RC Power Servo

Rc Robotics & Animatronics

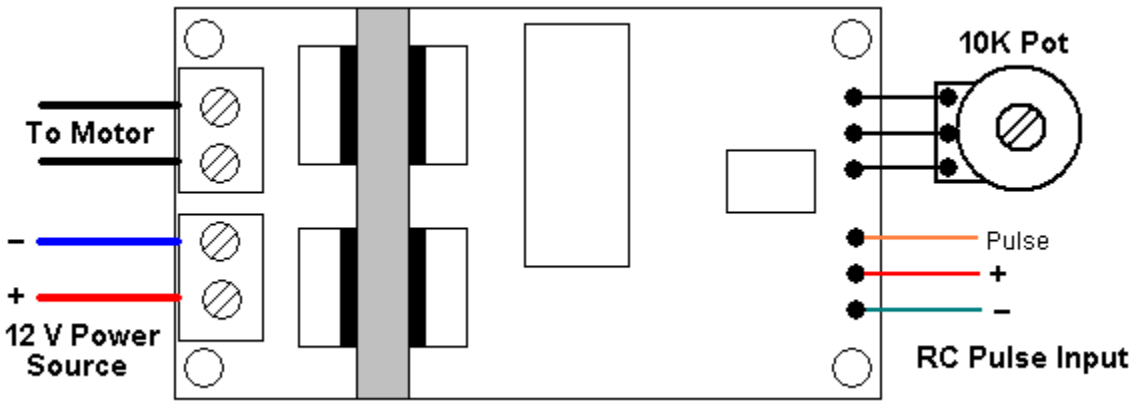
RCPOWERSERVO.COM **Contact us @ :** support@rcpowerservo.com

Thank You for purchasing our programmable Rc Power Servo Controller.

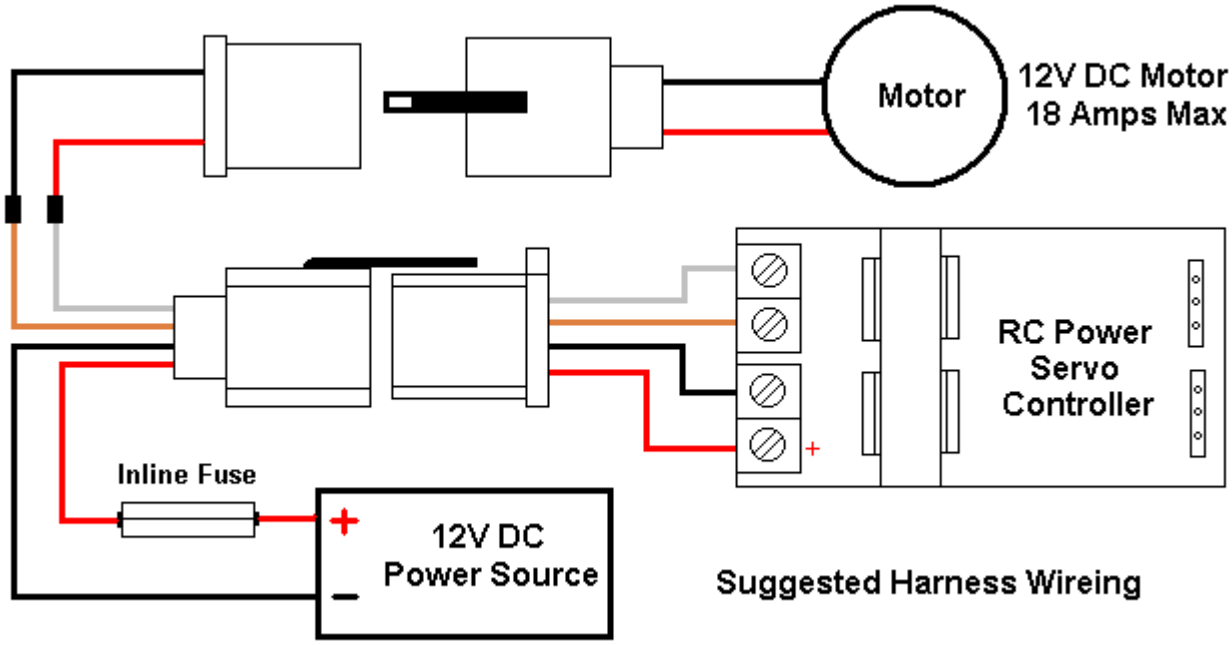
If you have purchased our Rc Servo Controller after Dec 1st 2011 you will have the user-programmable version. Check the last few pages of this document for details. As with any product, you must use it within the stated specifications and limits and have a basic understanding of electronics. Before you start connecting the Servo Controller, please read the Doe's and Don'ts list below.

