

# Issues with old 218 PDB

designing a new power distribution board for ME218

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- requires a USB battery
- 3x100mA @3.3v is limiting
  - line sensors draw 30mA each
- not enough plugs
  - old PDB has:
    - 2x 14v plugs
    - 12x 3.3v or 5v plugs
    - a majority of teams had to splice branches
- LP2950 hard to solder
  - pins too close together
- old pdb was 2.5x2.5”
  - Question: what's a good size?
    - is a thicker PDB a problem?

looking at schematics and trying to guess how many components use each voltage

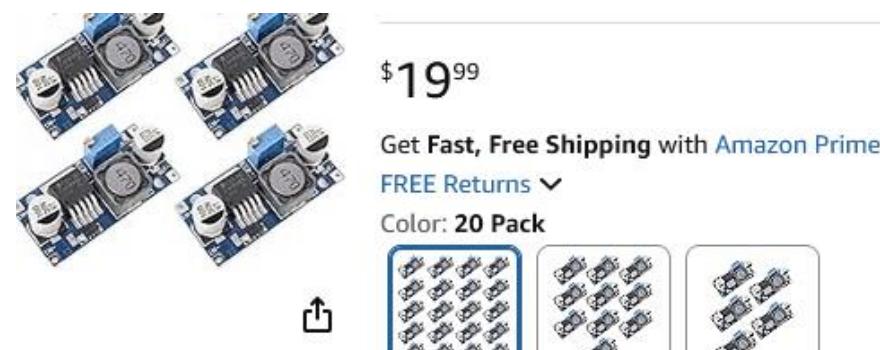
	3.3 volt	5 volt	14 volt	3.3v+5
atom	10	3	2	13
scratpack	11	3	3	14
lawn destroyer	6	4	2	10
nuttinspecial	5	4	4	9
simpbot	6	5	2	11
nimby	8	8	4	16
sealteam6	8	6	3	14
roboscrat	9	10	2	19
wacked	9	3	3	12
24t2	10	5	3	15
babygotbaxter	4	10	2	14
dumbo	7	7	3	14
MI218	8	7	2	15
CAT	10	6	2	16
todd	17	5	3	22
botx	13	7	2	20
ckp	5	4	3	9
creature	10	1	2	11
ledecky	10	2	3	12
karJR	7	4	3	11
blipperblob	10	6	2	16

# Voltage Regulator Research

- DC-DC switching regulator (battery voltage down to 5 volts)



- AKA “HW-411”
- On AliExpress and Amazon they are less than a dollar each
- seems cheaper than its parts, a great deal for a buck converter module
- I used one of these to power servos last year
- 2 amps
- one issue is that the output voltage is adjustable with a knob, so students would need to set the knob to 5 volts while building the board



# Voltage Regulator Research

- Linear regulator (5 volts down to a clean 3.3v)
  - previously [LP2950](#)
- LD1117V33
  - max of 800mA
  - available as through-hole TO-220 package
  - \$0.35 (very similar price to the LP2950 regulators the old pdb used)
  - fixed 3.3v output
  - needs 100nF on input 10uF on output
  - says it has a current limit, but doesn't say it has short circuit protection
- MCP1702
  - max of 250mA
  - available as through-hole TO-92 (small) package
  - \$0.5
  - if short circuited, turns off for “a short period” then restarts
- Question:
  - **what do we want the 3.3v regulators to do when they are short circuited?**
  - this is actually the most important slide, I should have researched this for longer

# do we like molex plugs?

- Servos be plugged into molex plugs.
  - (they won't latch but they do fit)
- Question: the old PDB has 3v,gnd,5v on every plug, how attached are we to that pinout?

