Design Considerations

Last updated 12/3/2019

Design Considerations

- Top Level View
  - Mechanical
    - Structural
    - Components
  - Electrical
    - Power
    - Control
    - Sensors

Design Considerations

- Mechanical
  - Structure - Materials
    - Perforated sheet
      - Heavy Duty
      - Hard to work with
      - Predrilled holes
    - Aluminum sheet
      - Light weight
      - Easy to bend / fold
      - No holes
    - Other
      - Requires instructor OK

Both are conducting

Design Considerations

- Mechanical
  - Structure - Access
    - Change Batteries
    - On/off switches
    - Attach / move wires
    - Chip / component access
  - Structure – Physics
    - Point of contact
    - Center of gravity
    - Offensive structure(s)
    - Defensive structure(s)

Design Considerations

- Mechanical
  - Components
    - Motor / Wheel assemblies
    - MSP board
    - Proto board
    - Battery Pack
    - Switches
    - Sensors

Design Considerations

- Mechanical
  - Special Considerations
    - Your bot is going to vibrate a lot
      - Many a bot has rattled itself to pieces

    DOUBLE NUT WHENEVER POSSIBLE

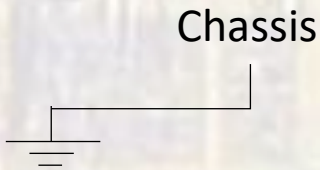
  - Prototype Development
    - Draw your design out in detail
    - Use heavy paper, file cards or card stock to mockup your design

Design Considerations

- Electrical
  - Power
    - 5 cell power source
    - Maximize voltage for motor
    - MSP432 supply voltage – 5v, 3.3v
    - Need to turn on/off the whole system
    - Need to turn on/off the motor subsystem
      - Required to prevent motors from running while powering the microcontroller

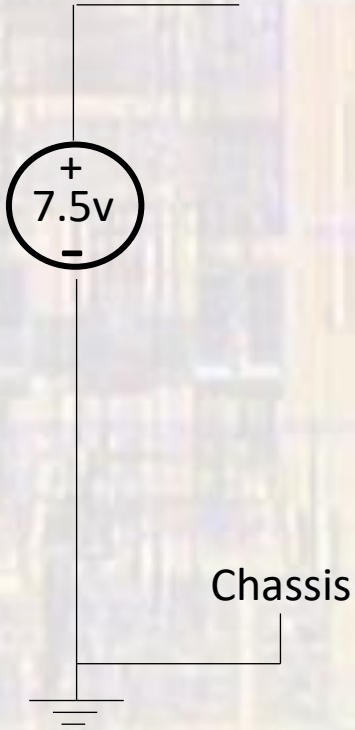
Design Considerations

- Electrical
  - Power
    - Mobile system
    - We decide what is the gnd reference
    - Chassis



Design Considerations

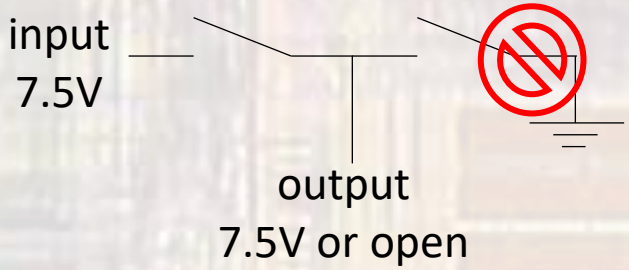
- Electrical
  - Power
    - 5 cell battery pack
      - 1.5V / cell nominal battery voltage → 7.5V
    - 7.5V DC supply from wall wart



Design Considerations

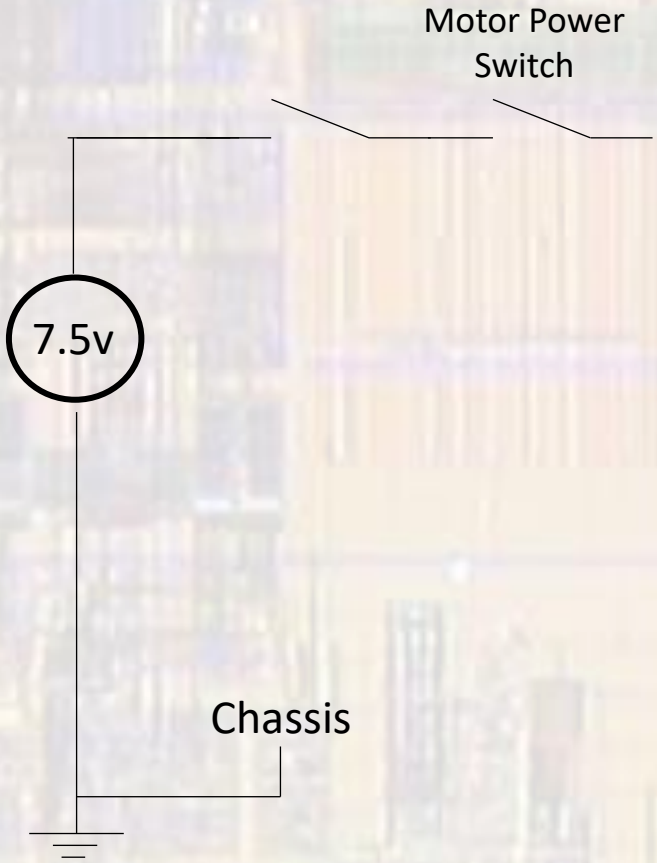
- Electrical
  - Power
    - Main Power Switch