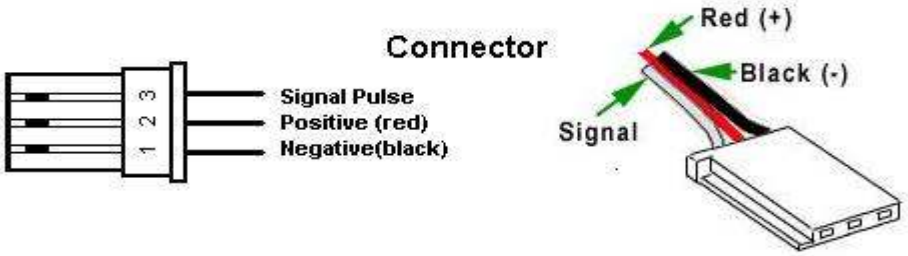
Important !

- You **must** use a power source of no more than 18V and never less than 10V. You **can not** run this device from a 6 Volt source.
- Your power source **must** be able to supply enough current (amperage) to your motor without a voltage breakdown under load. The voltage **must not** go below 10V under load.
- You have to add a variable resistor (Potentiometer) of no less than 2.5 Kilo Ohm and no more than 25 Kilo Ohm and it must be a Linear type.. This Feed-Back Potentiometer shaft must be coupled to the rotation axis of your end effecter arm, either direct or via gears.
- The 3 pin Input of the Servo Controller is compatible with any standard RC Pulse generating device like a Rc Radio or a Microcontroller. The center wire supplies the Microcontroller with power and should not exceed 6V
- If your Motor works continuously and draws more than 8 amps continuous, we recommend a small cooling fan from a computer that runs on 12V. Using such a fan at 15 amps current draw or more **is mandatory** for safe operating conditions. Check the temperature of the Heat Sink and decide for yourself.
- An Inline **Fuse** to each controllers power input is **highly recommended** as it could save your controller in case of any short circuit on the output to the motor.



Wiring and Pin-Outs





Features and specifications:

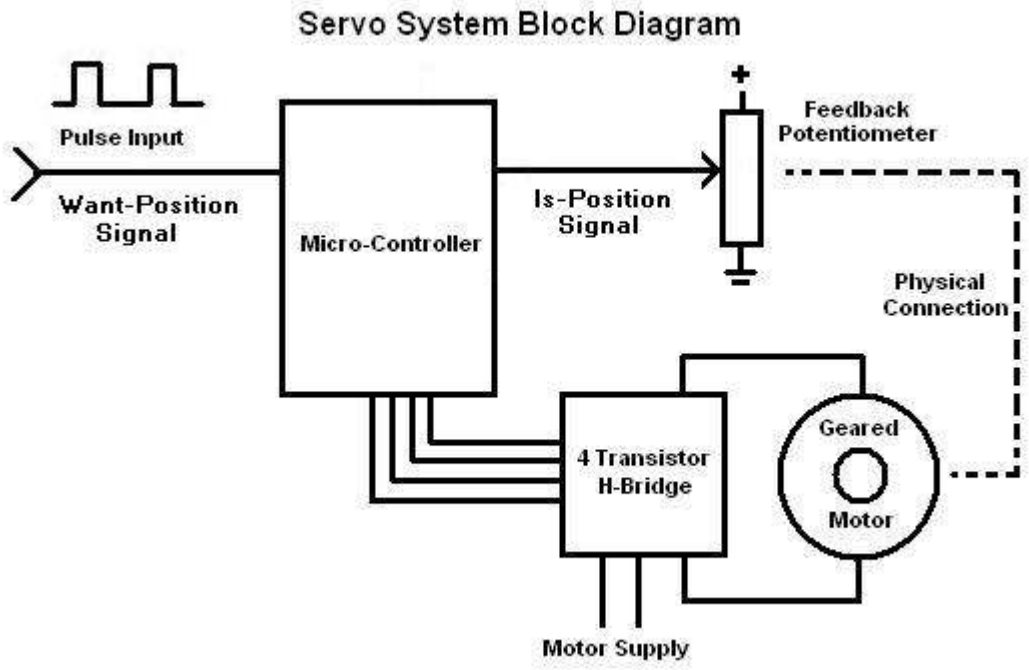
- Input 1: RC Pulse 0.9ms to 2.1ms.
- Input 2: Potentiometer 10 KOhm, Position Feedback for servo loop.
- Supply Voltage: 10 to 18 V DC (12V DC Recommended)
- 18 Amps Maximum Continuous Current
- Efficient H-Bridge design using Four High-Power MOSFETs
- PWM Frequency: Variable – Duty Cycle: 2% to 100% ** Programmable
- Built-in soft-start feature. Up-Slope and Down-Slope. ** Programmable
- Motor Reversal Protection. ** Programmable.
- Complete Optical Isolation from motor power and micro controller input signal.
- Power-Up safe start feature. Motor will only start if pulse of 1.5ms is detected. ** Programmable.

First the basics…. What is a Servo ?

A Servo is an Electro- Mechanical Positioning System and is the hearth of Automation and Robotics.

