Lecture 5
Parts/design Choices
(Part 1)

IR Sensor

- Consists of IR LED(transmitter/emitter) and IR receiver(transistor type most likely)
- Wavelengths much match between emitter and receiver
- Pulsing high current to raise Signal/Noise ratio
- Use voltage divider for receiver converting current signal to voltage signal

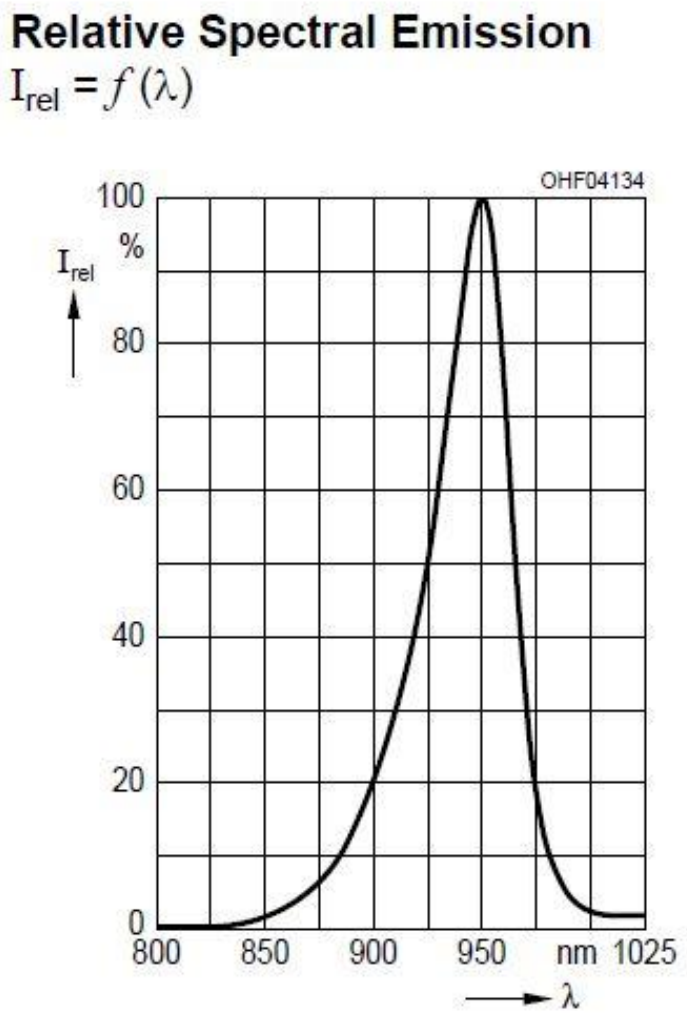
Specs for IR Emitter

- Specs need to know when choosing an IR Emitter:

1. Wavelength
2. Voltage drop
3. DC Forward current
4. Pulsing current/timing
5. Viewing angle(full angle)
6. Radiant Intensity