Implementation

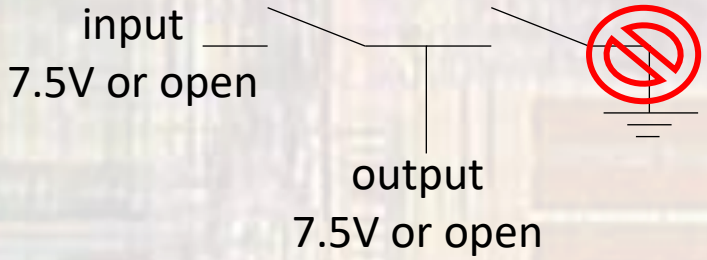


Power Subsystem

- Electrical
  - Power
    - Motor Power Switch

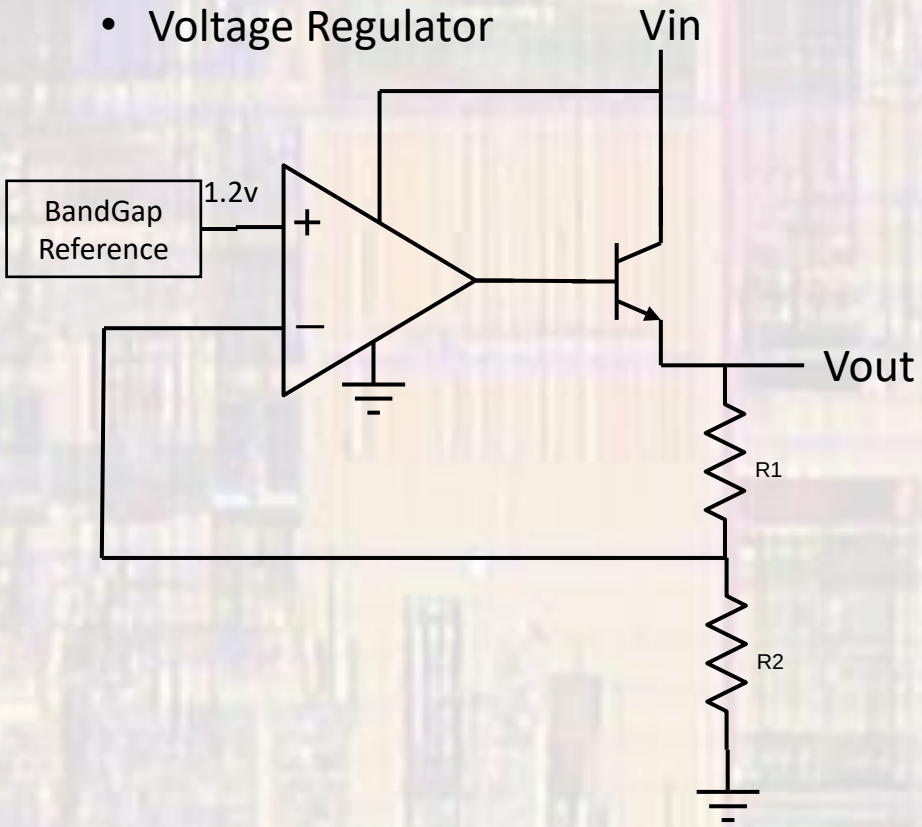


Implementation



Design Considerations

- Electrical
  - Power
    - How do we create the 5V supply for the MSP432?
      - Voltage Regulator



$$\frac{R2}{R1+R2}Vout = Vbg$$

$$Vout = Vbg\frac{R1+R2}{R2}$$

Design Considerations

- Electrical
  - Power
    - 5V Regulator

Table 1. Absolute maximum ratings

Symbol	Parameter		Value	Unit
V_{IN} (1)	DC input voltage		15	V
P_{TOT}	Power dissipation		12	W
T_{STG}	Storage temperature range		-40 to +150	°C
T_{OP}	Operating junction temperature range	for C version	-40 to +125	°C
		for standard version	0 to +125	°C

