Servomotor Information

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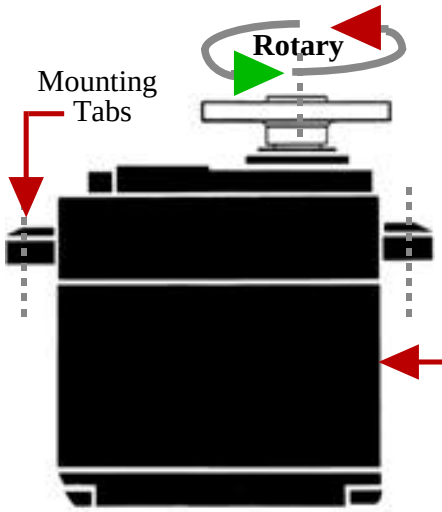
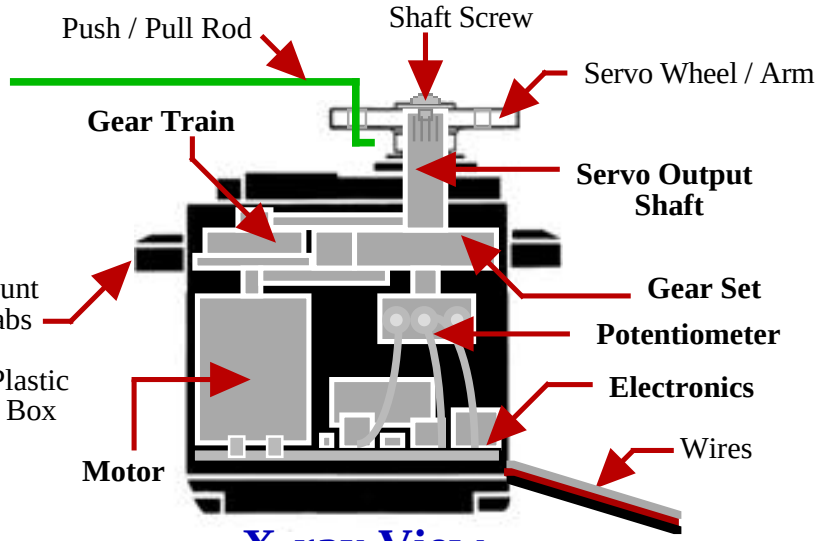
A servo is a mechanical motorized device that can be instructed to move the output shaft attached to a servo wheel or arm to a specified position. Inside the servo box is a DC motor mechanically linked to a position feedback potentiometer, gearbox, electronic feedback control loop circuitry and motor 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 electrical wires out of the servo side to a plastic 3 pin 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, ball joints 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 controller and is converted by the servo on board circuitry to operate the servo.

R/C Servos are controlled by sending pulse width signals (PWM) from an external electronic device that generates the PWM signal values, 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 values by electronics inside the servo. When the servo is instructed to move (Received a PWM signal) the on board electronics convert the PWM signal to a electrical resistance value and the DC motor is powered on. As the motor moves and rotates the linked potentiometer also rotates. Electrical resistance value from the moving potentiometer are sent back to the servo electronics until the potentiometer value matches the position value sent by the on-board servo electronics that was converted from the PWM signal. Once the potentiometer value and servo electronic signals match, the motor stops and waits for the next PWM signal input signal for conversion.

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

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 on the servo arm determines amps and can be from 200 mA to 1 Amp depending on moving or holding force the servo needs for position)

