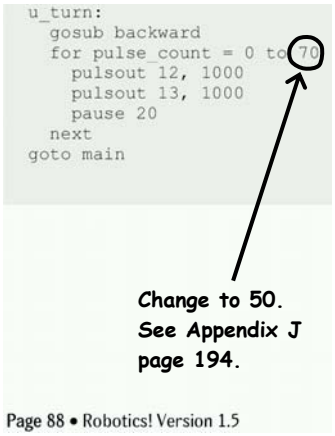
Appendix J: New Components and Special Instructions

Five of the components in the Boe-Bot kits have been upgraded. This appendix explains how to change the instructions in the *Robotics! v1.5 Student Workbook* for improved Boe-Bot performance with each component.

Figure J.1 shows a couple examples of how these updates can be recorded in your *Robotics! v1.5* text. We recommend that you pencil in small changes. For larger changes with extra information that might be difficult to fit on a particular page, pencil in a reference to this appendix so that you will know to check for special instructions when you get to that page. Also, make sure to keep this appendix with your *Robotics! v1.5* text.



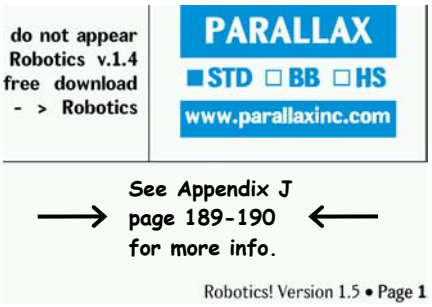


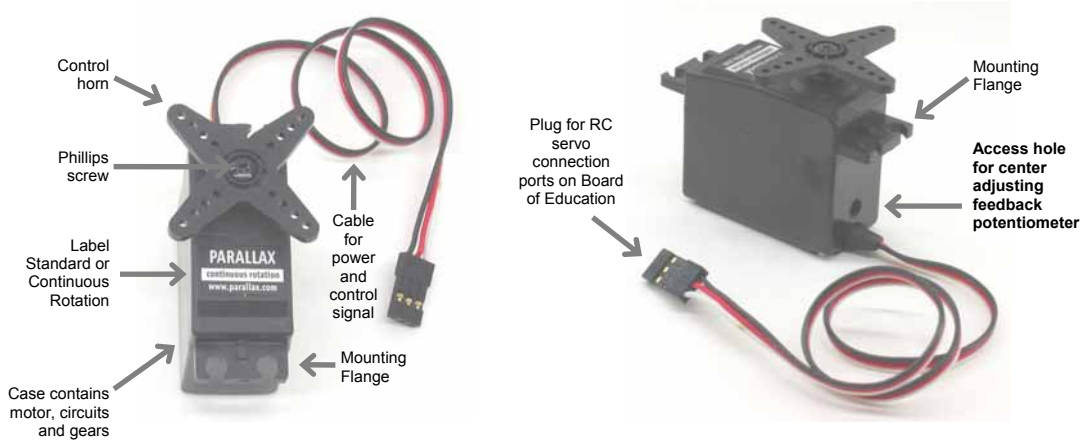
Figure J.1
Examples of Entering These Updates into Your Robotics! v1.5 Text

J

Page 1

The new, adjustable Parallax Continuous Rotation servo shown in Figure J.2 has replaced the Parallax PM (pre-modified) servo. The access hole for center adjusting the feedback potentiometer inside the servo is an important new feature. These new servos are also faster, quieter, and draw less power.

Figure J.2
Parallax Continuous Rotation Servo



- Add these entries to the Servo Identification Table on page 1.

PARALLAX continuous rotation www.parallax.com	Use *Robotics v1.5* plus the special instructions in Appendix J (this document).
PARALLAX standard servo www.parallax.com	This servo is used in the What's a Microcontroller kits. A pair of them can be used with *Robotics! v1.4* the same way an STD servo can.

Figure J.3
New Rows for Servo Identification Table

Page 13 and onward

The Board of Education shown in Figure J.4 is now Rev C, not Rev B. Its new features are the Servo Power selector and 3-position switch.

