

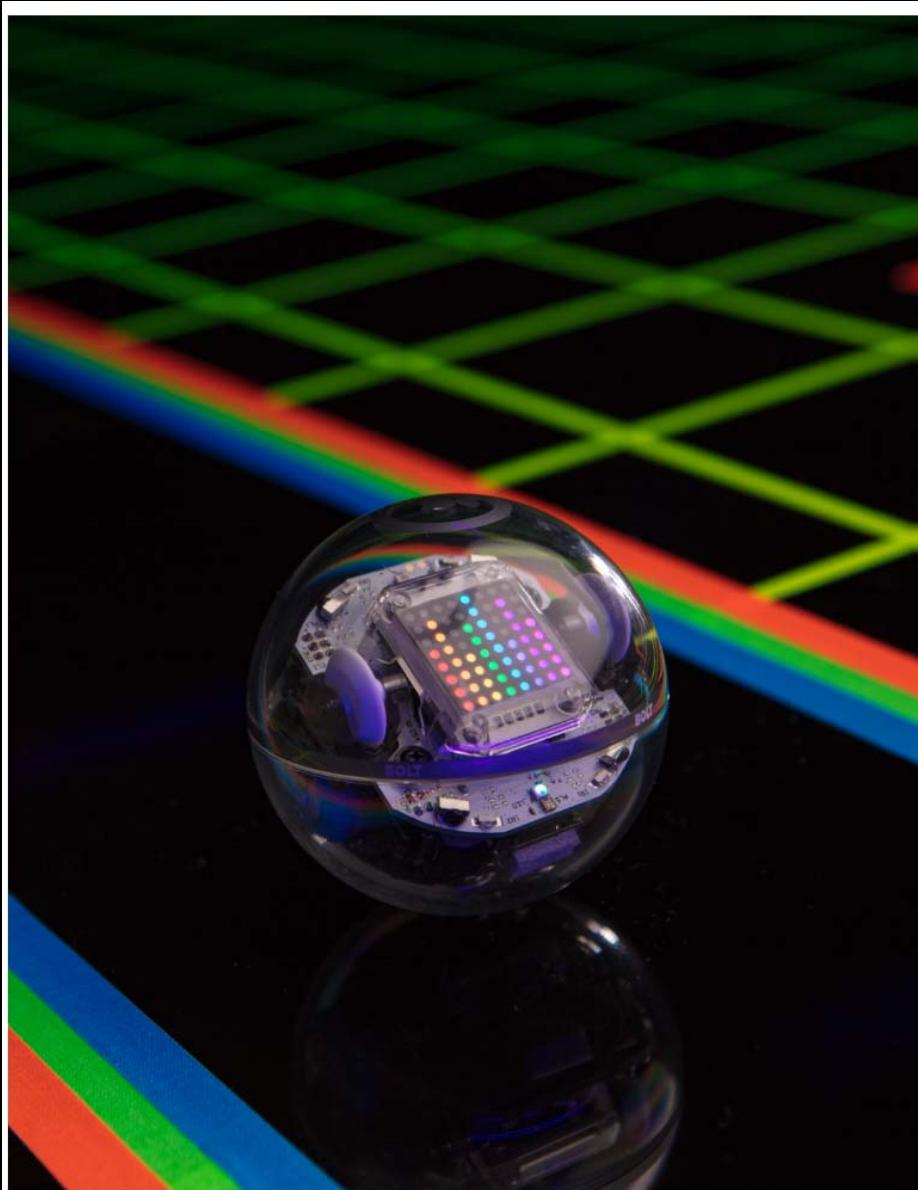
Displays, Actuators

Developing and Designing Interactive Devices

March 13, 2018

Lab debrief

Highlights? Questions?

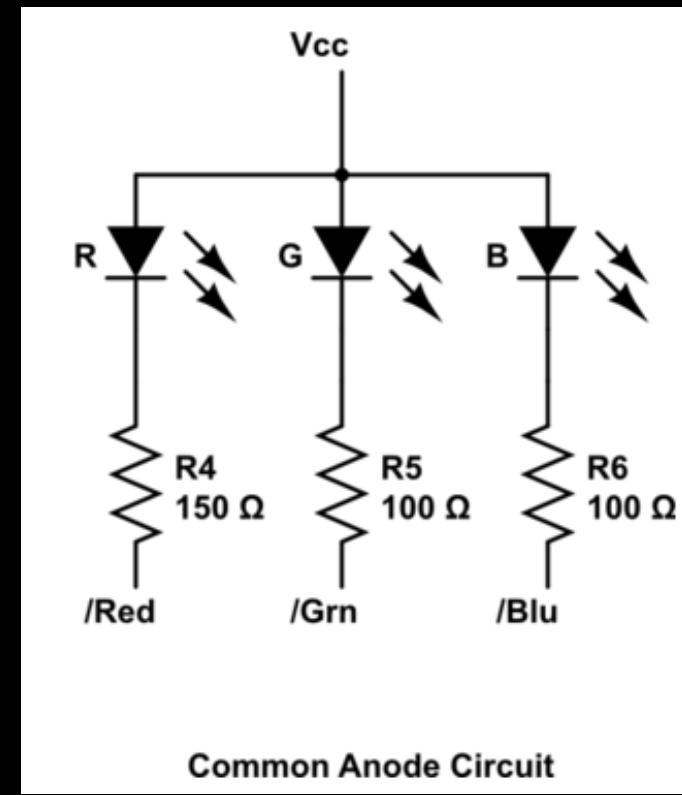


Sphero Bolt

Images from <https://www.sphero.com/bolt>

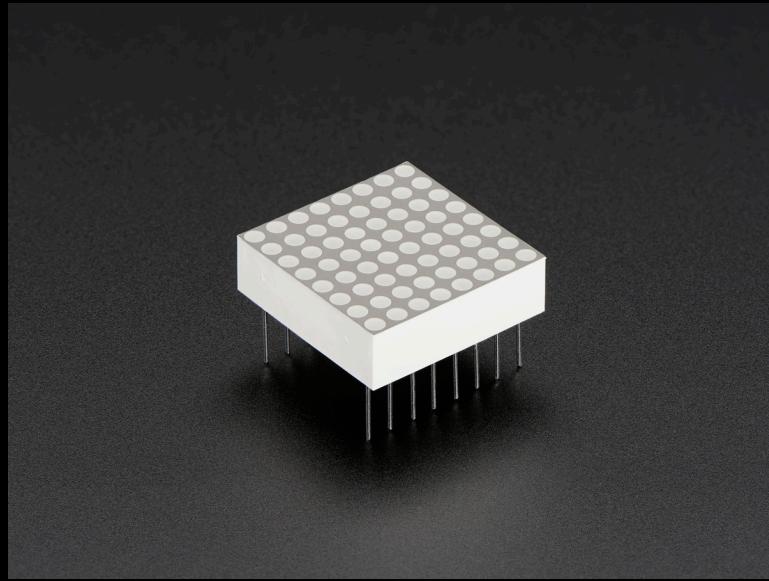
Displays

Variations on LEDs

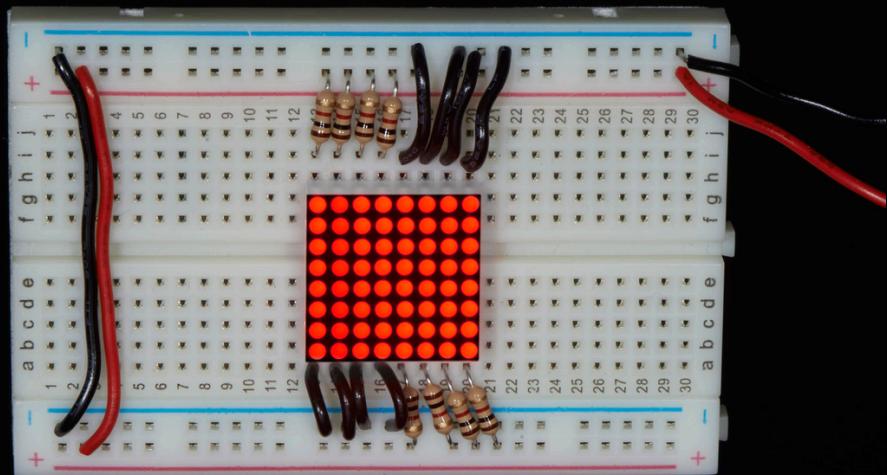
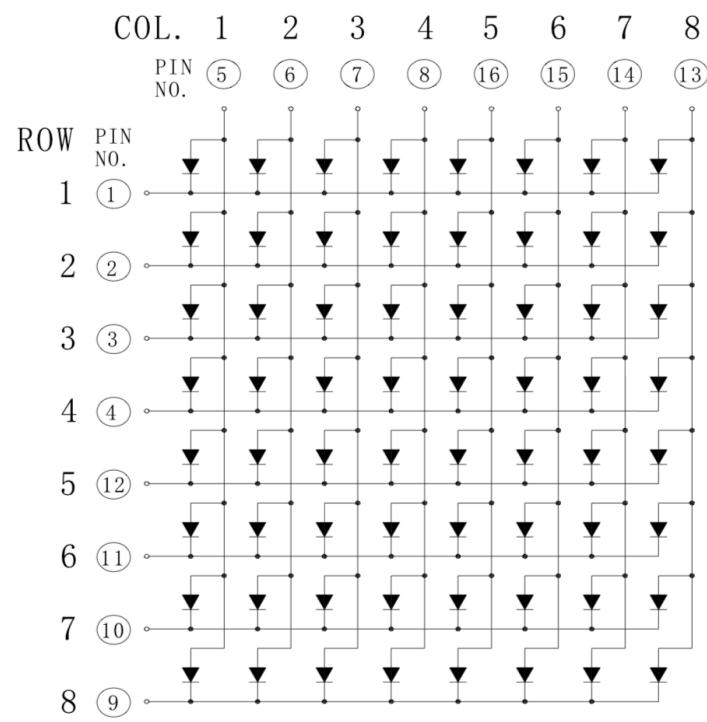


