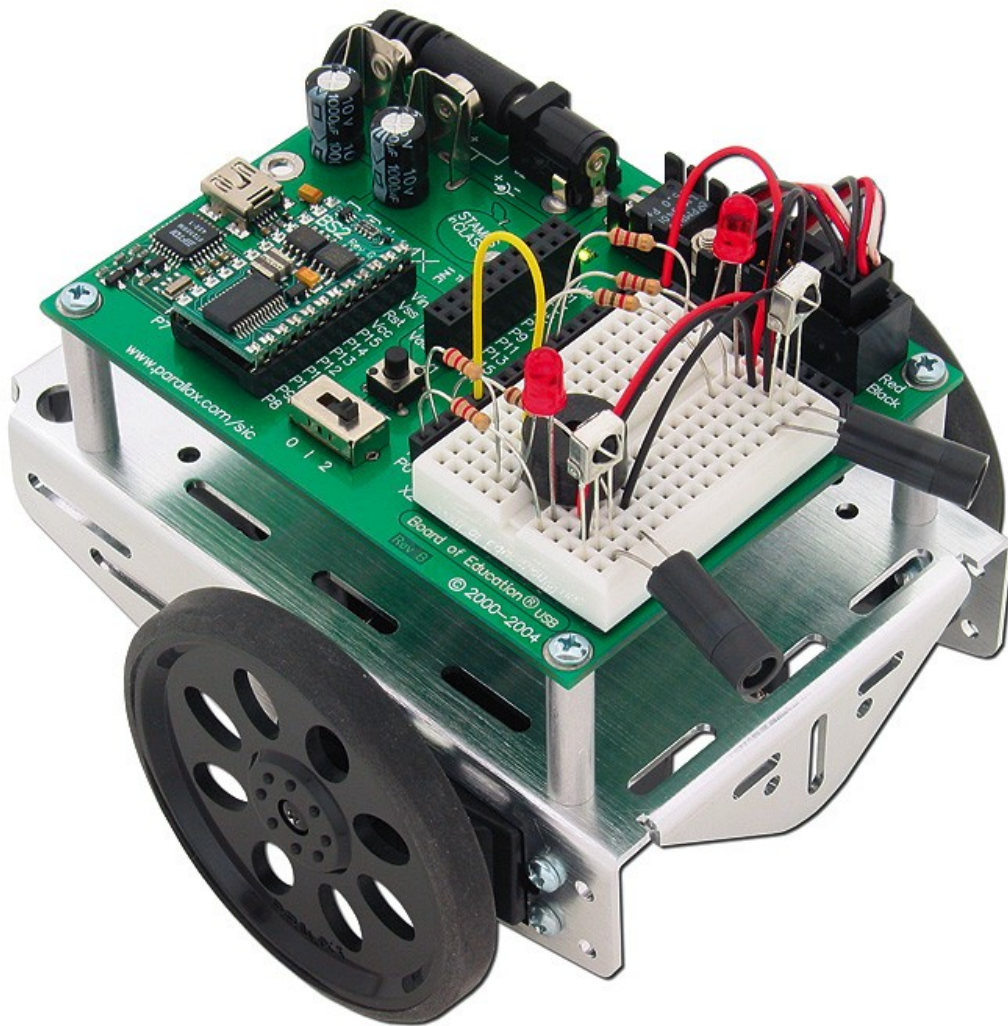


Troop 55  
Robotics Merit badge

Robot Construction Handbook  
Basic Assembly & Test



Revised: Feb 11, 2012  
Robert Rice  
rrice@r3home.net

## Table of Contents

Parts of the Robot.....	4
Before Getting Started.....	5
Building the Robot.....	6
Step 1 – Chassis & Standoffs.....	6
Step 2 – Mount the Servo Motors .....	8
Step 3 – Mount the Battery Pack.....	10
Step 4 – Mount the Wheels .....	12
Step 5 – Mount the Main Circuit Board.....	14
Step 6 – Connect the Servo Motors.....	15
Testing the Robot .....	17
Step 7 – Checking the Connection.....	17
Troubleshooting.....	19

## Copyright

This work is copyright © 2012 Robert C. Rice. All rights reserved.

This work may be used without charge by any local unit of the Boy Scouts, Girl Scouts, American Heritage Girls, 4H or other non-profit youth organization, provided that no charge is made, other than reasonable photocopy costs.

Robert C. Rice

[rcrice@r3home.net](mailto:rcrice@r3home.net)

Cover photo & page 3 photo, copyright Parallax, Inc.

All other photos, copyright © 2012 Robert C. Rice

All clip art is public domain, Open Clip Art Library - <http://openclipart.org/policies>  
<http://creativecommons.org/publicdomain/zero/1.0/>

<http://openclipart.org/detail/159/bulle-gauche-stop-by-technoargia>

[http://openclipart.org/detail/1667/robot-dog-by-johnny\\_automatic](http://openclipart.org/detail/1667/robot-dog-by-johnny_automatic)

[http://openclipart.org/detail/21684/robot-with-a-claw-by-silveira\\_netto](http://openclipart.org/detail/21684/robot-with-a-claw-by-silveira_netto)

<http://openclipart.org/detail/151723/robot-by-hector-gomez-151723>

<http://openclipart.org/detail/82495/cartoon-robot-by-wildchief>

## Parts of the Robot

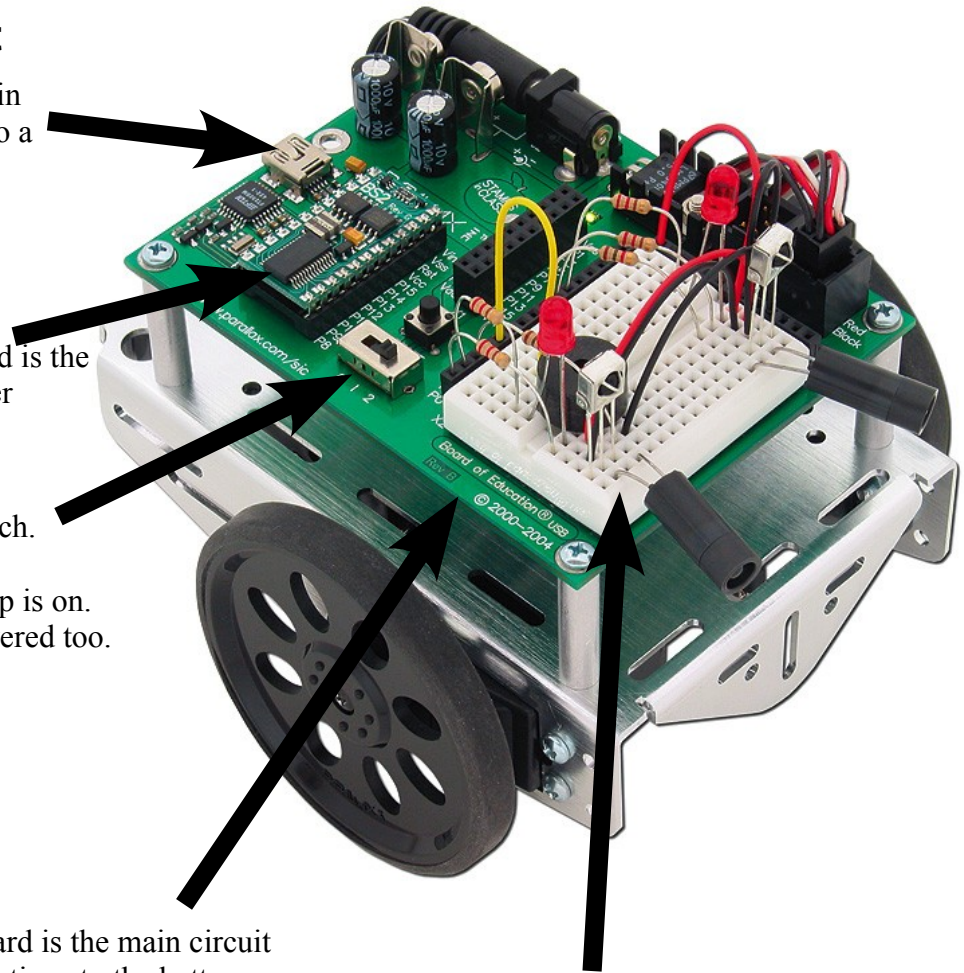
USB port – plug USB cable in here, to connect your robot to a computer for programming.