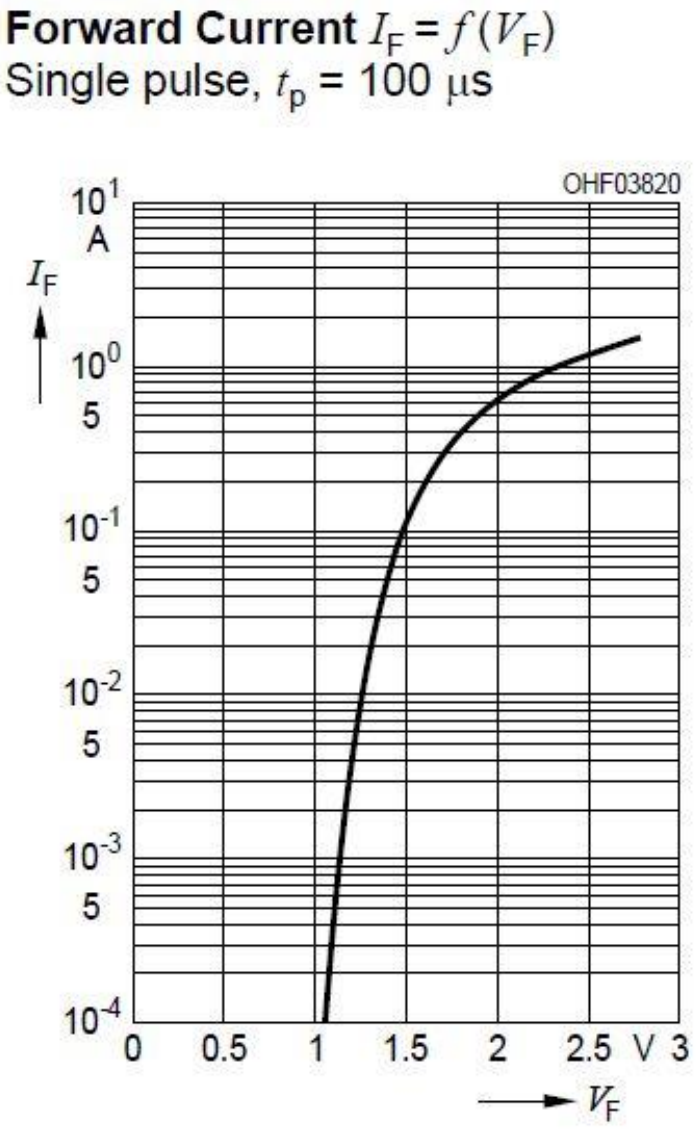
Wavelength

- 950nm and 850nm are the 2 most popular choices for IR emitter
- You need to find IR receive that matches the wavelength of emitter in order to max power efficiency



Voltage Drop

- IR Emitter is essentially an LED that emits infrared
- And LED is essentially an diode, and diode drops voltage
- Voltage drop varies depends of the expected current
- Examples:
  - SFH4550 drops 1.5V @100mah
  - SFH4545 drops 1.5V @100mah
  - SFH4511 drops 1.3V @ 100mah(discontinued)

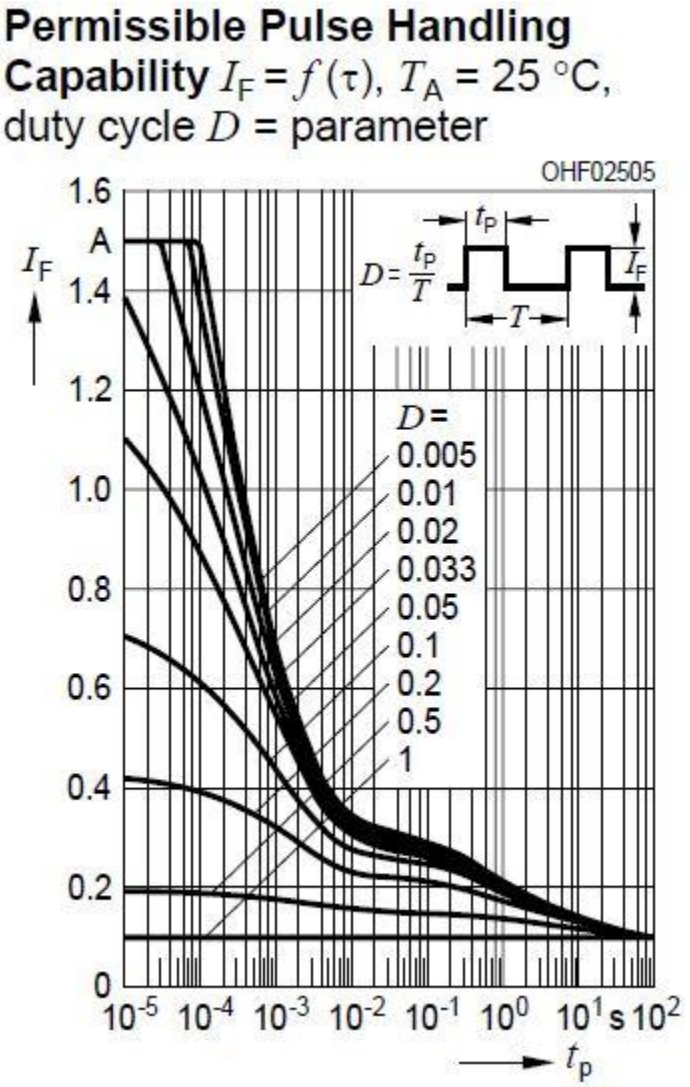


DC Forward Current

- Means the max constant current that the IR emitter can safely handle(max limit)
- Usually 100mah for typical 5mm diameter IR LED, 50mah for 3mm diameter IR LED. Some metal shield package version has even higher DC forward current
- DC forward current somehow indicates the capability of IR Emitter when pulsing at high current

