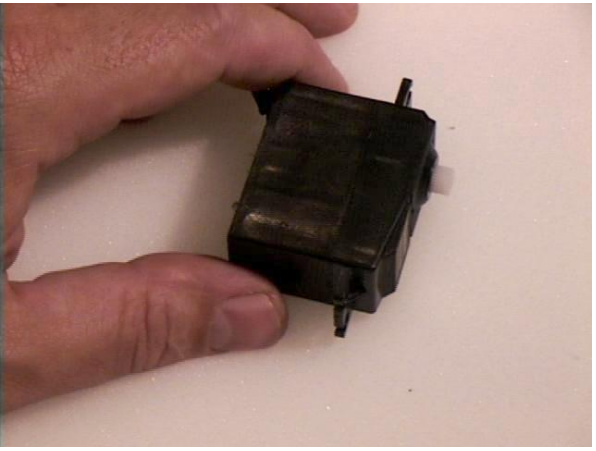
Servos

AJLONTECH

Overview

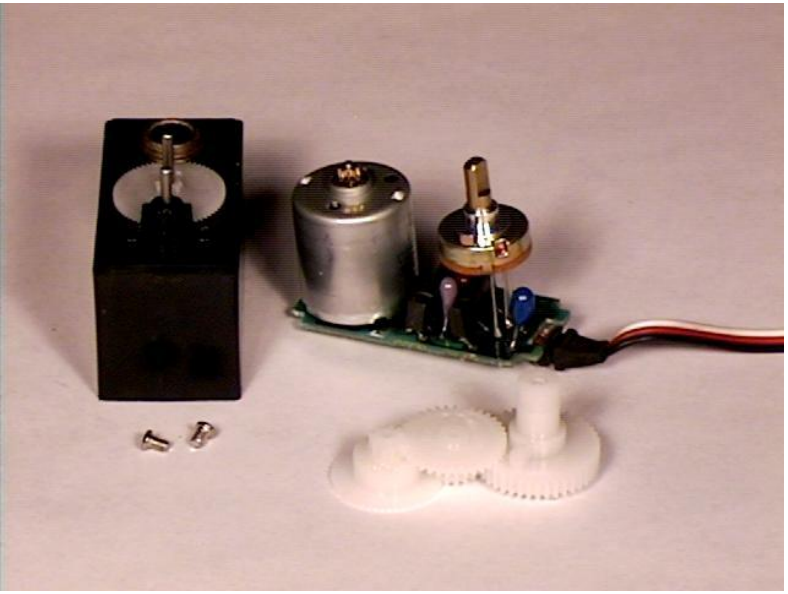


- Servo motors are used for angular positioning, such as in radio control airplanes. They typically have a movement range of 180 deg but can go up to 210 deg.
- The output shaft of a servo does not rotate freely, but rather is made to seek a particular angular position under electronic control.
- They are typically rated by torque and speed. A servo rated 40 ounce-in/.21 means that at 1 inch from the hub, the servo can exert 40 ounces of force and move 60 deg in 0.21 sec.

What makes a Servo

Servo motors and are constructed out of basic DC motors, by adding:

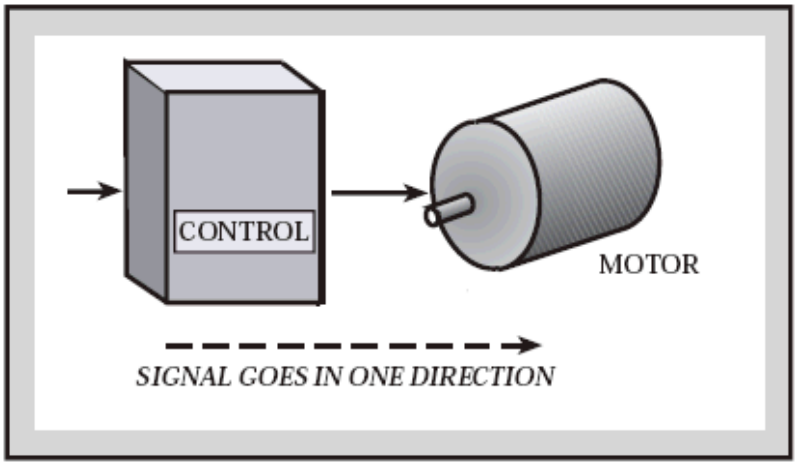
- some gear reduction
- a position sensor for the motor shaft
- an electronic circuit that controls the motor's operation