Basic Stamp – the small board is the programmable micro-computer system that drives the robot

Three position switch.  
0 = off  
1 = basic stamp chip is on.  
2 = motors are powered too.

The large green board is the main circuit board. It has connections to the battery pack and the motors, and provides the electronic circuits needed to support the Basic Stamp.

The white block is called a bread-board, and is used as a base for quickly building and testing circuits.



## Before Getting Started

- A. Read all of the the instructions for each step **before** you start working.
- B. Check the list of parts you need. Make sure you have all the parts.
- C. The screws, nuts and other parts are small. Take care not to lose parts by knocking them on the floor.
- D. Check off each step as completed. That's what the little boxes are for.
- E. When you complete a step, check your work before moving to the next step.
- F. Carpenters say “measure twice, cut once” - same idea applies here. Work slowly and carefully, following the instructions. This will avoid having to redo a step later.

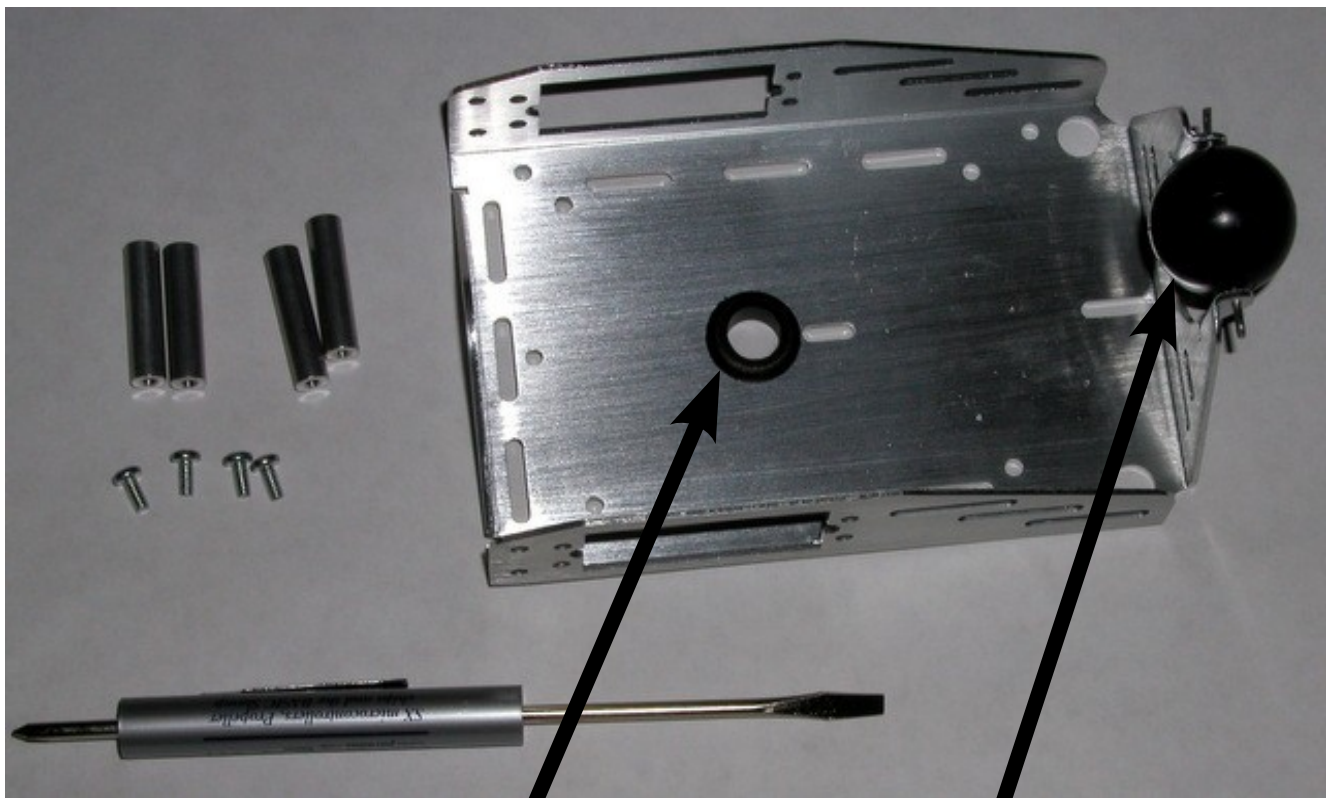
# Building the Robot

## Step 1 – Chassis & Standoffs

In this step you will mount four standoffs to support the main circuit board.

1A. The robot has three wheels, one of which is a ball that is mounted at the end of the chassis. Make sure your robot chassis has the ball mounted. Do not remove the ball, it stays mounted on the chassis.

1B. The robot chassis should have a rubber grommet mounted in the middle of the flat section. The grommet is there to protect the motor cables and the power cable from the sharp edges of the metal chassis. Make sure your chassis has a rubber grommet in the middle. Do not remove the grommet, it stays mounted in the chassis. Make sure the grommet covers all the sharp edges of the hole on both sides of the chassis.



Rubber grommet. Do not take this out.

Rear wheel. Do not remove.



1C. Check the photo above. You will need the following parts:

- Four ¼ inch #4-40 pan head screws  
There are two kinds of screws used in the robot kit, these are the shorter ones.
- Four 1 inch standoffs. The standoffs look like little pieces of pipe.
- Screwdriver

1D. The flat side of the chassis is the top. The edges fold down on the bottom. Mount the four standoffs to the top of the chassis in the four corners. The screws come up from the bottom. Use the screwdriver to tighten each screw until just snug.

**TIP:** Look carefully at the photo – the standoffs are mounted in small holes at each corner. Do not try to mount the standoffs using the slots or the large holes near the corners.

**TIP:** When the four standoffs are mounted, you can hold the main circuit board up and see if the mounting holes at each corner will line up with the standoffs.