- From page 13 onward, replace "Board of Education Rev B" with "Board of Education Rev C".

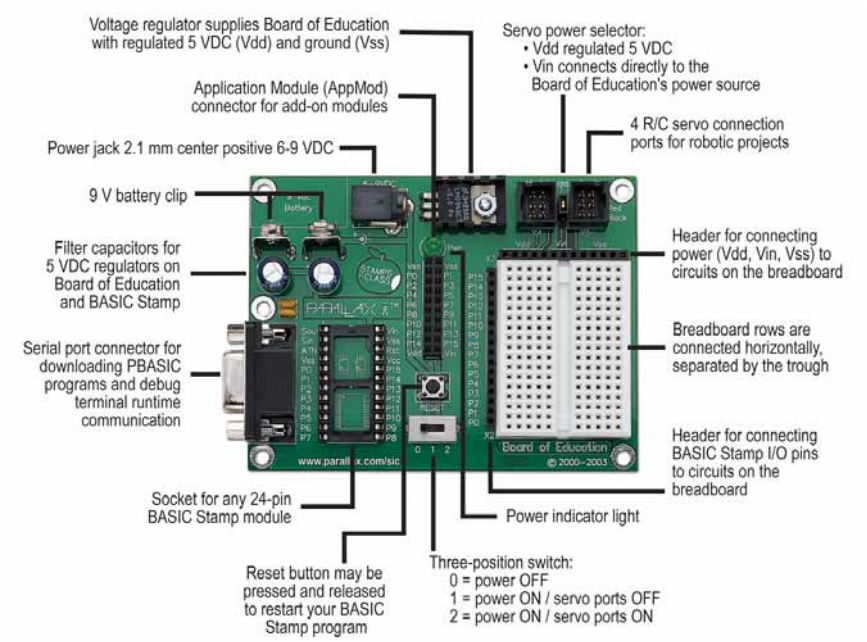


Figure J.4
Board of Education Rev C

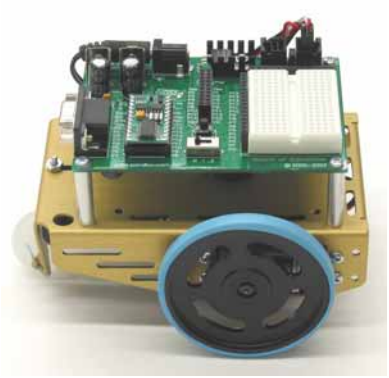
Top view - features and components

Page 16 and 17

The new molded plastic wheels shown in Figure J.5 give the Boe-Bot a more modern look, and the rubber-band treads provide improved traction.

- Substitute all instances of "o-ring tire" with "rubber band tread".
- Use the pictures below in place of figure 1.16 on page 16 and 1.17 on page 17.

Wheel Parts - Figure 1.16, page 16



Front wheel mounted on servo output shaft - Figure 1.17 (b), page 17

Figure J.5 Updated Wheel Assembly and Mounting Photos

➥ The first instruction on page 17 should read:

- ☐ Stretch each rubber band tread and seat it around the outer edge of each plastic wheel.

Page 19 instructions between Figure 1.20 and Activity 3

- ☐ Set the 3-position switch on the Board of Education to position-0 as shown in Figure 1.20 (c).

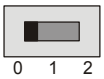


Figure 1.20 (c)
3-position Switch

Set to 0 to turn off the power.

- ☐ Plug the battery pack into the Board of Education.
- ☐ Move the 3-position switch from position-0 to position-1 as shown in Figure 1.20 (d).

Figure 1.20 (d)
3-position Switch

Set to 1 to turn the power on.

- ☐ The green light labeled Pwr on the Board of Education should now be on.

Warning Signs: If the green light doesn't come on, looks unusually dim, or flickers, disconnect the battery pack immediately and check your wiring. Any of these warning signs could indicate a wiring problem that could be dangerous to your servo and/or your BASIC Stamp.

Extend your battery life by always moving the 3-position switch to position-0 when you are not using the Boe-Bot.

