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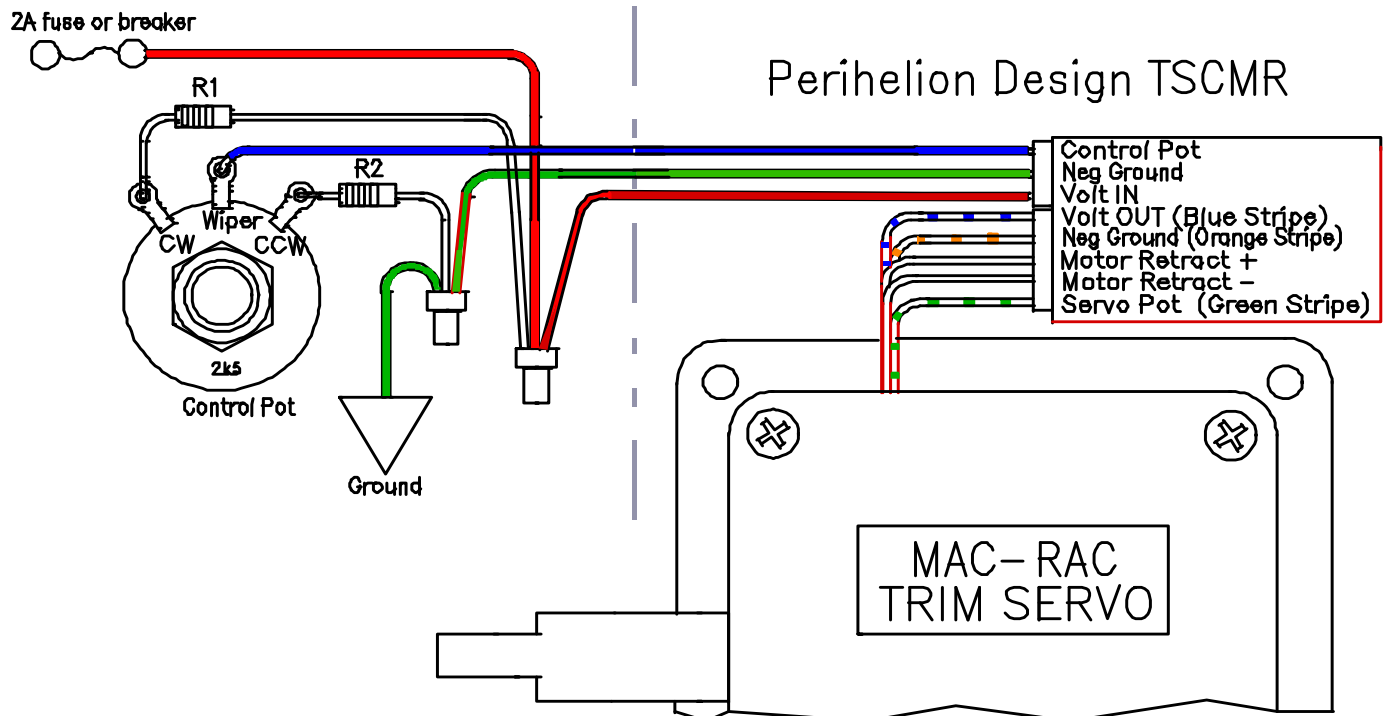
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True Servo Conversion for M.A.C.-R.A.C. "Sort-of-Servo"

True servos read a control signal and move a motor or mechanical part as commanded. Some feedback is required to complete the control loop. Usually, servos mimic mechanical control systems, but allow remote operation or magnified forces.

The standard MAC-RAC controls the motor with two pushbuttons and uses the visual feedback from their LED bar graph as well as the pilot's sense of stick forces. So it is really a "Sort-of-Servo". The MAC-RAC would be a *real* servo if its internal potentiometer wiper voltage (indicating its position) were fed back to a logic controller to drive the motorized mechanism to a desired position automatically.

