

Motor Control

Lab 8

Purpose

Arguably the core of the TekBots platform is the motor control board. This board accepts simple inputs to supply current to the motors on the TekBot's base to make the motors turn forward, reverse, or to stop.

You will add the motor control board to your TekBot™ and test it to ensure proper operation. You will also assemble the Analog Board.

Prelab

Be sure your TekBot is fully charged before coming to lab. To do this be sure that your TekBot has been plugged into the wall for at least 8 hours prior to lab. If your instructor has not looked at your system yet make sure she does BEFORE you plug it and try to charge it.

How it Works

Below is a simple description of how the motor controller works. During this lab you will need to construct the motor controller so a good understanding of how it works is very important.

Motor Control PCB

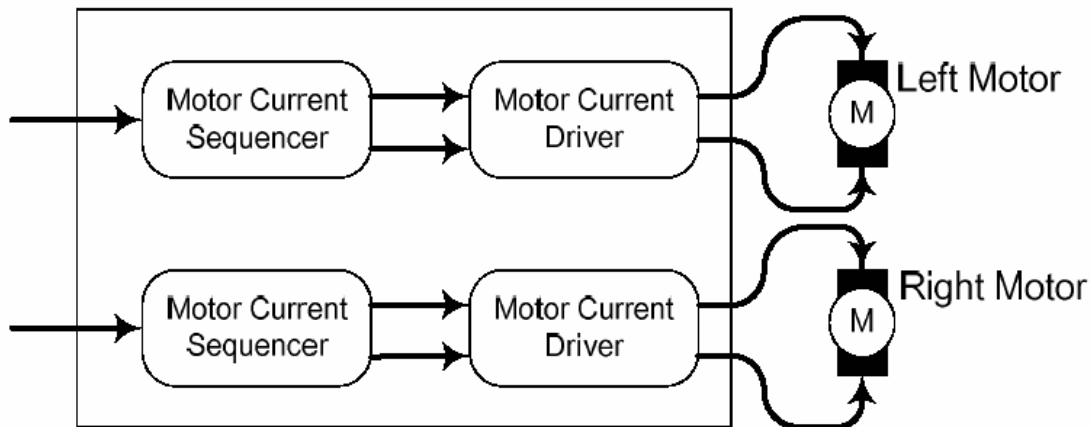


Figure 1. The Motor Controller System Diagram.

The Motor controller consists of two separate control channels. Each of these channels allows us to control the direction of a single motor. Each channel has two sections, the control logic and the H-bridge itself, composed of discrete transistors.

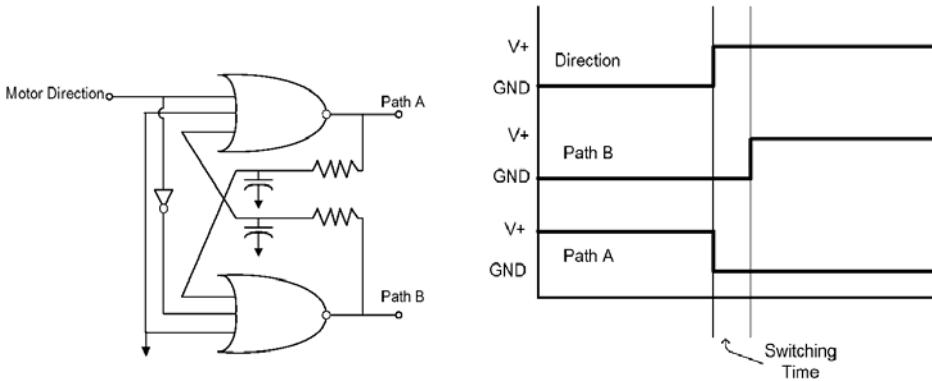


Figure 2. Motor control sequencer circuit and timing diagram.

The motor control sequencer circuits prevent the motor current drivers from momentarily shorting the power supply to ground when changing directions. This is done by using delayed feedback between the two cross-coupled NOR gates shown in Figure 9. For example when the 'Motor Direction' signal changes from ground to V+, 'Path A' immediately switches off. Then after the short delay (switching time) caused by the delay element, 'Path B' switches to V+.