Page 29 - Insert these instructions between Figure 1.27 and "Let's start by…"

Before programming the Boe-Bot to go anywhere, it's essential to program it to stay still and make sure it actually does stay still. If it doesn't stay still when it is supposed to, it means the Parallax Continuous Rotation servos need to be adjusted. These instructions will guide you through the steps of testing the servos to make sure they stay still, and adjusting them if necessary.

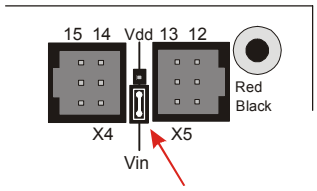
- ☐ Set the 3-position switch to position-0.

Figure 1.27 (b) shows the servo header on the Board of Education Rev C. This board features a jumper that you can use to connect the servo's power supply to either Vin or Vdd. To move it, you have to pull it upwards and off the pair of pins it rests on, then push it onto the pair of pins you want it to rest on.

- ☐ If you are using the 6 V battery pack, make sure the jumper between the servo ports on the Board of Education is set to Vin as shown on the left of Figure 1.27 (b). Also make sure that you are using four 1.5 V AA alkaline batteries.

> **Use only alkaline AA (1.5 V) batteries.** Avoid rechargeable batteries because they are 1.2 V instead of 1.5 V.

- ☐ Rechargeable 1.2 V AA batteries will not work.
- ☐ If you are using a 7.5 V, 1000 mA center positive DC supply, set the jumper to Vdd as shown on the right side of Figure 1.27 (b).



Select Vin if you are using the battery pack that comes with the Boe-Bot kits.

Select Vdd if you are using a DC supply that plugs into an AC outlet (AC adaptor).

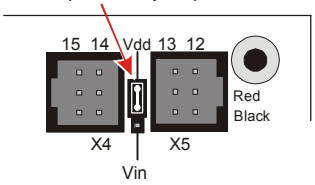


Figure 1.27 (b)
Selecting Your Servo's Power Supply

- ☐ Set the 3-position switch on the Board of Education to position-1.
- ☐ Enter Program Listing 1.6 from page 36 into the BASIC Stamp Editor.
- ☐ Click the Run menu and select Run.
- ☐ After the download is complete, move the 3-position switch to position-2 as shown in figure 1.27 (c)
- ☐ Be ready to catch and lift up your Boe-Bot if it starts moving fast towards the edge of a table, or place it on a small box so that the wheels cannot touch the table.

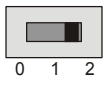


Figure 1.27 (c)
3-position Switch

Set to 2 to power both the Board of Education and the servos.

If the Boe-Bot did not stay still, the rest of the instructions in this section will guide you through calibrating the Parallax Continuous Rotation servos.

- ☐ Move the 3-position switch to position-0.

> **The BASIC Stamp will still remember the program even though you have disconnected its power.** When you reconnect power (a few steps from now) the same program will start running again. You will use this same program to adjust your servos.

- ☐ Remove the batteries from the battery pack.
- ☐ Disconnect the servos from the chassis as shown in Figure 1.20 (d).

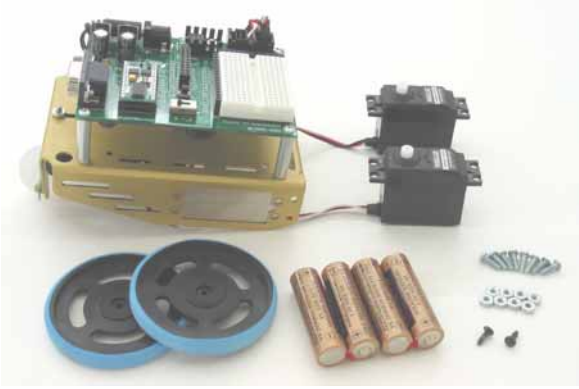


Figure 1.27 (d)
Boe-Bot with Servos Disconnected from Chassis

- ☐ Re-load the batteries in the battery pack.
- ☐ Move the 3-position switch back to position-2.

Because Program Listing 1.6 is still in the BASIC Stamp's program memory, the servos should start moving again as soon as the 3-position switch is moved back to position-2.

