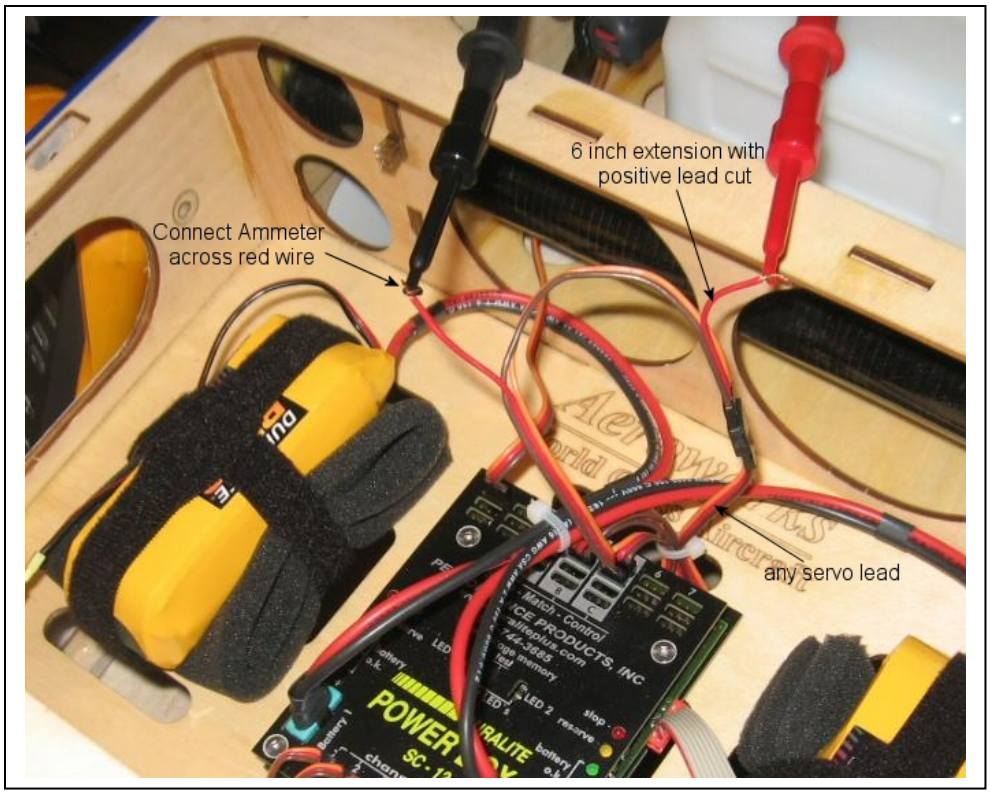
Matching Servos by Robert Vess

I have done a great deal of current testing when setting up multiple servos in my aircraft and have determined that proper procedures should be followed to minimize the necessary current draw of each servo. Here's the method that has worked very well for me.

First, you should have a multimeter that is capable of measuring current on the milliamp scale. In order to read the current draw of any servo, simply cut the positive (red) lead of a six-inch extension and connect the meter across the exposed ends. Then connect this extension between the desired servo and the RX or power distribution board. Here's the setup in one of my aircraft where I am using a Duralite Powerbox. I have the extension connected to one of my dual rudder servos in this example.



