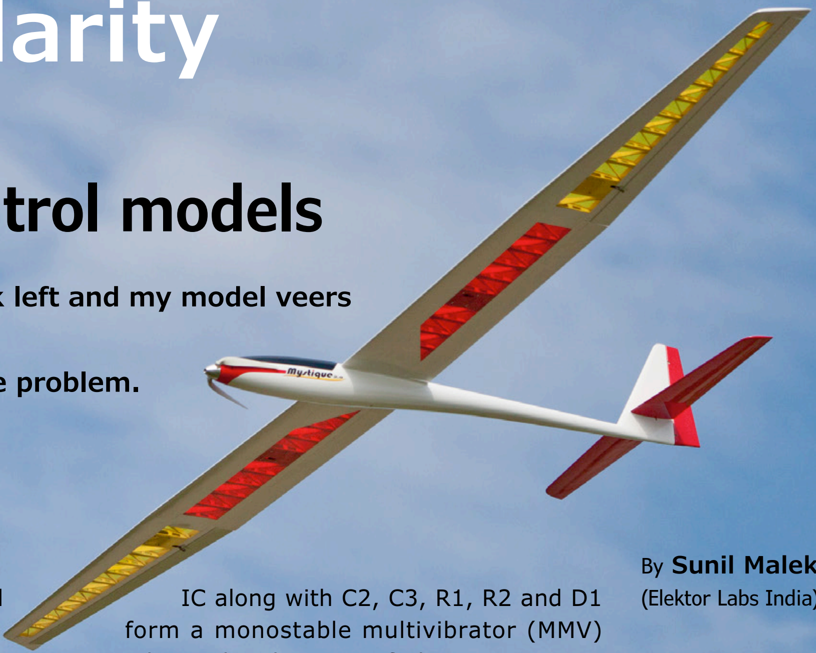
Servo Polarity Changer

for remote control models

Hell! I moved my control stick left and my model veers off right! And down is up!
Here's a simple solution to the problem.



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Servos are crucial electromechanical parts on board many remote control (RC) models. They are generally controlled by means of pulsewidth modulation (PWM): a pulsewidth of 1.5 ms corresponds to the neutral or 'straight ahead' position, whilst 1 ms and 2 ms represent the extreme settings of the control. The "polarity" of a servo can simply be reversed, enabling a 1-ms pulsewidth to make the servo disc assume the position previously adopted with a pulsewidth of 2 ms, and *vice versa*. All we have to do is modify the width of the control pulses.

Since in both cases the control's neutral position will correspond to a pulsewidth of 1.5 ms, it is possible to calculate the pulsewidth for all other positions on the basis of this figure. This can be done quite simply by subtracting the original pulsewidth from 3 ms, giving its counterpart in the opposite direction. Thus in order to reverse the "polarity" of the servo you simply arrange for the current control pulses to be subtracted from a reference pulse of 3.00 ms.
Servos come in two different types, either operating with positive-going control pulses, or devices requiring a negative-going pulse. The circuit described here can only be used with servos using positive-going pulses; however this represents the large majority of devices available off the shelf.

Hardware

In the circuit pictured in **Figure 1** the NAND gate inputs IC1c and IC1d from a CD4001 IC along with C2, C3, R1, R2 and D1 form a monostable multivibrator (MMV) with a pulse duration of about 3 ms. It is triggered by the servo control signal (IN), which is also fed to an input of IC1b and IC1a. The other inputs of these two gates receive negative-going pulses of approx. 3 ms duration from the output of IC1c. Since IC1a and IC1b are NOR (inverting-OR) gates like IC1c and IC1d, their outputs produce a positive-going pulse, the duration of which is equal to 3 ms minus the duration of the original control pulse. IC1a and IC1b are connected in parallel to increase the fan-out (drive capacity) of the circuit.