- ☐ Use a #1 point screwdriver to adjust the servo as shown in Figure 1.27 (e). By turning the screwdriver you can adjust the servo's speed and direction. **Adjust each servo so that it stays completely still.**

Do not push too hard with the screwdriver. The potentiometer inside the servo is pretty delicate, so be careful not to apply any more pressure than necessary when adjusting the servo.

Centering the servos: The process you just completed is called centering the servos. After your servos are centered, the BASIC Stamp can be programmed to control the servo's speed and direction.

Figure 1.27 (e)
Adjusting the Servo's Potentiometer

The servo must be connected to power and receiving the control signal from Program Listing 1.6 (on page 36).

- ☐ When you are done adjusting the servos, disconnect power by moving the 3-position switch back to position-0.
- ☐ Remove the batteries from the battery pack.
- ☐ Re-attach the servos to the chassis, and re-mount the wheels.
- ☐ Re-load the battery pack.

Use the 3-position switch as follows:

0 Stops the Boe-Bot from operating and allows you to safely build and modify circuits on the Board of Education Rev C.

1 Run PBASIC programs that do not require the servos to move. This will be the best way to run programs that test sensor and indicator circuits that you build on the breadboard.

2 Run PBASIC programs that require the Boe-Bot to turn the Parallax Continuous Rotation servos for Boe-Bot motion and navigation.

☐ Continue where you left off on page 29.

Page 30

☐ Verify that, as you're looking at the wheel from the Boe-Bot's right side, the wheel is turning clockwise fairly rapidly (**50 to 60** RPM).

Page 52 - from Figure 1.3 to the end of the page:

Let's assume your Parallax Continuous Rotation servos turn about 60 RPM (1 RPS), which means that the Boe-Bot travels at 21 cm/s.

t_{travel} is now 50 cm ÷ 21 cm/s = 2.38 s.

Number of loops = 2.38 s ÷ .023 s/loop = 103 loops.

Page 53

☐ Modify Program Listing 2.2 for **103** forward loops (50 cm), then run it and check your results.

Pages 54, 59, 83-84, 87-89, 91-92, 124-125

When turning at full speed, the Parallax Continuous Rotation servos are roughly 1.75 to 1.8 times as fast as the servos used to develop the example programs in this text. This can lead to some pretty crazy Boe-Bot behavior, especially when a program intended to make the Boe-Bot execute a ¼ turn actually makes it execute a ½ turn. Similar problems can occur when a program intended to make the Boe-Bot travel a certain distance actually makes it travel almost twice as far.

This problem only occurs when using pre-programmed navigation routines that are either intended to make the Boe-Bot go forward by a fixed distance or make it rotate to a specific angle. Here is how to fix the problem:

Wherever You See	Replace it with
`for pulse_count = 1 to 75`	`for pulse_count = 1 to 50`
`for pulse_count = 1 to 35`	`for pulse_count = 1 to 20`
`for pulse_count = 0 to 70`	`for pulse_count = 1 to 50`
`for pulse_count = 0 to 35`	`for pulse_count = 1 to 20`

Page 76 and 77

The Whiskers touch sensors have a new shape that improves reliability and improves the Boe-Bot's ability to detect objects on contact.

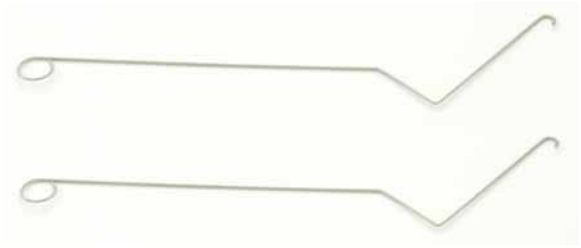
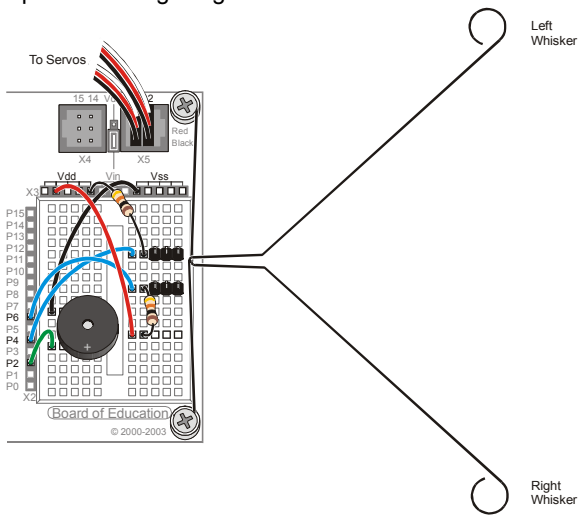