Servo Information

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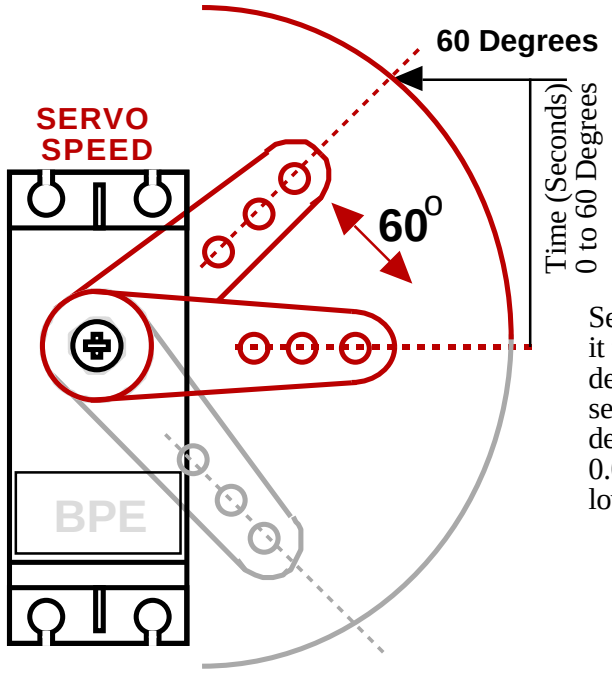
SERVO RATINGS

The most common details available on a servo are its speed and torque rating. Nearly all servo packages are listed with brand name, model name/ number, speed, and torque output at 4.8 volts and 6.0 volts. Some information about metal, plastic gears or ball bearings may also be listed.



SERVO SPEED

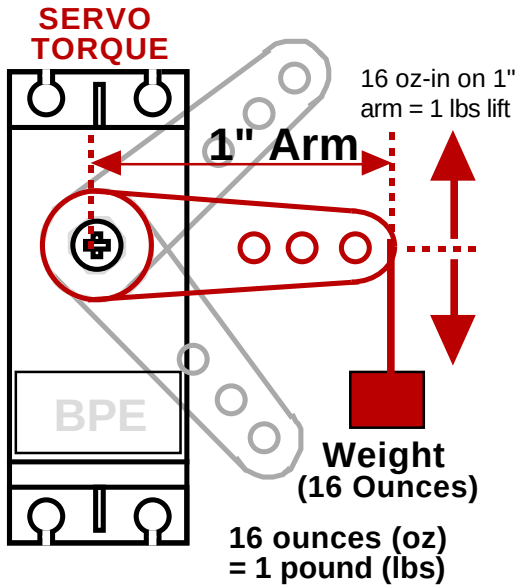
Servo Speed is defined as the amount of time (in seconds) that a servo arm attached to the servo output shaft will move from 0 to 60 degrees.

Note: The lower the time (Seconds) the faster the servo can move an attached wheel or arm.

Servo Speed is measured by the amount of time (in seconds) it takes a 1 inch servo arm to sweep left or right through a 60 degree arc at either 4.8 or 6.0 volts. A servo rated at 0.22 seconds/60 degrees takes 0.22 seconds to sweep through a 60 degree arc. Some of the fastest servos available move in the 0.06 to 0.09 second range. In some servos, faster speeds may lower torque available.

SERVO TORQUE (Power)

Servo Torque is defined as ounce-inch (oz-in) The total push / pull power a servo can apply on a 1" servo arm when moving.



Servos have a certain amount of torque (strength) that is generally proportional to their size. Servos come in all kinds of sizes, strengths and weight. Torque is the measurement of force given over a distance. For most servos in the USA, torque is measured in oz-in (force in ounces times inches, or ounce-inch). Servo Torque is measured by the amount of weight (in ounces) that a servo can hold at 1-inch out on the servo output arm in the horizontal plane, again at either 5.0 or 6.0 volts to see when the servo stalls as it tries to lift the weight horizontally. The reported result is a measurement like this: Servo XYZ = 100 oz/in. @ 6.0 V. That means that Servo XYZ is capable of holding 100 ounces using a 1 inch output arm without excessive deflection at 6.0 input volts. To convert oz-in to kilogram-centimeters (kg-cm) just divide by 13.9

Examples: Servo-A has 42 oz-in of torque
42 divided by 16 = 2.63 pounds of force on a 1" servo arm

Servo-B has 2.5 oz-in of torque
2.5 divided by 2 = 1.25 pounds of force on a 2" servo arm

Servo-C has 36 oz-in of torque
36 divided by 4 = 9 pounds of force on a 4" servo arm

