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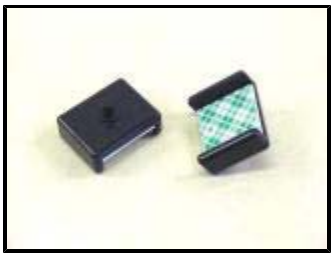
Lynx 5 Arm Inventory Sheet.
Updated 07/03/2003 Rev. 1

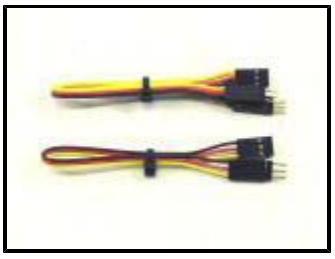
1) Lexan Parts (qty = 4)

2) Hitec HS-422 Servo (qty = 4)

3) Aluminum Servo Brackets (qty = 2)

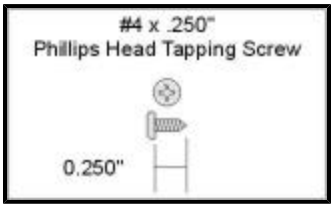


4) Injection Molded Servo Hinges (qty = 2)

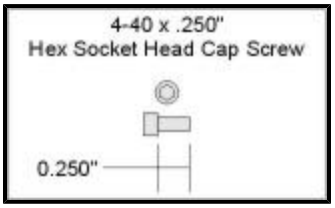


5) "Y" Adaptor Cable (qty = 1)
6) 6" Extender Cable (qty = 1)

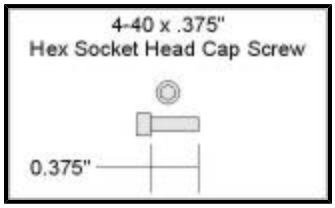
7) 7" Nylon Wire Ties (qty = 2)



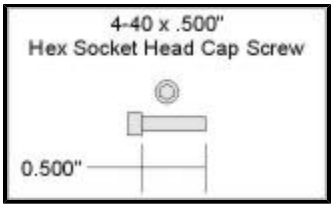
8) #4 x 1/4" Tapping Screw (qty = 6)



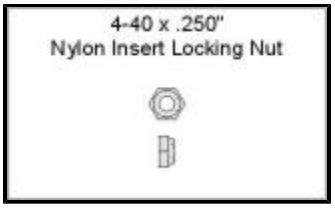
9) 4-40 x 1/4" Hex Head Cap Screw (qty = 8)



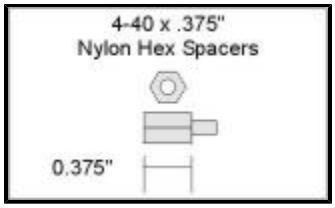
10) 4-40 x 3/8" Hex Head Cap Screw (qty = 8)



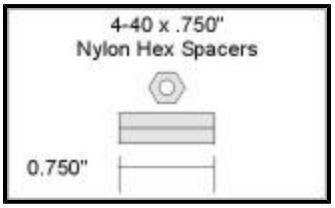
11) 4-40 x 1/2" Hex Head Cap Screw (qty = 8)



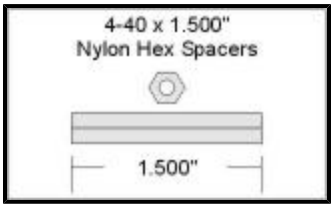
12) 1/4" Lock Nuts (qty = 12)



13) 1/4" x .375" M/F Hex Spacers (qty = 2)



14) 1/4" x .75" F/F Hex Spacers (qty = 4)



15) 1/4" x 1.5" F/F Hex Spacers (qty = 2)

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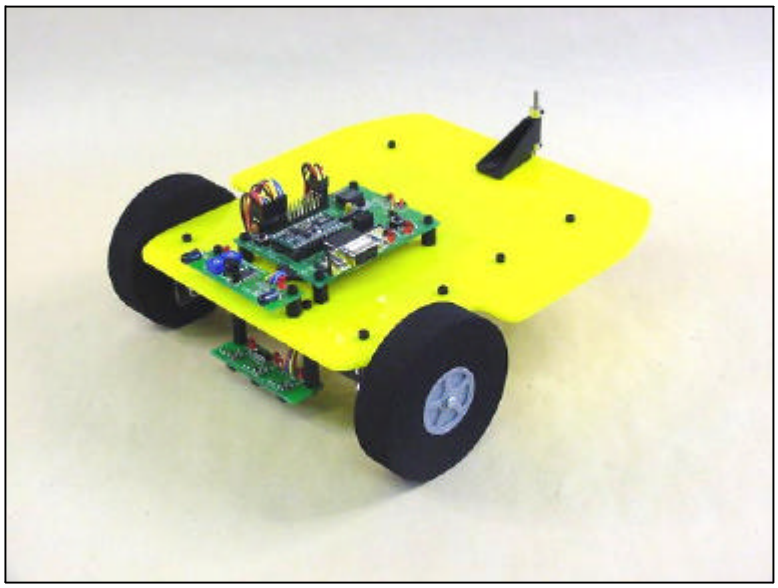
Carpet Rover Kit

This document covers the mechanical assembly of all versions of the carpet rover robot chassis.



Robot Projects and BASIC Programs are Available from our WebSite!

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Assembly Manual CR2-KT Ver 1.0

Introduction

Congratulations on your purchase of a Lynxmotion robot kit! Whether you are a newcomer or a seasoned veteran to the robotics hobby, you have obviously seen the value that a jump-start like this can be for a complex robot project. This kit is the result of countless hours of ongoing work to ensure that you get the highest quality product. However, we are not perfect and sometimes something in the documentation may not come through clearly. As always I invite your feedback. It is this open channel of communication that has been responsible for many improvements to date. It is my hope that the kit will provide you with many hours of enjoyment. Happy Roboting, Jim Frye

Safety First

Read and understand the documentation associated with any of the tools used in the assembly of these kits. Work in a clean, well-lit environment. Work slowly, taking breaks often. Plan your work with plenty of extra time to avoid cramming to complete the project at the last minute. Lynxmotion, Inc. has taken every step to ensure the products sold are safe when used in a responsible manner. Therefore, Lynxmotion, Inc. can not be held accountable for irresponsible, careless or reckless behavior of the builder. These kits are purely educational. Items sold by Lynxmotion, Inc. are not authorized for use in human contact, medical, life-saving, life-support, industrial or light industrial applications. Do not under any circumstances use these robots to move, touch, or handle dangerous or hazardous materials. Doing this could result in injury or death.

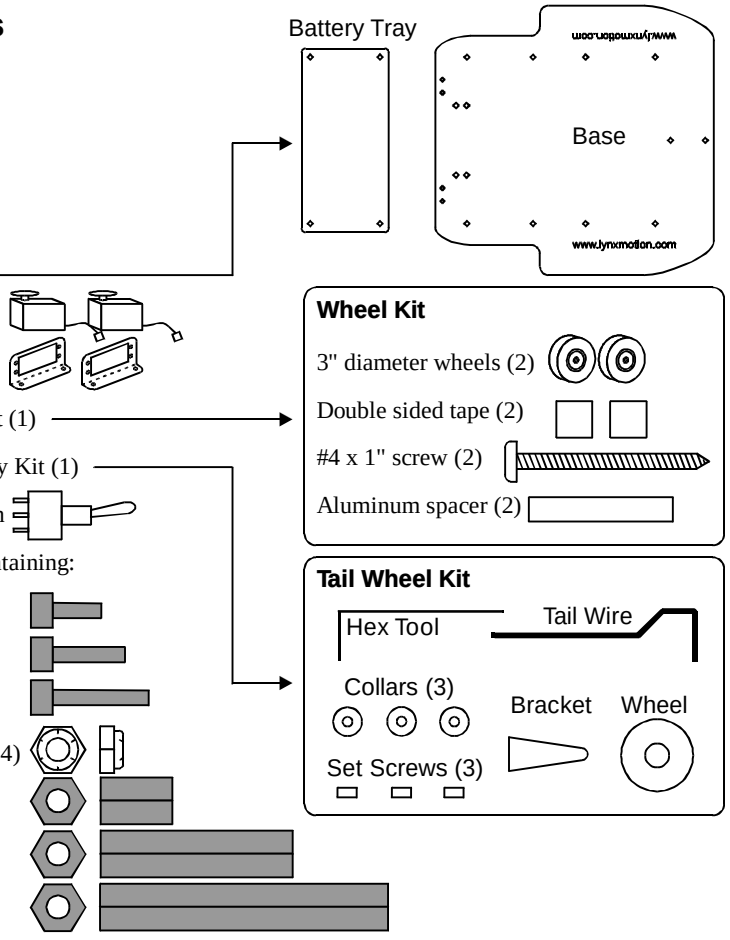
Robots move without warning, wear eye protection at all times!

Required Tools

- Philips screw driver
- 3/32" hex driver
- needle nosed pliers

Parts List

1) Plastic Panels (2)
2) Standard Servos (2)
3) Servo Brackets (2)
4) Wheel Mounting Kit (1)
5) Tail Wheel Assembly Kit (1)
6) DPDT Power Switch
7) One bag of parts containing:
   - 4-40 x ¼" (16)
   - 4-40 x 3/8"(14)
   - 4-40 x ½" (8)
   - 4-40 x ¼" lock nut (14)
   - .375" Hex spacer (6)
   - 1.0" Hex spacer (4)
   - 1.5" Hex spacer (2)



Modify two servos for continuous rotation

Step 1. The most important aspect of doing this step is to use a high quality screw driver, i.e. a Craftsman #1 or an Xcelite #1 Phillips. Disassemble the servo as shown in Figure 1. Be sure to keep the small parts in a safe place. Remove the round servo horn by removing the servo screw, then remove the four servo case screws from the bottom of the servo. Separate the servo case and remove the plastic gears. Remove the nut from the pot, and the small screw from inside the case to release the pot.

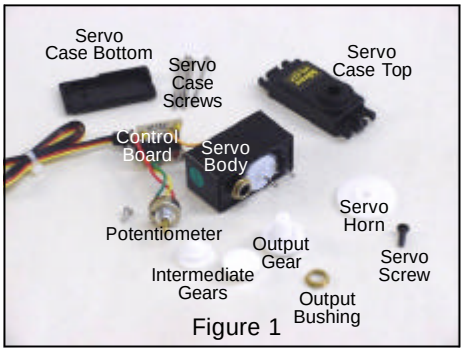


Figure 1

Step 2. The servo's output shaft has a mechanical stop that prevents it from rotating continuously. Remove the mechanical stop so it looks like the one on the right in Figure 2. Wear eye protection for this step! Make the short (vertical) cut first as illustrated in Figure 3, then make the long (horizontal) cut as illustrated in Figure 4. A 1/2" wide square Exacto blade (#18) works well. A fine tooth saw may also be used as shown in Figure 5 and Figure 6. Use whichever method you are the most comfortable with.

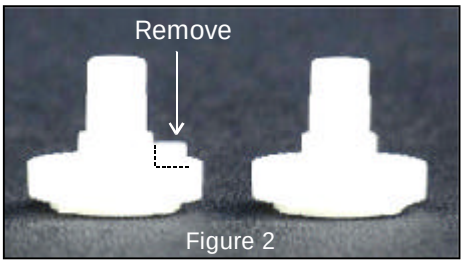


Figure 2

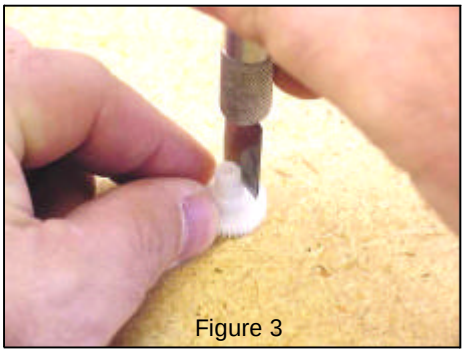


Figure 3

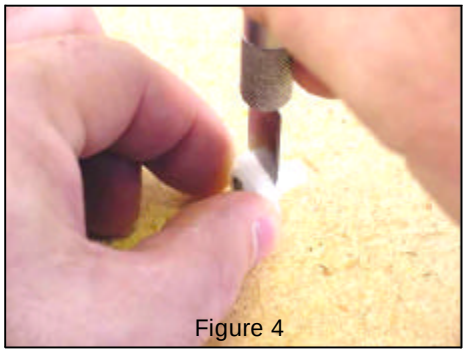


Figure 4

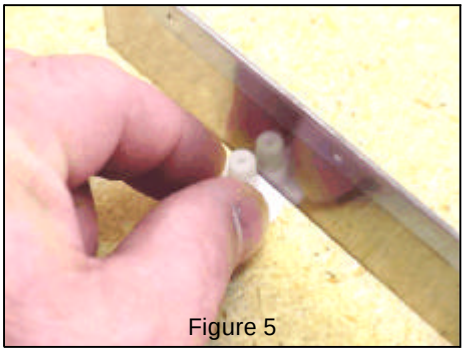


Figure 5

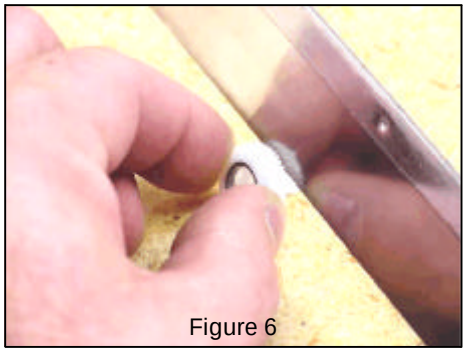


Figure 6

Step 3. When the modification is complete, the servos will turn clockwise with pulses over 1.5mS (longer), and counter clockwise with pulses less than 1.5mS (shorter). When both servos are given longer pulses, the robot will turn in place instead of going forward. This can be handled in software, but is confusing. To have the robot to go forward by sending longer pulses to both servos, simply reverse the wires to the motor inside the LEFT servo. This is optional, but modification to the programs will be necessary if it is not done.

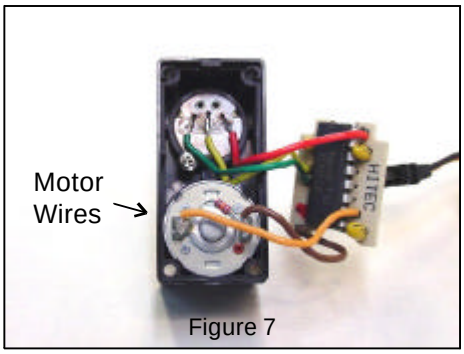


Figure 7

Step 4. In order to adjust the servos stop value, the potentiometer needs to be accessible. Use a pair of needle-nose pliers or a nibbler tool to remove a small section of the case to allow room for the wires to exit. Just give the pliers a twist and the plastic will come out easily. Having the pot on the outside means the servo can be adjusted to stop when given 1.5mS pulses. This will allow the robot, when properly programmed, to "soft start" (go from completely stopped to moving at full speed in a smooth transition) instead of jerking abruptly.

