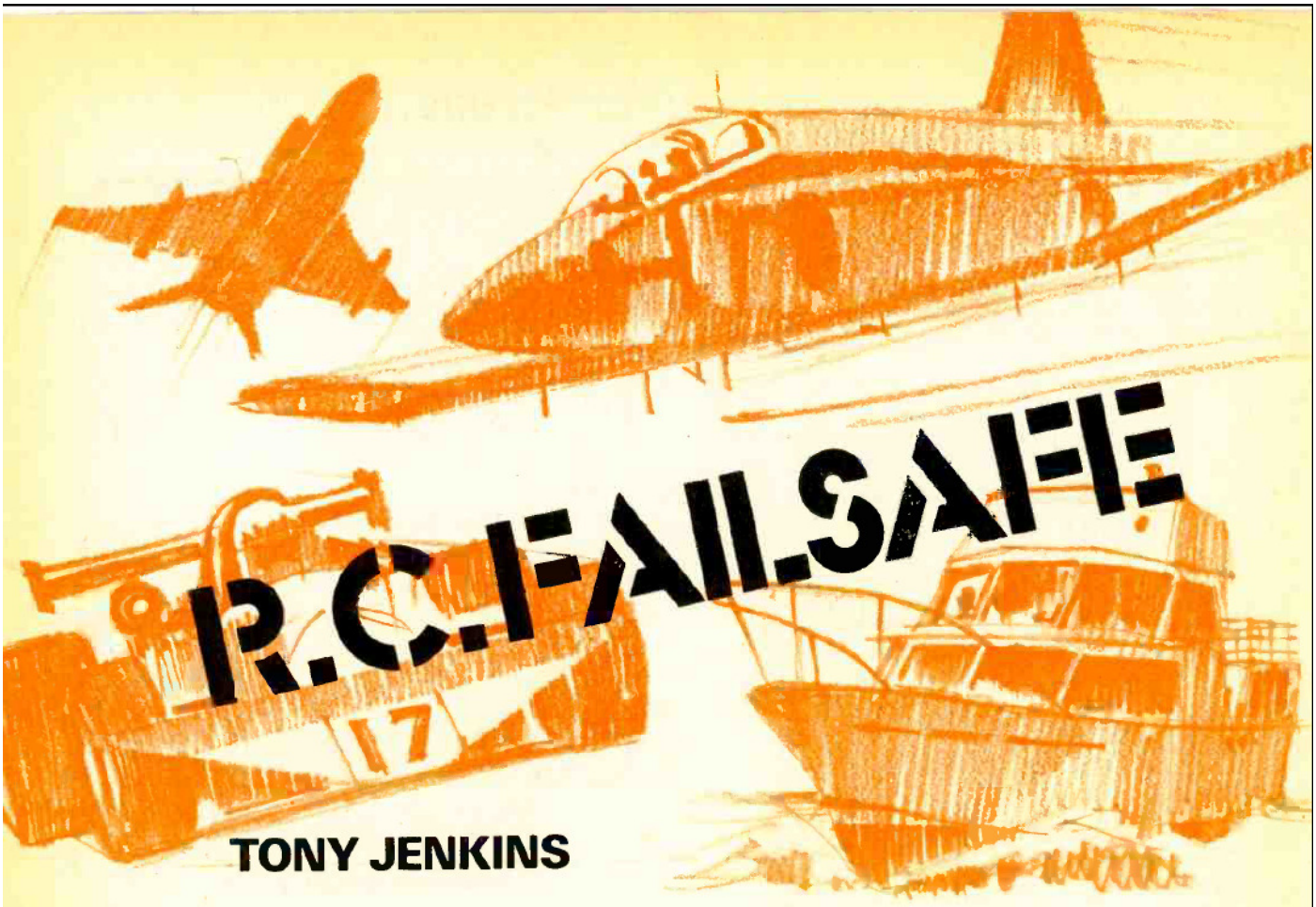


R.C. FAILSAFE

TONY JENKINS

If your radio controlled model out-ranges the transmitter, pre-program it to avoid a crash, with this simple circuit

MODERN digital radio control equipment is normally very reliable, but there is always a danger of loss of signal, due to faulty transmitter, dead transmitter battery, or the model even going out of range.

