

**CS107e**

**Sensors**

**Pat Hanrahan**

**Spring 2017**



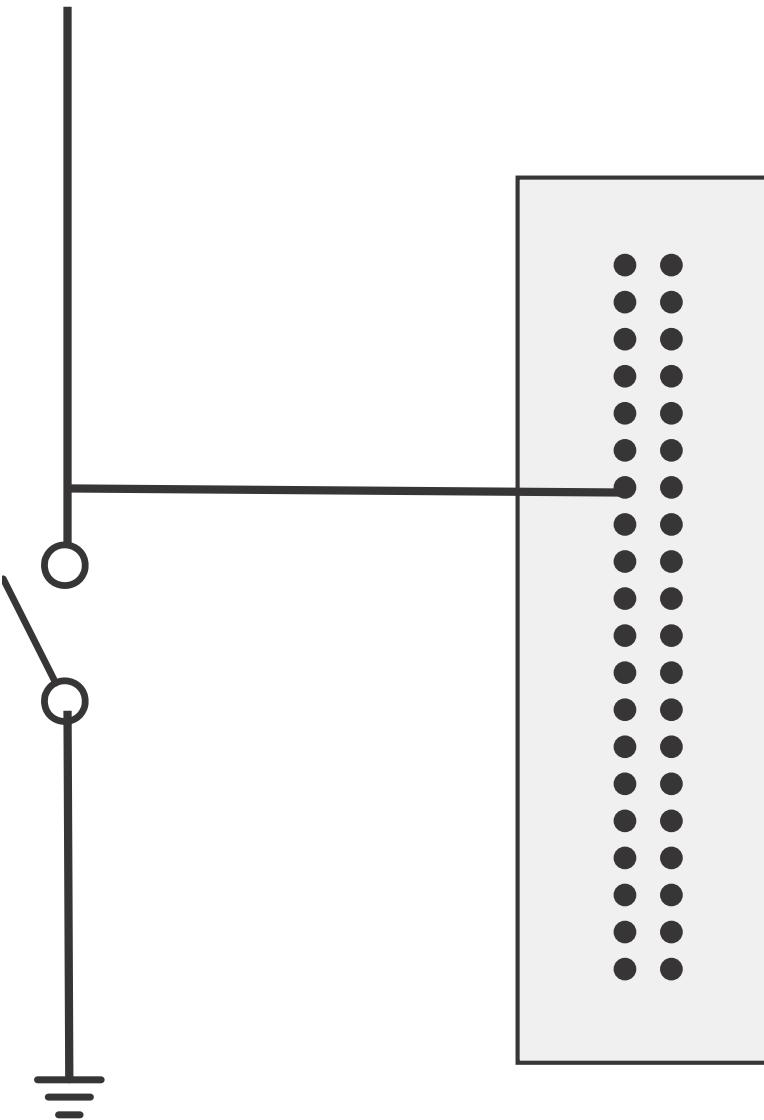
# iPhone7 teardown

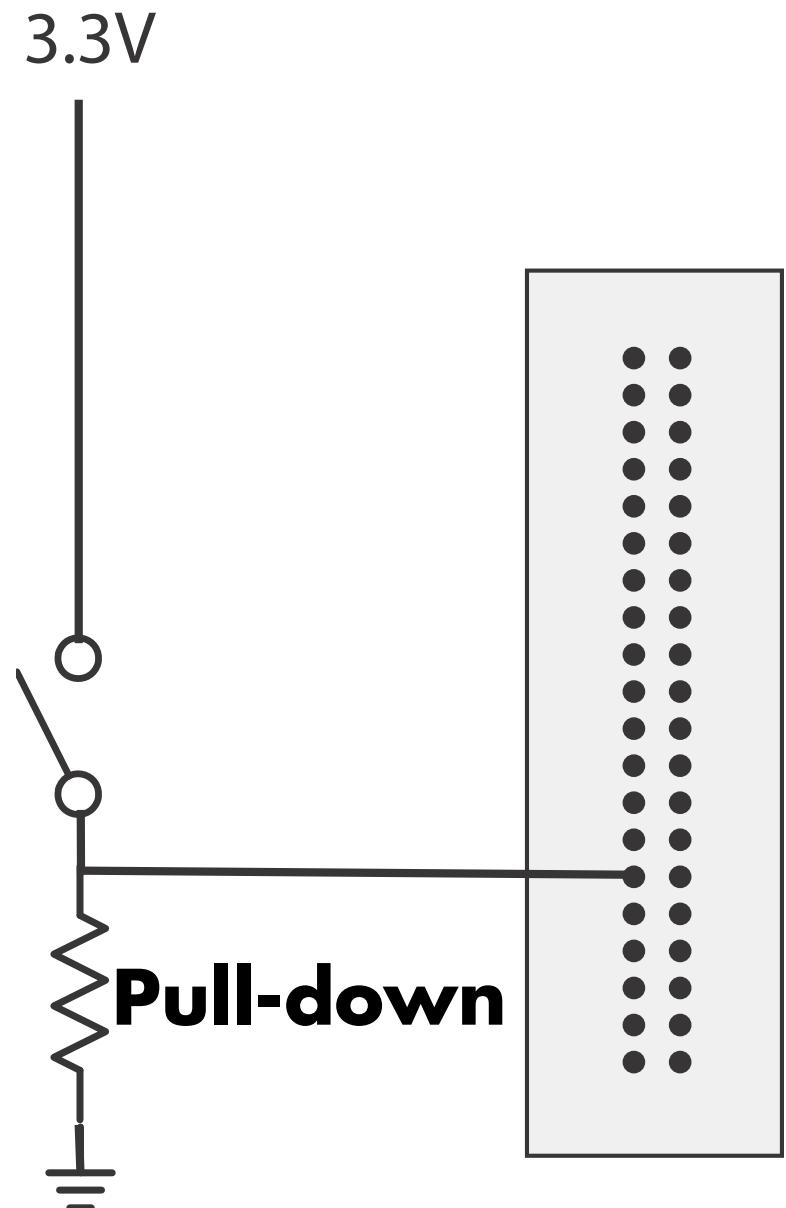
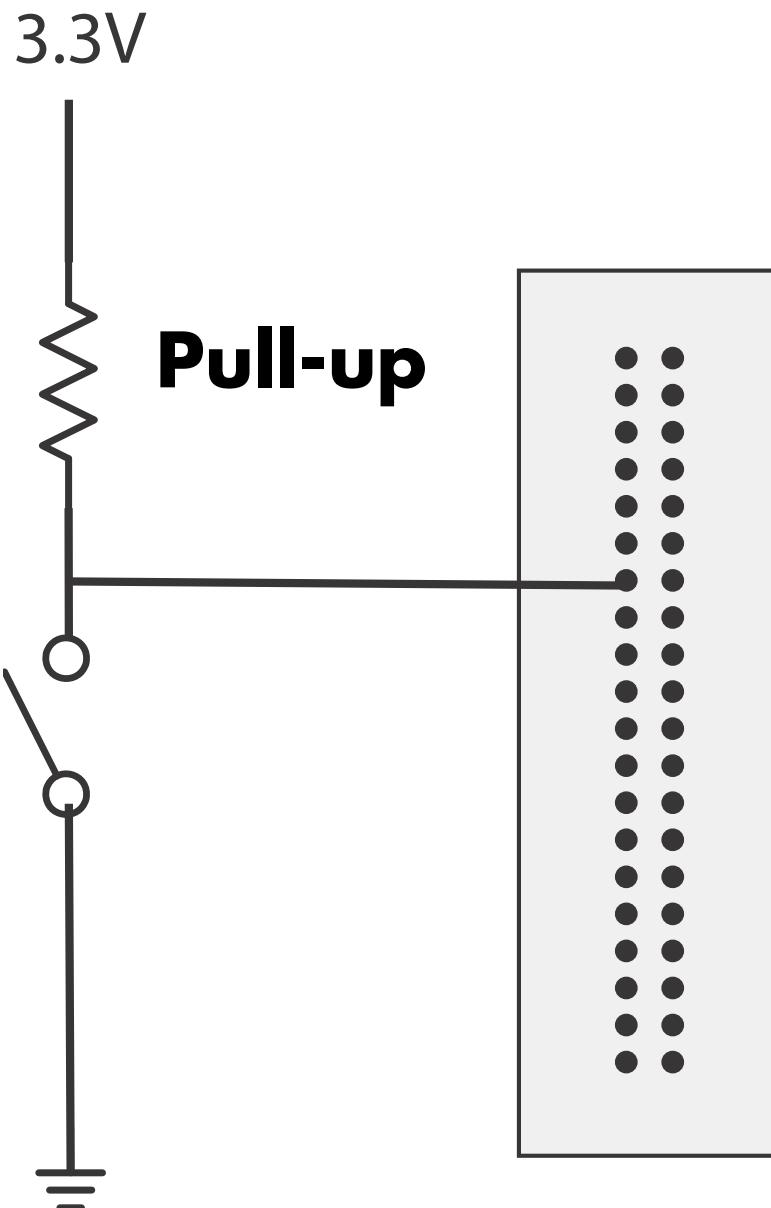