But of course...! Perihelion Design has developed the TSCMR for builders who want to use their MAC-RAC as a true servo, to trim the elevator, ailerons, or rudder or for simple jobs such as controlling heater or air vents, opening a baggage or dipstick door, and other tasks.



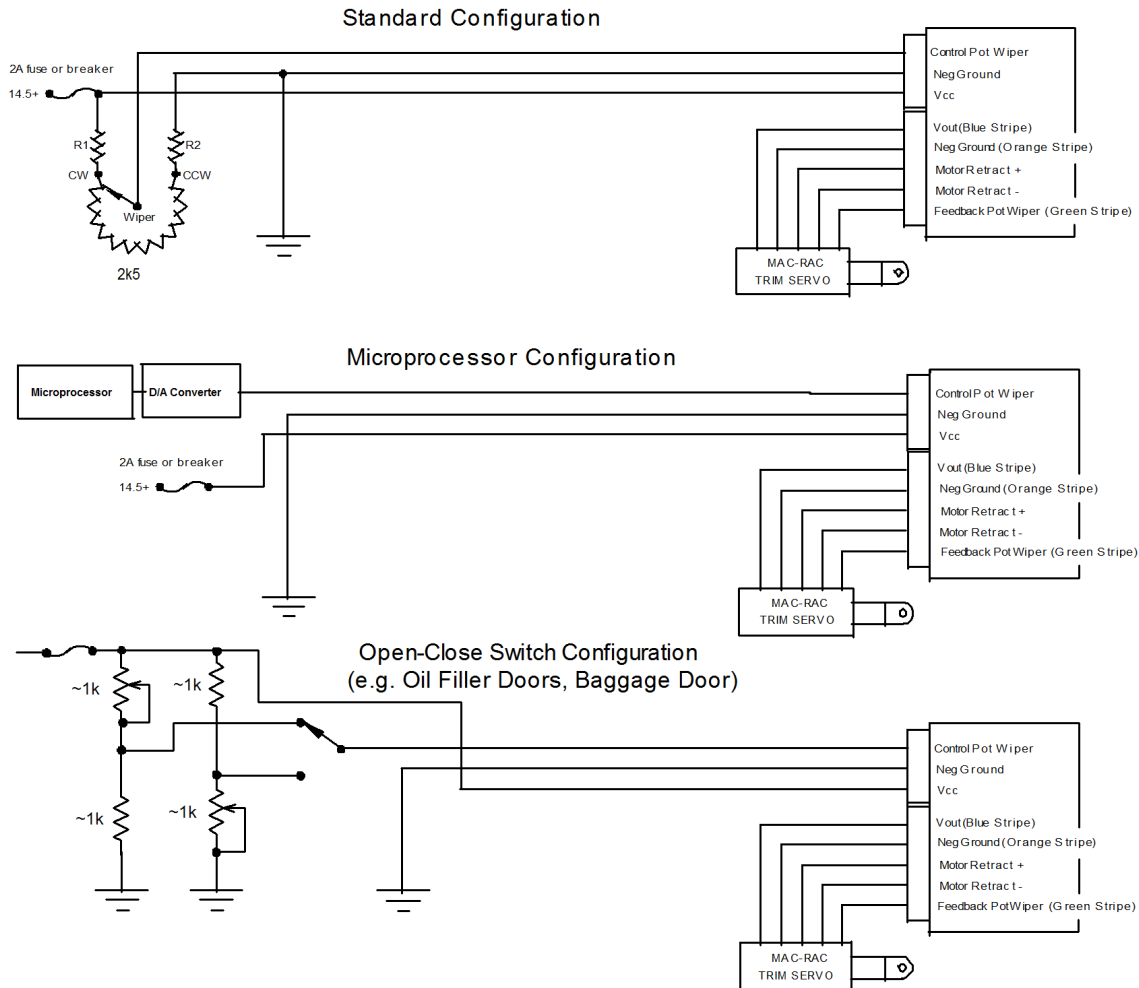
Advantages---True servo operation allows the pilot to position a control knob or wheel and have the servo go to the commanded position and stop.