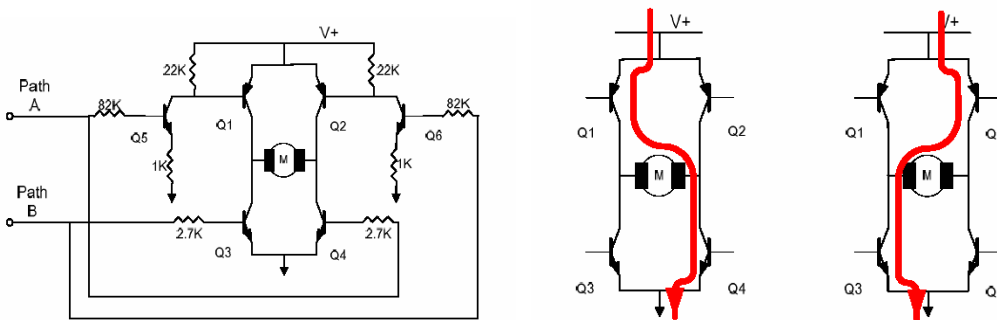


Figure 3. The motor current driver subsystems and examples.

Above is the H-bridge for each motor on the robot (right and left) that controls the direction of current flowing through the motor and therefore the direction of rotation. In Figure 3 we see that the motor current driver is composed of several transistors arranged in a classic 'H-bridge' configuration. When Q1 and Q4 are turned on, the current flows from left to right in the motor, while if Q2 and Q3 are turned on it flows from right to left. This current flow can be seen also in Figure 10. Q5, Q6, and the various resistors are used to correctly bias the H-bridge transistors to work with the input signals 'Path A' and 'Path B'.

Procedure

The Plexiglas board will need to be removed from your TekBot to mount the motor control board.

Mounting the Motor Control Board

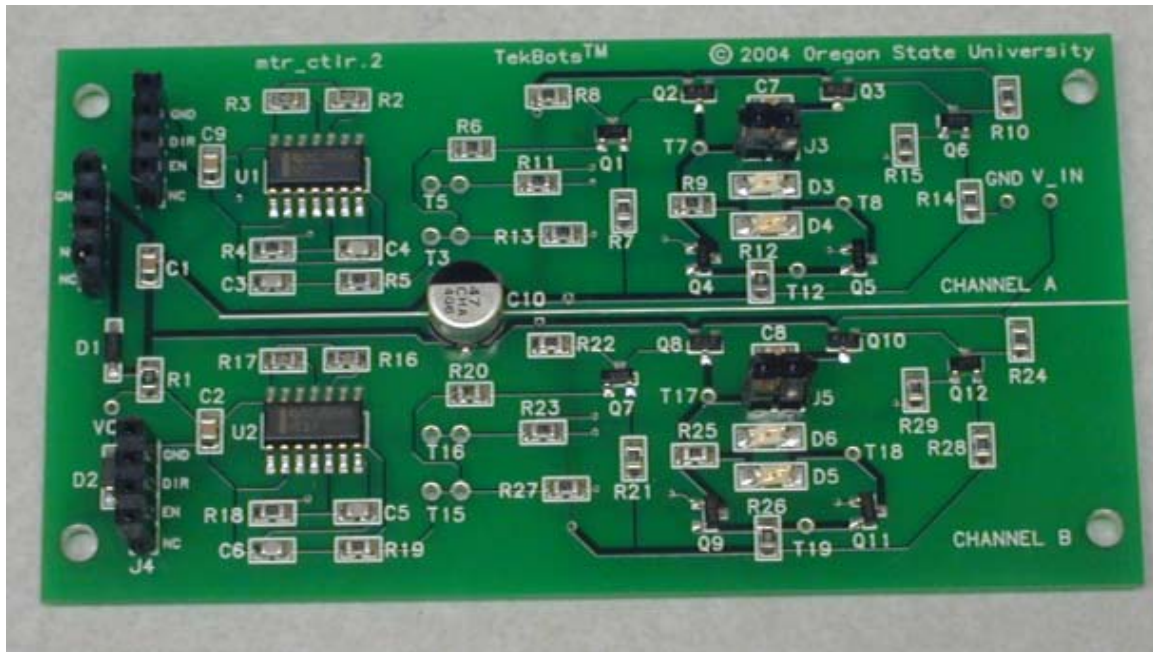


Figure 4. Motor Control Board with Connectors

1. Insert the screws into the printed circuit board. Put a small piece of tape over the head of each screw so it doesn't fall out when you turn the board over. Turn the board over and place spacers onto the screws. Place the Plexiglas over the spacers and attach with the nuts.
2. The Plexiglas layer attaches to the base of your robot using 8-32 Nylon bolts and the nylon standoffs. Bring the wires from the motors and the power cable through the hole in the Plexiglas. Figure 5 shows the placement of the breadboard and motor control board on the Plexiglas.

