Modifying a servo for reversed operation

For our most recent project, the Blackbird XC, we installed flaps in the wings and placed an actuating servo, an Hitec HS 605BB, right over each flap. We ended up using a Y-harness to drive the two servos. Since the servos were mounted facing outward, one turned in the correct direction, the other in the opposite. What would be the best way to reverse the direction of rotation of one servo?

We did an internet search ("servo reversing") and found a number of available in-line servo reversers. These electronic devices are similar to extension cables contain a small circuit board which changes the signal so the connected servo rotates opposite to the factory-set direction. All of the reversers we found cost around $20.00, and the connectors fit most any servo or receiver. There are a couple of these servo reversers which are designed to replace the standard Y-harness. These Y-harness cables send the normal signal to one servo and the reversed signal to the other, and at least one has built-in noise reduction circuitry so it's better suited for use with longer leads.

But somewhere in the deep recesses of our minds we seemed to remember reading that a servo can be reversed by exchanging the motor leads and exchanging the two outer wires on the potentiometer. We wouldn't need to purchase servo reversing circuitry if we could confirm that procedure being correct.

Another internet search ("reversing servos") found <http://www.barnyard-buzzards.com/Builders_Corner/Electronics/index.htm>. This page is on the web site of the Barnyard Buzzards, a power club in the Monroe Washington area. Photos and accompanying text depict the elevator control system on an MAT AirTrax, an IMAA legal airplane. This large aircraft requires two servos to drive the elevator, a situation which mandates one servo be reversed. Down near the bottom of the page is a simple method for reversing a servo. As a pleasant surprise, a photo of a partially disassembled HS 605BB servo leads off the instructions, showing there is a lot of working room inside. The remainder of the photos show how to modify the smaller HS 85 for reversed rotation.

Simply stated, our foggy memory was right on. You want to exchange the two wires on the motor so it runs backwards from the norm, and exchange the two outer wires on the potentiometer so the feedback signal is reversed. Doing this of course voids any warranty, so make sure you're up to some fine soldering before pulling the case apart.

Rather than unsolder and then resolder directly to the small SMT (Surface Mount Technology) circuit board, as described on the Barnyard Buzzards page, we decided to cut the four wires, bare a small portion at each end, solder the wires in the reconnected pattern and slide some shrink tubing over each of the joints to reestablish the insulation.

The HS 605BB has a lot of room inside due to the large size of the motor, the small size of the circuit board and potentiometer, and the location of the potentiometer at the very top of the case. There was sufficient slack to pull the wires up and out of the case for easier access once the circuit board was removed from the case and pushed aside.

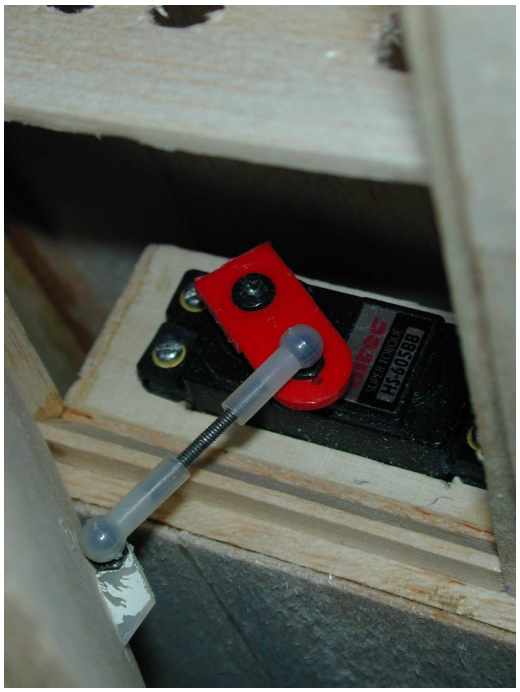
The orange and brown motor leads were cut at a point just past the edge of the motor. The red and green potentiometer wires were cut closer to the circuit board so the soldering iron would not have to be put inside the case.

To bare the end of any of the wires, the insulation must be held firmly in place with tweezers while a wire stripper is used. If you don't hold the insulation in place, it pulls off the wire. We slid short lengths of very small shrink tubing over the longer leads before soldering the wires together in their new positions. Once the joints cooled, the shrink tubing was smoothed over the soldered joint. Because the wires bend once the case is put back together, the tubing will not slip. Given the close surroundings, plastics and electronics, there's no room to manipulate a heat gun anyway.

After carefully folding the potentiometer wires under the board and bending the motor wires around the motor casing, we seated the circuit board in position and put the casing back together. Before screwing the case shut, we hooked up the modified servo and its twin to the Y-harness. Both worked flawlessly. Once the case was back together, a permanent sticker was placed on the outside of the servo to note the reversed rotation modification.

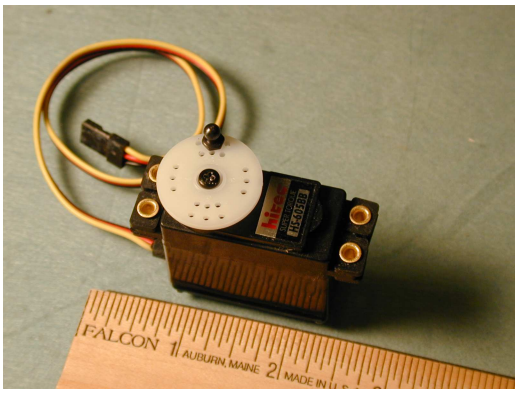
The leads to the two flap servos are around 20 inches in length, the leads to the elevon servos are nearly four feet. All of the cabling in this airplane is therefore twisted to reduce the possibility of noise in the signal lines. This is accomplished by taking the flat servo cable and splitting it into three separate strands. The strands are then twisted for the entire length and held in place while a heat gun is applied to set the twist.