How many sensors?



3.3V





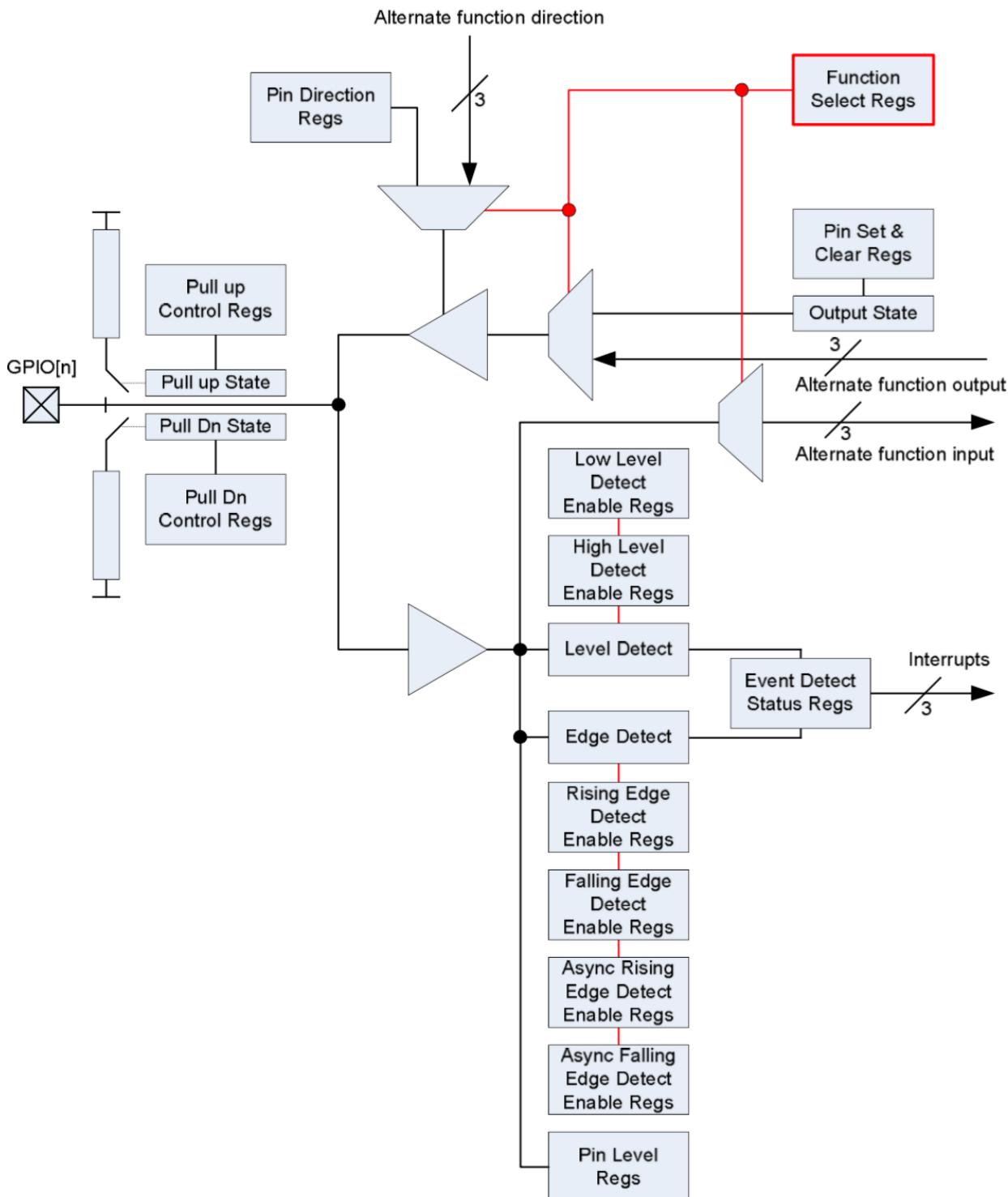