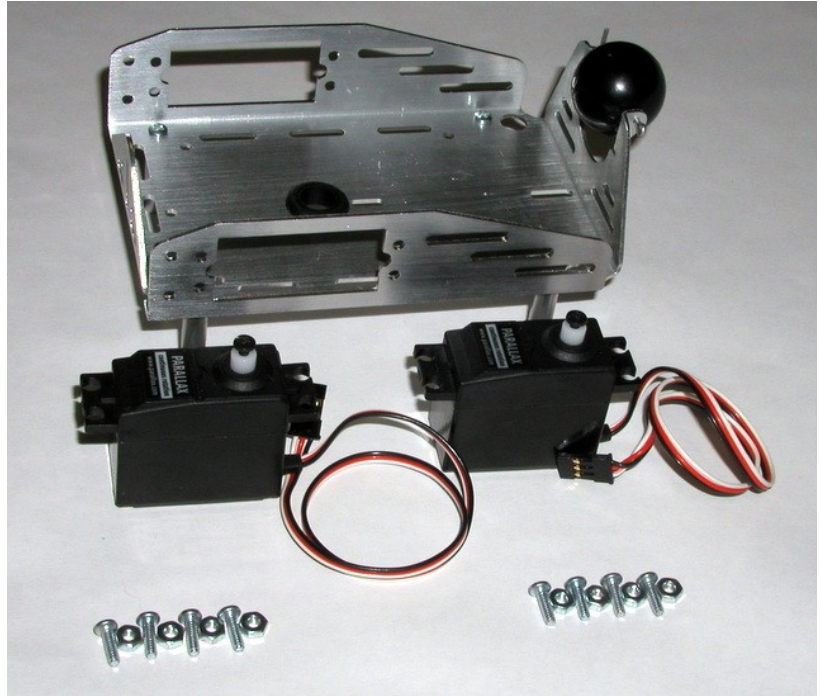


1E. Check your work. Are all four stand offs in place? Are they tightened up snug? They do not need to be very tight, just snug. Are the stand offs mounted to the top?

## Step 2 – Mount the Servo Motors

2A. Check the photo. You will need the following parts:

- Chassis with stand offs already mounted.
- Two servo motors. One marked L and one marked R. Look for tags on the end of the motor cables.
- Eight 3/8 inch #4-40 pan head screws. These are the longer screws.
- Eight #4-40 nuts
- Screwdriver

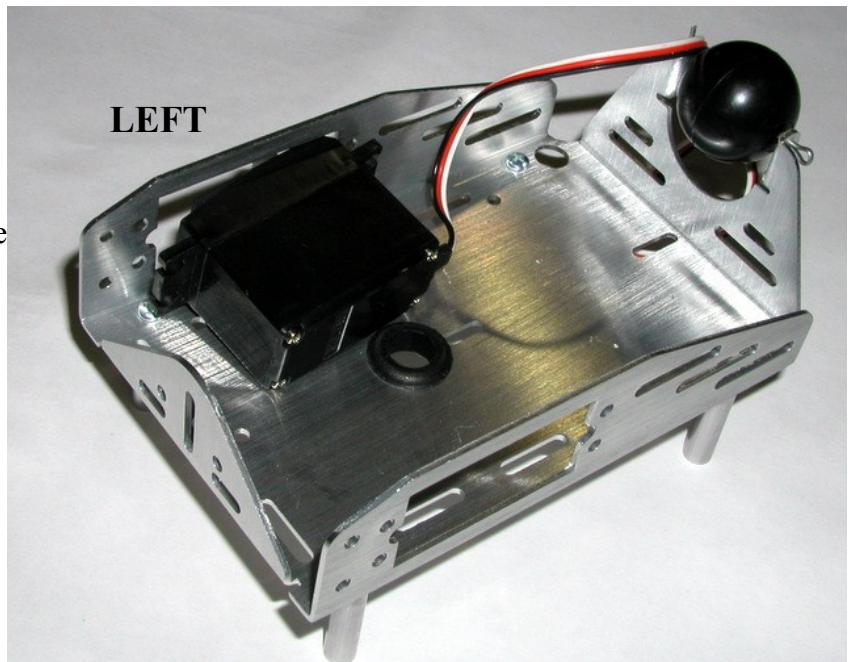


2B. Study the photo to the right.

The servo motors are mounted from the **INSIDE** of the chassis. (Do not drop the servo motors in from the outside.) Notice how the shaft of the motor is in the middle of the chassis – not all the way at the end. The signal cables for the motors should be at the end closest to the third wheel

### Left Side

2C. Lay the chassis down with the third wheel away from you. Install the servo motor marked L to the **LEFT** side of the chassis. Remember to mount the servo motor from the inside of the chassis.





Look for a tag marked L on the end of the control cable.

- 2D. Secure the Left servo motor in place with four screws and four nuts. Only tighten until snug.

**TIP:** Look carefully at the photo – make sure the servo motor is mounted from the inside of the chassis. Make sure that the shaft of the motor is in the middle of the chassis, not all the way at the end.

### Right Side

- 2F. Install the other servo motor (marked R) to the RIGHT side of the chassis. Remember to mount the servo motor from the inside of the chassis.

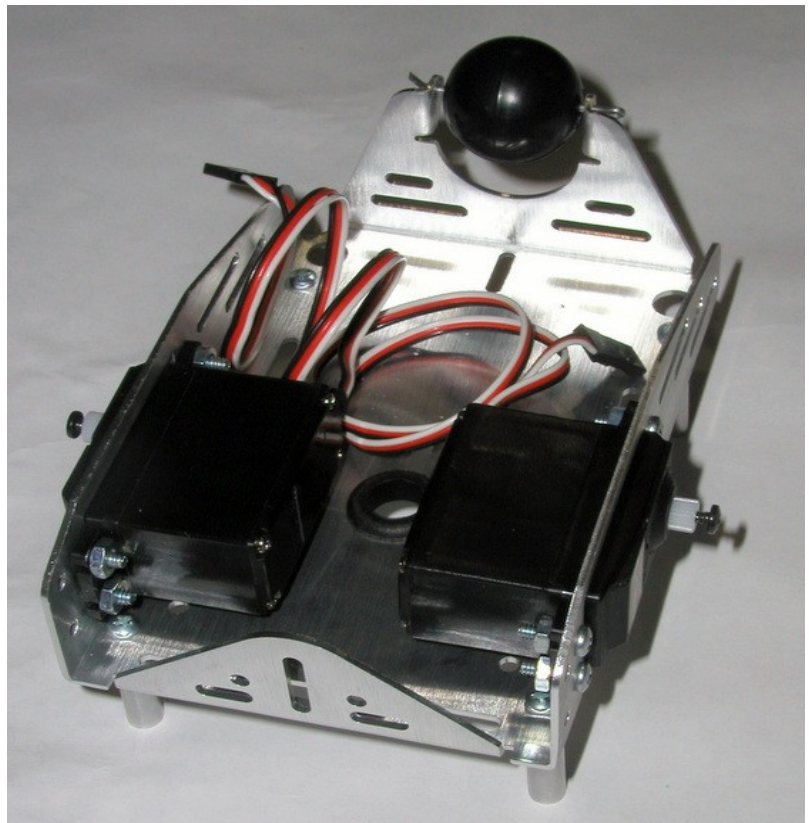
- 2G. Secure the Right servo motor in place with four screws and four nuts.