Displays

Variations on LEDs



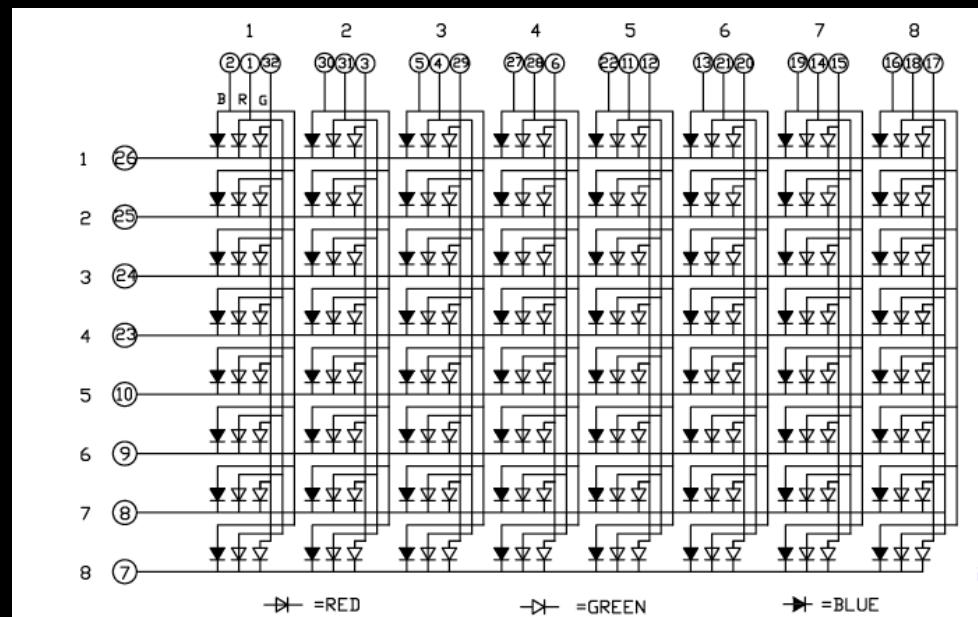
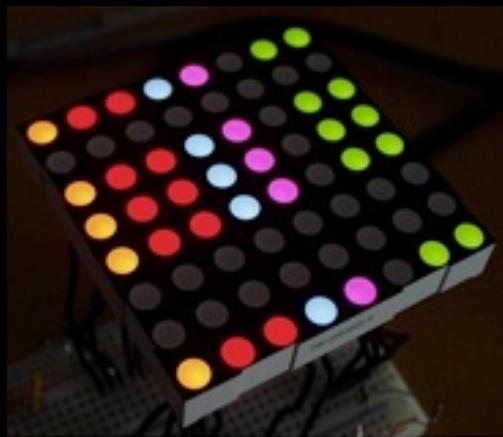
KWM-20882CVB



Images from Adafruit

Displays

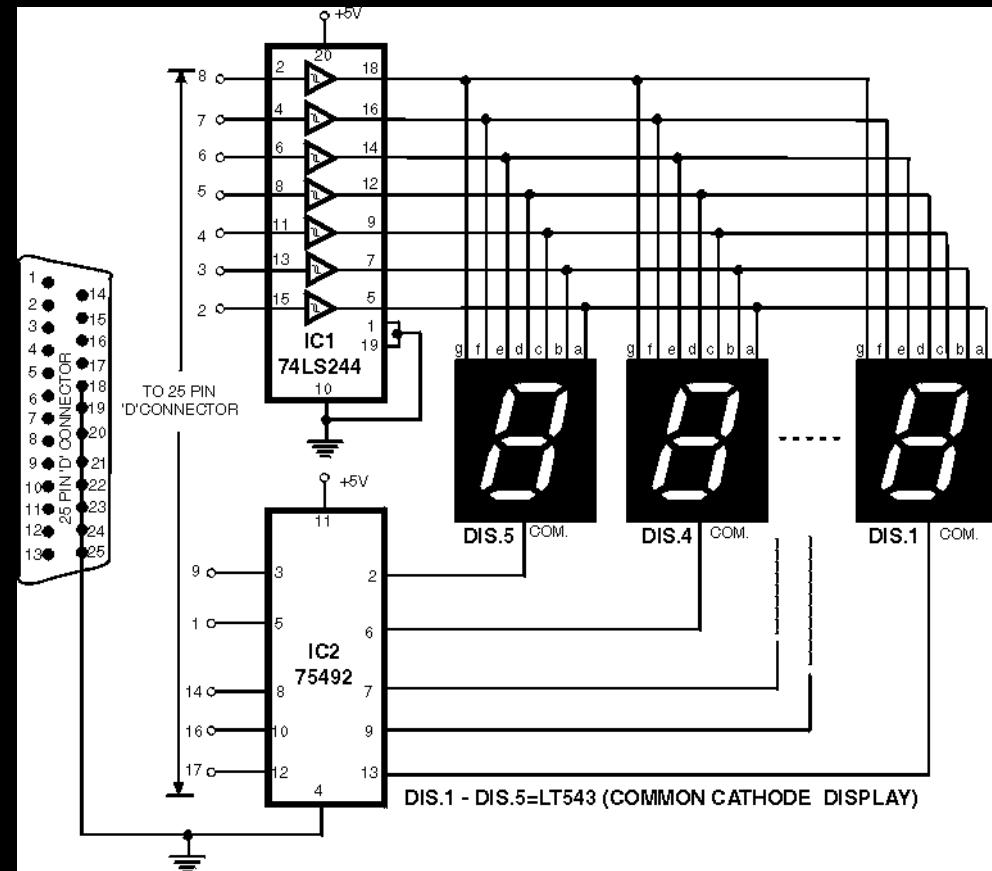
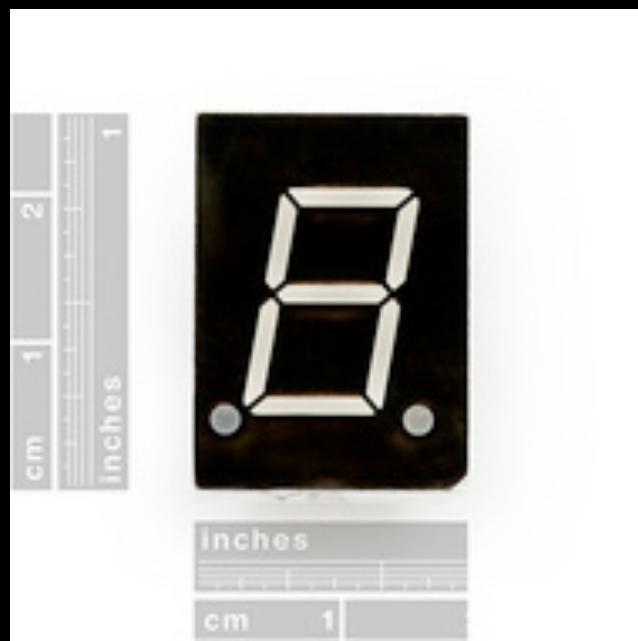
Variations on LEDs