Note: If you need to know how many pounds a servo can push or lift on a 1" servo arm, divide the oz-in by the number 16. Different sized arms can be used. Use the length of the arm and divide the oz-in value by the arm length

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Servo Information

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SERVO RATINGS

4.5 to 6.0 Voltage

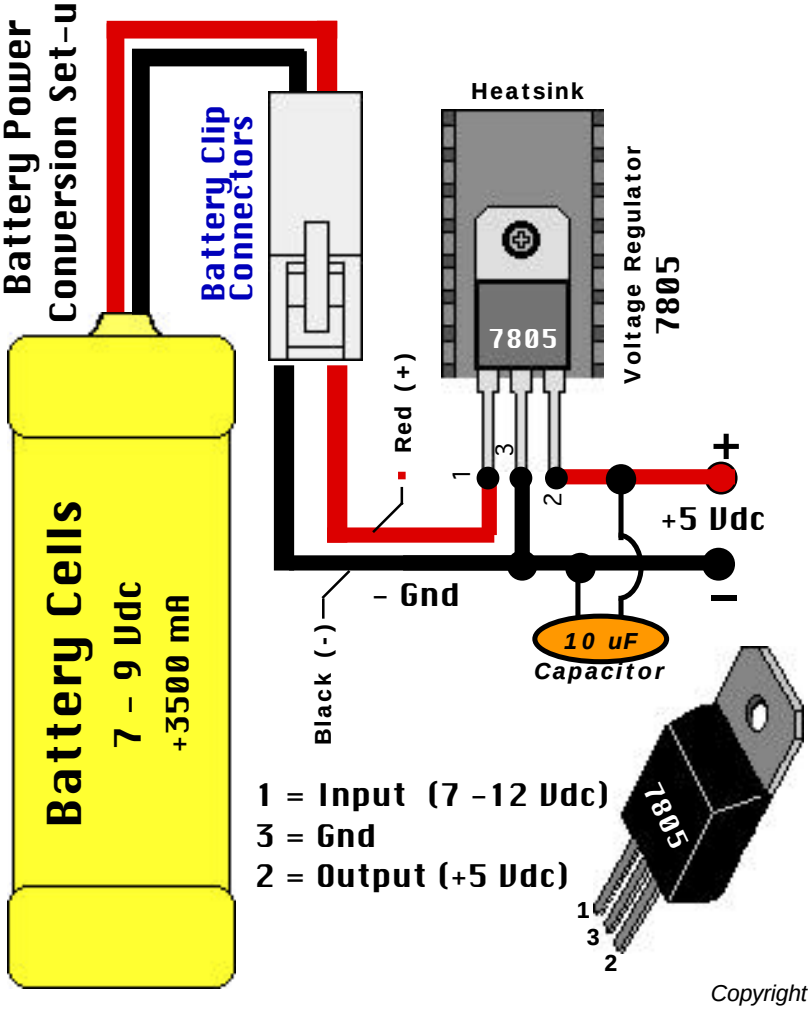
R/C Servo

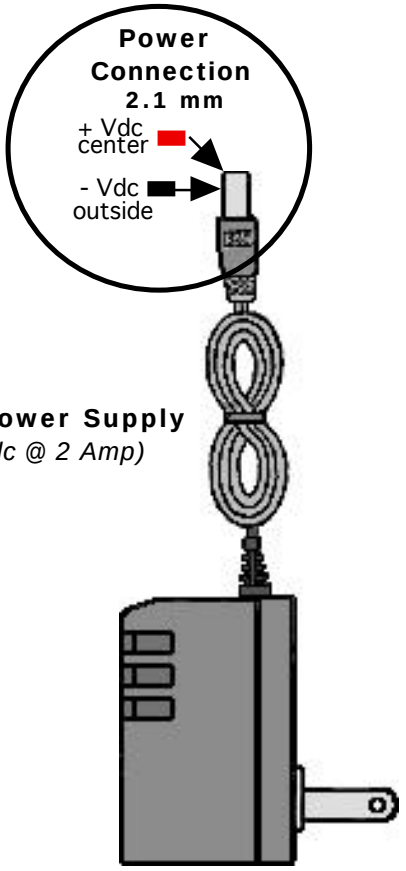
Servo Connector
(S) Signal =Yellow
(+) 5 Vdc = Red
(-) Ground = Black

SERVO POWER (4.5- 6.0 VDC)

Servo Power is defined as the amount of DC Voltage needed to operate a Servo without damage.