Design Considerations

- Electrical
  - Power
    - 5V Regulator

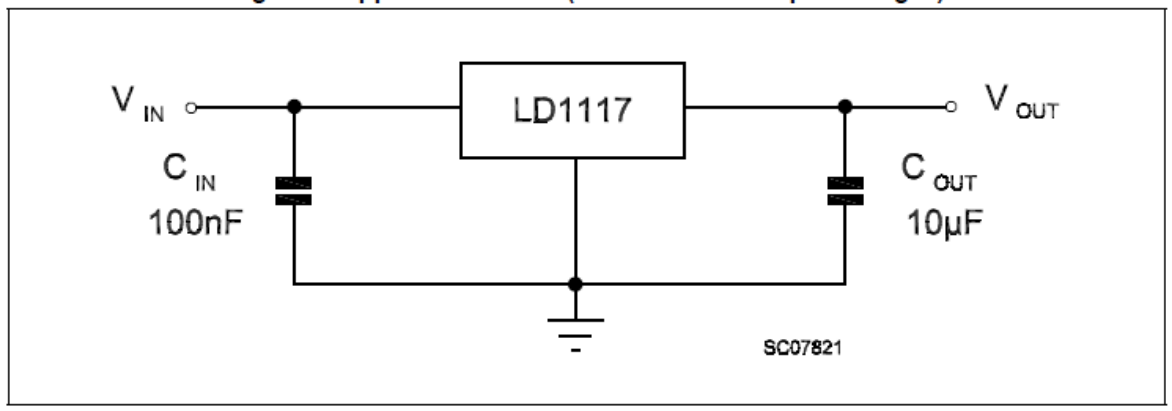
Table 7. Electrical characteristics of LD1117#50

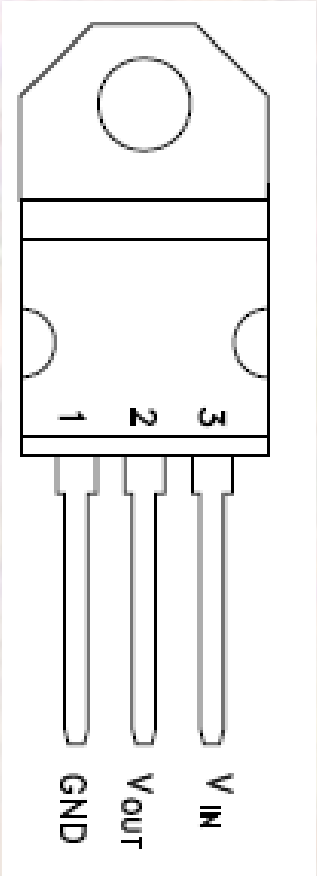
Symbol	Parameter	Test condition	Min.	Typ.	Max.	Unit
V_O	Output voltage	V_{in} = 7 V, I_O = 10 mA, T_J = 25 °C	4.95	5	5.05	V
V_O	Output voltage	I_O = 0 to 800 mA, V_{in} = 6.5 to 15 V	4.9		5.1	V
ΔV_O	Line regulation	V_{in} = 6.5 to 15 V, I_O = 0 mA		1	10	mV
ΔV_O	Load regulation	V_{in} = 6.5 V, I_O = 0 to 800 mA		1	15	mV
ΔV_O	Temperature stability			0.5		%
ΔV_O	Long term stability	1000 hrs, T_J = 125 °C		0.3		%
V_{in}	Operating input voltage	I_O = 100 mA			15	V
I_d	Quiescent current	$V_{in} \leq$ 15 V		5	10	mA
I_O	Output current	V_{in} = 10 V, T_J = 25 °C	800	950	1300	mA
eN	Output noise voltage	B = 10 Hz to 10 kHz, T_J = 25 °C		100		µV
SVR	Supply voltage rejection	I_O = 40 mA, f = 120 Hz, T_J = 25 °C V_{in} = 8 V, V_{ripple} = 1 V_{PP}	60	75		dB
V_d	Dropout voltage	I_O = 100 mA		1	1.1	V
		I_O = 500 mA		1.05	1.15	
		I_O = 800 mA		1.10	1.2	
	Thermal regulation	T_a = 25 °C, 30 ms Pulse		0.01	0.1	%/W

Design Considerations

- Electrical
  - Power
    - 5V Regulator

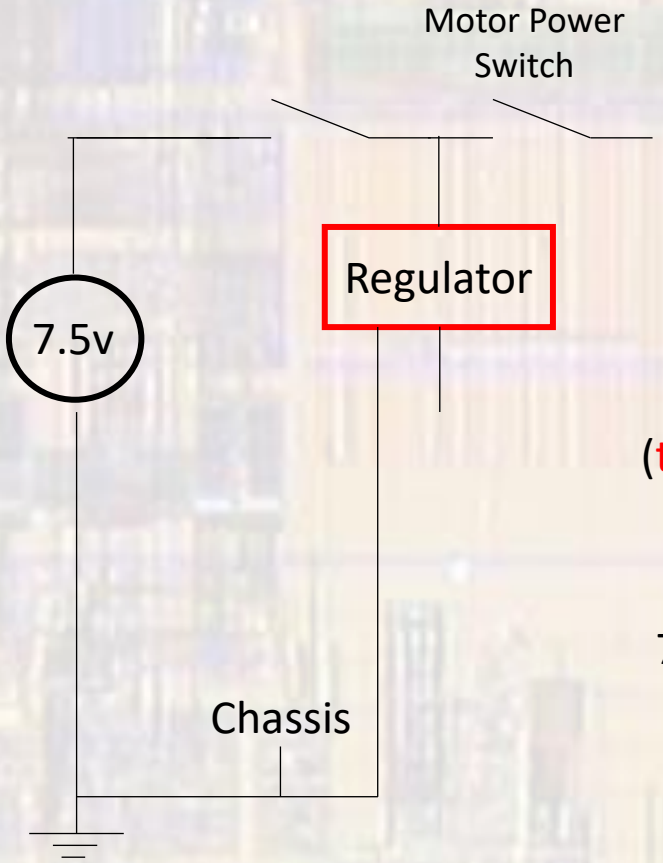
Figure 4. Application circuit (for other fixed output voltages)