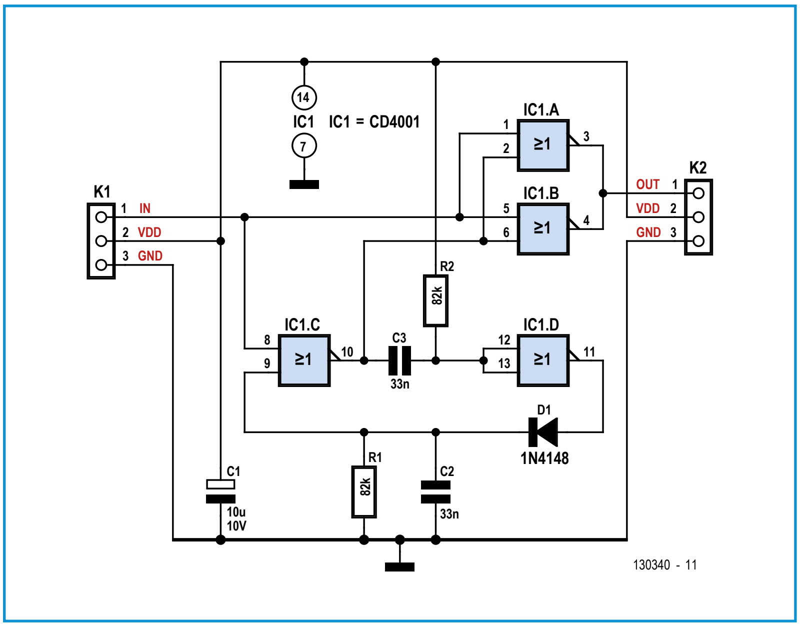

Figure 1.
Schematic of the Servo Polarity Changer.

On the prototype the monostable was found to produce a 3.15-ms output quite reliably. In most applications where the servo is permanently built into the model, allowance for slight tolerances in pulsewidth can be made at the transmitter. However, if a pulse duration of exactly 3 ms is required, then C2 and C3 should be changed to 27 nF (0.027 µF) and smaller capacitors connected in parallel until a pulse of exactly 3 ms is obtained on the oscilloscope. Even without a 'scope the pulsewidth can be accurately set by tweaking the value of C2 and C3 in the above fashion until the servo remains in exactly the neutral position with or without the polarity changer.

Component List

Resistors
R1,R2 = 10kΩ

Capacitors
C1 = 10µF 10V (preferably tantalum)
C2,C3 = 33nF

Semiconductors
IC1 = CD4001
D1 = 1N4148

Miscellaneous
K1,K2 = 3-pin pinheader, 0.1" pitch
PCB # 130340

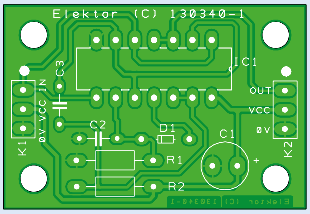

Figure 2.
Printed circuit board design for the Servo Polarity Changer.

Practical aspects

The circuit is very simple to build from conventional parts on a single-sided circuit board (**Figure 2**). The actual build is shown in **Figure 3**, and a test setup with an Arduino as the servo pulse source, in **Figure 4**.

The polarity changer consumes very little current (1 mA), and is hardly affected (<2%) by variations in the supply voltage between 3 and 10 V. To keep the dimensions of the circuit to a minimum, a tantalum type is recommended for capacitor C1. As a result of the symmetrical configuration (R1 = R2; C2 = C3) the circuit has a low temperature coefficient.

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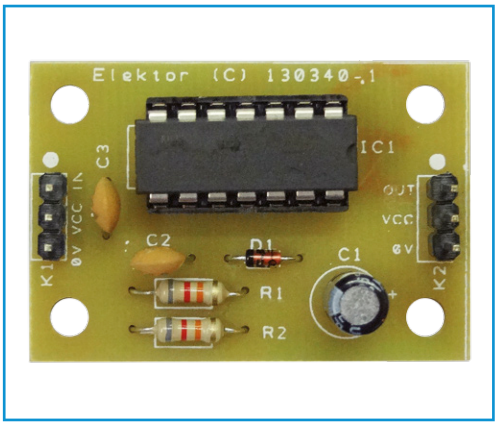

Figure 3. The finished board.

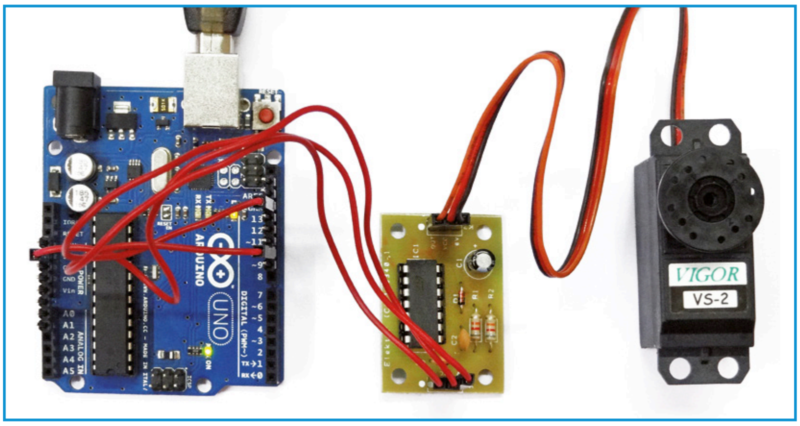

Figure 4. The operation of the circuit was verified using an Arduino microcomputer.