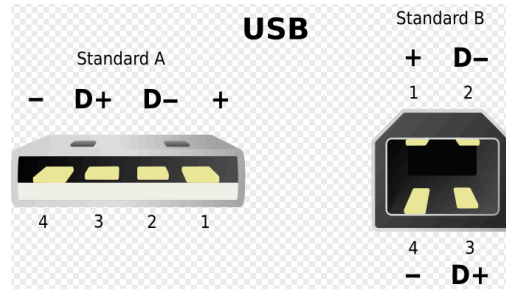


Output Devices

FabAcademy 2015

POWER SUPPLY

- USB PORT – 5V



Pin 1	V _{CC} (+5 V, red wire)
Pin 2	Data- (white wire)
Pin 3	Data+ (green wire)
Pin 4	Ground (black wire)

- Battery – 9V



- Adapter PC charger – 12V/16V/19V



- Switching Supply 48V



POWER SUPPLY

From Attiny24/44/48 datasheet

- **Operating Voltage:**
 - 1.8 – 5.5V for ATtiny24V/44V/84V
 - 2.7 – 5.5V for ATtiny24/44/84

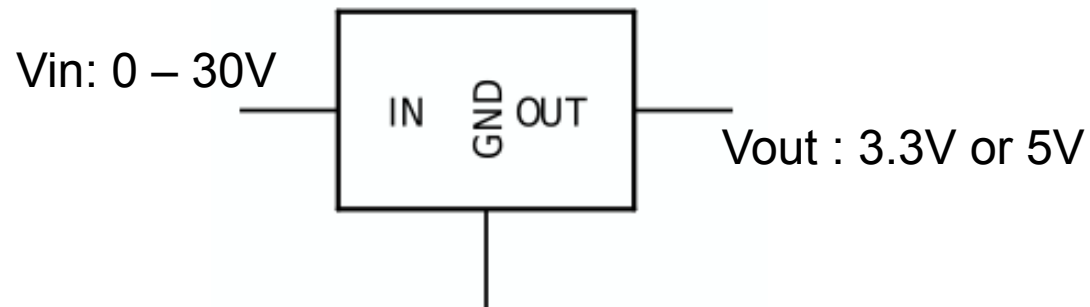
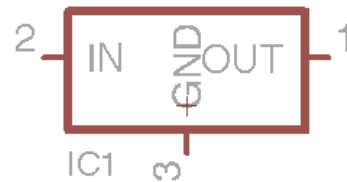


It means that if you connect $VCC > 5.5V$, you burn the Attiny.

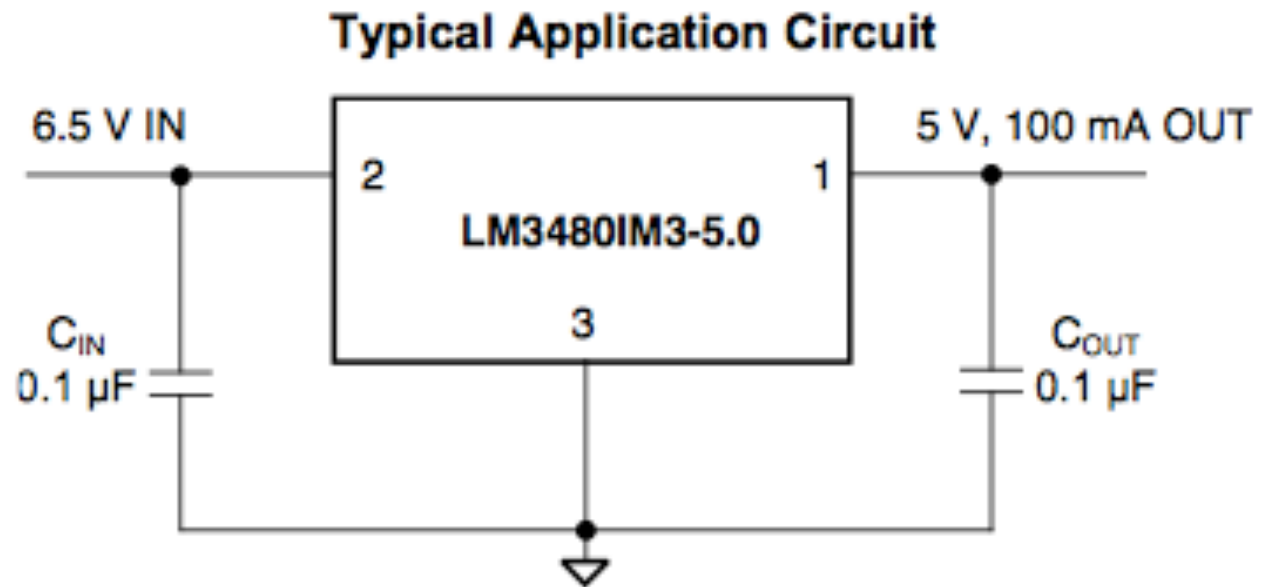
Can you use a high battery/supply on your board?
You use REGULATOR

REGULATOR

The Voltage regulator is used to generate a fixed output voltage.
In our case 3.3V or 5V

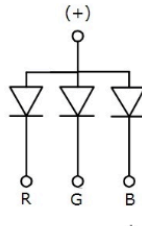
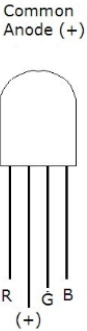
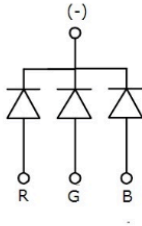
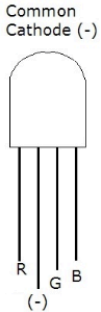


