Experiment 3.A

DC Motor Driver
Procedures

3.A.0  Turn in your Pre-Lab before doing anything else
3.A.1  Simulate Motor Driver Circuit
3.A.2  Construct Motor Driver Circuit
3.A.3  Test Motor Driver Circuit
Experiment 3

A.1 Simulate Motor Driver Circuit

• Construct the circuit seen below on the left, and create a symbol for it as seen on the right. You may use the motor model and its circuit symbol from last time as an example of how to do this. The internet and your TAs are another good resource for creating LTspice sub-circuits.

You may use the following LTspice library components instead of the lab kit components:
• FZT849 (npn) instead of KSD882 (npn)
• 2N2905A (pnp) instead of KSB772 (pnp)
Experiment 3

A.1 Simulate Motor Driver Circuit

- Use your DC motor model and symbol from Lab 2. In the report, include your simulation circuit diagram and simulation results; discuss any $R_B$ changes you made.

Shorting omega to zero in the motor DC model is equivalent to locking the wheel.

You may use the following LTspice library components instead of the lab kit components:
- FZT849 (n-p-n) instead of KSC1173 (n-p-n)
- 2N2905A (p-n-p) instead of KSA473 (p-n-p)
A.2 Construct Motor Driver Circuit

- Construct the motor driver circuit. The base, collector, and emitter have been labeled below. **Before soldering anything, draw a wiring diagram for your motor driver.** Include this diagram in your lab report, and if you are unsure ask a TA to check it before you begin building!

- Include capacitor C1 on your motor driver board. Place this capacitor directly between DCSupply(+10V) and DCgnd (GND) where these two signals enter the board.

- Keep all wires as short as possible to reduce noise.

- Review the following 4 pages before you begin.
Finished driver board example

Protoboard connector: DCsupply, DCgnd, B2, B1

DC motor connector: DC2, not used, not used, DC1

npn KSD882

pnp KSB772

nqn KSD882

pnp KSB772
Mount 2 pnp and 2 npn transistors on heat sinks

- npn KSD882
- pnp KSB772

Thermal pad: electrical insulator, good thermal conductor

Thermal resistance: \( R_{th} = 15 \, ^\circ\text{C/W} \)

Temperature rise: \( \Delta T \,[^\circ\text{C}] = R_{th} \,[^\circ\text{C/W}] \times P \,[\text{W}], \) where \( P \) is the power dissipated on the transistor
# Soldering tips

**Don’t:** Use the very tip of the iron. **Do:** Use the side of the tip of the iron, “The Sweet Spot.”

**Do:** Touch the iron to the component leg and metal ring at the same time.

**Do:** While continuing to hold the iron in contact with the leg and metal ring, feed solder into the joint.

**Don’t:** Glob the solder straight onto the iron and try to apply the solder with the iron.

**Do:** Use a sponge to clean your iron whenever black oxidization builds up on the tip.

<table>
<thead>
<tr>
<th><strong>A</strong></th>
<th>Error: Solder flows around the leg and fills the hole - forming a volcano-shaped mound of solder. Solution: Add flux, then touch up with iron.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>B</strong></td>
<td>Error: Solder balls up on the leg, not connecting the leg to the metal ring. Solution: Add flux, then touch up with iron.</td>
</tr>
<tr>
<td><strong>C</strong></td>
<td>Error: Bad Connection (i.e. it doesn’t look like a volcano) Solution: Flux then add solder.</td>
</tr>
<tr>
<td><strong>D</strong></td>
<td>Error: Bad Connection…and ugly…oh so ugly. Solution: Flux then add solder.</td>
</tr>
<tr>
<td><strong>E</strong></td>
<td>Error: Too much solder connecting adjacent legs (aka a solder jumper). Solution: Wick off excess solder.</td>
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</tbody>
</table>
Experiment 3

A.3 Test Motor Driver Circuit

• Connect your motor driver to your breadboard using the 4-wire connectors.
• Before you turn anything on double check connections!
• In the report, include your test setup diagram, and experimental results; try both clockwise and counter-wise operation; discuss any $R_B$ changes you made to meet $|I_{DC}| < 1$A specification
A.3 Test Motor Driver Circuit

- Make sure your experimental setup follows the diagram on the previous page; let the wheel rotate freely

- Measure:
  - Maximum speed of wheel rotation (in revolutions per second, and in radians per second), clockwise or counter-clockwise
  - Total DC supply current (from the +10V supply), when the wheel is rotating clockwise, or counter-clockwise

- In the report, describe the experimental setups, including circuit diagrams, and experimental results