

Modifying Hobby Servo Motors for Continuous Rotation

A standard hobby servo motor is designed to rotate through only 180 degrees. They are most often used in RC airplane applications to manipulate control surfaces, aileron, rudder etc so they mainly are just used as a lever. If you wish to use a servo motor for a robot drive system, you must modify it so that it will rotate through 360 degrees and beyond and in either direction. This paper details how to make this modification on a Futaba S3003 servo motor, but the principles will work on any standard hobby servo motor.

For this modification you will need the following tools:

- 1 standard servo motor
- Wire snippers
- Needle nose pliers
- 2 resistors, 2.2K (2.2 – 3K pairs will work equally well if you don't have 2.2Ks)
- Soldering iron and solder
- Desoldering tool (solder sucker), or copper braid
- Small Phillips screwdriver



Handy, but not necessary:

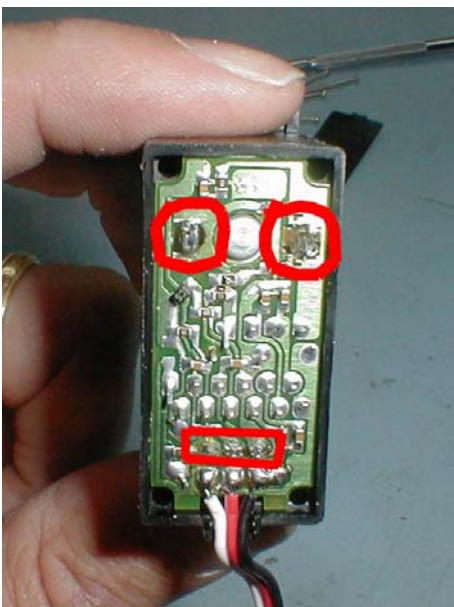
- Dremel tool with cutting disk attachment
- Very small regular (flathead) screwdriver
- Vise

Procedure:

1. Remove 4 screws from bottom of the servo. After you have removed the screws handle the motor carefully, preventing the top cover from coming off which may spill out the gears inside. You can replace them, but without knowing what order they go in it can take a while to figure this out.

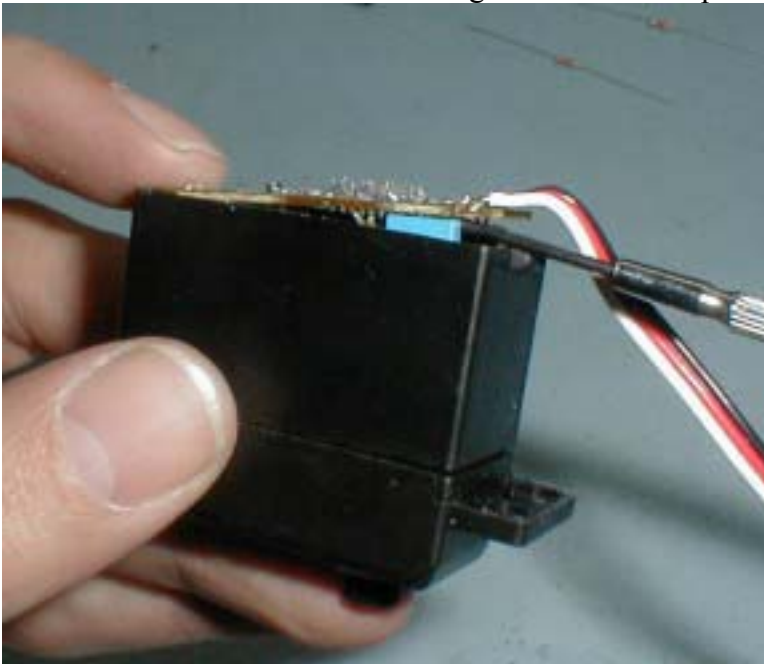


2. Remove the bottom cover, exposing the circuit board as shown below. You will be desoldering the motor terminals (top 2 red circles) and the potentiometer leads (3 leads, just above the cable connections). This photo shows a vise to hold the motor while desoldering. This isn't necessary. You can prop the motor between two books just as effectively or just lay it on the bench and work carefully.