Images from Adafruit

Displays

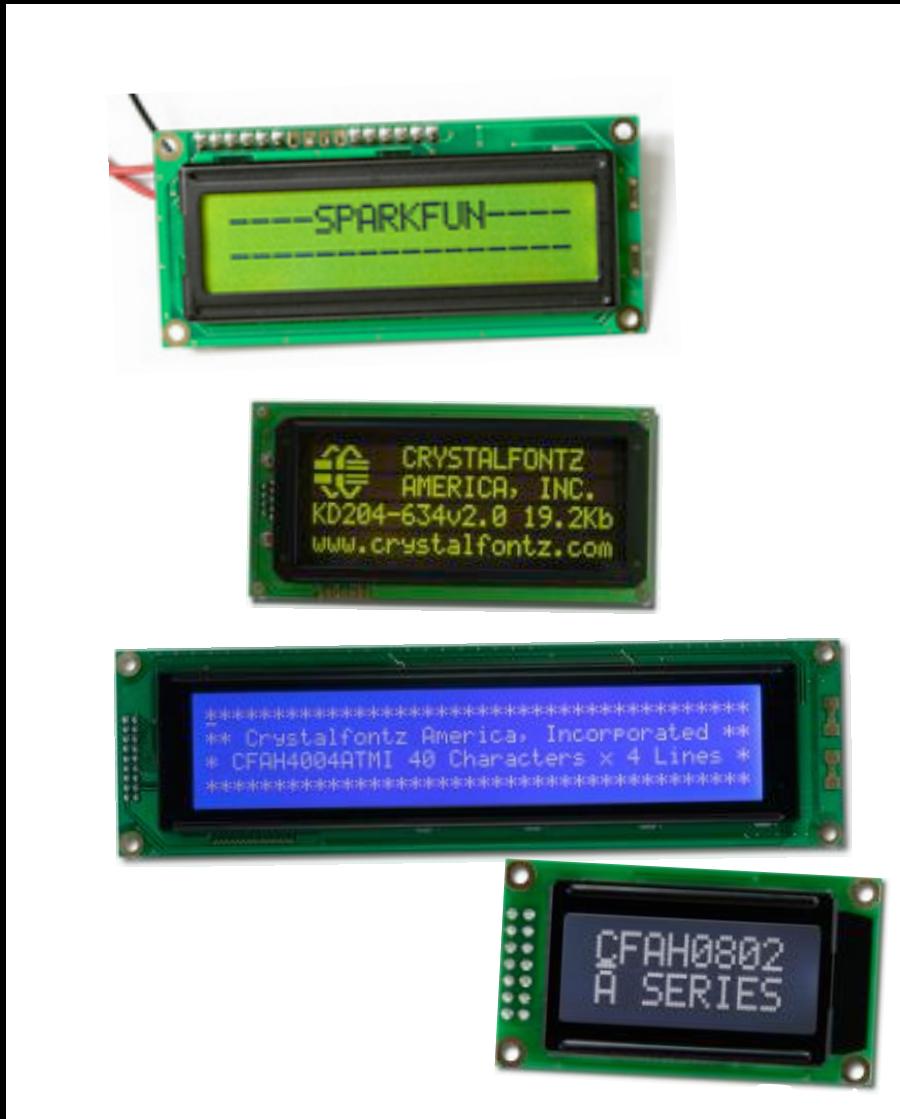
Variations on LEDs



Images from Adafruit

Displays

Character displays



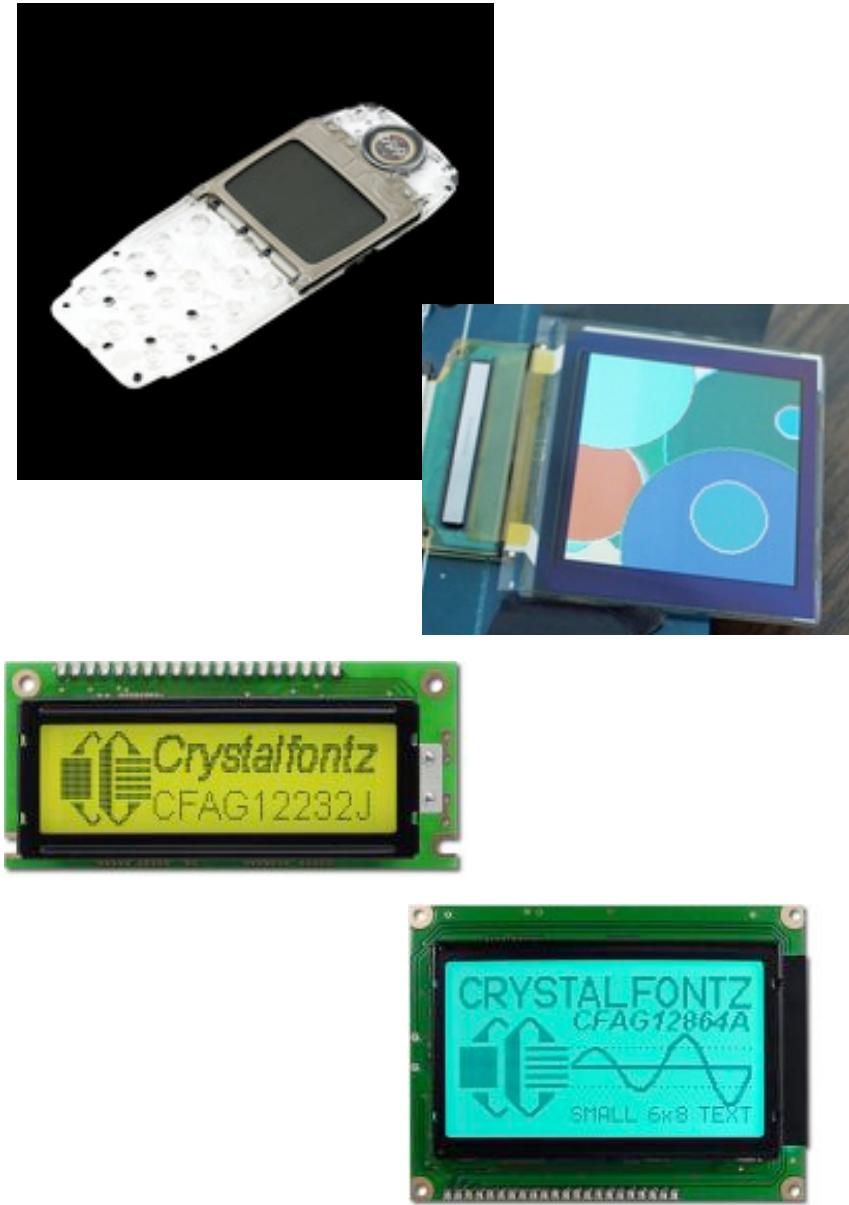
Variations:

- dimensions
- # columns and rows
- Colors
- Voltages
- Backlight
- HD44780 compatibility
- Control interfaces
(parallel v. serial)

Image from Sparkfun

Displays

Graphical displays



- Variations:
 - dimensions
 - pixel width & height
 - LCD v. OLED
 - Voltages
 - Backlight
 - Color
 - Control interfaces

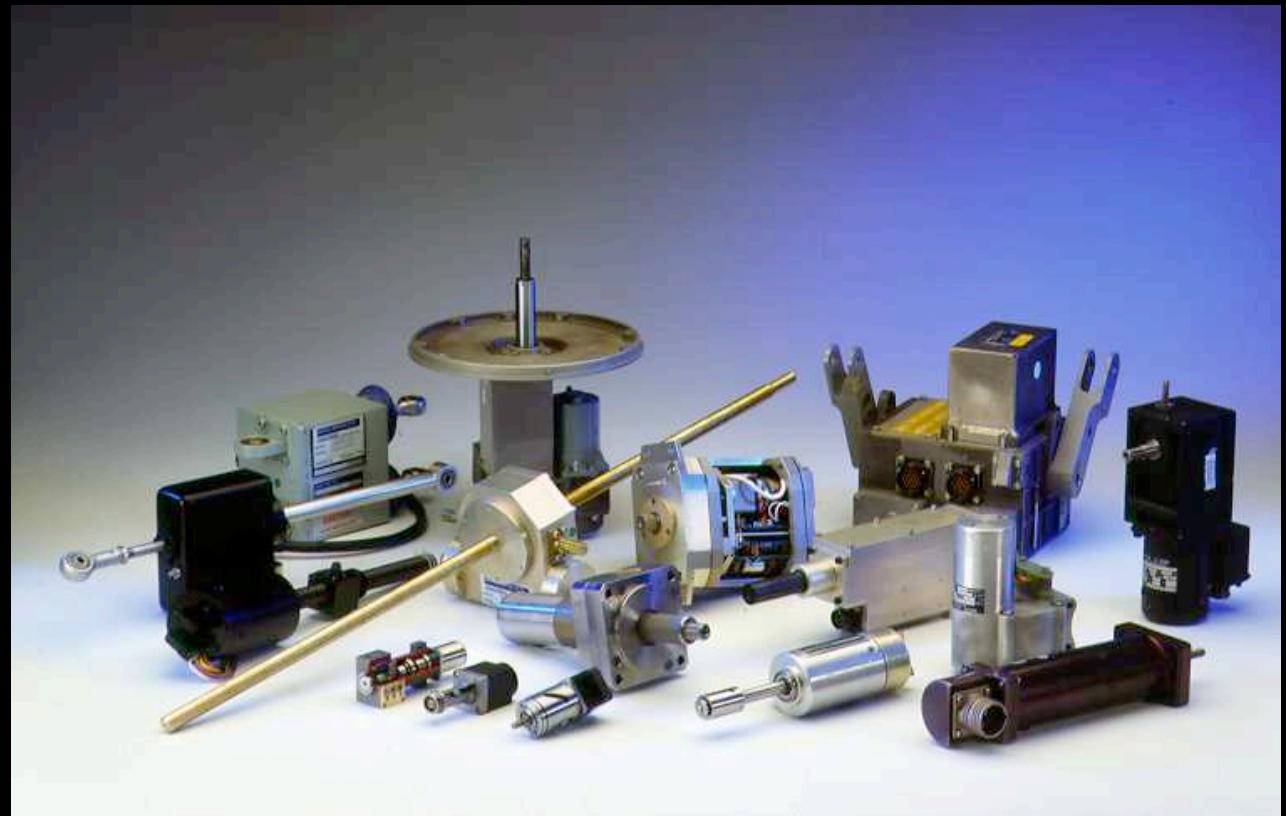
Image from Sparkfun, CrystalFontz

Actuators

Variations

An actuator is a mechanical device for moving or controlling a mechanism or system.

Motors
Solenoids
Clutches
Pneumatics
Hydraulics
Piezoelectrics



Actuators

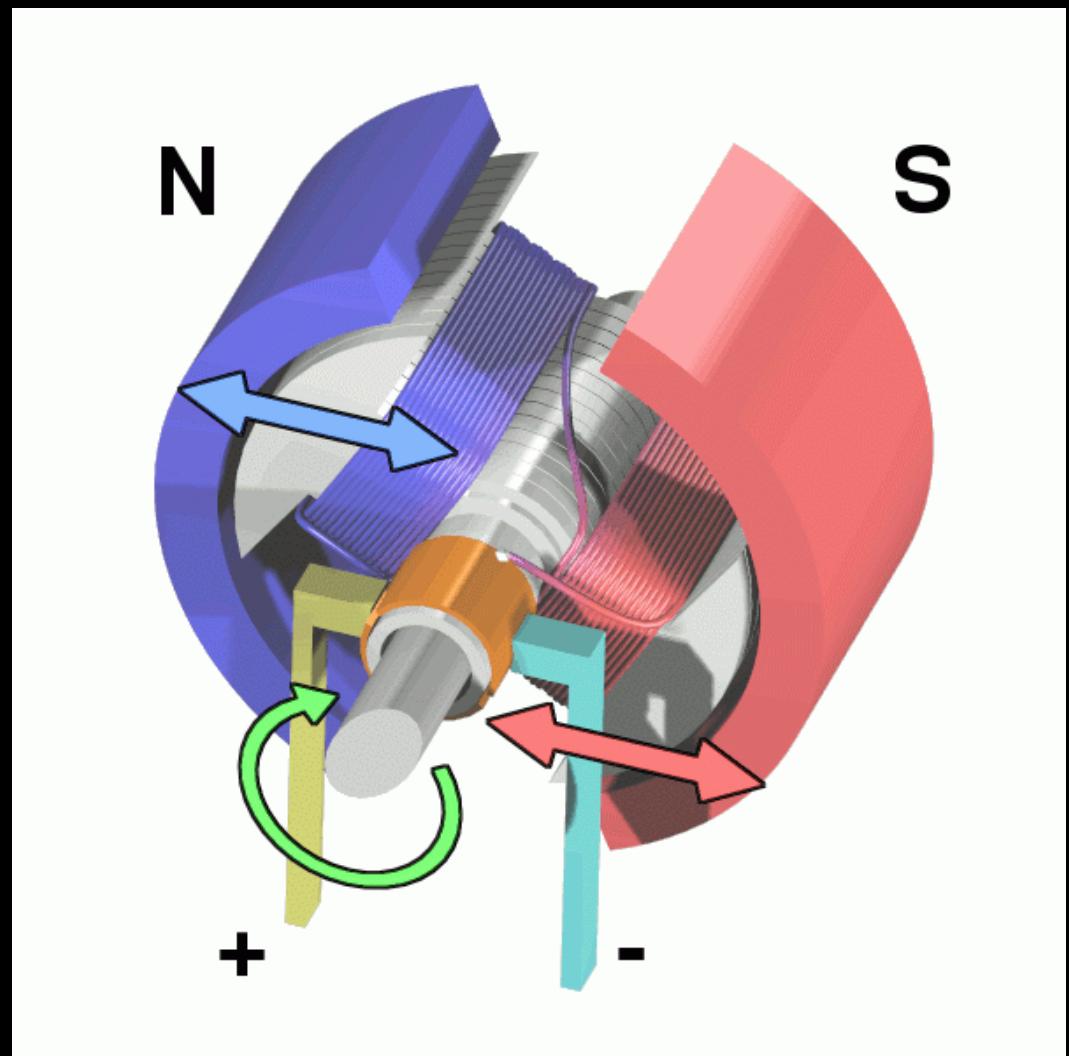
You've used one!

