

Modifying the Tower Hobbies TS-53 Servomotor for Continuous Rotation

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The following short article shows you how to modify the Tower Hobbies (<http://www.towerhobbies.com>) Model TS-53 standard servomotor for continuous rotation. Modification of other types and brands of servomotors follow the same basic procedures, however, consult with the manufacturer or seek other reliable sources of information before beginning.

1 Background

Standard hobby servomotors are motors with built-in gearboxes and position feedback controllers. Instead of rotating continuously, the servomotor can be commanded to an angle between 0 and 180 degrees. Standard hobby servomotors are widely available, easy to use, and are found in almost all radio controlled cars, airplanes, and motion control applications where position command is required. Many microcontrollers are capable of controlling servomotors by providing a pulse-width modulated signal to the on board electronic circuit in the motor. If these motors are used for actuating a mechanism that does not require continuous rotation, then modification is not necessary. However, if these motors are used for locomotion, modification is a must. The process of modifying a servomotor for continuous rotation is simple and straight forward. The main objectives are to remove all mechanical stopper(s) which prevent continuous rotation inside of the motor/gear assembly and to break or deactivate the position feedback loop or sensor.

2 Removing the Mechanical Stopper

The following steps refer to Figure 1. The objective of this first modification process is to remove the mechanical stopper on the gear/horn shaft which permits continuous rotation. Afterwhich, further modification of the electronic circuit inside the servomotor will break the feedback control sensor (i.e., potentiometer) loop allowing a pulse width modulated (PWM) signal to control the motor continuously.

1. Begin by removing the protective back covering of the servomotor using a small Phillips screwdriver as shown in Figure 1.1.
2. Disassemble the gear box and gear/horn shaft of the servomotor as shown in Figure 1.2. Located on the gear/horn shaft is a small mechanical stopper that is part of the unit. The objective is to remove this portion allowing the shaft to rotate freely. Take note of how things fit together for the reassembly process.
3. There are two ways to remove the mechanical stopper. The easiest approach is to use a file as shown in Figure 1.3 to file down the stopper. Be sure to file down the stopper completely without damaging the gears. The other approach (not pictured) is to use a utility knife to cut away the mechanical stopper. Be careful, knives are sharp and dangerous!

***Warning:** I am not responsible for any damages that may result from the following information, so use it at your own risk! Please direct all comments, suggestions, and complaints to kleang@eng.utah.edu.