The normal result of this is total loss of control, and probable loss of the model as well!

The unit to be described can eliminate this problem, because when it is connected in line with a servo, if the signal is lost, after a short time (approx. half a second) the unit feeds a signal to the servo, which causes it to take up a preset position (which can be adjusted throughout the servo's normal range of movement), where it will remain until signal is regained, when control will revert to the transmitter as normal.

A typical installation may require two to four units, normally one for each servo in use, set so that if signal is lost, a model aircraft for example, may go into a shallow dive, circling slowly, with engine at idle.

It is also possible to use them on a glider, so the transmitter may be switched off, and the model left circling, thereby conserving battery life, as receiver consumption is minimal with no servo movement.

CIRCUIT DESCRIPTION

Referring to Fig. 1, IC1 is a CMOS quad 2 input NAND gate connected to function as a data selector. When pins 2 and 12 are "high" the pulses on pin 13 appear at the output, pin 8. When pins 2 and 12 are "low", pulses from the 555 oscillator (connected to pin 5 of IC1), are fed to pin 8.

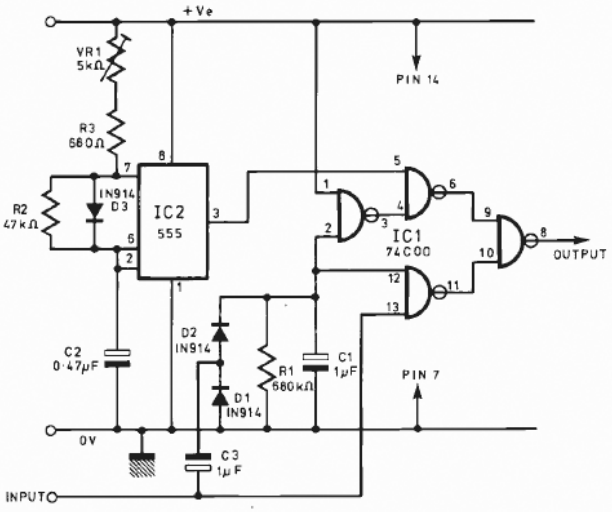
Control of pins 2 and 12 is via the rectifier circuit consisting of C3, D1, D2, R1, and C1. When there is a signal from the receiver coming into pin 13 on IC1 (and also C3), the voltage on the positive end of C1 will be around 4·5 volts, well above the threshold of the CMOS logic i.c., so the pulses from the receiver will be fed through to pin 8, and from there to the servo.

When the signal is lost, there will be a d.c. level on the input to the unit, no signal will pass through C3, capacitor C1 (1μF) will discharge via R1 (680kΩ), and the voltage on C1 will fall below the switching threshold of IC1, and so approximately half a second after loss of signal, control of the servo will be transferred to IC2. When the signal is recovered, C1 will again charge, and control of the servo will be transferred back to the receiver.

The oscillator formed by IC2 is slightly unusual, in that instead of the usual near square wave output, the output consists of short 1–2ms (variable by VR1) positive pulses,

with a gap of approximately 20ms between, thus simulating the output of the receiver decoder.

The operation of the oscillator is as follows: C2 charges via VR1, R3, and D3, until the voltage across it equals two thirds of the supply voltage, at which point pins 3 and 7 of the i.c. go "low", as the internal comparator (I/P at pin 6) switches. C2 then discharges at a much slower rate, via R2 (D3 now being reversed biased) until the voltage on it is reduced to one third of the supply voltage, when the other comparator (I/P at pin 6) in IC2 switches, pin 7 is then effectively open circuit, pin 3 goes "high", and the cycle commences again.



CONSTRUCTION

This unit is *only suitable for positive pulse systems,* which the majority of modern R.C. equipments use.

Construction is fairly straightforward, if normal care is taken. Figs. 2 and 3 show the p.c.b. layout.

Insert and solder all components (taking care to observe correct polarity, etc.), leaving IC1 to the last. This is a CMOS device, and may be damaged by careless handling, unless precautions are taken.

A servo extension lead to suit the equipment is required. To connect the unit, the positive and negative wires in the extension lead should be cut, a short length of insulation should be removed, both positive leads connected to the positive pad on the board, and both negative leads to the negative pad. Now trace the control lead from the receiver (in three wire systems the remaining wire), normally if the receiver connecting block is checked, it will be the only wire not common to all servos.