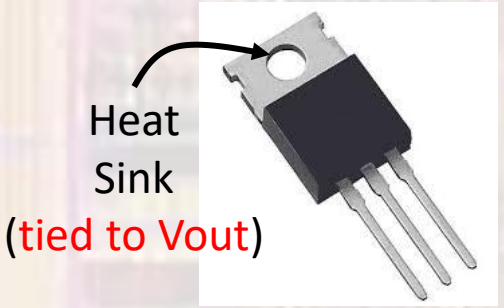


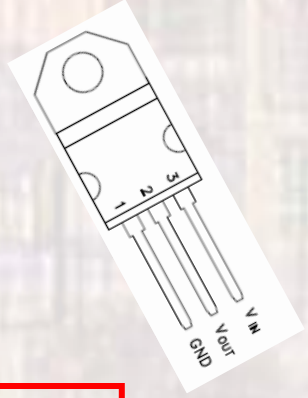
Design Considerations

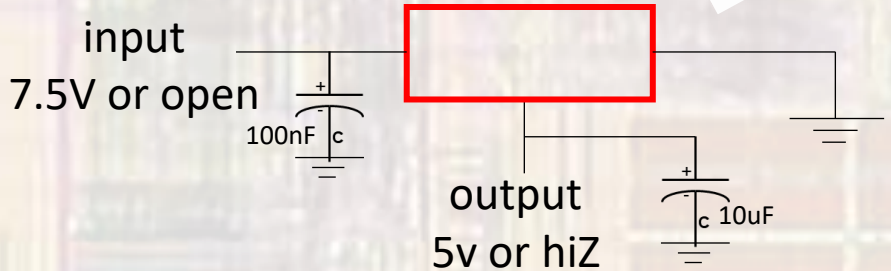
- Electrical
  - Power
    - 5V Regulator