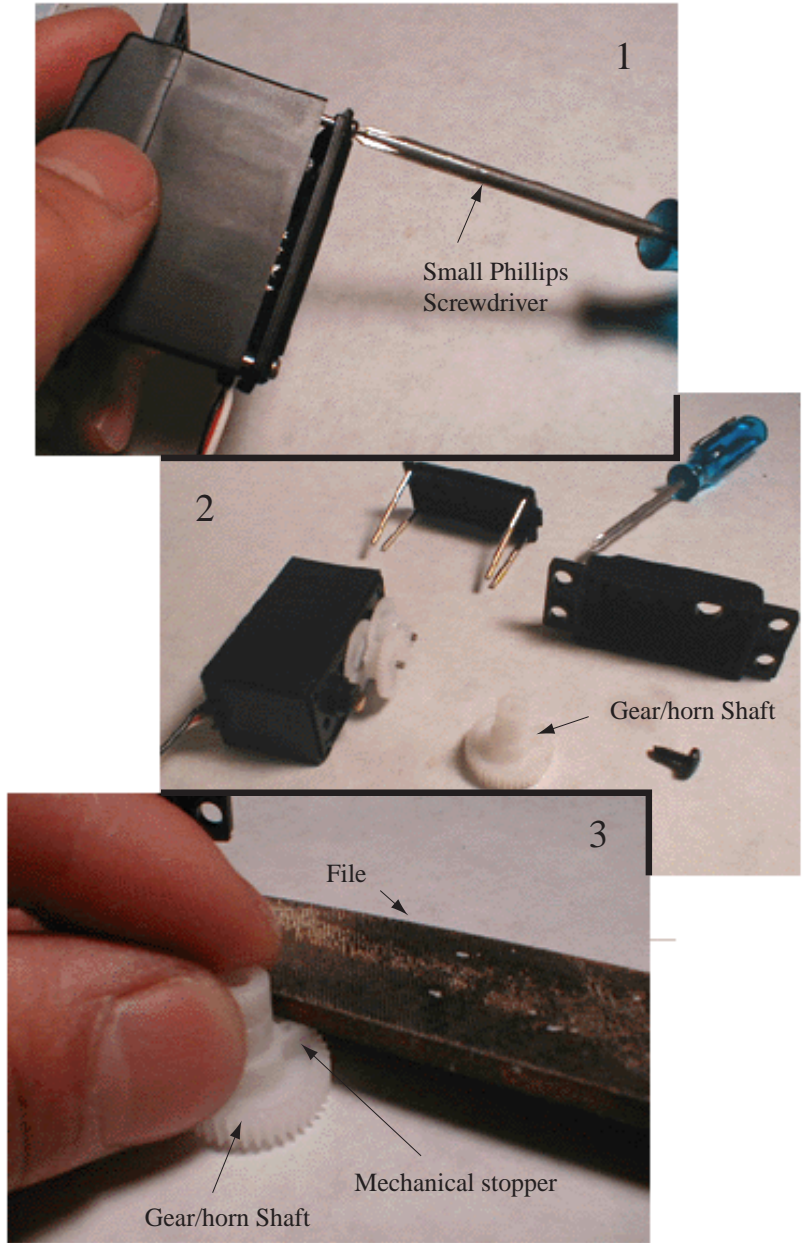


Figure 1: Dissassembling the servomotor and removing the mechanical stopper.

2.1 Breaking the Position Feedback Loop

In order to complete the continuous rotation modification, the position feedback device must be deactivated. There are two approaches outlined below. The first approach is the easiest, however, requires a little bit of tuning of the potentiometer for proper operation. The other approach is to replace the potentiometer with a voltage divider circuit by soldering resistors in its place. This approach involves more time and depending on how much soldering experience you have, can be more difficult.

2.2 The Easy Approach

The following steps refer to Figure 2.

1. Using a utility knife, **carefully** remove the electronic circuit board from the servomotor housing as shown in Figure 2.1. The circuit board contains various electronic components, the DC motor and potentiometer.

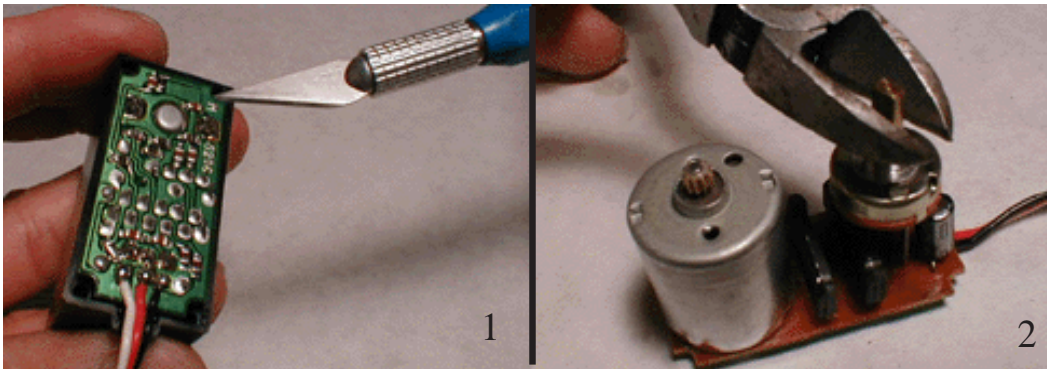


Figure 2: Cutting the shaft of the potentiometer with wire cutters.

2. To deactivate the potentiometer, remove the top portion of the potentiometer shaft (approximately 1/4") with a wire cutter as shown in Figure 2.2.
3. Now, turn and position the shaft so that it is half way between (middle) its limits. **Optional:** Add a small drop of Super Glue to glue the shaft in place. Make sure the glue is completely dry before reassembling!
4. Reassemble the motor and test it with a microcontroller or other PWM signal source compatible with the servomotor.

2.3 The Other Approach

The following steps refer to Figure 3.