A speaker is an actuator that converts electrical frequencies into sound.



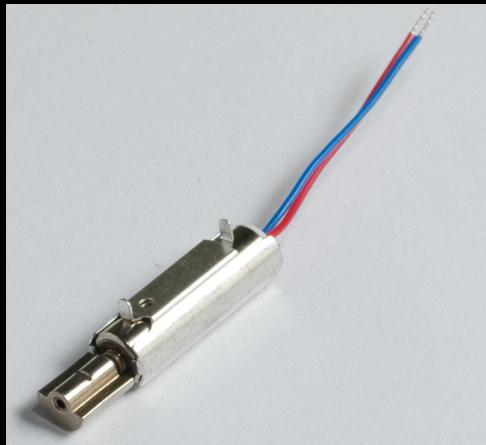
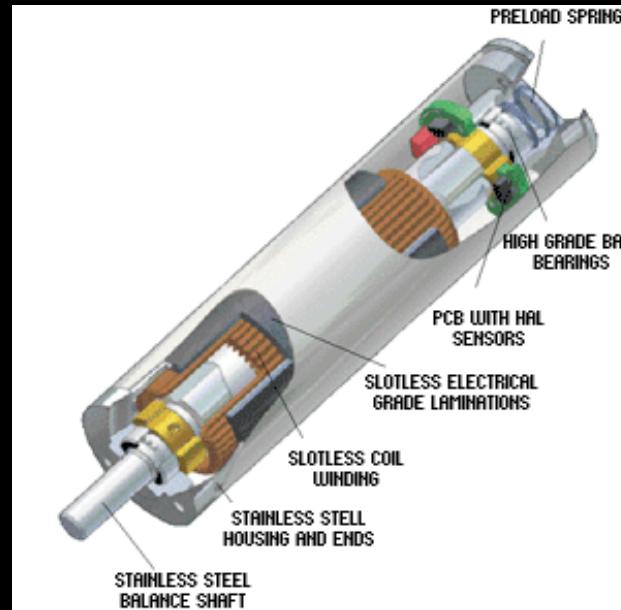
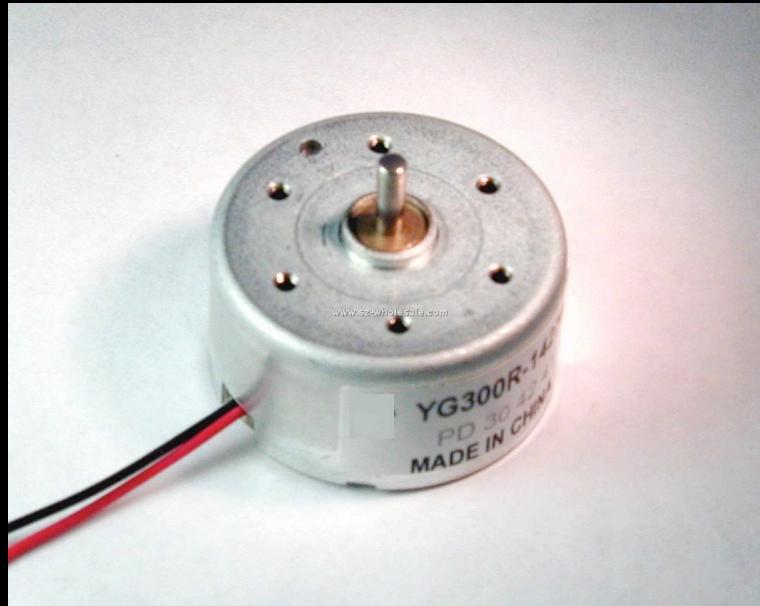
Motor

An electric motor is an electrical machine that converts electrical energy into mechanical energy.



Actuators

DC Motors



Actuators

Coin Cell Vibration Motor

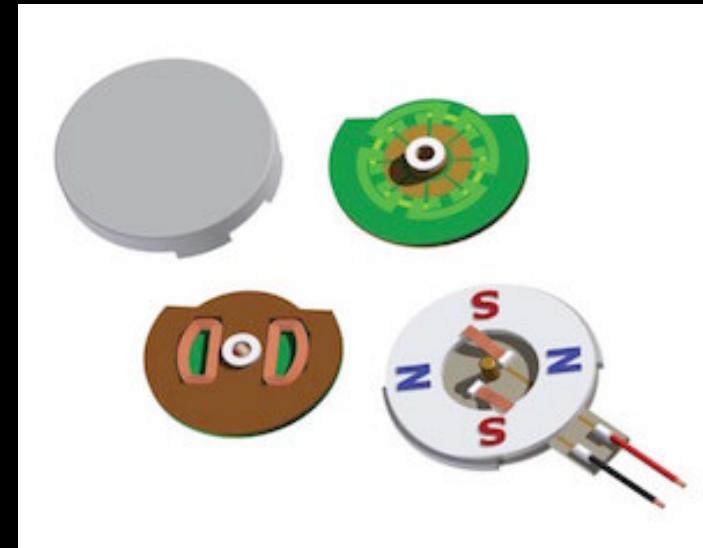
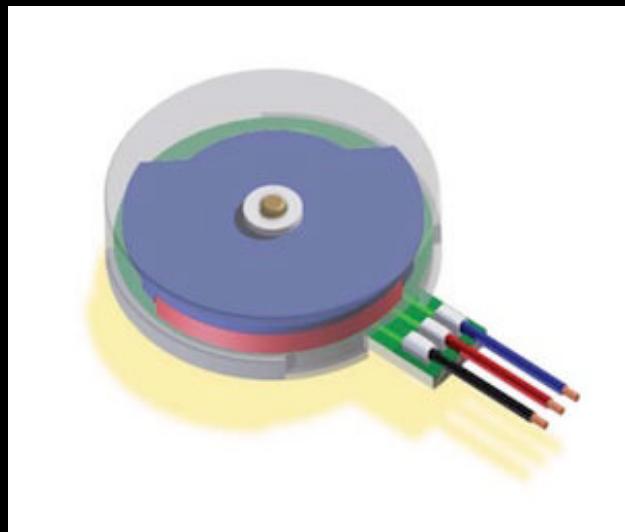
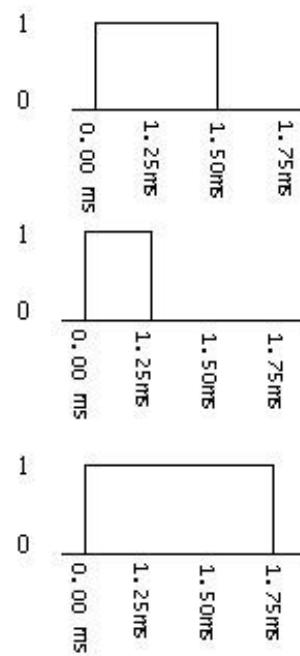
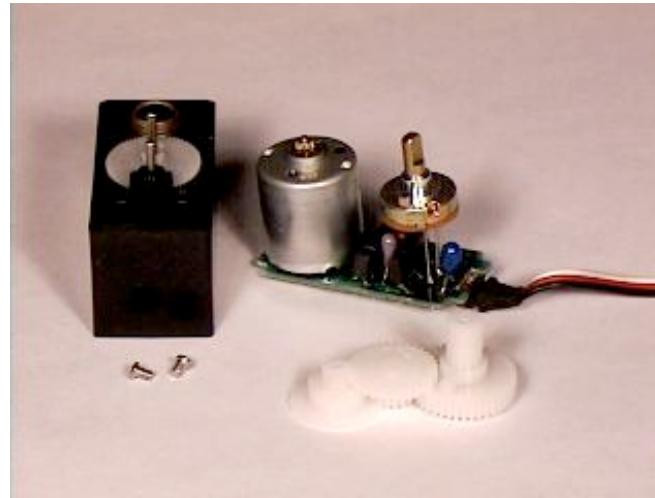
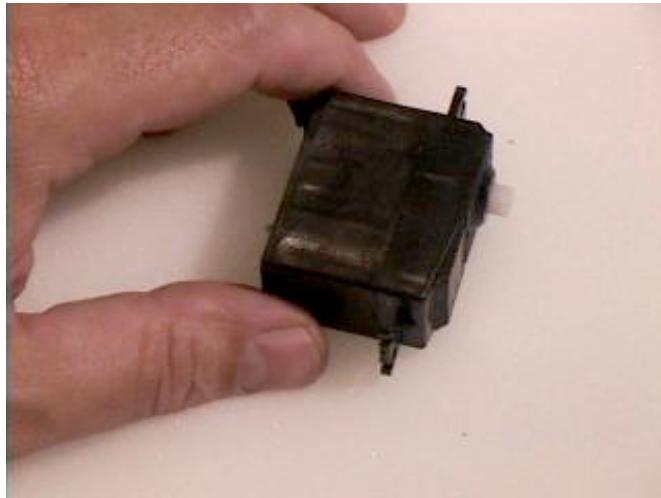


Image from <http://www.nfpmotor.com/products-coin-vibration-motors.html>

Actuators

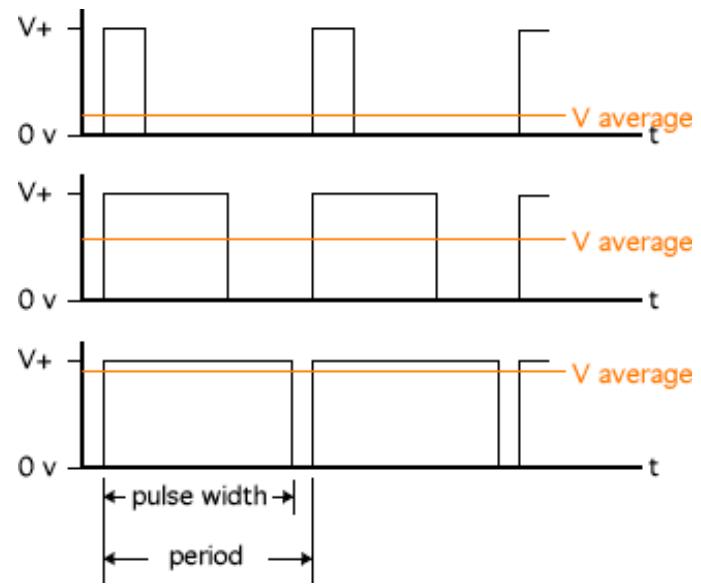
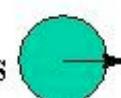
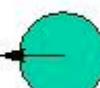
Servo Motors



1.50 ms: Neutral

1.25 ms: 0 degrees

1.75 ms: 180 degrees



The trouble with Actuators and Arduinos

from Arduino.cc

“Atmega pins can source (provide positive current) or sink (provide negative current) up to 40 mA (milliamps) of current to other devices/circuits. This is enough current to brightly light up an LED (don't forget the series resistor), or run many sensors, for example, but not enough current to run most relays, solenoids, or motors.”