Implementation

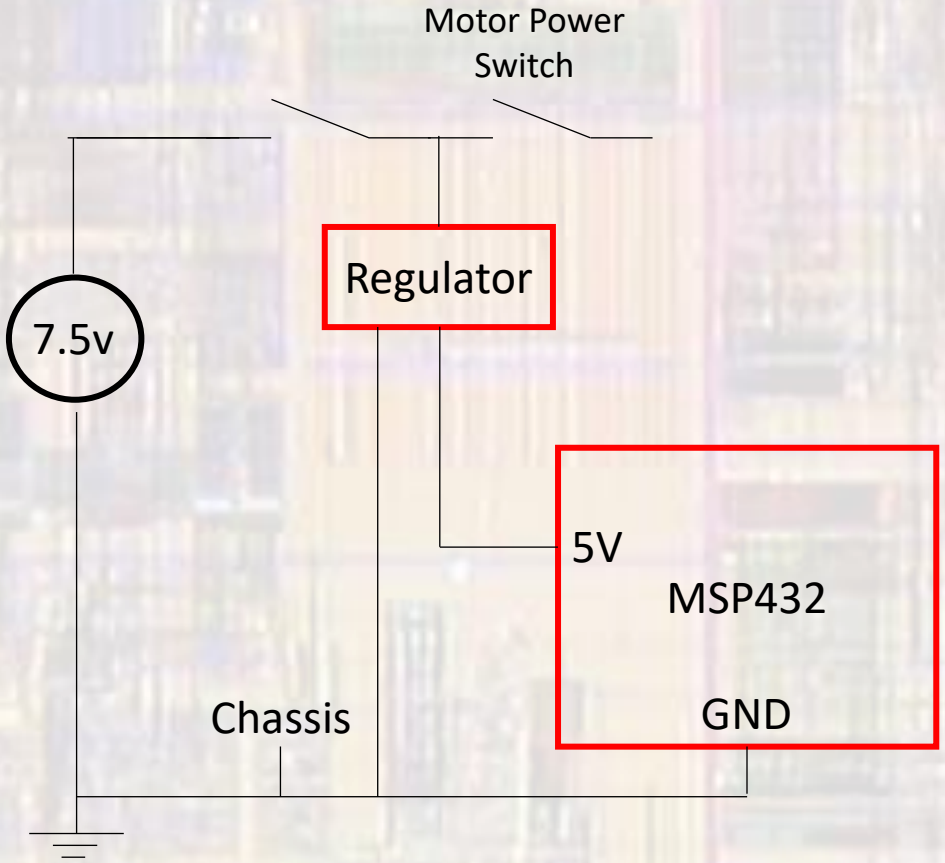






Design Considerations

- Electrical
  - Power
    - MSP432 power



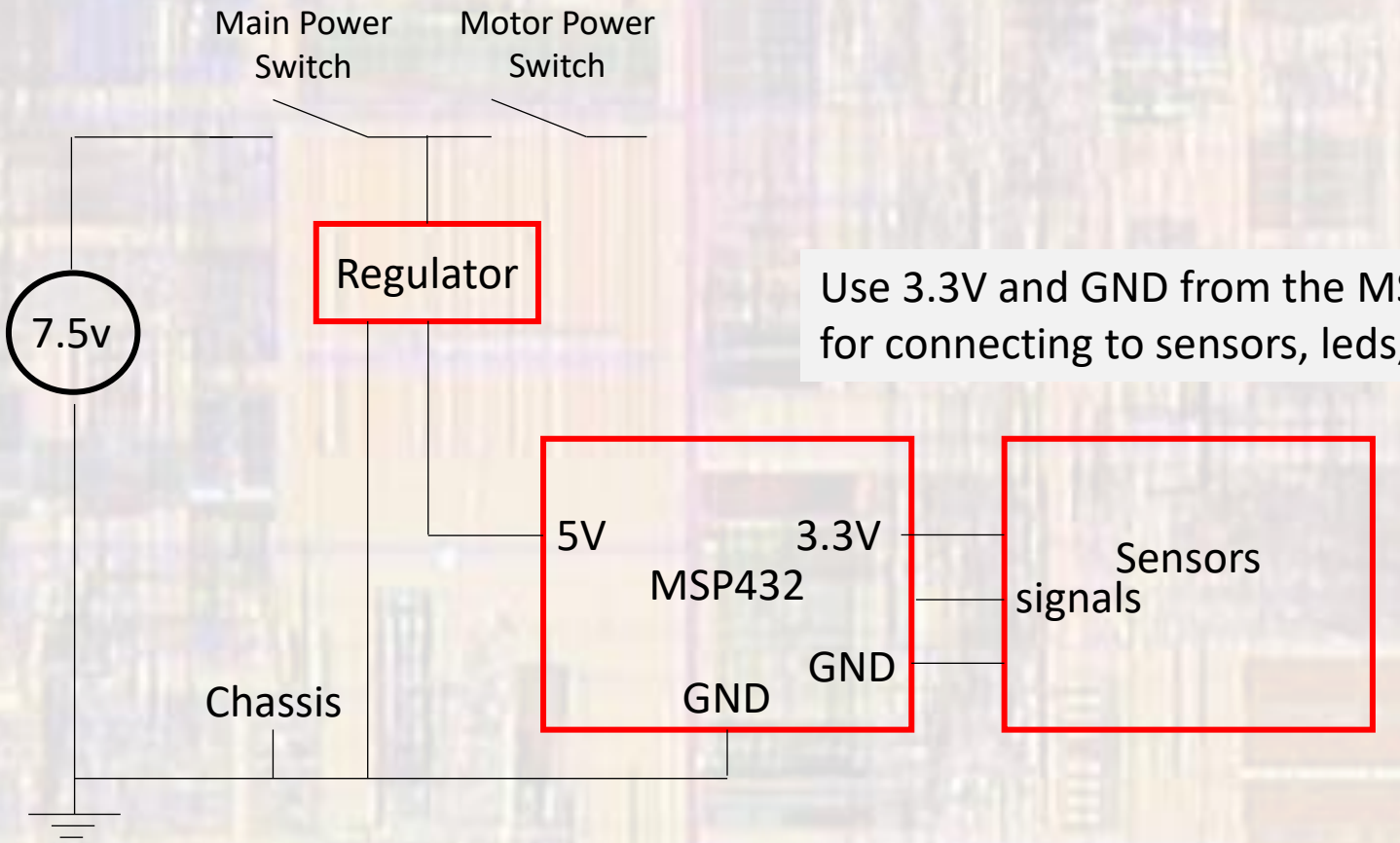
Need to run the robot off of the batteries

