BUILD YOUR OWN RC SWITCH (Issue 3)

PART ONE – SINGLE ELECTRONIC RC SWITCH

Fancy switching the lights using your radio, then here is a circuit you may consider building. It only uses one IC and seven other components for a single switch and you can build two or three to run from one output channel of your receiver, which will allow you to switch the navigation lights, cabin lights and deck flood lights of your vessel in sequence.

The circuit for the RC switch is by Tony Van-Roon and was found on the internet at **DiscoverCircuits.com** it is an adaptation from an original circuit by Ken Hewitt.

The circuit is a so-called "Radio Controlled Electronic Switch". It can be used to switch on/off anything electrical. The schematic diagram in Fig 1 shows the setup for switching general accessories such as motors, relays, navigation lights, landing gear, sound systems, glow plug driver, bomb release, parachute, search lights, gyros, and so on.

Please note that this system will not work with PCM.

Technical Description
The circuit is based on a CMOS Dual ‘D’ Flip-Flop integrated circuit type 4013. The input Flip-Flop is designed as a monostable pulse generator by means of R1, P1 and C1 connected between 'Q' and the RESET input, which produces a preset pulse-length set by the adjustable potentiometer (100k) and starts at the rising edge of the input pulse from the receiver. When this monostable times out its inverted 'Q signal goes high and clocks the output stage of the Flip-Flop, which is used as a normal type 'D, to sample the input pulse. If the duration of the input pulse is longer than the preset monostable pulse, then a logic high level will be clocked to the output of the D type. A shorter input pulse will cause a logic low to be clocked to the output. In short, both halves of the IC perform two different logic functions.
The IC output (pins 12/13) drive the output device which in this circuit is the IRF540A MOS FET it needs only 2 volts on its gate to fully turn-on and has an ‘ON’ resistance of only 0.028 ohm. To invert the operation of the R/C switch, you can connect R2 (1k0) to either pin 12 or 13 of the 4013. Please note that the system switches the negative or ground side of the supply and the positive supply is permanently connected to the device being switched. This device can be built as a single switch or two/three switches on the same board. It is easy to build and can be made using Strip Board, or a specifically design PCB layout.

