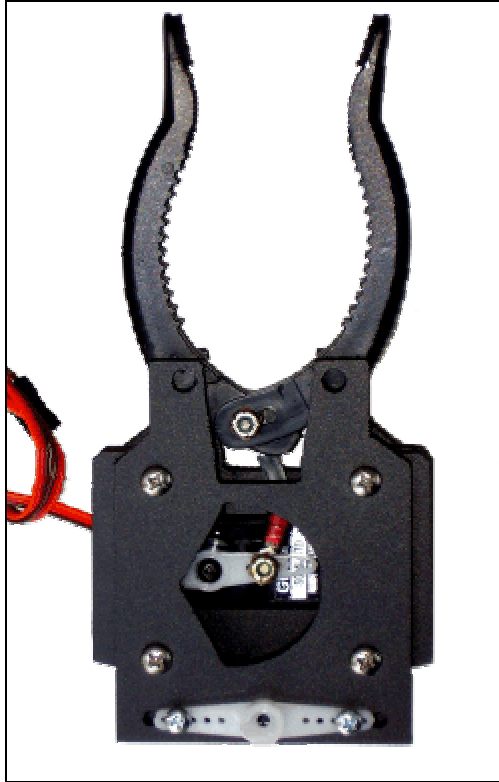


# Budget Robotics

## Big Gripper

### Assembly Instructions



The Budget Robotics Bigger Gripper kit offers a heavy-duty full size gripper at a low cost. It combines injected molded plastic gripper fingers, a high torque R/C servo motor (when purchased with the servo option), and strong but lightweight body construction using expanded PVC plastic and steel hardware.

Big Gripper's "fingers" measure almost 3" long, and open wide enough to grasp a 12 ounce beverage can or tennis ball. The Big Gripper is ideal for use in robot ball collection competitions.

At its widest the fingers open to a little over 3". Big Gripper measures 6" long, 2 3/4" wide, and 1 1/4" thick (with servo the total thickness is 2"). Weight with servo is 3.7 ounces. Lifting capacity is 8-12 ounces, but is conservatively limited by the wrist mechanism you use, if any. Full-open to full-close of the fingers requires approximately 90 degrees of servo rotation.

The Big Gripper kit is assembled in under 20 minutes, and requires only a small (#0 or #1) Phillips head screw driver and 1/4" nut driver, or flat-nosed pliers, for construction.

***Note: Do not use the Big Gripper to grab or lift glass or other fragile or breakable objects! Not for use with open beverage containers, as the container may be crushed. Use at your own risk. The Big Gripper is not designed to lift objects heavier than 8-12 ounces.***

## Parts List

The Big Gripper contains the following parts:

Quantity	Description
1	Gripper bottom
1	Gripper top
4	Spacers
2	Gripper fingers
1	Pushrod assembly (eyelets on both ends)
1	Short servo horn (with Futaba-compatible spline)
4	6-32 x 1" machine screws
4	6-32 recessed nuts
2	4-40 locknuts
6	4-40 x 1/2" machine screws, nuts
1	4-40 x 5/16" machine screw
1	4-40 x 5/8" machine screw
5	#4 steel washers
1	#4 black plastic washer
1	Long servo horn (with Futaba-compatible spline)
1	50 ounce-inch or better servo (if ordered with servo option)
2	Clear flexible vinyl tubing (for use as finger sleeves)

The following assembly instructions assume you have purchased the Big Gripper kit with the servo option.

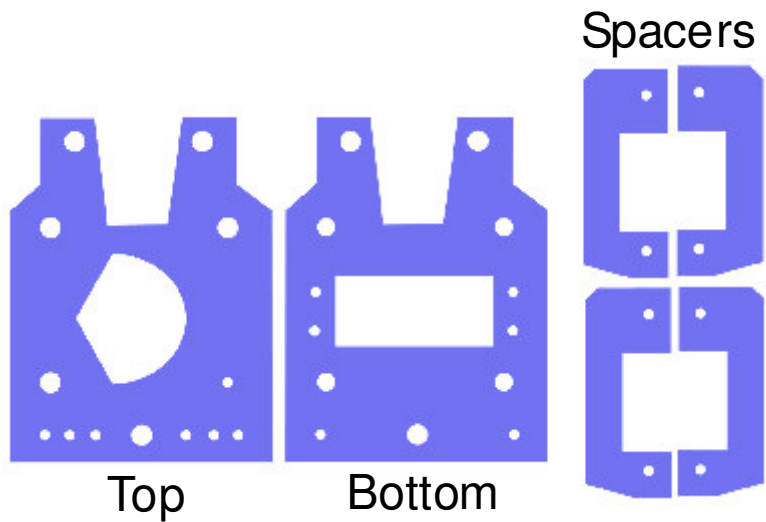
### **Step 0-Orientation and Setup**

Orient the six (6) plastic gripper hand pieces to familiarize yourself with them. The *top* of the gripper is identified by the "D" shaped cutout. The *bottom* of the gripper is identified by the rectangular servo hole.