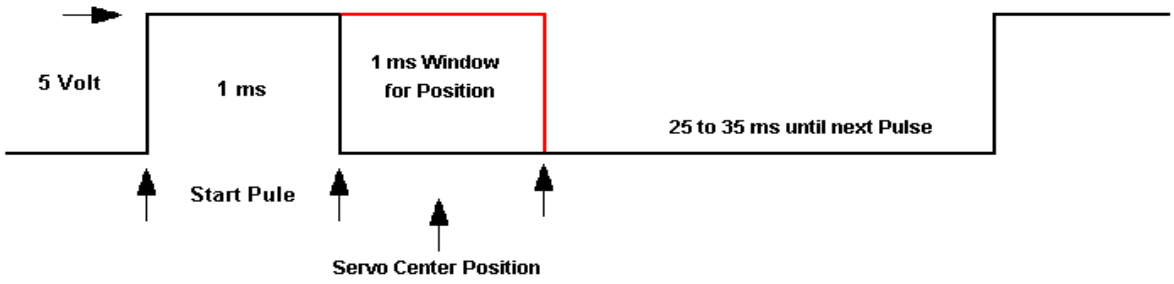
The job of a Servo is to position some mechanical device or arm via a motor to a selected position. To accomplish this, a Servos System needs to have one Output and two Inputs. The Output controls the Electric Motor that does the positioning. One Servo Input represents the position of some mechanical device. Let's call it the "WantPosition" signal. Rc Servos use a pulse of varying width. The second Servo Input measures the Present Position of this mechanical device. Let's call it the "IsNowPosition" signal. This signal can be generated in many ways. RC Servos use a variable resistor (Potentiometer) that is in some fashion attached to the mechanical device and is known as "Feedback Signal". The resistance changes as the device changes position. A Micro-controller reads both of these Signals and compares them in order to decide which way the Motor has to turn to reach that "WantPosition". It then switches the Motor on to turn in the correct direction. When the "WantPosition" signal and the "IsNowPosition" signal are equal in value the motor is instructed to stop. Whenever the "WantPosition" signal is different from the "IsNowPosition" signal, the controller will turn on the motor in the appropriate direction until both signals reach equilibrium.

An H-Bridge is an electronic switch that is controlled by the Micro-controller and switches the Motor on to turn forward, reverse or in the Off position.



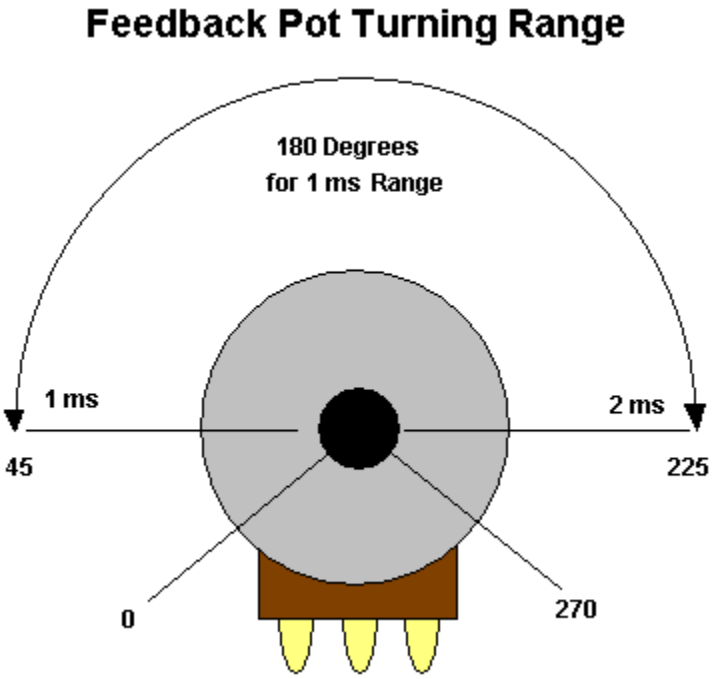
The RC Control Signal… How it works!

The RC Control Signal is a Pulse that is generated by an RC Radio Receiver or a Micro-Controller based circuit. The control signal is a pulse of varying width, called “Pulse-Width-Modulation”.There is always a start pulse of 1 millisecond followed by a 1ms window that determines the position of the servo. The minimum pulse width is 1ms and the maximum is 2ms. If the pulse width is 1.5 ms, then your servo would be at center position. A 1ms pulse would position your servo to one extreme end and a 2ms pulse to the other end. Most Rc Servos will rotate 90 degrees for a 1ms pulse window.