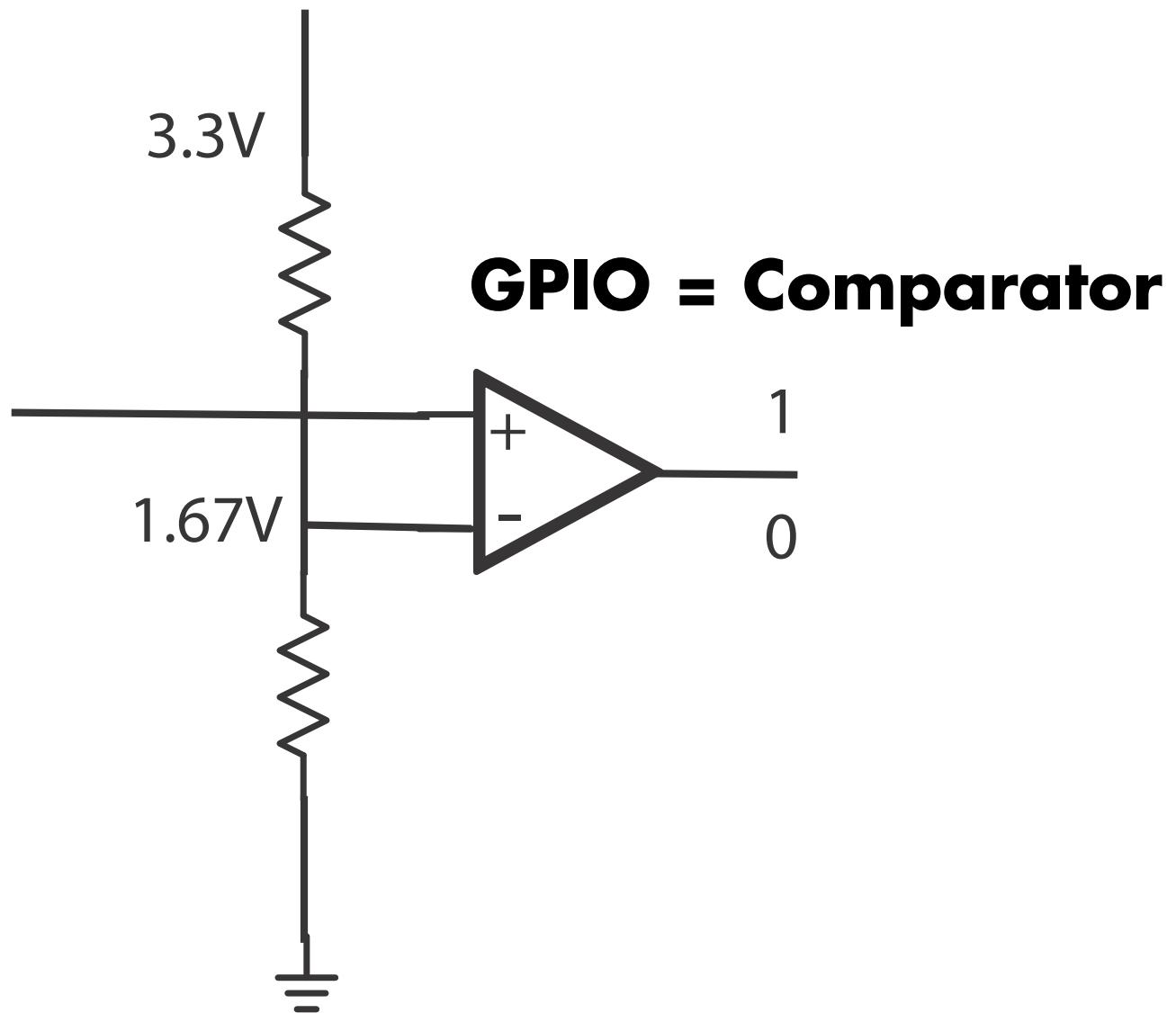
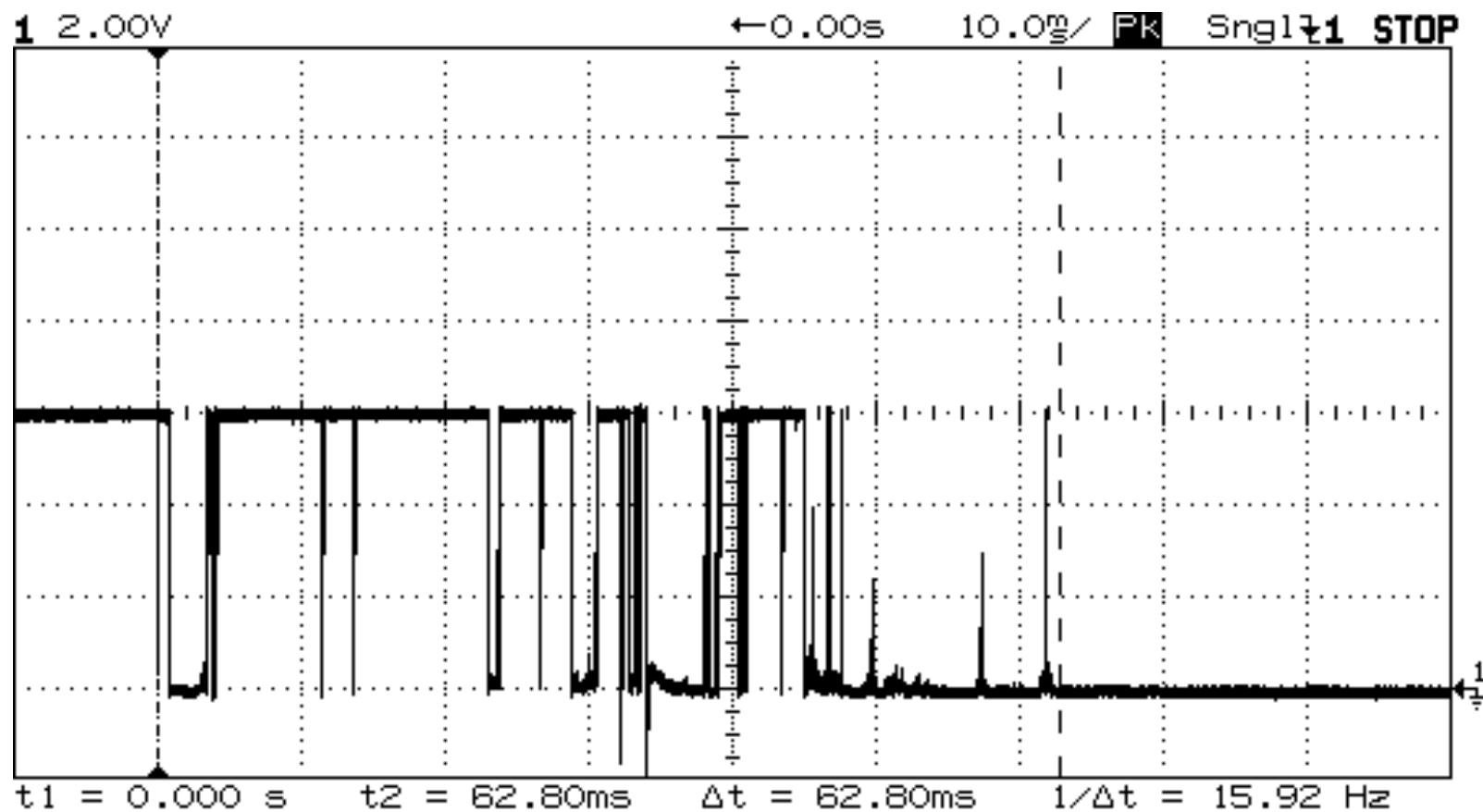


