## Mechanical Eye Kit-A Pro (Modifications)

Modification Instructions:
Note: This kit comes with the Professional Ball and Socket Set for the mechanical linkage setup.

Follow the Mechanical Eye L/R kit instructions, and use the threaded rod, ball joint and sockets for the mechanical linkage.
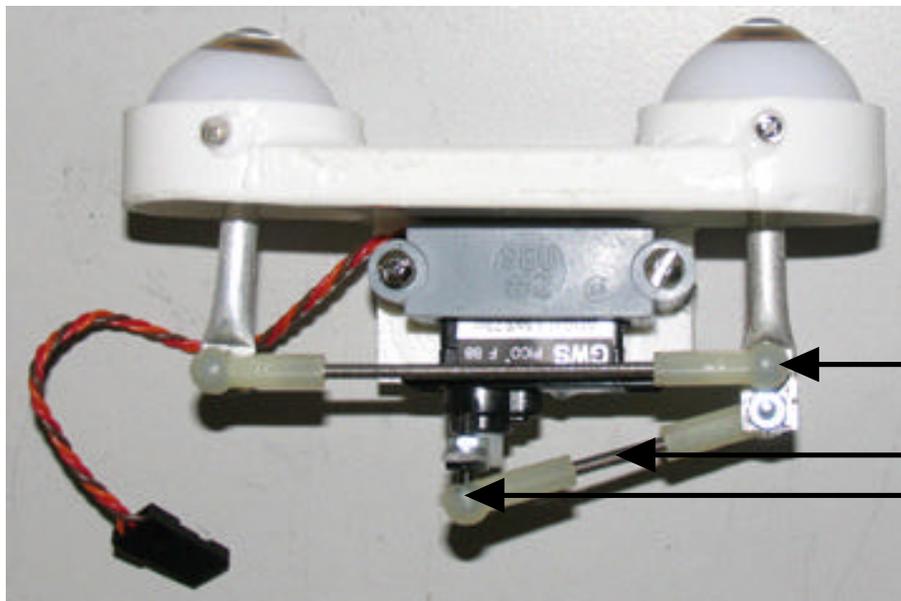
Sockets

Threaded Rods

Ball Joints
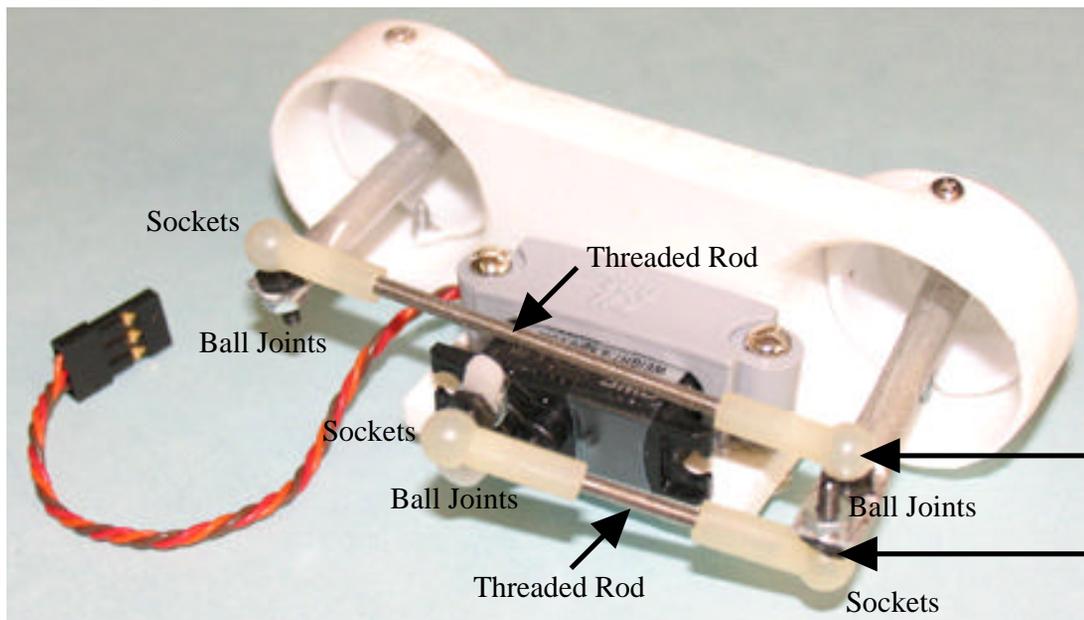
Sockets

Threaded Rod

Ball Joints

Sockets

Ball Joints

Sockets

Ball Joints

Threaded Rod

Ball Joints

Sockets

Blue Point Engineering

Mechanical Eye Kit-A (Optional Eyeball Assembly)

Optional Eyeball Pivot Setup

(Micro Screws Not Included in Kit)
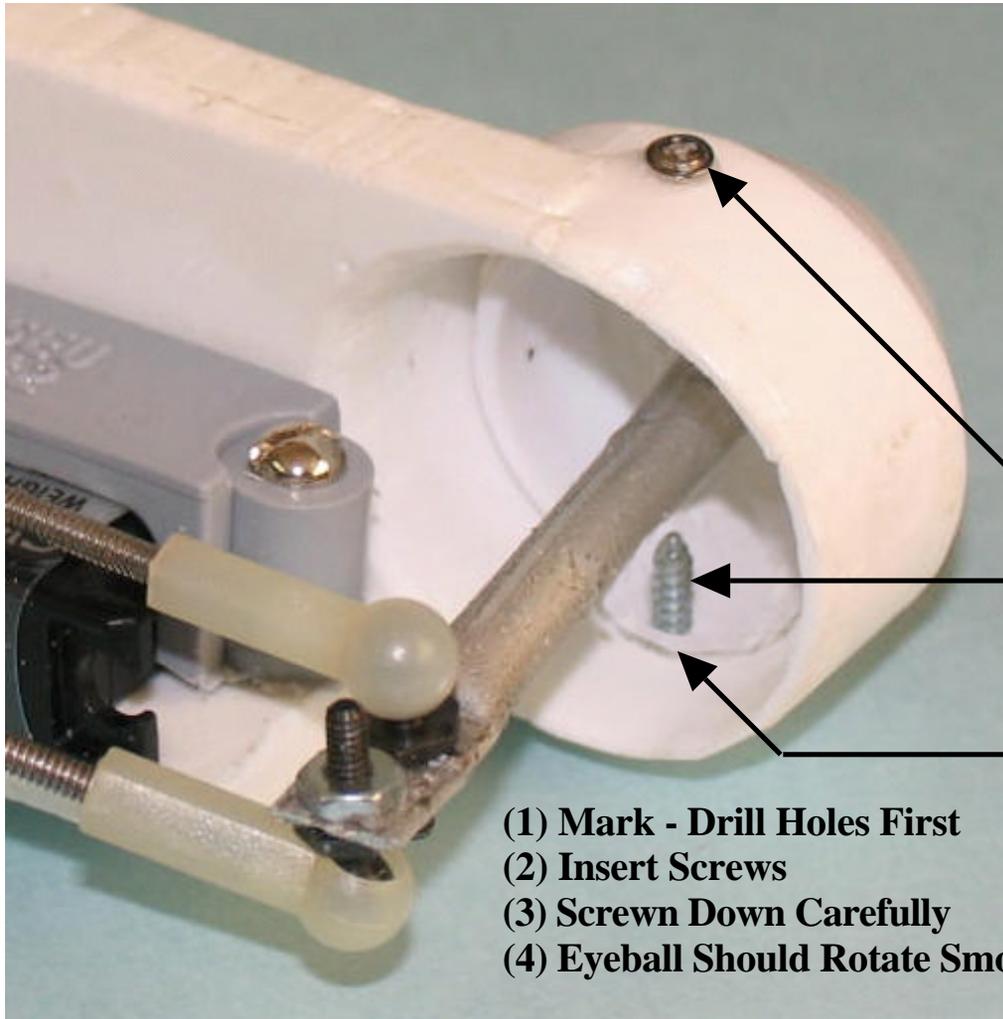
Micro Screws