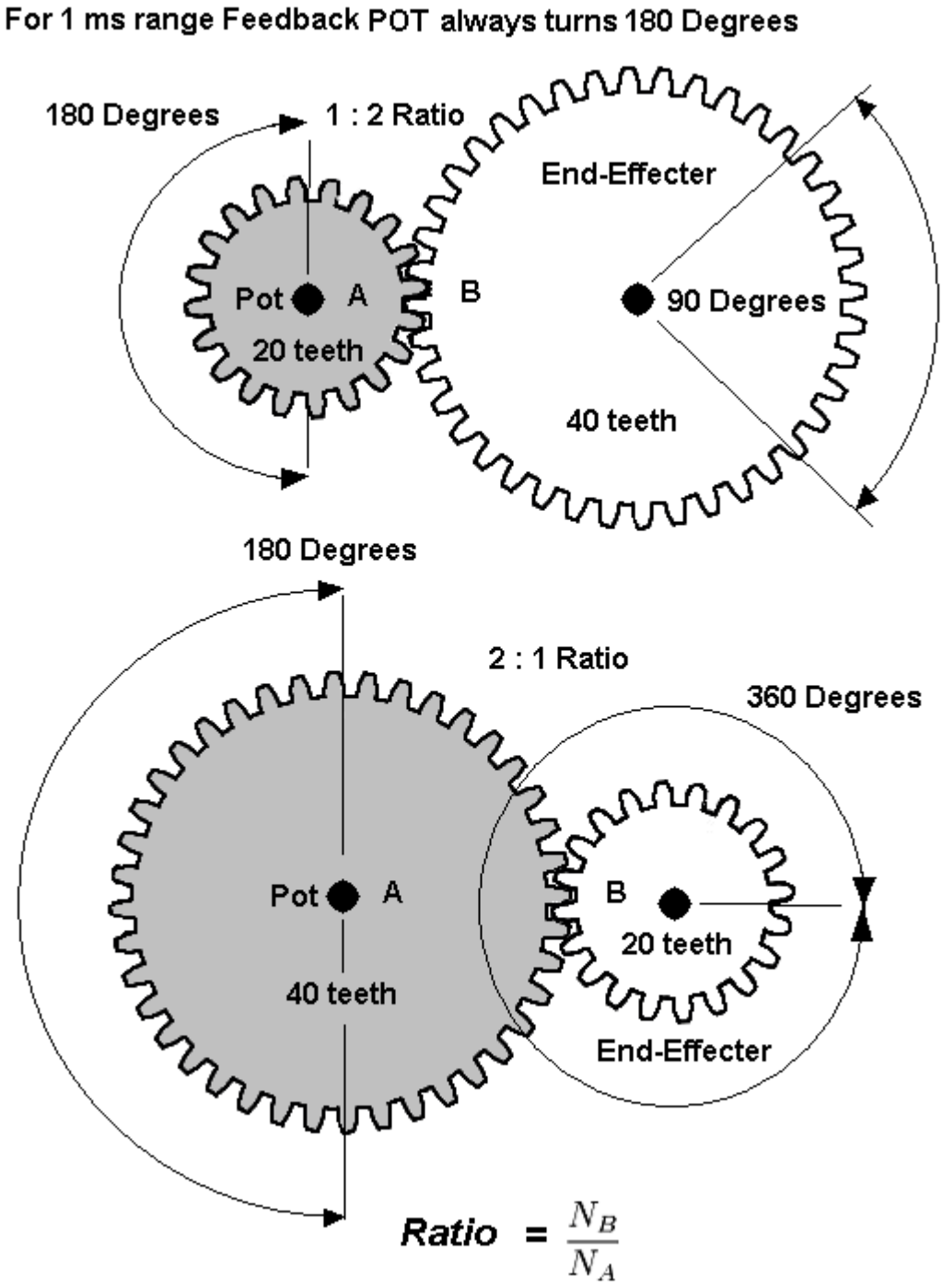
The important Feedback Potentiometer……

The RcPowerServo controller is the brain of the servo system. It is now your job to add the Motor and the Feedback Potentiometer. The very first thing you must do, is to establish the degree of movement your End-Effecter needs. The End-Effecter is the part of your design that does the actual work, either an arm, a pulley or a linear motion shaft. It is this Travel Range of the End-Effecter you must establish first. It is the relation between your Feedback POT and your End-Effecter we need to calculate. Your Feedback POT represents the Fixed Parameter. A 1 ms Pulse Range will turn the POT 180 Degrees regardless of where your End-Effecter is positioned. Therefore you have to establish the gearing ratio between your End-Effecter and the Feedback POT.



Controlling your End Effector

If you are making an Robot Arm and you attach the Feedback POT directly to the rotation axis of your arm without any gears, then your arm will have a 180 degree travel. Remember, the POT will always turn 180 degrees. If you want that arm to travel 90 Degrees, then you must use 2 Gear Wheels with a 1:2 Ratio. From the examples below, you should be able to calculate the gear ratio you need for your project. The number of gear teeth in the POT gear is not critical, only the teeth ratio between the two gears is important.