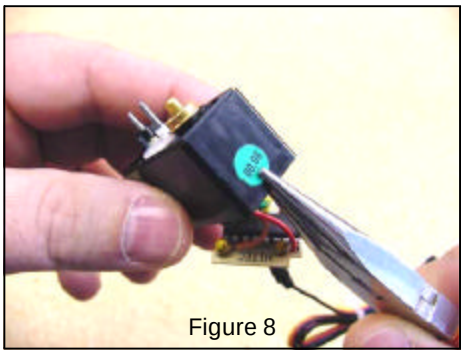


Figure 8

Step 5. Reassemble the servo as follows. Replace the plastic gears and bushing. Gently push the control board back into place. Install the servo case top and bottom. They should fit together squarely with little effort. Finally, replace the four long servo case screws. To test the servos, send them a series of 1.5mS pulses, and adjust the pot until the servo stops rotating. See the documentation that came with your electronics for more info on sending pulses.

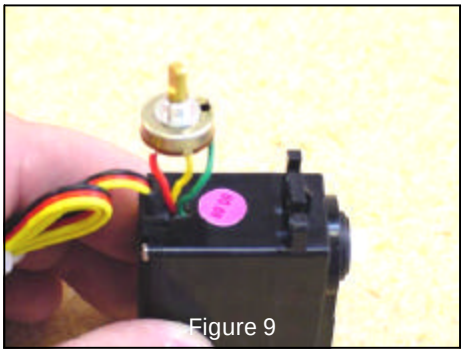


Figure 9

Step 6. Install the four rubber servo bushings on each of the drive servos as illustrated in figure 10. The other components in the servo parts bag are not needed. This completes the servo modification procedure. Now, on to the robot chassis assembly.

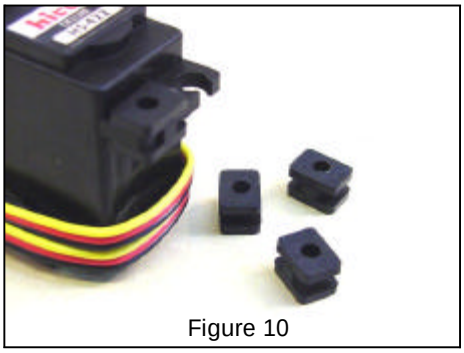


Figure 10

Robot Chassis Assembly

Step 7. Install the black anodized aluminum servo mounting brackets using four of the 3/8" x 4-40 hex socket head screws, and four of the 4-40 lock nuts.

4 -

4 -

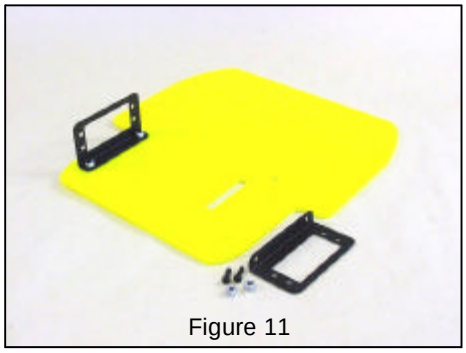


Figure 11

Step 8. Install four of the 1" standoffs to the underside of the chassis using four of the 3/8" x 4-40 hex socket head screws. These will be used to hold the battery tray. Tighten these down snugly.

4 -

4 -

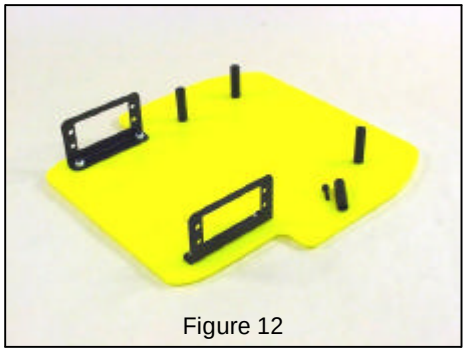


Figure 12

Step 9. Install the battery tray using four of the 3/8" x 4-40 hex socket head screws. This tray is designed to hold a six cell 7.2 volt NiCad or NiMh battery pack using some Velcro (not included at this time). It can also be used to hold many types of battery holders as long as they are less than 1" tall.

4 -

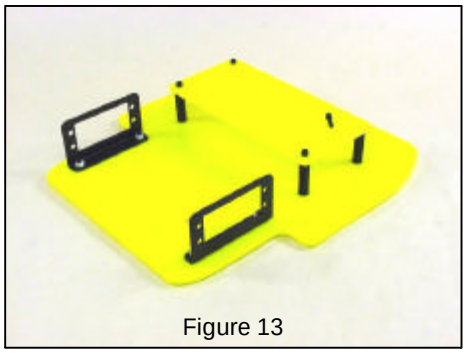


Figure 13

Step 10. Install the servos using eight of the 1/2" x 4-40 hex socket head screws and eight of the ¼" x 4-40 nuts as shown. The servos mount in the brackets from the inside. Take care not to over tighten these.

8 -

8 -

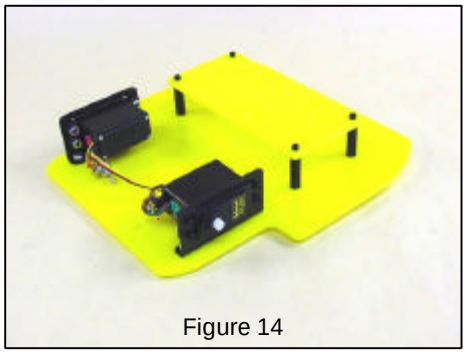


Figure 14

Step 11. Mount the wheels to the servos as shown. Press the aluminum spacer into the wheel.Apply one square of the double sided tape to the round servo horn. Put the 1" screw into the rim and press the servo horn onto the end of the screw, puncturing the tape. Then press the whole assembly onto the servo's output shaft. Screw the assembly together snugly. Take care not to over tighten it as it can strip out the threads.

2 -

2 -

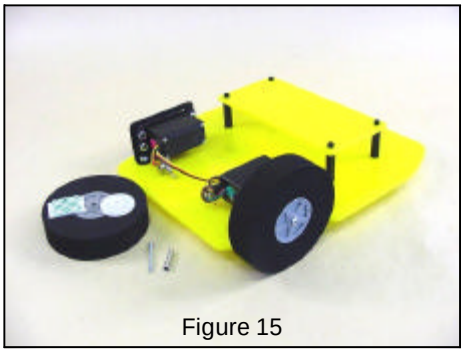


Figure 15

Step 12. Assemble the tail wheel as shown. Put a slight, 10° - 15° bend in the wire form about 1.75" from the straight end. Orient the bend straight up, as if the wire were laying on the table as shown in figure 17. Install the first collar 1" from the straight end. Put the wire into the tail wheel support from the bottom, and install the next collar on the top. Install the wheel and the last collar to the other end of the wire form and tighten everything securely.

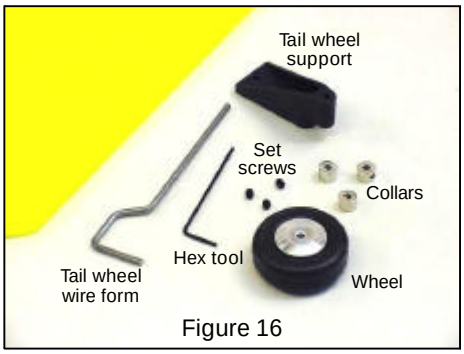


Figure 16

Step 13. Using two of the 3/8" x 4-40 hex socket head screws and lock nuts, install the tail wheel onto the robot chassis.

2 -

2 -

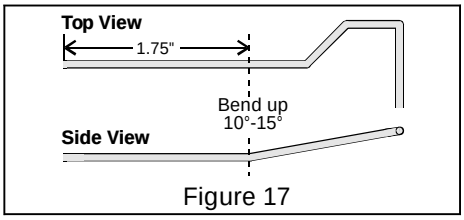


Figure 17

Step 14. Test the assembly. There should be no friction with any of the parts. If something sticks when moving, loosen the collar and adjust it for more play. The assembly should not bind at all when moving the base around in any direction. If it does, add a little more bend to the tail wheel wire. Be aware that some carpeted surfaces may cause a bit of friction when turning, but it should be minor. You will get the best performance on smooth, hard surfaces. If you here a squeak, add a bit of general purpose grease to the tail wheel hub.

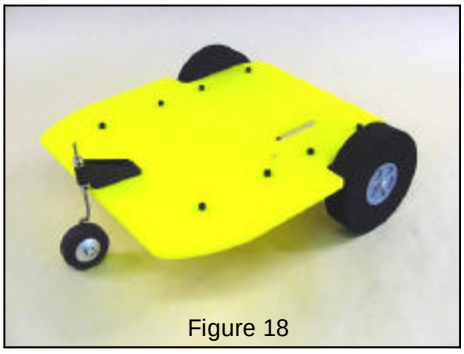


Figure 18

Mounting the Electronic PC Boards

The Carpet Rover chassis is available in three versions. The CR-KT is for the Next Step/BS2 or OOPic-R microcontrollers. The CRBB-KT is for the Board of Education or the Atom dev. board. The CRL5-KT is for the Lynx 5 Arm and the Next Step/BS2 or OOPic-R micro-controllers.Additionally, the CRL5-KT has mounting holes for an SSC-01 or SSC-12 servo controller if required.

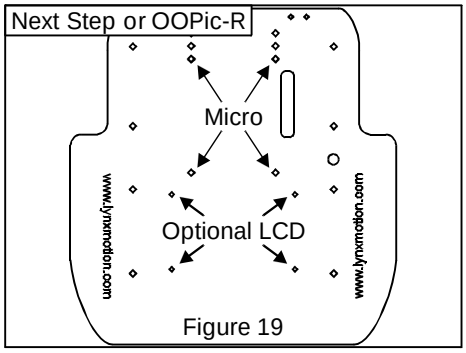


Figure 19

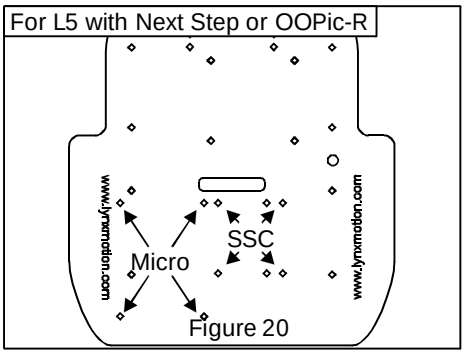


Figure 20

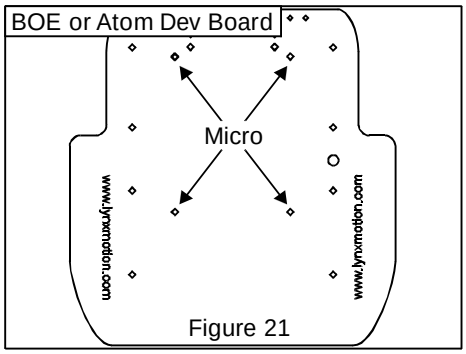
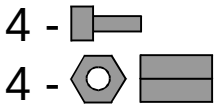


Figure 21

Step 15. The electronic PC boards are attached to the chassis with four of the ¼" x 4-40 hex socket head screws and four of the 3/8" hex standoffs. Figure 22 shows the CR-KT version of the Carpet Rover.



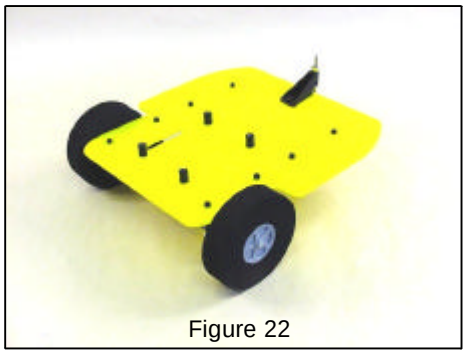
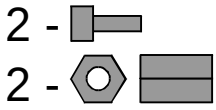


Figure 22

Step 16. The optional IRPD sensor can be attached in a similar fashion. Use two of the ¼" x 4-40 hex socket head screws and four of the 3/8" hex standoffs.



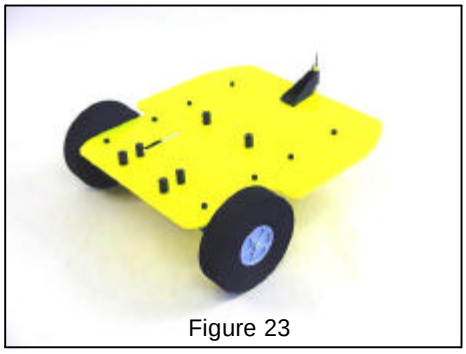


Figure 23

Step 17. The optional Tracker sensor can be attached using two of the ¼" x 4-40 hex socket head screws and two of the 1-1/2" standoffs.

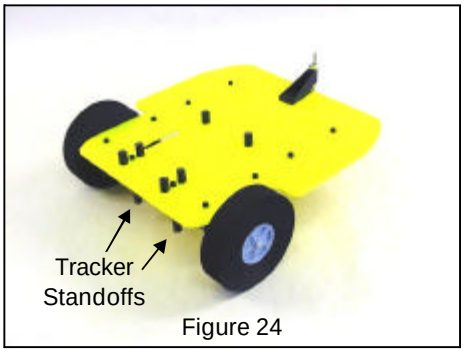


Figure 24

Step 18. The Microcontroller and sensor PC boards are attached to the standoffs using eight of the ¼" x 4-40 hex head screws. The optional LCD display is attached using 2-56 hardware, sold separately. Figure 25 illustrates the assembled CR-KT with the Next Step. Figure 26 illustrates the OOPic-R. Figure 27 and 28 shows the CRBB-KT using the BOE and the Atom boards. Figure 29 shows the CRL5-KT.

