SPIRIT

Phase 5 – Analog Board
Computer and Electronics Engineering

In this exercise you will assemble the analog controller board and interface it to your TekBot™. Print out the schematic, silkscreen and the parts list for the analog controller board from the Blackboard site.

Theory
How does it work?

When the robot bumps into an object one of the two switches, Figure 1, (right or left) closes shorting the capacitor to ground causing the ramp output signal to also go to ground, figure 2. Once the robot begins to reverse and the switch opens the capacitor begins to charge through the resistor from V+. The charging capacitor is used as a simple timer allowing the robot to react in a timed response. Each switch has a separate ramp generator so that the robot reacts differently depending on which switch is triggered.

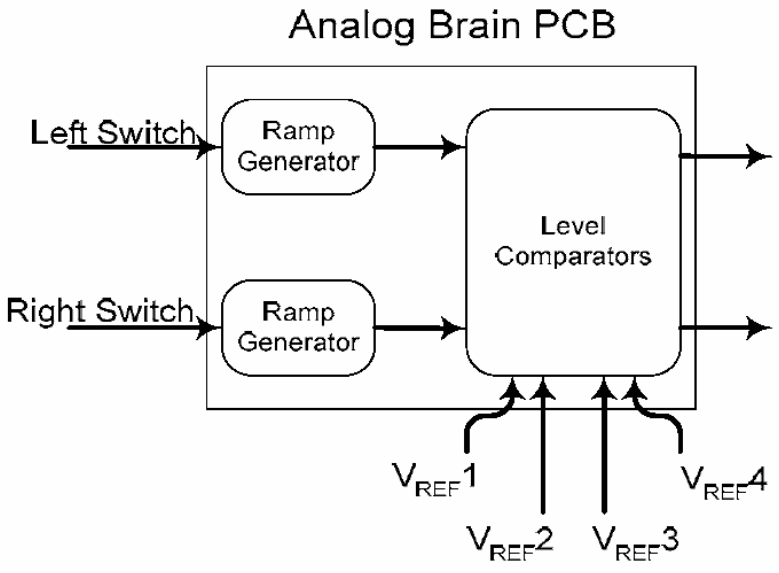


Figure 1. Block diagram of analog (brain) controller

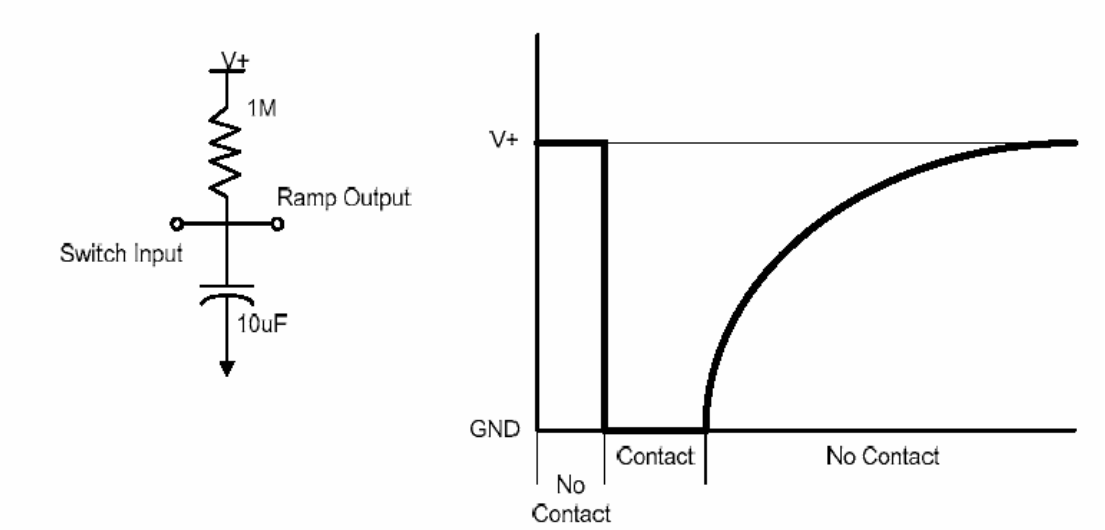


Figure 2: The input sensor timer schematic.