Transistors

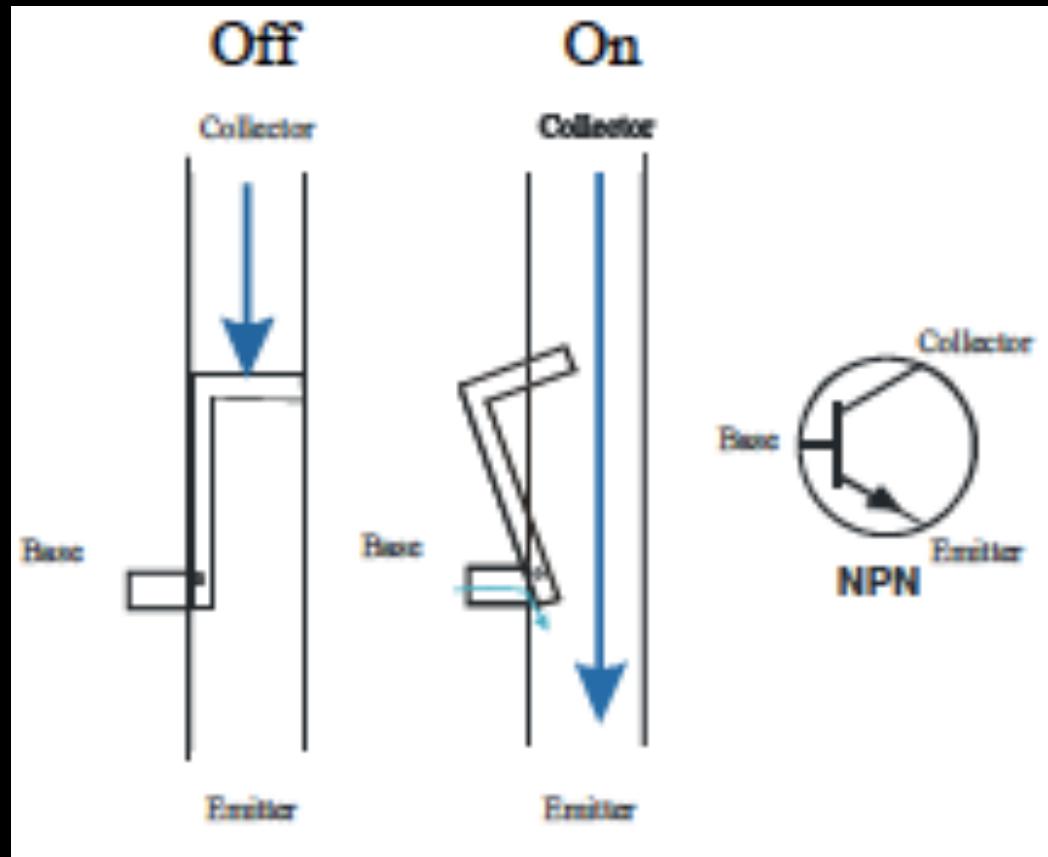
What would I use a transistor for?

For amplifying current

For switching current

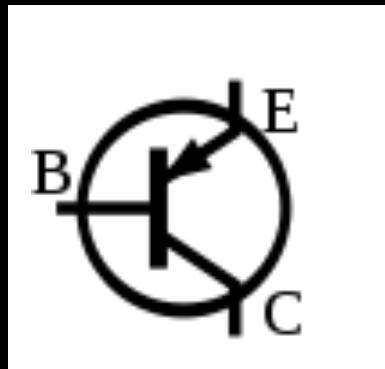
Transistors

BJT Transistors- Hydraulic Analogy

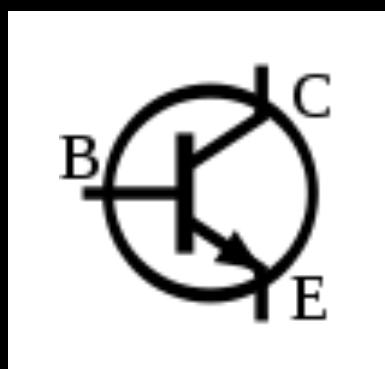


Transistors

BJTs: NPN or PNP?



PNP: Pointing In Proudly
If base is at lower voltage than
emitter, current flows from E to C
Small amount of current also flows
from E to B (sink current)

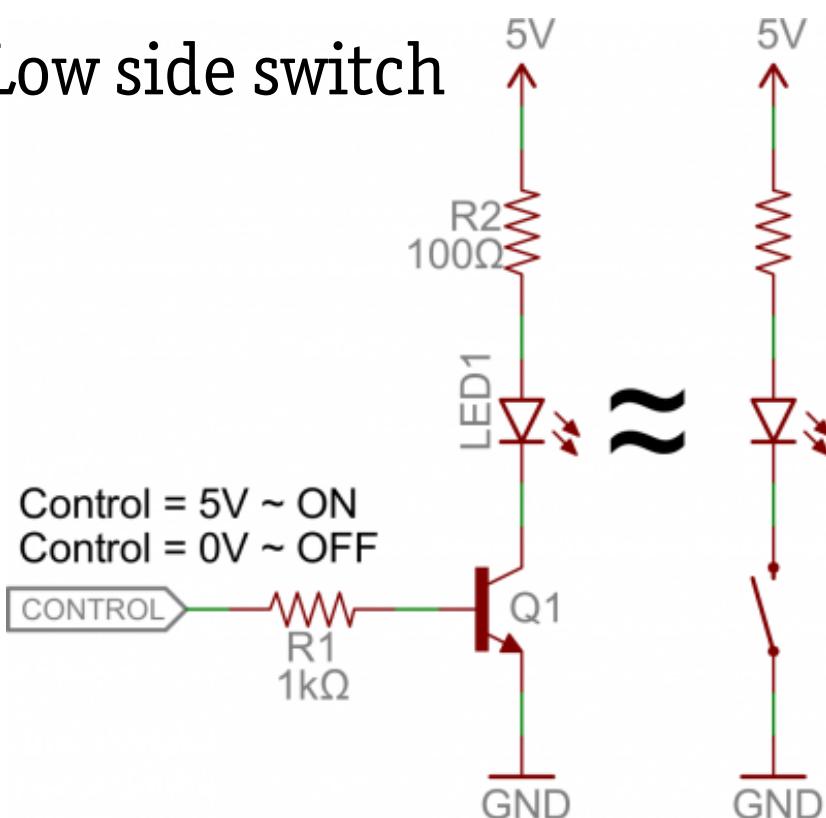


NPN: Not Pointing In
If base is at higher voltage than
emitter, current flows from C to E
Small amount of current also flows
from B to E (source current)

Transistors

How do I use a transistor?