REGULATOR



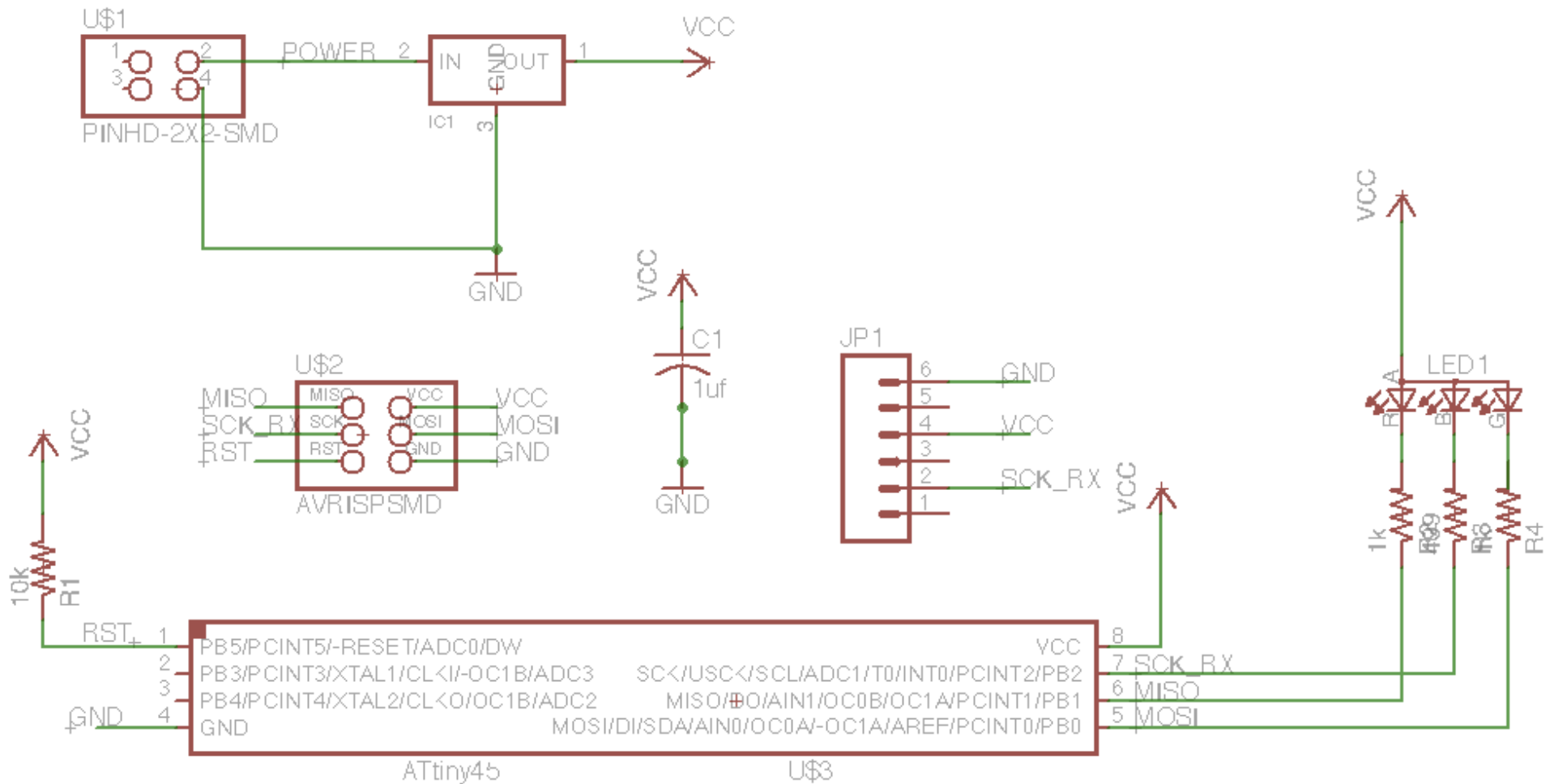
RGB LED

Three LEDs in one



Blue: less current => 1kOhm
Red/Green: more current => 500Ohm

RGB LED Schematic



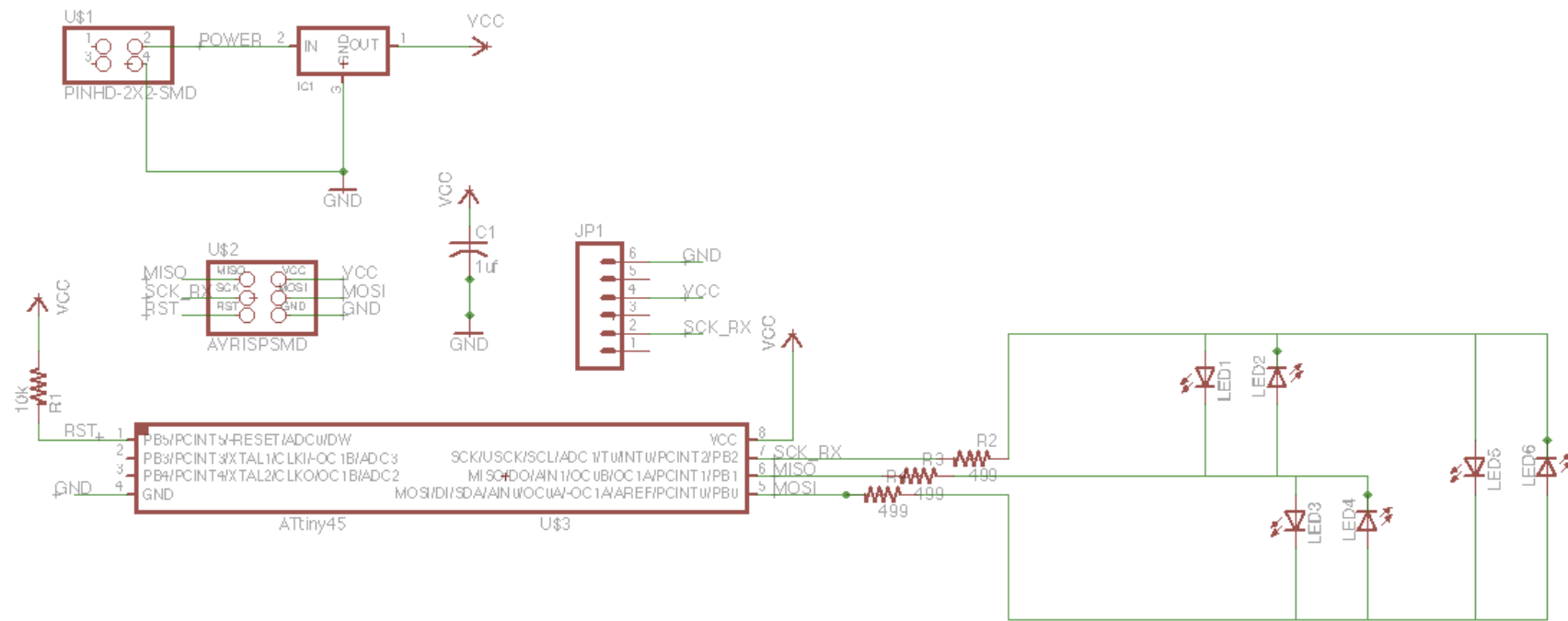
LED Array

- Version 1: single side
a lot of 0Ohm resistor
- Version 2: double layers
 - mill the bottom traces
 - vinyl cut the interconnect above that –
 - On top I attach the component

Architecture:

Charlyplexing

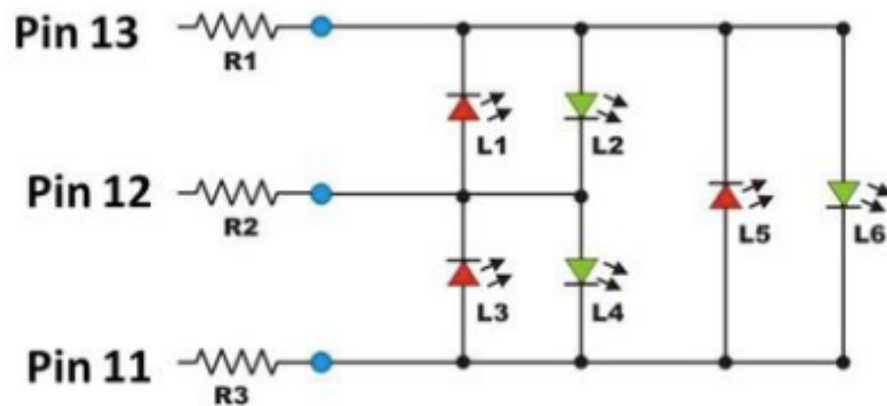
LED ARRAY



LED ARRAY

LED #	Pin 13	Pin 12	Pin 11
L1	L	H	Z
L2	H	L	Z
L3	Z	L	H
L4	Z	H	L
L5	L	Z	H
L6	H	Z	L

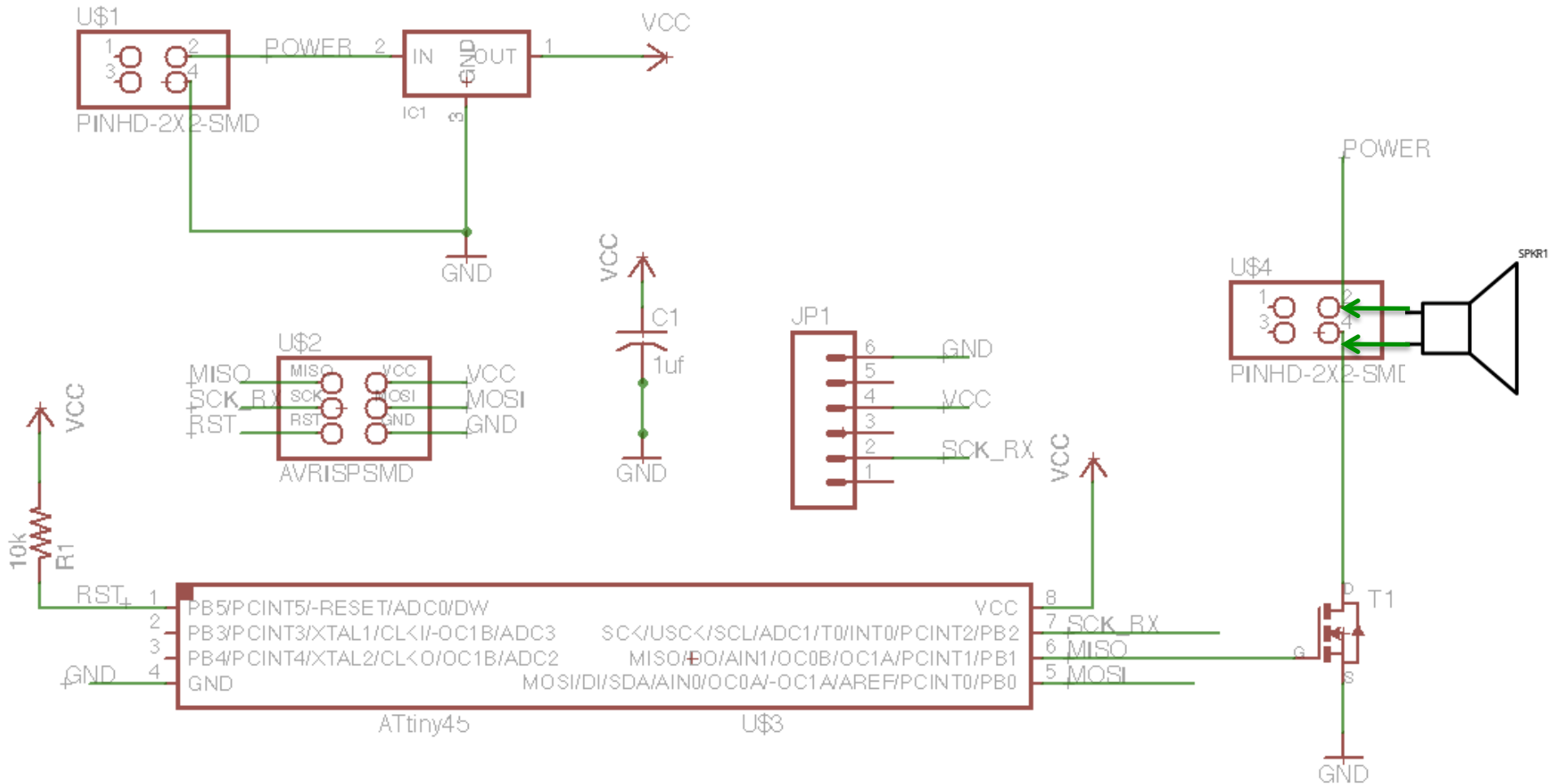
H: pinMode = OUTPUT; state HIGH
L: pinMode = OUTPUT; state LOW
Z: pinMode = INPUT; state LOW



