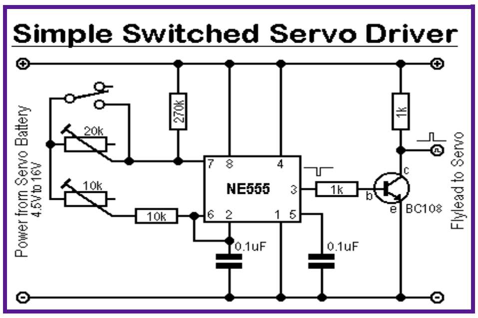
Simple Switched Servo Driver

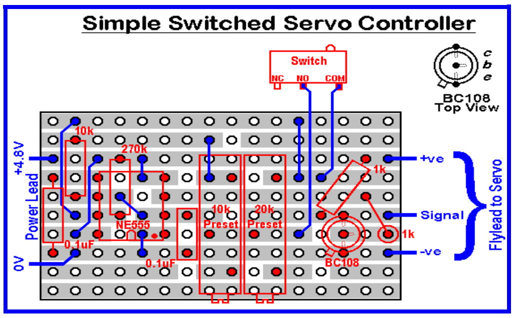
UPDATE! 25 Jul 03 - Design changed slightly.

This design was created to overcome a problem I was having with the tailwheel doors of the P-51 Mustang. The problem was that the undercarriage sequence is complicated and would have required 2 independent sequencers. The closing sequence is: Main gear doors open, Tailwheel retracts, tailwheel doors close, main gear retracts, main gear doors close. The complication is the main gear doors close again after the main gear extends, but the tailwheel doors remain open. Additionally the tailwheel takes 2 seconds to close (electronic servo slow) and the pneumatics for the main gear is restricted to slow their operation.

This design simply drives a servo to close the tailwheel doors once the tailwheel has retracted. It runs from the servo battery supply, but has no signal connection to the RX. When the tailwheel is almost completely retracted the wheel (or leg) closes a micro-switch. This circuit causes the door servo to move to the other end of its travel, closing the doors. almost as soon as the tailwheel starts to move the micro-switch is released and the doors open (almost instantly).

The signal that the RX sends to the servos (in most systems) is pulses between 1 ms and 2ms long at a rate of 50 Hz. This design produces pulses to drive the servo directly. The schematic and Vero Board layout are (click for full size):





Construction: The circuit is quite simple to construct, having few components and no particular handling problems with the components. Firstly cut a piece of Vero board the correct size and make the cuts in the tracks as shown. Insert the wire links and solder in place. I normally use PCB pins for the external connections (much easier to work with later) and if used insert and solder these. Fit the resistors to the board and solder. The NE555 is fitted in a socket and this will probably need trimming to sit over the 270k resistor, solder it in place. Solder the capacitor and preset resistors in place and fit the external flyleads. Bend the legs of the BC108 to fit in the board, and I recommend using a transistor base (if you can find one) to support it. Solder it place and insert the NE555 into the socket.

The circuit in use: Build the circuit, set the preset resistors to a central position and close the micro-switch. Connect an old servo (just in case) to the output lead and power to the input. The servo should move towards one end of its travel. Adjust the 10k preset to set the servo to the desired position. Release the micro-switch and the servo should move towards the other end. Use the 20k preset to set the other end point. If you want to reverse the operation, use the normally closed contact of the micro-switch.

How the circuit works: The NE555 is a highly stable timer configured here in astable mode (oscillator) which produces a constant series of square wave pulses. The oscillation is determined by the resistances between pins 7 and 8 (R_A) and pins 6 and 7 (R_B) and the capacitor between pins 2 and ground (C). The frequency is given by the equation $f = 1.44 / [(R_A + 2R_B)C]$, where R_A and R_B are in ohms and C is in Farads. For the above circuit R_A is 270k and C is 0.1uF. R_B is little more complicated and can lie anywhere between 10k and 40k. If the switch is closed the 20k preset is shorted out and the resistance is the sum of the 10k fixed resistor and the 10k preset. When the switch opens the value of the 20k preset is also added. The frequency is therefore between 49 and 41 Hz. In practice this seems near enough to the 50 Hz that most RC systems use, and I have not had any servos reject the signal (yet). I have used 18 turn preset resistors for the above circuit as it is what I had available. Whilst any preset resistor could be used, a multi-turn preset is recommended as it allows much more accurate setting of the servo positions. If you change the type you will, of course, have to revised the board layout.

More important than the frequency is the pulse width. The short pulse is during the output being low and it's duration is given by $T_H = 0.693\ R_B\ C$, or in our case between 0.7 ms and 1.4 ms with the switch closed increasing by between 0 ms and 1.4 ms when the switch opens. As the short pulses are logic low and we therefore need to invert the signal to the servo. The 1k resistor between the positive rail and servo output pulls the signal high and the transistor conducts when the NE555 output is high causing the servo signal to drop to zero.

22 Jul 00 - I was having problems with the servo chattering, particularly at one end of travel, when connected to the RX (for power supply). This problem did not manifest itself when connected to a separate supply, only when running from an RX connection. To reduce this problem an additional 0.1uF capacitor was connected between pin 5 of the NE555 and the negative rail. This drastically improved the situation and the movement is now hardly noticeable.

25 Jul 03 - At the advice of Briendjf@aol.com I reversed the orientation of the transistor so that the emitter is connected to the negative rail.

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