The screws go in from the outside, the nuts will be on the inside. Only tighten until snug.

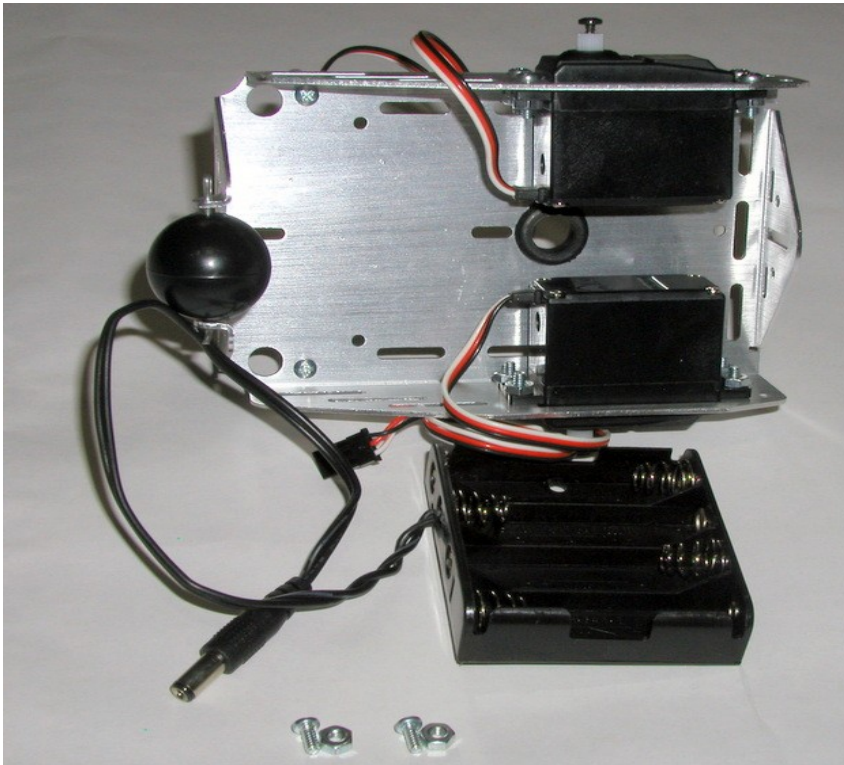


### Check your work

- 2I. Are both motors mounted correctly? Do the control cables point toward the third wheel? Are the mounting screws snug?

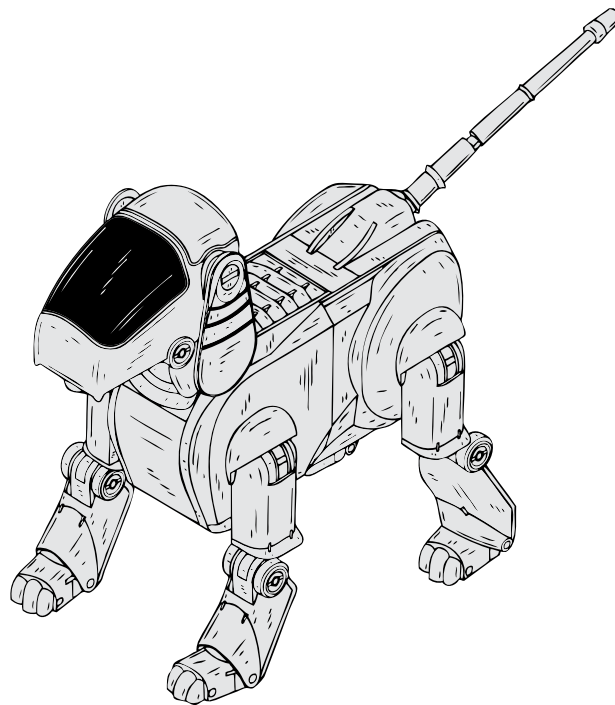


### Step 3 – Mount the Battery Pack

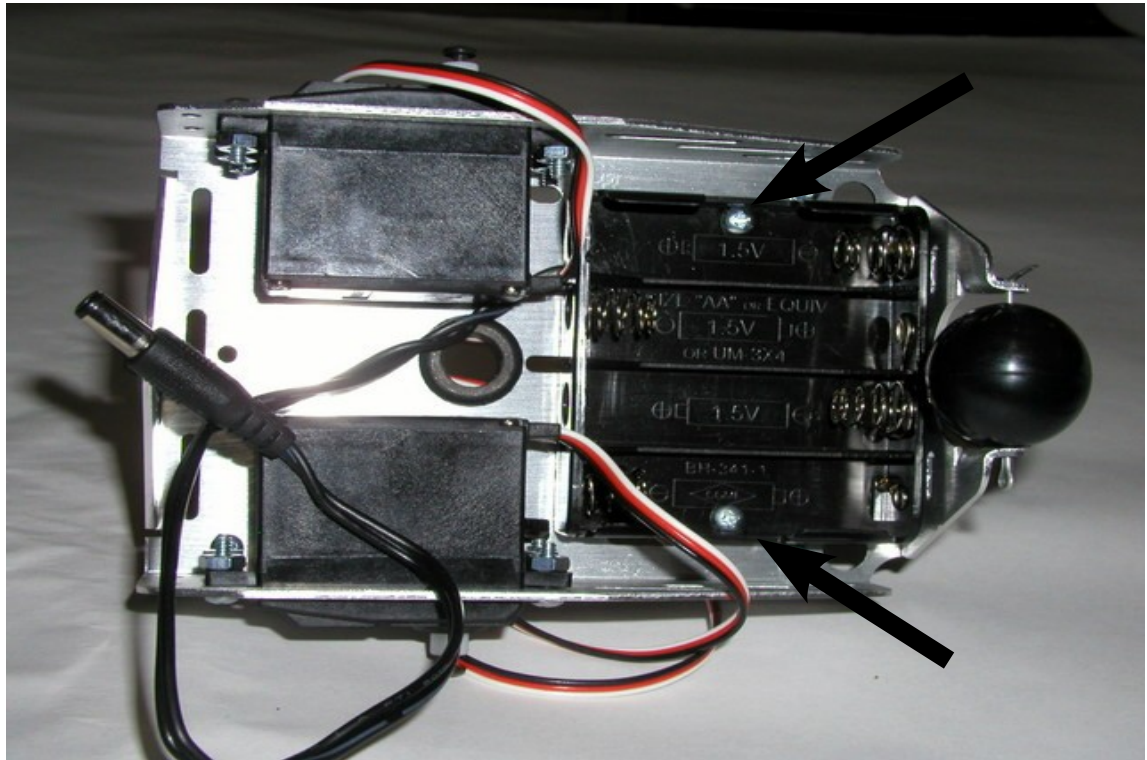


☐ 3A. Check the photo. You will need the following parts:

- Robot chassis, with standoffs and servo motors installed
- Battery pack with attached power cable.
- Two 1/4 inch #4-40 pan head screws
- Two #4-40 nuts



- ❑ 3B. Study the photo below to see how the battery pack fits into the chassis and is fastened with two screws and nuts. Notice how the AA batteries will run long-ways in the chassis, not side to side. The power cable should be closest to the rubber grommet.