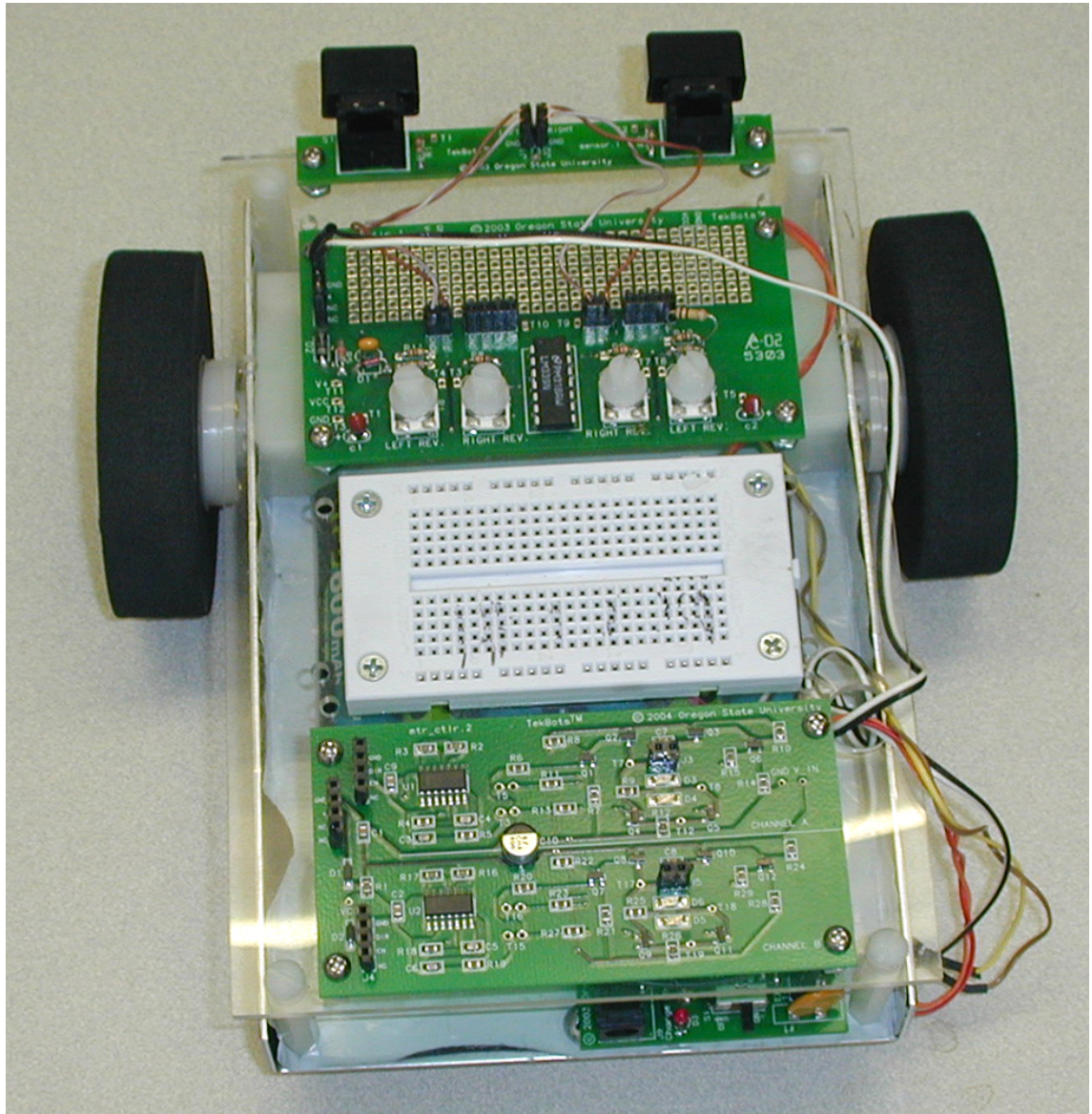


Figure 5. Motor Control Board and Breadboard

Constructing Cables

3. You will need to construct two cables approximately 9" long – both with 3 wires but use 4-pin male connectors on each end.

Testing of Motor Control Board

4. Connect the power cable from the charger board into J1 of the motor control board. Connect the right motor wires into J3 and the left motor wire into J5. Note that this is a FRONT WHEEL drive robot.

The motor board can perform three functions with each motor: forward, reverse, and stop. These functions are controlled by the two inputs for each motor.

To test the function of your motor controller you will place one of your three conductor cables from J2 to the protoboard as shown in Figure 6.