Pulsing Current

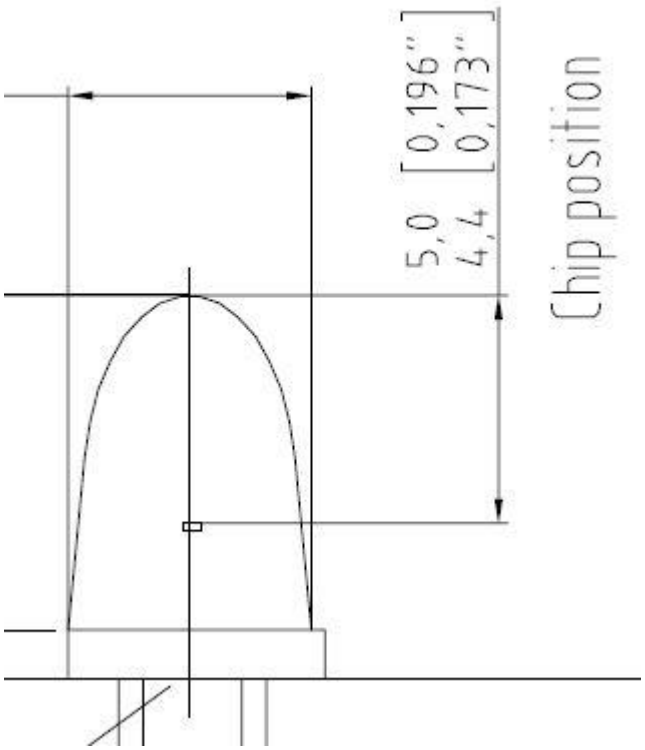
- LED allows pulsing current higher than DC forward current during a short time period
- Max Capability are different at different turn on time
- Exceeding max cap will damage the IR LED
- Should always check table to ensure your time/current choice for your design

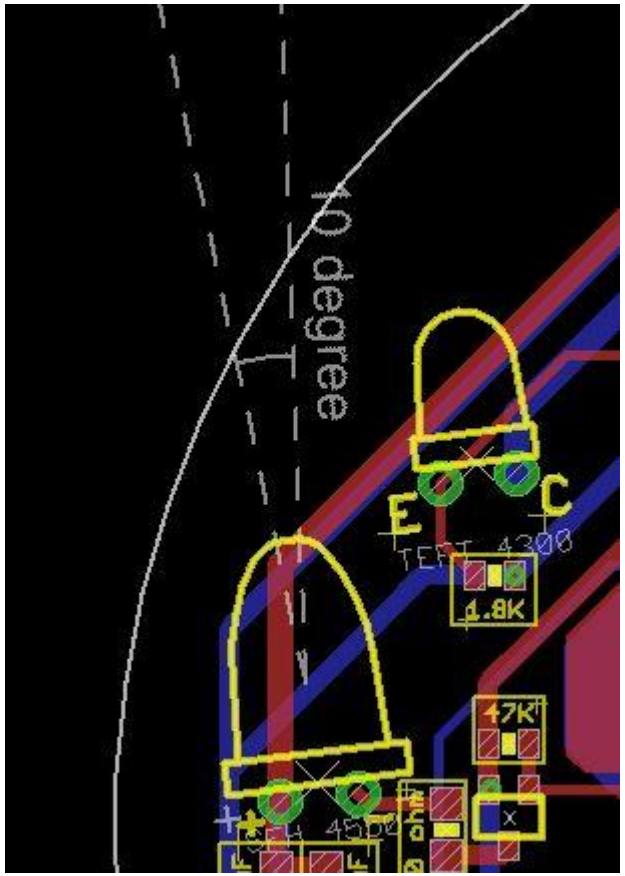


Viewing angle

- Smaller angle is preferred for higher power intensity and more accurate distance detect, usually under 10 degree

Chip position indicates where the IR light starts to emit





Radiant Intensity

- Indicates the power intensity per unit area
- Varies between different models
- The higher the better
- 850nm type has higher Intensity than 950nm in general
- Example:

  - SFH4550(850nm)6^{degree} 630mW/sr @ 100mA
  - SFH4545(950nm)10^{degree} 550mW/sr @ 100mA
  - SFH4511(940nm)8^{degree} 63mW/sr @ 100mA(discontinued)

Some other important facts

- Package:

  - T 1 ¾ is about 5mm diameter package

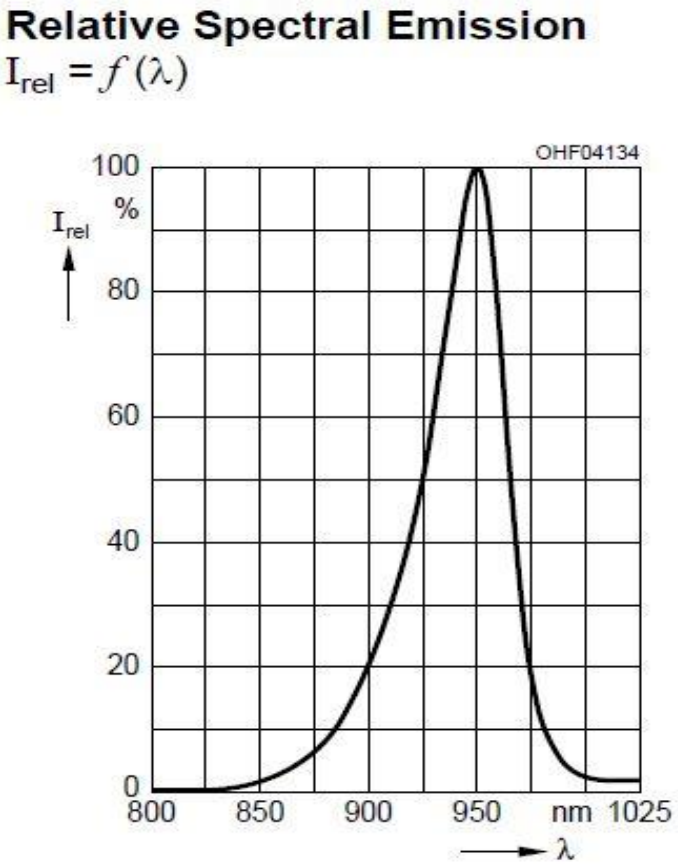
  - T1 is about 3mm diameter package
- Through hole preferred for the availability and efforts on mounting it on the mouse
- Choices are pretty obvious when you use the filter on vendor's site(ie. Mouser,digikey, etc) when you apply the preferred specs

IR Receiver

- Viewing angles are always wider than emitter
- Angles are between 30-60 degree
- Receiver has sensitive wavelength range, as long as it covers the wavelength for IR emitter
- The resistance of the resistor that serial with is based on your own test and preference. Resistance value will affect the max reading value and receiver charge/discharge time
- Faster charging time saves pulsing time but could be too sensitive, slower charging time takes more time but less sensitive(less sensitive for ambient noise)

Matching wavelength

Emitter(SFH4545)



Receiver(TEFT4300)