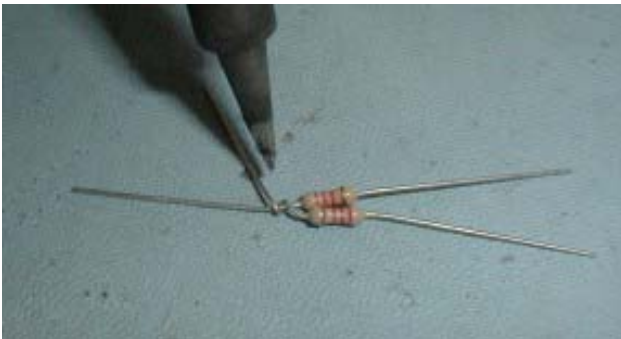
3. VERY CAREFULLY, lift out the circuit board. Once you have desoldered the motor connections and the pot leads, it should come out pretty easily. You may need to apply GENTLE pressure with a small screwdriver or similar device to get it started. But if it takes more than slight pressure, then recheck your desoldering work. Most likely you still have some solder which is holding the board to the parts beneath.



4. Remove the potentiometer from the case. The pot will have 3 leads similar to that shown. For a model other than the Futaba S3003 the leads may be wires instead. Either way, the pot will go up into the body of the motor, inserting into the output gear above. Gently remove the pot. You should hang onto it in case you want to restore the motor to partial rotation. You may also be able to use it in a circuit later.



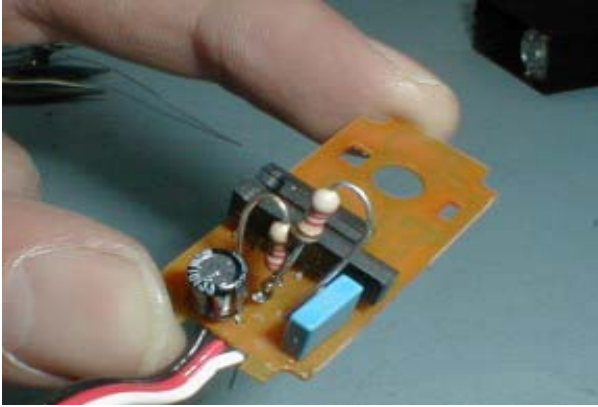
5. Wrap a lead of one of the 2.2K resistors around the other one, close to the body and solder in place.



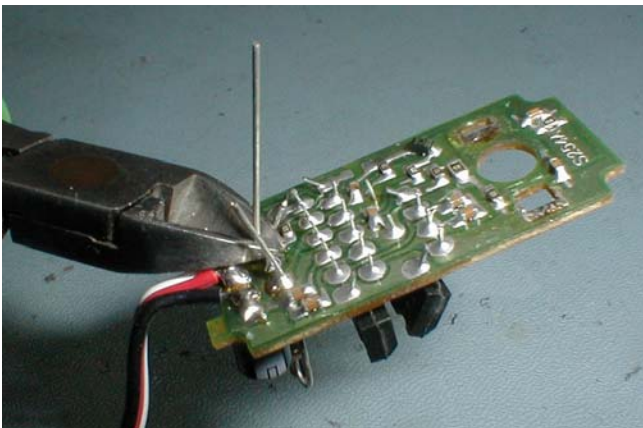
6. Snip the excess lead. This will leave you with 3 leads.



7. Place the combined resistors into the holes where the pot leads went. The lead where the two resistors are joined must be in the middle hole. Otherwise what lead goes where does not matter.