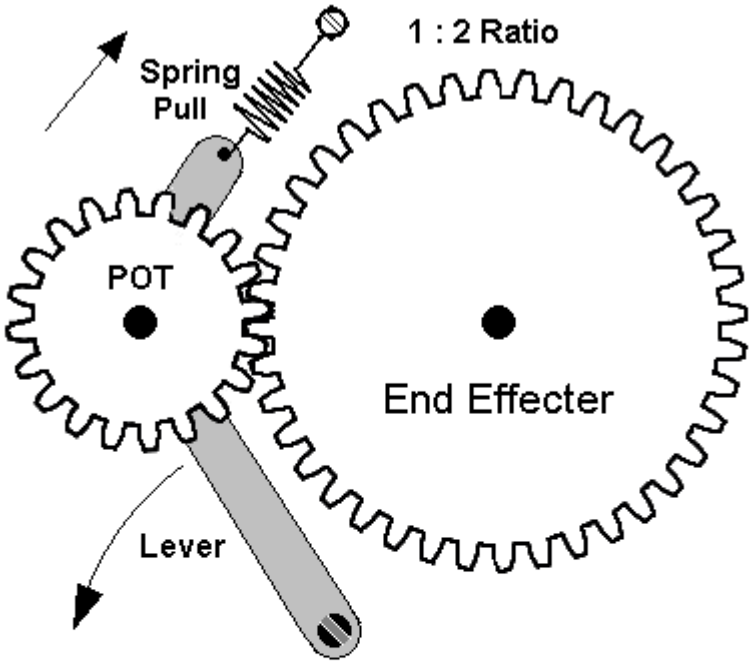


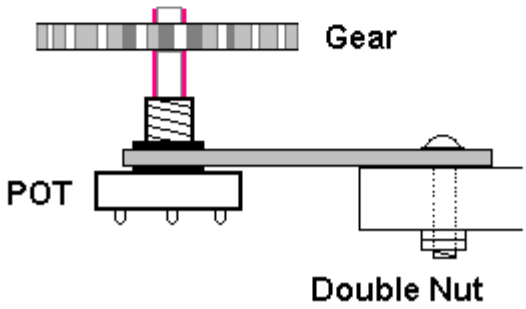
How to mount the Feedback Potentiometer….

From experience, I strongly suggest NOT to mount the Feedback POT rigidly in a fixed position.

Reason 1:
If you accidentaly reverse the plug to the Feedback POT into the controller, the end effecter will run past the POT limit and likely damage it. If you use this spring pulling system, the gear will simply slip and cause no damage to the POT.

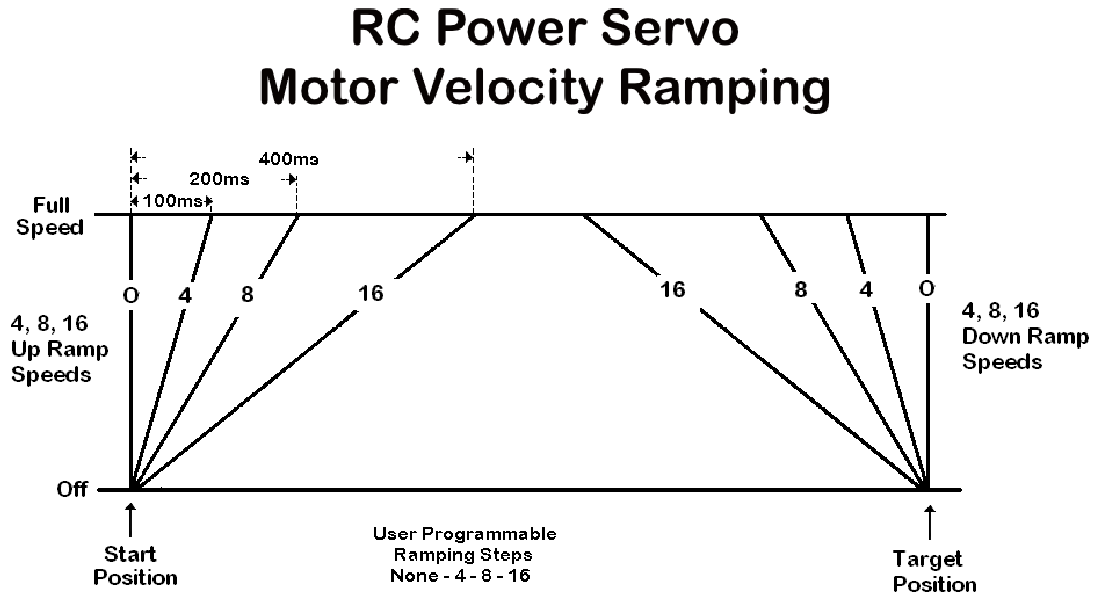
Reason 2:
To set your end effecter to a physical position in relation to your joy stick or other controller, you don't have to loosen any screws. Simply pull the lever back and align the POT gear wheel to a different teeth position on the end effecter gear.