Micro Screws

Use Caution so as not to break out the plastic eyeball

(1) Mark - Drill Holes First
(2) Insert Screws
(3) Screwn Down Carefully
(4) Eyeball Should Rotate Smoothly

Micro Screws

Micro Screws
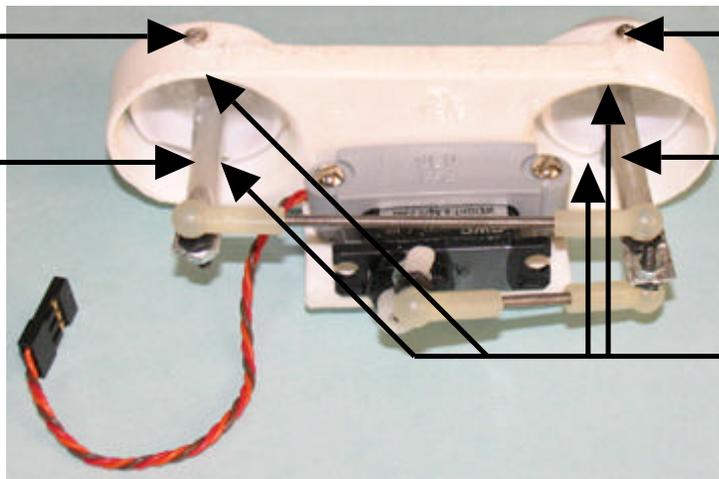
Micro Screws

Micro Screws

Use Caution so as not to break out the plastic eyeball

Assembly Steps

Step 1
Using sanding paper and an X-acto knife, carefully clean up the excess plastic from the Servo Base(3) and the Eye Motion Bracket(1).

Excess Plastic
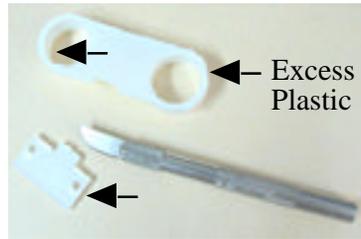
Step 2
Super glue the Servo Base(3) onto the Eye Motion Bracket(1) by aligning the tab on the Servo Base(3) into the Eye Motion Bracket(1) tab slot. **Note:** The Servo Base(3) should be in the center of the Eye Motion Bracket(1), if it is not, simply turn over the Servo Base(3) and assemble the tab into the Eye Motion Bracket(1).

Tab / Notch

Center
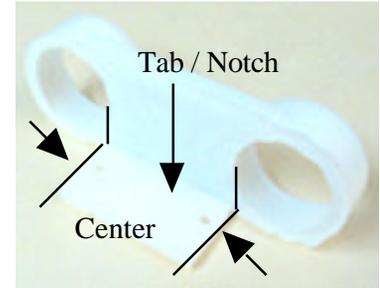
Step 3
Locate the reference dots on the top and bottom of the Eye Motion Bracket(1). Using a drill and a 3/32 drill bit drill a vertical hole down on the top two reference points of the Eye Motion Bracket(1). Flip the Eye Motion Bracket(1) over and drill vertical holes down on the two reference points of the Eye Motion Bracket(1) These will become the pivot points for the eyeballs.
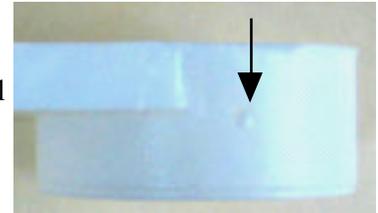
Step 4
Carefully sand the outer edge of an Eyeball half(7) and place into the right eye socket of the Eye Motion Bracket(1). Align the back half of the Eyeball(7) (flat side) so that it is flush with the Eye Motion Bracket(1) back side (servo base(3) side). Mark the Eyeball(7) pivot point, by placing a small rod, drill bit or long pencil point through the two holes drilled in the Eye Motion Bracket(1). These will be reference points where you will later drill. Make a small reference number (R), marking on the inner part of the Eyeball(7). Also mark up and down references on the Eyeball(7) as this will help re-align each Eyeball(7) back into the correct Eye Motion Bracket(1) socket and align the pivot points correctly up and down. Repeat the above procedure for the left Eyeball(7). (**Note:** you can slightly move the Eyeball(7) in and out of the Eye Motion Bracket(1) socket to have the Eyeball(7) extend farther out or closer in to the Eye Motion Bracket(1). Be careful not to move the Eyeball out so far that when you drill the pivot hole it will end up too close to the edge of the Eyeball(7). Remove the Eyeballs(7) and drill (3/32 bit) through the two reference marks made for each Eyeball(7).

Sand the outer edge of Eyeball

Eyeball half (7)   Flush
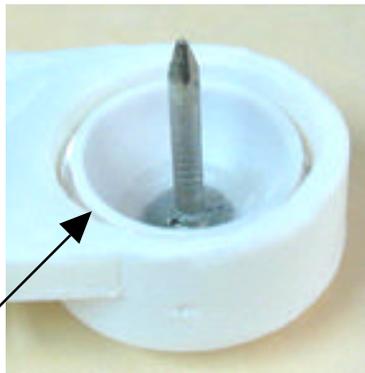
Marking Rod / Drill Bit / Pencil

Mark-U

Mark-D   Mark-R

Eye Adjustment
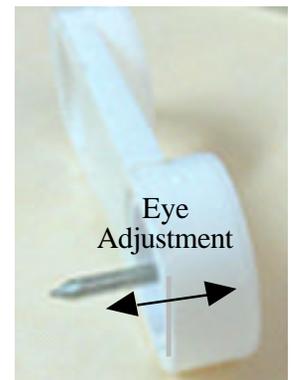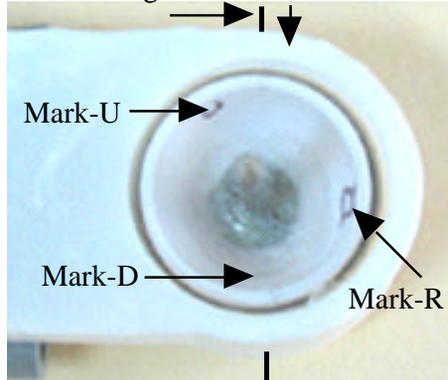
Step 5
Take one of the small brass rods(9) and cut four 3/4" lengths of rod. Place an Eyeball half(7) back into the Eye Motion Bracket(1) using the reference markings and alignment up / down marks for that Eyeball(7) you established earlier. Place the 3/4" length of rod down into one of the Eyeball(7) pivot points. Center the rod in the hole, between the Eyeball(7) and Eye Motion Bracket(1) . Using a pair of needle nose pliers, carefully bend the rod at the top of the Eye Motion Bracket(1) back toward the back of the Eye Motion Bracket(1) (toward servo base). Repeat this for the bottom pivot point of the Eyeball(7) and then do the exact same for the second Eyeball(7). When you are done, each Eyeball(7) should be secured into the Eye Motion Bracket(1), but loose enough to move back and forth (left / right) smoothly. You may need to sand the edge of the Eyeball to get smooth action left and right. Carefully super glue the brass rods at the top and bottom of the Eye Motion Bracket(1).