Servo operate from 4.5 to 6.0 volts DC. At the higher voltage servos tend to be faster and sometimes stronger, but can heat up faster when stalled or in a hold position with stress forces against the servo output shaft. Some servo controllers require a separate power source from the control source to deliver the higher 6.0 Vdc. The current drain (Amps required) depends on the torque being put out by the servo motor and can be in excess of one amp if the servo is stalled under load.
It is best to calculate 1 Amp per servo when figuring power supply needs for most servos.





6-12 Vdc to +5 Vdc Converter	
7805	Voltage Regulator
10 uF	Capacitor
6-9 Vdc Supply	Battery Supply
Heatsink	

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Servo Wire Information

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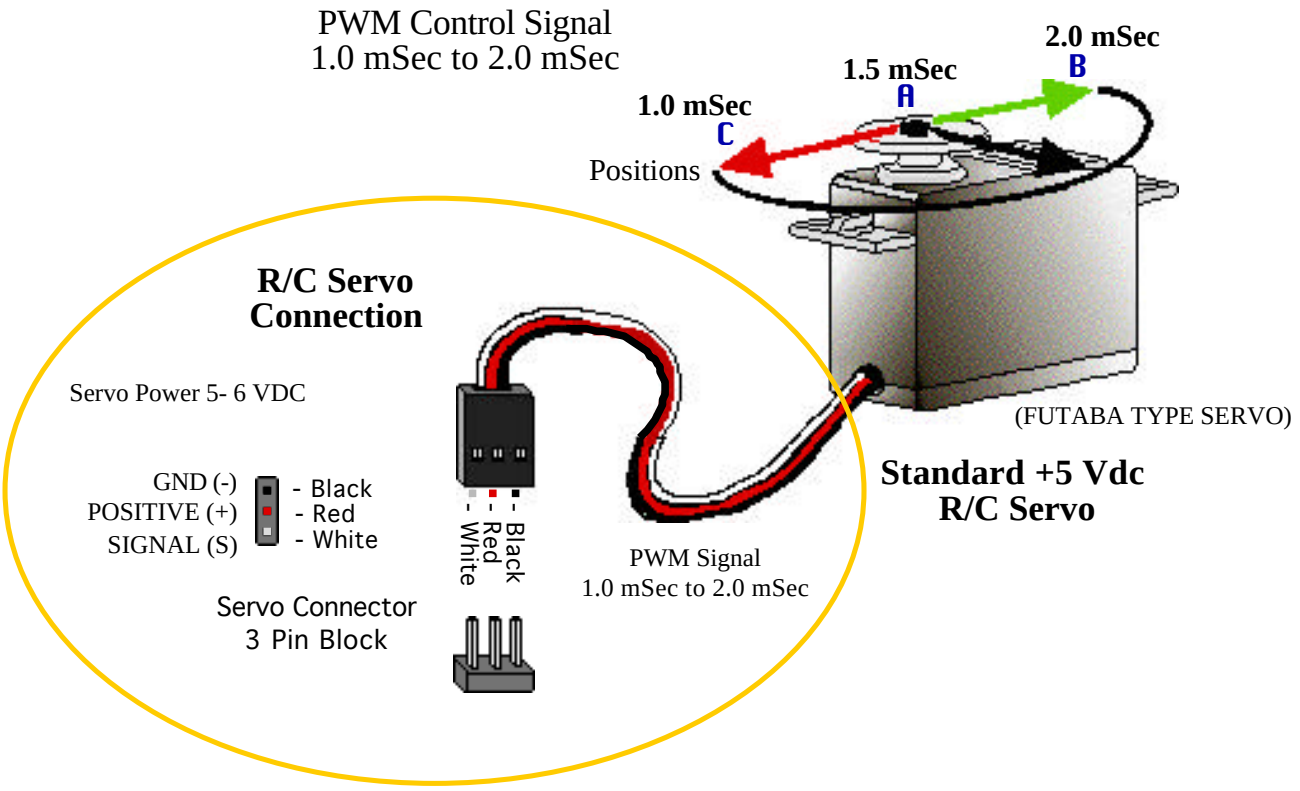