# how should the power switches work?

**Question:**

**The old pdb had the motors on one switch and everything else on the other switch. Now, we have more options, but what options do we want the PDB to have?**

# Why do switches have such low current limits?

# PCB “design-A”

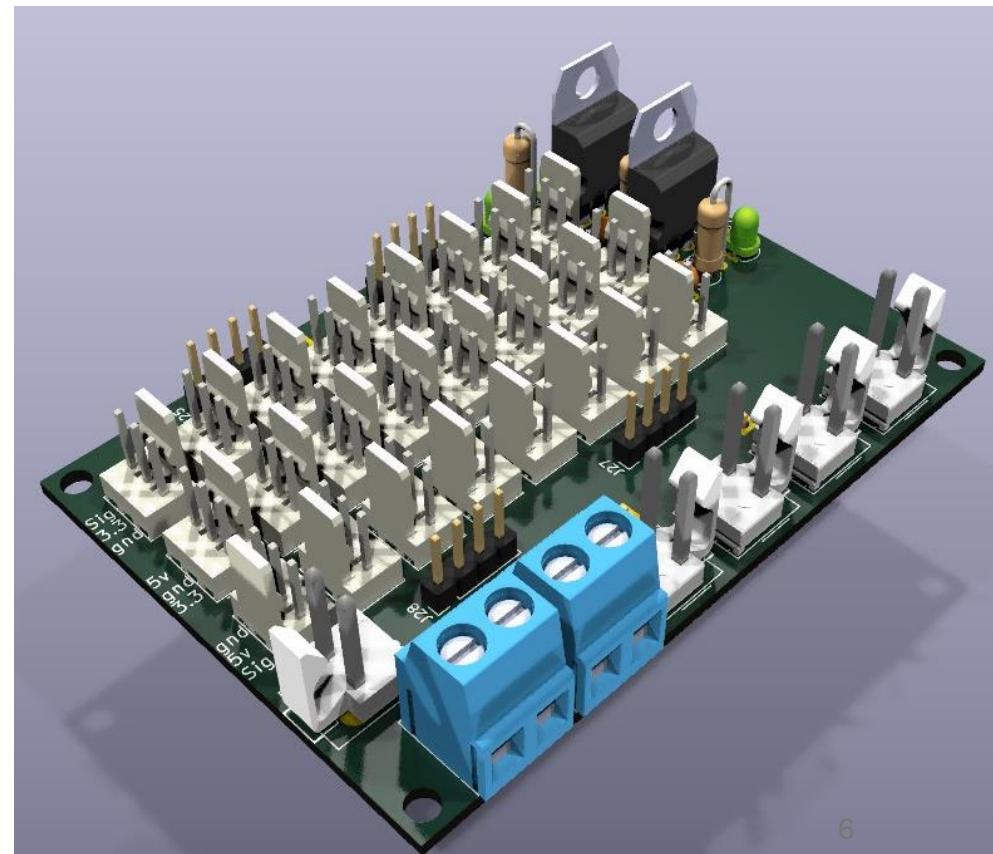
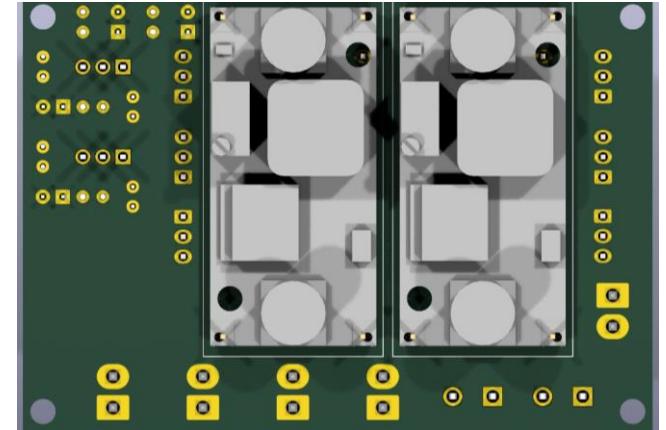
(naming things is hard)

I haven't drawn traces in KiCAD yet, this is just a mockup

See [readme](#) for a list of questions I have about this design and a to do list

3d model <https://github.com/joshua-8/218-pdb/blob/design-A/218-pdb.stl>

- 3.15 x **2.18** inches (10% larger area, ~2x taller)
- buck converters on back
- 24 plugs + 4 14v plugs
- each row is different, see schematic
- connects signals (can stop cutting servo plugs off?)