Rod   Rod
Rod bend   Rod bend

Center

Rod bend

Center   Rod bend
Rod   Rod bend
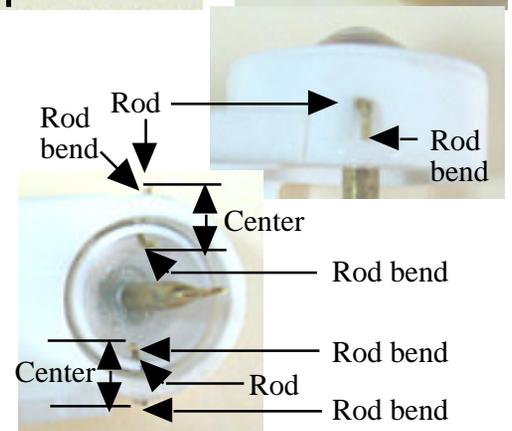
Step 6

Take the larger hollow tube(8) and cut it in half, approximately about
1-1/2" length of rod. Place some super glue (thick or gap filling type)
down one end of each rod and slide each rod over the Eyeball(7) center
support shaft. Let the super glue cure/ dry before going on.
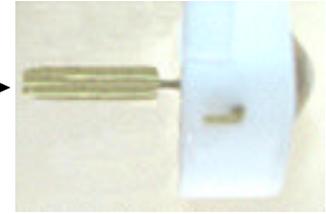
Step 7

Take the Mechanical Eye Module(1) and place it down on the table, with the Servo Base(3)
down on the table facing you and the Eyeballs looking forward. Take the needle nose pliers,
and slowly squeeze (flatten) down the right side end of the large eyeball motion hollow
tube(8) down to approximately 3/8" wide. Support the hollow motion tube, eye module and
drill (3/32) down a hole (hole1) near the end of the large right motion hollow tube(8) and
another hole (hole 2) down approximately 1/4" away from the first hole toward the eyeball
along the large right hollow motion tube(8)(see image for details). Use caution as not to
damage or bend the hollow motion tubes(8) or break the eye module when drilling down
through the squeezed hollow motion tube(8) ends. Use a wood block or strong support
when drilling. Use caution as not to drill your fingers or damage the table.

Flatten
Tube

Hole 2
Hole 1
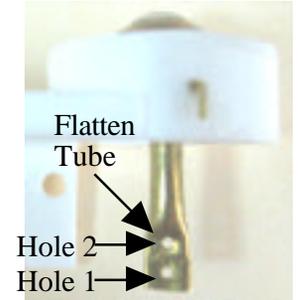
Step 8

Take the Mechanical Eye Module(1) and place it down on the table, with the Servo Base(3)
down on the table facing you and the Eyeballs(7) looking forward. Take the needle nose
pliers, and carefully squeeze (flatten) the left side end of the large motion tube connected to
the eyeballs(7) to approximately 3/8" wide supporting the eyeball motion tube and eye
module.

Align each Eyeball(7) so that the eyes are each looking forward. Take a ruler, straight edge,
or other small rod(9) and align the second hole on the right Eyeball hollow motion tube(8)
straight across to the left Eyeball hollow motion tube(8). Using a fine marker, mark on the
large left motion tube, where the rod, straight edge from the right Eyeball(7) motion tube(8)
aligns up (see drawing for details). Drill (3/32) down a hole center of the left hollow motion
tube(8) with the alignment mark. Use caution as not to damage, bend the motion tubes(8) or
break the eye module when drilling.

Flatten
Tube

Hole 3

Straight
Edge

Hole 2

Hole 3 Mark
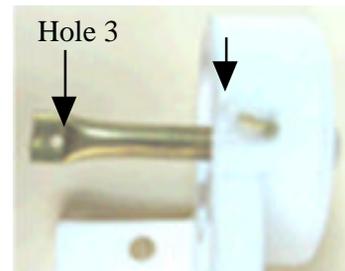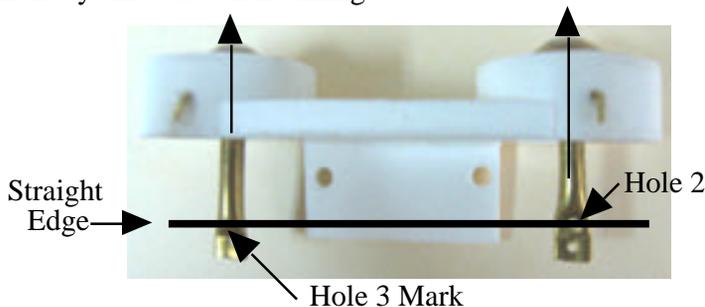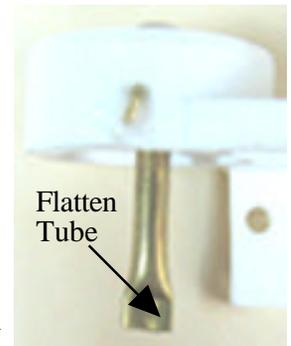
Step 9

Take the Micro Servo(2) and lay it down flat into the Servo
Holding Bracket(5). Mark the inside of the Servo Holding
Bracket(5) on both sides of the Servo Holding Bracket(5) legs
level with the servo body.
Take an X-acto saw or hacksaw and cut off the small oversized
Servo Holding Bracket(5) legs. (see image for details). Use
sandpaper to smooth the Servo Holding Bracket(5) and make
sure that the legs are flat and square. Check to see if the bracket
will hold down tight the Micro Servo(1) on a tabletop.

Cut - Remove
measured part of
both support legs

Mark

Mark

Servo Holding Bracket(5) holding
Micro Servo(2) flat on tabletop
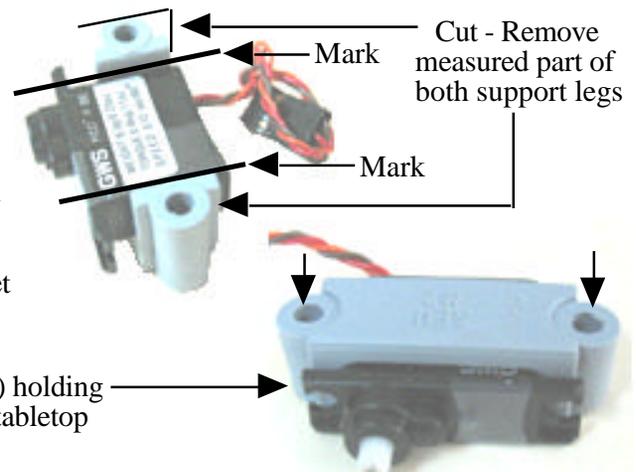
Step 10

Take the Micro Servo(2) lay it flat and using an optional servo checker or servo controller adjust the servo so that output shaft on the servo will be center when a servo arm is later attached (arm = Vertical -Up/Down) . You can also manually adjust the micro servo(3) center position. Attach a servo arm to the servo. Hold the servo flat and very carefully and slowly move the servo arm left and right. You may need to move the servo arm off the servo shaft and re-adjust the servo arm back on the shaft until you find the center position of the servo by determining how far left and right the servo is moving. Attach a servo arm vertical (Up /Down) securely with small servo shaft screw. It is also possible to adjust the servo arm on and off the servo output shaft when making a final connection to a servo controller.

Center
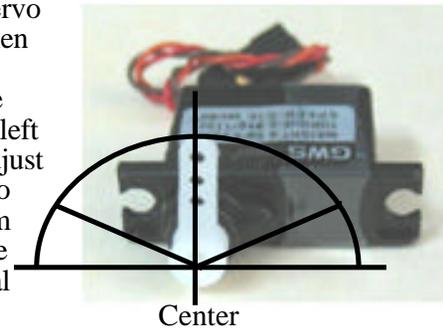
Step 11

Take the Micro Servo(2) and lay it down flat onto the Servo Holding Base(3) with the servo output shaft, on the left side of the Servo Holding Bracket(5) or left side of the Eye Motion Bracket(1). Place the Servo Holding Bracket(5) down over the servo using the nuts and bolts, mount the Servo Holding Bracket(5) to the Servo Holding Base(3). Caution, do not over tighten the nuts and bolts and make sure that the legs are flat and square. Check that the servo wire is not bent, twisted or pinched between the Servo Holder Bracket(5) and Eye Motion Bracket(1).
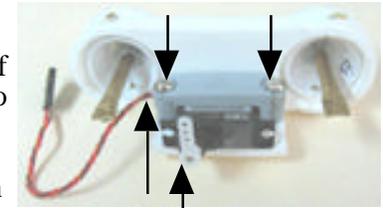
Step 12

Align the Eyeballs(7) so that they are looking straight ahead in the Eye Motion Bracket(1). Make a "Z" bend on one end of the small rods(9). Place the "Z" bend into the second hole (2) on the right eyeball tube. Lay the rod across to the left eyeball motion tube. Make a mark on the small rod where the rod would turn and go down through hole (3) on the left eyeball motion tube(8). From the mark on the small rod add another 1/4" and then cut the rod.