- ❑ 3C. Using the two screws and nuts, mount the battery pack to the bottom side of the chassis.

**Tip:** The screws go in from the battery pack side, the nuts go on from the other side.

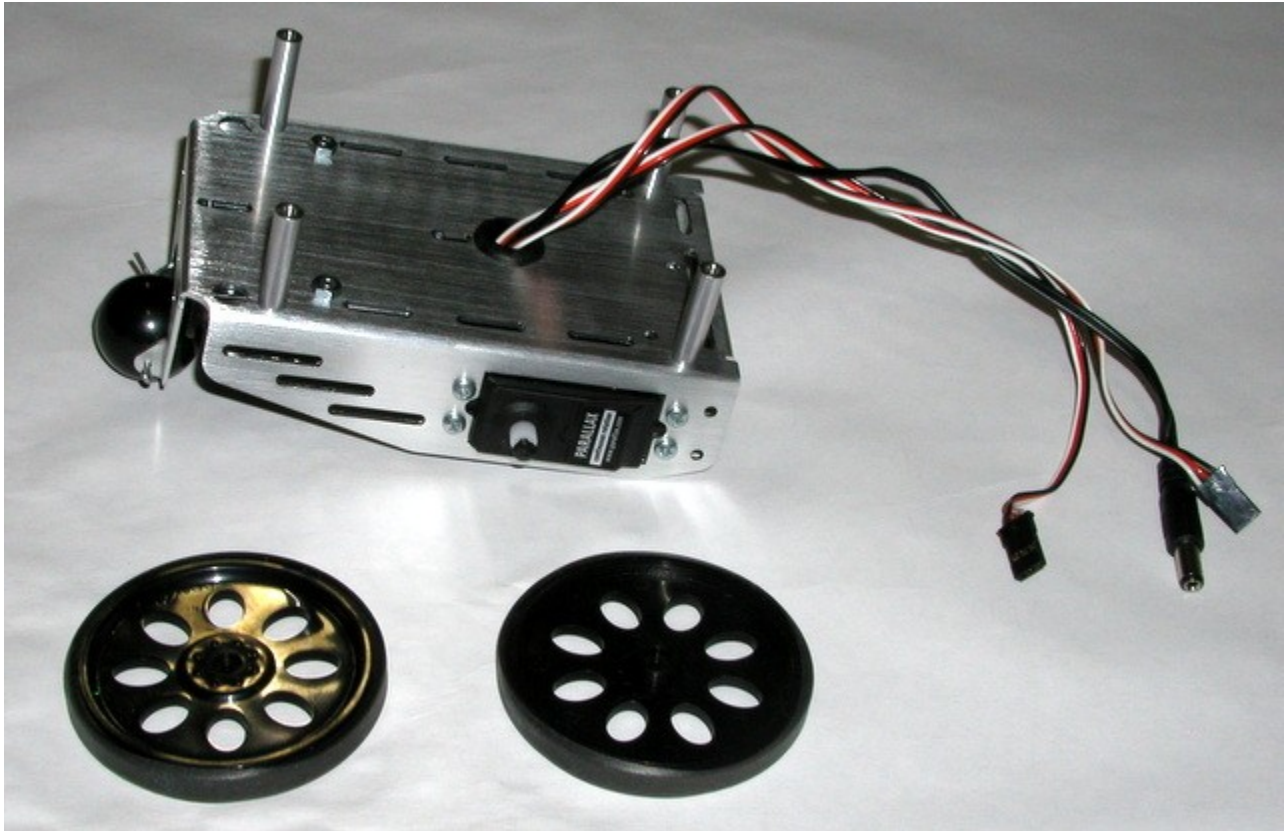
- ❑ 3D. Carefully thread the power cable through the rubber grommet.

**TIP:** Be careful and don't pull the grommet out of place

- ❑ 3E. One at a time, thread the control cables for the servo motors through the rubber grommet. Be careful, and do one at a time.



## Step 4 – Mount the Wheels

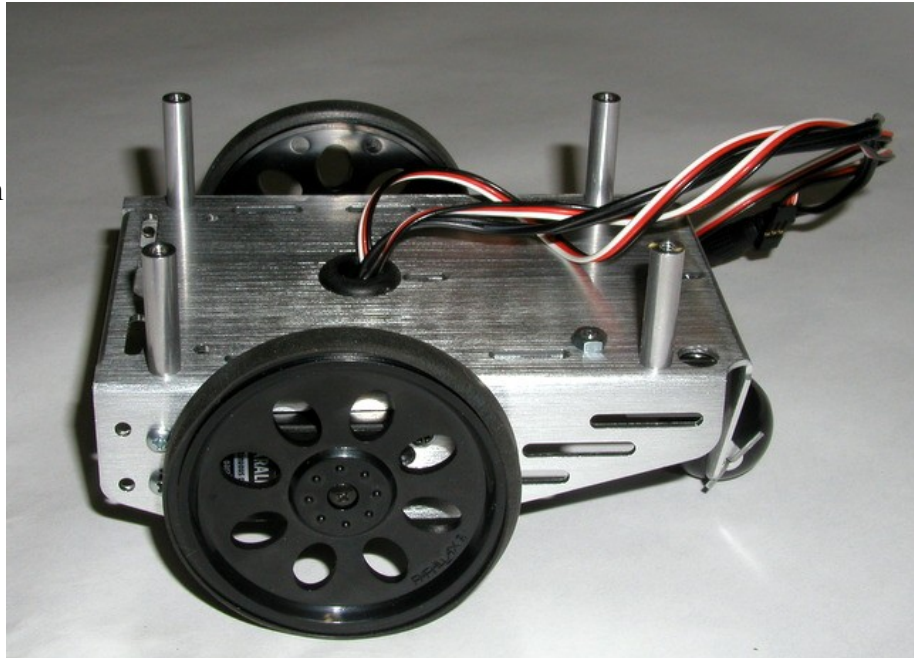
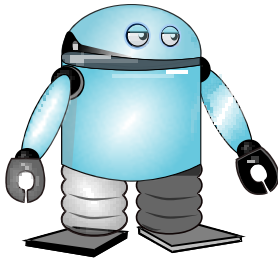


- 4A. Check the photo above. You will need the following parts:
  - Robot chassis, with standoffs, servo motors and battery pack.
  - Two wheels with rubber band “tires.” (Do not remove the rubber bands.)
  - Two black screws (You will find these screws on the the shaft of each motor)
  - Screwdriver
- 4B. Carefully remove the screw from one of the motor shafts. Make sure you do not lose the screw.
- 4C. Press the wheel onto the motor shaft. It should stay in place on its own.  
**Tip:** The wheels have decorative lug nut pattern that faces out. The inside has a deep recess that fits on to the motor shaft.
- 4D. Secure the wheel in place with the screw you removed in step 4B. Be very gentle when installing the screws. Tighten the screw just enough to be snug against the wheel – no more.