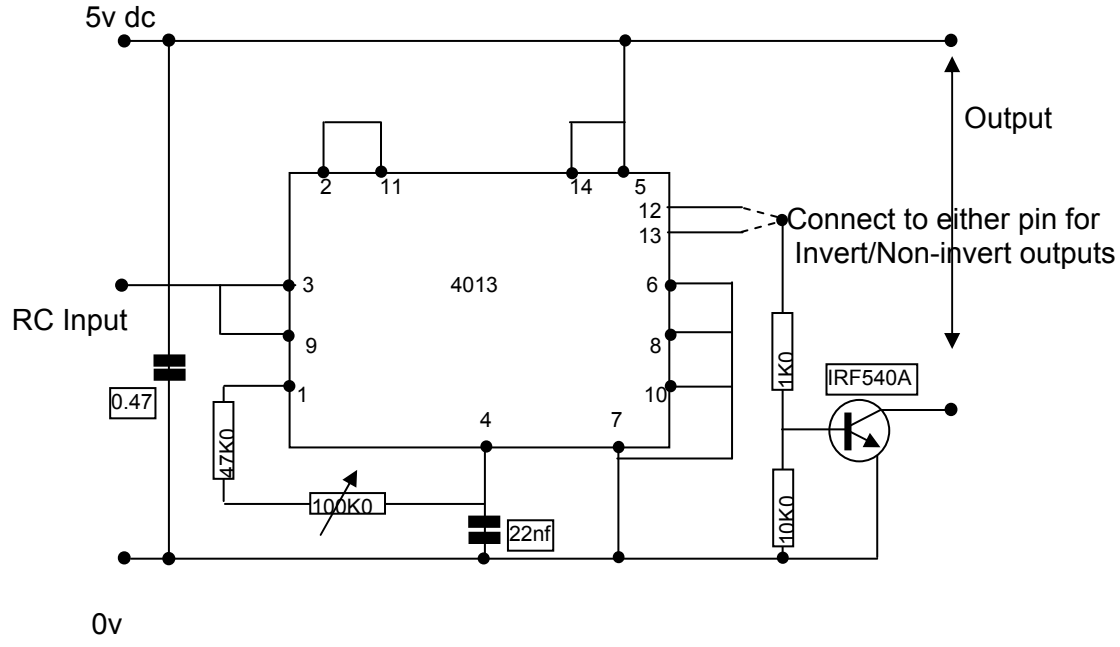

Fig 1 Schematic Diagram of Single RC Switch

Note: The 100k potentiometer sets the trigger point at which the circuit will switch on.
Only one 0.47uf decoupling capacitor is required per circuit board irrespective of the number of switch circuits built on the board

Switch Construction
The Printed Board track and component layout for a single switch is shown in Fig 2.

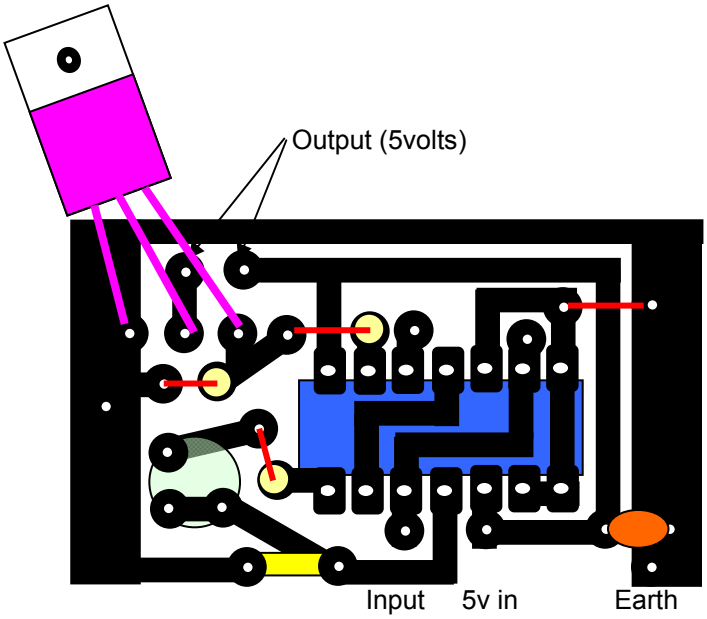

Fig 3 Switch PCB Component Layout (Scale 2:1) PCB actual size 42 x 24mm see Fig 4.

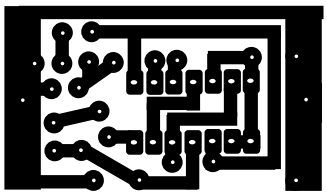

Fig 4 PCB Master (Scale 1:1) for the list of components see appendix A.

If you intend to make a printed board in order to construct your switch, you will need some pre-sensitised PCB material and Caustic Soda for developing. Then you will need to etch the copper to form the tracks using Ferric Chloride.

If you do not wish to play around with chemicals, you could build your switch using Strip /Matrix Board (Vero Board). A board layout indicating where to cut the copper tracks is shown in Fig 5 (scale approx. 2:1) all that is required is that you cut the strips of copper where marked by the yellow squares shown on the drawing, the view is from the copper track side of the board.