Remove the black screw from the white spindle of the servo. Set the screw aside for the time being, and don't lose it!

Next, use the long servo horn to slowly and gently position the servo to its center position. Do this by placing the splined hub of the horn over the white spindle of the servo.

*Slowly* rotate the servo all the way clockwise until it stops. Note the position of the horn. Then, *slowly* rotate the servo slightly more than 90 degrees counter-clockwise. Remove the servo horn from the servo, and set it aside.



*Suggestion: Use 150 grit sandpaper to remove any burrs on the plastic pieces left over from the manufacturing process.*

## **Step 1-Attach pushrod to servo horn**

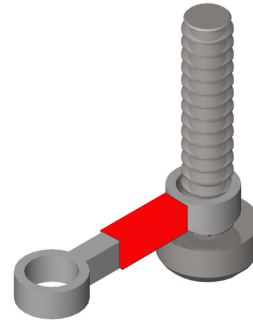
Use:

- (1) 4-40 x 5/16" machine screw
- (1) 4-40 locknut
- (1) Pushrod (has eyelets on both ends)
- (1) Short servo control horn

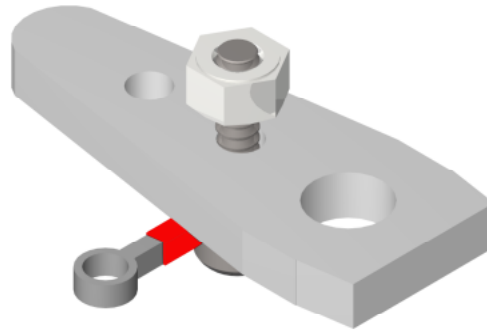
Slip the eyelet with the red end over the 4-40 x 5/16" machine screw.

Thread the screw into the hole of the servo control horn. *Important: Orient the control horn as shown. The serrated spline of the control horn should face down.*

Secure the screw using a 4-40 locknut. Do not over tighten.



*Orient the pushrod so that the seam of the long crimped end (the end facing away from the red) is facing upward*



*Tighten the locknut so that the pushrod pivots freely, but is not too loose.*

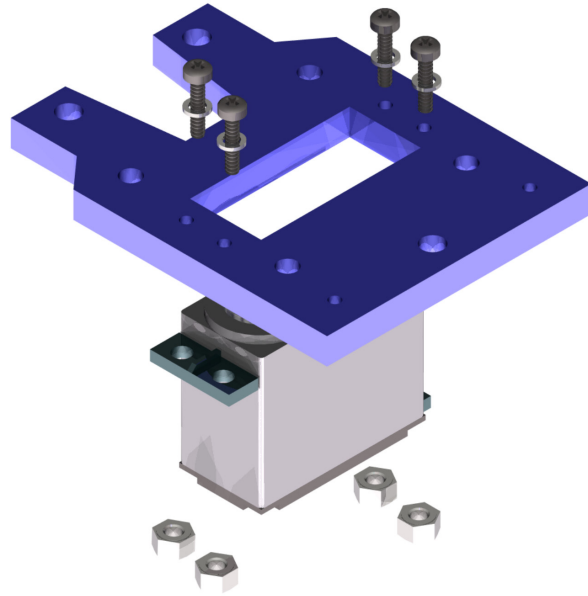
## **Step 2-Mount servo to gripper bottom**

Use:

- (1) Servo
- (1) Gripper bottom
- (4) 4-40 x 1/2" machine screws
- (4) 4-40 hex nuts
- (4) #4 steel washers

Mount the servo to the gripper bottom. Note that the flange of the servo is mounted to the "underside" of the bottom, as shown.

To secure the servo, push a #4 washer onto a machine screw, then insert the machine screw through the hole of the gripper bottom, and then through the flange of the servo. Thread a nut onto the screw. Repeat for the remaining three mounting screws.