Differences between Perihelion Design's EGPNSMC and TSCMR Servo Controllers--

Perihelion Design's EGPNSMC (Extremely General Purpose Non-MAC Servo Controller) is designed to drive Futaba and other servos that require a pulse-width modulated signal as well as a 6VDC power source.

Perihelion Design's TSCMR (True Servo Controller for MAC-RACs) is designed to drive MAC and RAC trim controllers. The TSCMR converts the system that uses pushbuttons and an LED bar graph to a true servo system.

The TSCMR is used in the Perihelion Design Trim Wheel Assembly too.



TSCMR Features:

- Reverse voltage protection
- Over-voltage shutdown
- Over-current shutdown
- Sets servo position according to signal voltage.
- Ideal for adapting to many flap and trim control types
- EZ Computer control via D/A converter
- Servo cannot lose synchronization.

- No pushbuttons or relays to fail (common cause of runaway trim).

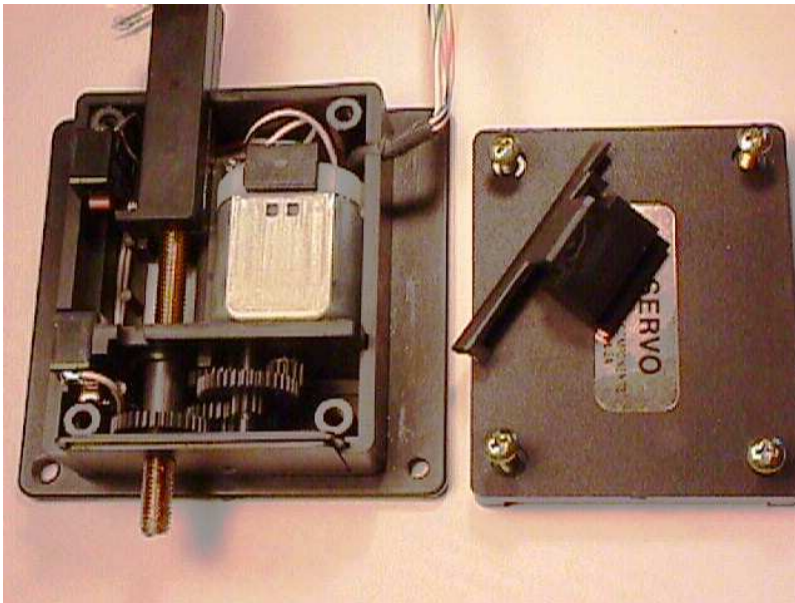
Specifications:

Input voltage 14.5 VDC
1A guaranteed output current
Size: 0.30 W; 1.4 L; 0.82 H
Weighs less than 1/2 oz (14 g)

Additional suggestions:

- 1) There is a "dead-band" in the extend direction only, where the trim box rod will extend without changing the feedback potentiometer. RAC/MAC designed it like this on request of Vans who wanted slightly more extension.
- 2) There is no information from MAC on how long the feedback potentiometers are expected to work, how smooth they are, how linear they are, what the end resistances are or if vibration and cycling damages them. MAC does offer a complete repair service that seems to work well.
- 3) Internal capacitors on the motor will improve performance and lower noise.

The MAC-RAC series of trim boxes is a reasonably rugged and tested design. However some improvements can easily be made to enhance the design further—