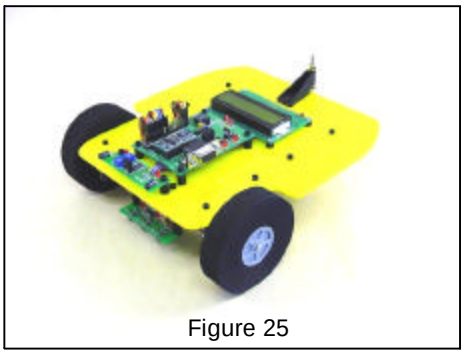


Figure 25

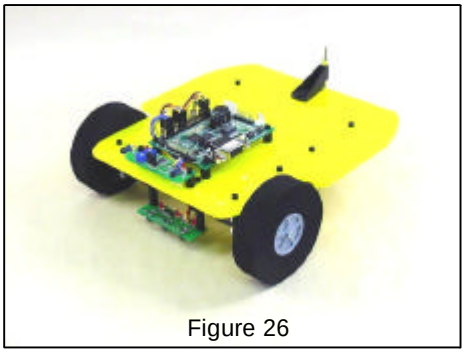


Figure 26

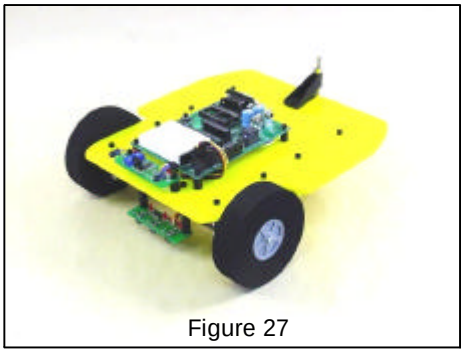


Figure 27

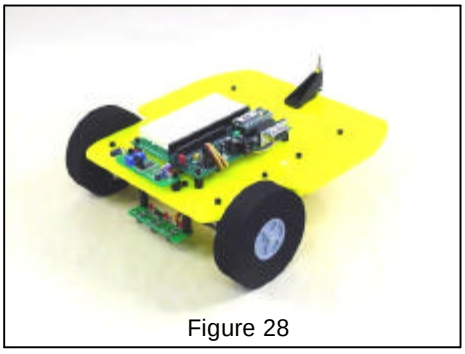


Figure 28

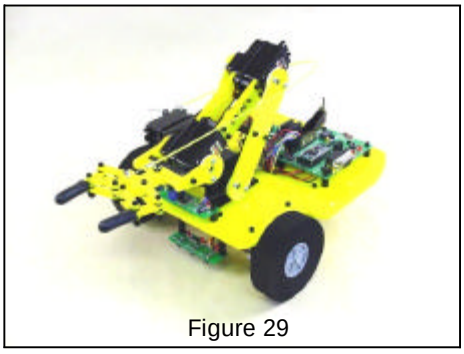


Figure 29

Step 19. Assemble the bumper switches as shown. Add a slight bend in the levers. Push the rigid plastic tubing onto the levers of the switches. Compress the tubing with plyers before assembly to make them slide on easier. Push the rubber end caps onto the tubing.

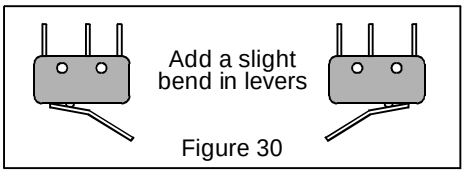


Figure 30

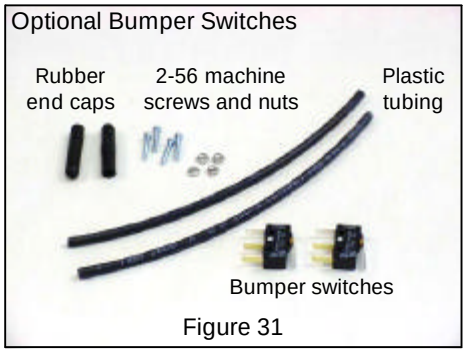


Figure 31

Step 20. Install the bumpers onto the chassis using four of the 2-56 screws and nuts.

This hardware is included in the optional Bumper Switch kit.

4 -

4 -

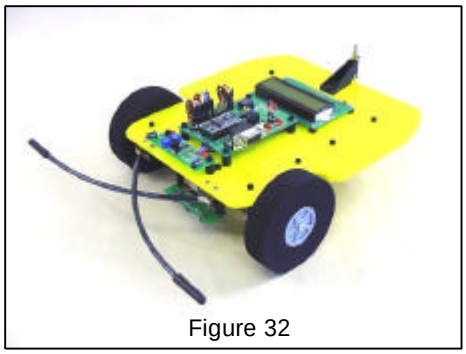


Figure 32

Step 21. Wire the power switch as illustrated. Note: This example is for the Next Step micro-controller, but the principle should be applicable to other electronics. This method uses a DPDT switch to provide battery power to either the microcontroller and servos (normal operation), or just the microcontroller. This is useful to prevent the robot from moving around when making program changes that don't require motion.

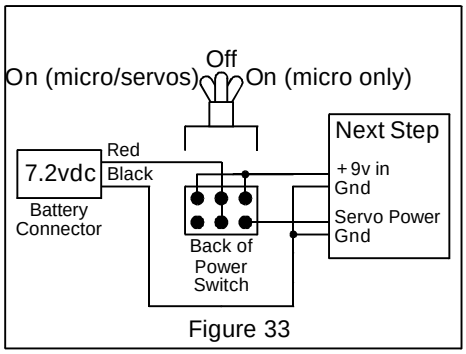


Figure 33

Using your robot

There are many project examples on the web site illustrating the use of a variety of sensors for different robot behaviors. The BASIC programs are available for free download. The I/O pin connection information is also included within the text of the programs, so check this if the project doesn't include a schematic. Check the web site often, as there are new updates weekly.

Lynxmotion also sells a Connector Kit to provide a means of connecting other items to the .1" spaced metal (header) posts that make up the Next Step I/O pins. This kit provides all of the material and tools needed to make up to 25 removable jumper wires. Use these to wire any electronics that do not include the wire and connectors like our plug and play peripherals.

Programming your robot

The Carpet Rover is available with different microcontrollers. It is beyond the scope of this manual and Lynxmotion Inc. to teach programming and write programming examples for every version of microcontroller than can be used to control this robot. We will provide example programs as they are submitted by other users. You are encouraged to submit your programming examples. Lynxmotion will post them on the web site with complete credit. We will provide a quick start for the Next Step with the BS2.

Downloading Programs for the Next Step / BS2

In order to program your Next Step / BS2 you will need the Parallax Windows Editor. This editor is available for free download from http://www.parallax.com. The Parallax Programming Manual is also available for free download, but be warned - it is a large file. You will also need a DB9 programming cable to connect the Next Step to the PC's serial port.

Step 1. Download and install the Parallax BASIC Stamp Windows Editor.

Step 2. Run the editor and become familiar with its features. Try the help menu as well.

Step 3. Connect the programming cable to the PC's serial port and the Next Step's connector.

Step 4. Apply power to the Next Step PC board.

Step 5. Write a program or download one from the Lynxmotion web site.

Step 6. Press CTRL-R to download the program to the robot.

Note: The robot will immediately begin to run the program. If a change is needed, simply type the changes and press CTRL-R. The microcontroller will stop, accept the new code, and immediately begin running the modified code. There are no jumpers to change or EPROM's to erase. It's that easy! The program is held in an EEPROM so your program is safe when you turn the robot off. Once the robot has been programmed, the cable to the PC can be removed.

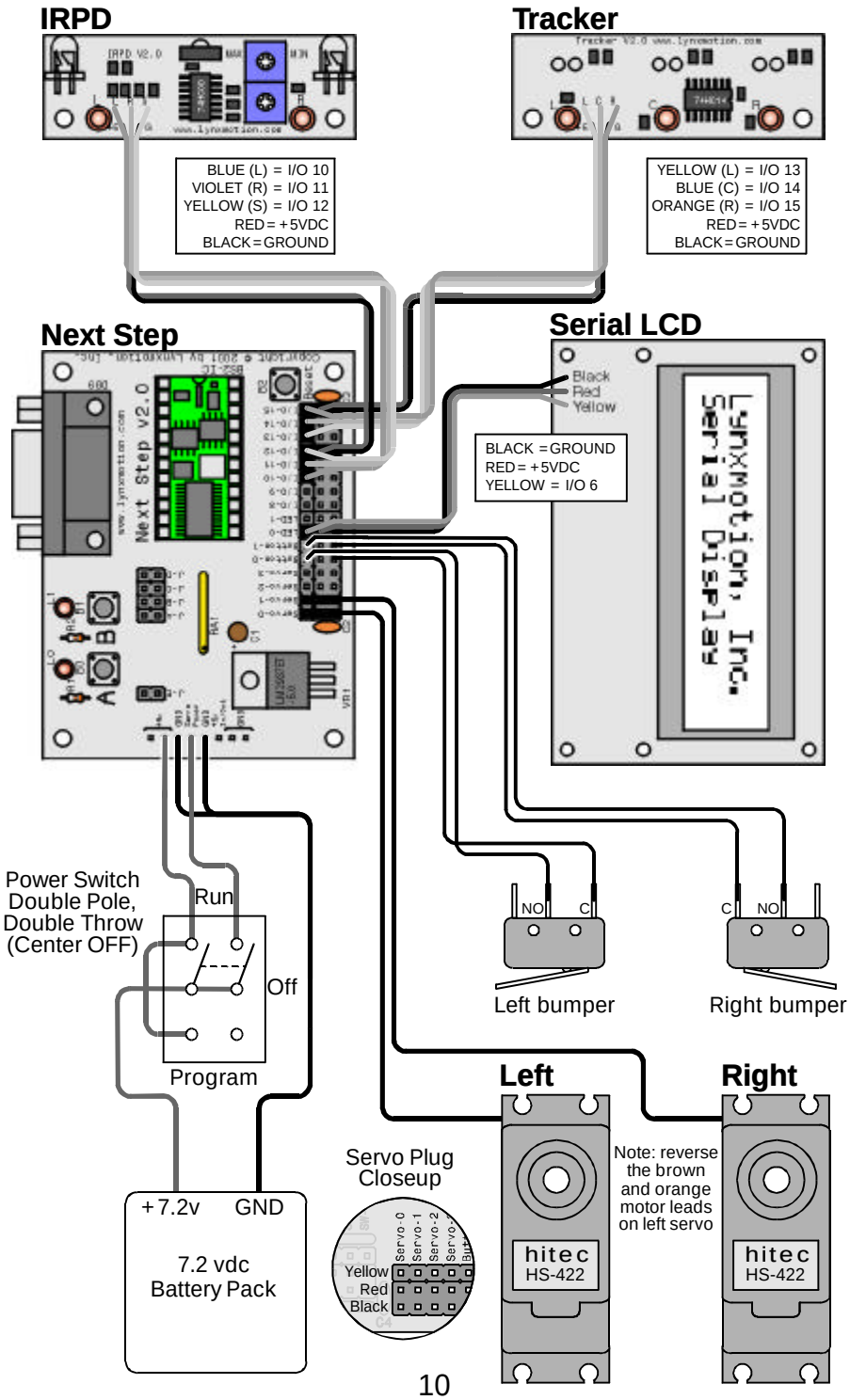
Troubleshooting

If it doesn't work correctly, or gives an error, check that the 7.2 volt battery is fully charged, and you have measured a solid +5 volts at the test pad labeled +5v In/Out . Make sure the Stamp is inserted correctly in the socket. Always check the web site for the most up-to-date information. The editor allows the use of a directive in the text of the program so it knows how to talk to the device. Place one of the following lines at the TOP of your program:

'{$STAMP BS2SX}for a BS2-SX -or-
'{$STAMP BSE}for a BS2-E -or-
'{$STAMP BS2}for a BS2

Note: You can not run *.BAS programs on the BS2 series of Stamps without significant editing.

When controlling servos from the Next Step, remember the pulsout timing values for the BS2-SX are different than the BS2 and BS2-E. For the BS2 and BS2-E use the following pulsout values: 1mS = 500, 1.5mS = 750, 2mS = 1000. For the BS2-SX use the following pulsout values: 1mS = 1250, 1.5mS = 1875, 2mS = 2500.


IRPD
Tracker
BLUE (L) = I/O 10
VIOLET (R) = I/O 11
YELLOW (S) = I/O 12
RED = +5VDC
BLACK = GROUND
YELLOW (L) = I/O 13
BLUE (C) = I/O 14
ORANGE (R) = I/O 15
RED = +5VDC
BLACK = GROUND
Next Step
Serial LCD
Black
Red
Yellow
BLACK = GROUND
RED = +5VDC
YELLOW = I/O 6
Lynxmotion, Inc.
Serial Display
Power Switch
Double Pole,
Double Throw
(Center OFF)
Run
Off
Program
NO
C
C
NO
Left bumper
Right bumper
Left
Right
Servo Plug
Closeup
Yellow
Red
Black
+7.2v
GND
7.2 vdc
Battery Pack
hitec
HS-422
hitec
HS-422
Note: reverse
the brown
and orange
motor leads
on left servo

www.lynxmotion.com www.lynxmotion.com

Lynx A-Base Inventory Sheet.
Updated 07/16/2003 Rev. 1

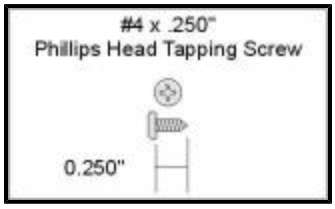
1) Lexan Parts (qty = 4)

2) Hitec HS-422 Servo (qty = 1)

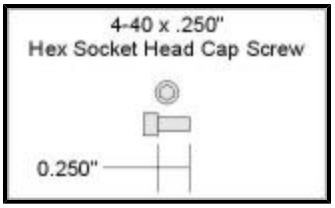
3) Aluminum Bracket (qty = 1)

4) 1/4" Mini Power Switch (qty = 1)
Note, may not have been included in early kits

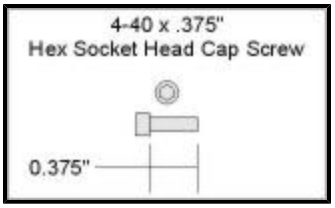
5) 5mm Power Pack Plug (qty = 1)



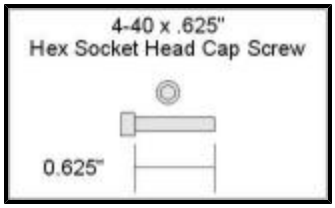
6) #4 x 1/4" Tapping Screw (qty = 2)



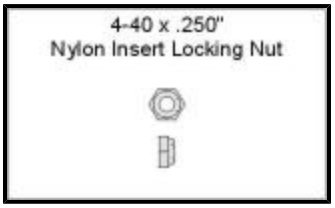
7) 4-40 x 1/4" Hex Head Cap Screw (qty = 20)



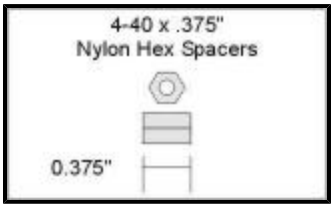
8) 4-40 x 3/8" Hex Head Cap Screw (qty = 15)



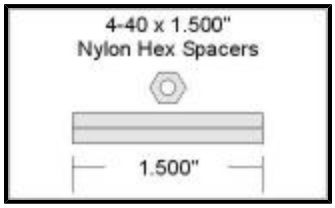
9) 4-40 x 5/8" Hex Head Cap Screw (qty = 2)



10) 1/4" Lock Nuts (qty = 2)



11) 1/4" x .375" F/F Hex Spacers (qty = 11)



12) 1/4" x 1.5" F/F Hex Spacers (qty = 6)

Lynxmotion, Inc.
PO Box 818
Pekin, IL 61555-0818

Sales: 309-382-1816
Support: 309-382-2760
Fax: 309-382-1254
Sales: sales@lynxmotion.com
Support: tech@lynxmotion.com
Web: www.lynxmotion.com

www.lynxmotion.com www.lynxmotion.com

Tools Required to assemble the Lynx Bases.