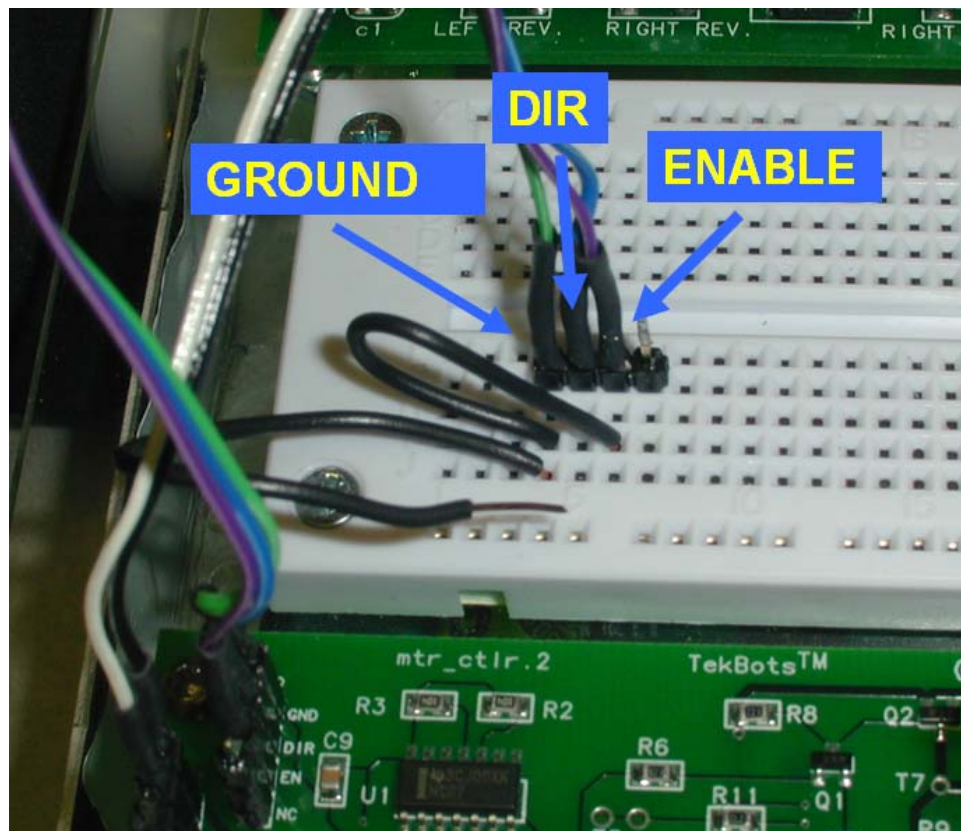


Figure 6

5. Place a wire from the Ground to the Enable. The right wheel should turn forward. A green LED on the control board should also turn on. If the wheel goes backwards but the green LED is on, reverse the motor cable in J3. Place a wire from Ground to Dir (don't remove the Enable wire). The wheel should turn backwards and the red LED should light.
6. Remove the cable from J2 and place in J4 and test the left wheel in the same manner.

Using Wired Remote Control

Place the cables from J4 and J2 from the Motor Control board on the prototype board as shown in Figure 7.