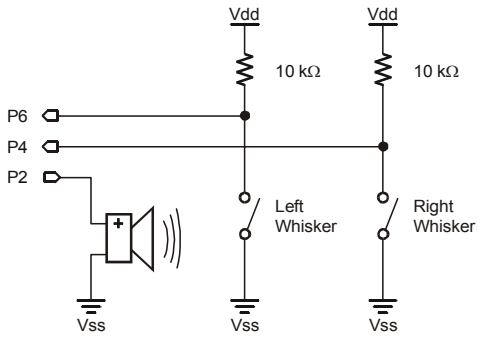
Figure J.6
New Whiskers

- Replace Figure 3.3 and Figure 3.4 with the wiring diagram and schematic shown here in Figure J.7.
- Make sure to follow the wiring diagram shown in Figure 3.3 very carefully. The wires that run from the whisker contact posts to the I/O pins have to be crossed for the system to work correctly. The whisker that detects objects on the Boe-Bot's right (Right Whisker) contacts the left of the two posts, which is connected to P4. The whisker that detects objects on the Boe-Bot's left (Left Whisker) contacts the right of the two posts, which is connected to P6.

Figure J.7
Updated Wiring Diagrams and Schematics for New Whiskers



Wiring Diagram (Figure 3.3)



Schematic (Figure 3.4)

J

Page 119

The infrared LED featured in chapters 5 and 6 is now a 3-part assembly (see Figure J.8) instead of a one piece unit. These infrared LEDs significantly extend the Boe-Bot's ability to remotely detect objects.

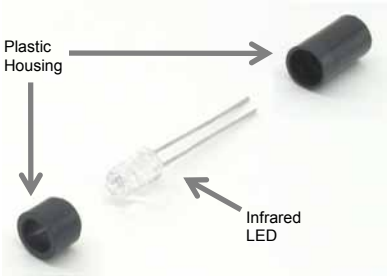
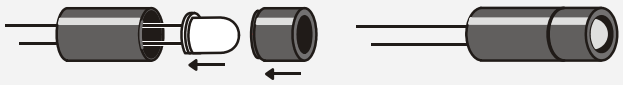


Figure J.8
New Infrared LED and Plastic Housing

Infrared LED Assembly: Your infrared LED should be assembled before using it in a circuit. There are three parts: the IR LED (emitter), the LED Standoff (large cylinder) and the LED Light Shield (small cylinder).

1. Insert the IR LED into the Standoff so that its pins come through the small holes in the bottom. Apply pressure so that the LED snaps into place.
2. Snap the Light Shield onto the end of the Standoff over the IR LED.



↳ Replace the bottom-right part drawing in Figure 5.3 with this figure.

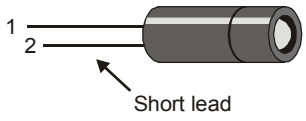


Figure 5.3 (lower right part)
Infrared LED Part Drawing and Terminals.

Page 146

↳ **Modify this code**			↳ **So that it looks like this**		
`Kp_r`	`con`	`125`	`Kp_r`	`con`	`35`
`Kp_l`	`con`	`125`	`Kp_l`	`con`	`35`
`set_point`	`con`	`3`	`set_point`	`con`	`2`

Page 119

√ Increase all pulse width ***`Period`*** arguments that are 500 to **720**.
√ Reduce all pulse width arguments that are 1000 to **780**.