# design A

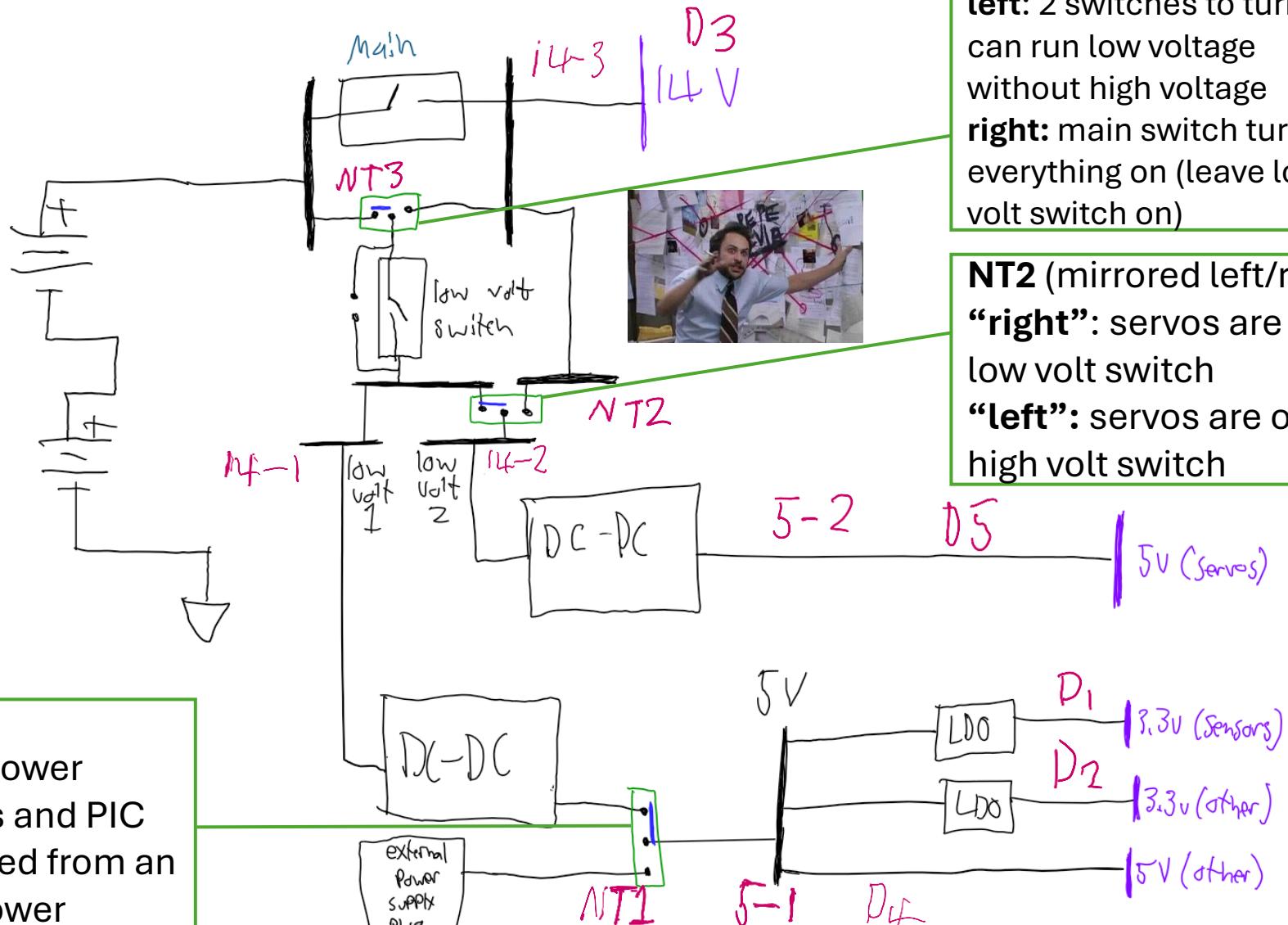
*“Ask me how to make your robot more complicated.”*

– Joshua Phelps

I'm trying to design the PDB to almost force separation between servos and sensors.