8. Solder the resistor leads in place and snip off the excess.



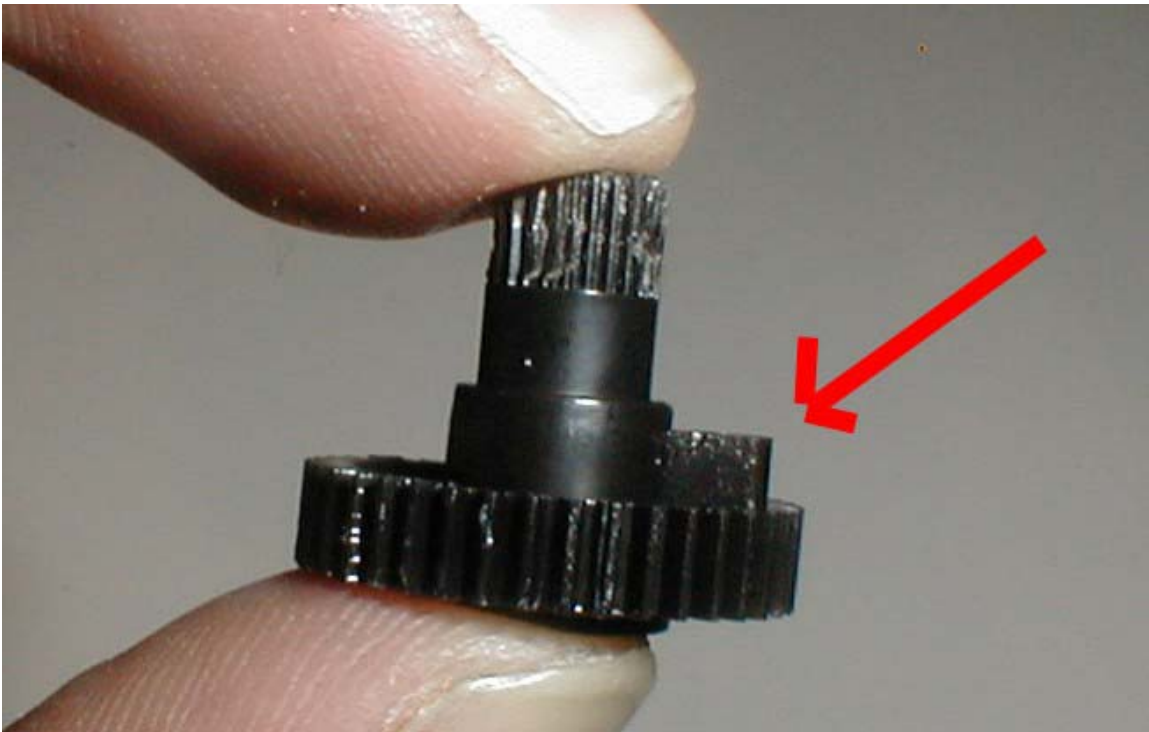
9. Carefully remove the top cover, exposing the gears. A gear, usually the top white one may come off depending on how much grease is touching it and the top cover. The top cover mates with the main body precisely with the axles mounting into both, so when you have completed the modification to the output gear, you'll have to fit them back together.



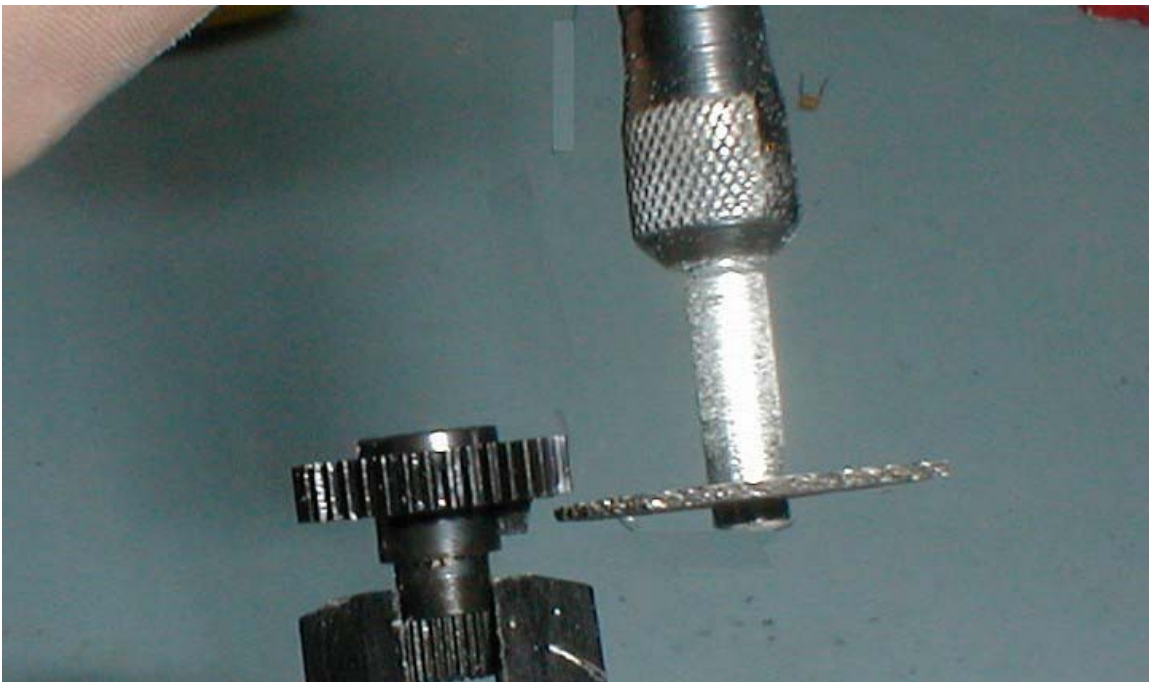
10. Assuming that the gear didn't come off already, remove it carefully and set aside. Remember that it has grease on it, so set it down somewhere clean. Dirt or anything else will stick to it and can cause damage when the motor is spinning later. So keep that and all the other gears clean.