Hole 2

Rod

Using the needle nose pliers, carefully bend down the small rod where the first mark was made over the left eyeball motion hollow tube(8) and push the rod(9) down the hole. Use the needle nose pliers to turn the bottom portion of the rod(9) through the left eyeball motion hollow tube(8) up to the left.
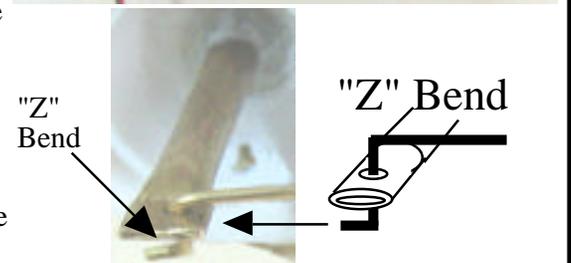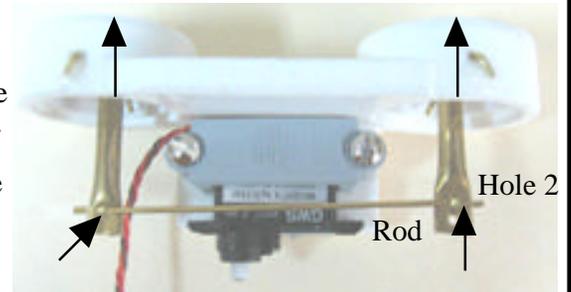
"Z" Bend

"Z" Bend

Step 13

Align the Eyeballs(7) so that they are looking straight ahead in the Eye Motion Bracket(1). Make a "Z" bend on one end of the small rods(9) and place it into the outer hole of the servo arm end. Lay the rod across to the right eyeball motion hollow tube(8) over the outside hole. Make a mark on the small rod(9) where the rod would turn and go down through the hole on the right eyeball motion tube(8). From the mark on the small rod add another 1/4" and then cut the rod. Using the needle nose pliers, carefully bend down the small rod(8) where the first mark was made over the right eyeball motion tube and push the rod down the hole. Use the needle nose pliers to turn the bottom portion of the rod(7) through the right eyeball motion tube(8), up to the right. Your Mechanical Eye Module is now done and ready to use in your project.

Rod

Rod

Outer Hole (1)

"Z" Bend

Hole (3)

Servo Arm

"Z" Bend
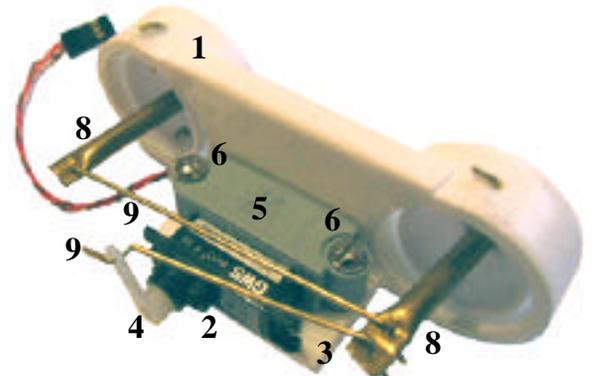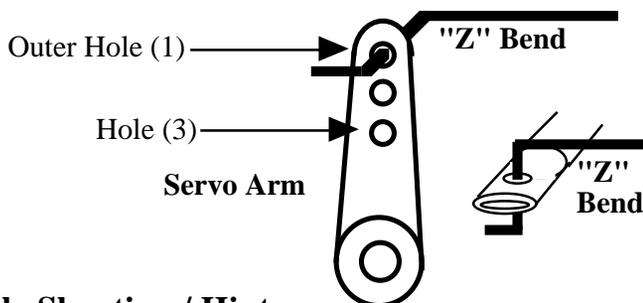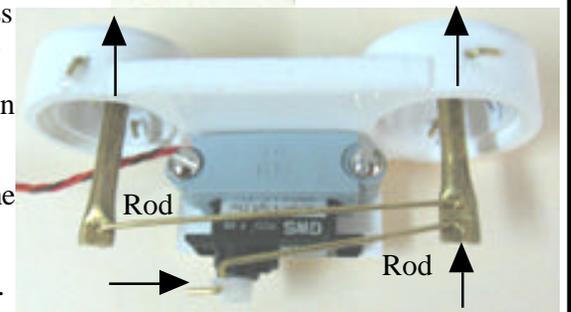
Trouble Shooting / Hints

See Trouble Shooting Guide for help and hints.