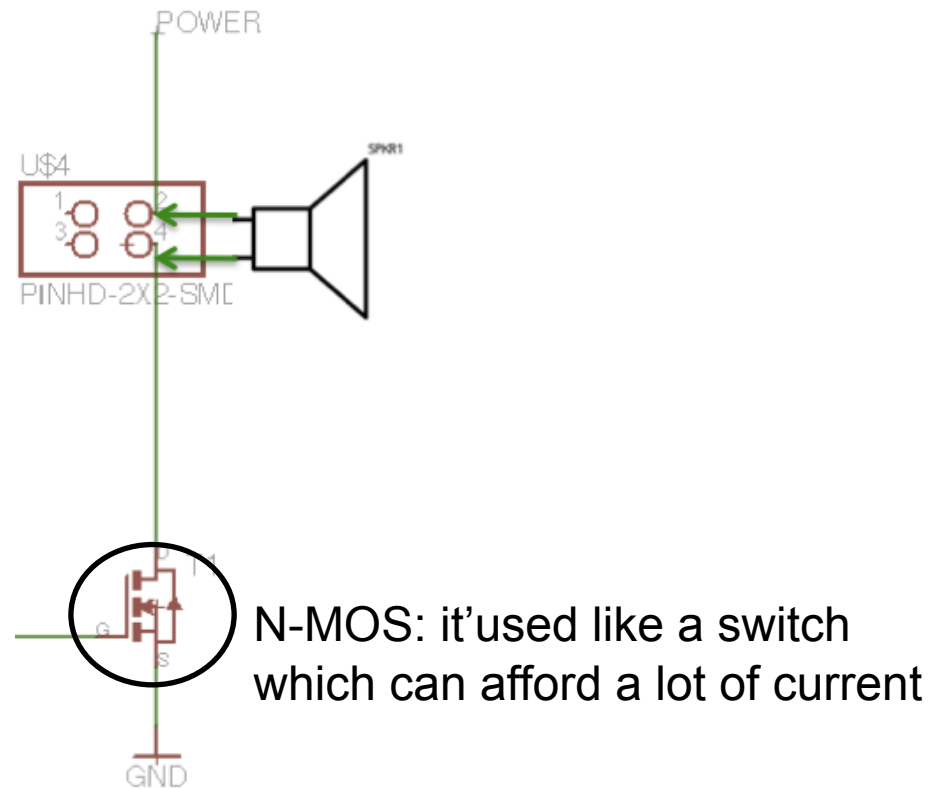
NL: number of LED
NP: number of PINS

$$NL = (NP * NP - NP)$$
$$NP = (1 + \sqrt{1 + 4NL}) / 2$$

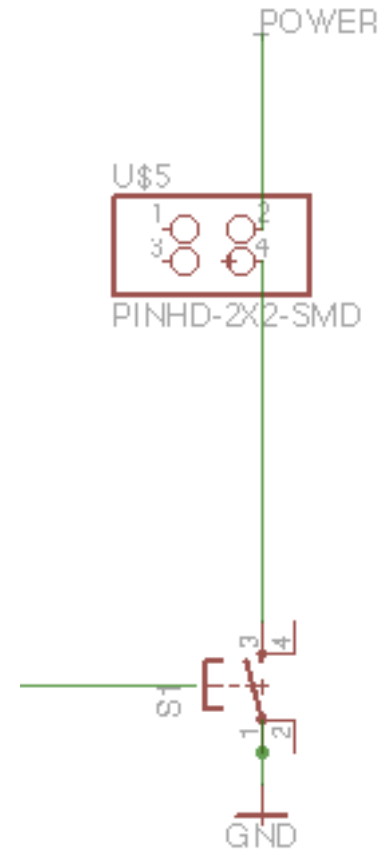
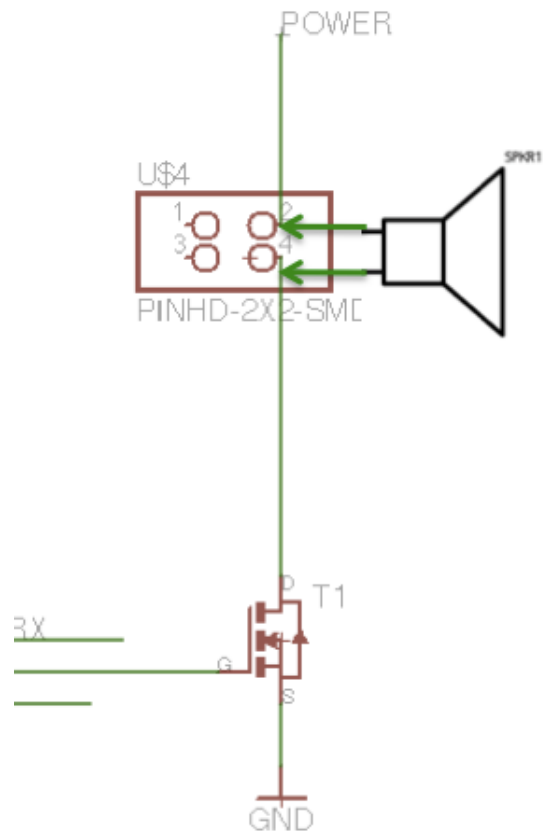
Audio