green boxes:  
jumpers to  
select what  
paths the  
power follows

**NT1**  
**left:** battery power  
**right:** sensors and PIC  
can be powered from an  
external 5v power  
supply for benchtop  
testing



better diagram on slide 7

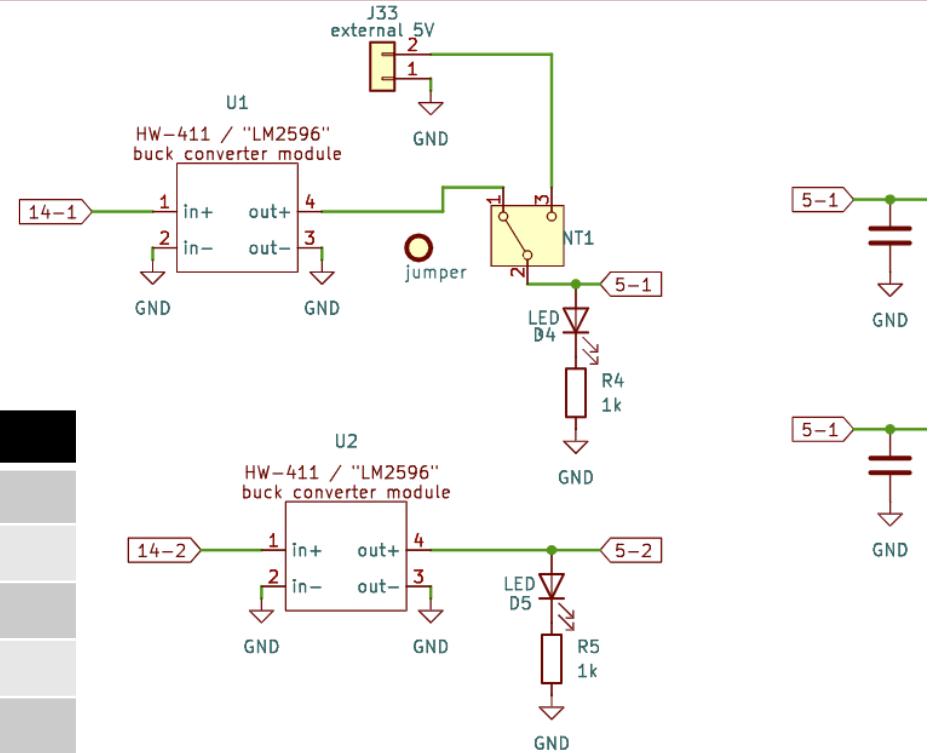
## NT3

**left:** 2 switches to turn on,  
can run low voltage  
without high voltage  
**right:** main switch turns  
everything on (leave low  
volt switch on)

## NT2 (mirrored left/right)

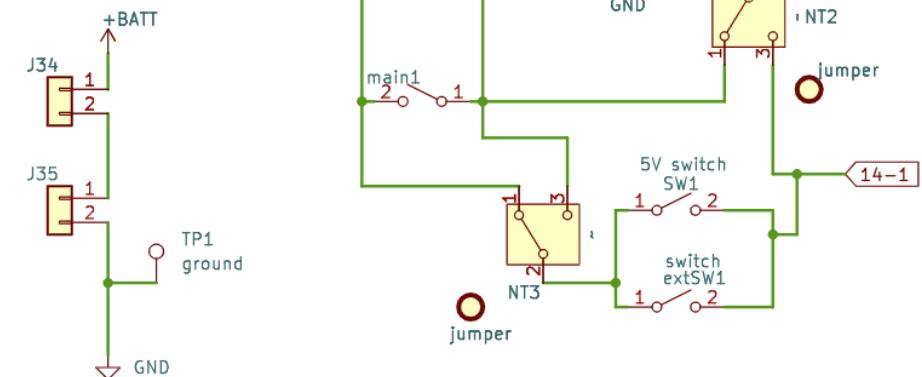
**“right”:** servos are on  
low volt switch  
**“left”:** servos are on  
high volt switch

NT1	NT2	NT3	motors	servos	PIC and sensors
LEFT	LEFT	LEFT	main sw	main sw	5V sw
LEFT	LEFT	RIGHT	main sw	main sw	main sw and 5V sw
LEFT	RIGHT	LEFT	main sw	5V sw	5v sw
LEFT	RIGHT	RIGHT	main sw	main sw AND 5V sw	main sw and 5V sw
RIGHT	LEFT	LEFT	main sw	main sw	external power / off
RIGHT	LEFT	RIGHT	main sw	main sw	external power / off
RIGHT	RIGHT	LEFT	main sw	5v sw	external power / off
RIGHT	RIGHT	RIGHT	main sw	main sw AND 5V sw	external power / off