AND

Need to program the board when in the robot

Design Considerations

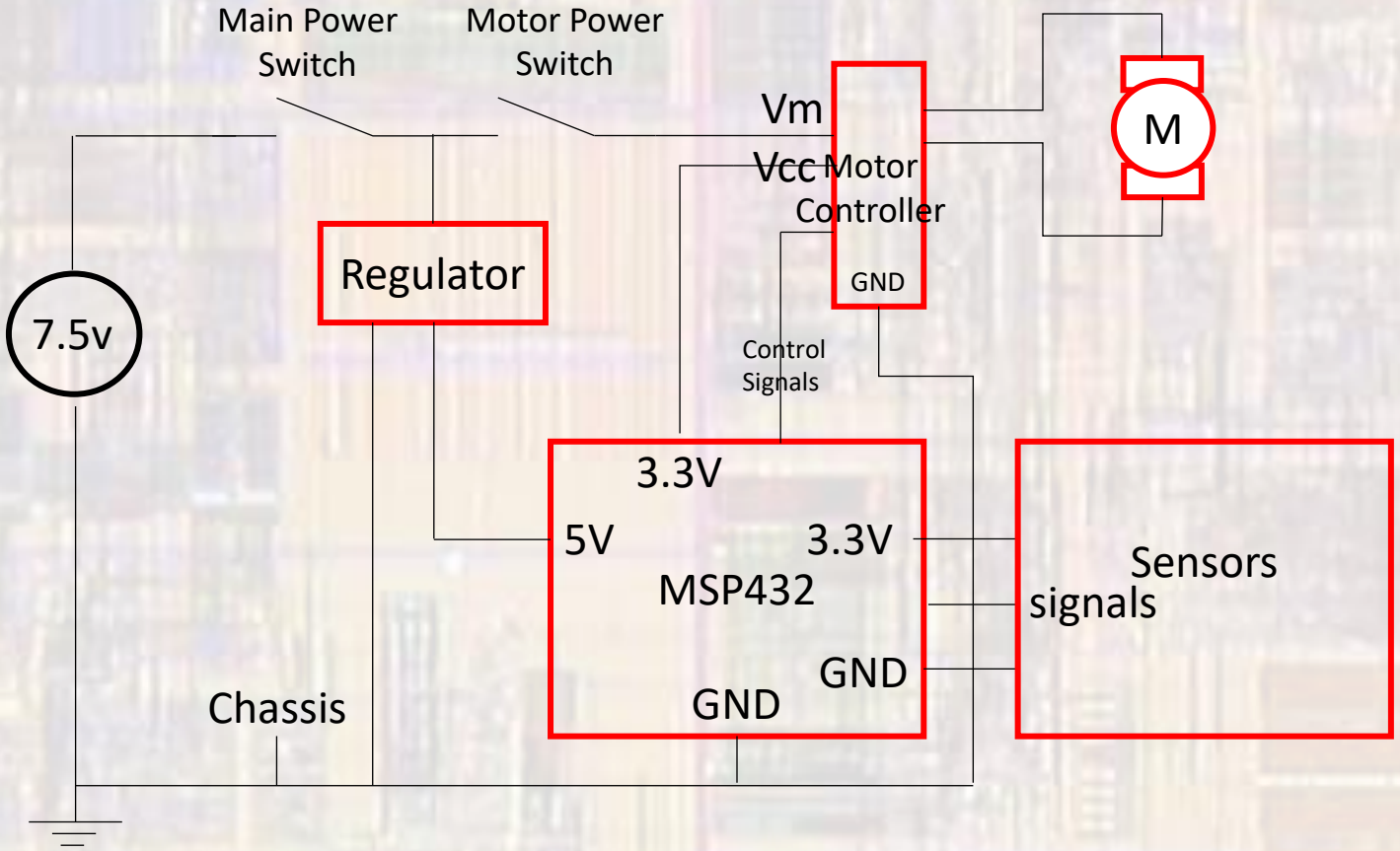
- Electrical
  - Power
    - Sensors



Use 3.3V and GND from the MSP board for connecting to sensors, leds, …

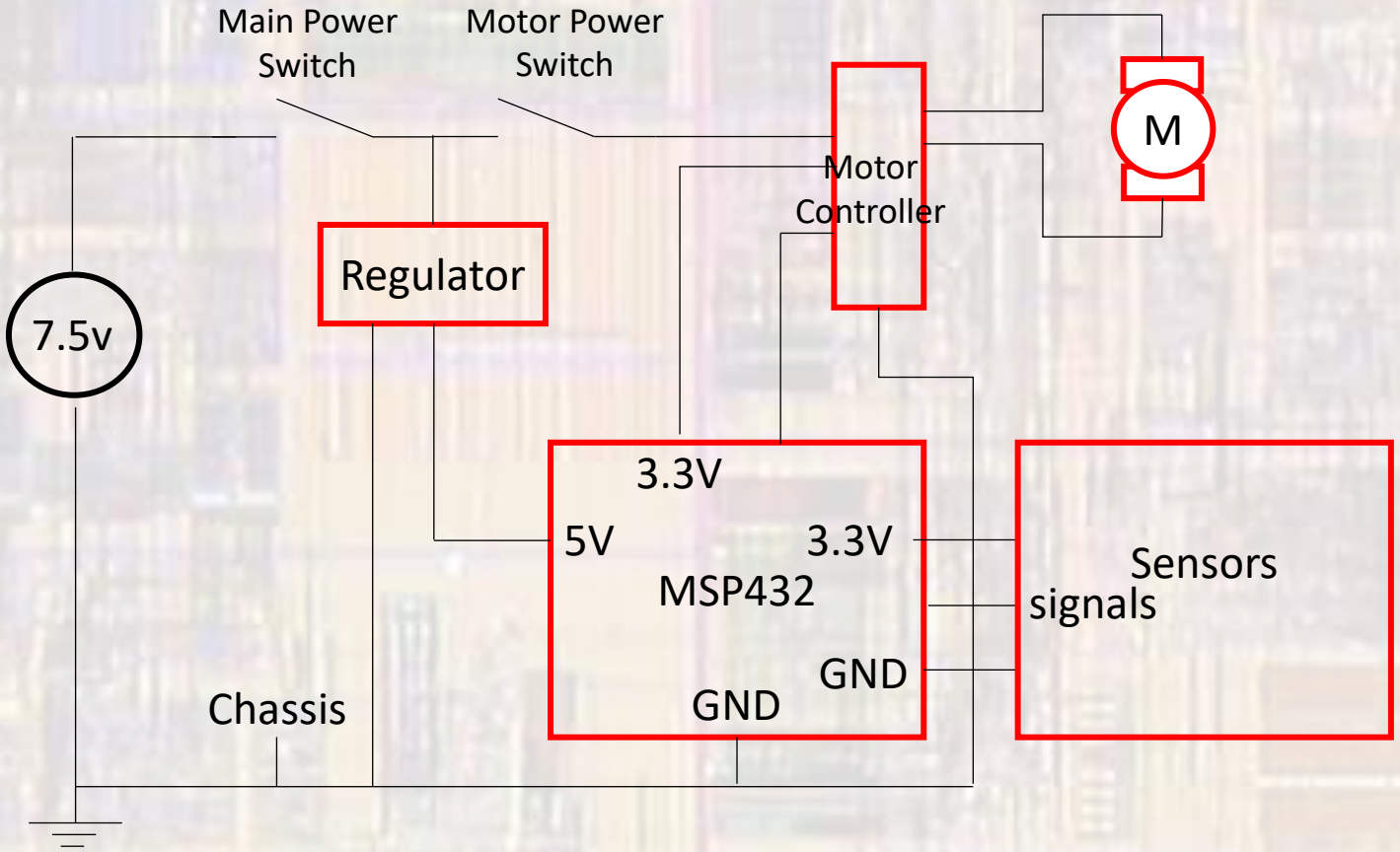
Design Considerations

- Electrical
  - Power