Updated 06-23-2003 Rev. 1

1) 3/32" Hex Driver

2) Phillips Screw Driver

3) 5/64" Drill

4) Pliers

Lynxmotion, Inc.
PO Box 818
Pekin, IL 61555-0818

Sales: 309-382-1816
Support: 309-382-2760
Fax: 309-382-1254
Sales: sales@lynxmotion.com
Support: tech@lynxmotion.com
Web: www.lynxmotion.com

www.lynxmotion.com www.lynxmotion.com

Lynx A-Base Assembly Instructions.

Updated 07/03/2003 Rev. 1

Print this out and get the kit.

Please read this Safety First.
Check your Inventory
Lexan panel Preparation
Required Tools

Note: Do not use Loctite or thread locks on the assembly. They are not necessary and may cause damage to the Lexan.

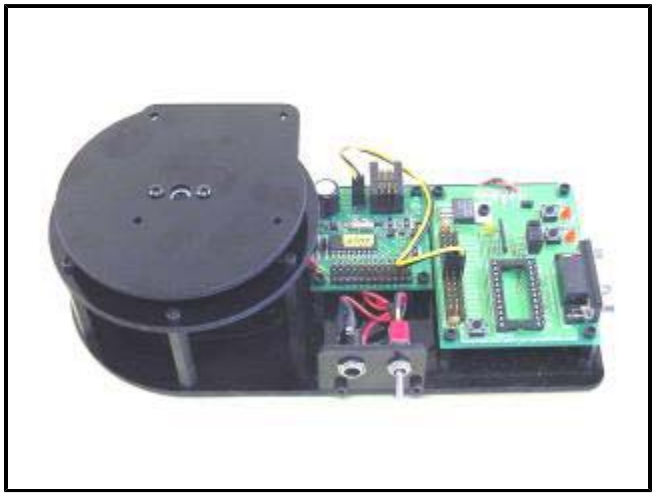
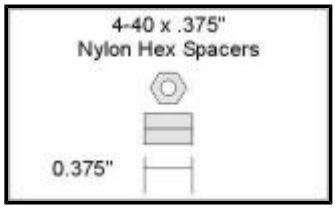


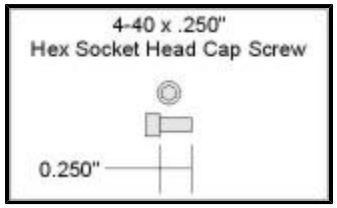
Image of base with Next Step/SSC-12.

Step 1.
Install the PC board standoffs. Use four .250" 4-40 screws, and four .375" hex spacers. Tighten these down snugly. Note: Figure 1 illustrates mounting an SSC-12. Use the holes to the right of the left hex spacers for mounting a Mini SSC-II servo controller.

8 x



8 x



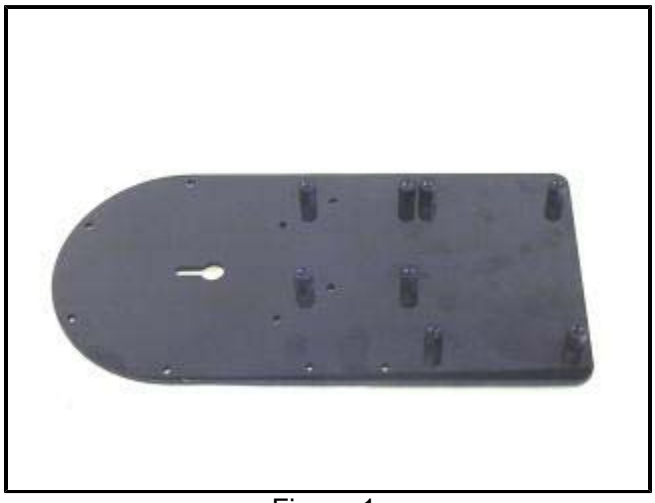
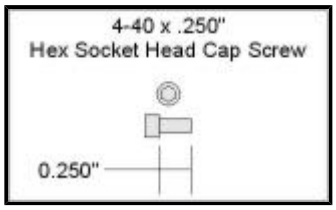


Figure 1.

Step 2.
Install the aluminum bracket as shown. Use two .250" screws, and tighten them down snugly.

2 x



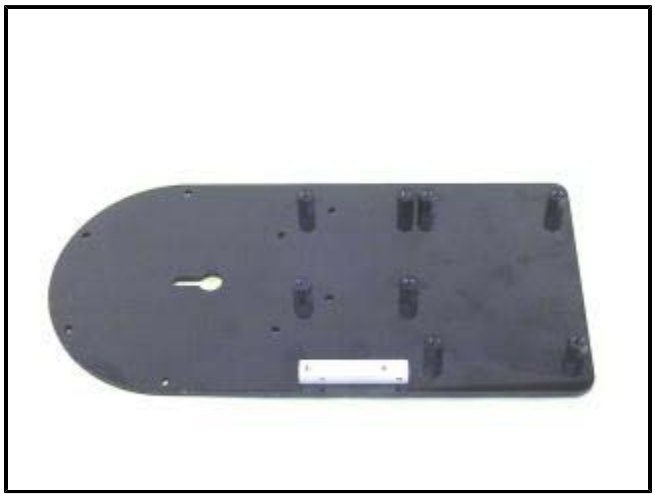
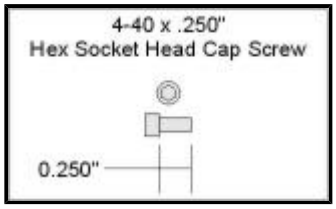


Figure 2.

Step 3.
Install the power panel using two .250" screws. Tighten these down snugly.

2 x



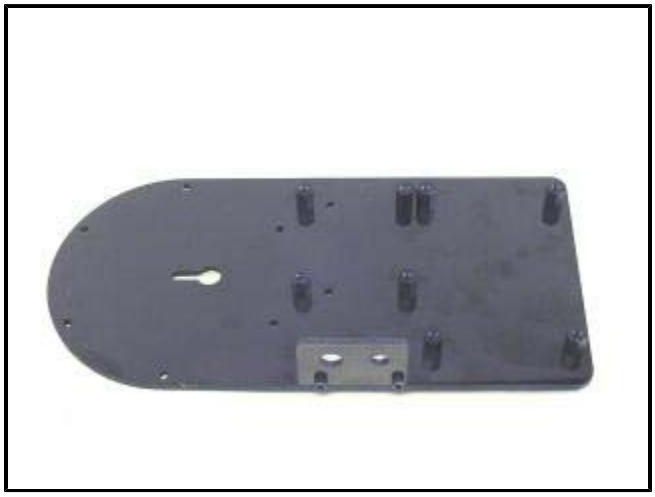
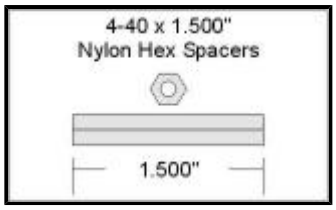


Figure 3.

Step 4.
Install the six 1.500" hex standoffs using six .375" 4-40 screws as shown. Tighten them down snugly.

6 x



6 x

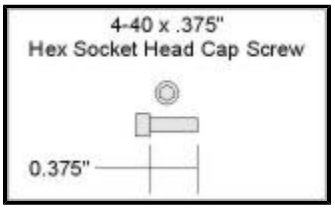
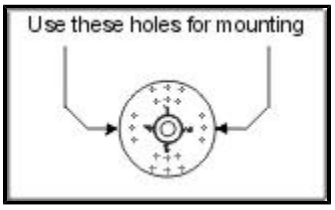


Figure 4.

Step 5.
You should have a small bag of parts packaged with your servo. Locate the four small rubber bushings and install them onto the servo as illustrated in figure 5. The other components in the servo parts bag are not needed. Drill the servo horn with the 3/32" drill in the indicated positions. These holes are by the 2 and the 4 on the horn.



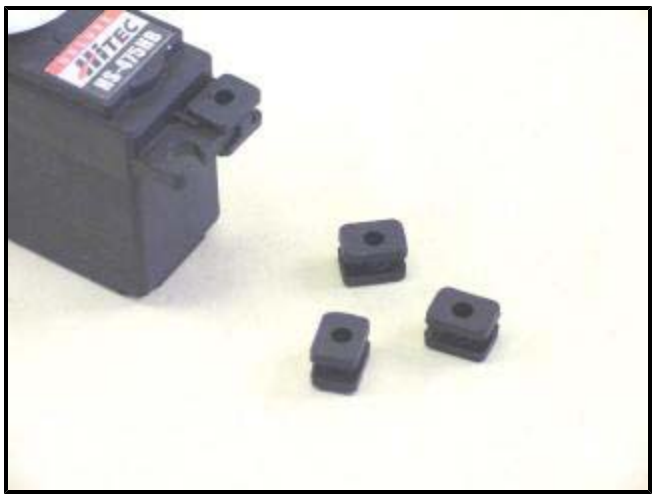
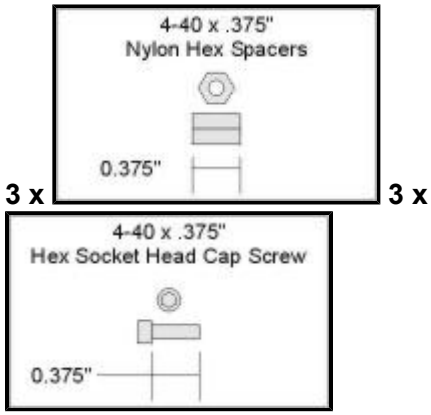


Figure 5.

Step 6.
Install the three .375" hex spacers using three .375" 4-40 screws. These are the bearing surfaces for the base rotate panel. Tighten these down snugly.



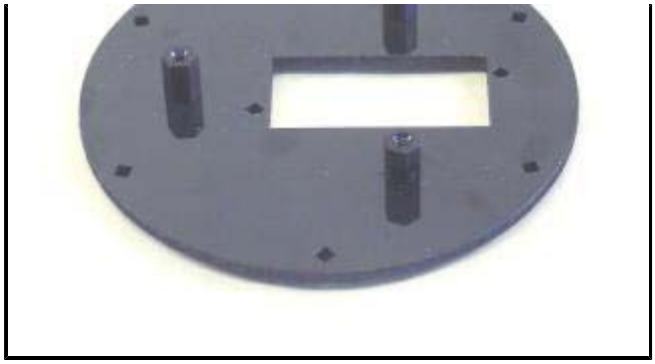


Figure 6.

Step 7.
Install the servo into the top panel using two of the .625" 4-40 screws and two 4-40 nylon insert lock nuts. These can be over tightened. Easy does it. You just want the rubber bushings to be slightly squashed.

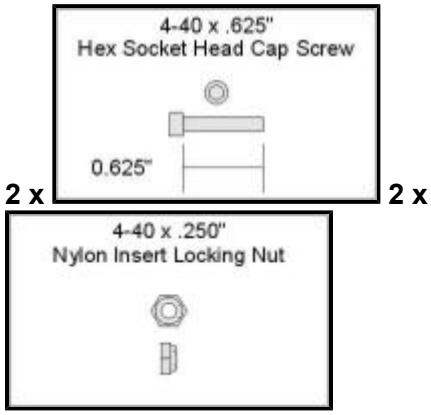
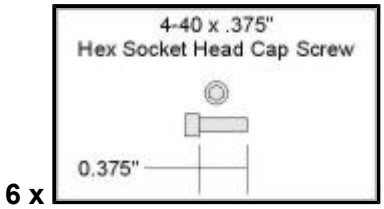


Figure 7.

Step 8.
Install the top panel onto the base assembly using six .375" 4-40 screws. Tighten these down snugly.



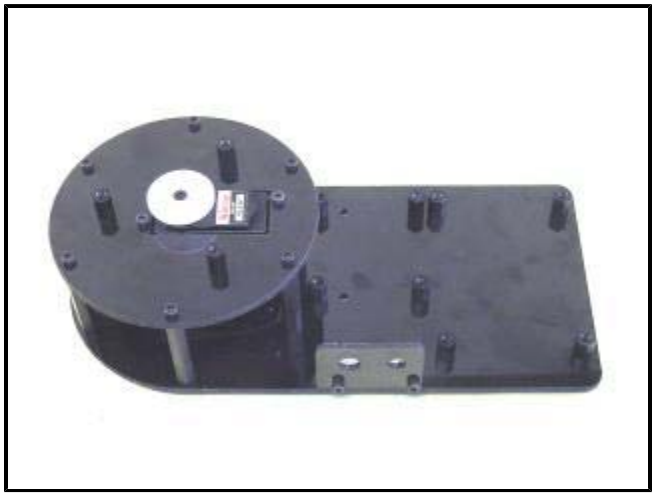


Figure 8.

Step 9.
Now we need to rotate the servo horn by 90 degrees. Remove the screw from the center of the servo horn, and pull it off of the servo. Move the servos output shaft to it's center of rotation using a servo controller or a

microcontroller. The SSC-12 will automatically produce the proper 1.5mS pulses when powered up. It is not necessary to connect it to a PC or microcontroller for this procedure. Consult the documentation that came with your electronics if you are using something other than the SSC-12. Reinstall the servo horn as illustrated.

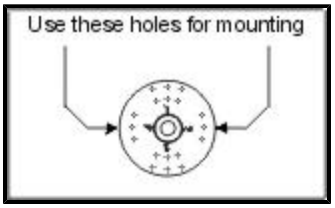


Figure 9.

Step 10.
Install the rotating base to the servos as illustrated. Use two #4 .250 tapping screws for this step. Be careful not to over tighten these screws as they can strip out the nylon servo horn. The robot base can rotate +/- 90 degrees from it's mid position for a total of 180 degrees of rotation.

2 x

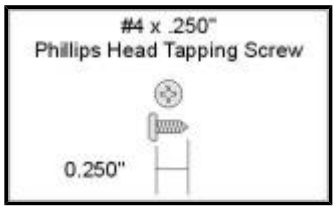
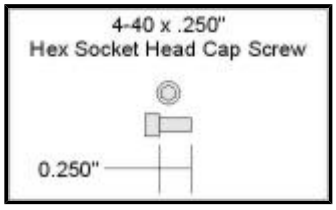


Figure 10.

Step 11.
Install the PC board as shown. Plug the base rotate servo into channel 0. Follow the instruction included with your electronics for applying power and plugging in servos.