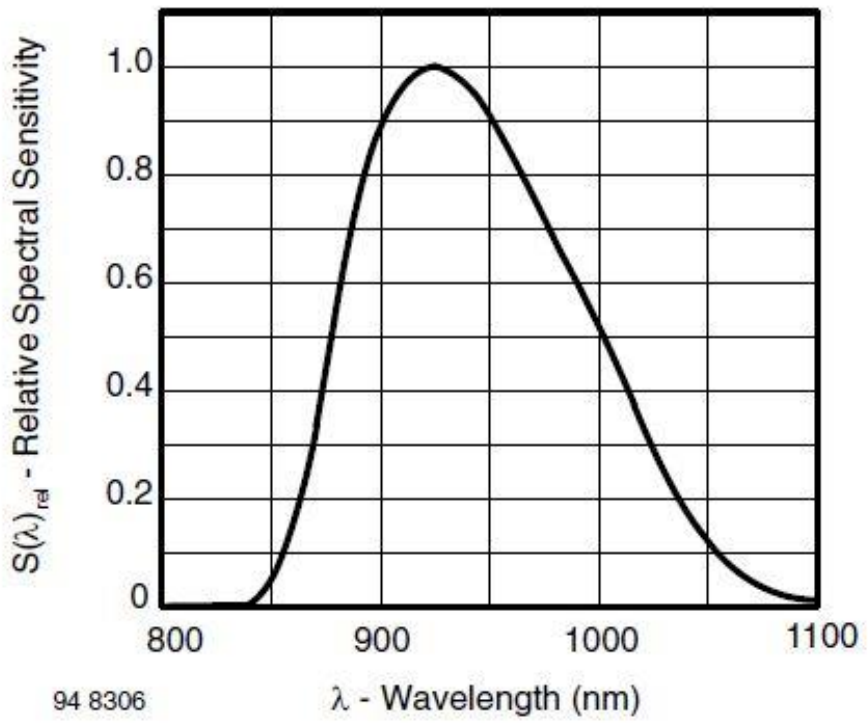
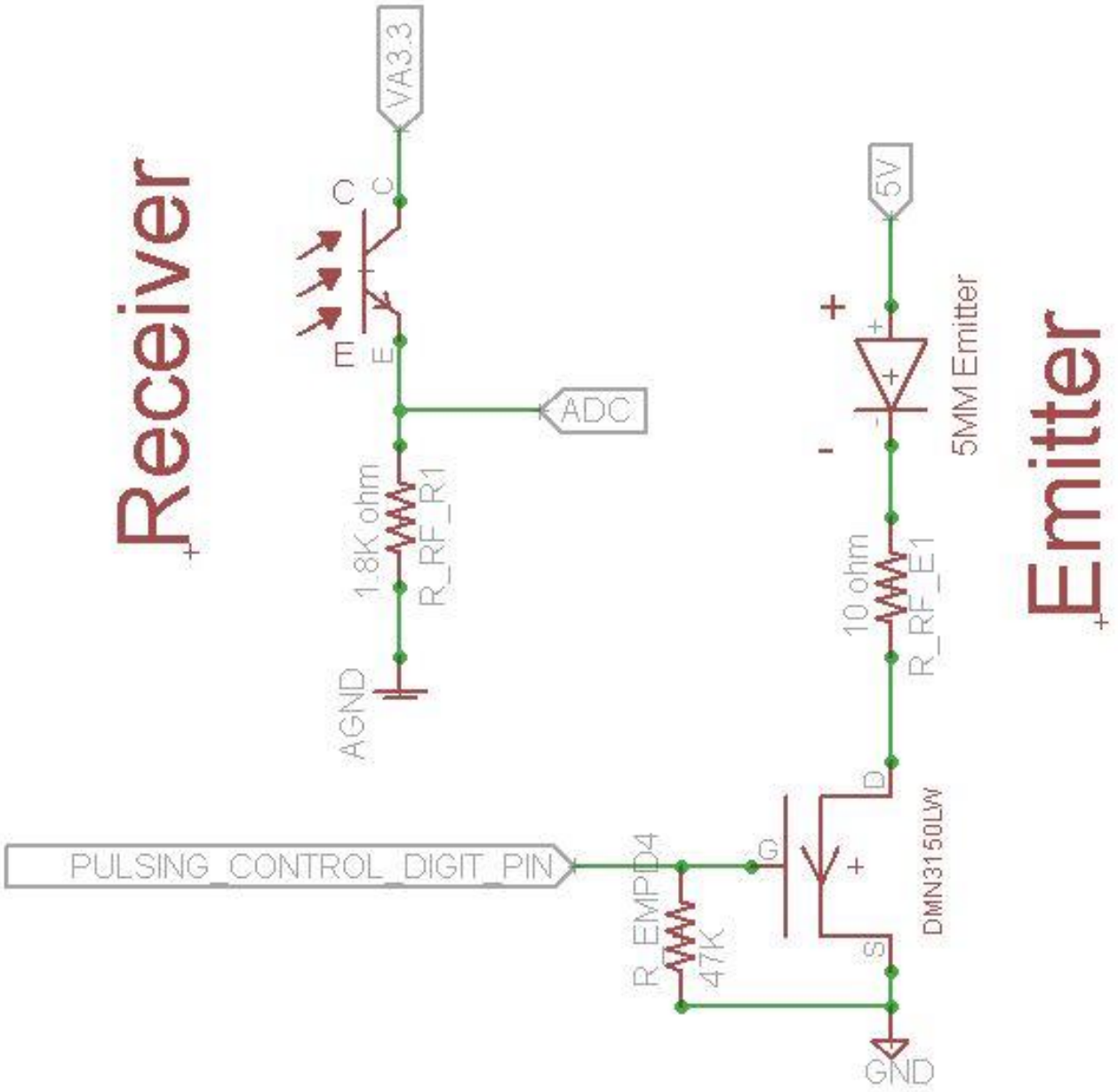