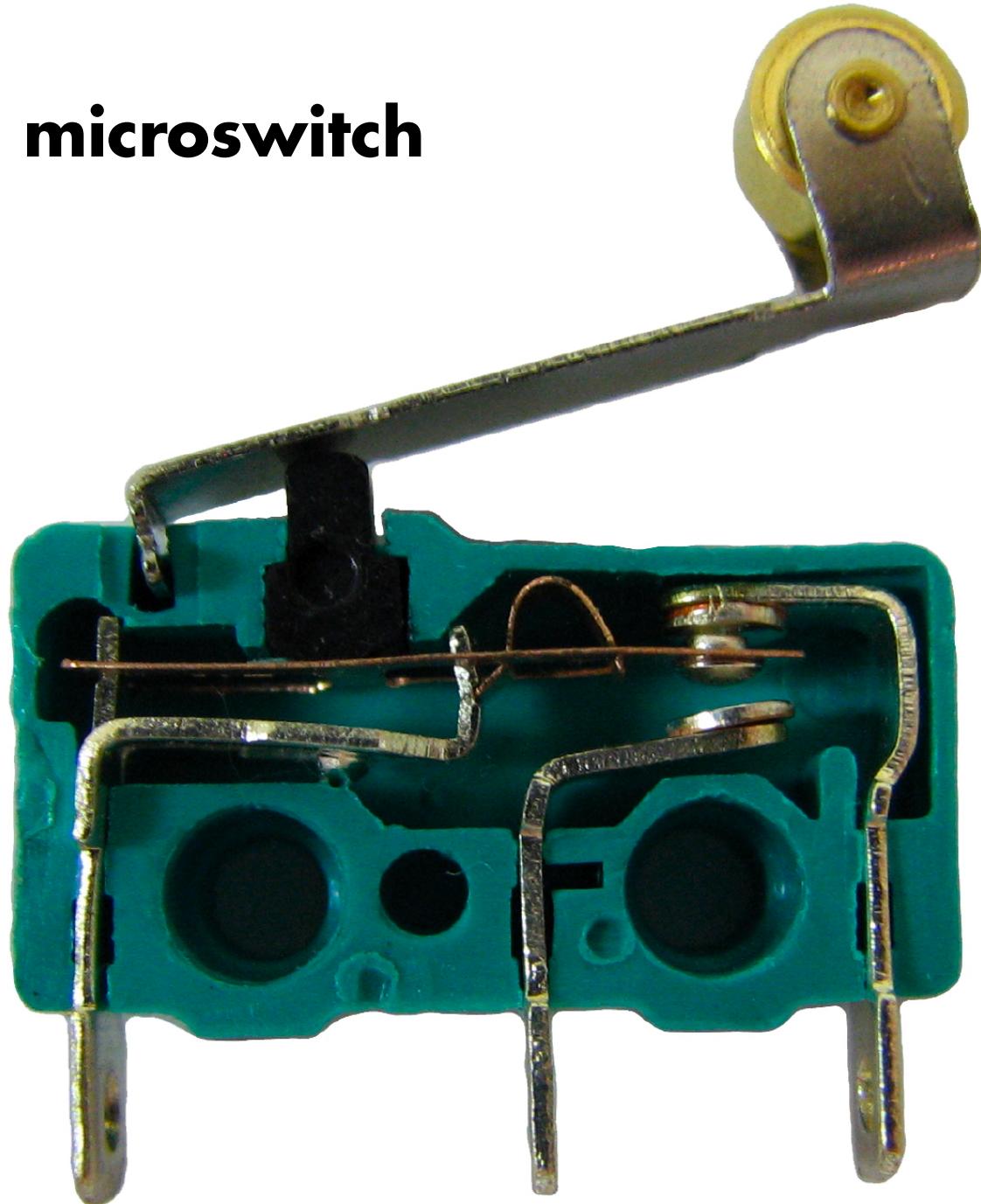
Figure 6-1 GPIO Block Diagram





<http://www.ganssle.com/debouncing.htm>

# **snap-action microswitch**



[https://en.wikipedia.org/wiki/Miniature\\_snap-action\\_switch](https://en.wikipedia.org/wiki/Miniature_snap-action_switch)