2 x



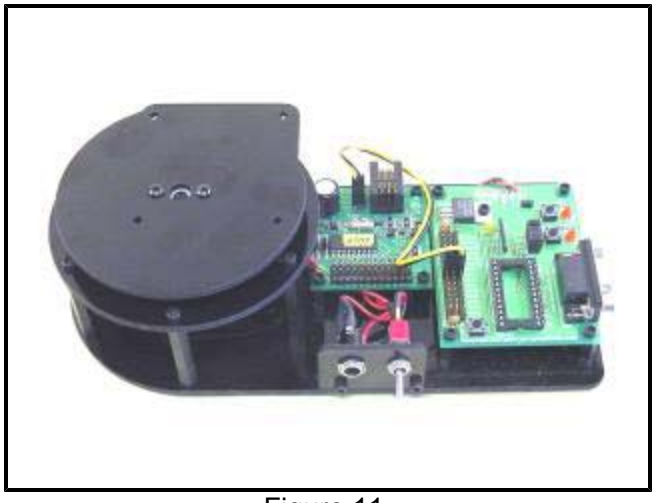
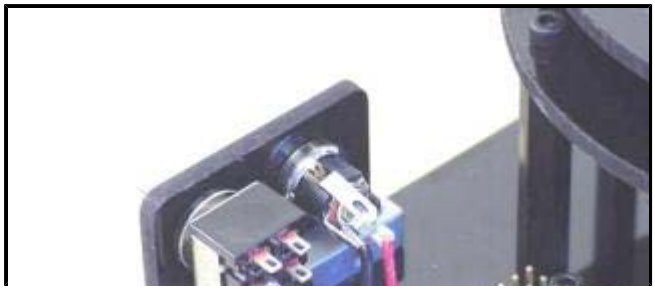


Figure 11.

Step 12.
Install a 1/4" power switch and power plug into the power panel. The 5mm plug is included with our wall Pack power supply. The 1/4" power switch was just added to the kit, however it will take awhile for them to make it through the system. They may not be included in the kit you receive.



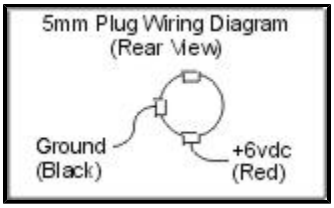
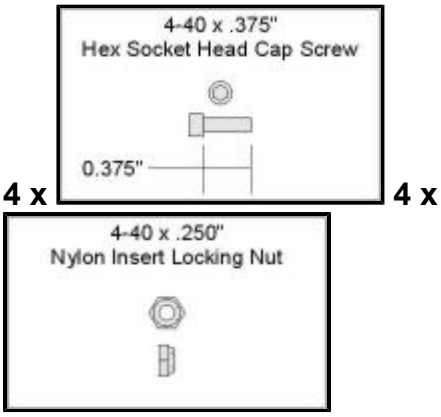


Figure 12.

Step 13.
Now the arm can be mounted to one of the optional rotating bases or a mobile robot such as the CRL5 or the 4WD2. The .375" 4-40 hardware is included in the arm kit.



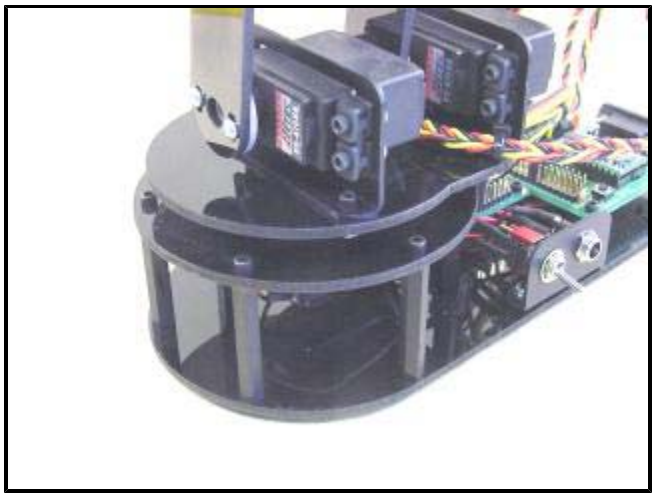


Figure 13.

Powering Options.
If you power the servos and the electronics from a 6vdc power supply, the control electronics (Next Step, SSC-12 etc.) can reset when moving several servos at once. For this reason we recommend using the wiring diagram in figure 14 when using a 6vdc power supply.

Note: Most servos can handle 7.5vdc, but there are exceptions. Micro servos can have trouble with 7.5vdc. We recommend 6vdc power supplies for our robotic arms.

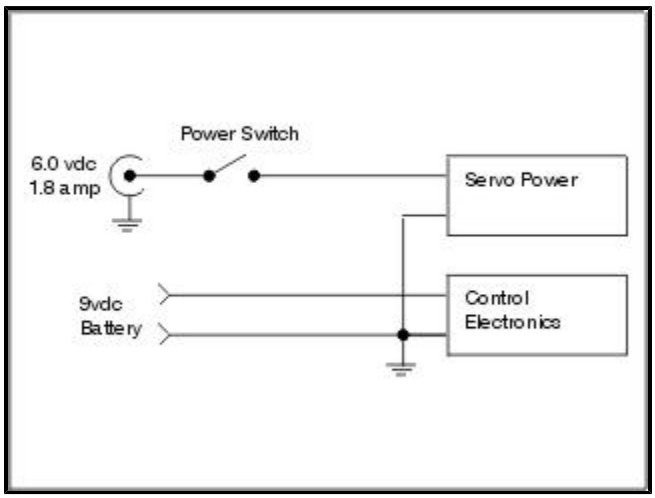


Figure 14.

Powering Options.
Use the wiring diagram to the right for a Next Step / SSC-12 when using 7.5vdc supply.

Note: Most servos can handle 7.5vdc, but there are exceptions. Micro servos can have trouble with 7.5vdc. We recommend 6vdc power supplies for our robotic arms.

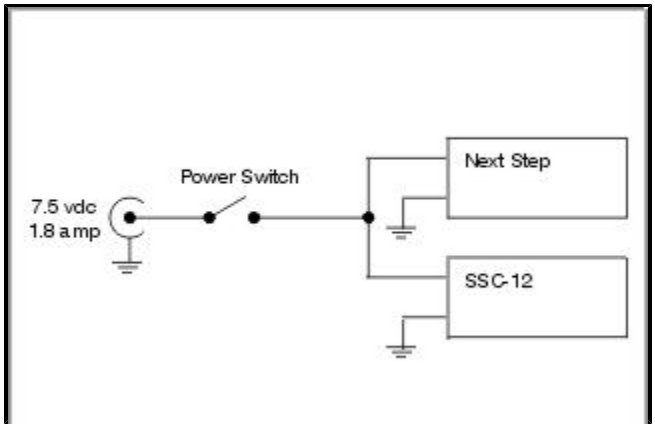


Figure 15.

Powering Options.
Use the wiring diagram to the right for a Mini SSC-II when using 7.5vdc supply.

Note: Most servos can handle 7.5vdc, but there are exceptions. Micro servos can have trouble with 7.5vdc. We recommend 6vdc power supplies for our robotic arms.

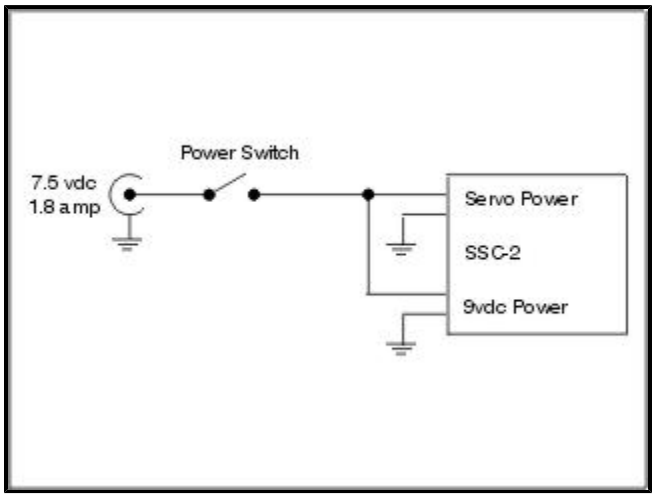


Figure 16.

Powering Options.
Use the wiring diagram to the right for an OOPic-R when using 7.5vdc supply.

Note: Most servos can handle 7.5vdc, but there are exceptions. Micro servos can have trouble with 7.5vdc. We recommend 6vdc power supplies for our robotic arms.

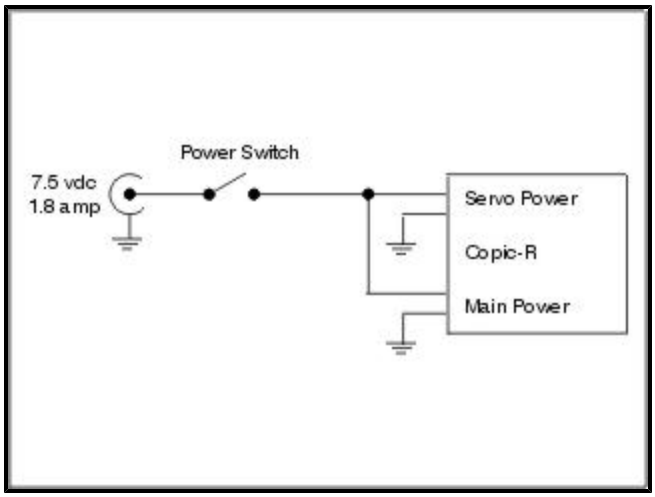


Figure 17.

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Lynx 5 Arm Assembly Instructions.

Updated 08/07/2003 Rev. 1

Print this out and get the kit.

Please read this Safety First.
Check your Inventory
Lexan panel Preparation
Required Tools

Note: Do not use Loctite or thread locks on the assembly. They are not necessary and may cause damage to the Lexan.

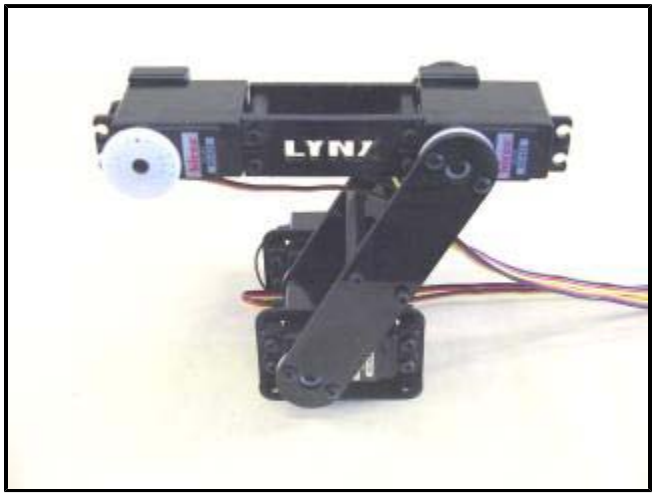
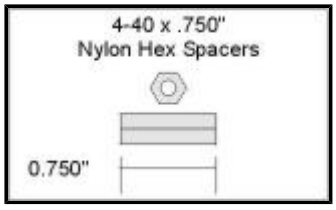


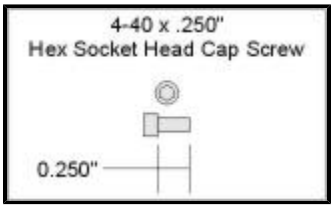
Image of arm without base, or gripper.

Step 1.
Assemble the forearm structure as illustrated. Use four of the .250" 4-40 screws and four of the .750" hex spacers. Tighten these down snugly.

4 x



4 x



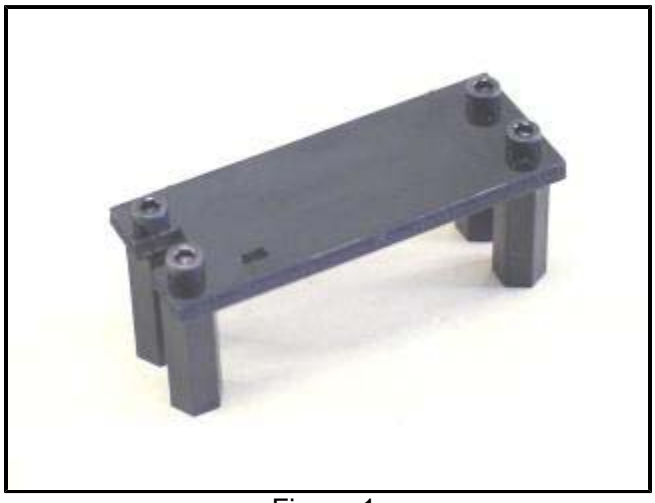
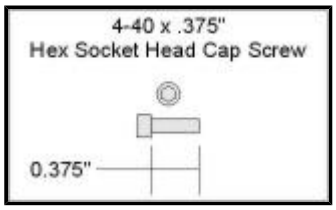


Figure 1.

Step 2.
Attach the wrist servo as shown. Turn over the forearm assembly, sandwich the servo mounting tabs in between the forearm assembly and the plastic panel with the Lynx logo on it. Use two of the .375" 4-40 screws for this step. Tighten these down snugly.

2 x



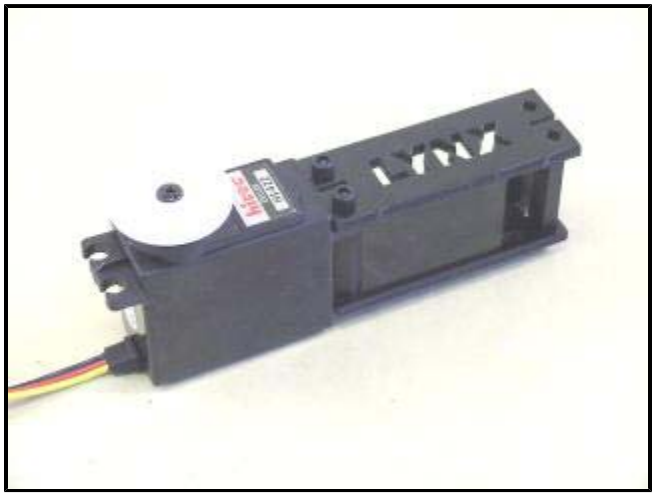


Figure 2.

Step 3.
Attach the elbow servo as shown. The servo wire goes inside the forearm assembly in the opening provided. Use two of the .375" 4-40 screws. Tighten these down snugly.

2 x

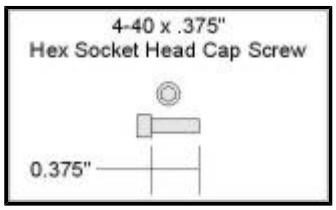
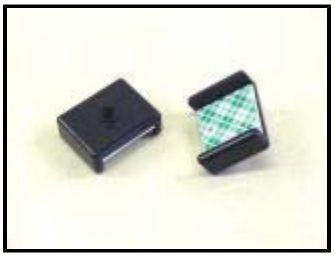


Figure 3.

Step 4.
Install the servo hinges as shown. Remove the green plaid cover from the double sided tape and press it firmly into place. The hinge should be lined up with the edge of the servo, directly across from the servo output shaft.