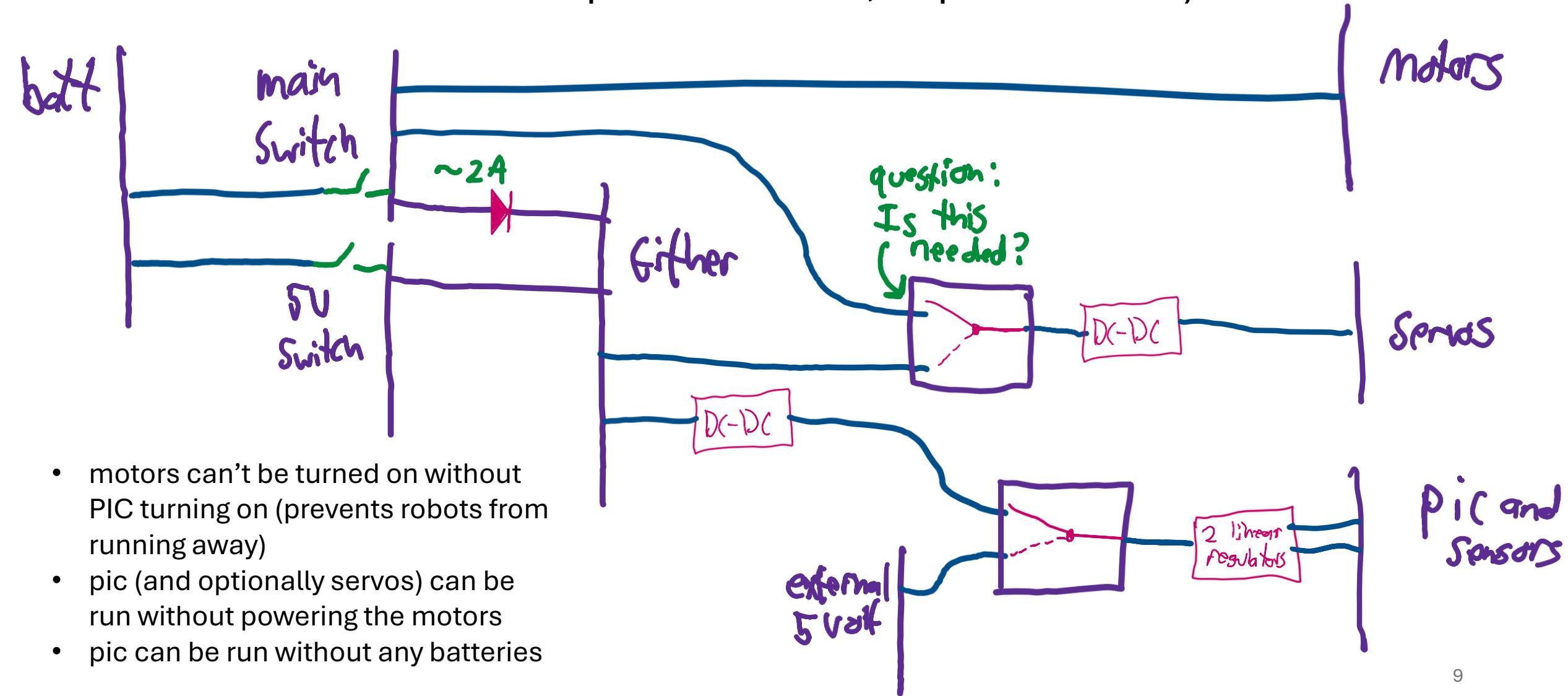


NT1 is needed to turn off 3.3v regulators when setting HW411 voltage

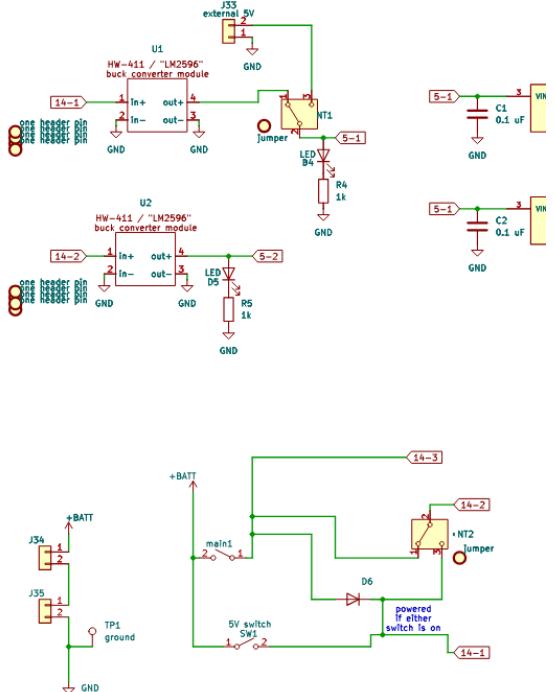
Question: do we need all these options or are we ok with removing one (maybe