11. Remove the output gear, which is usually black as shown in this photo. It will have a mechanical stop on it which will prevent the motor from rotating more than 180 degrees, so you must remove this stop in addition to the potentiometer replacement.



You can use a pair of snippers to carefully nip off pieces of this stop. Start at the outside and snip off small pieces at a time rather than trying to get it all in one cut. If you try it in one, you may break the gear, ruining the motor. If you have a rotary cutting tool, use it instead of snipping.

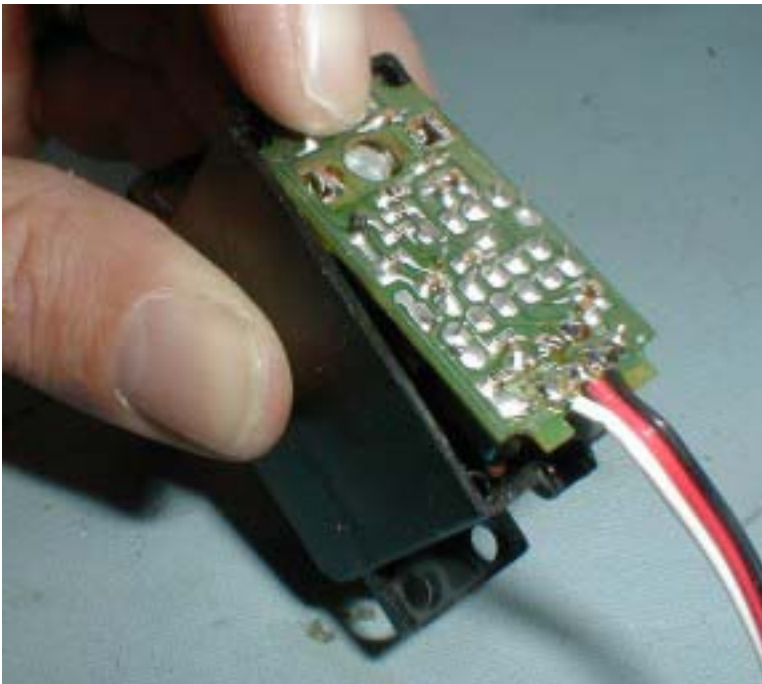


Again, you must be careful. Not just of trimming your fingers but also of trimming the teeth on the gear. You also want to be careful not to throw dust onto the motor's other gears below you if you have it sitting on the bench where you are using the rotary tool.

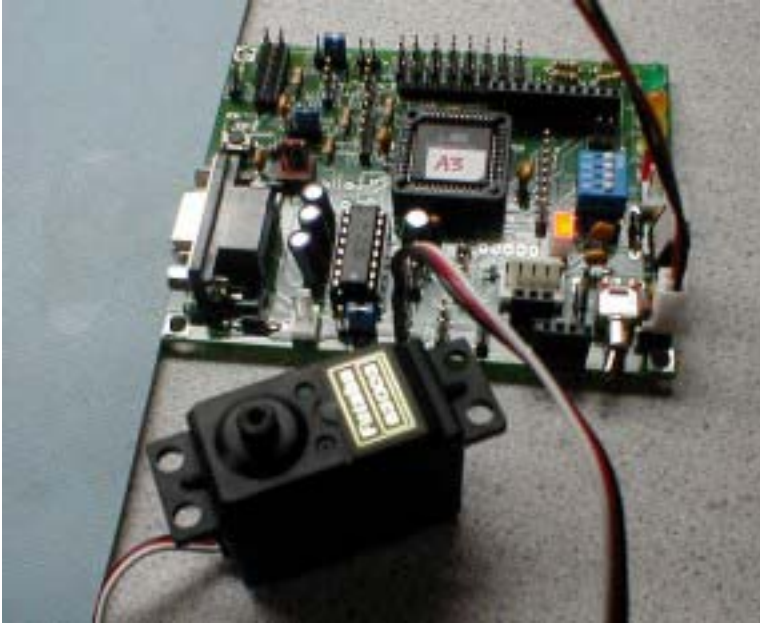
This photo shows the mechanical stop removed. You should clean up any plastic burs like those shown in this photo, as they may come off and get caught up in the gear box later.



12. Replace the gears and the top cover. Refer to the beginning photo if you don't remember what gear goes where. Then put in the circuit board. Be sure that the cable rests in the recess so that the bottom cover will go on flat.



13. Once you have reassembled the motor, test it using the DARC Board or some other device that will generate the proper signals to drive it. If it works in both directions okay, you're done. If not, you may have to disassemble it and repair some work that was done incorrectly.



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