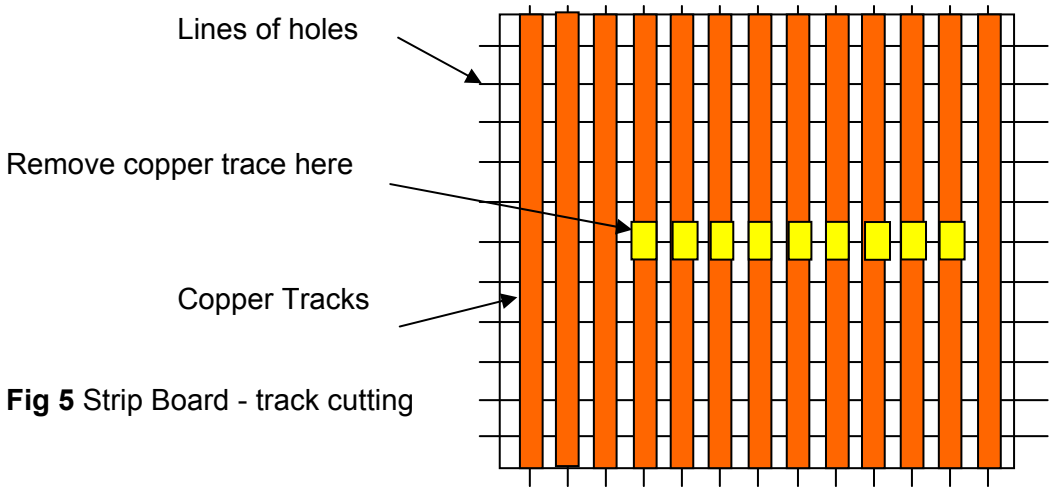

Fig 5 Strip Board - track cutting

Having cut the tracks you will now need to fit the components, as shown fitted in Fig 6.

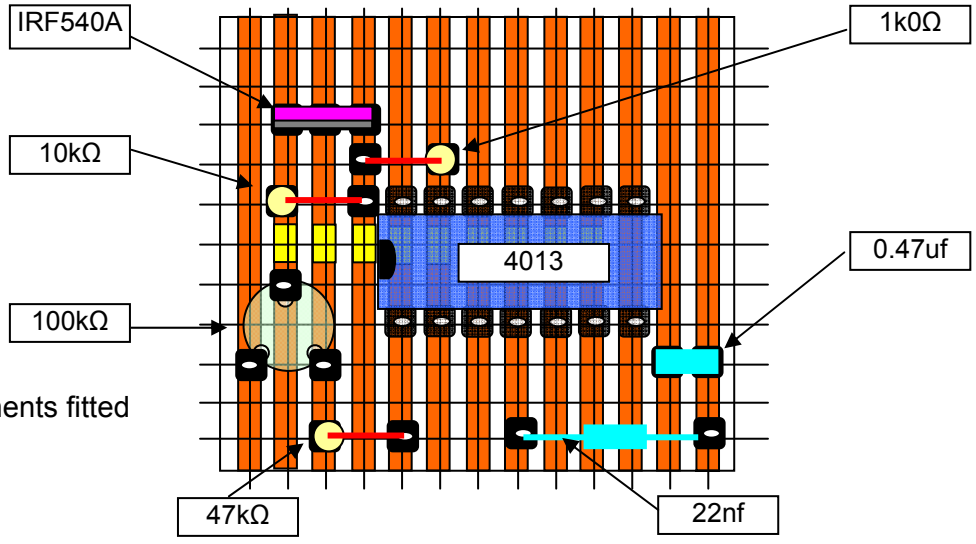

Fig 6 Components fitted

Place the leads of the component legs through the holes in the strip board so that they poke through to the copper side of the PCB and solder the legs into position on the copper strips.

For the resistors and capacitor bend the leads to suit the strip board hole spacing. A picture of a finished assembly can be seen in Fig 9.

Now add all the wire links (**green lines**) shown in Fig 7. This may be done using some very thin Tin Copper wire. If you have not got any, try stripping the insulation from some 7/0.2 equipment wire, this will do just fine. Insulate the link wires across the IC pins from the copper tracks that they cross by placing some insulating tape or masking tape over the tracks prior to fitting the links