Servo Wire Code

Servo Type	Positive (+)	Signal (S)	Negative (-)
Cirrus	Red	White	Black
Futaba - J	Red	White	Black
JR	Red	Orange	Brown
Hitec	Red	Yellow	Black
Airtronics	Red	Orange	Black
	Red	White	Black
	Red	Black	Black
Airtronics - Z	Red	Blue	Black
Fleet	Red	White	Black
GW	Red	Orange	Brown

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R/C Servo Function

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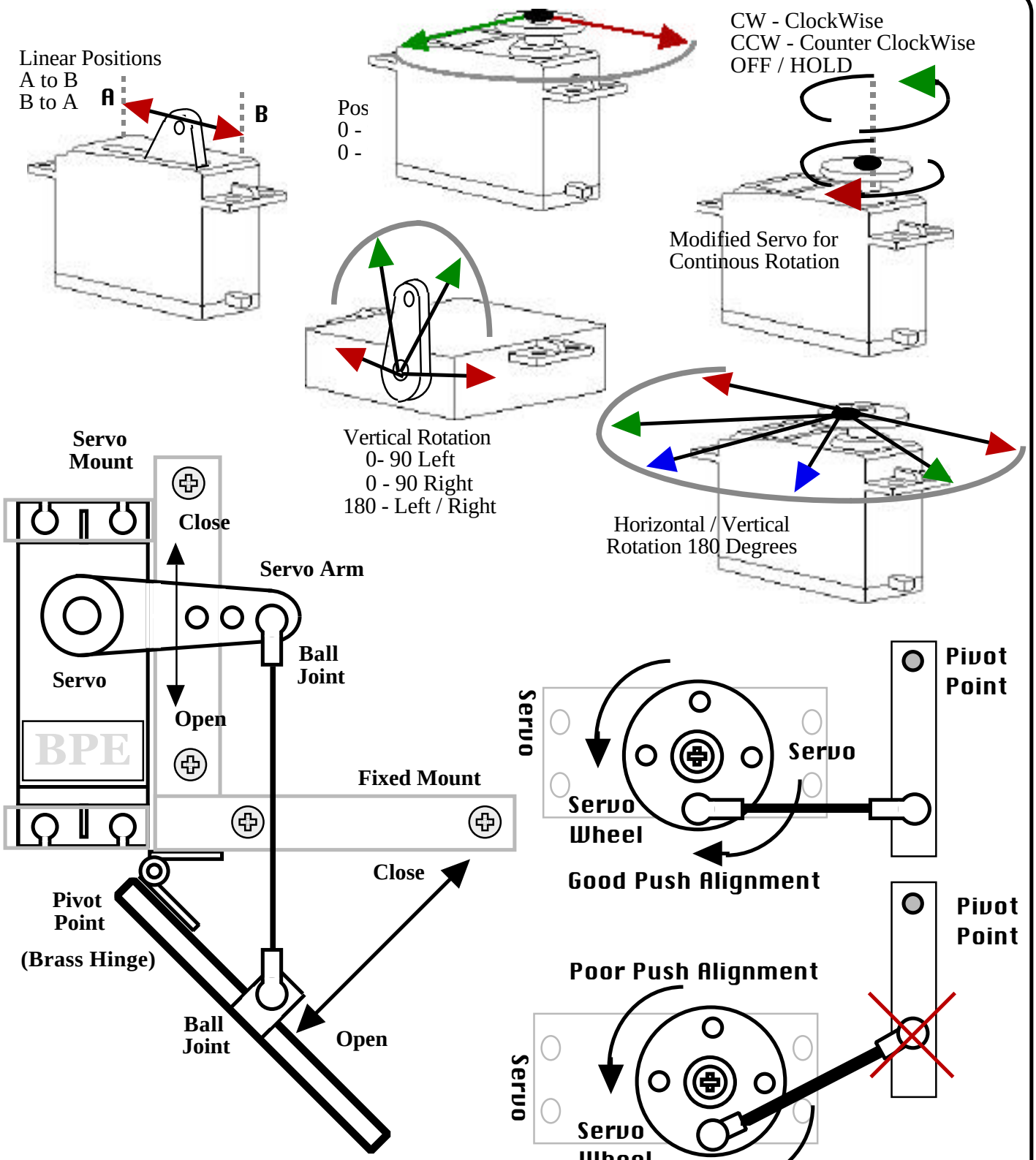

