HOW THINGS WORK - RELAY SWITCHES

We've found after a couple of years of running ACTion that there is a lot of confusion about how our gizmos operate and what you need to know to get them to do what you want.
Firstly, you don't have to understand electronics! Have you a TV set at home? Yes? Do you know exactly how the pictures and sounds are produced in that inscrutable black box? No; of course you don't unless it's your *job* to know. You do, however, know how to plug it in; turn it on and change the channels.
It's the same with our units; we've done all the clever stuff for you. All you need to do is follow the wiring diagram and instructions and, with a modicum of common sense, everything will do what it says on the tin. Don't forget that every single unit is tested before it is despatched so if doesn't work then it's probably YOU doing something daft with it.
Having said that, a bit of background always helps you to work out whether a device is appropriate or not for the job you have in mind, so I shall write a few notes about the various types of units which we produce.

Let's start with a very simple device; the relay switch. There are three types in our lists; the non-latching type, (P43); the latching type (P62) and the type which can be either latching or non-latching (P44). I'll explain these two terms in a while. There are also a few others such as P69 and P91, but these don't have relays and are a bit more difficult to understand.

A relay is an electro-mechanical gubbins which uses a small electrical current to turn on a much larger one. I don't know what car makers use these days, but car starter-motors were once always fired up from the ignition switch via a relay. This meant that you didn't need big thick, high-current cables running up inside the passenger compartment to a heavy-duty ignition switch. The circuits for flashing direction-indicators and intermittent screen wipers also have relays fitted to them (you can often hear the relays under the dashboard 'clicking' when the indicators and wipers are switched on).

A relay comprises of a wire-wound coil which turns into a magnet when Direct Current is passed through it. This is called an electromagnet. In our ACTion relay switches, this current comes from the receiver via the red and black wires in the connection lead from the R/C switch to the receiver. When you move the transmitter stick, there is a corresponding signal generated inside the receiver which passes down the white (or yellow) wire into the microprocessor of the switch. This is a small computer and you have no need to know *how* it works! What it does is to sense that signal and - when it gets to a certain value (the "switching point") - it sends a very small but steady current through the little black switching transistor. This in turn allows a bigger current to pass from the receiver battery, via the red and black wires, through the coil of the relay and magnetises it. (That's the 'clever' bit dealt with now.)
Fig #1 shows the layout of P43 and where these various bits and pieces are to be found. OK so far?
The electromagnet acts on a thin-metal sprung contact and pulls it towards the centre of the coil, against the power of the spring See Figs #2-4. Naturally, as soon as the current through the relay coil is switched off by the little transistor then it stops being a magnet, and that contact springs back to its resting position.

If we connect the sprung contact to one terminal of a battery and arrange for it to touch another contact inside the relay when the coil is actuated then we have a means of switching an external load (e.g. a light bulb). This load is connected in the circuit from the battery positive terminal via the relay contacts back to the battery negative. Note that this battery is entirely independent of the receiver battery so, within certain limits, you can use pretty much any voltage battery you wish for this external circuit.

The conventional terms for these contacts are Common - which is the one connected to the battery - and Normally Open, which is the one which the Common touches when the coil is energised. There is another contact, called Normally Closed, which is in contact with the Common when the coil is *not* energised. You can see that the actuation of the coil changes the switched path from the N/C contact to the N/O one; for this reason such a relay is called a Changeover (or "Double-throw") relay. The flow of current is shown in red in Figs #2-4. This 'changeover' facility would be used if you wanted to change the flow of current from one circuit to another when the relay is switched e.g. from standing lights to running lights. Normally, though, you would only be using the Common and Normally Open contacts to make a simple ON/OFF switch in the circuit.

NOW …… "*To latch or not to latch; that is the question*"

A good example of a non-latching switch is a bell-push. At rest, no current flows from the battery through the bell sounder until you put your thumb on the button and push it, to 'make' the circuit. As long as you keep your thumb there then the bell will continue to ring. When you remove your thumb, the circuit is broken and the bell stops ringing. Similarly, P43 is actuated from rest (Fig #2) by moving the corresponding stick on the transmitter to one end of its travel and holding it there - Fig #3. When you release the stick then the relay is switched off and current stops flowing - Fig #4. This is most useful for switching items which you only want ON for a short time e.g. a steam whistle or fog-horn. P43 has a moveable link which allows you to change over the switching point from one end of the stick movement to the other (or you can use the servo reverse switch on that

channel to do the same thing). If you connect P43 to a channel which is controlled by a simple two-way switch on your transmitter then moving that switch from one position to the other has the same effect as pushing the bell button and holding it down. In other words, you *can* use this type of channel to operate P43 as a latching switch. You cannot operate any other ACTion switch with this type of channel, however.