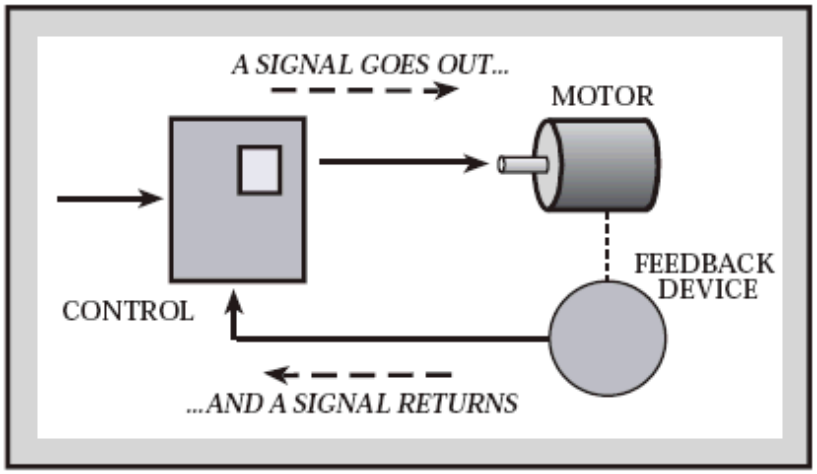
- The basic hobby servo has a 180:1 gear ratio. The motor is typically small.
- Typically, a potentiometer (variable resistor) measures the position of the output shaft at all times so the controller can accurately place and maintain it’s setting.

Feed-back loop

open-loop



closed-loop



Control

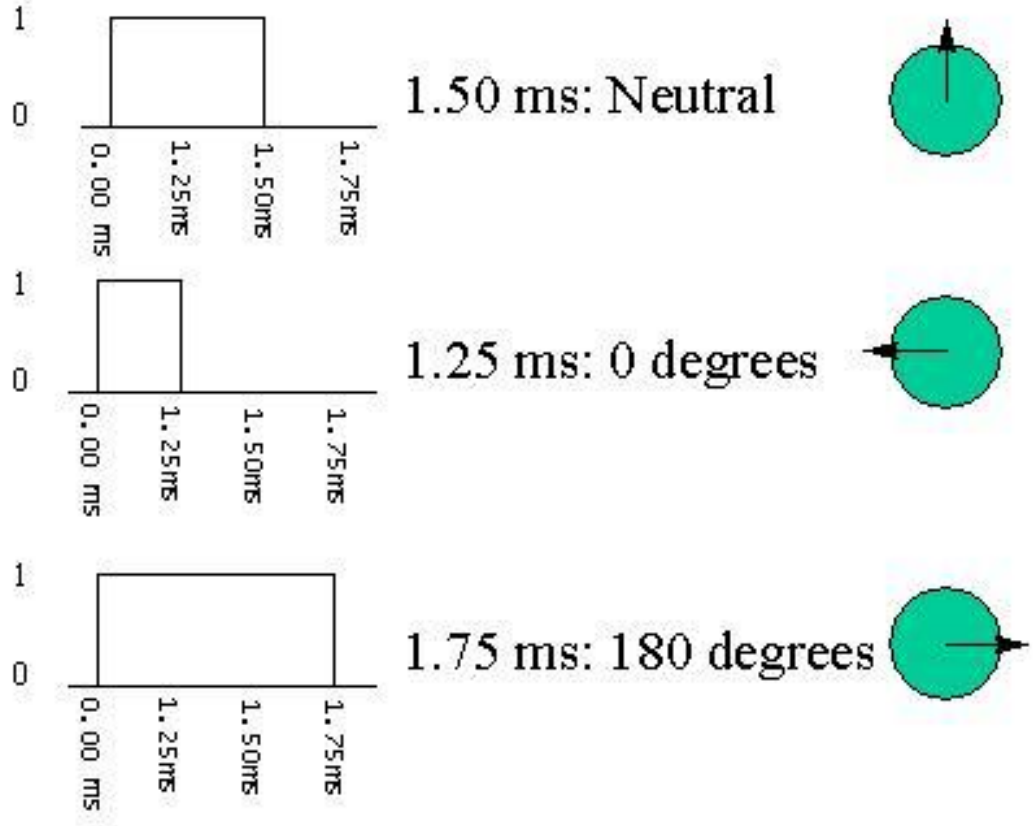
- An external controller (such as the Basic Stamp) tells the servo where to go with a signal know as *pulse proportional modulation* (PPM) or *pulse code modulation* (which is often confused with *pulse width modulation,* PWM).