4E. Install the second wheel in the same way. Remove the screw from the motor shaft, taking care not to lose the screw.

4F. Press the second wheel in place, then gently install the screw, just tight enough to be snug and no more.

4G. Check your work. Both wheels in place? Both screws installed? Do both wheels have their rubber band tires? (The rubber bands stay in place on the wheels and should not be removed.)

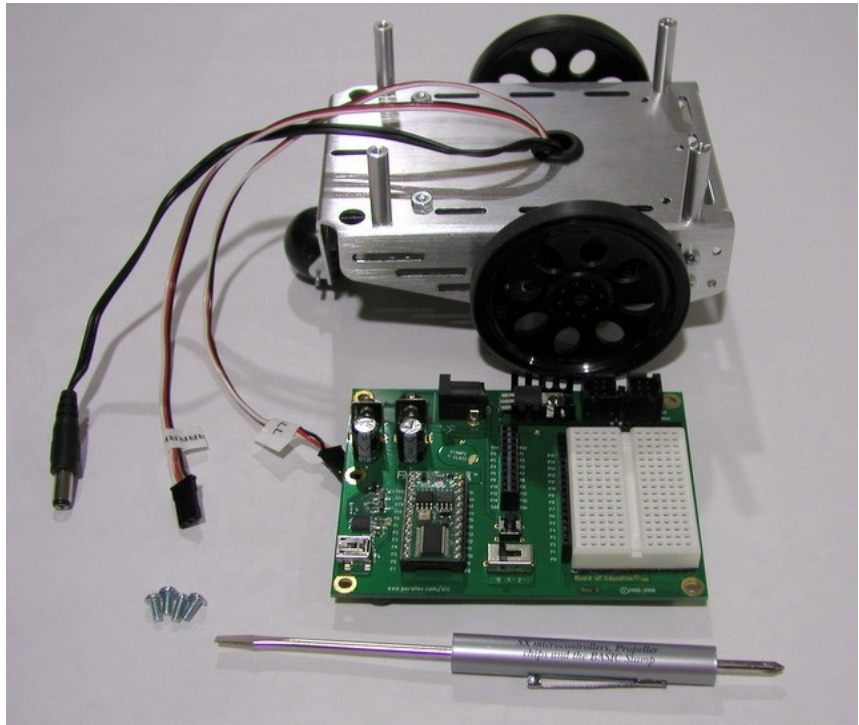




## Step 5 – Mount the Main Circuit Board

5A. Check the photo. You will need the following parts:

- Robot chassis, with standoffs, servo motors, battery pack & wheels
- Main circuit board
- Four ¼ inch #4-40 pan head screws (these are the short screws)
- Screwdriver



5B. Set the robot chassis in front of you. The back (ball) wheel will be on your left. Make sure the power cable from the battery pack and the two control cables from the two servo motors have been threaded through the chassis through the rubber grommet, and are on top.

5C. Set the main circuit board on top of the four standoffs. Make sure the white block is closest to the large wheels (NOT on the same end of the chassis as the back (ball) wheel).

5D. Install the four screws through the mounting holes on the main circuit board and screw down into the standoffs. Tighten until just snug.

5E. Arrange the power cable so it comes out the back, over the rear wheel.

5F. Arrange the servo motor cables so they come out the side, opposite the switch.

## Step 6 – Connect the Servo Motors

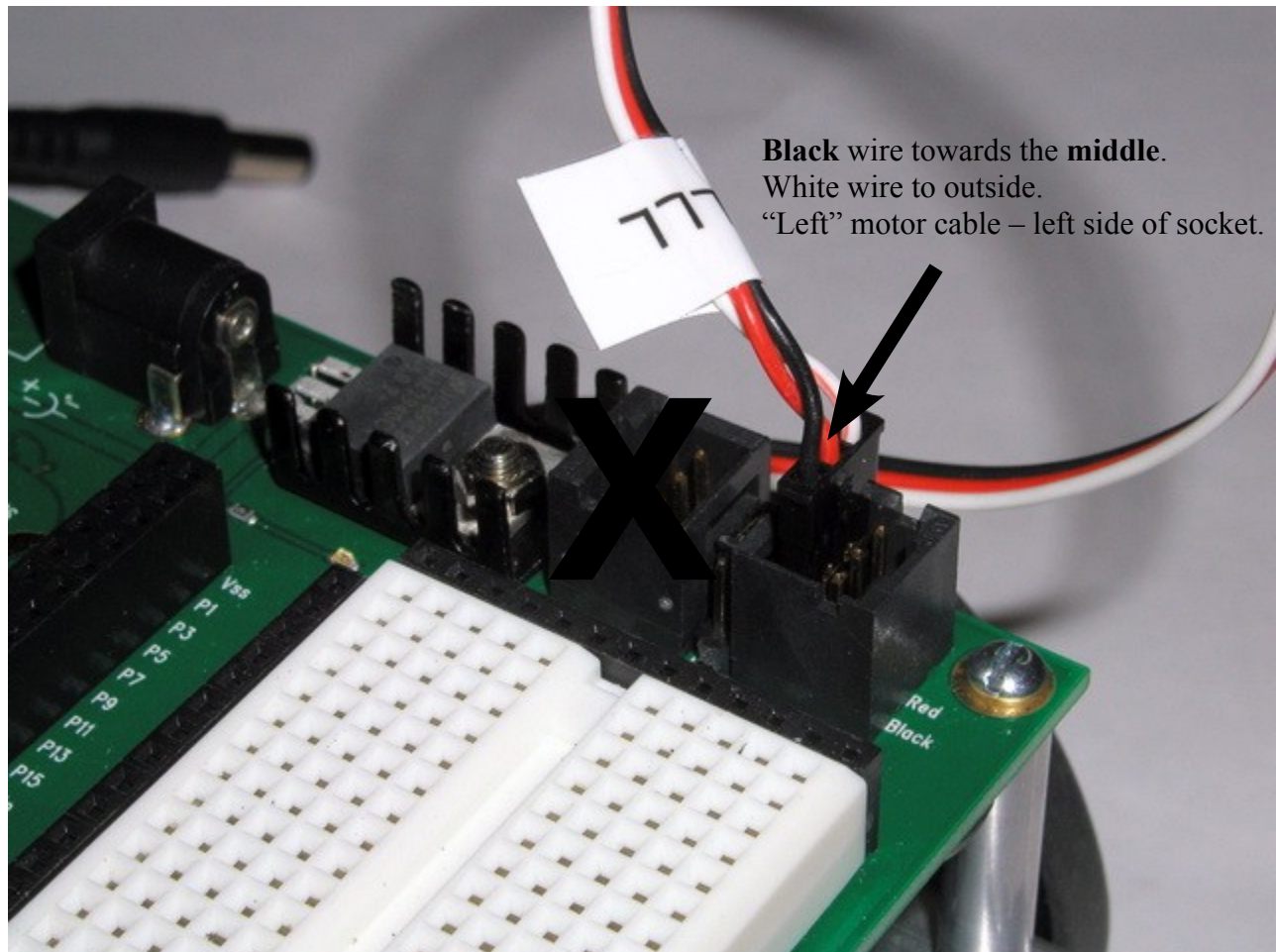
6A. You will need the following parts:

- Assembled robot chassis

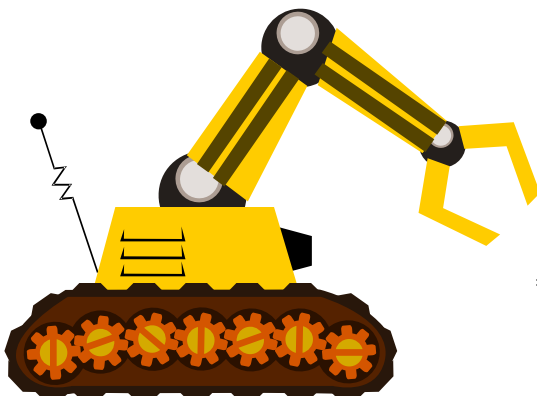
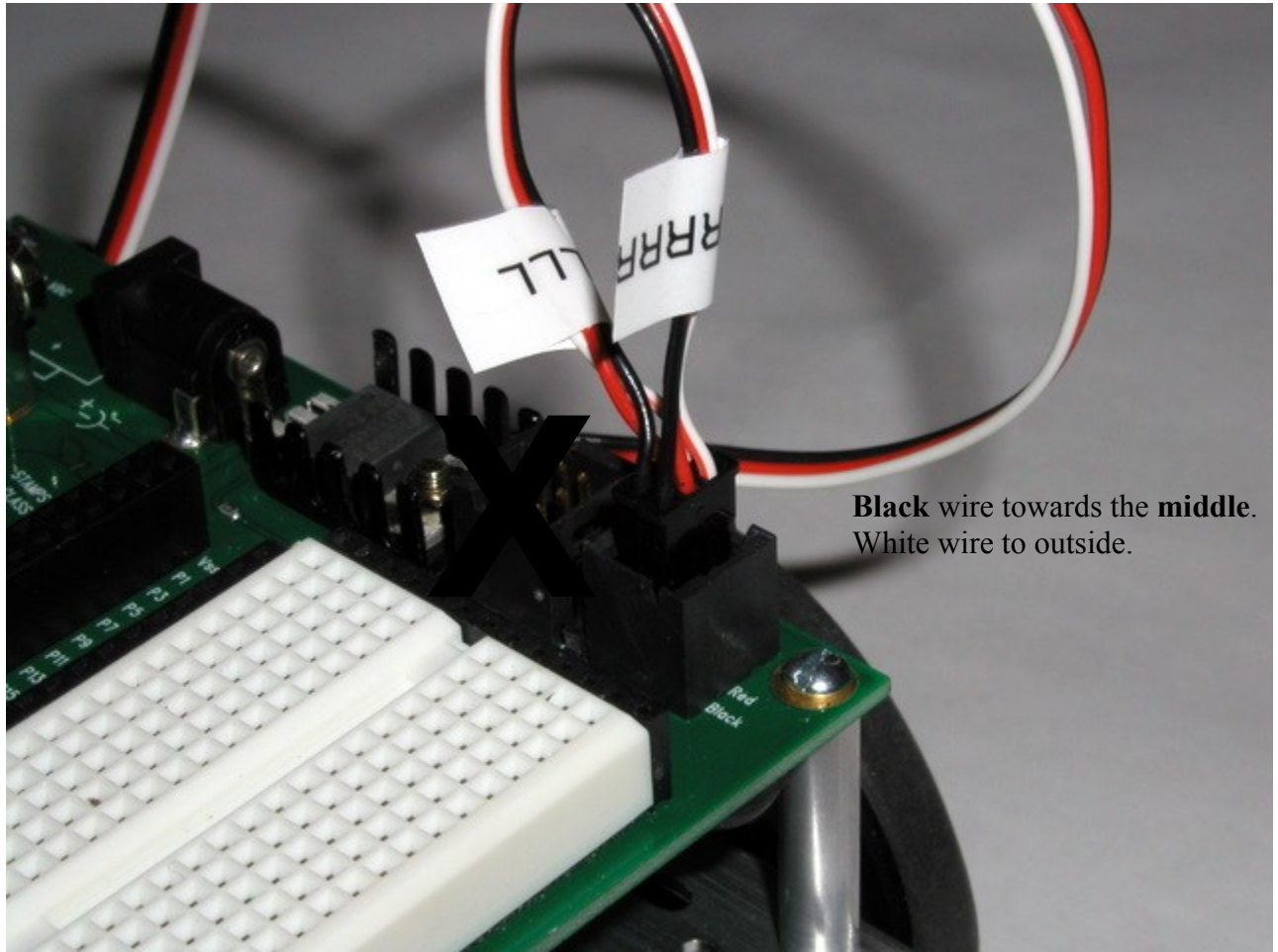
6B. In this step you are going to connect the servo motors to the main circuit board. Look at the top right corner of the main circuit board – there are two square connectors, each with six metal pins. The servo motors plug into the connector closest to the corner of the circuit board.

6C. Study the photo below. The control cable for the left servo motor is labeled “L.” Plug the L cable into the left side of the connector in the corner of the main circuit board. The black wire goes toward the middle of the circuit board. The white wire towards the edge of the circuit board.

**Tip:** Be careful – do not bend the pins in the socket.



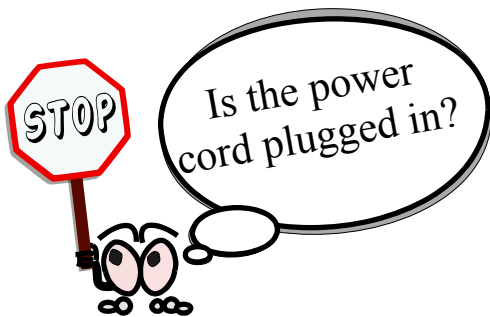
- ❑ 6C. Now plug in the R motor control cable. It plugs into the right side of the connector. Again – BLACK wire towards the middle of the circuit board. White wire towards the edge.