P62 is a latching switch; to be exact, it's actually *four* latching switches, but they all work in the same way. If you look at Fig #5 you'll see the latching switch is the same as the non-latching switch when at rest i.e. the COM contact touches the N/C. Similarly, when you move the transmitter stick to turn the relay ON then the COM moves from the N/C contact to the N/O one and a circuit is made - Fig #6. HOWEVER, when you let go of the stick the relay stays ON and the current continues to flow through the external circuit - Fig #7. To turn OFF that circuit you have to move the transmitter stick again and then release it - Figs #8 & 9. In P62 this second movement is in the *opposite* direction to the first, so you move the stick to the right to turn on a circuit and to the left to turn it off. A similar analogy to the bell-push one above would be a light switch; it takes one action to turn it on and another one to turn it off again. P62 can be used to switch up to four different external circuits if you wish. As each relay is independent of the others then you can even use four different batteries e.g. a 12v deck lighting circuit plus a 6v mast light circuit plus a 3v spotlight circuit plus a 1.5v radar motor circuit.

P44 has only two separate relays *but*, by moving the two little white dual in-line (DIL) switches, you can select to use either of them as latching or non-latching i.e. you can have two latching or two non-latching or one of each. Again, these need not use the same external battery. This is really useful where, for example, you wish to have lights and a horn-sound operated from the same transmitter stick. Push it one way to latch the lighting circuit (and the same way again to turn the lights off), and the opposite way to sound the horn (which stops when you let go).

The other switches in the ACTion range work on the principle that you can use a semiconductor device such as a transistor to act very much like a relay. In P69 these are small transistors, and so the unit is limited to switching small currents of the order of 250mA (or three Grain of Wheat bulbs) per circuit. However, P91 and P93 have very high-capacity semiconductors called MOSFETs to switch much higher currents. For those who really like to suffer, this stands for Metal Oxide Semiconductor Field Effect Transistor. These act a bit like a relay in as much as you can use them to switch a very high current between two of their connections by passing a much smaller current between one of these connections and a third one. They can also be made to switch these high currents on and off very*, very* quickly - which makes them ideal candidates for use as the basis of the next item on the list for discussion - Electronic Speed Controllers.

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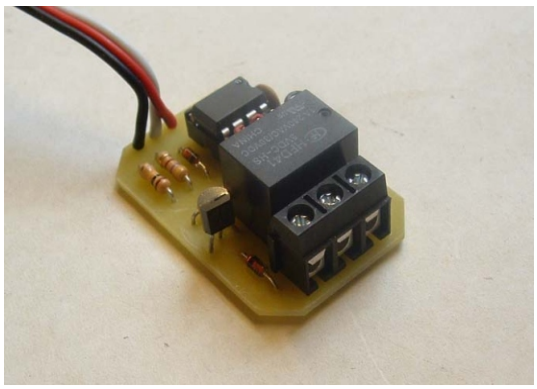
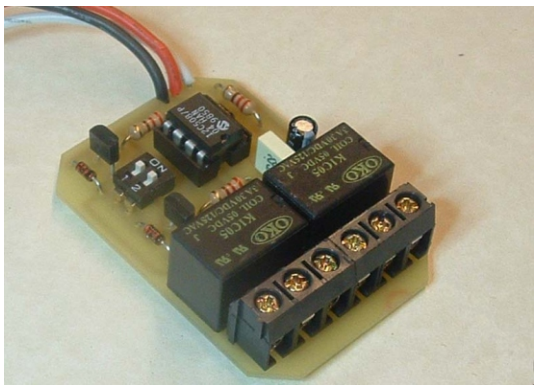
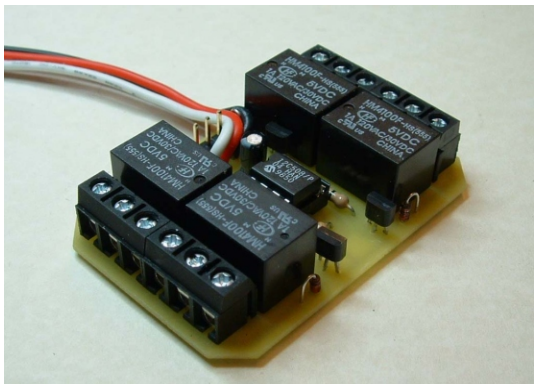