1

8

6

9

5

6

9

4   2   3   8

Mechanical Eye Kit-A

Manual Eye Motion Control Example

Mechanical Eye Module

Micro Servo Connection

Optional Wizard-12 Controller

Example Eye Base Extension and Mounting Bracket

Linear Slide Potentiometer

Servo Control

- W +

Power

Optional Wizard-12 Controller

(-) Black Wire

- OR -

Rotary Potentiometer

Servo Control

Wall Plug Power Supply 9 Vdc @ 2.0 Amp

(+) Red Wire

- W +
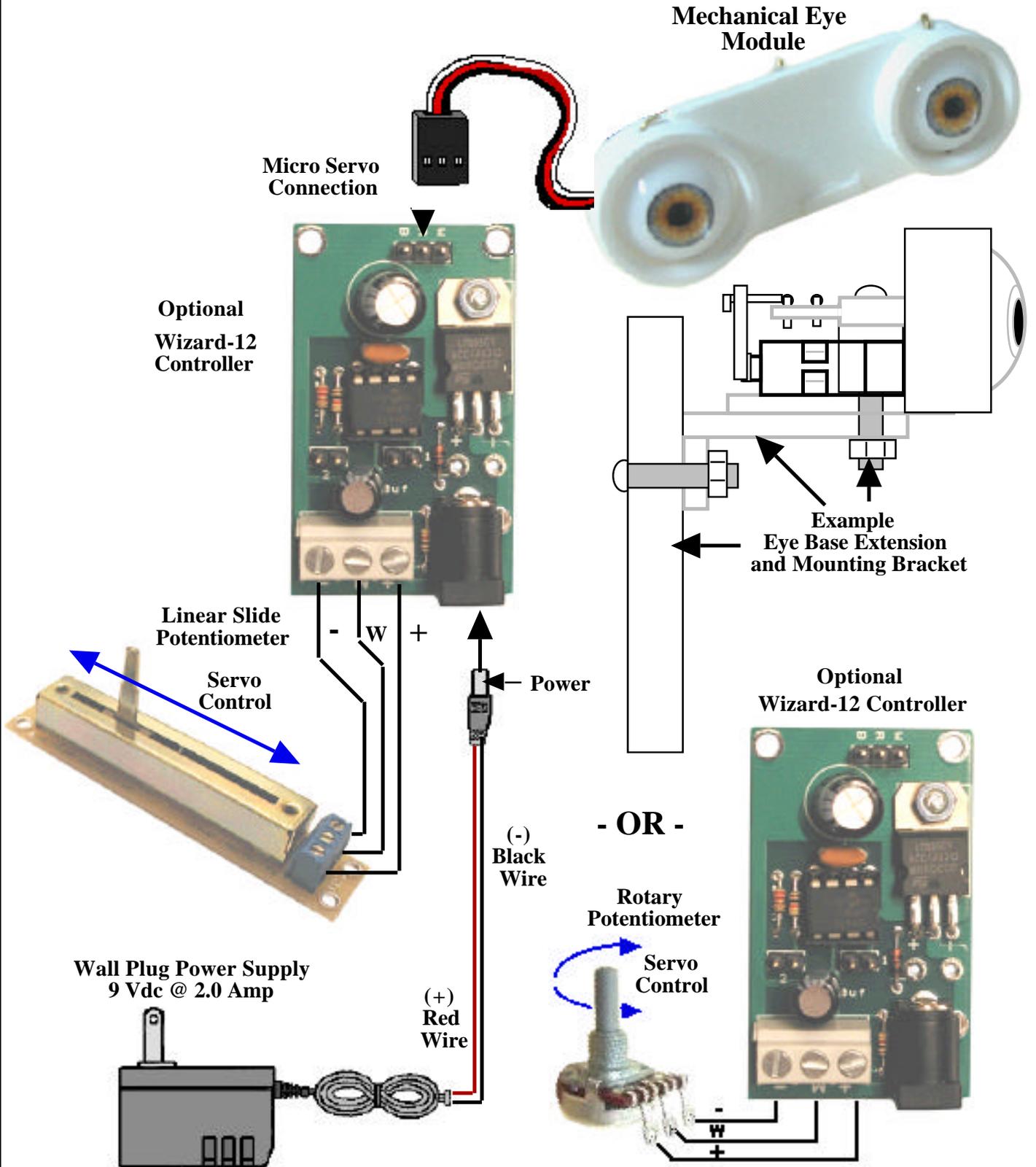
Mechanical Eye Kit-A

Automated Eye Motion Control Example

Mechanical Eye Module

- OR -

- OR -

Servo Output Connection

- OR -

Wizard 6 Random Controller

- OR -

Puppet + Controller

Servo Output Connection

Wizard 1 Controller
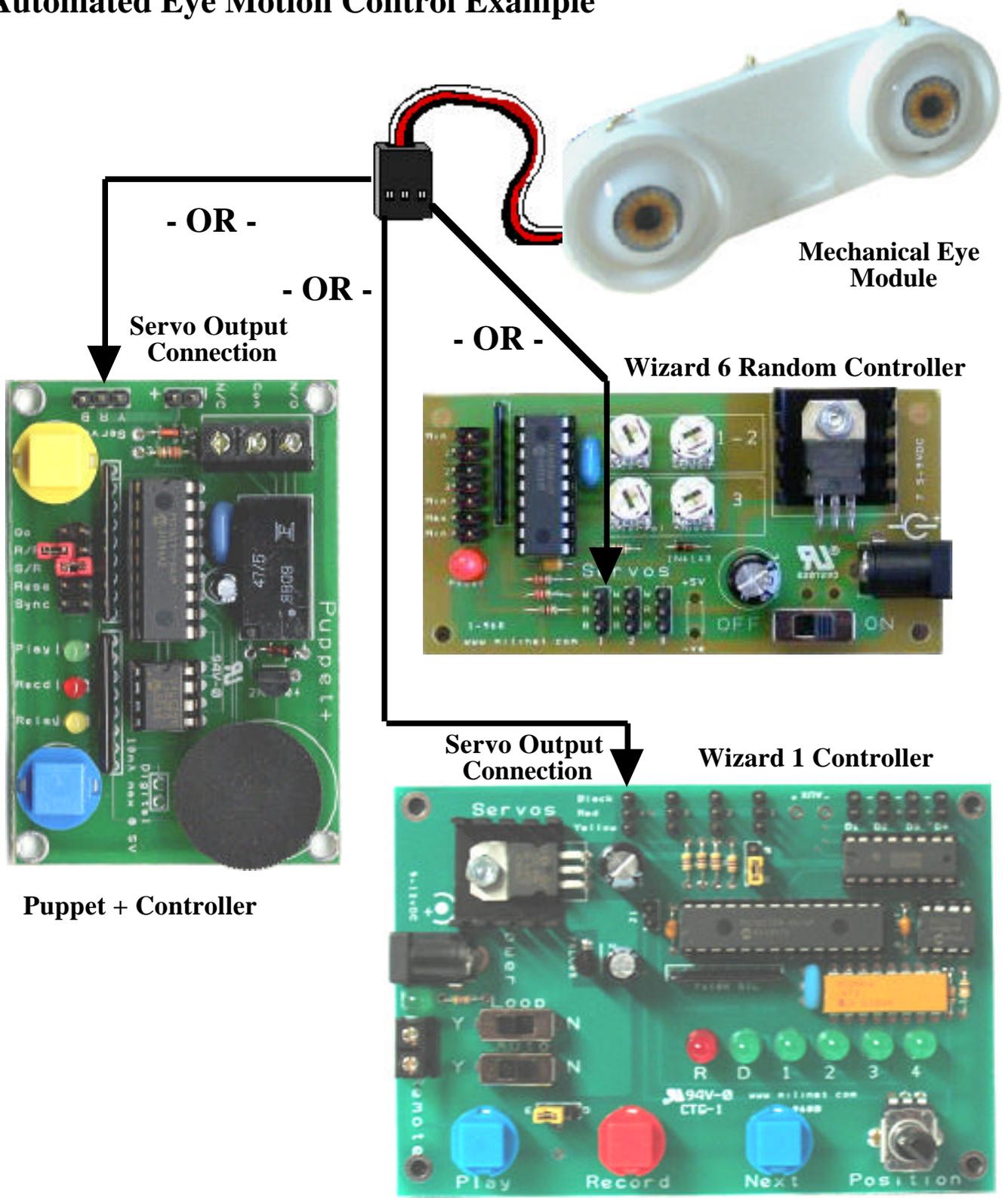
Mechanical Eye Module
Trouble Shooting / Hints

Q. **Micro Servo(1) is shaking, vibrating.**
A. Make sure that you have set the servo arm to the center position of the servo Left and Right travel positions. Use a servo checker, servo controller board to set center or manually adjust the servo for center position.
 • Check to see that the eyeball pivot joints are loose and that the Eyeballs(7) move smoothly left and right in the Eye Motion Bracket(1). You may need to remove the Eyeballs(7) and sand the outer edge of the eyeball.
 • Check to see that the optional servo controller is powered correctly and that the servo travel limits have been set. for mininum and maximum travel.

Q. **The Eyeballs(7) move in a jerking like motion.**
A. Check to see that the Eyeballs(7) pivot joints are loose, and that the Eyeballs(7) move smoothly left and right in the Eye Motion Bracket(1). You may need to sand the outer edge of the Eyeballs(7) to get a smooth action left and right on the Eyeballs(7).

Q. **When I look at the Eyeballs(7) straight on, one of the Eyeballs(7) is slightly out to an angle away from center.**
A. Adjust the push and pull rods between the Eyeballs(7) until the eyes are center. You may have to remove the rods(9), center the Eyeballs(7) and re-do the push and pull rod lengths.

Q. **The micro servo seems to be off center of the Eye Motion Bracket(1).**
A. Make sure that the Servo Base(3) is connected to the Eye Motion Bracket,(1) correctly. You may have to flip over the Servo Base(3) and attach it back to the Eye Motion Bracket (Tab to Slot).

Q. **The Micro Servo(2) is making a click noise and will not move.**
A. The servo has been jammed or the servo arm has been forced. You probably will need to replace the Micro Servo(2) as the servo internal gearing has been stripped out.