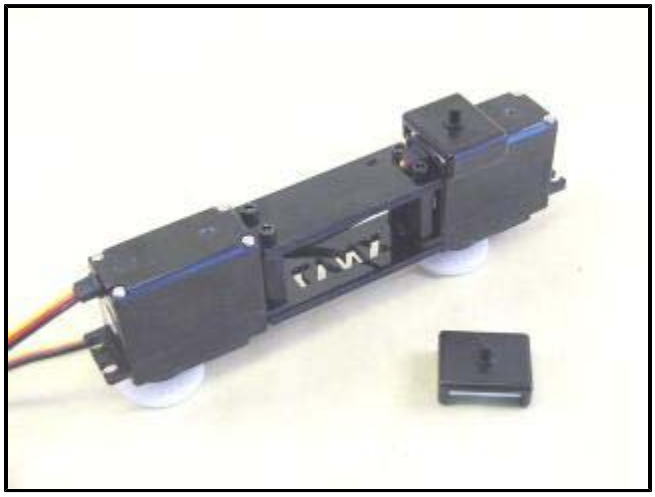
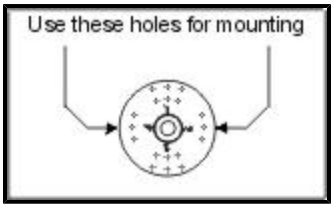


Figure 4.

Step 5.
Drill the servo horn with the 3/32" drill in the indicated positions. These holes are by the 2 and the 4 molded on the horn. Do this to both servos.



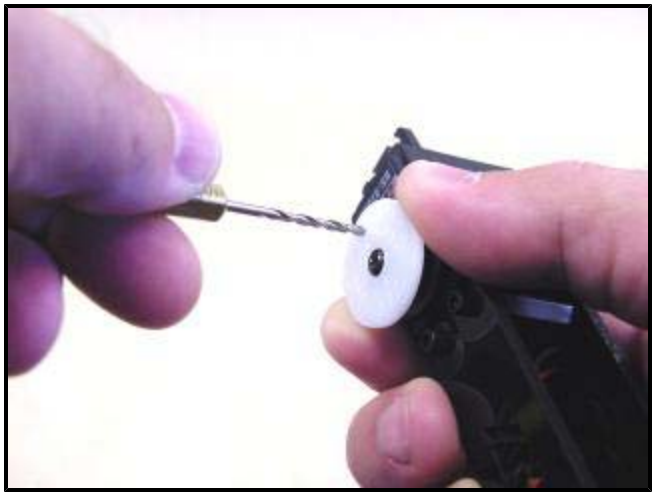


Figure 5.

Step 6.
Next, we need to rotate the elbow servo's output horn by 90 degrees. Remove the screw from the center of the elbow servo horn (the one on the right) and pull it off of the servo. Move the servo to its center of rotation using a servo controller or a microcontroller.

The SSC-12 will automatically produce the proper 1.5mS pulses when powered up. It is not necessary to connect it to a PC or microcontroller for this procedure. Consult the documentation that came with your electronics if you are using something other than the SSC-12. Reinstall the servo horn as illustrated.

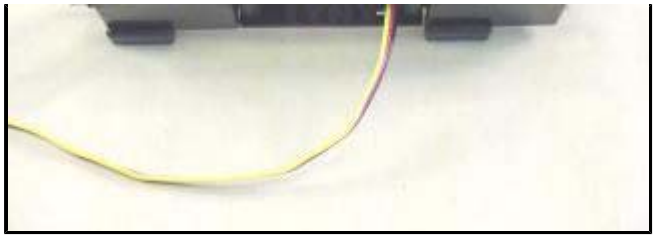


Figure 6.

Step 7.
You should have a small bag of parts packaged with your servos. Locate the four small rubber bushings and install them onto the servo as illustrated in figure 7. These parts are polarized, meaning they can only be installed one way. If you have difficulty, try turning the part around. The other components in the servo parts bag are not needed. Do this for the remaining two HS-475 servos.

Note: These servos will make up the shoulder of the arm. They will receive the same control signals via a "Y" cable. Therefore, they will both move to the same commanded position.

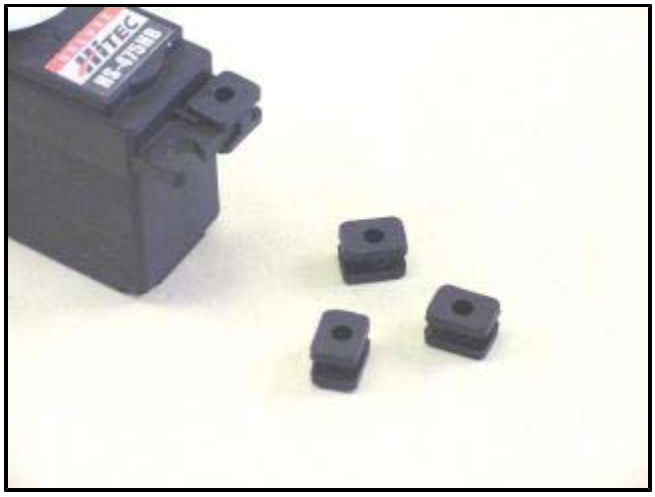
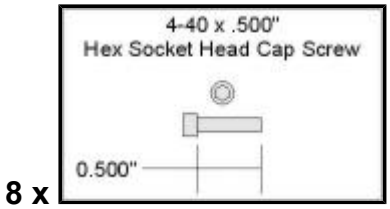
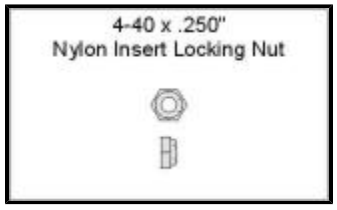


Figure 7.

Step 8.
Mount the servos to the servo bracket as shown. Use four of the .375" 4-40 screws and four of the 4-40 nylon insert lock nuts. Make two of these.



8 x **8 x**



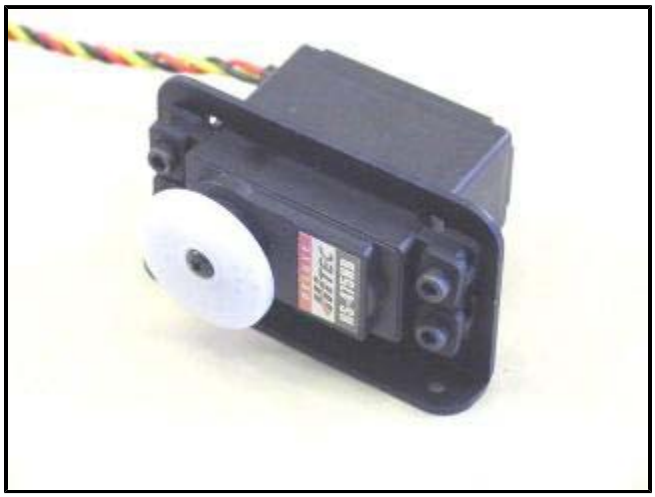


Figure 8.

Step 9.
Now we need to rotate these servo horns by 90 degrees. Remove the screw from the center of the servo horn, and pull it off of the servo. As before, position the output shaft to its center of rotation and reinstall the servo horn. Drill the servo horn with the 3/32" drill in the indicated positions. These holes are by the 2 and the 4 molded on the horn. Do this the both servos.

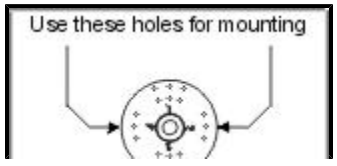
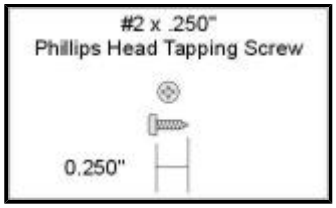


Figure 9.

Step 10.
Attach the arm upright panels to the servos as illustrated. Be careful not to over tighten these screws as they can strip out the nylon servo horn. The assembly on the right is adjustable. It will go on the robots left side to allow adjusting the dual servo arrangement later in the setup.

4 x



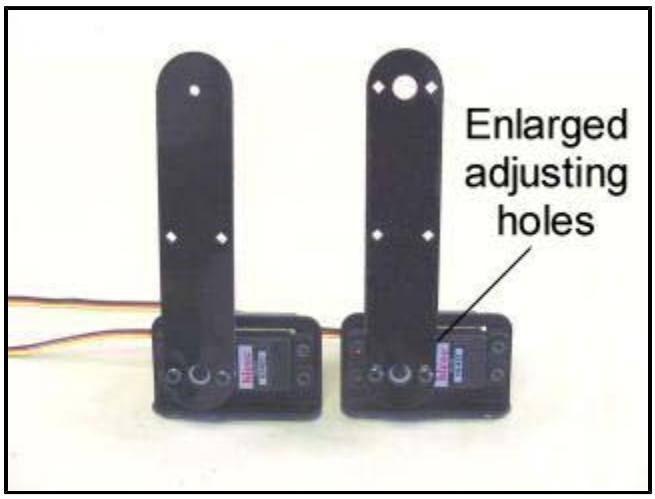
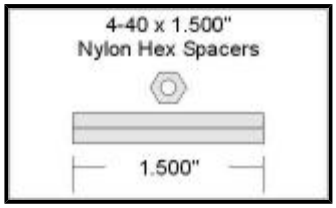


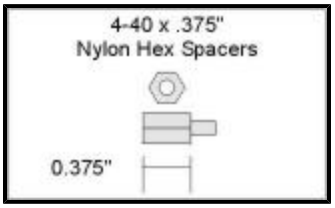
Figure 10.

Step 11.
Make two 1.875" cross members using the .375" and 1.500" nylon spacers. Attach them to the arm uprights as illustrated in figure 11 using four of the .250" 4-40 screws. Make sure the upright with the enlarged adjusting holes is on the outside so it can be adjusted later.

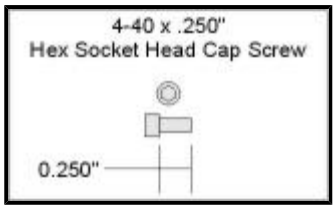
2 x



2 x



4 x



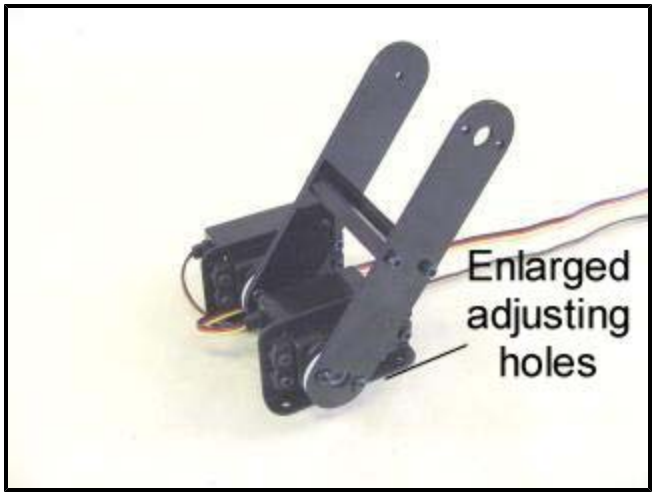


Figure 11.

Step 12.
Attach the forearm to the uprights as shown. The uprights can be spread apart without worrying about breaking something. Install the two .250" #4 screws and tighten them snugly.

2 x

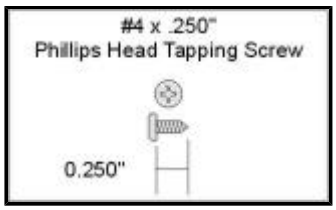


Figure 12.

Step 13.
Attach the 7" nylon wire ties to strengthen the forearm assembly. Do this two both ends of the forearm. Pull these tight.

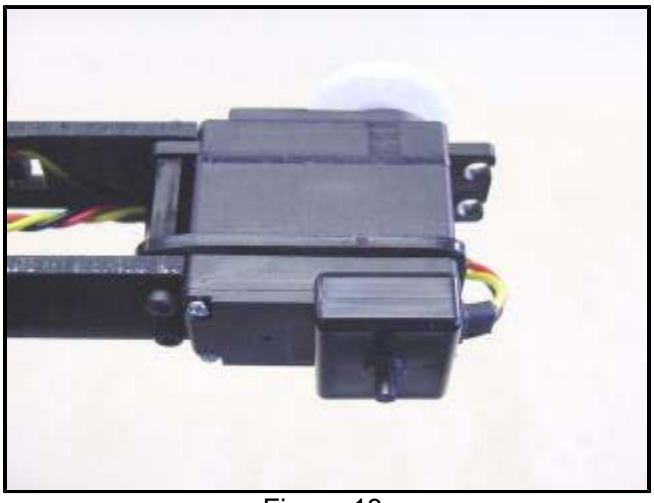


Figure 13.

Step 14.
Now it's time to align the shoulder servos. Plug both shoulder servos into the "Y" adaptor, and plug the other end into any channel on the SSC-12 servo controller. Power it up and the two servos should move to their center of rotation. They probably will not be lined up at this point. Now loosen the two .250" #4 screws on the adjustable upright. Place the arm on the table so the two shoulder servos are sitting flat. Then carefully tighten the two screws. Now the two servos that make up the shoulder are mechanically aligned. Also add the 6" extender cable to the wrist servo cable. Plug the elbow and wrist servos into the SSC-12. The arm should look like figure 14. If not then the servos probably were not properly aligned during the construction. Remove the servo horn screws, pull the horn off the servo, align it properly, push the servo horn back onto the servo, then replace the servo horn screw.

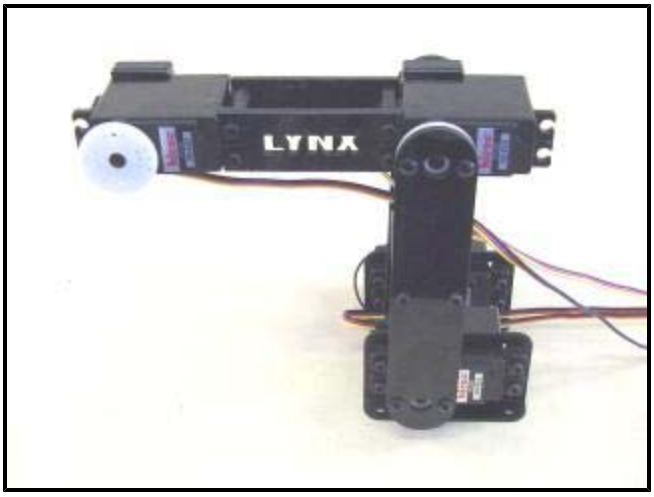
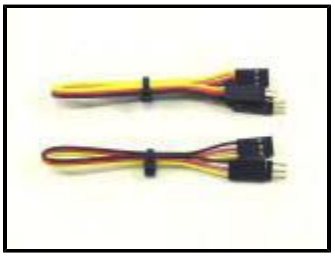


Figure 14.



Step 15.
Now the arm can be mounted to one of the optional rotating bases or a mobile robot such as the CRL5 or the 4WD2. The .375" 4-40 hardware is used for this

purpose.

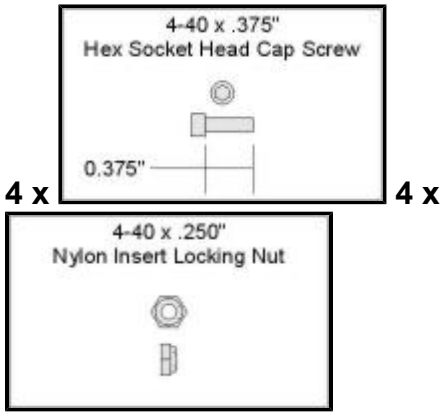


Figure 15.