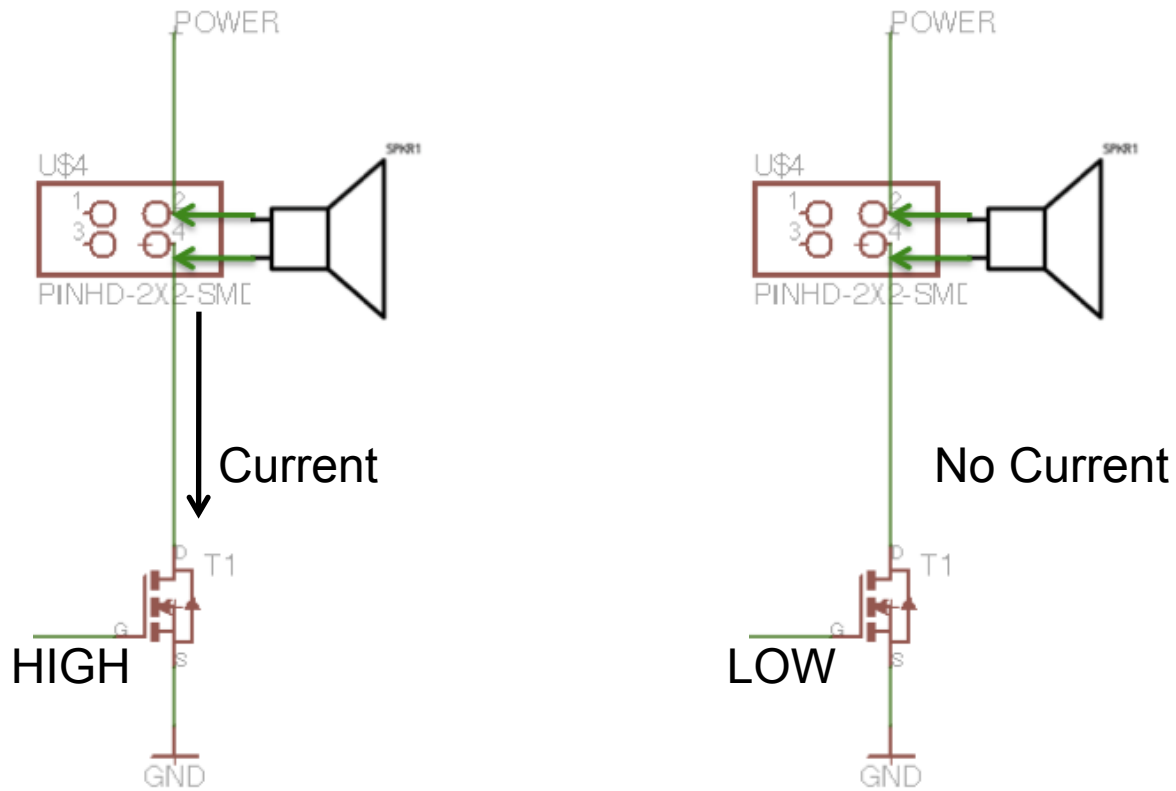
Audio – Output Stage



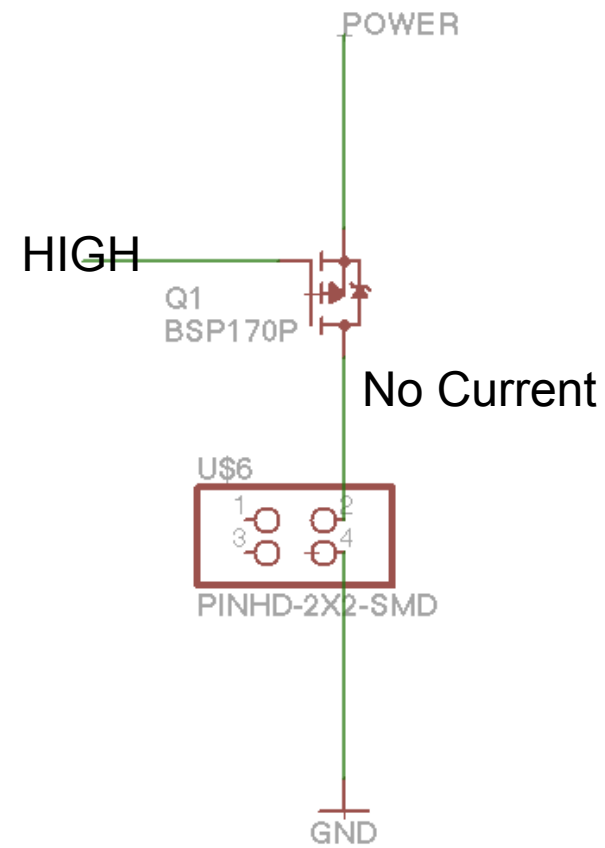
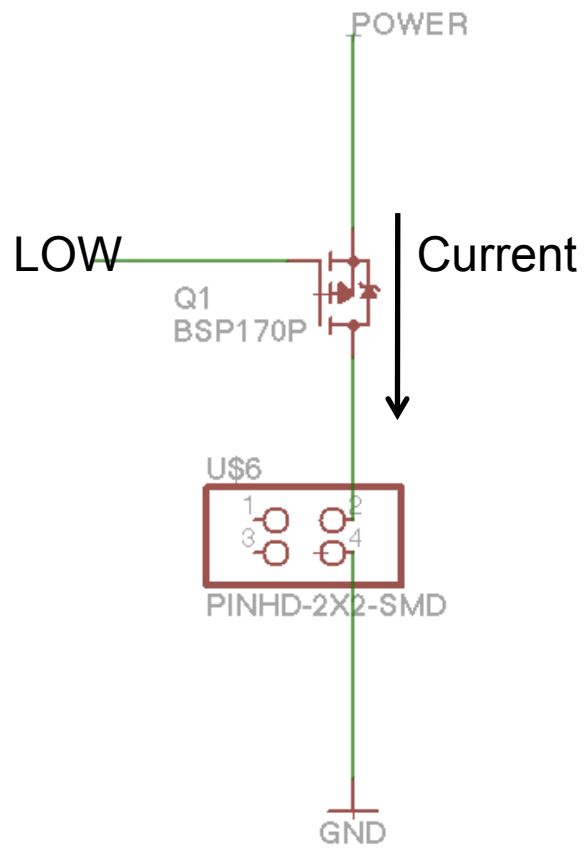
MOSFET N-Channel



Audio – Output Stage

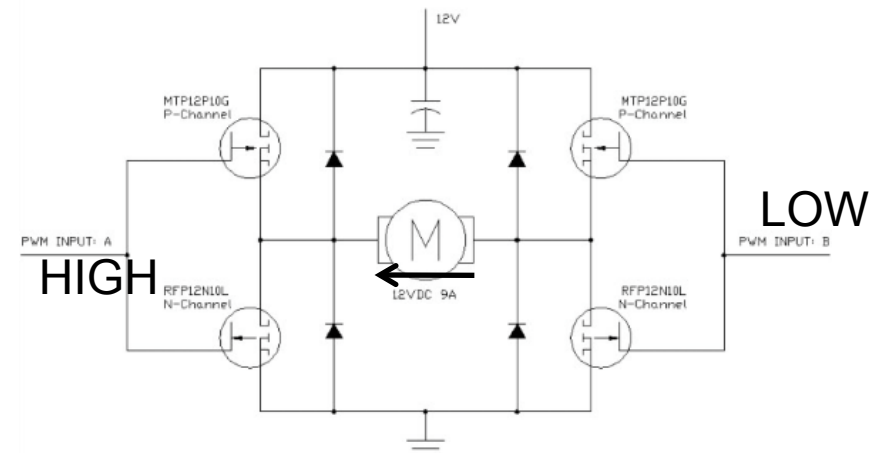
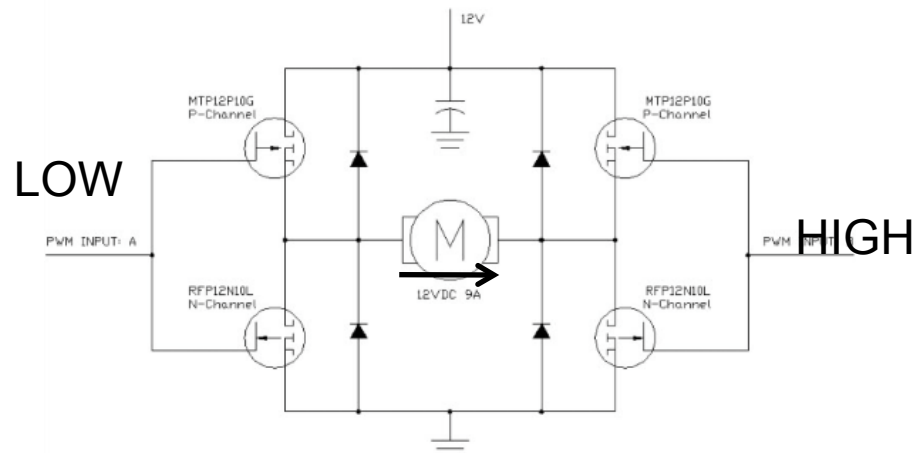