- PPM uses 1 to 2ms out of a 20ms time period to encode its information.

PPM

- A control wire communicates the desired angular movement. The angle is determined by the duration of the pulse applied to the control wire.
- The servo expects to see a pulse every 20 milliseconds (.02 seconds). The length of the pulse will determine how far the motor turns. A 1.5 millisecond pulse will make the motor turn to the 90 degree position (often called the neutral position).
- If the pulse is shorter than 1.5 ms, then the motor will turn the shaft to closer to 0 degrees. If the pulse is longer than 1.5ms, the shaft turns closer to 180 degrees.

PPM


1
0
0.00 ms
1.25ms
1.50ms
1.75ms
1.50 ms: Neutral
1
0
0.00 ms
1.25ms
1.50ms
1.75ms
1.25 ms: 0 degrees
1
0
0.00 ms
1.25ms
1.50ms
1.75ms
1.75 ms: 180 degrees

PPM

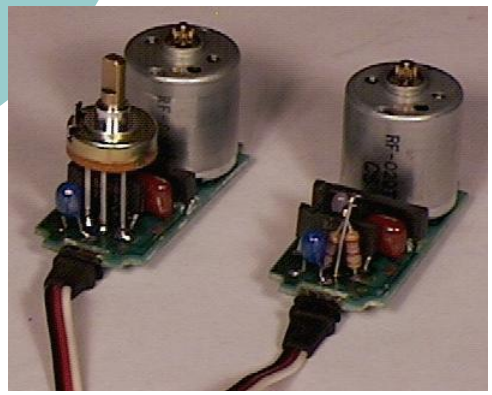
- The amount of power applied to the motor is proportional to the distance it needs to travel. So, if the shaft needs to turn a large distance, the motor will run at full speed. If it needs to turn only a small amount, the motor will run at a slower speed.

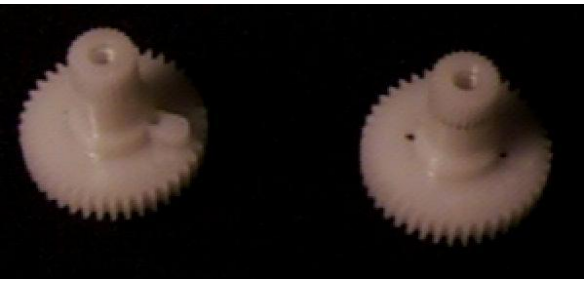
Modified Servos

- Servo motors can also be retrofitted to provide continuous rotation:
  - Remove mechanical limit (revert back to DC motor shaft).
  - Remove pot position sensor (no need to tell position) and replace it with 2 equal-valued resistors with a combined resistance equivalent to that of the pot. This makes the servo “think” it is in the 90 deg position.

Not always necessary

Modified Servos





- The idea is to make the servo think that the output shaft is always at the 90 degree mark.
- This is done by removing the feedback sensor, and replacing it with an equivalent circuit that creates the same readings as the sensor being at 90 degrees.
- Then, giving it the signal for 0 degrees will cause the motor to turn on full speed in one direction. The signal for 180 degrees will cause the motor to go the other direction.
- Since the feedback from the output shaft is disconnected, the servo will continue in the appropriate direction as long as the signal remains.

Parallax Servos

- The parallax servos are modified servos with the potentiometer intact.
- The potentiometer (a.k.a., pot) should be adjusted to make the servo think that it is at the 90 degree mark.