While we had the HS 605BB servo apart, we took a good look at the mechanics. It's a pretty impressive piece of machinery for its $30 price tag. It has dual ball bearings and very large plastic helical gears (a metal gear set is available, #6397), puts out 77 oz-in of torque, and can rotate 60 degrees in 0.16 secs on 4.8 volts. Weight is 1.73 ounces. A few minutes in time and a minuscule amount of solder proved to be an educational experience which saved $20.00 and eliminated a possible source of in-flight electronic failure.

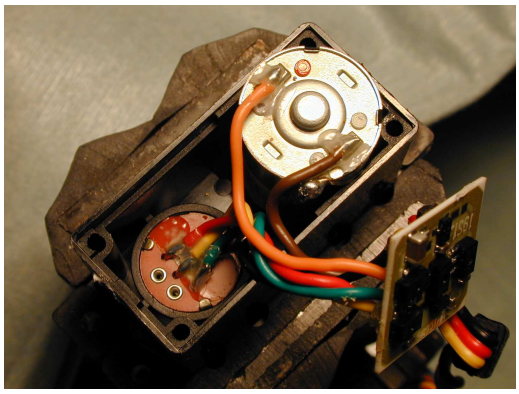


A photo of the reversed servo in place in our newest Blackbird XC. The flap is deflected to 45 degrees. Notice the high strength output arm which comes with the servo. (The three unused arms have been cut off.)

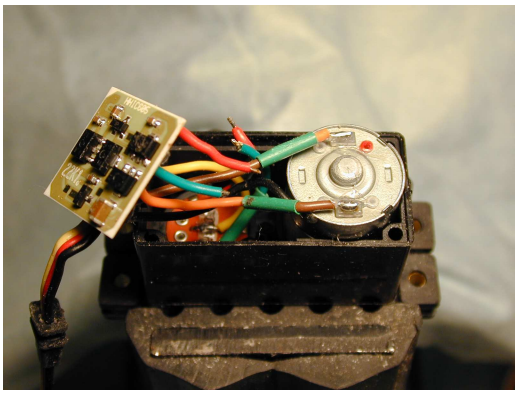
Photos of the HS 605BB servo wiring modification procedure are on the next page.



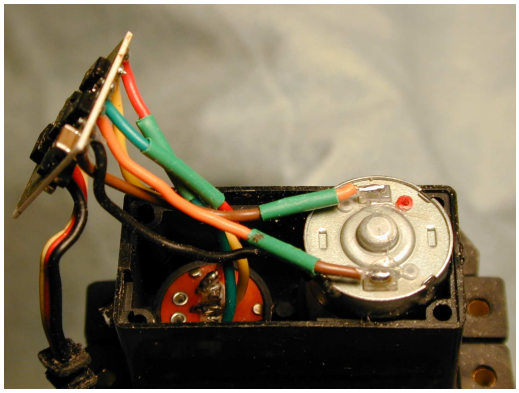
1. The Hitec HS 605BB servo.



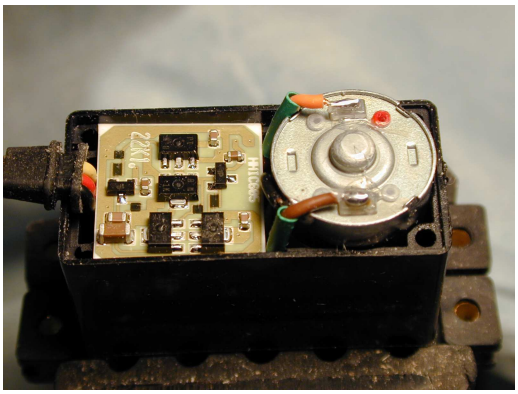
2. With the bottom of the case removed and the circuit board moved aside, the servo wiring is easily accessible.



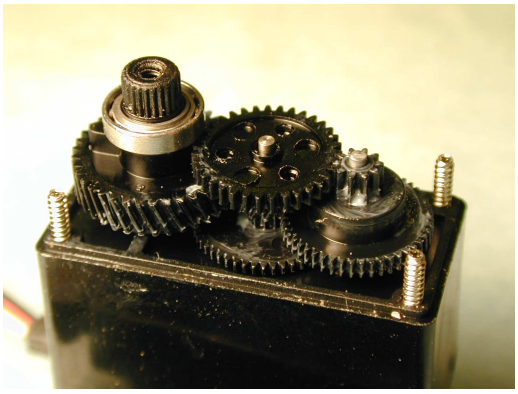
3. In this photo, the motor wires have been switched and the bare connections covered with shrink tubing. The bare ends of the potentiometer leads can also be seen.



4. Both pair of leads have now been switched and the bare solder joints are covered with small diameter shrink tubing.



5. In this photo, the circuit board is back in place and the motor leads are routed through the openings near the case sides. Once the bottom of the case is screwed back on, the project is complete.



6. The Hitec 605BB gear train. There are two ball bearings on the output shaft — one at the top of the shaft, the other is recessed in the underside of the large helical gear.