The ramp output signals feed into the comparator logic, Figure 3, which compares the voltage on the capacitors with adjustable references. By comparing these values the analog controller can move the motors in reverse for a certain length of time after a switch is pressed.

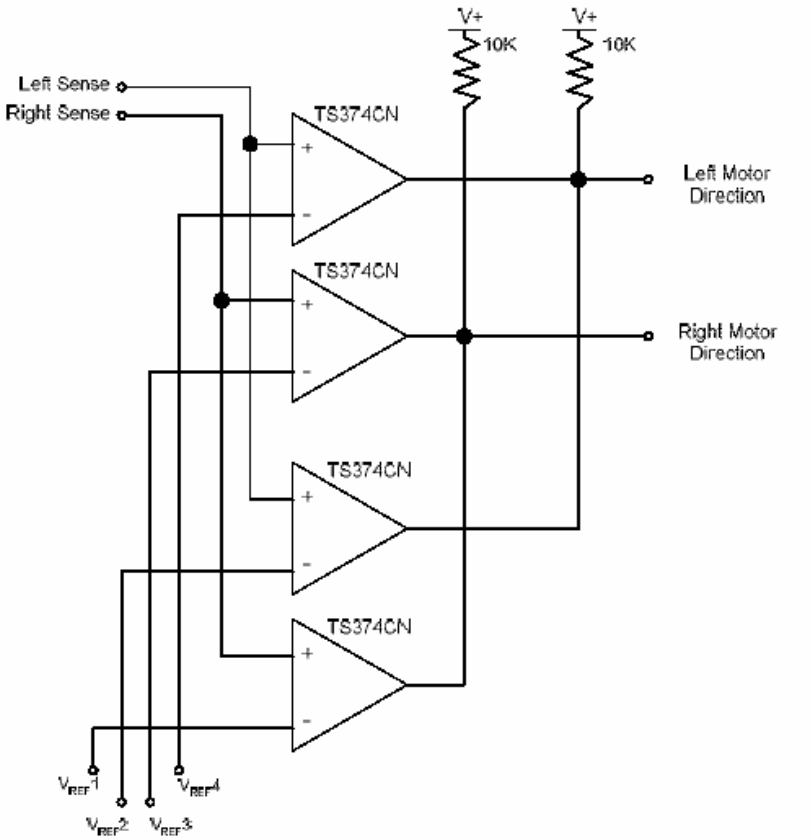


Figure 3: Comparator Logic

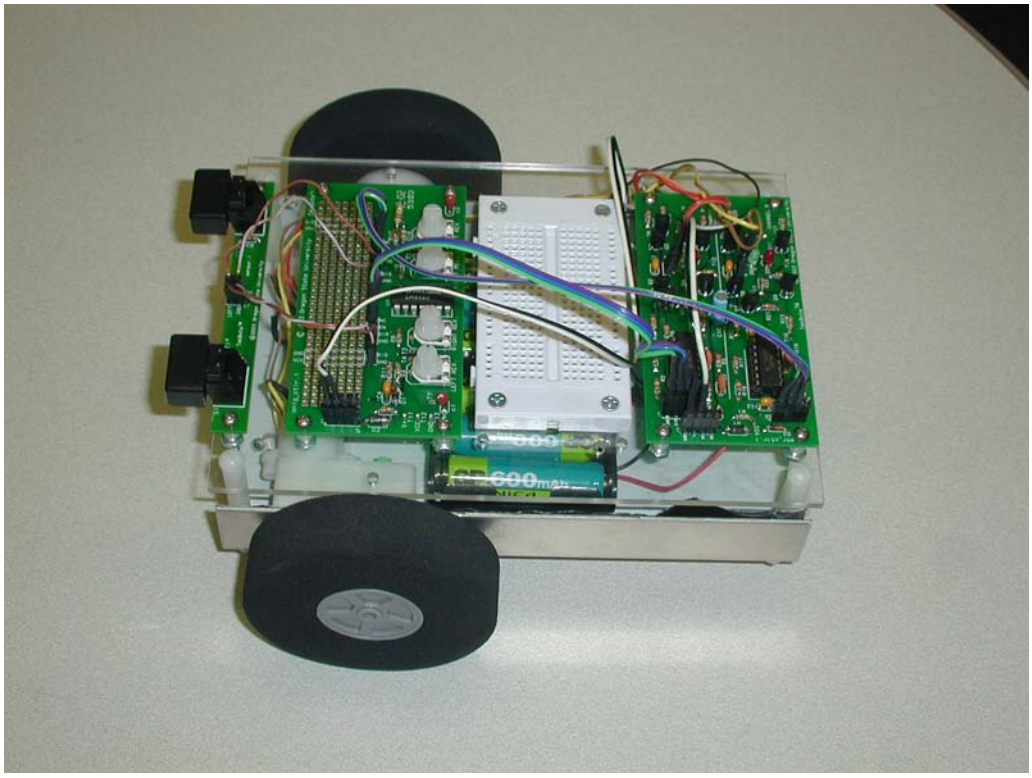
Putting it all Together

Assemble your analog controller board using the schematic, silk screen, and parts list. You may also want to use Lab 2 as a reference for parts and such. NOTE: C1 and C2 are polarized. Be sure to insert them correctly. The line is the '+' terminal and should align with the '+' on the silk screen. Make certain you have the integrated circuit oriented correctly before soldering it. D1 and D2 need to be oriented correctly also. All connectors are female.

Sensor Assembly

As the last part of this exercise you will assemble the sensor board for your TekBot.
The sensor board parts list, schematic, and silk screen are posted on the lab web site. Use female jacks for J1 and J2.

Mount the analog board as shown in the following photo.



You will need three cables – all will have male connectors – to connect the analog board.

1. 12 inch, two conductor with four pin male connectors for power. Connect from charger board to J1 of the analog board.

2. Two 3 conductor with four pin male connectors. Use one to connect to J3 of analog board to J4 of motor control board. Use the other to connect J4 of analog board to J2 of motor control board. You have already constructed these cables.

The cable from the right motor should be connected to J3 of the motor control board and the left motor to J5.