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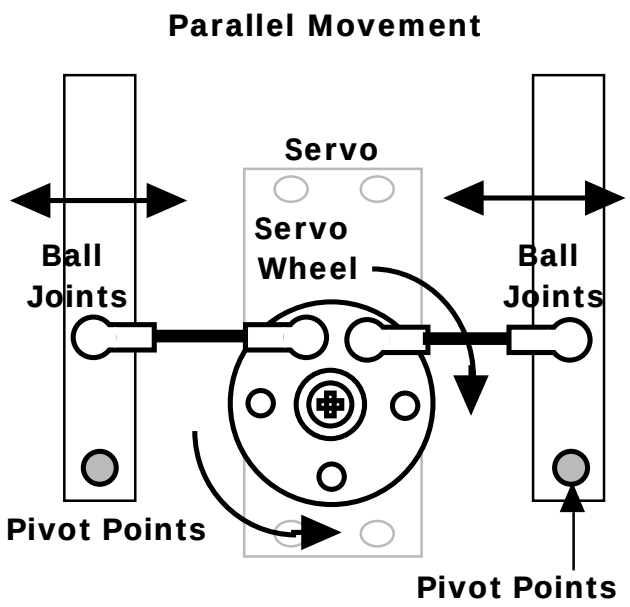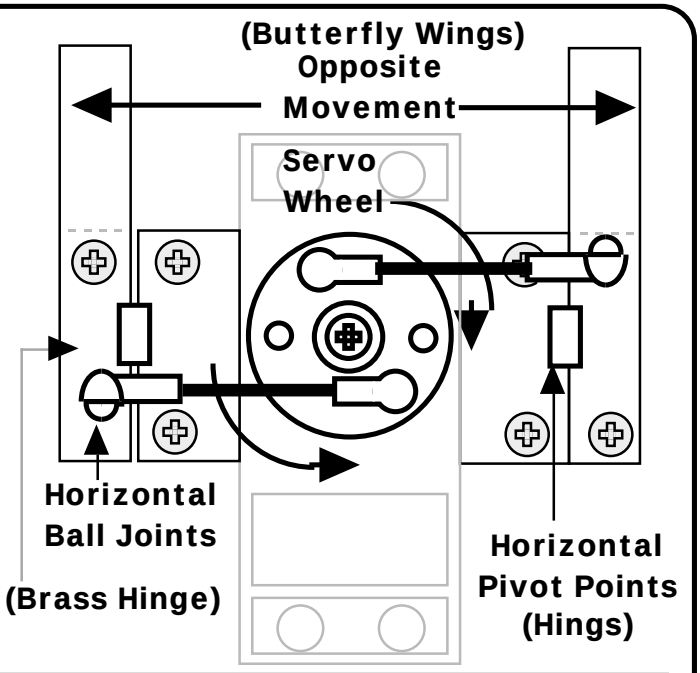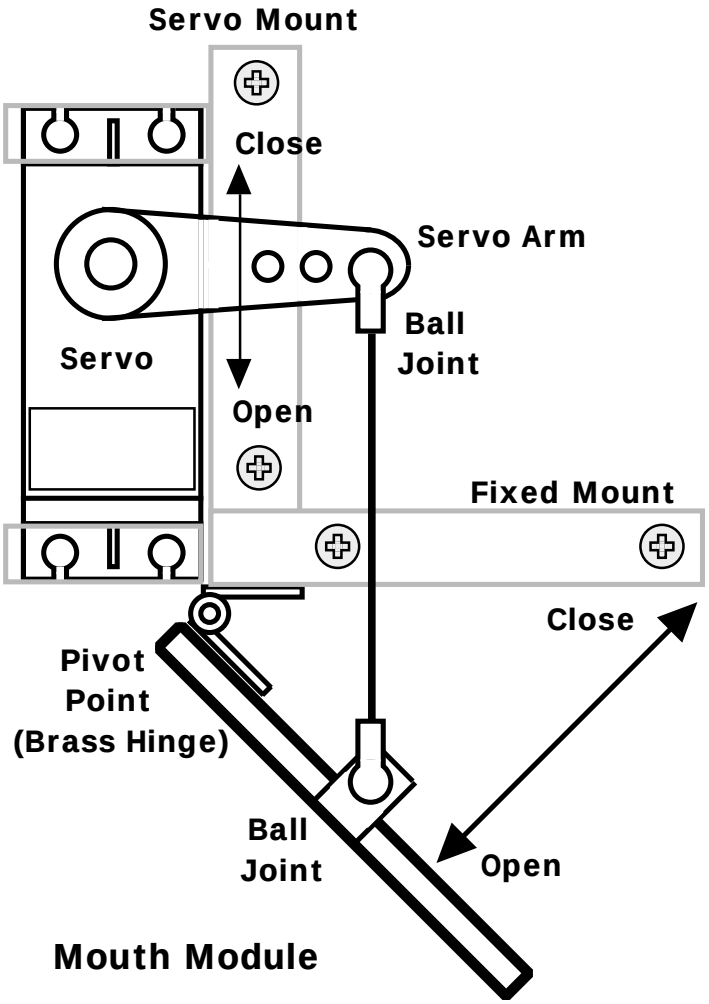