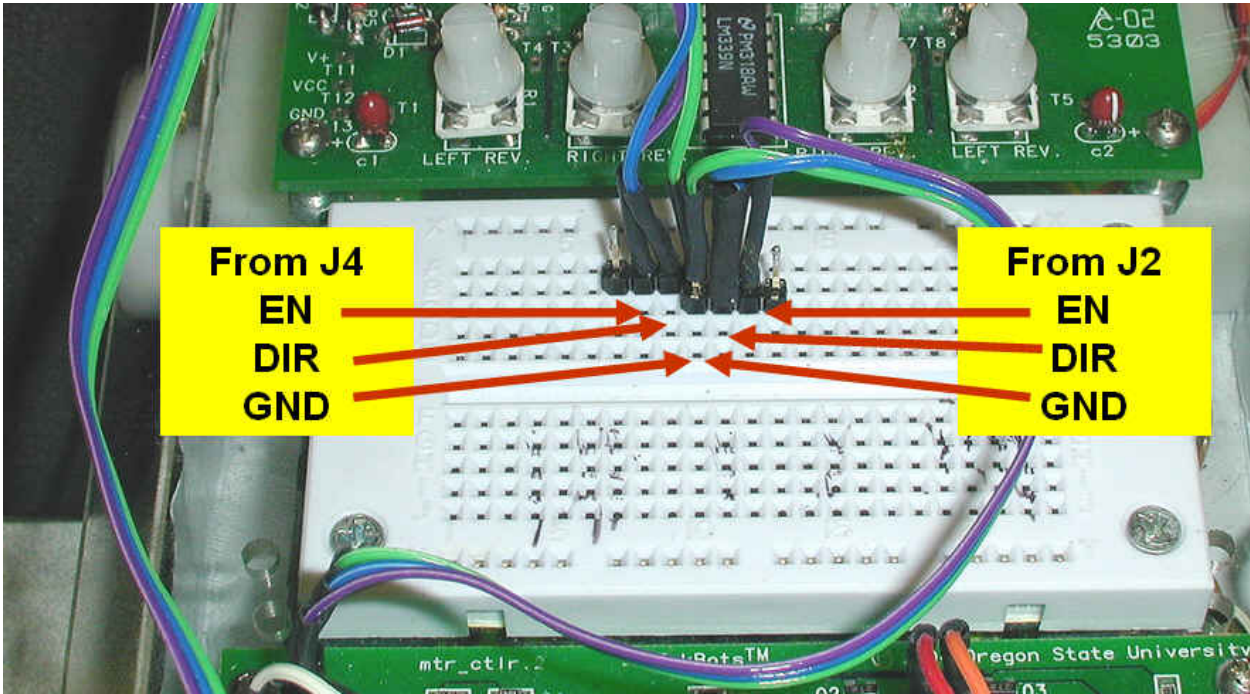


Figure 7. Wired Remote Control

Place the plug from the wired remote control into the breadboard as shown in Figure 8. Move the charger board switch to ON. The TekBot right wheel should go forward when you press the right switch forward and go backward when you press the switch back. If the TekBot goes the opposite direction, rotate the plug from the motor 180 degrees. The left wheel should work in the same manner.

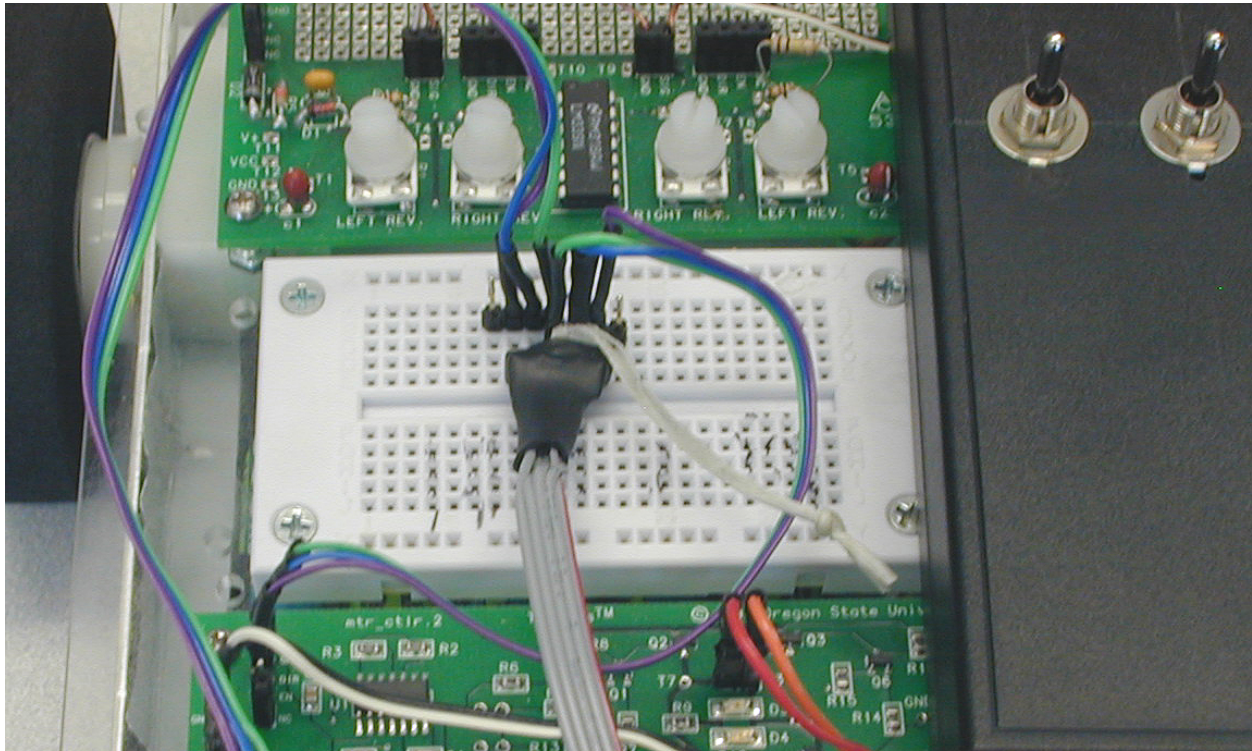


Figure 8. Remote Control Plug

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