Q. **The Micro Servo(2) arm is bending outward during servo motion.**
A. Check to see that the Eyeballs(7) pivot joints are loose and that the Eyeballs(7) move smoothly left and right in the Eye Motion Bracket(1). You may need to remove the Eyeballs(7) and sand the outer edge of the Eyeballs(7)
 • Check to see that the brass push rod "Z" bend is correct in the servo arm hole. The "Z" bend should be within the arm hole.
 • Make sure that the servo is pushed back up against the Eye Motion Bracket(1).
 • Put the "Z" bend lower down the servo arm hole toward the servo output shaft. (Hole 2 or 3)

"Z" Bend

Flat Tube

Brass Rod

Outer Hole (1) ⟶ **Brass Rod**

Hole (3) ⟶

Servo Arm
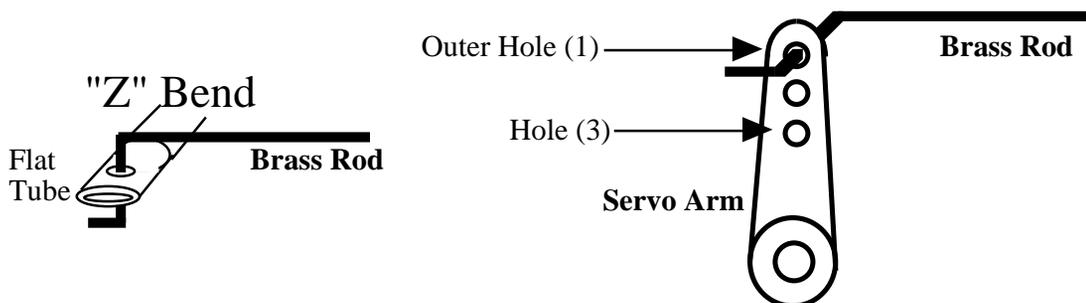
Q. **The MicroServo(2) is jammed as it moves far left and far right.**
A. Check to see that the eyeball pivot joints are loose and that the Eyeballs(7) move smoothly left and right in the Eye Motion Bracket(1)
 • Set the Min and Max servo travel position on the controller so that the servo is not being driven hard past its normal movement stops. You will only need to move the servo left and right a small amount to get a good movement of the eyeballs left and right.

Servo Info and Centering

A servo is a mechanical motorized device that can be instructed to move the output shaft attached to a servo wheel or arm to a specified position. Inside the servo box is a DC motor mechanically linked to a position feedback potentiometer, gearbox, electronic feedback control loop circuitry and motor drive electronic circuit.

Standard Servo Motor

X-ray View
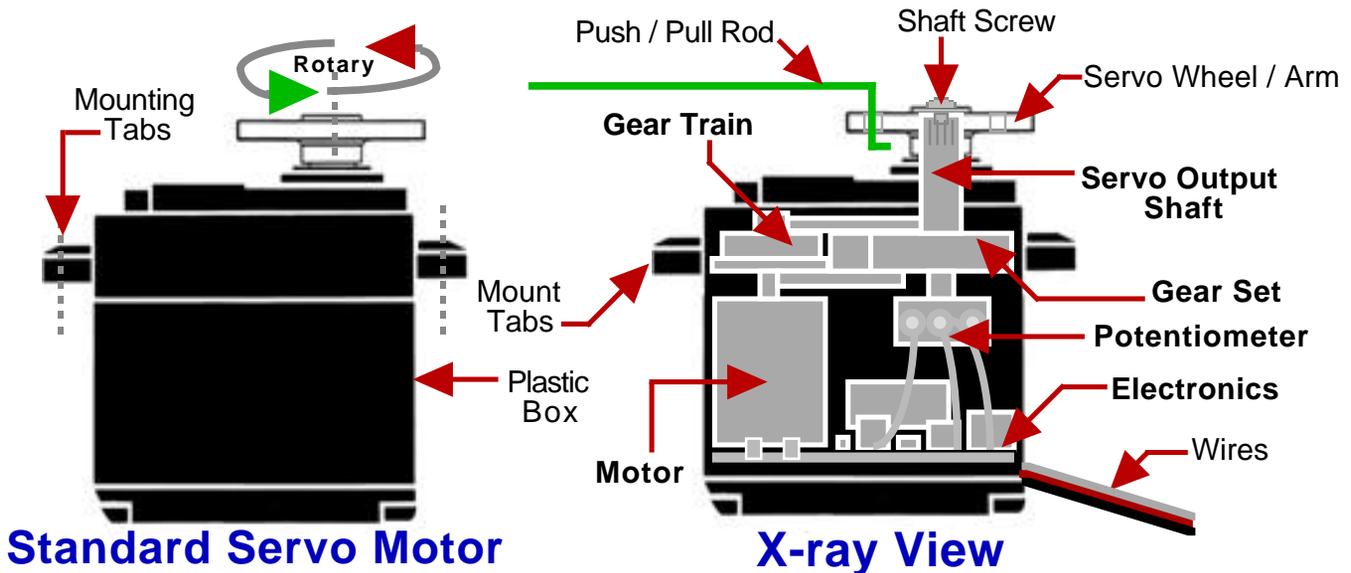
A typical R/C servo looks like a plastic rectangular box with a rotary shaft coming up and out the top of the box and three wires out of the servo side to a connector. Attached to the output shaft out the top of the box is a servo wheel or Arm. These wheels or arms are usually a plastic part with holes in it for attaching push / pull rods or other mechanical linkage devices to the servo. The three electrical connection wires out of the side are V- (Ground), V+ (Plus voltage) and S Control (Signal).

The control S (Signal) wire receives Pulse Width Modulation (PWM) signals sent from an external electronic controller and is converted by the servo on board circuitry to rotate the motor, gearbox, potentiometer and output shaft connected to the servo arm or wheel.

R/C servos run on 5 volts DC but they often work with voltages V-, V+ between 4 and 6 volts DC power, near 1 Amp of current. (Torque load determines amps and can be from 200 mA to 1 Amp depending on moving or holding force the servo needs for position)

R/C Servos are controlled by sending a pulse width signal (PWM) from an external electronic device such as a servo controller, servo driver module or R/C transmitter and receiver. Pulse Width Modulation or PWM signals sent to the servo are translated into position instructions by electronics inside the servo. When the servo is instructed to rotate, the DC motor is powered on until the rotating potentiometer linked, geared to the DC motor reaches the electric value corresponding to the instructed position sent to the servo and translated by the on board electronics.

A pulse width signal (PWM) of approximately 1.5 mS (1500 uS) is the "neutral" position for the servo. The servo, neutral is defined to be the point where the servomotor has exactly the same amount of potential rotation in the counter clockwise direction as it does in the clockwise direction. When the pulse width signal (PWM) sent to a servo is less than 1.5 mS. the servo moves some number of degrees counterclockwise from the neutral point. When the pulse is greater than 1.5mS the servo moves some number of degrees clockwise from the neutral point. Generally the minimum pulse will be about 1.0 mS and the maximum pulse will be 2.0 ms with neutral (Stop) movement at 1.5 mS

Servo Info and Centering

R/C servos are usually mechanically stopped from moving at full rotation. They have limited rotation through a mechanical, plastic block on the internal gearing and can rotate about 90 to 180 degrees or less only. Servos are unable to continually rotate and usually can't be used for driving rotating wheels. A servos precision positioning makes them ideal for robotics and animatronics, since servos are self contained with control loop circuitry, drive circuits, servo position, speed control, and are very easy to control by an external device such as a electronic servo controller board used in animatronic character and robotic applications.

Servos are dynamic devices that when instructed to move position, will actively move to hold the position, If for example a servo is instructed to move in the clockwise position and an external force is present and pushing against the servo such as a mechanical linkage, the servo will resist being moved out of that position or continue to try and move to the instructed position, even if the servo arm is incorrectly placed on the motor shaft, until powered off. It is for this reason that every servo output arm or servo wheel used should be placed into the neutral position before instillation into your project.

Setting the servo arm or wheel to the neutral position prevents stress to the servo motor, damages to the electronics and provides wider movement ranges and angles for operating the mechanical linkages connected to the servo arm or servo wheel.