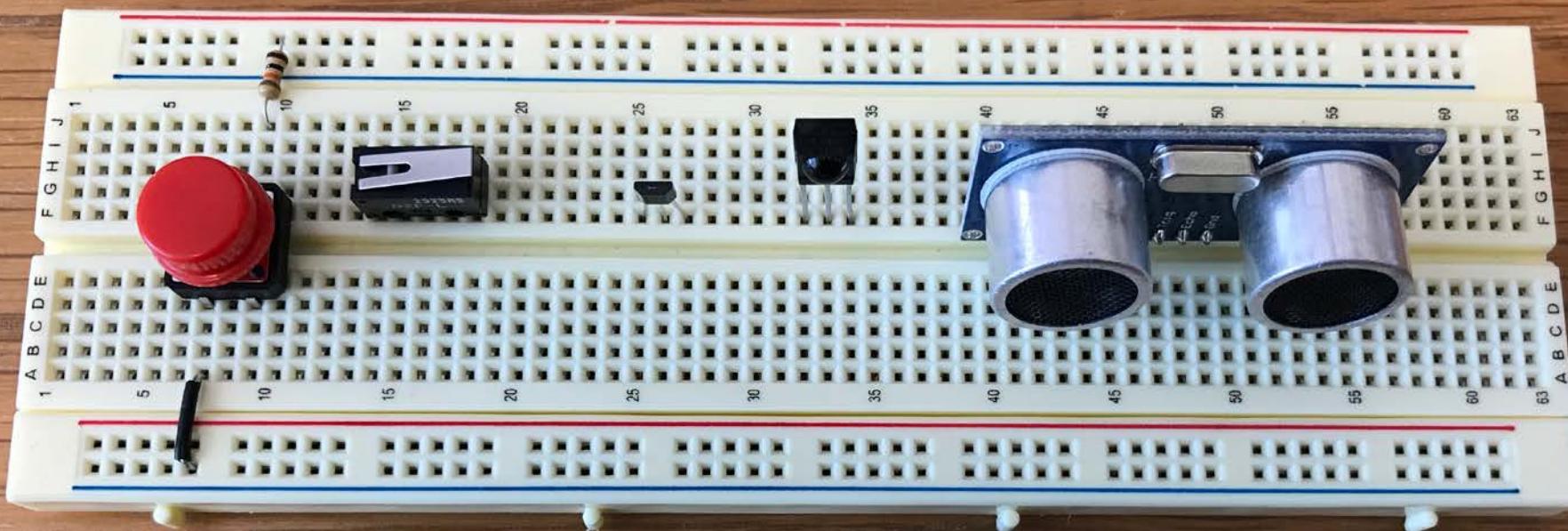
**NES / Famicom D-pad**



**Happ Button**



**Happ Joystick**



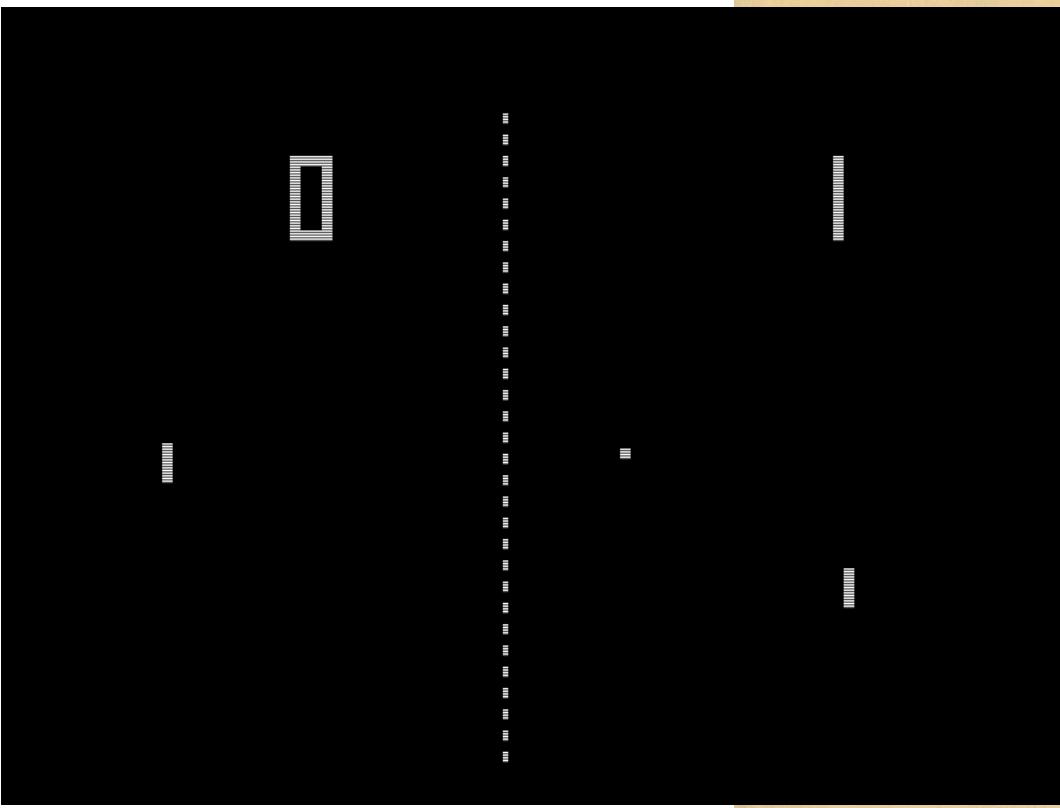


THE NEWEST 2 PLAYER  
VIDEO SKILL GAME

# PONG

from ATARI CORPORATION  
SYZYGY ENGINEERED

The Team That Pioneered Video Technology



TRACT MODE  
AUTOMATICALLY  
MOVES POSITION  
OF BALL  
ACCORDING TO  
MOVEMENT OF  
PADDLE  
CONTROLS  
FOR COMPUTER  
AND TELEVISION  
SYSTEMS.  
LONG,

COMPUTER

PROFITS  
IN LOCATION  
SUITABLE  
LOCATIONS

FROM YOUR LOCAL DISTRIBUTOR

Maximum Dimensions:

WIDTH - 26"

HEIGHT - 50"

DEPTH - 24"

SHIPPING WEIGHT:

150 Lb.



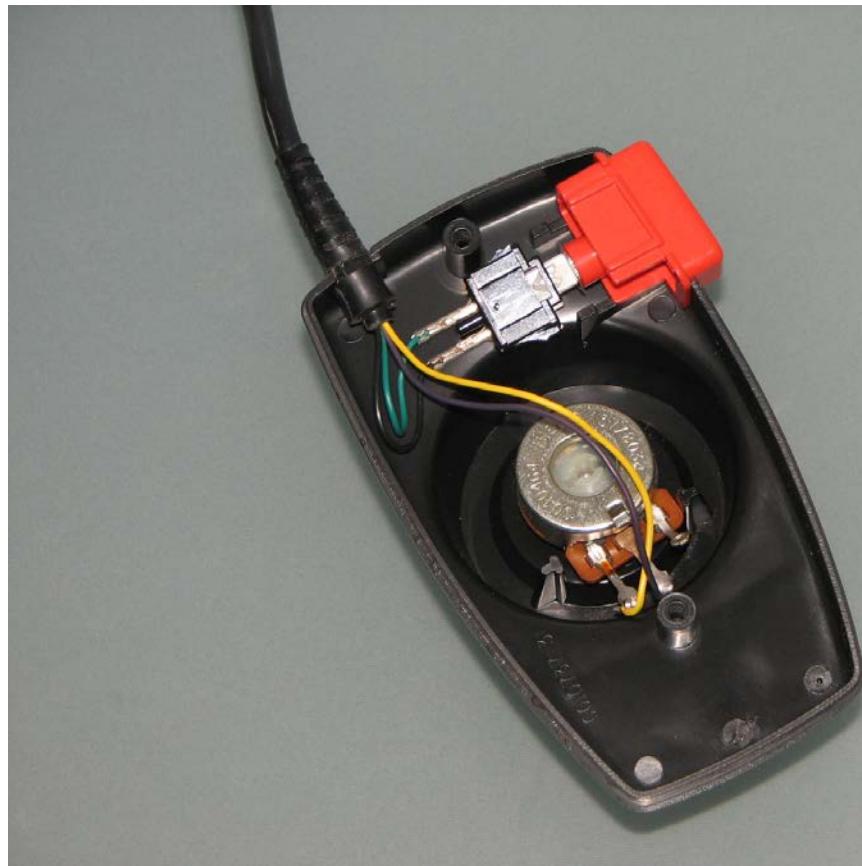
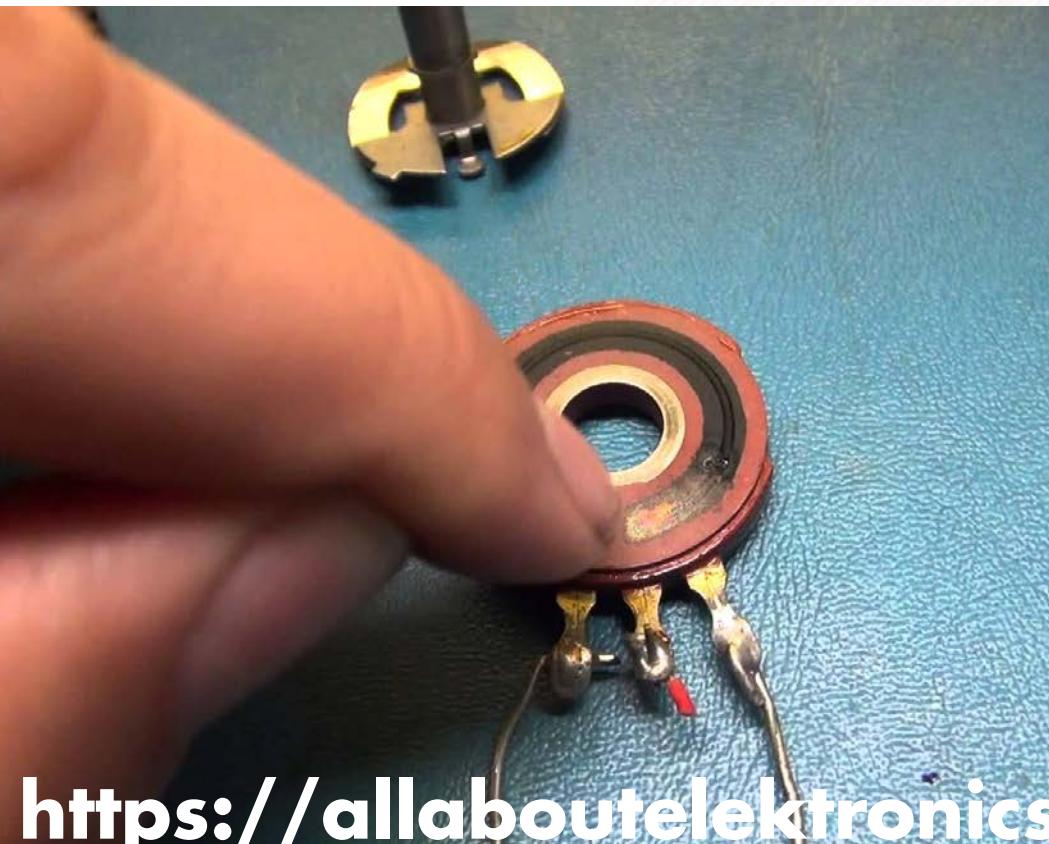
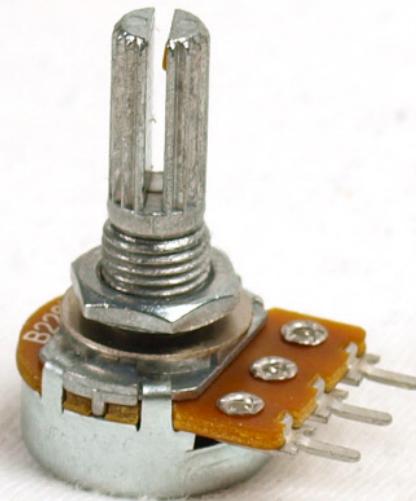
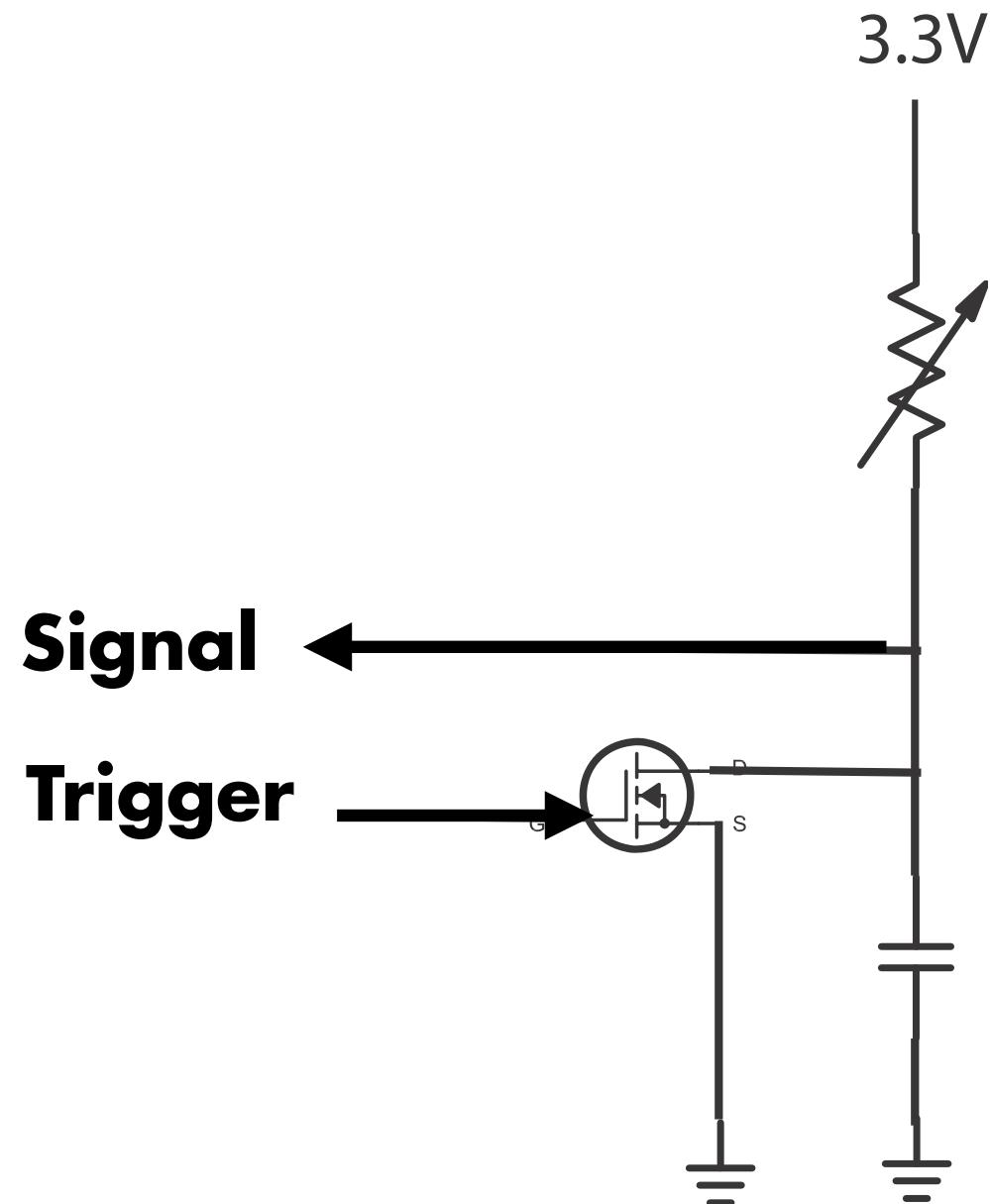