*Important! The servo is attached from the **underside** of the gripper bottom.*

*Be sure the screws are on tight!*

### **Step 3-Attach pushrod assembly to gripper fingers**

Use:

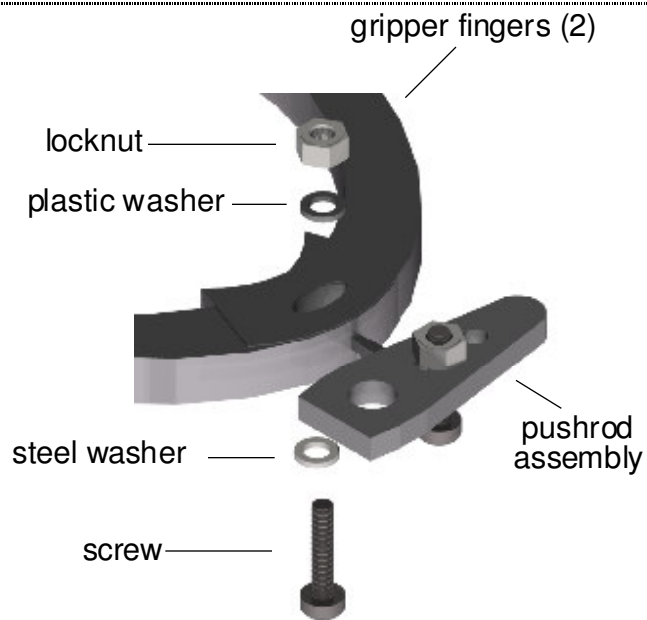
- Pushrod assembly from Step 1
- (2) Gripper fingers
- (1) 4-40 x 5/8" machine screw
- (1) 4-40 locknut
- (1) #4 steel washer
- (1) #4 plastic washer

Join the two gripper fingers at their base. The flanges of the fingers will interlace thick-thin-thin-thick (view edge-on). The rubber tips of the fingers will face each other.

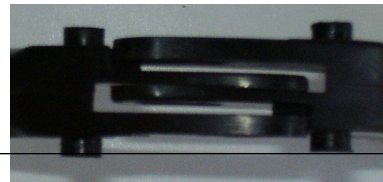
Insert the steel washer over the 4-40 x 5/8" machine screw. Push the free end of the pushrod assembly from Step 1 into the middle of the finger flanges (between the two thin flanges.)

Carefully thread the machine screw through the slots of the fingers and eyelet of the pushrod. Be sure the screw goes through the eyelet.

Place the black plastic washer over the end of the screw, and secure the locknut. Do not over tighten! The eyelet must be able to pivot freely inside the finger mechanism.



*Do not over tighten the locknut. Keep it just loose enough to allow enough play in the mechanism for the fingers to open and close, and the eyelet to move freely within the flanges.*



*Important: Connect the two fingers of the gripper so that the rounded "nubs" are at the same level (even with one another) on both the right and left.*

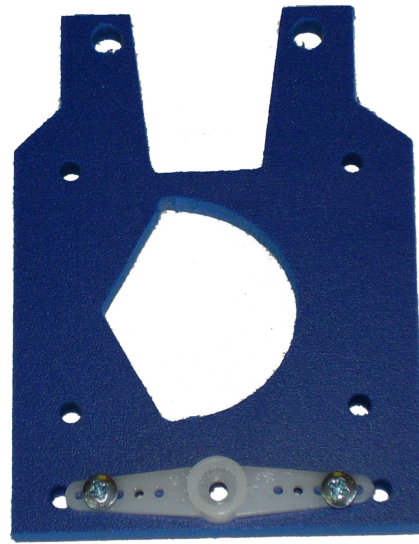
### **Step 4-Attach long servo horn to gripper top (optional)**

Use:

- (1) Long servo horn
- (1) Gripper top
- (2) 4-40 x 1/2" machine screws, nuts

If you wish to attach the Big Gripper to another servo to allow for wrist motion, attach the long servo horn to the gripper top, as shown. Secure with two 4-40 by 1/2" machine screws and nuts.

Note: Skip this step if you are mounting the Big Gripper directly to your robot.