NT2? changing which switch controls servos might be unnecessary)



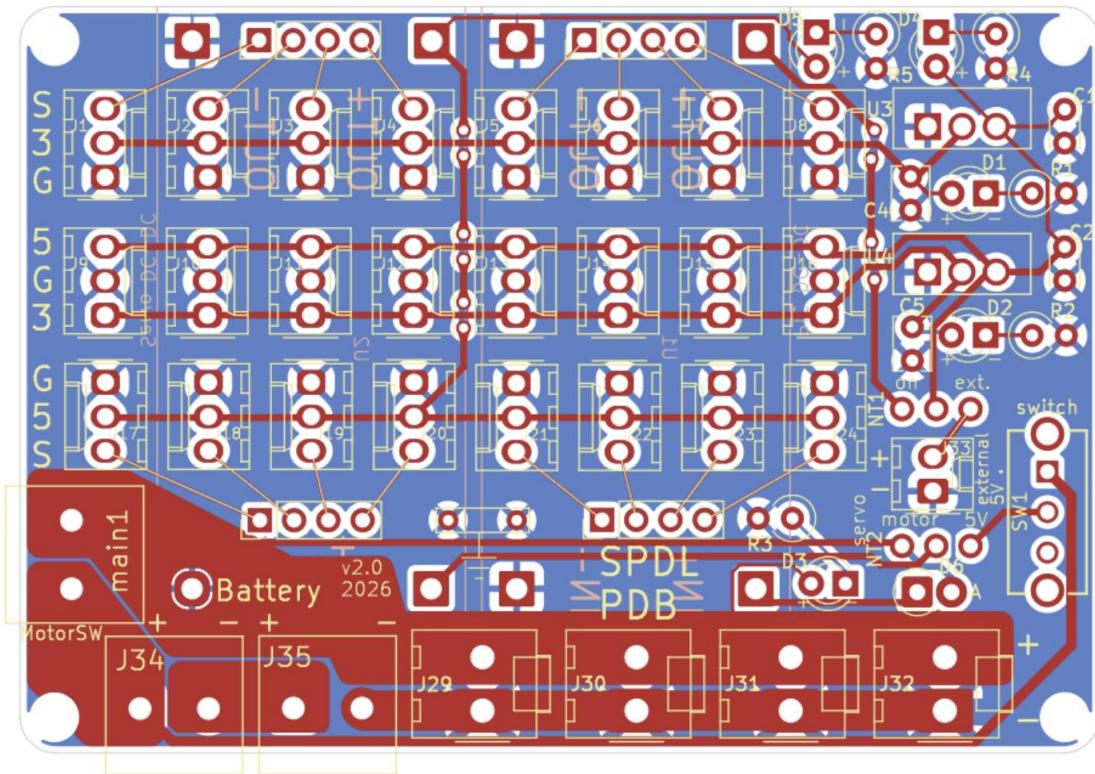
design B (small variation on design A, has different options for the switches and routes that power can take, requires a diode)