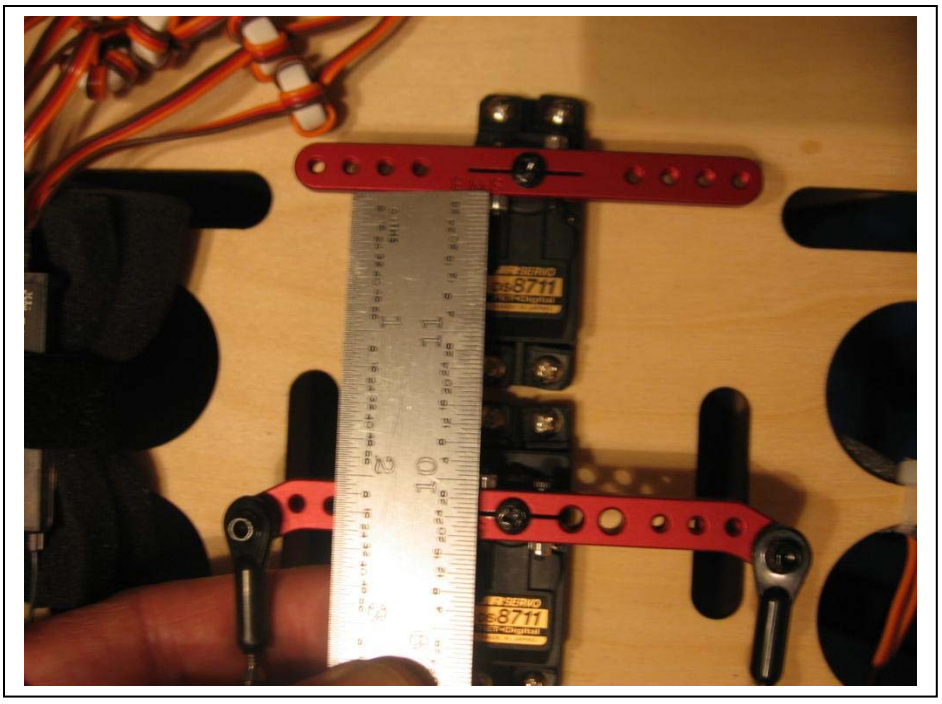
You need to have the ability electronically adjust the centers and endpoints of each servo to properly match them and this Model SC-2 Powerbox has this programming capability built in. Obviously, each radio manufacturer sells devices that also facilitate this so use whatever works with your equipment or suits your needs.

I like to check each servo in a "building block" manner to document changes in current as subsequent mechanical connections are made. Once again using the dual rudder setup as the example, I begin by measuring and recording the current draw of the aft servo (toward the rear of the aircraft) with no rudder cables attached. I find that even the amazing JR 8711 servo draws about 20 ma or so at idle and at its' endpoints. I take this

opportunity to make sure that the servo arm is square with the case when at neutral and use the programmer to adjust accordingly. A small "square" helps tremendously here.

Next I connect the rudder cables to the servo arm and mechanically adjust the ball links to center the rudder while providing modest tension. I don't like to hear my servos whine too much so I only use the tension necessary to provide little rudder "free play" with the servo energized. And now that the rudder cables are connected, the new current reading reflects any friction that has been introduced into the system (since there are no aero loads yet). So I consider significantly elevated current readings to mean that something in the hinging, control horn connections, or cable paths needs attention. I have found that stiff ball links can certainly have a detrimental effect here so make sure yours are freely moving. Once everything is correct, the servo current should read quite close to the no-load value already noted. If not, fix the offending problem now.

Now it's time to match the forward servo to the aft one. The ideal situation is to have the forward servo move precisely the same as the aft servo throughout the entire range of travel. This is easier said than done. I start by using the programmer to make sure that the forward servo arm is parallel to the already-centered aft one. You can use an accurate ruler or calipers and adjust the forward servo only until measurements on each side are identical.

