

ENPH 253 – Lecture 8

- stock materials – waterjet room + PHAS Stores
 - Mark Reynolds in PHAS stores
- Design Document - general comments
- Electronics – additional components
- 3D printed examples
- Laser-cut examples

Circuit Planning

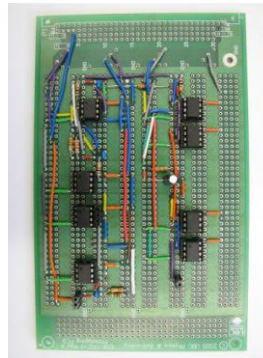
Best Practices when laying out circuits



- Inputs/outputs on accessible part of the board
- Label inputs and output connections
- Uses a single connector for inputs/outputs (although not done on this board)

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Things to avoid on your circuits



- Inputs/outputs in the middle of the board
- Connectors with a single wire coming out! (likely become loose over time.)
- Hard to understand board layout, even with the schematic (although board on the left is fairly clear, it lacks labels)
- Wasted circuit board space

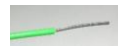
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Electronics Components

Wire



Stranded wire for all flexible wires
Take care with frayed wire ends when pushing into holes!
In phys 253 - Black, White, Red, Green



Solid core wire for permanent, non-flexing wires on PCBs
In phys 253: Blue, Yellow, Grey, Orange



Multi-conductor shielded wire for noise isolation and organization



Ribbon cable to group several wires together.
Use IDC connectors for ribbon cable (6-wire, 8-wire, etc...)

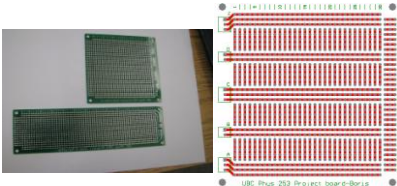
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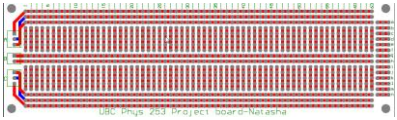
Printed Circuit Boards

• 2 styles of PCBs ("Boris" and "Natasha") available for Phys253.

• Both have layouts similar to the solderless breadboards used in labs (5-pins/row, with power busses).

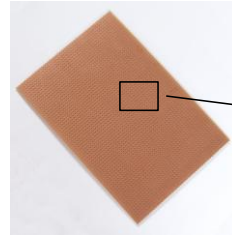


• You can plan/debug your circuits on your breadboards and transfer directly to PCB.



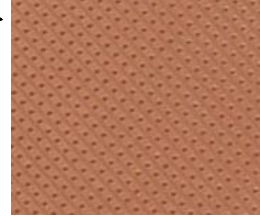
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Printed Circuit Boards – other styles



• Veroboard (or strip-board) have continuous rows of copper

• Lines can be cut with a knife



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Connectors

Male/Female Header pins

- Normally used to connect PCBs to other PCBs. (board-to-board)
- We mainly use header pins in Phys253 to connect wires to PCBs because they're cheaper than proper wire-to-board connectors.
- "polarize" your connections to prevent putting them in backwards or off by one position.



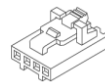
Strain relief - Use shrink tubing around each solder joint from wire to pin/connector

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Connectors, cont.

Molex CL-Grid Style connectors

- These are a type of wire-to-board connectors, and wire-to-wire connectors
- Expensive (\$2 for 2 headers + pins), but won't come apart. Use sparingly!
- Crimping tool is used for pins.
- See a 2-wire connector on the bottom of the TINAH Board



Wire housing



Right-angle header (on PCB)

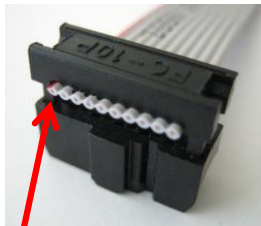
IDC connectors

- for ribbon cable.
- Don't close them before you put in ribbon cable!
- Assembly Instructions here: <http://bit.ly/92mXjp>

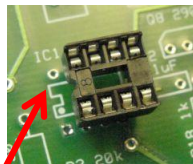


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Polarized Connectors, Sockets and Wires



Ribbon cable is marked – red is wire #1

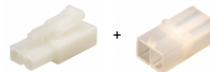


DIP sockets are polarized (the notch indicates where Pin #1 goes)

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Connectors for Power

Molex "toy battery" (tamiva) power connectors - for high-current connections to battery + TINAH, rated to 15A max.



You have 2 choices for connecting power to external circuits, H-bridges, etc:



(A) Screw-down terminal is directly connected to battery input (it doesn't go through the power switch). Very useful, but you need to screw in/out to swap TINAHs.

(B) You may want to make a T-connection so that external circuits connect directly to the battery pack.

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Other Electronics Components:

Hall Effect Sensors (Allegro A1362)

- small, moderately expensive. Kept in front of lab.

5V voltage regulator (7805)

- 3 pins: input (6V-30V), ground, output (5V)
- can supply up to 1A (with a heat-sink)
- useful, since TINAH board 5V line should only output ~500 mA in total (TINAH is also using its own 7805)

Dual comparator (LM393)

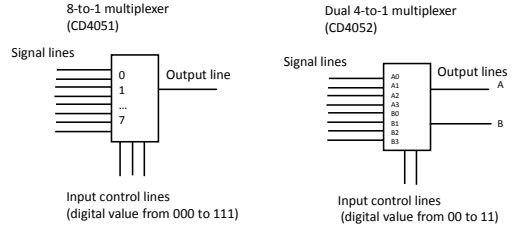
- 2 comparators on one 8-pin chip
- Ground and negative power combined into one pin (they are separate on the LM311), so may not function as desired.
- Input voltages (Vin+ and Vin-) can operate to ground, same as LM311.



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Analog Multiplexers

Multiple inputs can be combined into a single input, selected by digital control lines (useful if you want more analog inputs than you have on your microcontroller)



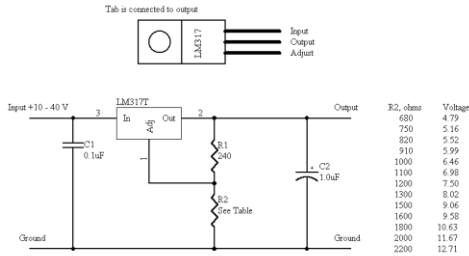
We also have triple 2-to-1 multiplexer (CD4053)

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Other Electronics Components:

Variable voltage regulators (LM317)

- 3 pins: input (6V-30V), ground, output (3.6-18V)
- Might be useful to supply variable voltage (e.g. R/C Servo motors can handle upto 6V)



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Rotary Encoders

- can rotate continuously (not like a potentiometer)
- produces pulses on two channels (A&B, or Phase 1&2) to indicate speed and direction

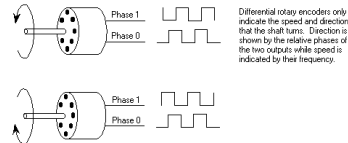


Image from http://www.mikesflightdeck.com/pedestal/switches_indicators.html