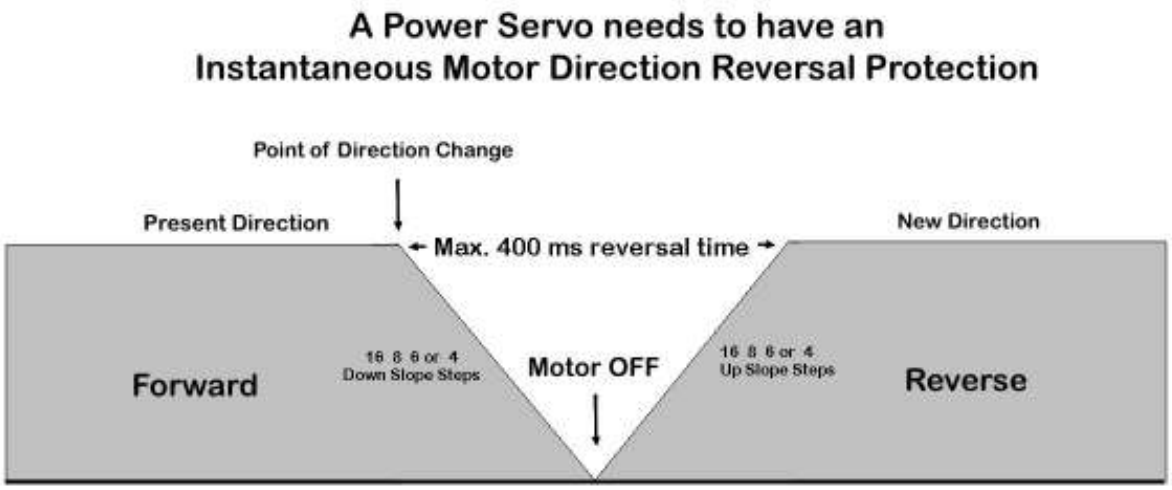
RC Servo Controller

Rc Power Servo Controllers are for low voltage DC MOTORS to control Robotics, Electric Carts, Buggies, RC cars and Animatronics just to mention few. Any inexpensive 10 to 18 Volt motor rated at up to 18 Amps is suitable. Our Rc Power Servo Controller is a direct replacement for any Standard RC Servo. Rc Hobby Servos are the most popular and inexpensive choice for building Robots and Animatronics Devices. However, torque (power) is limited when using a Futaba or other small Servo. Larger and more powerful motors are essential to achieving this. Using more powerful motors necessitates the use of velocity ramping. If we were to apply full power to our servo that has to lift 1 or 2 pounds of load, we would first get a very jerky motion, and second, our hardware may not survive the stress of this instantaneous force. To bring a large weight into motion, we must match motor torque to motor load. Our Rc Power Servo Controller will do this by slowly increasing the speed of the motor, which is known as Up-Ramping or Soft-Start, and do the same to slow it down by Down-Ramping.. Basically we need to control the Speed when we want to go from one servo position to another.



Reverse-Protection Feature:

We also have to prevent the motor from instantaneously reversing direction. When the servo runs at full speed in the forward direction and we tell it to go to a position in the opposite direction, we must first process the Down-Slope, only when the servo motor comes to a stop can we reverse direction and process the Up-Slope. This is necessary to allow robots to move fluidly and avoid stress or damage to gears, levers and pulleys. For some applications, like power steering, these features are not wanted or not necessary. Both features, Sloping and Reversal Protection can be disabled by programming #5. See programming.

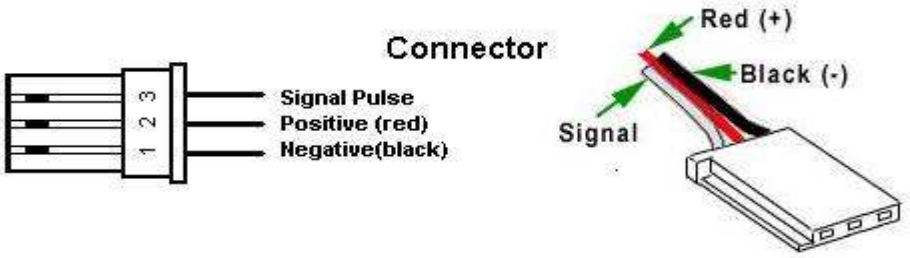


Missing Rc Pulse Protection Feature:

The Rc Power Speed Controller should not activate the motor until it receives at least one valid RC Pulse at 1.5ms. This prevents your robotics going a mock and cause serious damage. This can occur if you apply power to the Speed Controller before you activate your RC Controller. If during operation there is no Rc Pulse detected for more than 50 milliseconds, the Motor will shut-off until it receives another valid Rc Pulse..