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with this watermark intact.

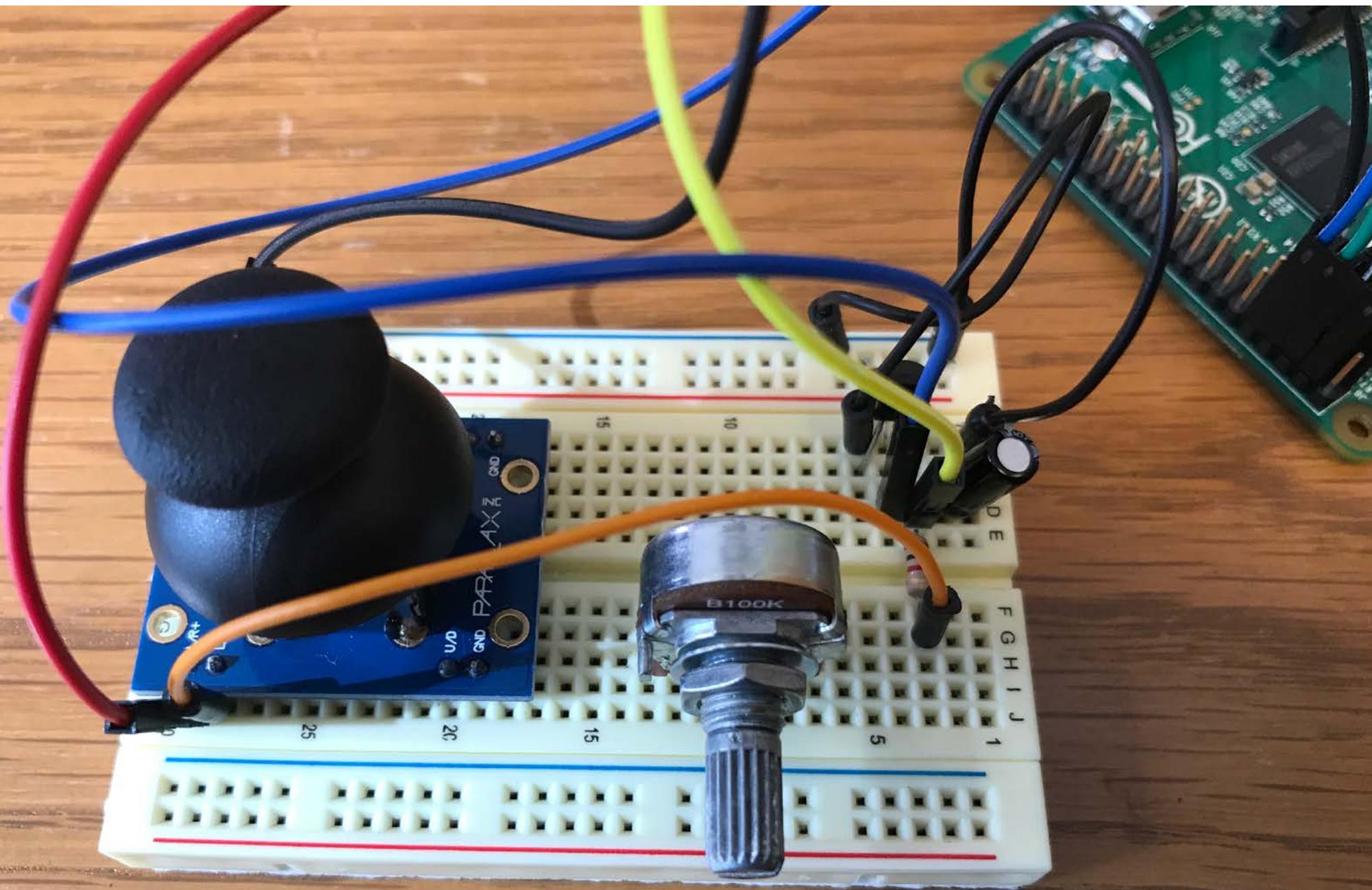


<https://allaboutelektronics.wordpress.com/resistors/>

**How would you measure the voltage?**



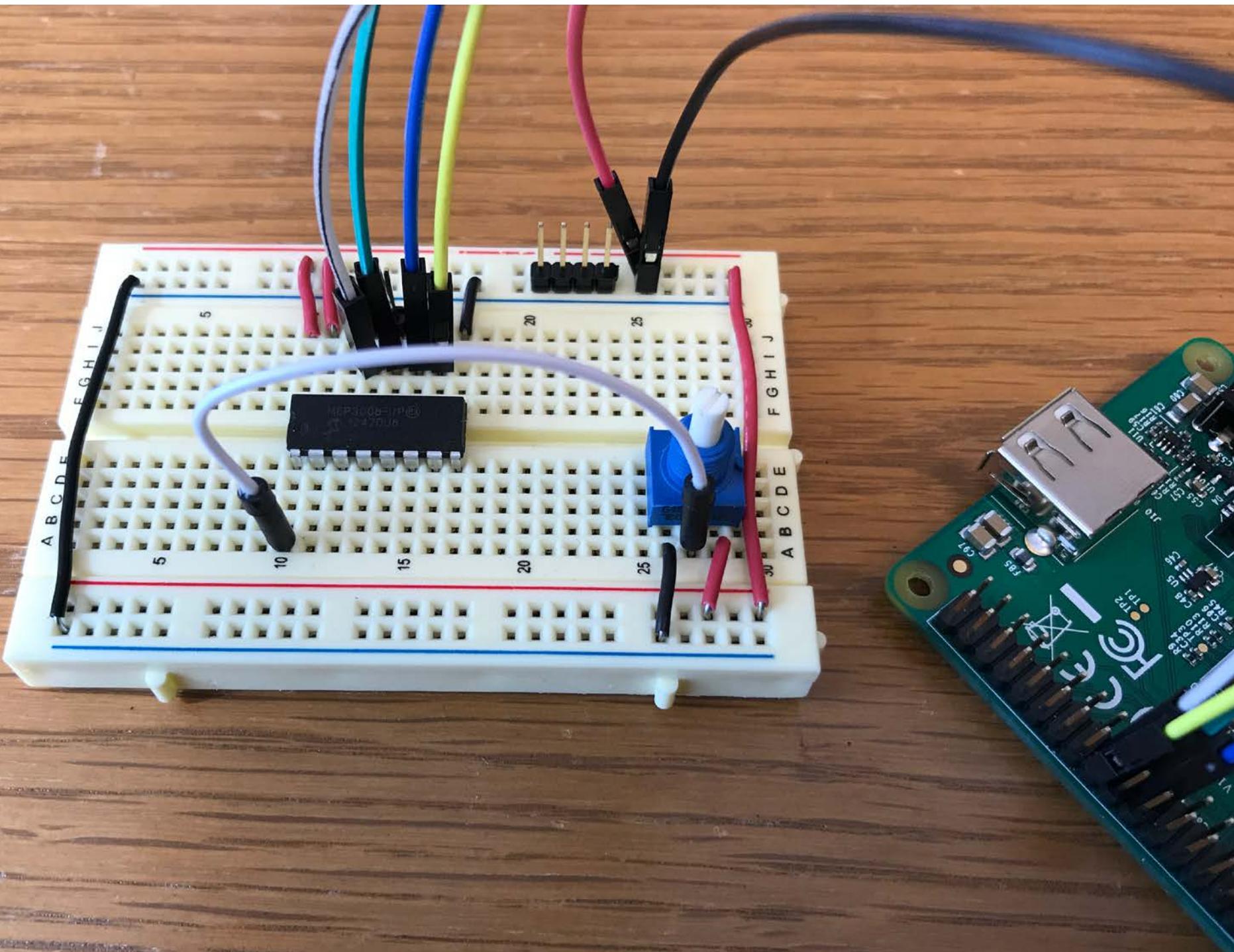
**Timing Circuit**



```
unsigned get_time(void) {
    // discharge the capacitor
    gpiowrite(discharge, 1);
    delay_ms(1);
    gpiowrite(discharge, 0);

    // time the capacitor charging
    unsigned start = timer_get_time();
    while(!gpioread(signal))
        ;
    unsigned end = timer_get_time();

    return (end - start);
}
```