CW - ClockWise
CCW - Counter ClockWise
OFF / HOLD

Positional Location
0 - 90 Left
0 - 90 Right
180 full left to full rig

Servo

Servo Wheel or Arm

Servo

Servo Connector

Modified Servo for
Continous Rotation

(-) = Black Wire
(+) = Red Wire
(S) = White/Yellow Wire

(-) Ground
(+) 5 Vdc
(S) Signal

Horizontal / Vertical
Rotation 180 Degrees

R/C
Servo
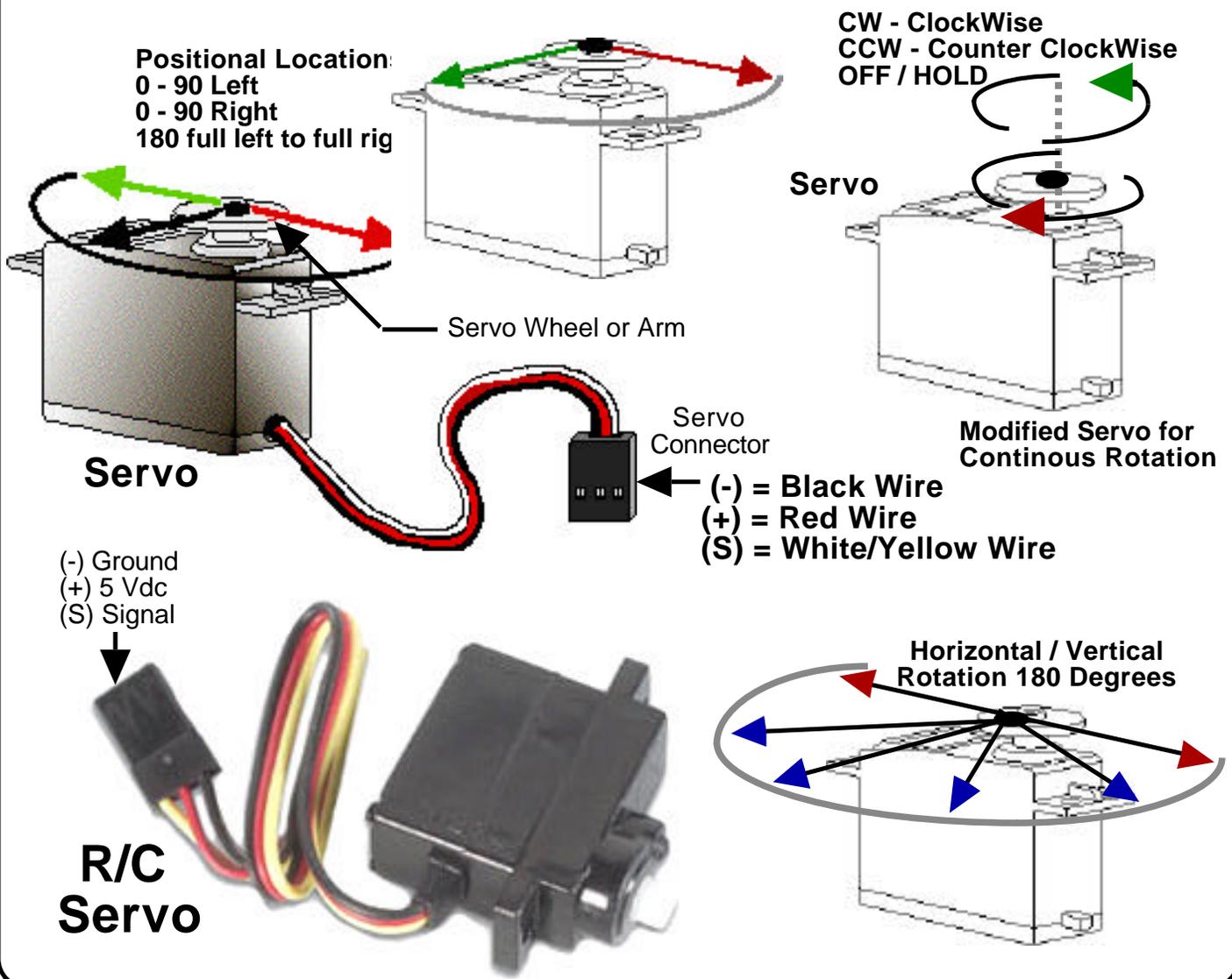
Servo Info and Centering

How to Determine the Center Position of a R/C Servo

Automated Servo Center Position
There are several ways to do this:

(See Servo Checker Operation Guide)

The best and easiest way to set a servo's center position is to connect the servo to a servo checker or tester. There are several low cost servo checkers worth purchasing and having in your toolbox if planning to work with servos. To use a Servo Checker simple set the Servo Checker to its automated center position and let the controller move the connected servo to center. If the servo arm is pre-attached, you may have to remove the servo arm on top of the servo shaft and re-position it back onto the servo shaft center point. The servo is now ready for instillation.   Once centered place the servo arm on top of the servo shaft, secure it with servo screw and install the servo as needed or carefully remove the servo arm from the servo if not needed for instillation. Do not move the shaft at this point, if it moves, simply repeat the above procedure to find the servo center again.

Manual Servo Center Position - Steps:

Carefully place one of the servo arms or wheel onto the servo shaft, mark a reference line through (across) the servo arm or wheel center point.
Slowly and carefully rotate the servo arm or wheel by hand as far to one side as it will go, do not force servo arm / wheel.
Mark a line on the servo base where the servo arm or wheel reference line stops.
Slowly and carefully rotate the servo arm or wheel by hand to the opposite position, as far to one side as it will go, do not force servo arm / wheel. Should travel about 180 degrees.
Mark a line on the servo base where the servo arm reference line stops.

Rotate the servo arm back to 90 degrees between the two end reference line positions (A,B) marked on the servo base. You may have to remove the servo arm on top of the servo shaft and re-position it back onto the output shaft to get the center point if the arm is off center position. This should put the servo arm close to center position.
Carefully remove the servo arm from the servo if not needed for instillation or place the servo arms on top of the servo shaft, secure it with servo screw and install the servo as needed. Do not move the shaft at this point. If it moves, simply repeat the above steps to find the servo center again.

SERVO CENTERING

(A) **Reference Mark**
Reference Line
Arm/Wheel Screw
(B) **Reference Mark**
Servo Arm

(A) **Reference Mark**
Reference Line
(B) **Reference Mark**
Servo Wheel
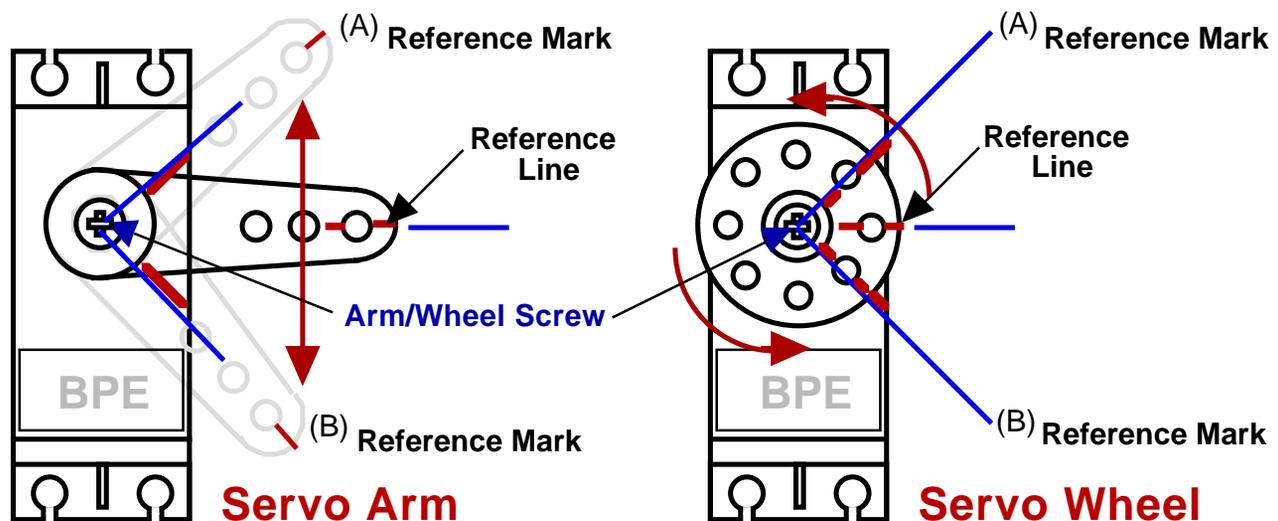
Servo Checker

Test and calibrate hobbyist "Radio Control" type servos.