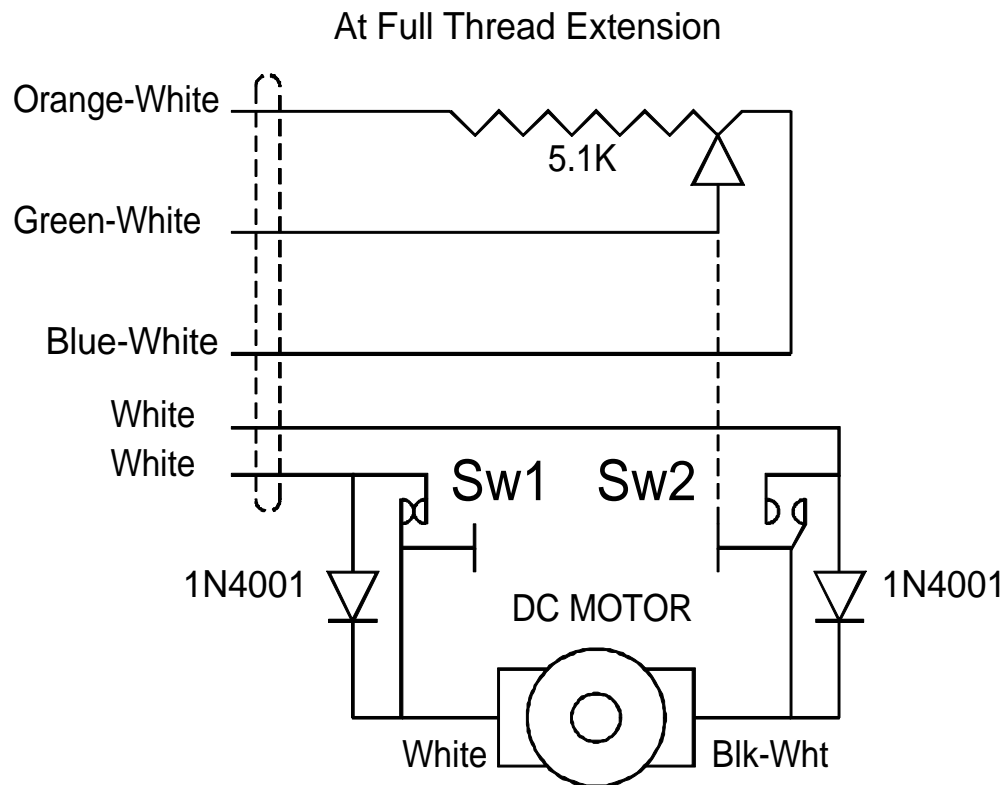
The MAC controller has a couple of possibilities for improvement:

- 1) Cover the actuator screw: This takes a part which could be made from a ball-point pen cap or any other minor piece of plastic (or aluminum) glued onto case to cover the screw, which extends 1-1/8 inches out from the housing (for the MAC8A). This seals one of several possible entries for dirt, water and corrosion. It is axiomatic that excluding dirt from the servo is a very good way to extend its service life.
- 2) Bondo the trough in the bottom of the square rod. Same reason.
- 3) Cover the actuator square rod: A small extensible boot can be fashioned to cover this part. Otherwise a wiper made from Gortex, little brushes, etc., could be made for it. Same reason.
- 4) Seal the cover: A little (very little) non-hardening gasket seal. Tape on the seam would technically be better because no sealant could get into the parts.
- 5) Run the cover screws through the body. This is a minor point; but some improvement can be made by using metal inserts in the case.
- 6) Squash the motor EMI capacitor at the motor. The standard method of handling this is to put a small (0.01 μF ceramic) across the motor leads and 0.1 μF ceramic caps from each motor lead to ground. This should be done right at the base of the motor and the capacitor leads should be very short. Then the motor case

should be grounded. The TSCMR does have a similar approach onboard but is less efficient at quieting the EMI because it is some distance from the motor.

- 7) Other changes to the inside...? Well, I pored over this and believe the inside is actually pretty good. There is no way to know how tough the plastic parts are, but there is good reason to believe they are fine. Time will tell.

How long will the motor brushes last? Who knows? But it would be nice to be able to see them.



MAC8A Schematic

Here's a simple electronic schematic that shows how the MAC-RAC works: The servo is shown at the position where the brass actuator thread is fully extended (the square rod is fully retracted). The limit switch SW2 has opened, allowing ONLY movement in the opposite direction. The 1N4001 diode conducts only until the limit switch SW2 again closes (almost immediately). The motor can drive the rod all the way to the other end so that the other switch SW1 opens, or the motor can stop anywhere in between

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