## Testing the Robot

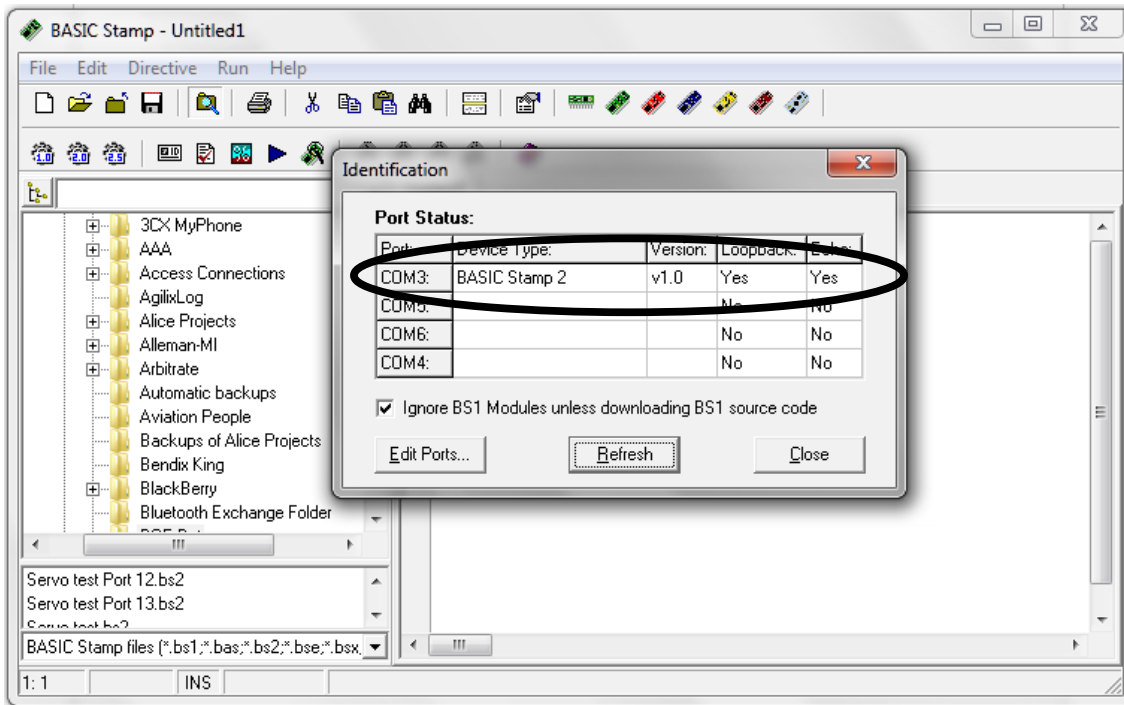
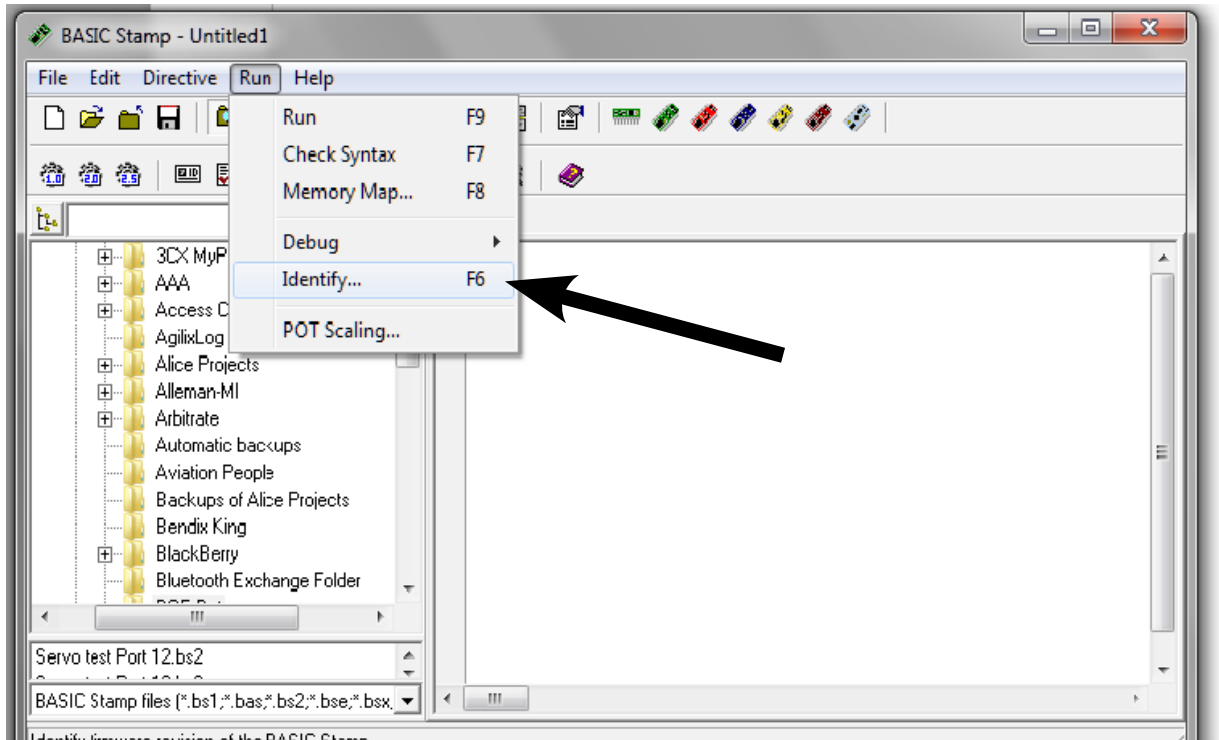
### Step 7 – Checking the Connection

- 7A. In this step you will connect your robot to a computer to test the main board and make sure that the servo motors are connected correctly.
  
- 7B. You will need the following parts:
  - 4 AA size batteries
  - Assembled robot chassis
  - USB cable
  - Laptop computer with Basic Stamp Editor v. 2.5.2 software installed.
  
- 7C. Install 4 AA size batteries into the battery pack. Follow the outlines in the battery pack. Flat end of the battery toward the spring.
  
- 7D. Insert the power plug from the robot's battery pack into the power jack at the top left of the main circuit board.



- 7D. Set the robot's 3 position switch to position 1. This turns on power to the circuit board, but does not power the motors. Look for a green light
  
- 7E. Start up the Basic Stamp Editor software.
  
- 7F. Plug the USB cable into the robot and into the laptop computer.

7G. Click on Run, then Identify. The software will communicate with the main circuit board and identify the version of the Basic Stamp chip installed.

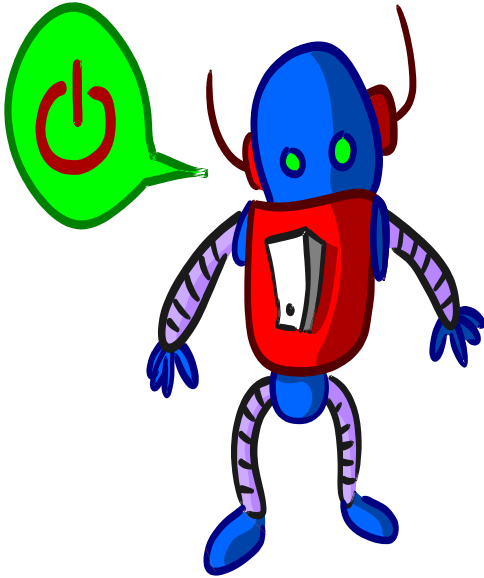


This shows that the computer can communicate with the Basic Stamp and will be able to program the robot.



## Troubleshooting

If the robot is not detected, follow these steps.



robot, then unplug the USB cable, press the reset button on the main board, then plug the in usb cable again.

- **Make sure you really did plug in the battery pack.** This is the most likely reason it won't communicate.
- Did you remember to put the **batteries** into the battery pack?
- Is the three position switch set to position 1? When set to position 0 (all the way to the left) the main board is turned off.
- If the main board has power, a small bright green light shows at the upper middle part of the board.
- Press the small “reset” button which is on the main circuit board, next to the 3 position switch.
- Click the Refresh button in the software. Is the robot detected?
- If the Basic Stamp Editor program still cannot detect the