Fig. 7 - Relative Spectral Sensitivity vs. Wavelength

Circuit example



Power Supply

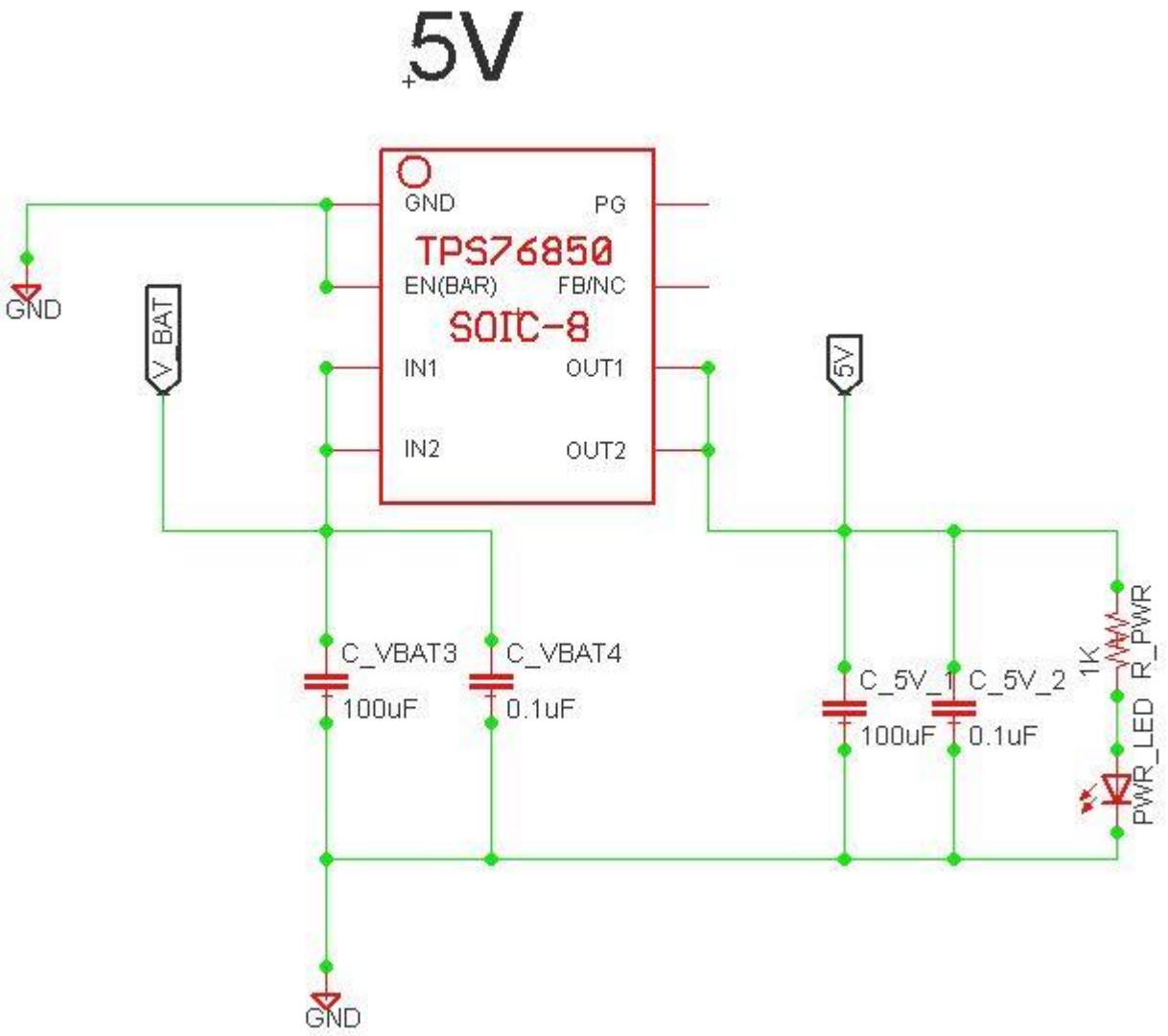
- Use 2 lipo Batteries serial at 7.4V at V_bat
- Use 2mm pitch JST male plug mount on PCB
- 2.54mm or 2mm pitch slide switches are usually used, pay attention with power rating
- Large value tantalum capacitors are used to stabilized the power supply, pay attention of the max voltage and ESR(equivalent serial resistance) of tantalum capacitor

Power Supply(cont.)