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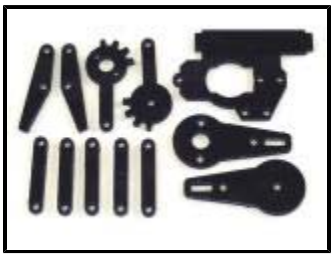
Lynx A-Gripper Inventory Sheet.
Updated 07/03/2003 Rev. 1

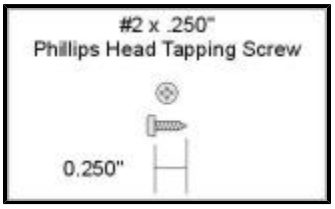


1) Lexan Parts (qty = 12)

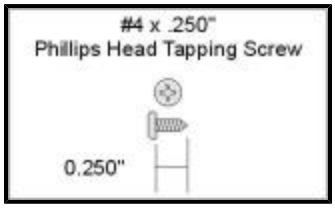
2) Hitec HS-81 Servo (qty = 1)

3) 12" Extender Cable (qty = 1)

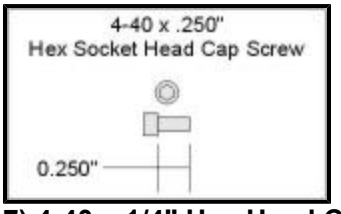
4) Rubber Fingers (qty = 2)



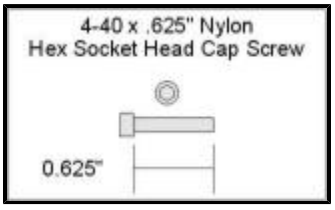
5) #2 x 1/4" Tapping Screw (qty = 2)



6) #4 x 1/4" Tapping Screw (qty = 2)



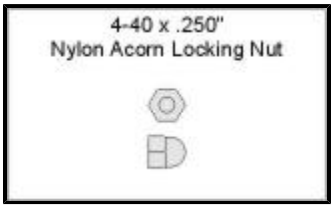
7) 4-40 x 1/4" Hex Head Cap Screw (qty = 2)



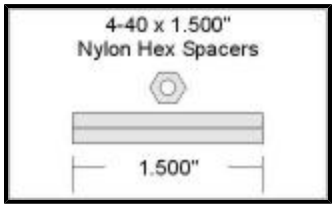
8) 4-40 x 5/8" Nylon Hex Head Cap Screw (qty = 9)

9) 1/4" Nylon Washer (qty = 15)

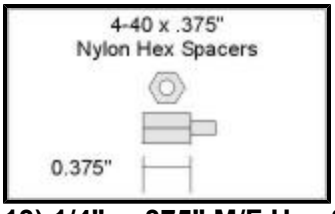
10) 1/4" Nylon Nut (qty = 4)



11) 1/4" x .75" F/F Hex Spacers (qty = 9)



12) 1/4" x 1.5" F/F Hex Spacers (qty = 1)



13) 1/4" x .375" M/F Hex Spacers (qty = 1)

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Tools Required to assemble the Lynx Gripper.

Updated 06-23-2003 Rev. 1

1) 3/32" Hex Driver

2) Phillips Screw Driver

3) 1/16" Drill

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Lynx A-Gripper Assembly Instructions.

Updated 07/03/2003 Rev. 1

Print this out and get the kit.

Please read this Safety First.
Check your Inventory
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Required Tools

Note: Do not use Loctite or thread locks on the assembly. They are not necessary and may cause damage to the Lexan.

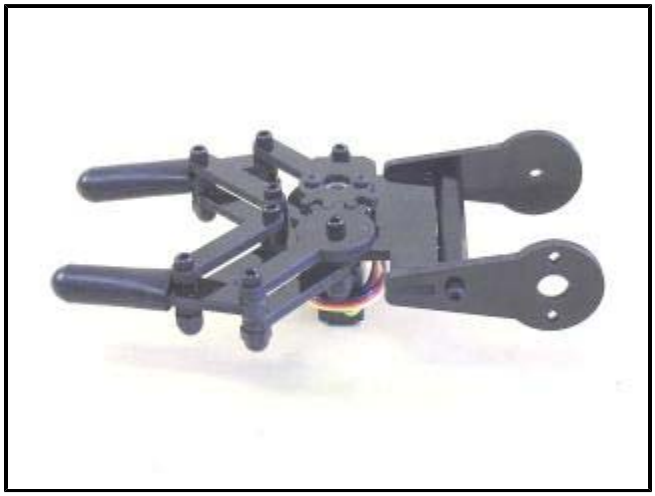


Image of the gripper.

Step 1.
Make a 1.875" cross member using the 1.500" and the .375" nylon hex spacers. Then connect it to the wrist servo panel as illustrated in figure 1. Tighten these down snugly.

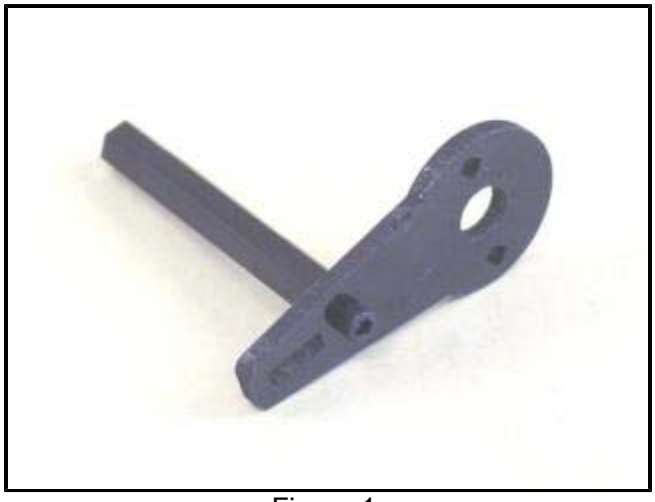
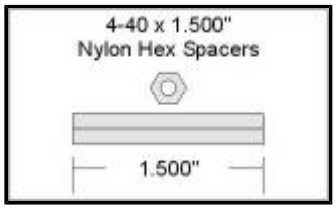
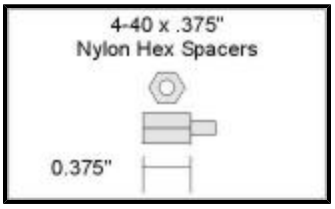


Figure 1.

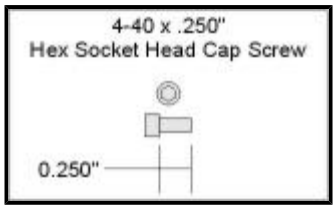
1 x



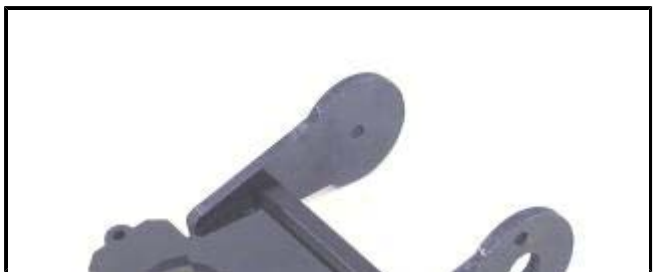
1 x



1 x



Step 2.
Install the gripper servo plate and the servo hinge panel as shown. Use a .250" 4-40 screws for this step. Tighten these down snugly.



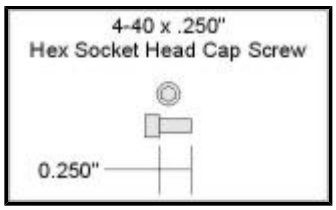
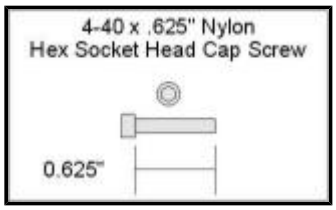
1 x 

Figure 2.

Step 3.
Turn the assembly over and insert two .625" 4-40 nylon screws up from the bottom. Hold them in place with two 4-40 nylon nuts on each screw. Tighten these down snugly.

2 x 

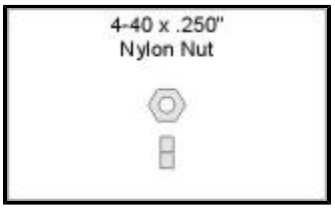
4 x 

Figure 3.

Step 4.
Install two of the rubber bushings onto the mounting tabs of the HS-81 servo. These parts are located in the servo parts bag. These are the only components needed. These parts are polarized, meaning they can only be installed one way. If you have difficulty, try turning the part around.

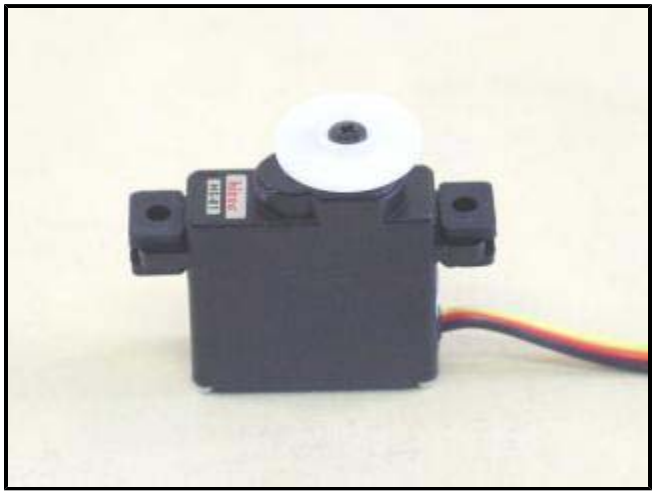


Figure 4.

Step 5.
Install the gripper servo into the assembly as shown. Use two of the 4-40 nylon acorn nuts for this step.

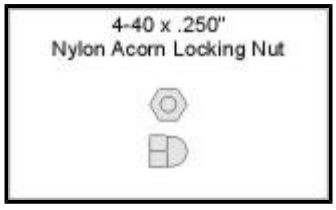
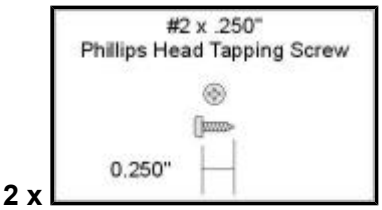
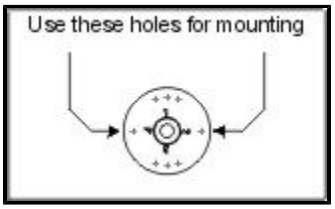
2 x 

Figure 5.

Step 6.
Drill the servo horn with the 1/16" drill in the indicated positions. These holes are by the 2 and the 4 molded on the horn. Then install the driven gripper cross member to the servo using two of the .250" #2 tapping screws. Use care not to over tighten these.



2 x



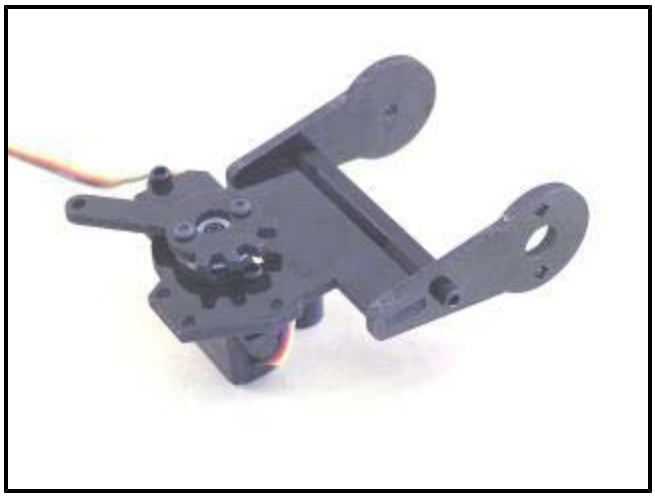
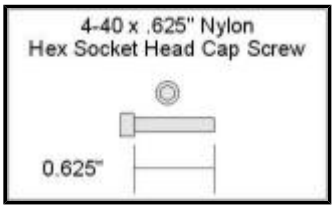
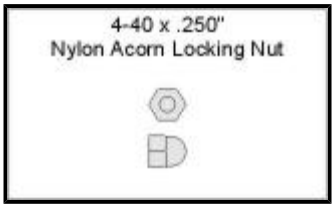


Figure 6.

Step 7.
Attach the passive gripper cross members as instructed. Insert a .625" 4-40 nylon screw into the geared passive cross member, install two 4-40 nylon washers, insert it into the gripper main plate, add a passive gripper cross member, and finish it off with a 4-40 nylon acorn nut. This should not be tightened down fully. It should be as friction free as possible.



1 x **2 x**



1 x

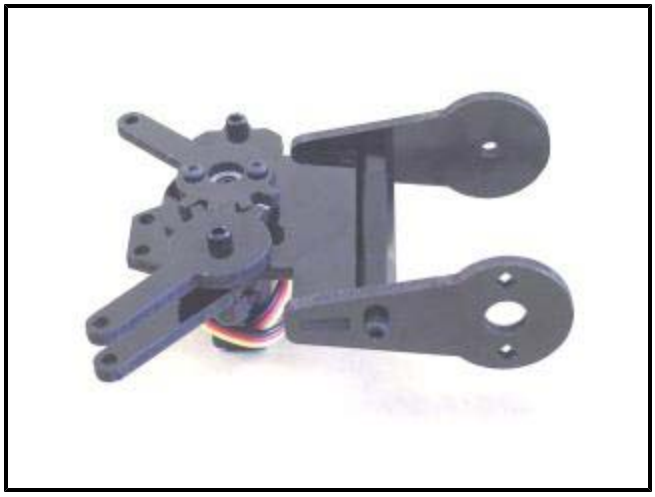


Figure 7.

Step 8.
Install the four passive gripper cross members as shown. Use two .625" 4-40 nylon screws, four nylon washers, and two nylon acorn nuts for this step. Start

with the .625" screw. Insert it into one of the passive cross members, add two nylon washers. Insert this into the gripper main plate, then add another cross member and the acorn nut. These should not be tightened down fully.

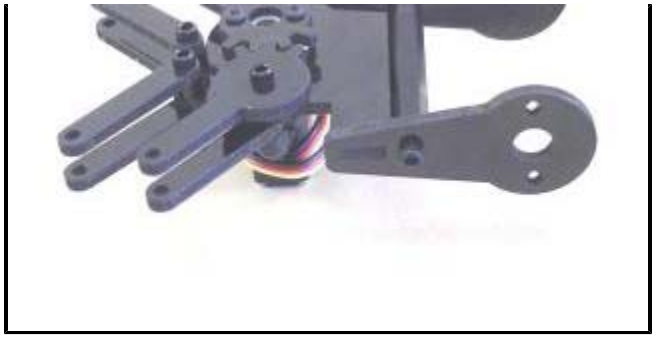
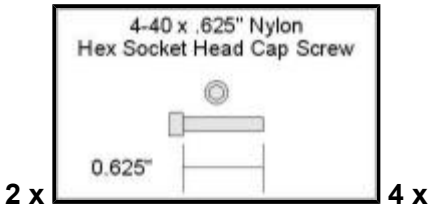
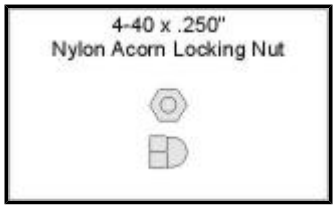


Figure 8.