Connect the sensor board to the analog board by using pieces of CAT-5 cable available in your kits. This cable is very inexpensive and plugs in nicely to the female header receptacles on your boards. Wires connect J1 on the sensor board to J2 on the analog board. J2 on the sensor board connects to J3 on the analog board.

Now you need to tune your TekBot so that is operates intelligently. We do this by adjusting the variable resistors R1, R2, R3, and R4 on the analog brain board. You will notice that these resistors are labeled 'Left Rev.' and 'Right Rev.' The variable resistors on the left (R1 and R2) control the robot's response when the left switch is triggered, and the ones on the right (R3 and R4) work when the right switch is triggered. This allows for different responses to each switch.

When the left switch is hit we want the robot to back straight up, then turn to the right and continue. To do this, first both motors should reverse then the left motor should turn forward while the right motor continues in reverse. So the 'reverse time' on the left motor should be shorter than the right motor. On our TekBots, turning the variable resistors clockwise makes a wheel turn backwards longer. So adjust R1 and R2 so that when the left switch is hit the left wheel backs up for less time than the right wheel. The Right Rev resistor (R2) should be slightly more clockwise than LEFT REV (R1).

These resistors can be set using a voltmeter. Disconnect the cables to the motors so you can turn power on and not have the wheels turn or you can elevate the TekBot so the wheels turn freely. Measure the voltage from T4 to GND. Adjust LEFT REV (R1) until the voltage is 0.5 volts. This gives about 1.0 seconds reverse time. Measure the voltage from T3 to GND. Adjust RIGHT REV (R2) until the voltage is 0.75 volts. This gives about 1.5 seconds reverse time.