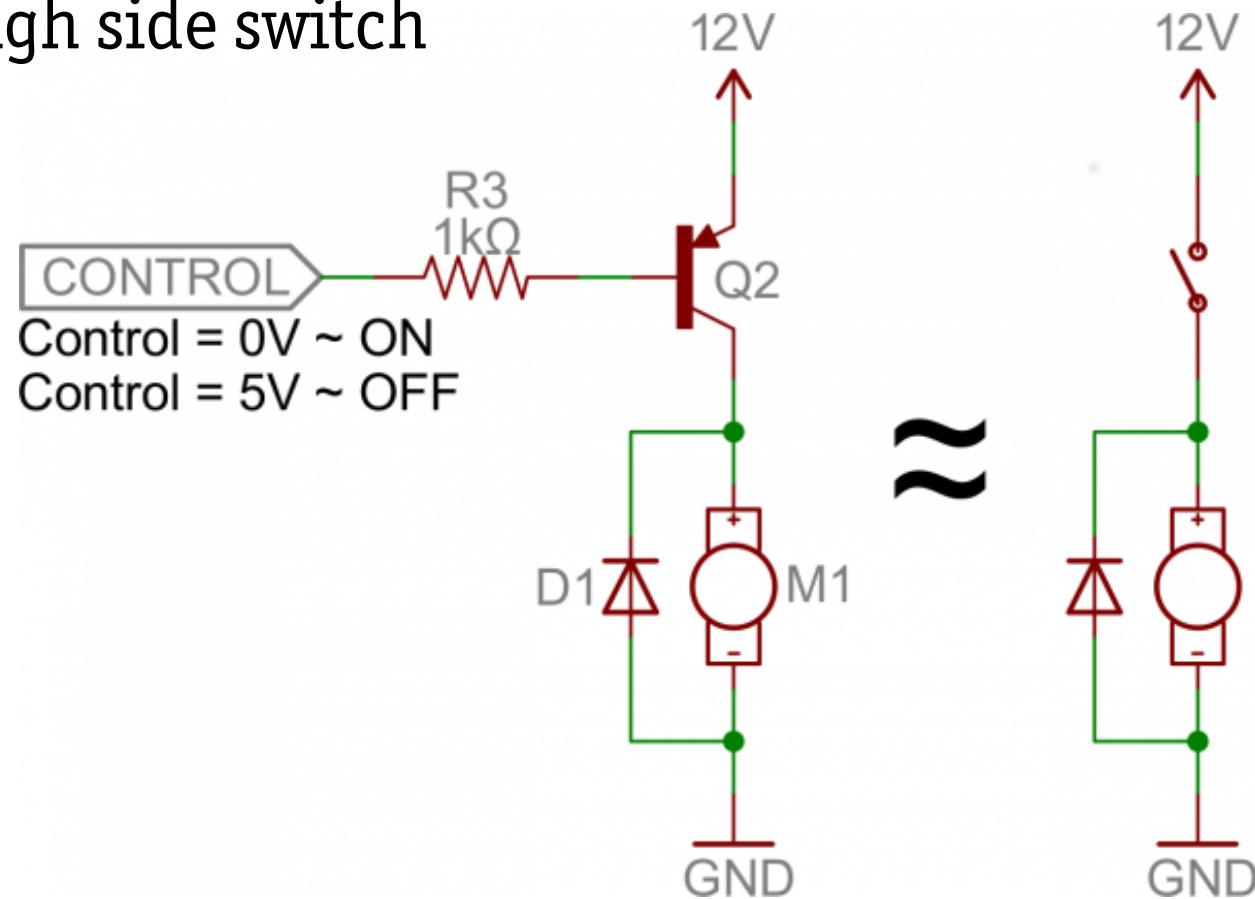
Low side switch



Transistors

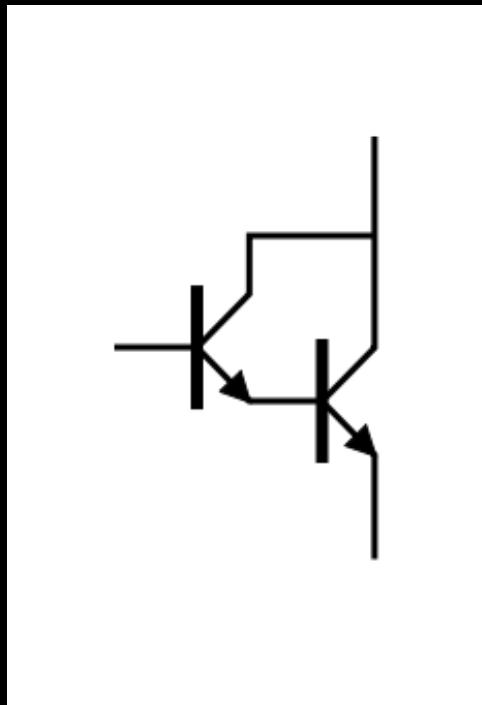
How do I use a transistor?

High side switch



Transistors

Darlington transistors



Allow higher gain

A little slow

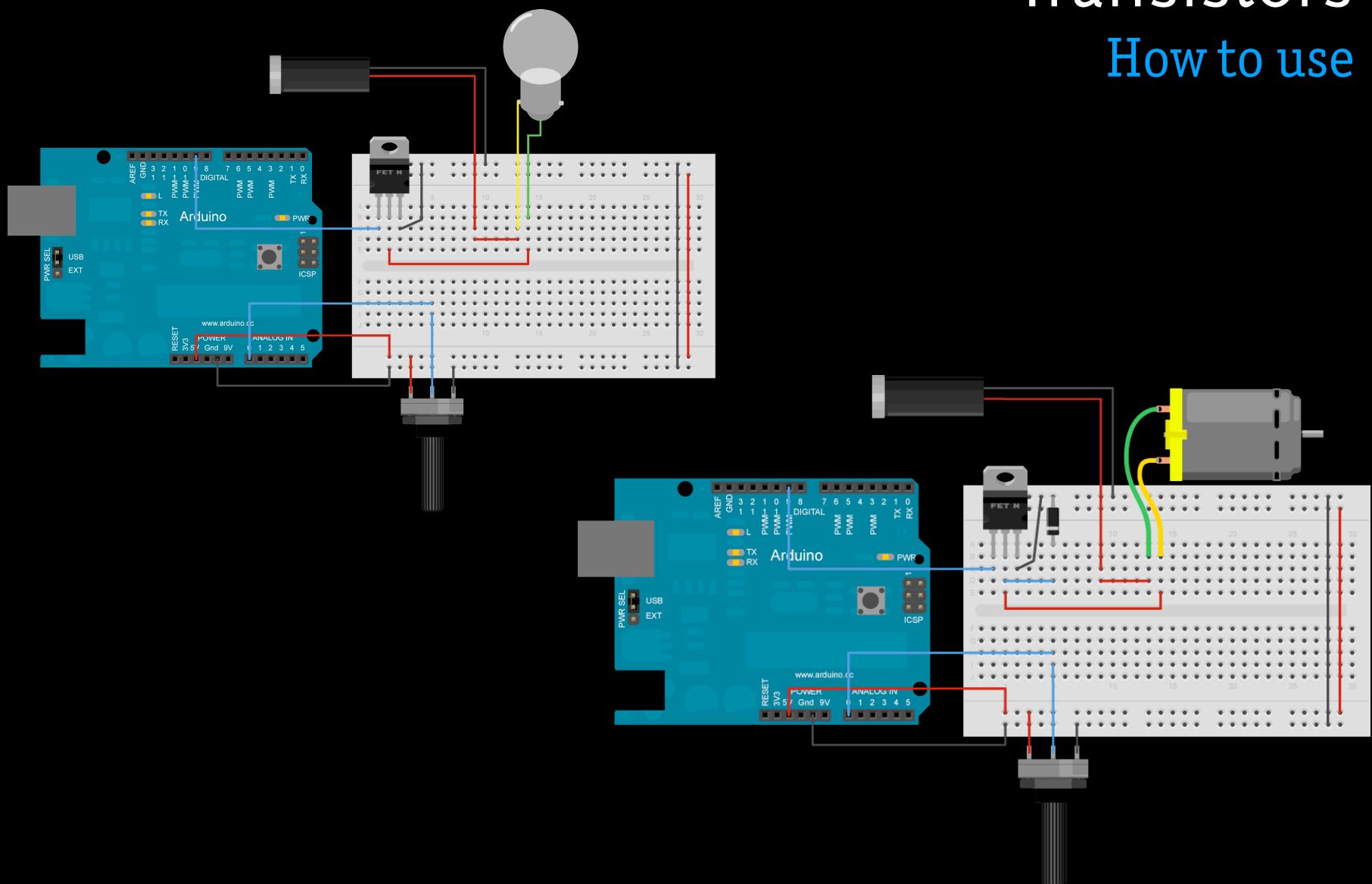
Common ones to use:

ULN2003 for LED arrays,
relays, printer hammers

TIP120 for motors,
incandescent lamps

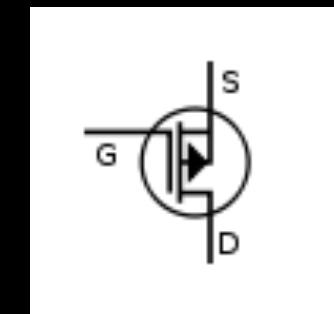
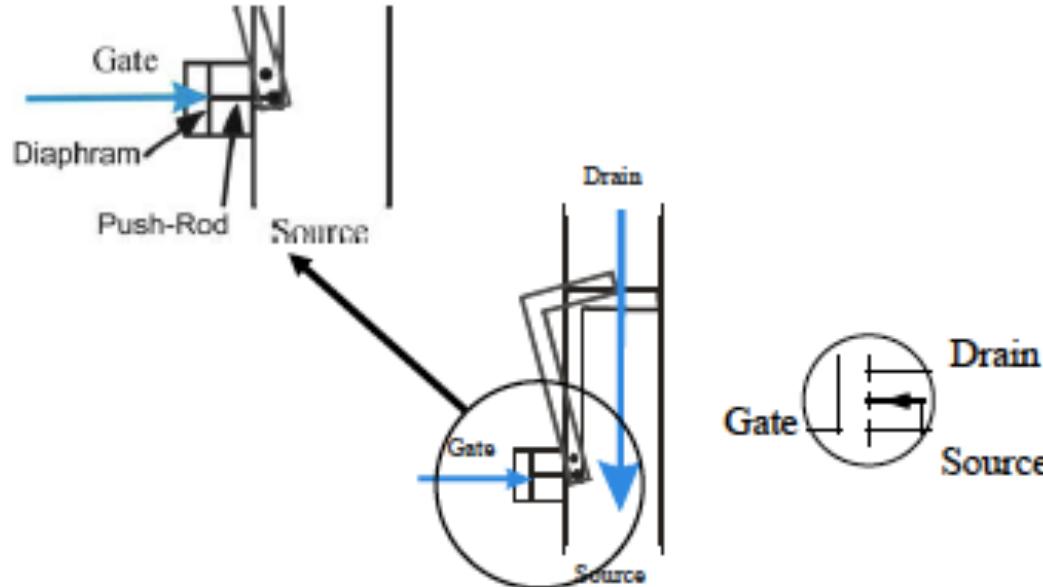
Transistors