Control Inputs :

This Speed Controller is designed for the RC Pulse protocol and accepts 1.0 ms to 2.0 ms pulses and can be controlled via an RC Radio Receiver or a Micro-controller Board. The 3 pin header input is compatible with any standard RC Servo layout, e.g. Futaba. The center pin is the positive supply and should not exceed 6 Volts. The on-board potentiometer is used to match Throttle Center on RC Radio Transmitter or other controller to adjust the Motor-Off position.



Programming the RC Speed Controller and RC Power Servo Controller

Why do you need to program your controller? What is it for? What will it do?

Not all Servo Applications are equal. Some are for moving large weights, torque being the main criteria. Others are for quick responding applications like Power Steering. Velocity being the main criteria. Every application needs varying degrees of Velocity Ramping, One problem with Rc Servos, compared to CNC Servos is the slow refresh rate of the position signal. All Rc Controllers use the RC Standard that refreshes the RC Pulse every 25 to 35 milli seconds. That means we can process the position algorithm only 40 times a second. CNC Servos sample1000s of times. A 180 degree turn on the feedback potentiometer is divided into 255 distinct values or positions. Therefore, to keep up with Rc Pulse processing, the feedback potentiometer should take not less than 6 seconds for a 180 degree turn.

If your feedback potentiometer takes less than 6 seconds for a 180 degree turn, then the feedback signal is faster than what we can process and your effecter arm might overshoot the target position. For this application scenario, we have to reduce our slope count or disable Velocity Ramping. Try setting #2, then #3 and #4. If your effecter arm still overshoots the target, use setting #5 to disable Ramping.

If the feedback potentiometer takes more than 5.5 seconds for a 180 degree turn, we can easily process up-slopes and down-slopes (Ramping). It is for the high-torque applications where we really need Velocity Ramping. To bring a large weight into motion, we must match motor torque to motor load. Setting # 3 is the default. Try setting #1,2,3 or 4 for a slope that matches your need to move smoothly without any jerkiness.

All DC Motors will resonate at some frequency and become noisy. You can select 5 different PWM Frequencies. The fastest is about 5Khz and is usually the most silent setting. For fast Servos that do not need a Velocity Slope, this is the best setting. For slow moving High Torque Servos, this setting is not ideal. For smooth ramping choose a lower frequency setting.

There is also a Start Up Safety Protection The controller will not arm the motor until it receives at least one valid RC Pulse of 1.5 ms. This prevents your Robotics from going a mock and cause serious damage. This can occur if you apply power before you activate your RC Controller. But if you choose, it can be disabled. **Default ON**

Programming Parameters

Listing for the 12 program parameter settings.

---- 5 Parameters are for the Velocity Slope Steps. (Ramping Steps) --

1: Both Velocity Slopes, up and down, have 16 steps. This produces the longest slope.
Usage: Slow moving arms, servos that have lots of torque and lift heavy weights.

2: Both Velocity Slopes, up and down, have 8 steps. Slope count is divided by 2.
Usage: Same as above but lower weight.

3: Both Velocity Slopes, up and down, have 6 steps. Slope count is divided by 3. This is the default setting.
Usage: For faster moving servos. **Default Setting**

4: Both Velocity Slopes, up and down, have 4 steps. Slope count is divided by 4. This is the shortest slope but still useful.
Usage: use if the servo starts to have signs of overshooting.

5: Both Velocity Slopes, up and down, are completely disabled.
Usage: For fast moving servos with low torque. Use when any of the above settings still cause overshooting the target position. Also best when instant response is needed like for a steering servo.