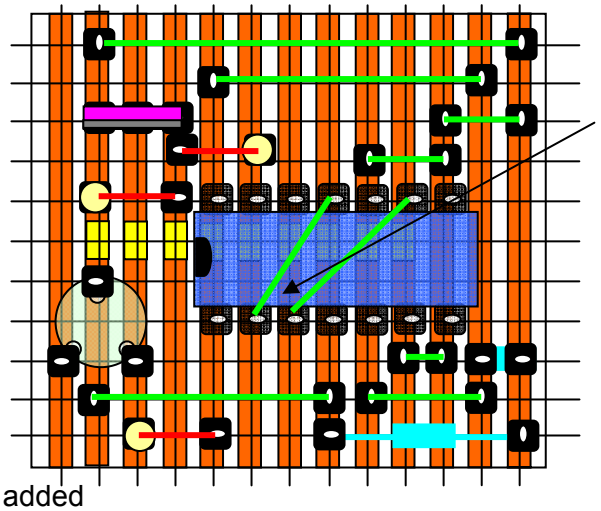

Fig 7 Wire Links added

Now you have added the wire links you are almost ready to test the device. But, first you will need to add an input cable that can plug it into your receiver and some form of output indicator in order to verify that the unit is switching correctly.

Connect the three wires from the receiver input cable to the +5 volt supply, receiver input and earth. Now fit an LED and 470Ω resistor across the output as shown in Fig 8, so that the switch and unit being switched are running from the receiver 5 volt supply.

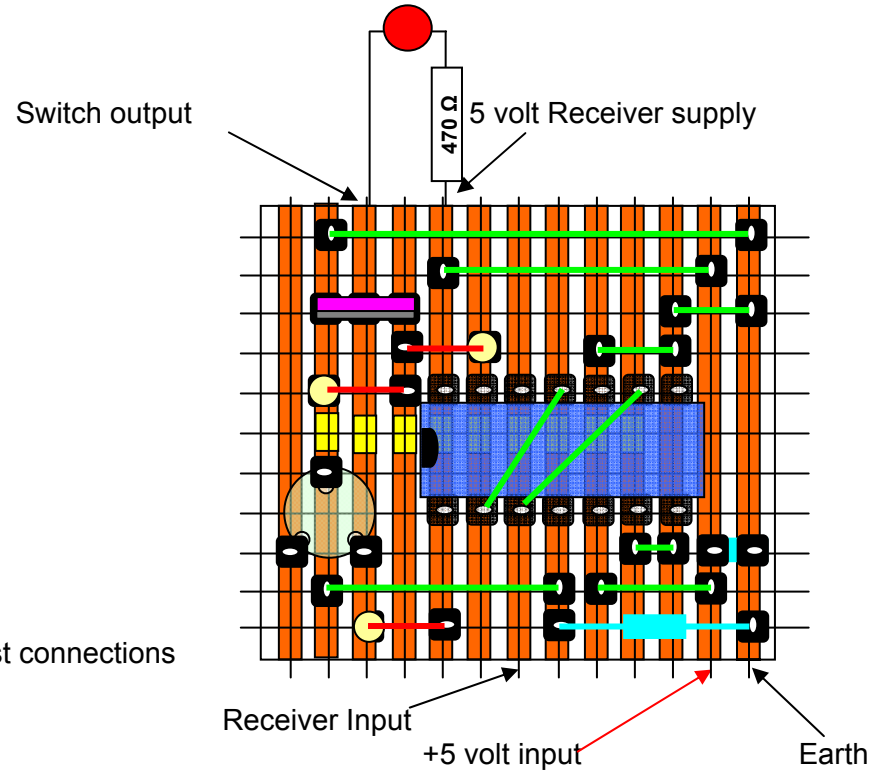

Fig 8 Test connections

Test and Set-Up

Now you are ready to test the assembly. Connect the servo lead to one of the receiver outputs. Adjust the potentiometer to somewhere in the middle and set the transmitter control to the point where you wish the Switch to turn ON. Now adjust the potentiometer on the switch to the point the where the LED is illuminated. If it does, your unit is functioning correctly and you can play with whatever other setup you have in mind.