- Manual and Automatic Sweep Mode.
- Slow 90 degree sweep function.
- 0 and 90 degree calibration marks (servo 1ms and 2ms pulse widths)
- Calibration marker every 15 Degrees

Advanced Setup Port

Manual Test

Power Connection 4.8 - 6.0 Vdc

Servo Connection R/C- Servo (-) (+) (S)

R/C Servo

Test LED

Auto Test

Servo Position Adjustment
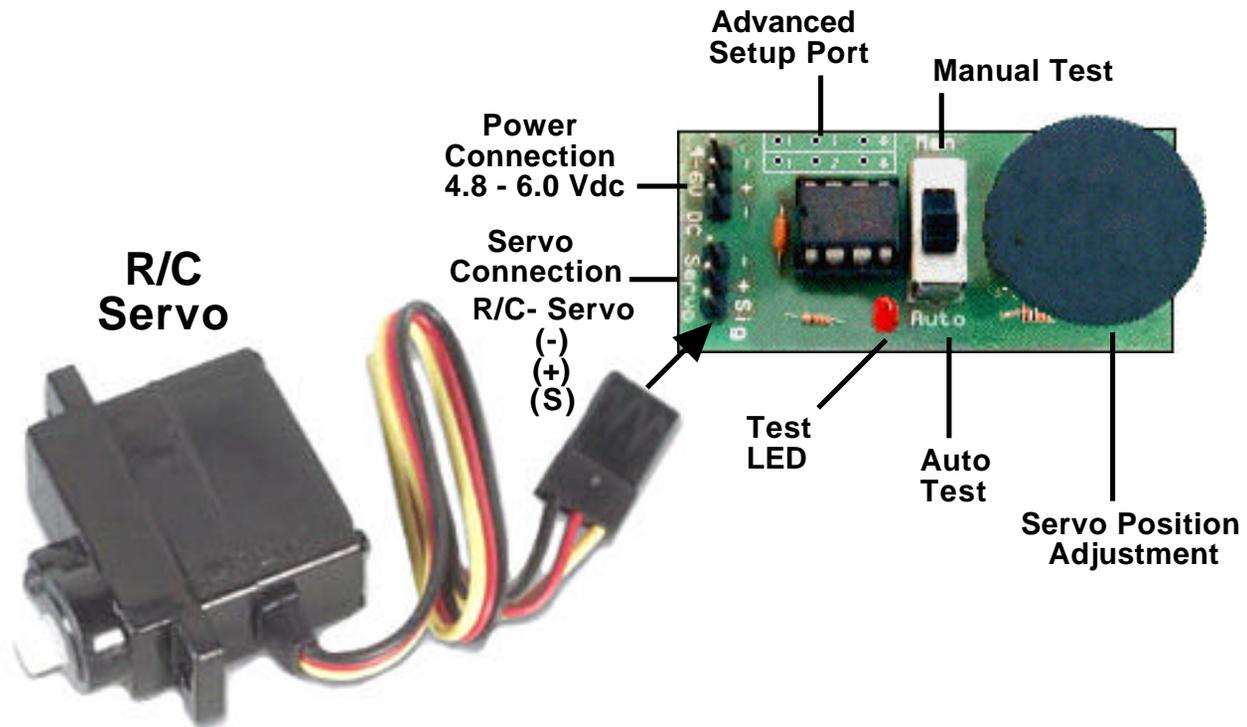
Connections:
Battery = 4.8 to 6 Vdc only-middle pin connection (Plus (+Vdc), either side connection pin (Negative (-Vdc). **NOTE: Incorrect polarity will damage the servo checker.**

Operation
Connect a battery and servo to the servo tester.
NOTE: Check servo connector polarity (-minus) (+Plus) (Signal)

Manual Mode: (Slide switch to **MAN** position)
The servo checker generates a standard servo pulse stream. The width of the pulses varies between **1.0** msec and **2.0** msec depending on the position of the potentiometer. Turning the potentiometer fully to either end of its travel will cause the Red LED to turn ON, indicating that either a **1.0** or **2.0** pulse with which should correspond with a servo angle of either **0** or **90** degrees.
Additionally, as the potentiometer is turned, the Red LED will turn ON at positions corresponding to **15, 30, 45, 60** and **75 degrees**, thereby providing a visual calibration status of where the servo should be at these angle degree points.

Automatic Mode: (Slide switch to **AUTO** position)
This mode will demonstrate a smooth action of the servo. The output pulse stream to the servo is gradually increased from **1.0** to **2.0** msec which should make the servo smoothly transverse from one end stop to the other without any sign of servo jitter. At the end of the servo sweep the servo should quickly transverse to the start point. The potentiometer will adjust travel speed.

Servo Checker

Setup

**Wall Power Supply
(5 Vdc @ 1 Amp)**

BLACK
- Vdc

RED
+ Vdc

POWER CONNECTION

-Gnd

+5V
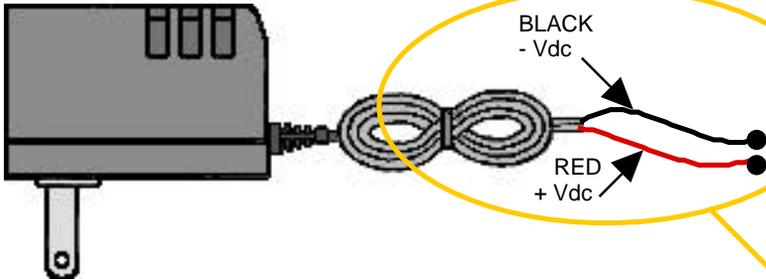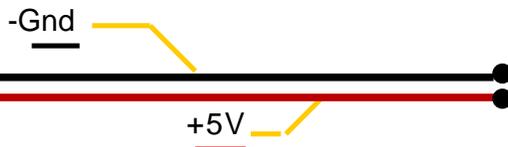
**Optional
Mobile Power
+5 Vdc Supply**

**Power
Connection
5 Vdc**

- Vdc Black
+ Vdc Red
- Vdc Black

Caution

**Check Correct
Polarity (-/+)**

**Manual
Operation**
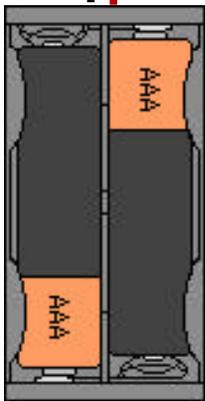
(Servo Checker)
Blue Point
Engineering

**R/C Servo
Connection**
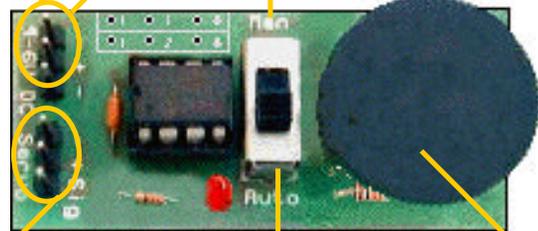
- Black
- Red
- White / Yellow

**Automatic
Test**

**Servo
Position
Adjustment**

Positions

A
B
C

Caution

**Check Correct
Servo Connection**

**R/C Servo
Connection**
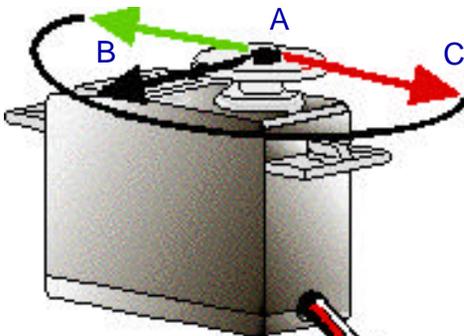
**Standard +5 Vdc
R/C Servo**

- Black
- Red
- Yellow / White