- 3 different voltage usage in system
  - v_bat for motor driver and voltage meter
  - 5V for IR emitter and encoder power supply
  - 3.3V for rest of the sytem
- Current consumption level
  - Motor(V_bat)>5V(emitter)>3.3V
- Choice on Futura Kit Mouse
  - 5V LVO regulator with 1A max output
  - 3.3V LVO regulator with 400mah max output
- Sufficient current with the regulator chosen above
- The voltage drop for LVO regulator is as low as possible(especially for 5V regulator)

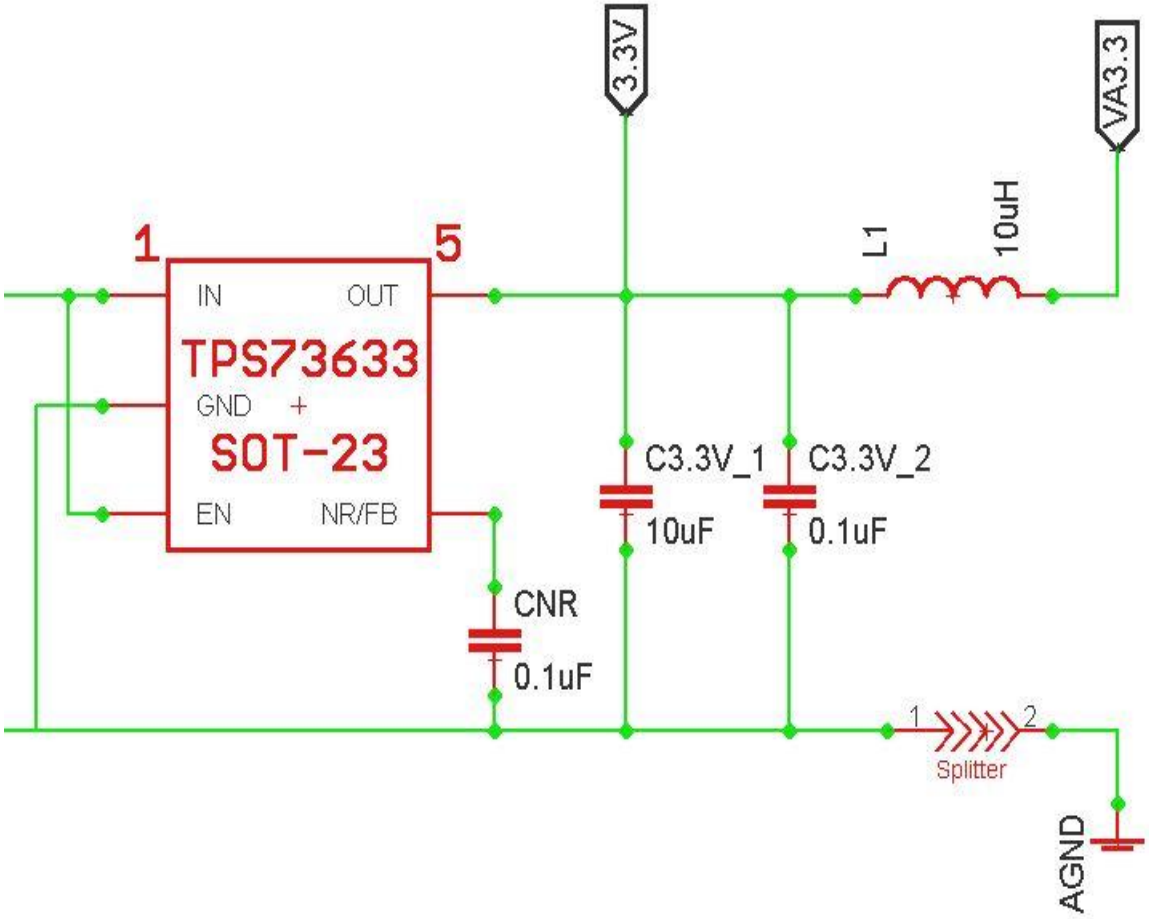
Power Supply(digital)

- Add by pass cap before and after to stabilize supply
- Add low pass cap before and after to filter out high freq. noise