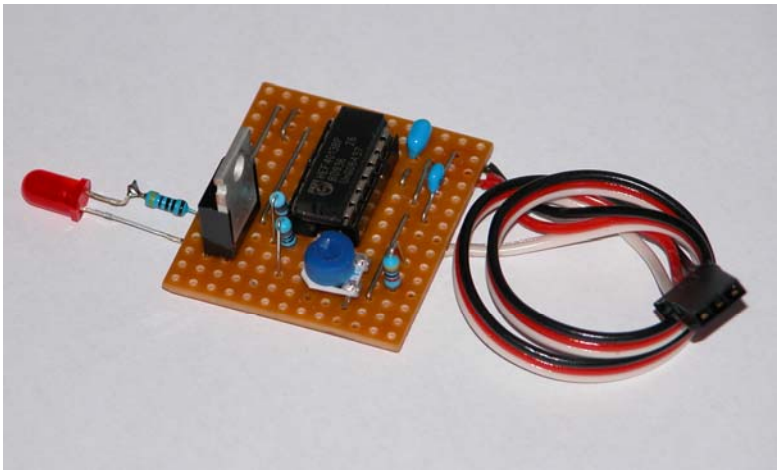

Fig 9 A competed switch assembly

Should you wish to switch an item which runs from a higher voltage, first ensure that the negative of the higher voltage is common to the negative of the Receiver supply. Then connect the item to be switched between the positive of the higher voltage and the Switch output.

Should you wish to switch a number of voltages or connections at the same time then use the electronic switch to drive a relay, then utilise the relay contacts to do your switching, an example of such a system is shown as in part two of this article.

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PART TWO – SINGLE ELECTRONIC RC SWITCH WITH RELAY OUTPUT

For the Club Boat 'Phoenix' there was a requirement to switch two voltages to control the mister that was used to generate the imitation smoke (24 volts for the mister and 3.5 volts for the fan) to do this an electronic switch was designed which operated a relay to provide two sets of switched contacts, the circuit diagram is shown in Fig 10.

