SPIRIT

Phase 3 – Analog Board
Computer and Electronics Engineering

In this exercise you will assemble the analog controller board and interface it to your TekBot™.

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.

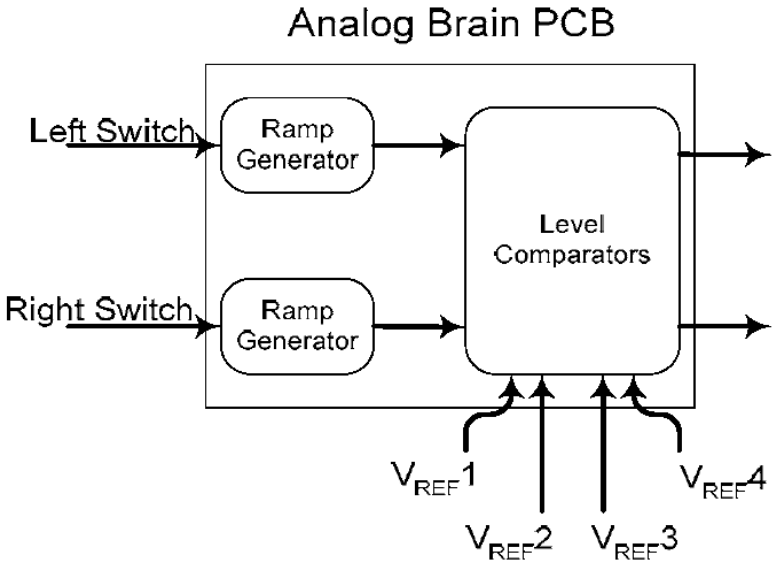

Figure 1. Block diagram of analog (brain) controller

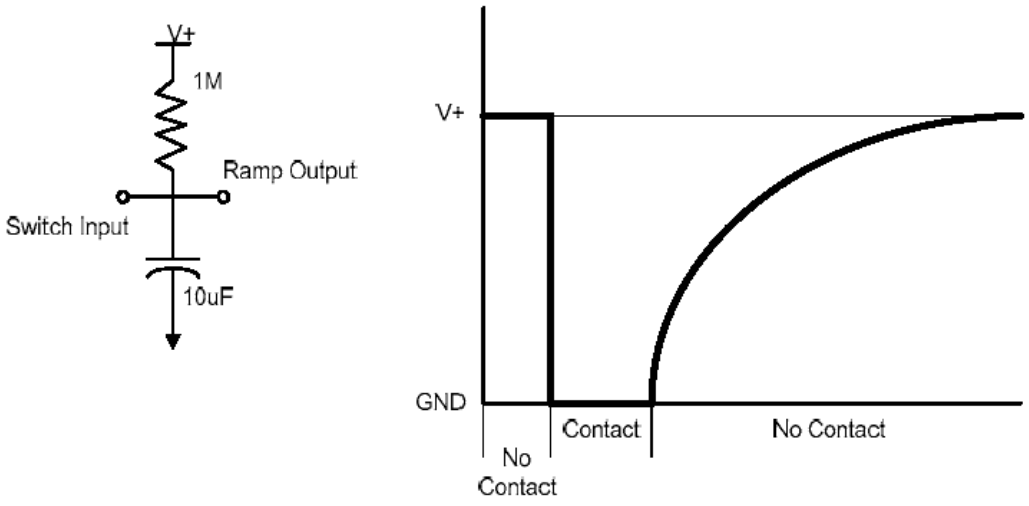

Figure 2. The input sensor timer schematic

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.