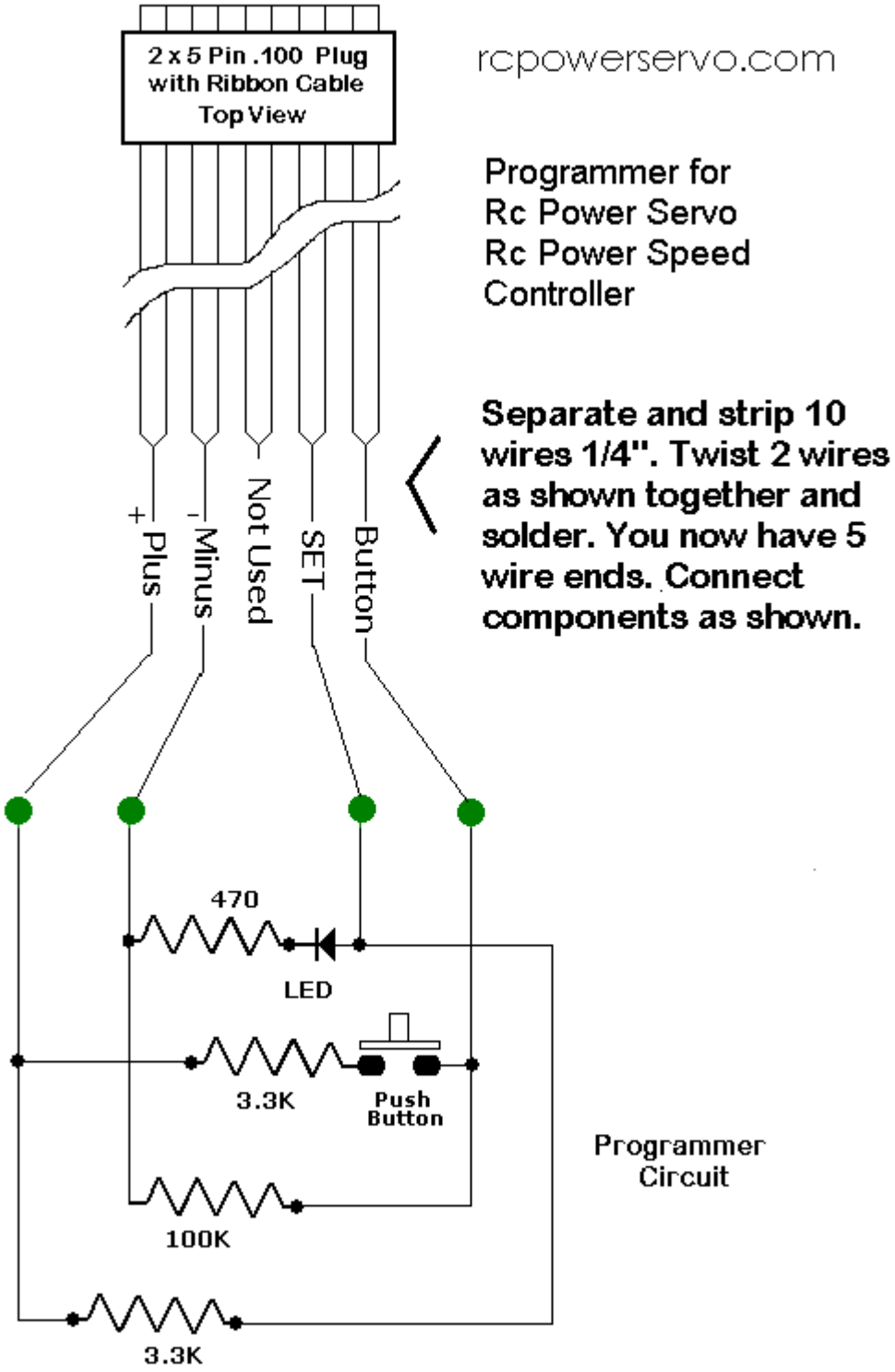
------ 5 Parameters are for Pulse Width Modulation Frequency settings ----

	PWM-Loops	Frquency	MaxSlopeSteps	
6:	18	5.5khz	xx	Almost completely inaudible.
7:	25	4.0khz	xx	
8	29	3.8khz	xx	
9	34	3.6khz	16	
10	40	3.4khz	16	**Default Setting** - smooth ramping

-- Power-Up safe start feature. 1.5ms Rc Pulse detection. --

11: 1.5ms pulse detection = ON **Default Setting**

12: 1.5ms pulse detection = OFF



You can use a serial port cable from an old PC. The internal cable from the Motherboard to the DB9 Connector on the frame. It is a ribbon cable, 10 wires and a small female plug with two rows of 5 pins. Cut the DB9 off and follow instructions above.

Programming Instructions for the
RC Power Servo Controller **or**
RC Power Speed Controller

Please follow these steps in sequence, or your programming efforts may fail.

1.) **Disconnect the Power Source for the Motor**. This is for safety reasons. Your motor will start turning when you disconnect the Feedback Potentiometer.

2.) **Disconnect the Feedback-Potentiometer**, remove the 3 pin plug that connects to the Feedback-Potentiometer. Must stay disconnected during programming.

3.) **Remove** the 3 pin plug that comes from your RC-Controller Board or RC Radio Receiver. This is **the power source** for the Micro-Controller.

4.) **Connect the Programmer** by inserting the 5 or 10 pin plug that connects to your programmer circuit. This must be done when the controller has no power.

5.) **Connect the power source**, insert the 3 pin plug that comes from your RC-Controller Board or RC Radio. It supplies the Microcontroller with 5 to 6 volts for power.

6.) Now press the **Pushbutton on your programmer** the number of times that matches the parameter you like to set. The LED light will light up each time you press the button for verification. Wait until the LED goes off before pressing the button again. The maximum # is 12

7.) When you have completed pressing the button X times, **Disconnect the programmer** plug. **This must be done before you disconnect the power**. The Micro-Controller will now safe your Setting in Flash-Memory.

8.) You must now **disconnect the power**, the cable that comes from your RC Controller or RC Radio. Your controller is now programmed to a new setting.

9.) To change another setting, go to step # 4.

10.) To test your new setting, re-connect your motor, then connect your feedback potentiometer and the power source for the motor, and last the cable to your RC Controller or RC Radio.