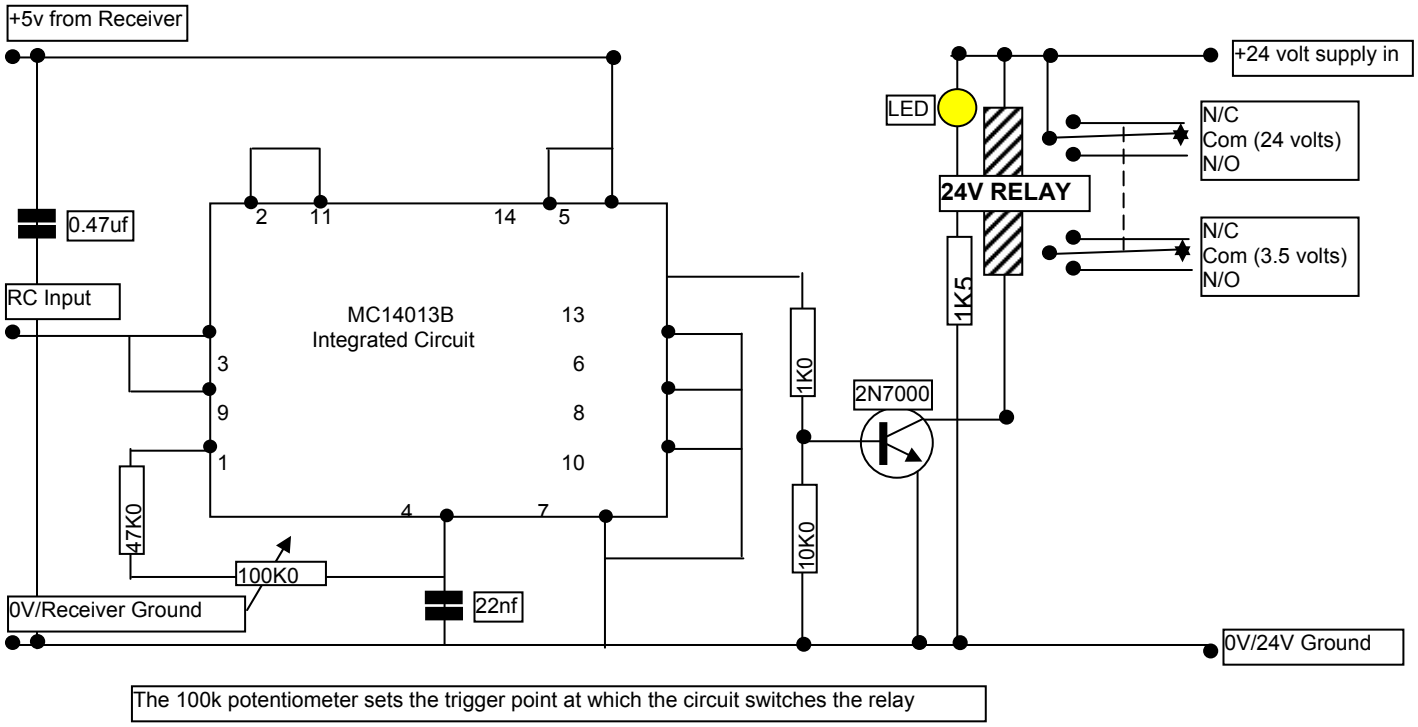

Fig 10 Circuit diagram of the electronic switch with relay output.

A printed board was created to accommodate the relay and wire connection points. This layout is shown in Fig 11 and the printed board master is shown in Fig 12.

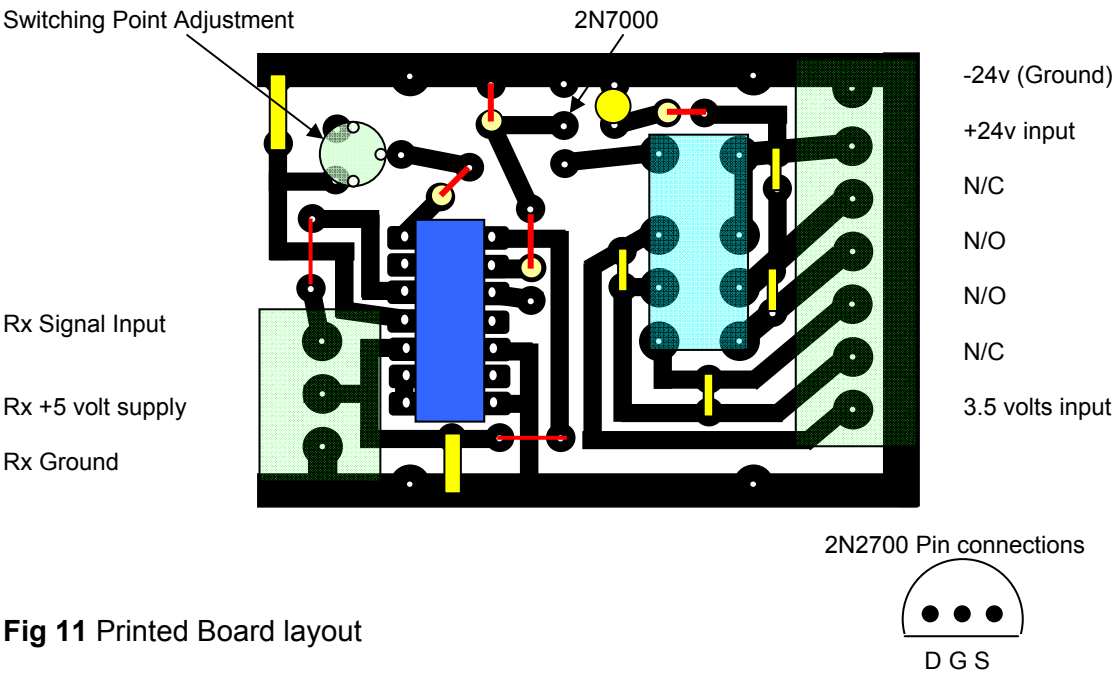

Fig 11 Printed Board layout

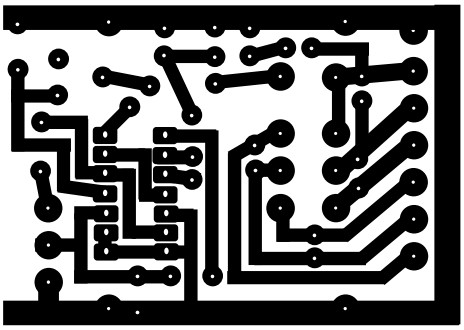

Fig 12 Printed Board Master (actual size 42 x 60mm)