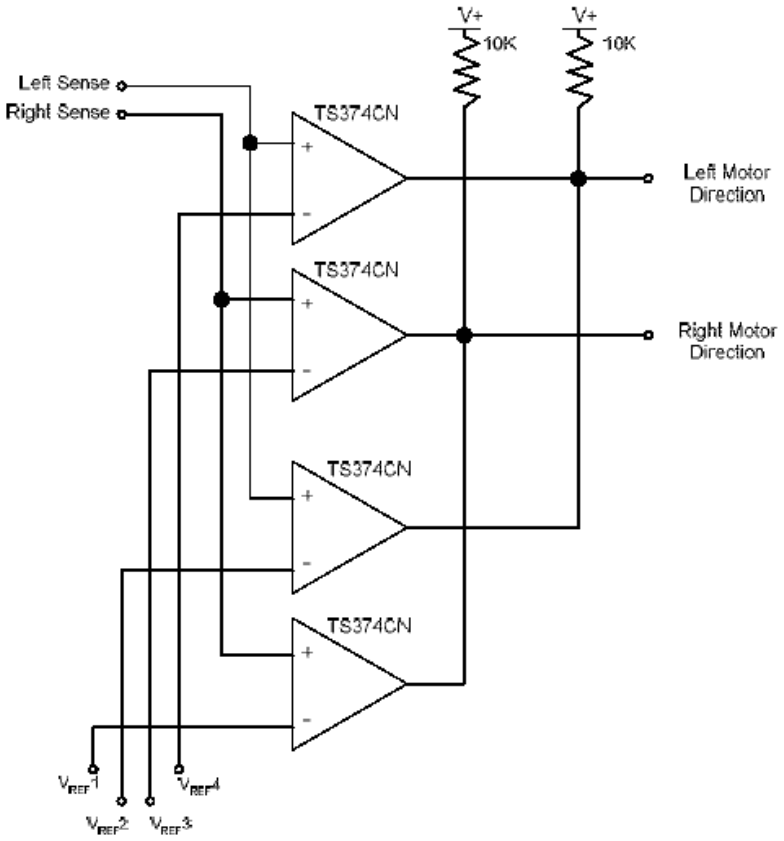

Figure 3. Comparator Logic

➢ Solder Components on Analog Board

- **Description:**
  - **Use parts list to identify components**
- **Warning:**
  - **Orientation Critical Components:**
    - **C1, C2, D1, D2, U1**