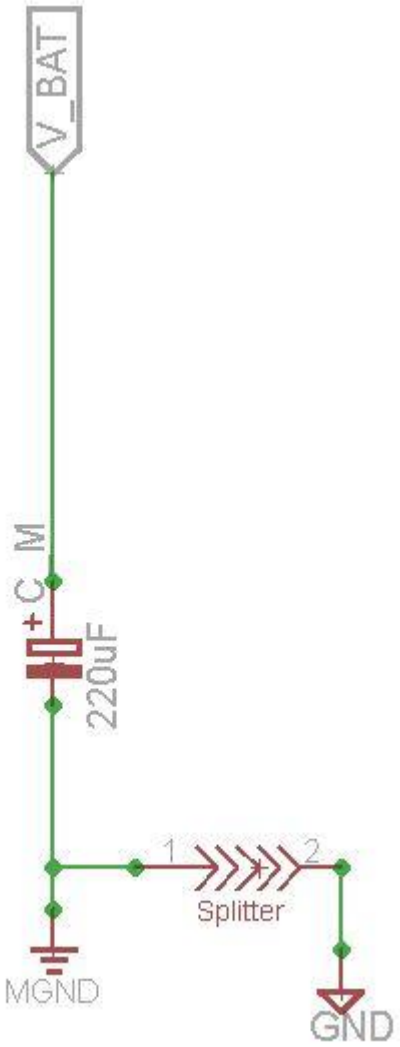
Power Supply(analog)

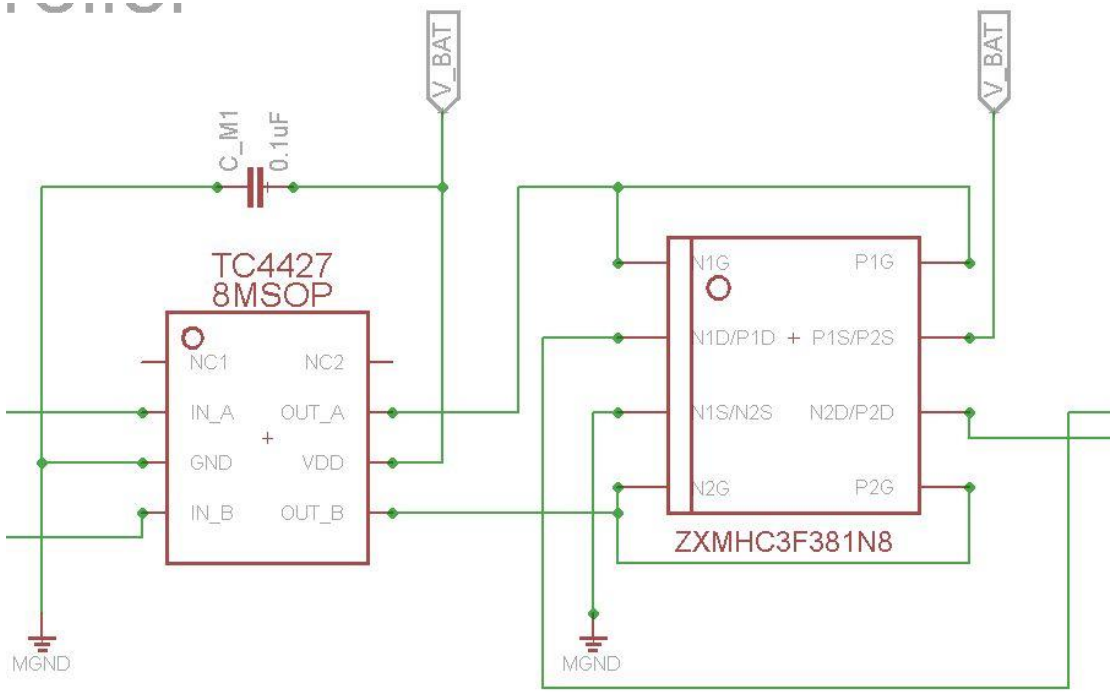
- Separate ground is preferred to reduce the noise to analog device
- Usually serial a inductor between supply and analog supply to stabilized the analog power supply



Power Supply(motor)

- Tantalum cap to supply motor power(place very close to motor driver)
- Low pass filtering cap very close to motor driver
- Separate ground for motor





RCL selection

- Smaller package leaves you more space on mouse, harder to solder, and higher ESR
- Package on Futura Kit Mouse:

  - 0603 resistor for IR Emitter(250mw rating, because of high current)

  - 0402 resistor for rest of the system

  - 1220(in) tantalum cap for 100uF 2917(in) tantalum cap for 220uF(motor supply)
- 0603 caps for rest of the system
- 1007 10uF Inductor
- RCL availability in lab

  - 0402 resistor stocked for all value you need for micromouse

  - 0603 capacitor stocked for all value you need for micromouse

Pay attention of the max voltage of the cap and power rating for resistor