    - Motor Controller



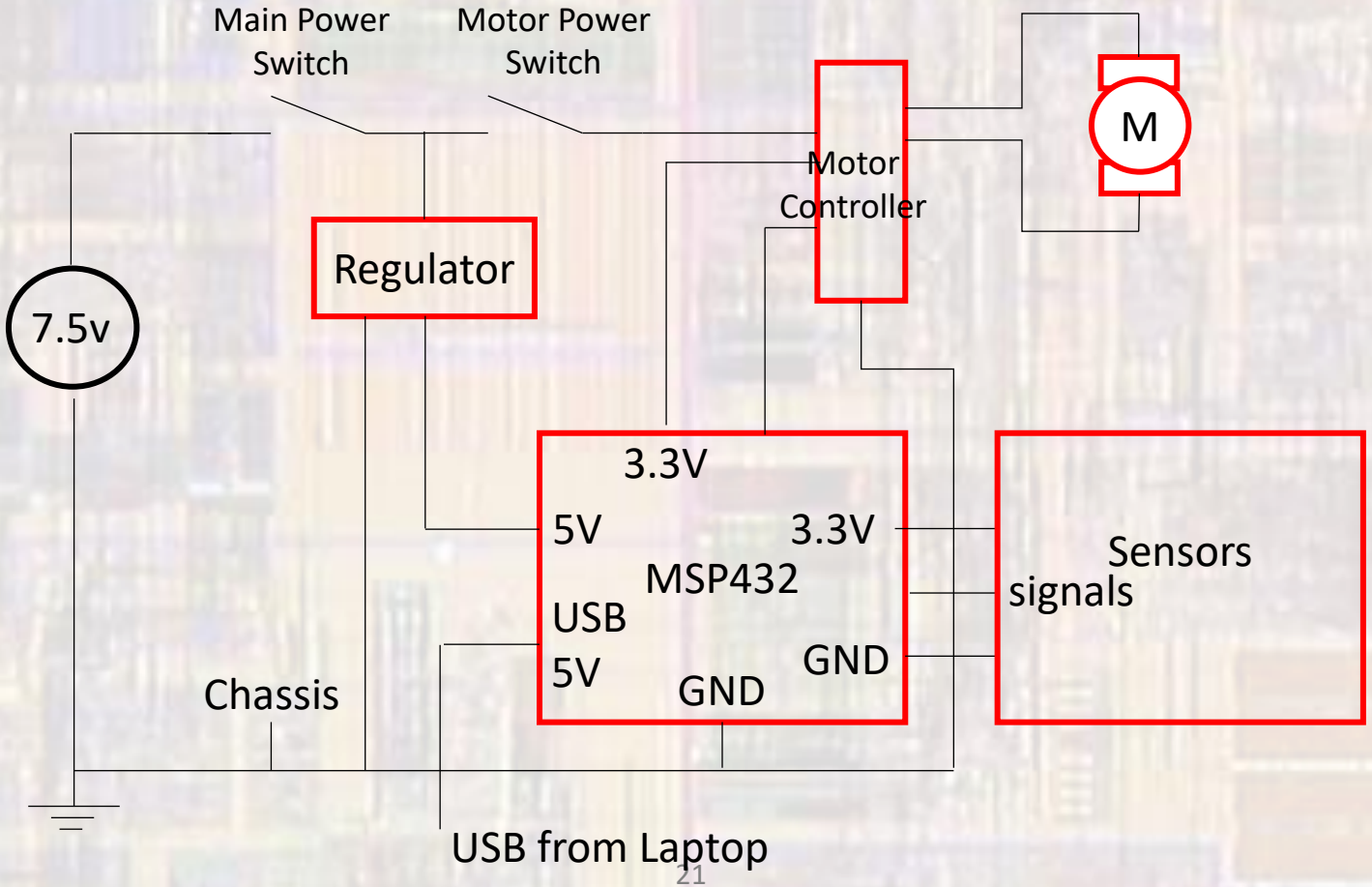
Design Considerations

- Electrical
  - Power



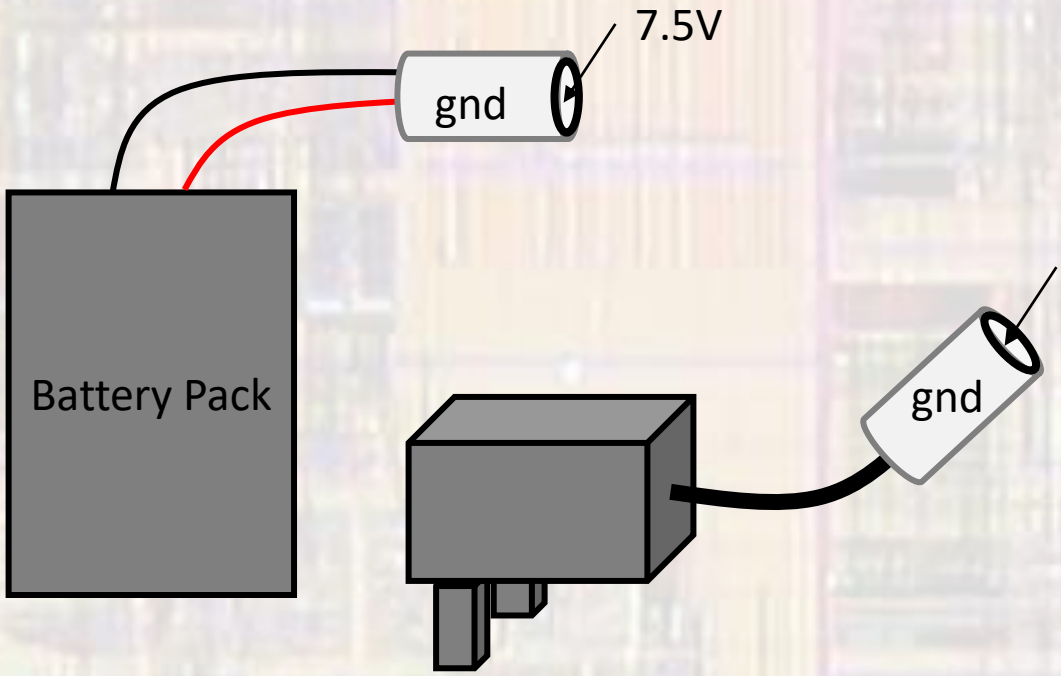
Design Considerations

- Electrical
  - Power
    - USB also supplies power (when programming)

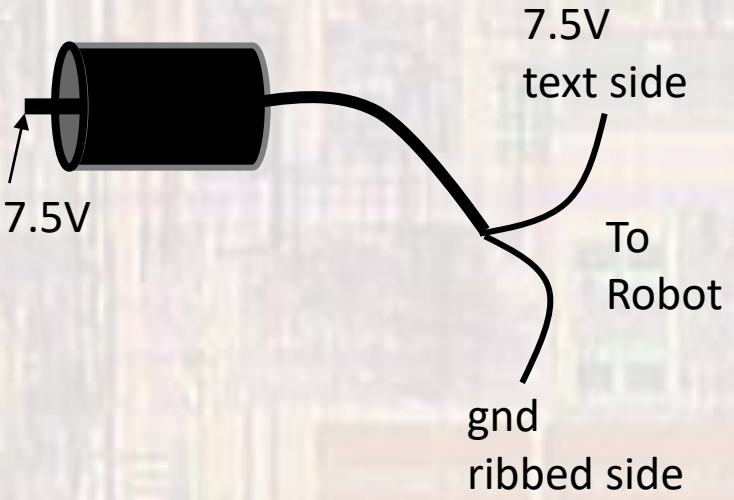


Design Considerations

- Electrical
  - Power
    - Dual supply options
      - Batteries
      - AC-DC converter



Cut the male end off of the extender cord



Design Considerations

- Electrical
  - Power
    - Special concerns
      - Wire sizes for power lines and gnd
      - NO GND LOOPS
    - Chassis ground – nut/bolt