Parallax Servo Connections

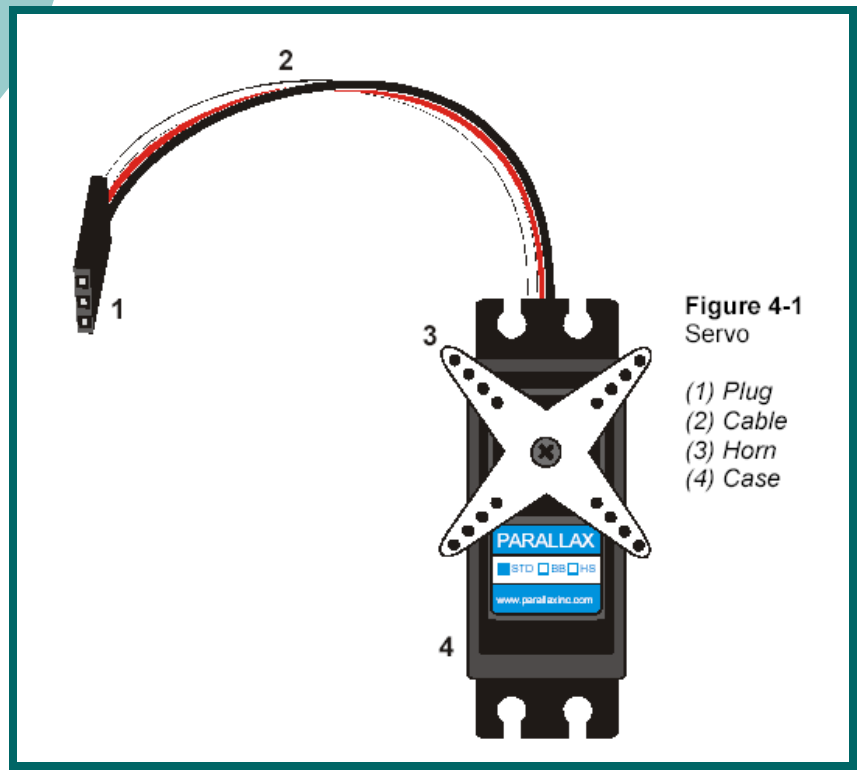
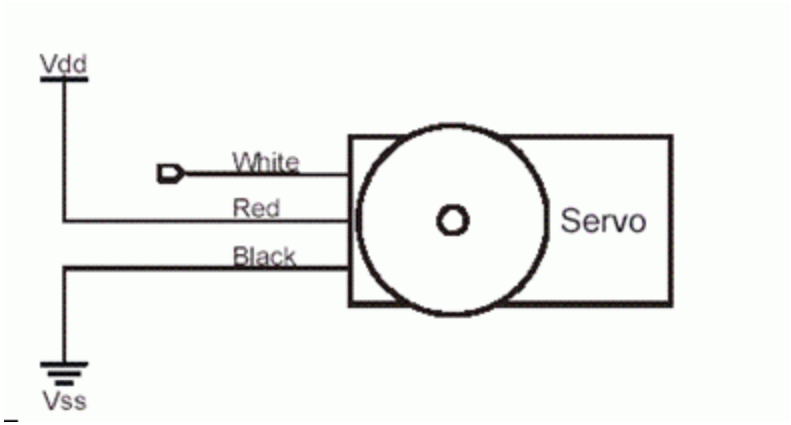


Figure 4-1
Servo

(1) Plug
(2) Cable
(3) Horn
(4) Case

Servo Connector:

- Black – Vss
- Red – Vdd or Vin
- White – Signal



Servo on BOE Rev. C

Adjust jumper to connect to Vin

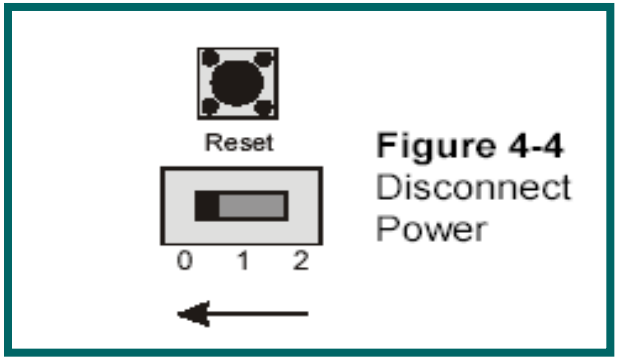


Figure 4-4
Disconnect Power

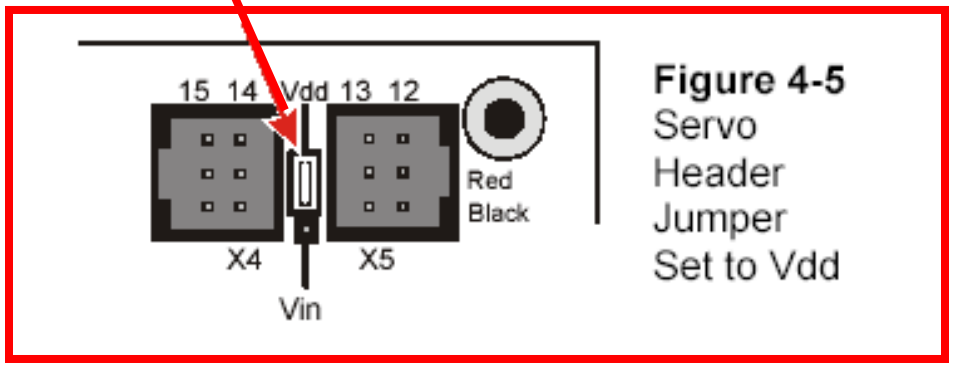
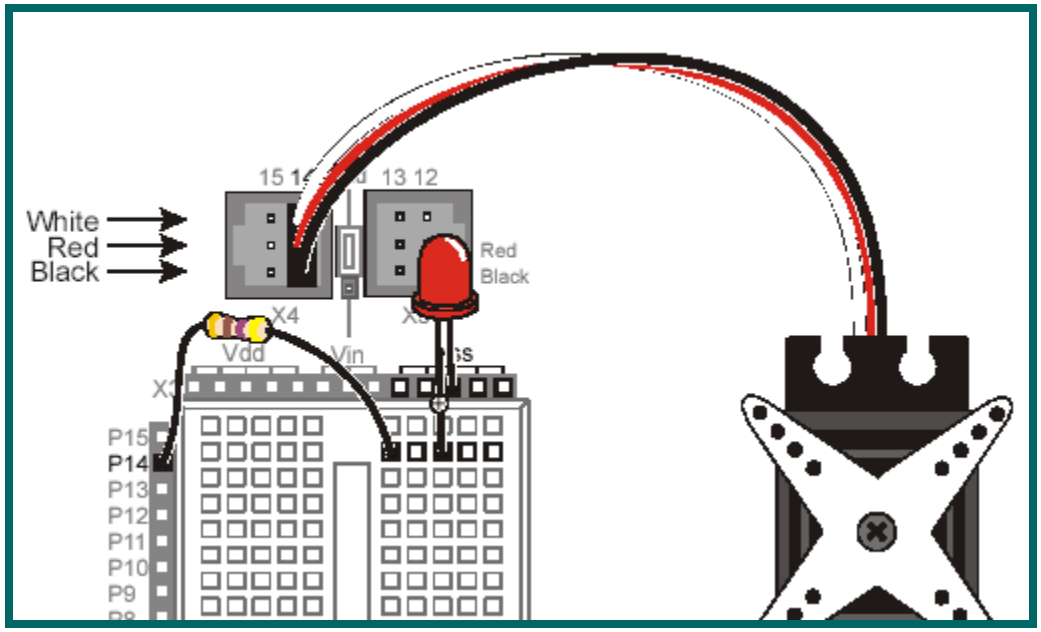


Figure 4-5
Servo Header Jumper Set to Vdd



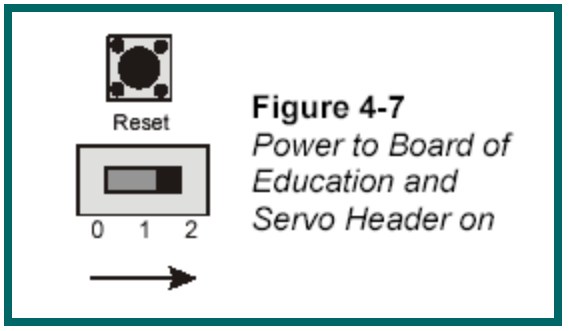


Figure 4-7
Power to Board of Education and Servo Header on

Programming Servo Control

The servos is controlled by bursts of signals **spaced 20mS** apart. A high signal can last between **1mS to 2mS**.

The PULSOUT instruction is used to send the signals:

PULSOUT *pin, duration*

pin: Defines which I/O pin to use.

duration: defines how long the pulse should last, but it in NOT in mS.

PBASIC `PULOUT` command

The `PULSOUT` duration is in 2 microsecond (uS) increments.

1 μS = .000001 seconds.
1 mS = 1000μS

For a command of: `PULSOUT 14,750`

This would be sending a pulse that lasts 750 x 2 μS = 1500 μS or 1.5 mS on pin 14.

Example control program

```
counter VAR Word
DEBUG "Counterclockwise 10 o'clock", CR
FOR counter = 1 TO 150
  PULSOUT 14, 1000
  PAUSE 20
NEXT

DEBUG "Clockwise 2 o'clock", CR
FOR counter = 1 TO 150
  PULSOUT 14, 500
  PAUSE 20
NEXT

DEBUG "Center 12 o'clock", CR
FOR counter = 1 TO 150
  PULSOUT 14, 750
  PAUSE 20
NEXT

DEBUG "All done."
END
```