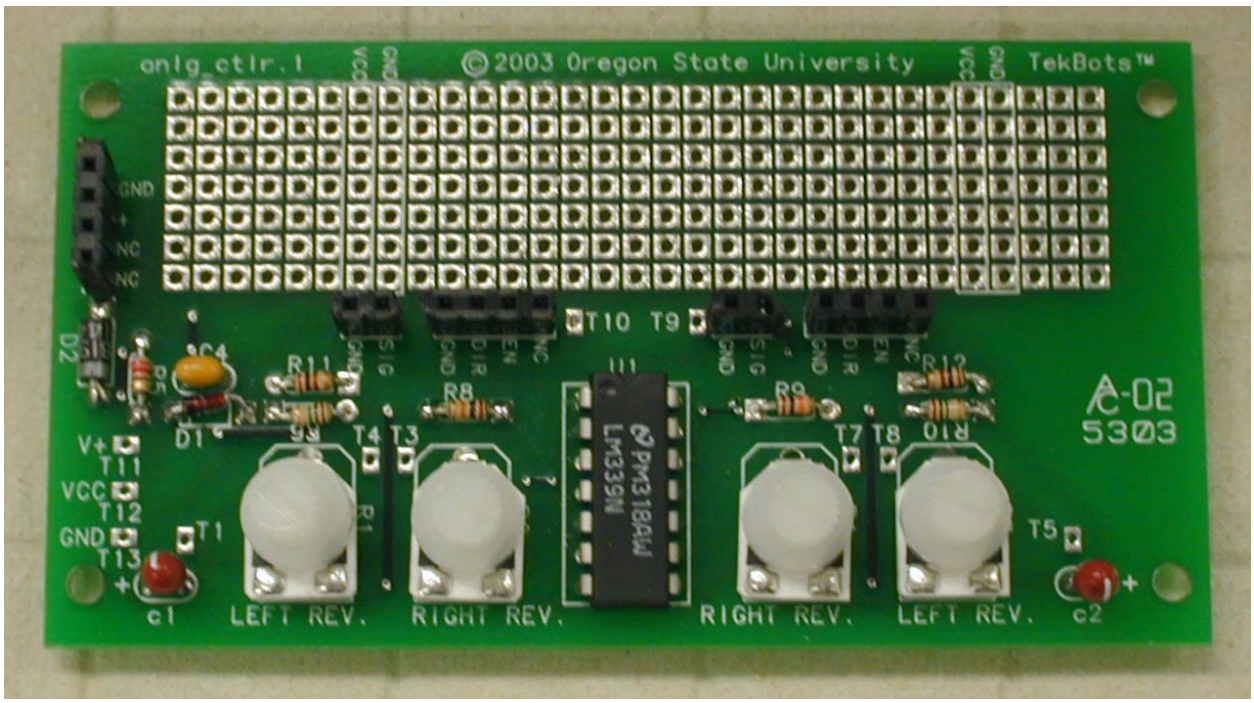

Figure 4. Analog Board

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. You will need three 4-pin female connectors and two 2-pin female connectors.

➢ Solder Components on Sensor Board

- **Description:**

- **Use parts list to identify components**

As the last part of this exercise you will assemble the sensor board for your TekBot.
Use the sensor board parts list, schematic, and silk screen as guides. You will need two 2-pin female jacks for J1 and J2.

➢ Make Cables

- **Description:**
  - **12” long, two conductor, four-pin male header on each end (same as the one to the motor control board).**
  - **You should already have these: Two 9” long, three conductor, 4 pin male header on each end.**
  - **Two 4” long, two conductor, 2-pin male header on each end**
- **Warning:**
  - **Don’t cross wires on the first cable-Same wire on outside pin of both connectors**

➢ Attach Circuit Boards to Plexiglass

Remove Plexiglass from chassis and attach the analog board and sensor board as shown in Figure 5.

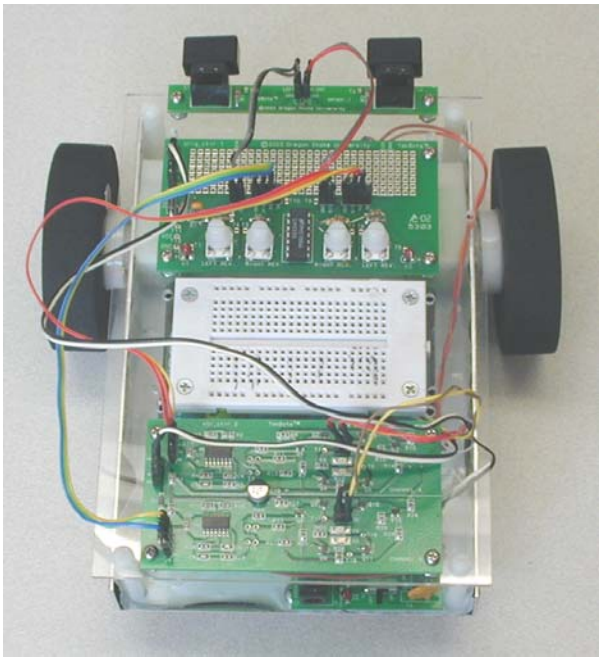

Figure 5. Placement of Analog and Sensor Boards

➢ Reattach Plexiglass to Chassis

- **Warning:**
    - **Connect the new 2 conductor power cable to the charger board and thread through the ½" hole before mounting.**