mcp3008 analog to digital converter (ADC)

# **Sensing the World**

**resistance (conduction, impedance, capacitance)-**

**light (phototransistor, lidar)**

**sound/pressure/deformation (piezo, electret, strain gauge)**

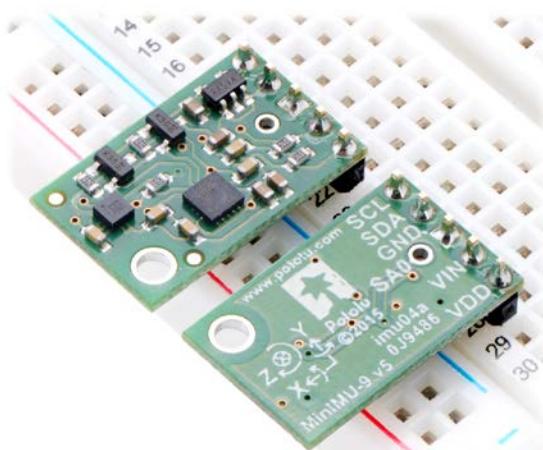
**temperature (heat), humidity, pressure**

**electromagnetic fields (hall effect, compass, antenna)**

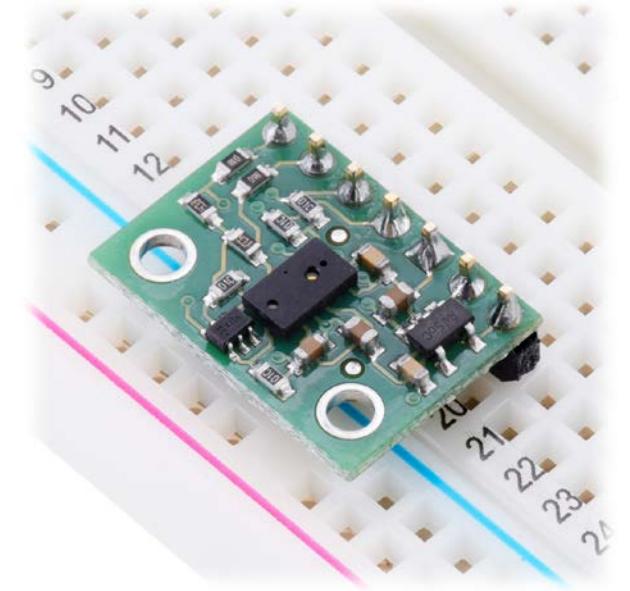
**acceleration (force direction)**

**orientation (gyroscope)**

# I2C Sensors



**Accelerometer  
Gyroscope  
Magnetometer**



**VCSEL Time of Flight**



**Temperature,  
Humidity,  
Pressure**



**Arducam (SPI and I2C)**