1. Remove the circuit board as explained in Step 1 from Section 2.2.
2. Remove the potentiometer from the circuit board with a wire cutter as shown in Figure 3.1. Just simply cut below the potentiometer, making sure all 3 wires are cut.
3. Take two 2.2k Ω resistors and solder their leads together and bend them in the configuration as shown in Figure 3.2. This will serve as the replacement voltage divider circuit for the absent potentiometer.
4. Solder the three corresponding leads of the resistor voltage divider to the three leads on the circuit board as shown in Figure 3.3.
5. Reassemble the motor and test it with a microcontroller or other PWM signal source compatible with the servomotor.

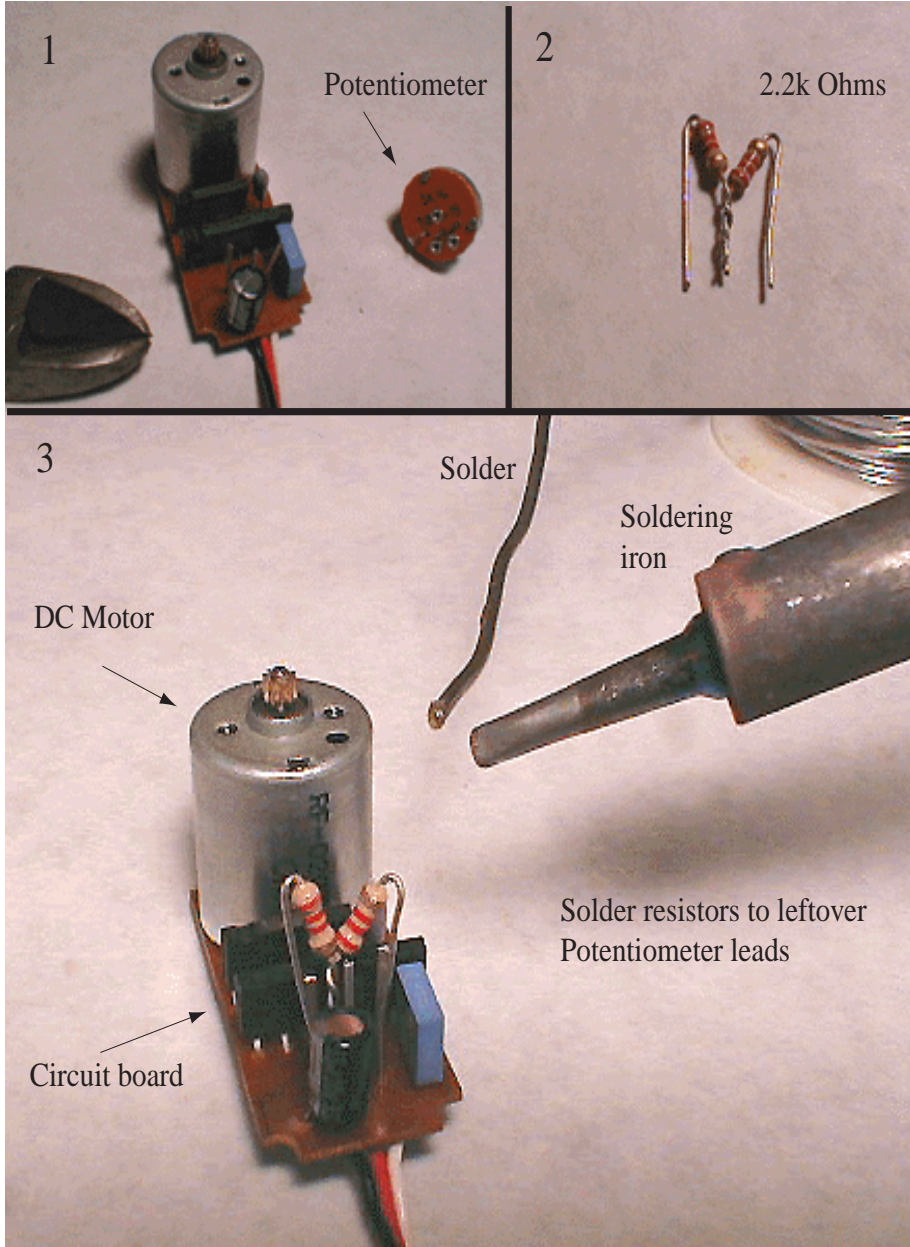


Figure 3: The other approach.