### **Step 5-Mount spacers into gripper top**

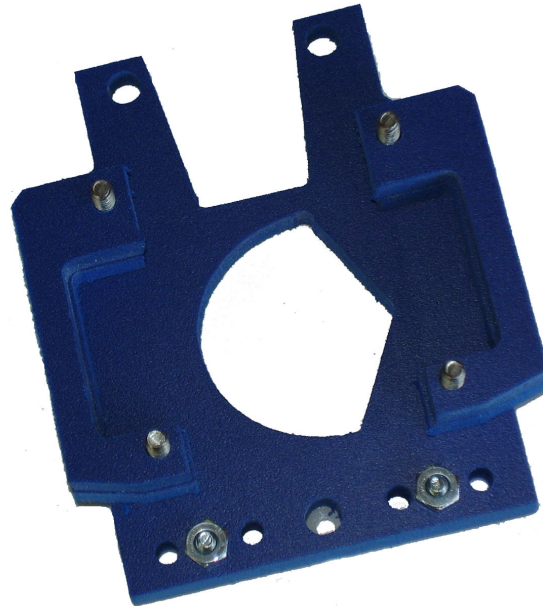
Use:

- Gripper top
- (4) spacers
- (4) 6-32 x 1" machine screws

Thread (4) machine screws into the holes of the gripper top.

Note: The screw holes are a tight fit, so you may need to use a screwdriver to thread them through.

Turn the gripper top over, and place two each spacers onto the screws. Refer to the illustration for the proper orientation of the spacers.



*Note: Shown here is the **underside** of the gripper top, with the spacers inserted onto the four machine screws.*

## ***Step 6-Mount fingers onto gripper bottom***

Use:

- Gripper bottom from Step 2
- Gripper fingers, with pushrod assembly, from Step 3

Carefully align the round nubs of the gripper fingers into their two holes, as shown in the illustration. The fit may be a little tight; the nubs will seat into the holes after first use.

While keeping the nubs in their holes, open the fingers of the gripper to about halfway. Place the servo horn onto the white spindle of the servo so that the horn is parallel to the body of the servo (see illustration).



## **Step 7-Secure gripper top and spacers to gripper bottom**

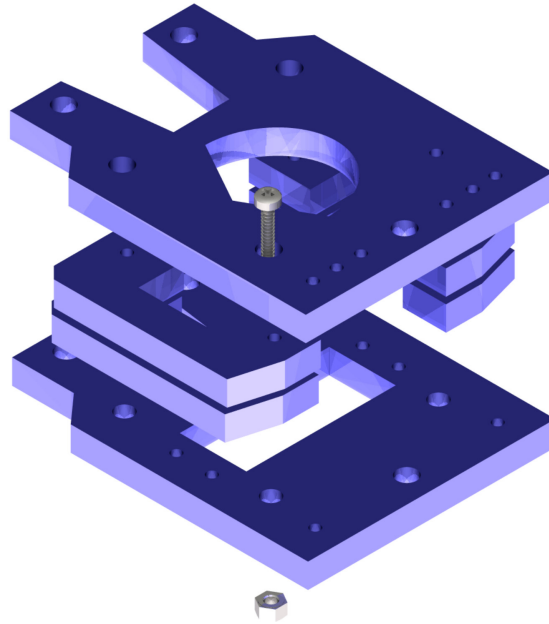
Use:

- Gripper top, with spacers and machine screws, from Step 5
- Gripper bottom and gripper fingers, from Step 6
- (4) 6-32 recessed nuts

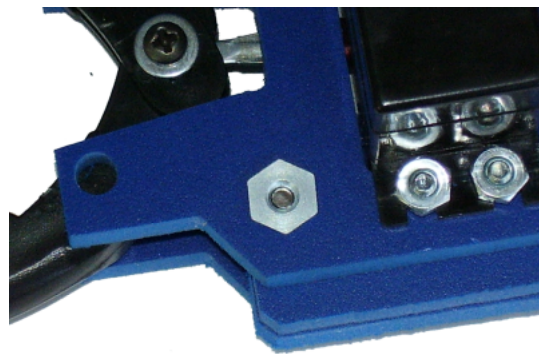
Orient the gripper top (with its spacers and machine screws) over the gripper bottom, being careful to insert the round nubs of the fingers into their corresponding holes of the gripper top.

Press one 6-32 recessed nut into its hole in the gripper bottom. Use a screw driver to fasten the 6-32 machine screw to the nut. Don't tighten yet. Repeat for the remaining three recessed nuts.