How to use



Transistors MOSFETs

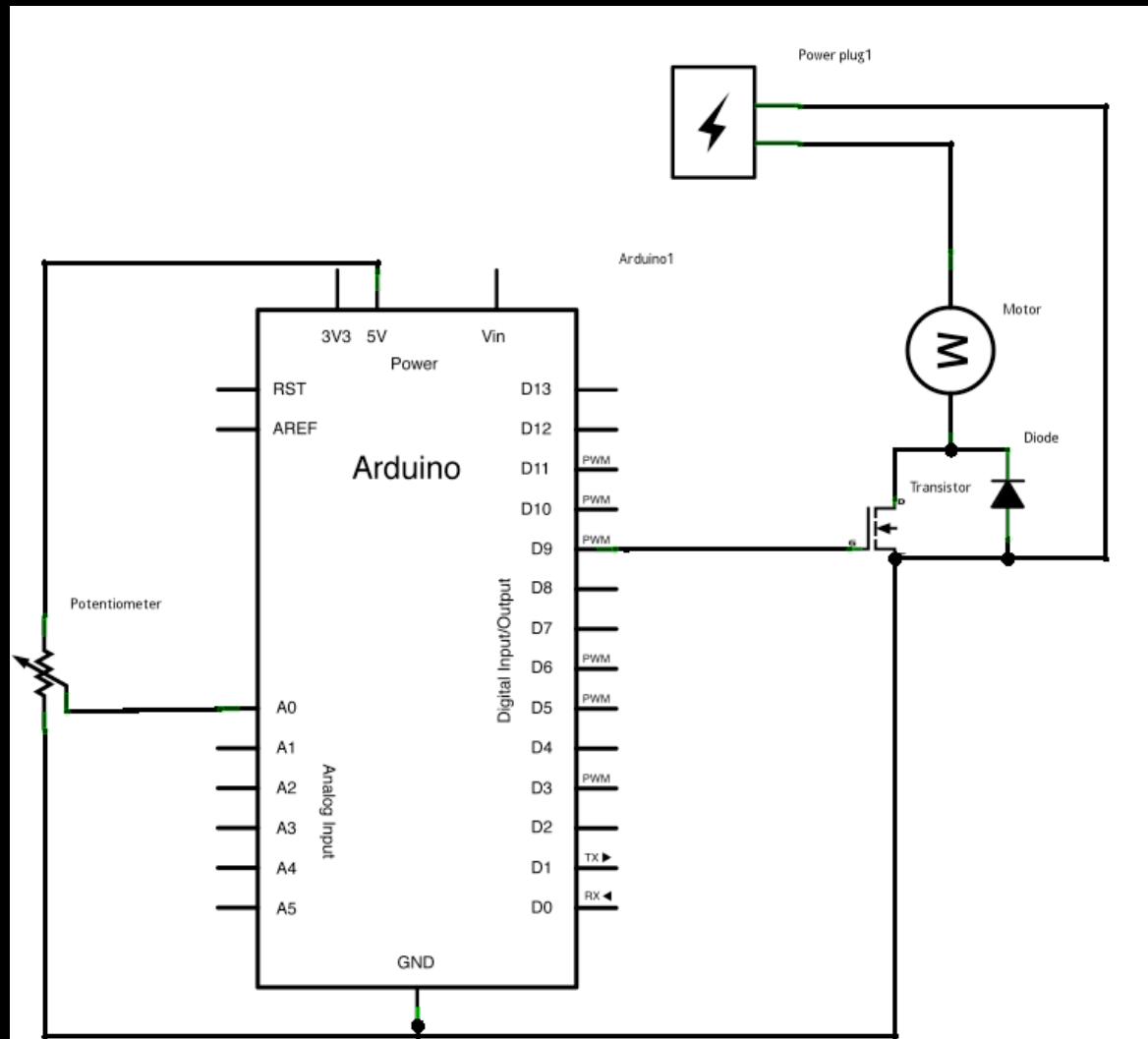
Hydraulic Analogy for N-Channel MOSFETs



Gate, Drain, & Source are analogous to Base, Collector & Emitter

No current flows from Gate to Source/Drain.

Transistors MOSFETs

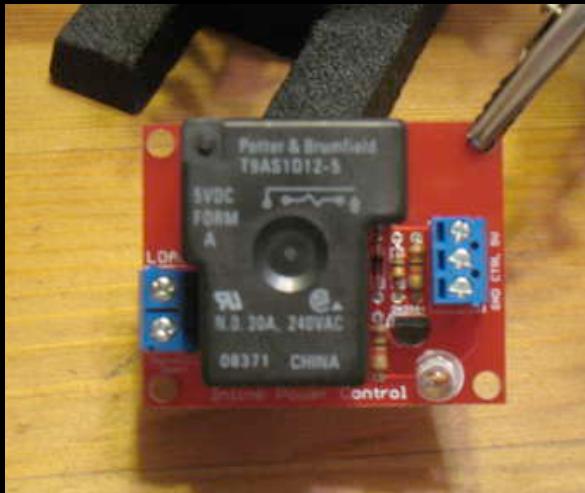


Common N-channel
MOSFET is BS270N

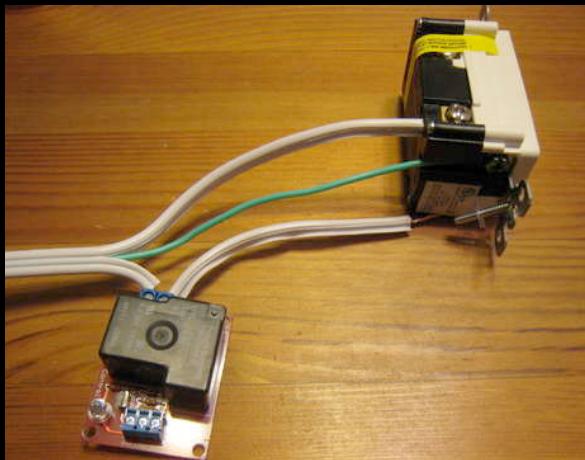
Faster turn off and
higher max currents
than BJTs, but req.
higher gate voltages

Relays

Good if you're controlling an AC device!



Here, Sparkfun board for SPST relay capable of switching 220VAC@30A



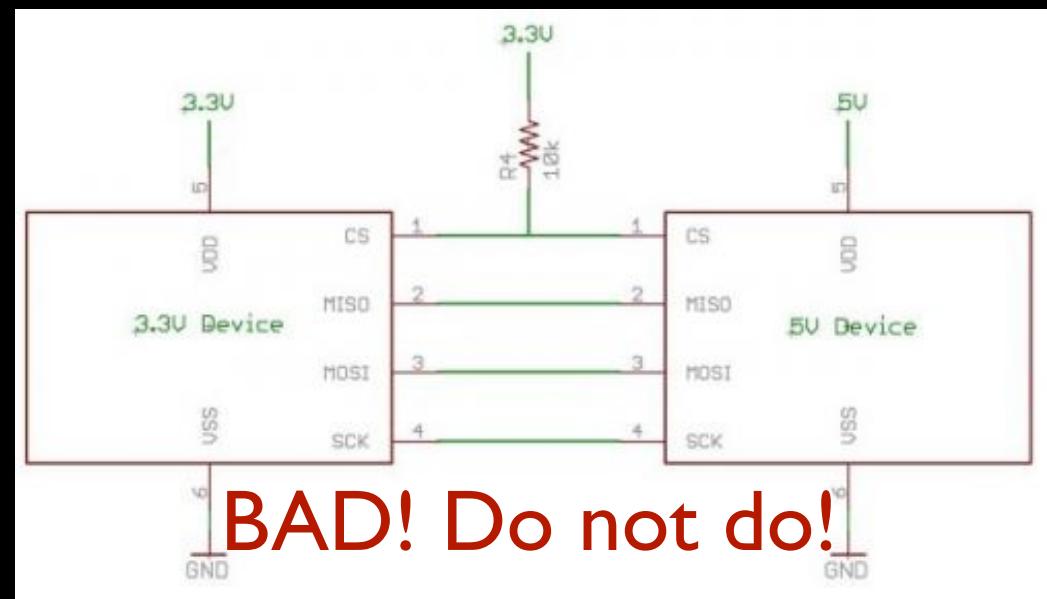
In general, relays are like electronically controlled switches

Voltage Level Shifting

Why would you want to shift the voltage?

Why are there
different
voltages
anyway?

What can go
wrong when
connecting 3.3 V
and 5V devices?

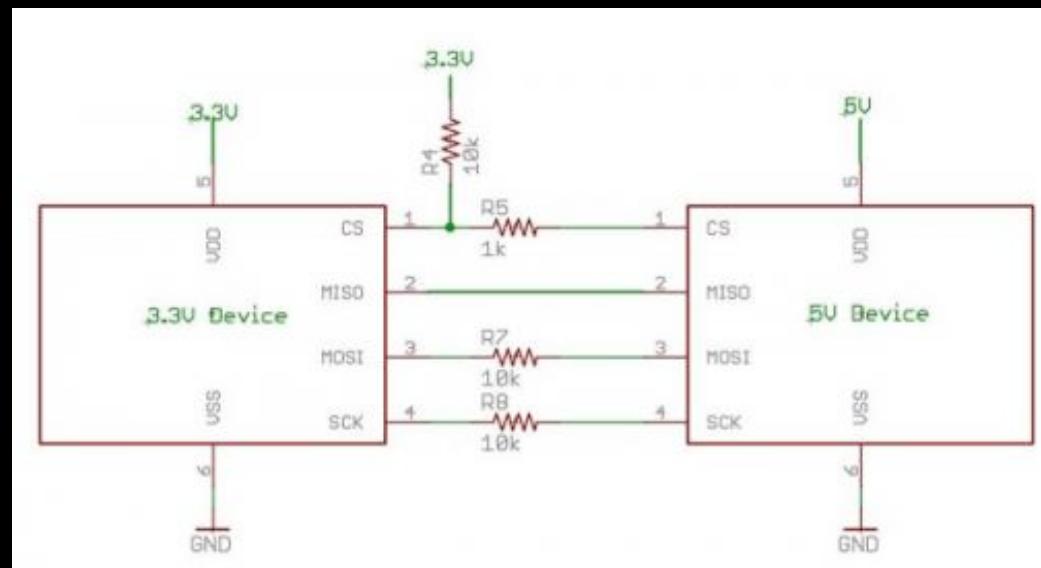


Voltage Level Shifting

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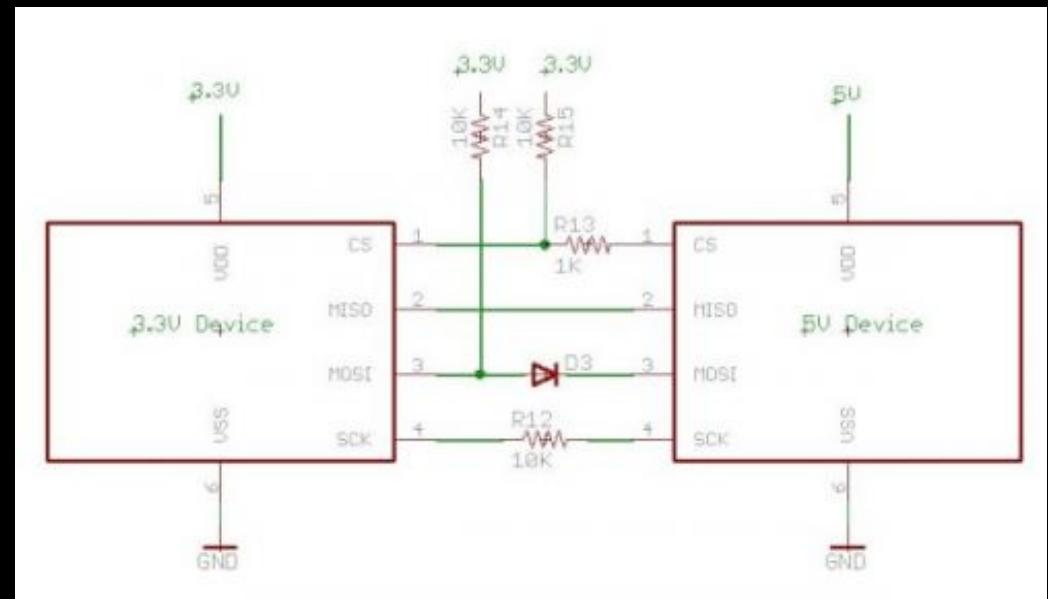
Inline resistor method

Voltage Level Shifting

Why would you want to shift the voltage?