➢ Connect Cables

- **Connect 2 conductor power cable from charger board to J1 of the analog board.**
- **Three conductor cable from J4 of motor control board to J3 of analog board.**
- **Three conductor cable from J2 of motor control board to J4 of analog board.**
- **Two conductor cable from J1 of sensor board to J2 of analog board**
- **Two conductor cable from J2 of sensor board to J5 of analog board**
- **The cable from the right motor should be connected to J3 of the motor control board and the left motor to J5.**

➢ Adjust Timing

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. Either disconnect the cables to the motors or elevate the TekBot so the wheels turn freely. This will allow you to turn power on and not have

the wheels turn. For the left bumper switch: **Put the black lead of the voltmeter on GND (ground) also labeled T3. The "T" stands for Test Point. Put the red lead on the test point stated below.**

- **Adjust LEFT REV (R1) until the voltage at T4 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 at T3 is 0.75 volts**. This gives about 1.5 seconds reverse time.

Repeat for the right bumper switch.

- **Adjust LEFT REV (R3) until the voltage at T8 is 0.5 volts.** This gives about 1.0 seconds reverse time. Measure the voltage from T3 to GND.
- **Adjust RIGHT REV (R4) until the voltage at T7 is 0.75 volts**. This gives about 1.5 seconds reverse time.

You have completed your TekBot construction!

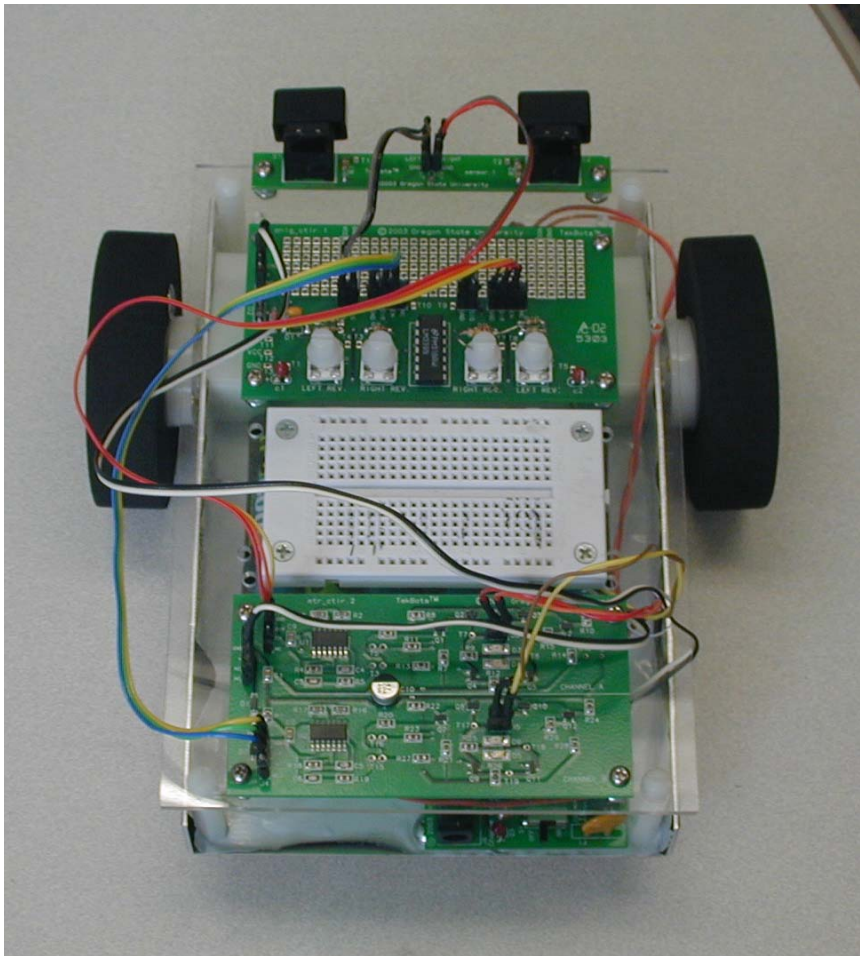

Figure 6. Completed TekBot