2 x **4 x**



2 x

Step 9.
Install one of the gripper fingers as shown. Use a .625" 4-40 nylon screw inserted into the driven geared cross member, add a nylon washer, add the gripper finger, add two more washers, then finish it off with a nylon acorn nut. This should not be tightened down fully.

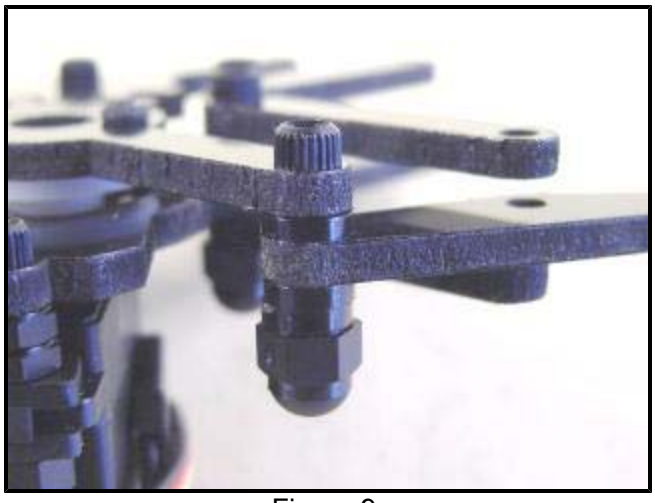
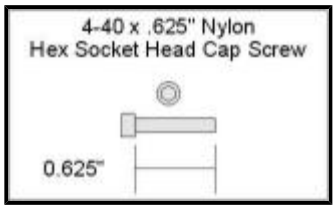
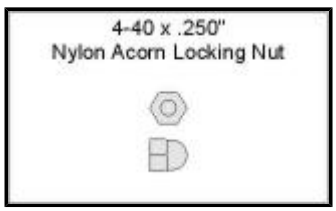


Figure 9.



1 x **3 x**



1 x

Step 10.
Attach the finger to the cross members at the front using a .625" 4-40 nylon screw, two nylon washers, and a nylon acorn nut. Start with a .625" nylon screw

inserted into the top cross member, add a nylon washer, go through the gripper finger, add another nylon washer, go through the lower cross member, then finish it off with a nylon acorn nut. As before, not too tight.

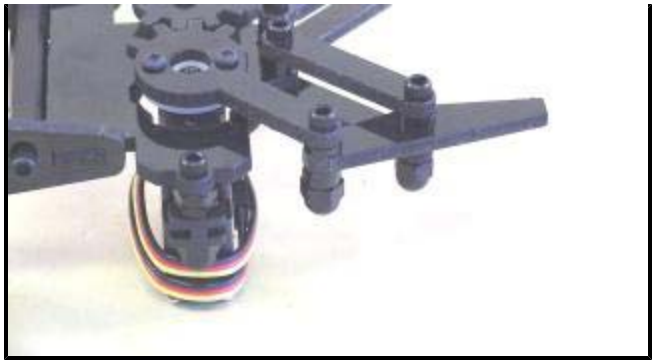
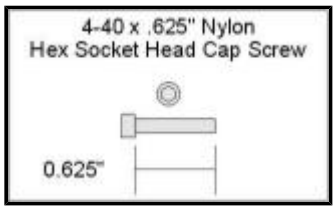
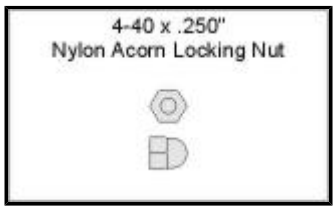


Figure 10.

1 x



2 x



1 x

Step 11.

Attach the other finger to the cross members as follows. Use two .625" 4-40 nylon screws, four nylon washers, and two nylon acorn nuts. For each position start with a .625" nylon screw inserted into the top cross member, add a nylon washer, go through the gripper finger, add another nylon washer, go through the lower cross member, then finish it off with a nylon acorn nut. As before, not too tight.

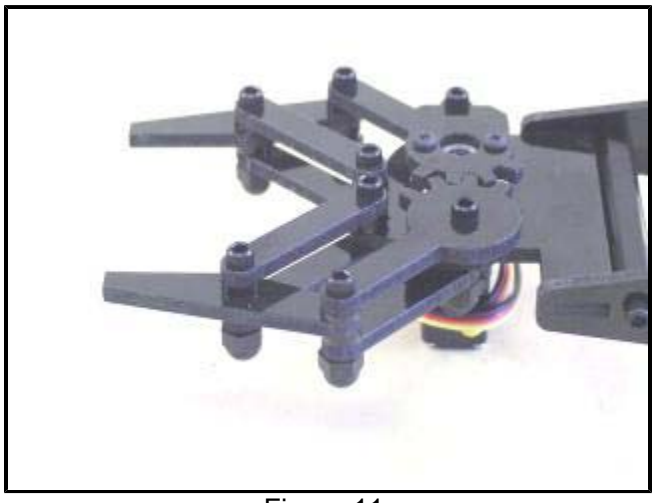
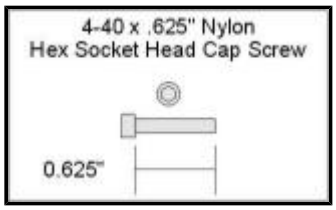
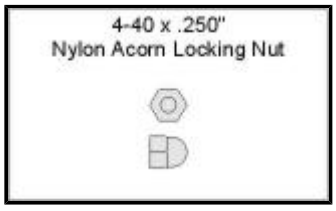


Figure 11.

2 x



4 x



2 x

Step 12.
Now for something easy. Press the rubber fingers onto the gripper fingers as shown.

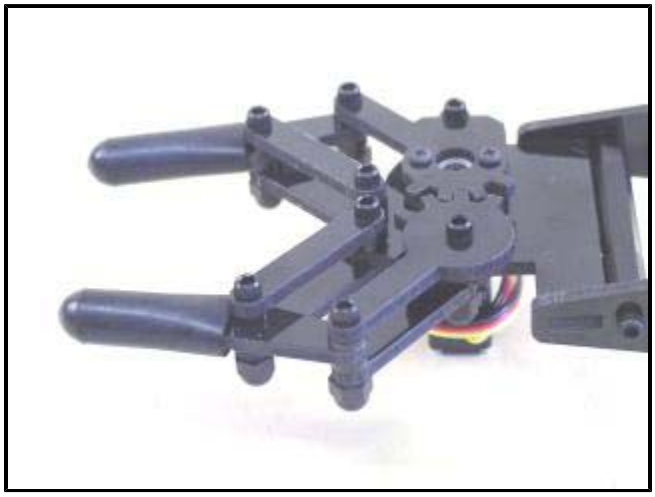


Figure 12.

Step 13.
Install the gripper onto the arm using two .250" #4 tapping screws as shown. Install the 12" servo extender cable onto the servo cable to finish the gripper installation.

2 x

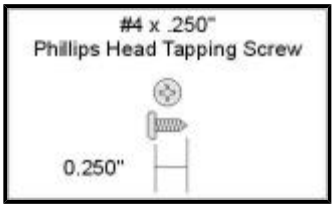


Figure 13.

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Controlling an Arm with the Next Step (BS2) and the SSC-12

Make the connection

Before I discuss how to write a program to control the arm, we need to make the serial data connection. The SSC-12 includes a short two conductor cable assembly. The black wire goes to ground and the yellow wire is for the signal. The .1" spaced end goes to the SSC-12 where it is marked S/In. The yellow wire goes closer to the round capacitor, and the black wire goes closer to the RJ-11 connector. The .2" spaced end goes to the Next Step I/O pin 8. The black wire goes closer to the outside edge of the board, and the yellow wire goes closer to the IC.

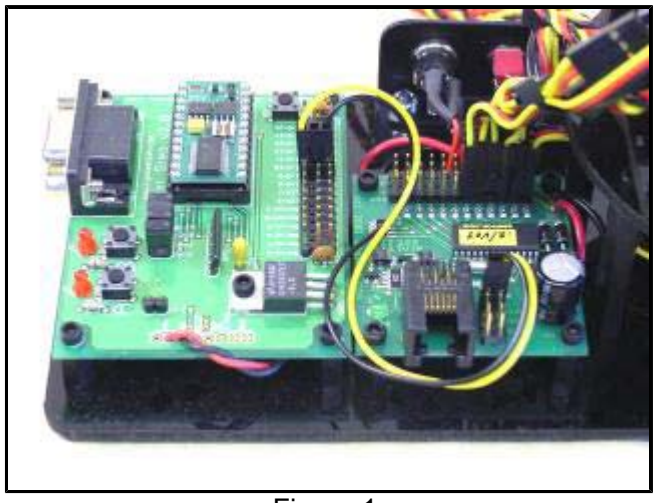

Figure 1.

The old school method of controlling the arm

Let me take a minute to explain the advantages of using the new SSC-12 for controlling the arm from a BASIC Stamp-2. Servo control has evolved over time. In the old days the best way to go was to use the Scott Edwards Mini SSC-2, our part no. SSC-01. The controller works great for moving the servos to positions as quickly as the servo will respond. Look at the BASIC Stamp code to the right to see how moving from one position to another is done on the Mini SSC-2. For an arm this can be a problem as it will overshoot and overcorrect, etc.

```
'The following code assumes a Mini SSC-2 is
on I/O pin 8
'and a servo is plugged into servo port 0.

start:
serout 8,$4054,[255,0,50]   'Moves the servo
to position 50.
pause 1000                  'Pause for 1
second.
serout 8,$4054,[255,0,200] 'Moves the servo
to position 200.
pause 1000                  'Pause for 1
second.
goto start                  'Do it again.
```

Slow down thar...

To fix this overshoot problem, the host microcontroller can send all of the intermediate positions from point A to point B. This results in smooth operation, but when moving several servos at once, due to timing issues, some steps need to be skipped and the result is the arm will stutter. Not to mention the code becomes very complicated. Look at the BASIC Stamp code to the right to see how moving slowly from one position to another is done on the Mini SSC-2. Imagine what is necessary to do 5 or 6 channels for the arm! Yuck!

```
'The following code assumes a Mini SSC-2 is
on I/O pin 8
'and a servo is plugged into servo port 0.

x var byte

start:
for x=200 to 50             'Loop to send
servo positions.
serout 8,$4054,[255,0,x]    'Moves the servo
in increments.
next                        'Close the loop.
for x=50 to 200             'Loop to send
servo positions.
serout 8,$4054,[255,0,x]    'Moves the servo
to increments.
next                        'Close the loop.
```

```
goto start                  'Do it again.
```

Introducing the SSC-12 with speed control
The SSC-12 has the ability to control the servos speed. Just add the speed value to the servo argument and viola, it moves slowly. Note, this servo controller provides the absolute smoothest movement for a servo! -and it's easy to boot! Also note, you can move any servo at any speed simultaneously! Read on...

```
'The following code assumes an SSC-12 is on
I/O pin 8
'and a servo is plugged into servo port 0.

speed var byte
speed = 32                  'Speed values
are intervals of 16.
                            '16 is slowest
10 sec for full travel.
start:                           '32 is 5
sec for full travel.
serout 8,$4054,[255,0+speed,50]  '48 is 3.4
sec for full travel.
pause 5000                       '64 is 2.5
sec for full travel.
serout 8,$4054,[255,0+speed,200] '80 is 2.0
sec for full travel.
pause 5000                       '96 is 1.7
sec for full travel.
goto start                       'There are
more iterations...
```

Tell me more...
Check out the code to the right to move 2 servos at different speeds at the same time. This will move servo 0 at a slow speed, and servo 1 at twice the speed.

```
'The following code assumes an SSC-12 is on
I/O pin 8
'and a servo is plugged into servo port 0
and port 1.

speed1 var byte
speed2 var byte
speed1 = 32                  'Medium speed.
speed2 = 64                  'A bit faster.

start:
serout
8,$4054,[255,0+speed1,50,255,1+speed2,50]
pause 5000
serout
8,$4054,[255,0+speed1,200,255,1+speed2,200]
pause 5000
goto start
```

Formatting the code for easier reading
The code to the right will work the same as above, but is easier to follow.

```
'The following code assumes an SSC-12 is on
I/O pin 8
'and a servo is plugged into servo port 0
and port 1.

speed1 var byte
speed2 var byte
speed1 = 32                  'Slow speed.
speed2 = 64                  'A bit faster.

start:
serout 8,$4054,[255,0+speed1,50]
serout 8,$4054,[255,1+speed2,50]
pause 5000
serout 8,$4054,[255,0+speed1,200]
serout 8,$4054,[255,1+speed2,200]
```

```
pause 5000
goto start
```

Code specific to the arm
By taking advantage of the "constant" feature of programming the code can become even easier to follow. Note, the code to the right doesn't move the arm, because the position values are the same as the default values for the controller. However it can be used as a "position finder". This would be useful for finding the values for each axis for a certain position, such as posturing in preparation to pick up an object.

```
'The following code assumes an SSC-12 is on
I/O pin 8
'and the arms servos are plugged into servo
port 0 - 4.

sync     con 255
baud     con $4054
base     con 0
shoulder con 1
elbow    con 2
wrist    con 3
gripper  con 4
speed    var byte
speed = 32                  'Slow speed.

start:
serout 8,baud,[sync,base+speed,127]
serout 8,baud,[sync,shoulder+speed,127]
serout 8,baud,[sync,elbow+speed,127]
serout 8,baud,[sync,wrist+speed,127]
serout 8,baud,[sync,gripper+speed,127]
pause 5000
goto start
```

Going further...
By taking advantage of the "gosub" feature even more flexibility can be incorporated into the program. The code to the right will allow the gripper to grasp an object of known size with a single line of code. It assumes the gripper has previously been moved to the object.

```
'The following code assumes an SSC-12 is on
I/O pin 8
'and the arms servos are plugged into servo
port 0 - 4.

sync     con 255
baud     con $4054
base     con 0
shoulder con 1
elbow    con 2
wrist    con 3
gripper  con 4
speed    var byte
speed = 32                  'Slow speed.

start:
gosub close_gripper
pause 5000
gosub open_gripper
pause 5000
goto start

close_gripper:
serout 8,baud,[sync,gripper+speed,200]
return

open_gripper:
serout 8,baud,[sync,gripper+speed,50]
return
```

In conclusion
I hope you find this simple tutorial helpful. I will

add more content in the future. Now you can control the Lynx arms easily and eloquently from a BASIC Stamp-2 / SSC-12. We have also added an example file for controlling an M&M color sensor. You can look at this file for more ideas.

Happy Roboting,

Jim Frye

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