capacitance: Full Cycle

2. Disconnect clean switch from ground to enable charge storing



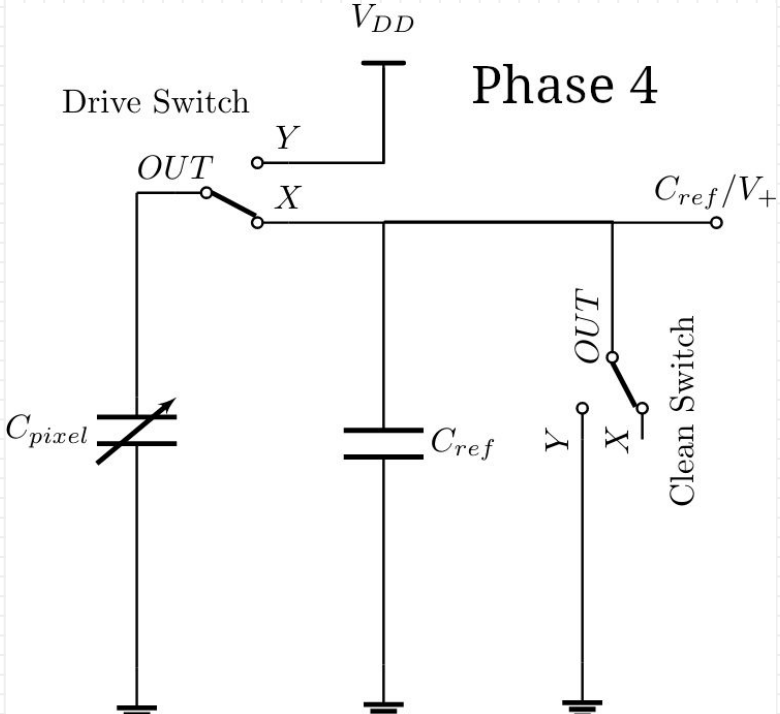
Measuring Capacitance: Full Cycle

3. Charge touchscreen (+ finger?)

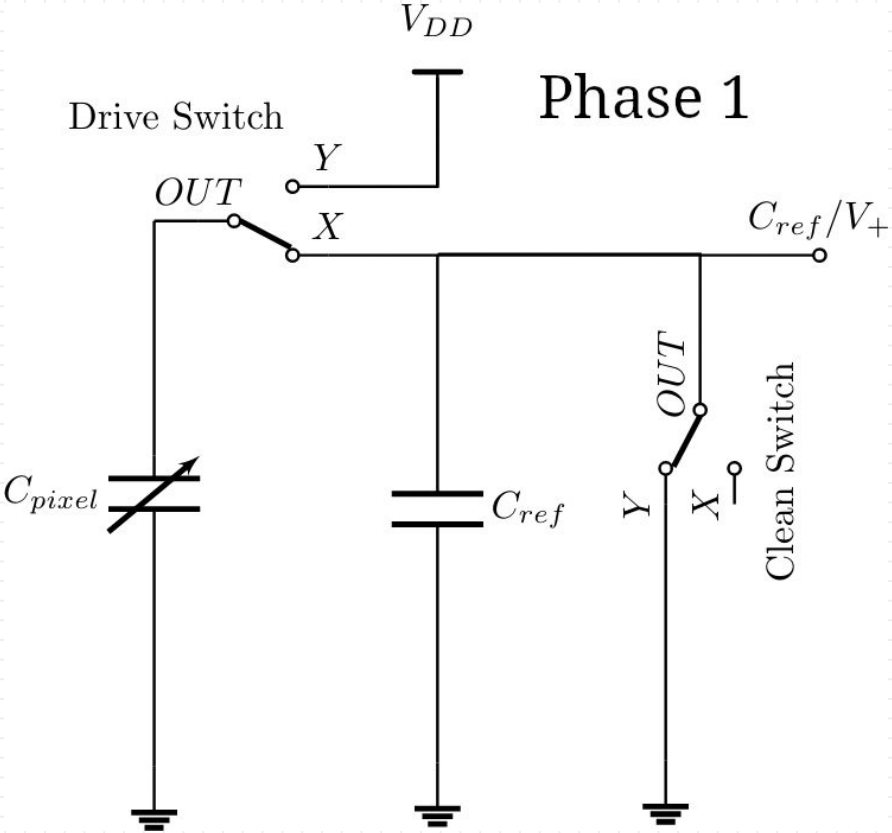


Measuring Capacitance: Full Cycle

4. Share charge between **C_pixel** and C_fixed



Measuring Capacitance: Full Cycle

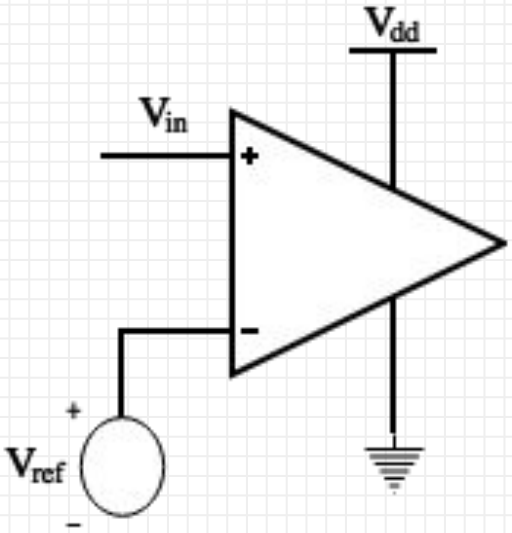


Process Comparator

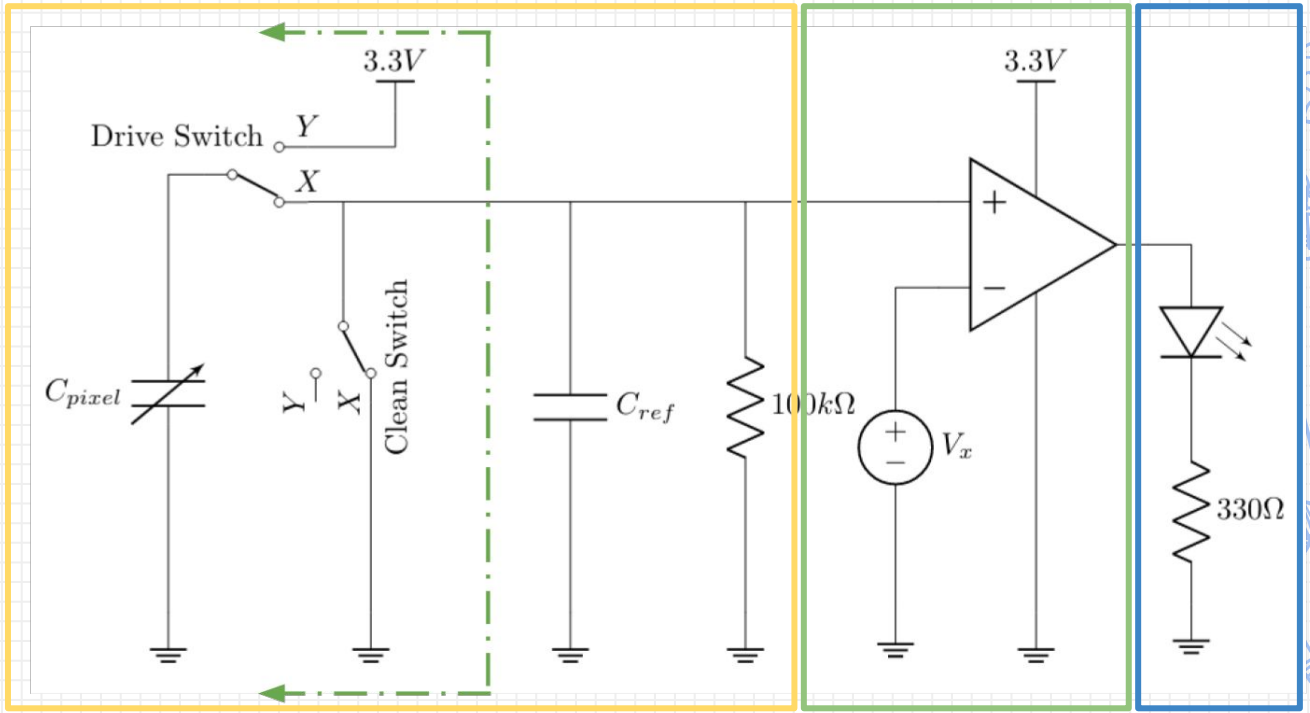