This should be cut and the insulation removed from the ends. The end that will connect to the receiver should be connected to the "in" pad on the unit, and the other end to the "out" pad. The unit is now ready for testing.

TESTING

Set the preset to mid travel, connect up the R.C. equipment with the unit in line, with the servo. Switch on the transmitter, then the receiver, and check that control is as normal. Switch off the transmitter, the servo should jerk towards one end of its travel, as normal. After a short delay, the servo should move back towards the centre of its travel, and the position may now be varied by means of the preset.

COMPONENTS . . .

Resistors
R1 680kΩ
R2 47kΩ
R3 680Ω
All $\frac{1}{8}$ watt 5%

Potentiometers
VR1 5kΩ Sub min hor'preset (4·7kΩ will do)

Capacitors
C1, C3 1μF Tantalum bead (2 off)
C2 0·47μF Tantalum bead

Integrated Circuits
IC1 74C00
IC2 LM/NE 555

Diodes
D1, D2, D3 1N914/1N4148

Miscellaneous
Printed circuit board (available from W.K.F. Electronics. Worksop 720695)
Servo extension lead—to suit equipment in use.

Fig. 1. (left). Circuit diagram of Failsafe

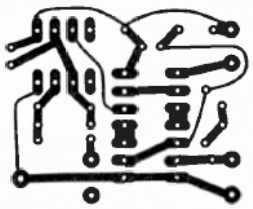


Fig. 2. Printed circuit layout (actual size)

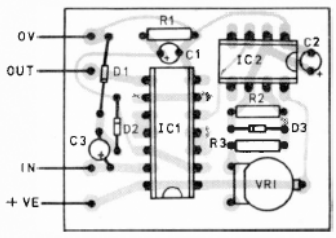


Fig. 3. Component layout

WARNING

To cope with the different pulse lengths used by different manufacturers, the pulse range available from the unit is wider than required by most servos. Do not exceed the servos normal range of movement, as it is possible (although most types will withstand a certain amount of mistreatment), that damage may occur. *Adjust the preset slowly.*

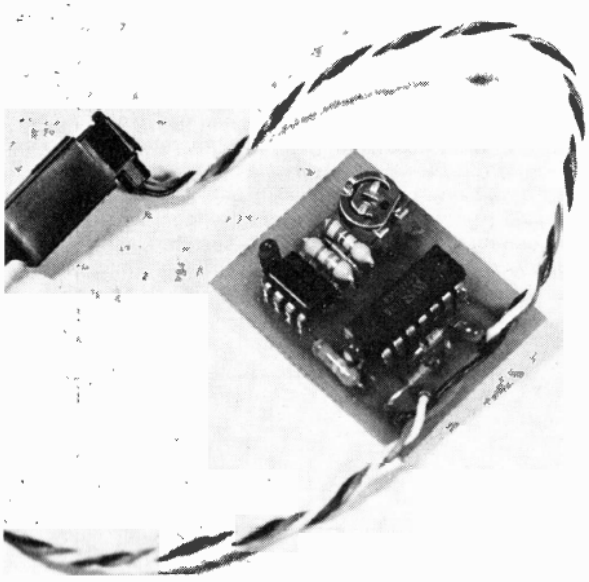
INSTALLATION

If all is well, the unit(s) may now be installed in the model. This is simply a matter of sticking them in a suitable position with "servo-tape", and adjusting them for a suitable trajectory with no signal.

If the unit does not work in one mode, but is okay in the other, check the area around the rectifier (C3, D1, D2, R1 C1). If the unit does not work at all, carefully inspect the board for solder bridges or wrongly placed components.

If nothing is visibly wrong, temporarily transfer the lead from the output to pin 3 of IC2, if control by the preset is now possible, it is probable that IC1 is faulty. If still no output, it is probably IC2 (or associated components).

The unit may also be built as a servo tester, in which case only R2, R3, C2, D3, IC2, and VR1 are then required. VR1 should now be a calibrated potentiometer, and the output is taken from IC2 pin 3. It can be built into a suitable box with 6V battery and on/off switch, and a socket for the servo. ★



One R.C. Failsafe board. As many can be used as required to preset the various servos