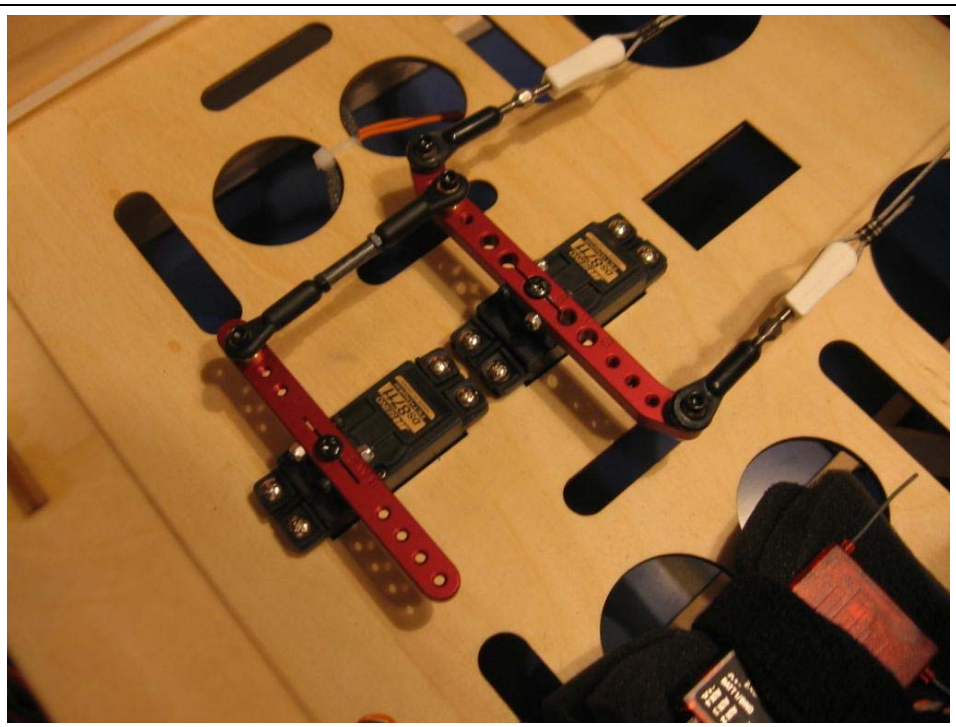


Once you have accomplished this, it's time to attach some linkage between the two servos so that you can double the torque to the rudder. I measure between the appropriate forward and aft servo arm holes (make sure they are at the exact same radius!) to determine the proper linkage length. Then I fabricate the linkage and attach it to the aft servo arm on one side. I temporarily affix it to the forward servo arm and observe any

current changes. Adjust the linkage length until the current at neutral arm position is the same as for the single servo with the rudder cables attached. Do not change the servo centers since the arms are already square to each servo and parallel to each other.

Now it's time to match the endpoints of the two servos. The aft servo should already have endpoints programmed that produce the desired maximum rudder travel in each direction. So we must make the forward servo match these and thus only want to make electronic adjustment to that particular servo. To so this, I remove the bolt on the forward servo attach ball link, go to one extreme stick position on the TX, adjust the programmer until the bolt goes back into the same hole with no binding, and then remove it again. Then I repeat the process for full opposite travel. This gets me close enough so that I can now tighten the bolt to secure the linkage without fear of the servos fighting each other too much. Now it's time for the all-important final adjustments. Once again, I observe the meter readings (with the meter still connected to the aft servo) at neutral and both endpoints and use the programmer on the forward servo to minimize the current at each position. I do not change the aft servo programming since it has a square neutral and endpoints set for desired rudder travel!

It might seem that you are done at this point but I have found that it is very important to now connect the meter to the forward servo (reconnect the aft servo to the RX or power distribution board) and observe its' current draw at all servo positions. I often find that it is not at the minimum current that was measured for the aft servo. I usually adjust it as required, and then repeat the process a few times with the meter moved back and forth between the two servos. A compromise in the adjustments is usually required to get each servo to some common low current across the range of travel.



You may have noticed that I have yet to connect the usual second linkage on the opposite side of the arms. Well, I have found that the iterative process of simultaneously minimizing the current of the two servos was adversely affected by the addition of the second linkage. Any adjustment on one end of the arm has the opposite effect on the other so you effectively "chase your tail". I'm not saying that it's impossible to get it right, but that it's much more complex. And when you stop and think about it, one rigid linkage between the servos is all that is needed to transfer torque between them! So I have left off the second linkage ever since and have really made the matching process much easier. Do not use two rigid linkages. You won't ever feel a difference in flight but you will feel added frustration on the bench!

So what current levels should be expected from each servo in a well setup dual rudder system? Here is what I typically achieve after any adjustment compromises are made:

Idle – 20 to 30 ma
Endpoints – 100 to 130 ma with no load on the rudder
1.5 amps with a good push on the rudder

You will see transient current spikes as you move the stick but these are typical at the steady state endpoints. I have also seen a poorly setup system draw in excess of 2 amps per servo at the endpoints with no load. So take the time do it right and you will be rewarded with happy batteries, more flights per charge, and much less chance of power related radio issues.