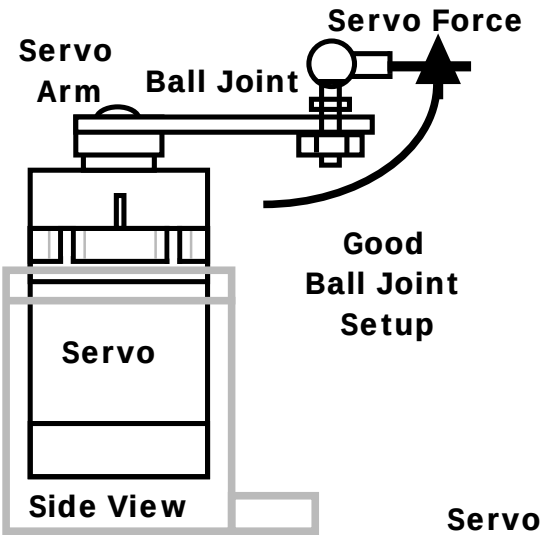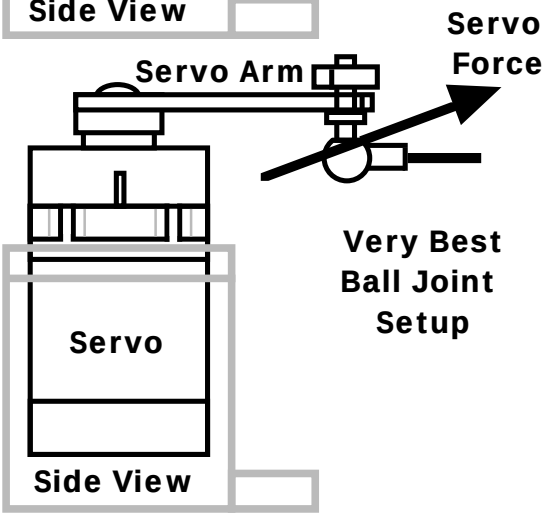
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