As 24 volts was required to operate the 'Mister' I used a 24 volt relay to do the switching, as I had some that where surplus to requirements, however, any relay that will operate on a voltage that is available within the vessel will be satisfactory. It will be noted also that this circuit uses a 2N2700 switching transistor on the output, as the relay does not require such a high switching current. All the other functions are the same as for the non-relay circuit shown in Fig 1. A picture of the completed switch is shown in Fig 13 and a list of materials for the relay version is given in appendix B.

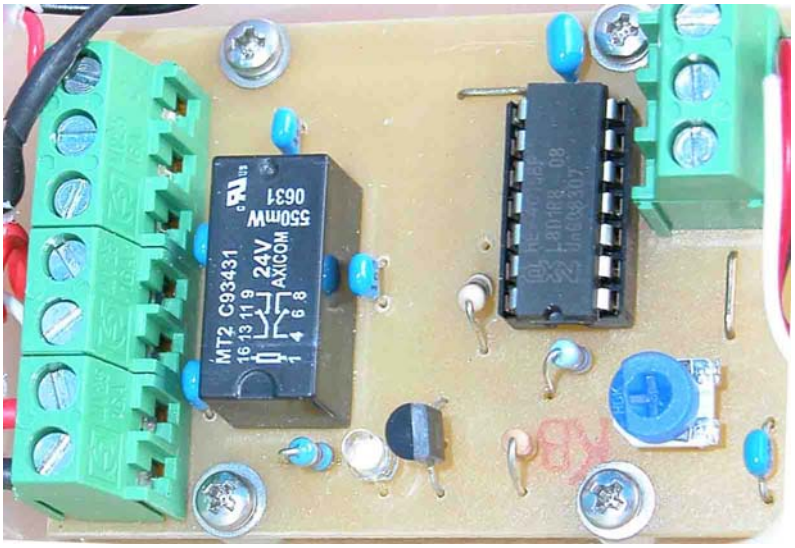

Fig 13 Completed Electronic Switch with Relay Output

I have not provided a Strip board layout for this circuit, but if anyone requires one I will be happy to provide some assistance in order to create the necessary layout.

This now concludes the article on electronic switches. I trust that the information has been clear, informative, not too difficult to understand and will be of some use. Should you wish any further information please do not hesitate to contact me at one of the monthly Club meetings, I attend most of them.

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APPENDIX A - Component List for Single Electronic Switch

Description	Qty Reqd	Maplin Part No.	
Integrated Circuit 4013	1	QX07H	
14 pin DIL Holder	1	BL18U	Not essential
Transistor IRF540A	1	N10AH	
100k Potentiometer	1	WR44X	
1k0 Resistor	1	M1k0	
10k0 Resistor	1	M10k0	
47k0 Resistor	1	M47k0	
22nf Capacitor	1	RA45Y	
0.47uf Capacitor	1	RA52G	
Matrix/Strip Board	1	N95CF	Enough to make 8 switches

APPENDIX A - Component List for Single Relay Type Electronic Switch

Description	Qty Reqd	Maplin Part No.	RS Part No.
Integrated Circuit 4013	1	QX07H	
14 pin DIL Holder	1	BL18U	Not essential
Transistor 2N2700	1	UF89W	
100k Potentiometer	1	WR44X	
1k0 Resistor	1	M1k0	
10k0 Resistor	1	M10k0	
47k0 Resistor	1	M47k0	
22nf Capacitor	1	RA45Y	
0.47uf Capacitor	1	RA52G	
Relay 24 volt	1		619-3091