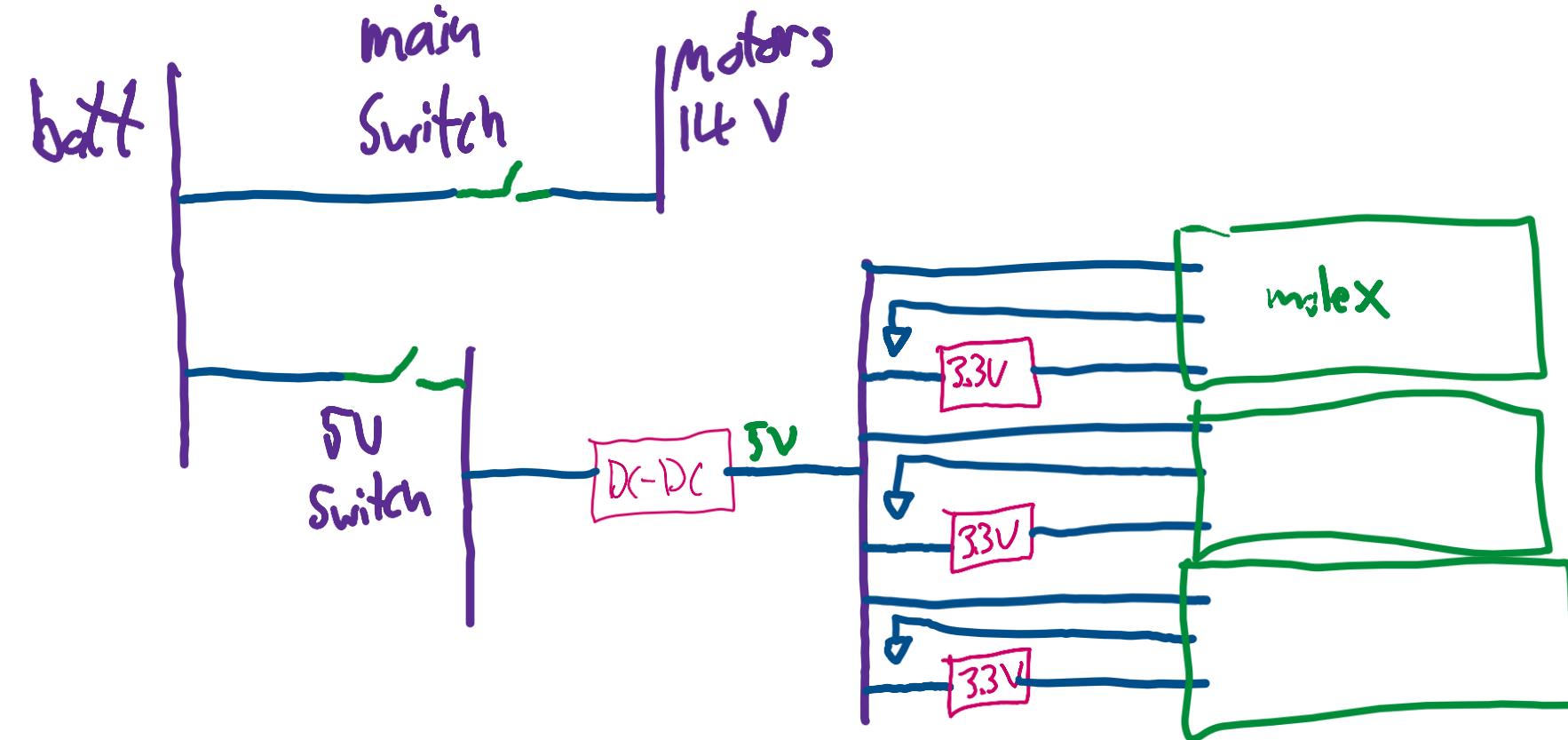
# B



NT1	NT2	motors	servos	PIC and sensors
LEFT	LEFT	main sw	main sw	main sw OR 5V sw
LEFT	RIGHT	main sw	main sw OR 5V sw	main sw OR 5V sw
RIGHT	LEFT	main sw	main sw	external 5V / off
RIGHT	RIGHT	main sw	main sw OR 5V sw	external 5V / off



# design C simpler, like the old PCBs, no KiCAD yet



# cost estimate

- Digikey list (everything except HW-411 regulators and PCB)
  - [link](#) (estimate, and SPDL has many of the parts in stock already)
  - \$8 per board at 25 boards
- HW-411 buck regulators
  - \$2 for 2 regulators (if bought \$20 at a time)
- PCBs
  - JLCPCB and PCBWay estimate around \$2.5 per PCB (but tariffs ☹ )
- I'd estimate new PCBs can be made for \$15 each