MOSFET P-Channel



MOSFET

N-Channel - P-Channel



DC MOTOR

- Amount Current (PWM) -> Spindle
- Direction of the current -> Rotation
Orientation

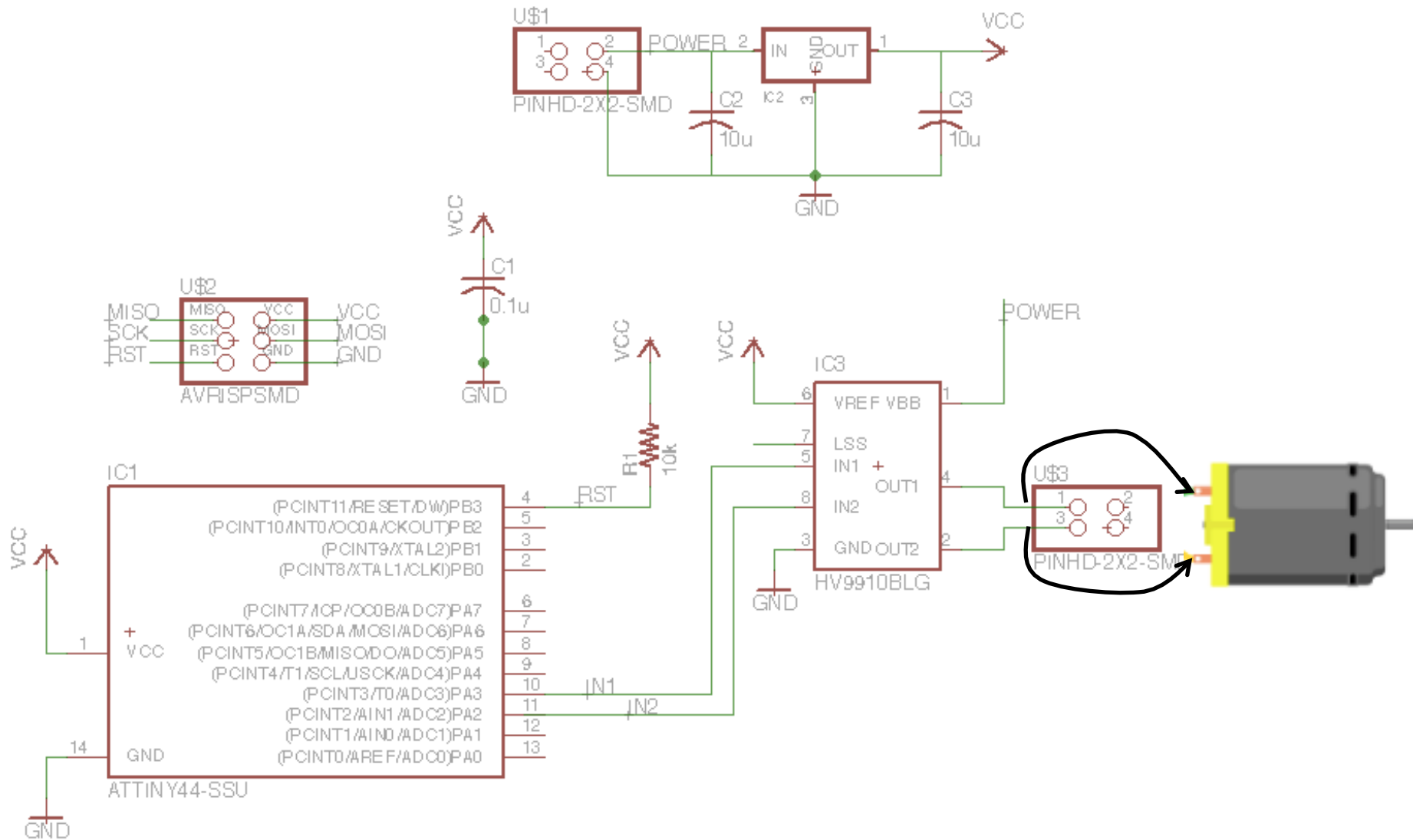
Notes:

- Fast Spinning
- To Slow -> torque gear

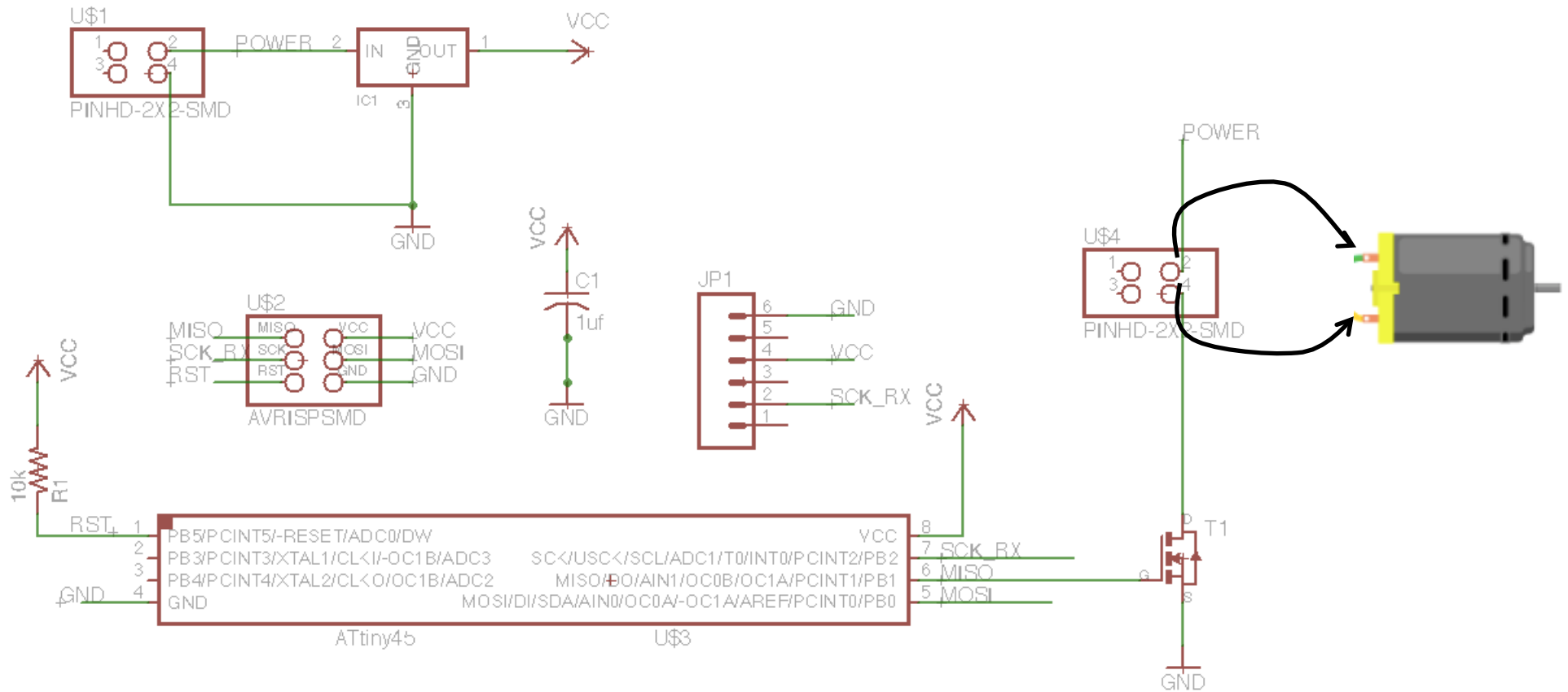
Disadvantage:

No Control Over Position

DC MOTOR - HBridge



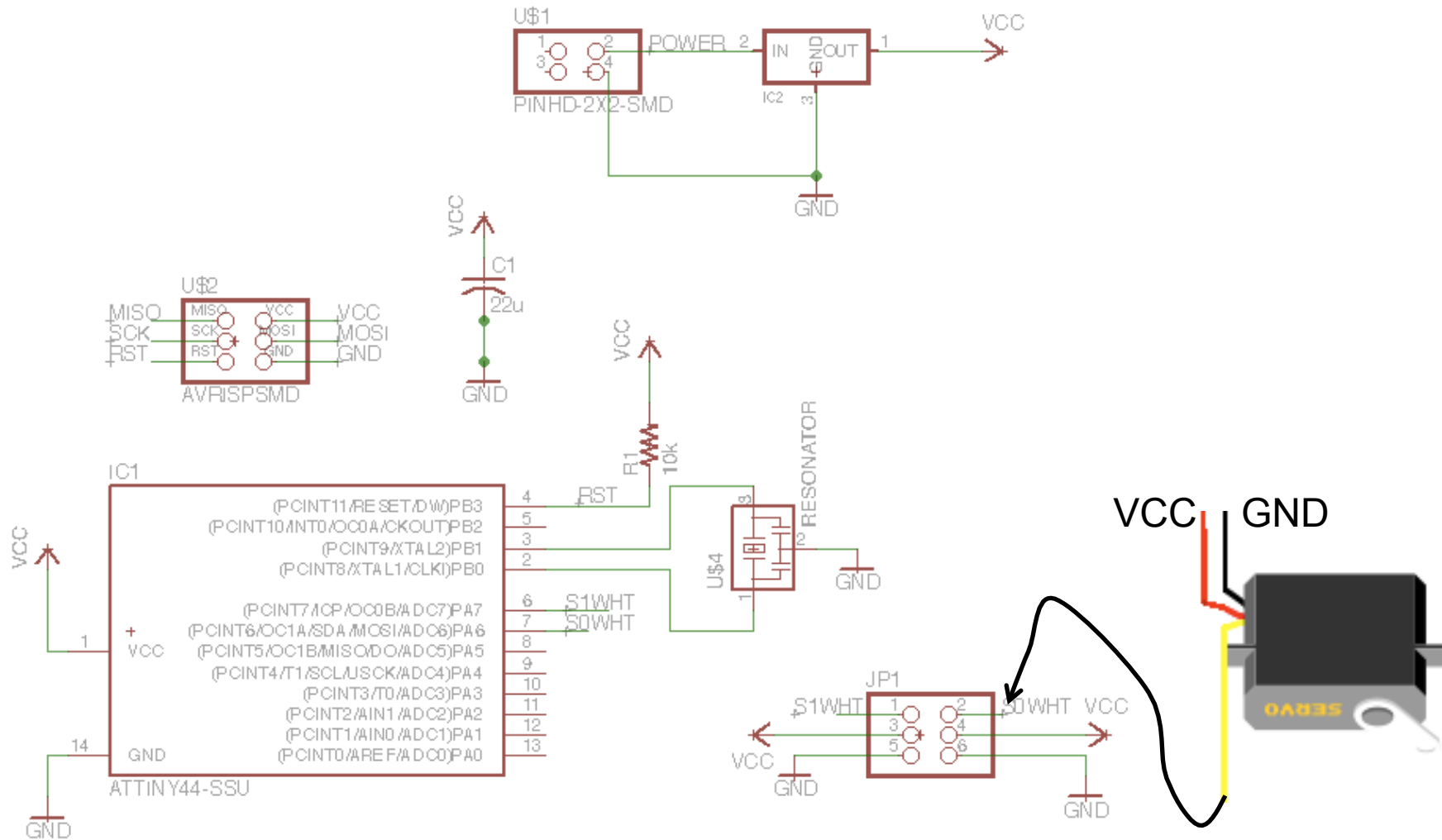
DC MOTOR – Single MOS



SERVO

- It's a DC Motor with control over position with feedback.
- It can't work continuously -> it work in a range of rotation
- It needs regulated Voltage