Compares input voltage at positive terminal to a reference voltage at negative terminal (think ">" symbol)

<u>Essentially does:</u>

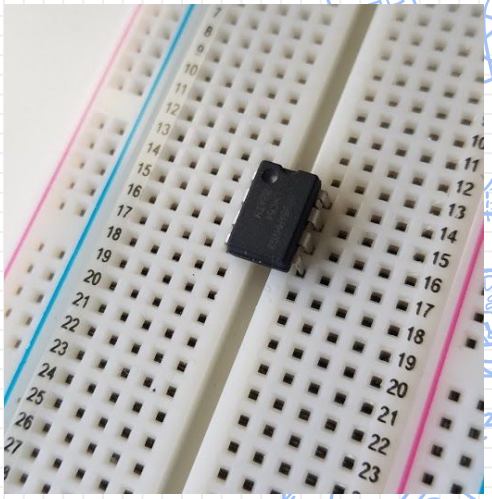
if V_in > V_ref:
    return V_dd
else:
    return GND = 0V



Full Circuit - Sense Process Actuate



Notes



- ✘ **Unplug MSP before moving circuit components**
- ✘ Op Amp goes across middle of breadboard
- ✘ **Make sure your circuit is grounded and has a common ground**
- ✘ Initial charge sharing diagrams are theoretical--don’t start building right away