Repeat for the right bumper switch with the right motor reversing for less time than the left motor. T7 (R4) is set to 0.75 volts and T8 (R3) is set to 0.5 volts.

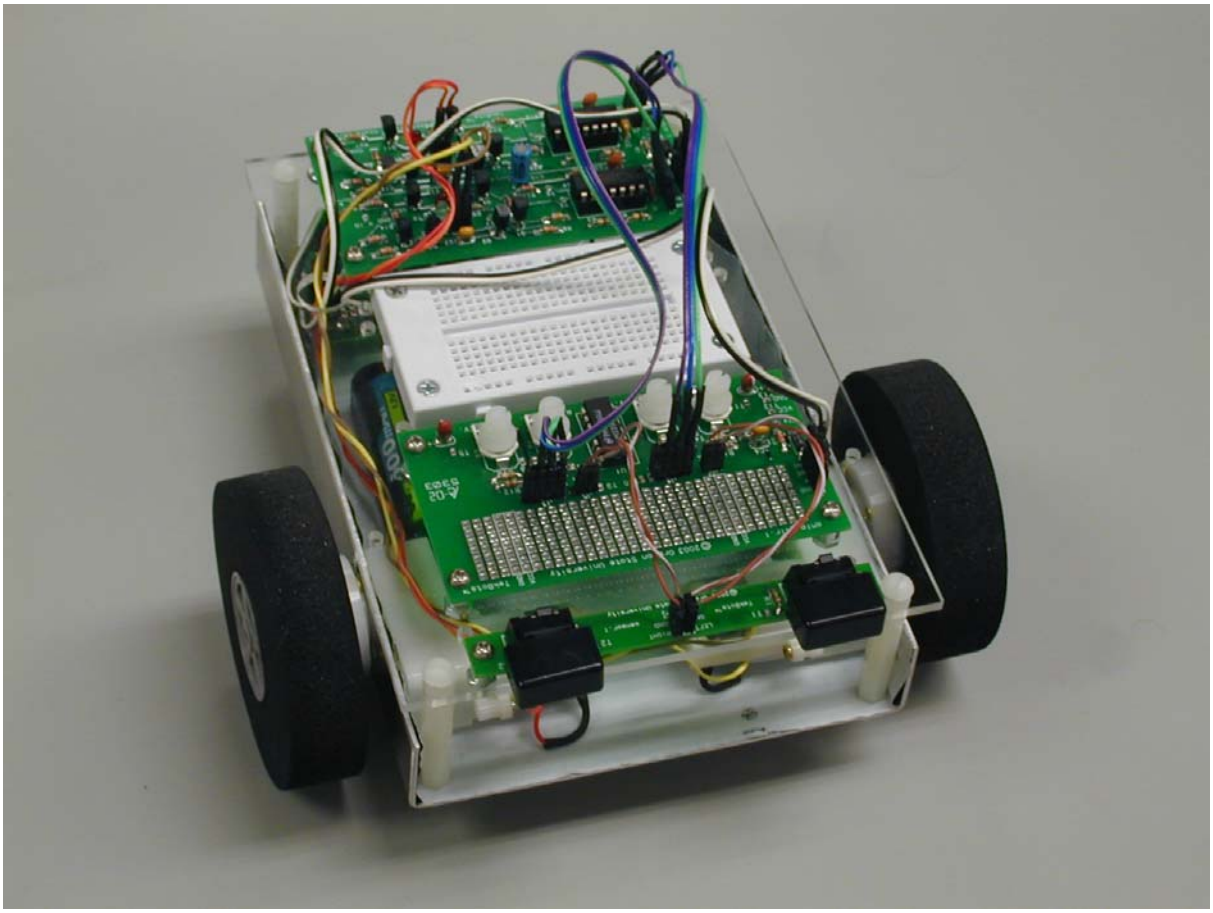


Figure 4. Completed TekBot