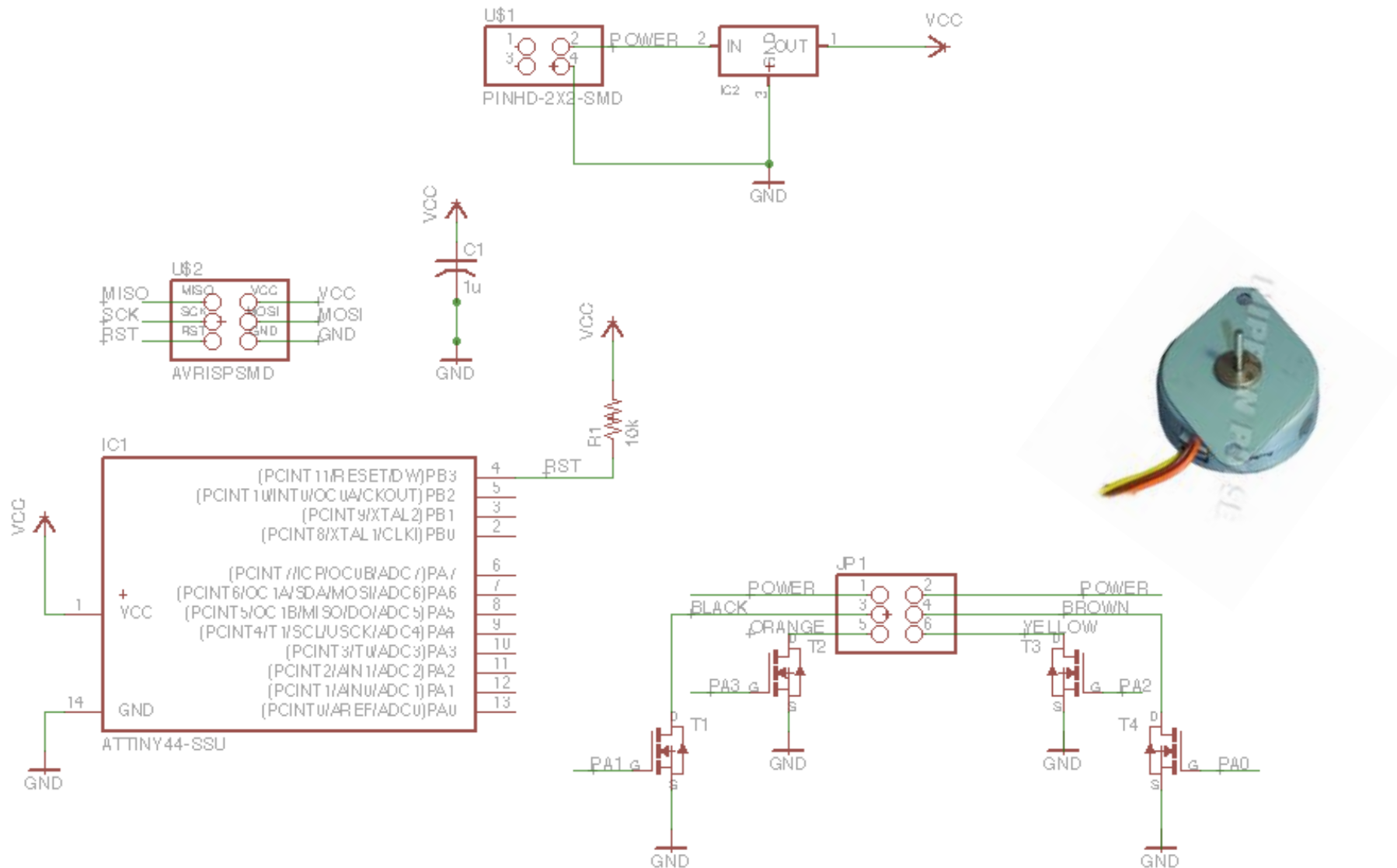
SERVO



Stepper Motor

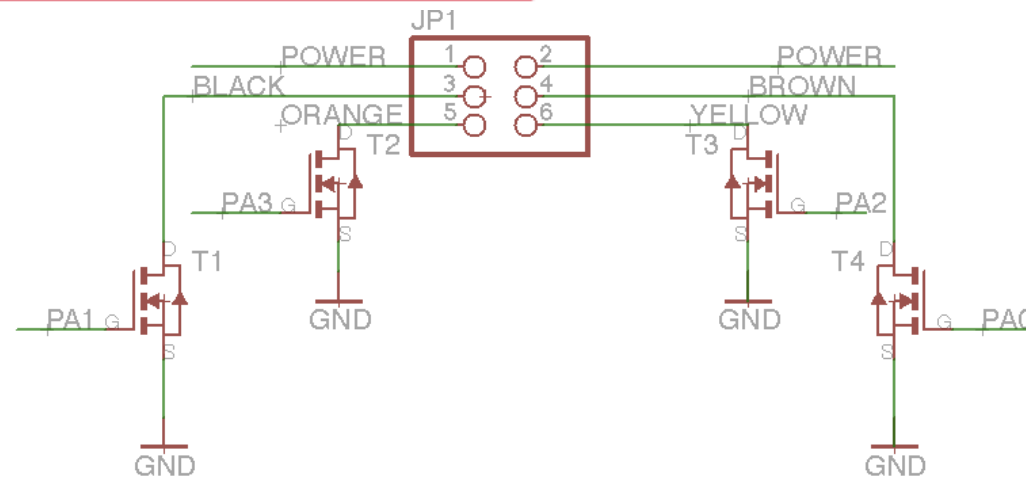
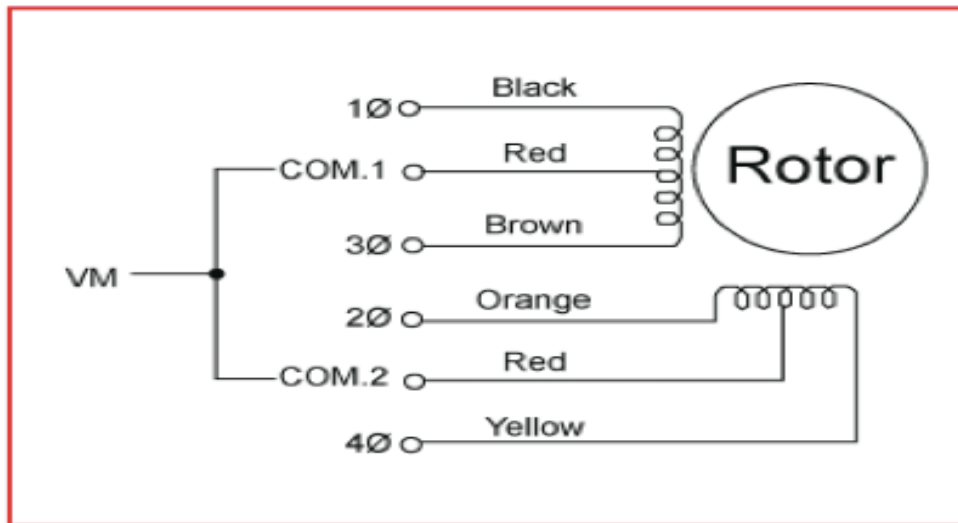
- servo motor that uses a different method of motorisation
- Control over position

Stepper motor Unipolar



Stepper motor Unipolar

Unipolar Wiring Diagram



- http://academy.cba.mit.edu/content/tutorials/akf/output_device_examples.html
- <http://arduino.cc/en/Tutorial/StepperUnipolar>
- <http://www.instructables.com/id/Attiny85-as-a-StepDir-Stepper-Motor-Controller/?ALLSTEPS>
- <http://fabacademy.org/archives/2014/students/prete.davide/12.htm>
- http://fabacademy.org/archives/2014/students/zona.kelly/electronics_design.html

- Supply orientation!!!
- Capacitor Values

- Missing in this presentation:
 - LCD
 - Bipolar Stepper Motor