When all four nuts are secured, tighten the screws to apply even pressure to each one. *Do not over tighten!*



*Note: For clarity the servo and gripper fingers are not shown.*



*The recessed nuts are inserted from the underside of the gripper bottom.*

## **Step 9-Secure horn with black servo screw**

Secure the servo horn onto the servo with the black screw that you removed in Step 0.



# The Big Gripper Kit

## Notes for Construction and Use

1. Don't put your fingers, nose, or other body part in the gripper and close the fingers -- or someone else's fingers, nose, or other body part. While serious injury is not likely, the pinch can be a little painful.
2. The gripper fingers open at their widest to over three inches, and the rounded portion of the fingers open far enough to accept a tennis ball or 12 ounce beverage can. However, while the gripper is large enough to grasp fairly big objects, this doesn't mean it can lift them without damage to either the object, the gripper, or both. Big Gripper is designed to lift approximately 8-12 ounces, but use your best judgment in grabbing objects. *DO NOT attempt to grab glass or other fragile or breakable objects!! Use at your own risk! Not for use with open beverage containers, as the container may be crushed. The Big Gripper is not designed to lift objects heavier than 8-12 ounces.*
3. You may find that for some objects the hard plastic of the gripper fingers does not provide adequate traction. To increase traction, use a rubberized sleeve or coating. Two lengths of soft PVC vinyl tubing are provided with the Big Gripper kit for use as sleeves. Slip the sleeves onto the fingers (and past the rubber tips on the ends of the fingers) in order to increase the grip.
4. The thickness of the vinyl tubing (above) may prevent the Big Gripper from adequately grasping larger objects. Experiment with other traction methods, such as:
  - Wrap a rubber band around each finger;
  - Apply a plastic coating to the fingers; plastic dip is available at home improvement stores for adding rubber grips to tools;
  - Cut the "pinky" fingers from a pair of latex or nitrile gloves, and place over the grippers;
  - Glue rubber pieces into the groove of the gripper fingers.
5. The Big Gripper is available with and without a servo. When ordered with a servo, we provide a Futaba or Futaba-compatible brand with a torque of no less than 50 ounce-inches, at 6 vdc. If you provide your own servo, we recommend a torque of at least 45 oz-in. If you use a Hitec, Airtronics, or other servo that does not use a Futaba-compatible spline, you will need to provide your own servo horn. It should be of the same size and general shape as the short horn provided with the kit.
6. Avoid using a servo with more than 80 ounce-inch torque, to limit the squeeze placed on the objects that are grabbed by the gripper mechanism.
7. To provide you the ultimate in experimenting freedom, you may purchase extra gripper fingers separately from us. Refer to the Website listed below for ordering details.

## Finger Calibration

*Note: The following assumes you are using the servo we provide in the Gripper with Servo kit option. If you are using a different servo you may need to modify the calibration procedure as required for the operation of your server.*

To calibrate the finger position, use a microcontroller, serial servo controller, or servo tester to send the servo 2.0 millisecond pulses. (The pulses should be repeated 30-50 times per second.) The servo should move to one end of its rotation position, and should correlate with the fingers opened to their widest.

The servo horn should be *approximately* at the one o'clock position. As necessary, remove the black servo horn screw (being careful not to lose it!), and gently pop the horn off the white spindle of the servo. Use a small flat bladed screwdriver to carefully pry the horn off the spindle. Reorient the horn so that it is at the one o'clock position, and put it back onto the white spindle. Replace the black servo screw and tighten.

## Opening and Closing the Fingers

When using the servo supplied by us, close the fingers by sending the servo 1.0 millisecond pulses. Open the fingers by sending the servo 2.0 millisecond pulses. These pulses should be repeated 30-50 times per second.

*Note: Operation may be inverted if you use a servo other than the one we provide in the Gripper with Servo kit option.*

Note that the pulse timing to open and close the fingers to their full extent varies somewhat for each individual servo. Experiment to find the shortest pulse duration that closes the fingers to their full extent, and avoid shorter pulses. Conversely, find the longest pulse duration that opens the fingers to their full extent, and avoid longer pulses. While you may use longer or shorter pulses, doing so will be an extra drain on your robot's battery, as the servo is placed under additional load.

Big Gripper is available from:

**Budget Robotics**  
**PO Box 5821**  
**Oceanside, CA 92056**  
**<http://www.budgetrobotics.com/>**  
**[orders@budgetrobotics.com](mailto:orders@budgetrobotics.com)**

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