Why are there
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anyway?

What can go
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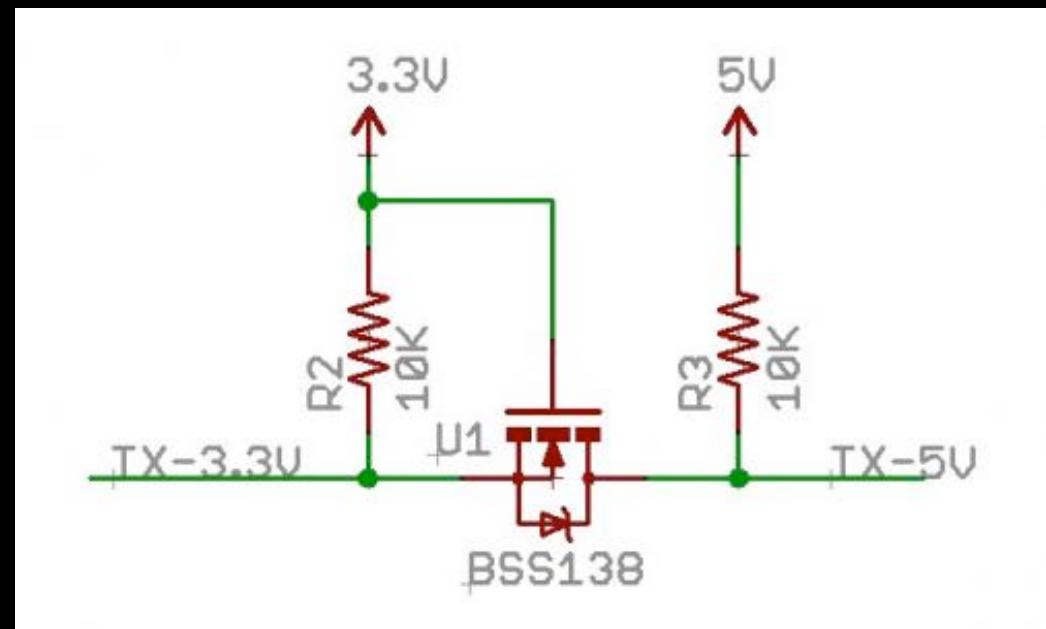
Reverse diode method

Voltage Level Shifting

Why would you want to shift the voltage?

Why are there different voltages anyway?

What can go wrong when connecting 3.3 V and 5V devices?



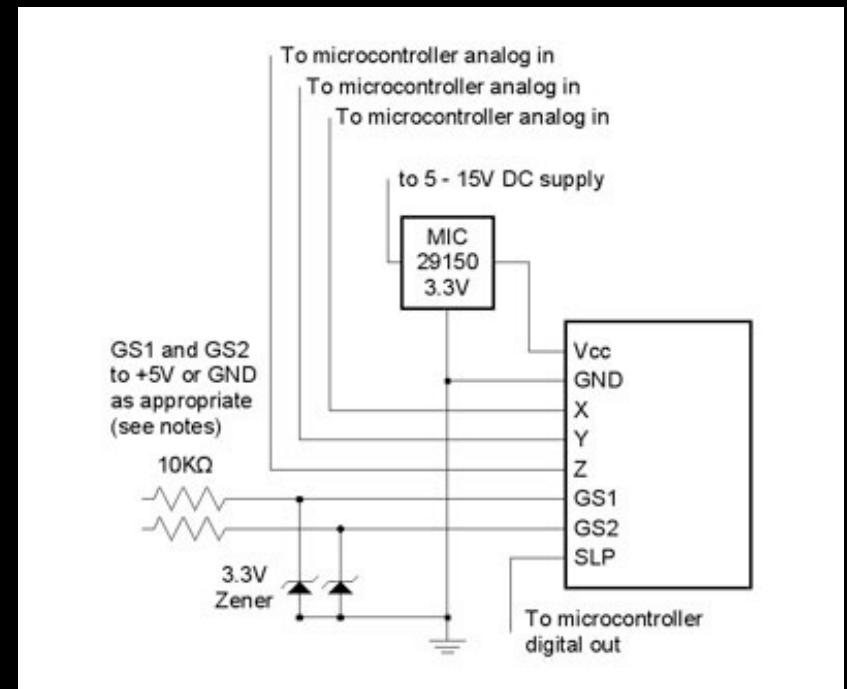
MOSFET (metal oxide semiconductor field effect transistor) method

Voltage Level Shifting

Why would you want to shift the voltage?

Why are there
different
voltages
anyway?

What can go
wrong when
connecting 3.3 V
and 5V devices?



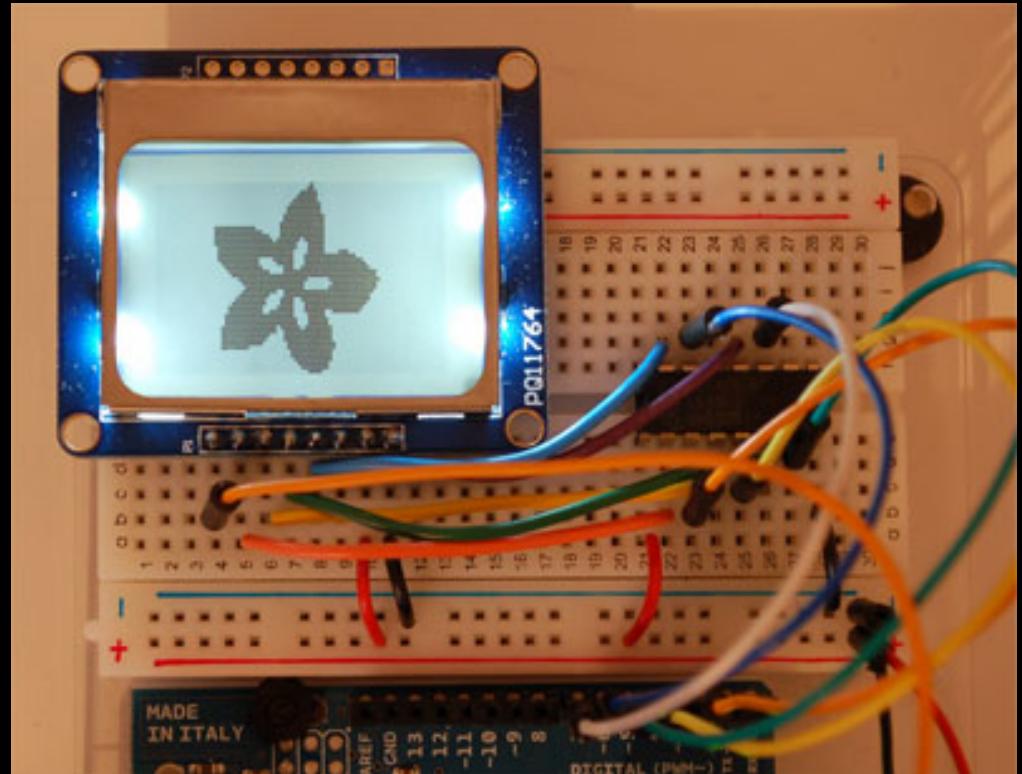
Zener diode method

Level Shifting

Why would we want to level shift voltage?

"The display driver is a PCD8544 chip, and it runs at 3.3V so you'll need a 3V supply handy (you don't need that much current though, maybe 10mA tops). Logic levels must be 3V to prevent damage."

-<http://www.adafruit.com/products/338>



The 4050 Level Shifter

Interfacing between 3V and 5V communications

Important to convert
HIGH 5V
microcontroller output
voltage to 3V.

Is it important to
convert 3V HIGH signals
from back to the
microcontroller to 5V?

PIN DESCRIPTION		
PIN NO.	SYMBOL	NAME AND FUNCTION
1 V _{cc}		positive supply voltage
2, 4, 6, 10, 12, 15	1Y to 6Y	data outputs
3, 5, 7, 9, 11, 14	1A to 6A	data inputs
8	GND	ground (0 V)
13, 16	n.c.	not connected

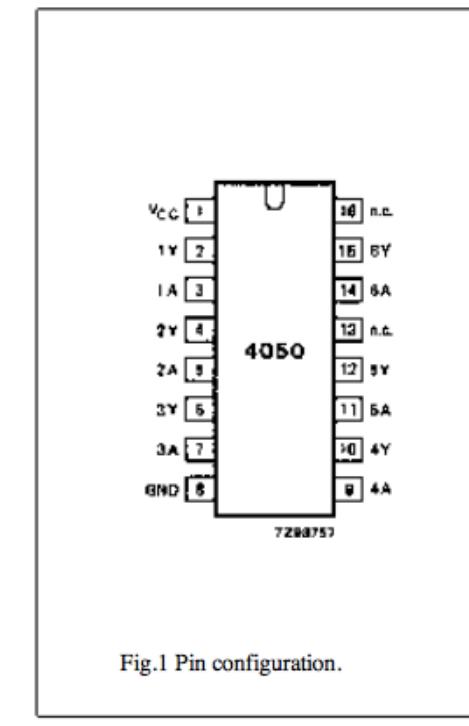


Fig.1 Pin configuration.

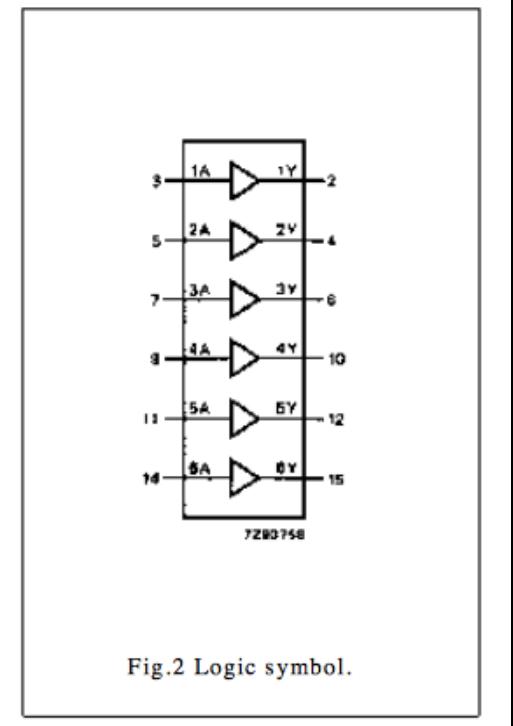


Fig.2 Logic symbol.

This week's Lab

Highlights? Questions?