P43 Single Relay Switch

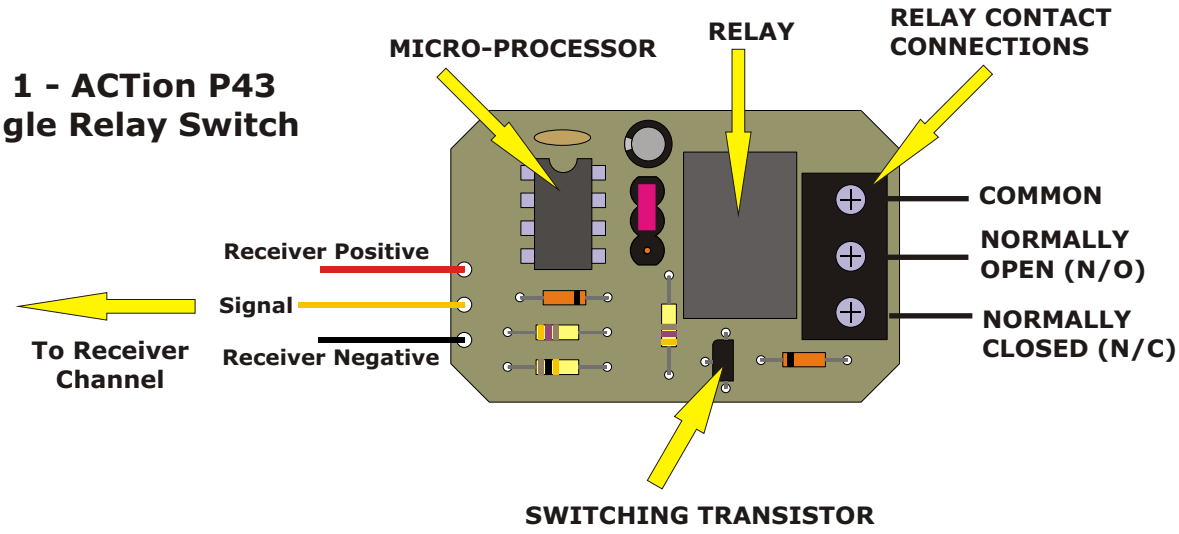


P44 Twin Relay Switch



P62 Quadswitch

Fig 1 - ACTion P43 Single Relay Switch



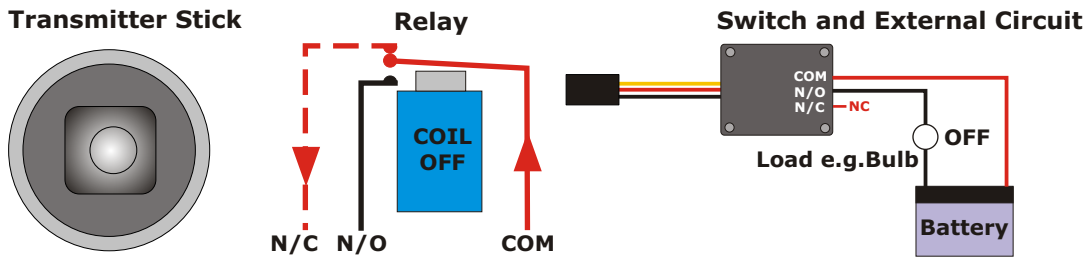


Fig 2 - Stick centred

(Path of current shown in RED)

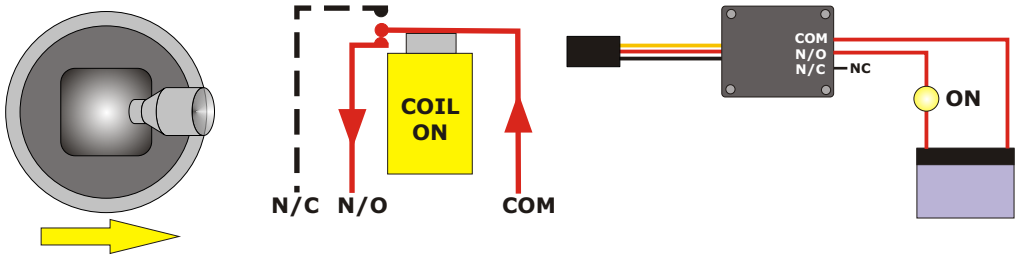


Fig 3 - Stick moved to end

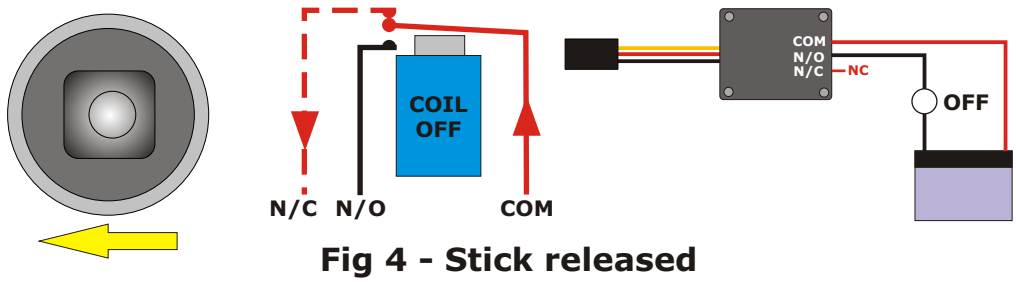


Fig 4 - Stick released

Figs 2 - 4 - Operation of Non-Latching Relay Switch

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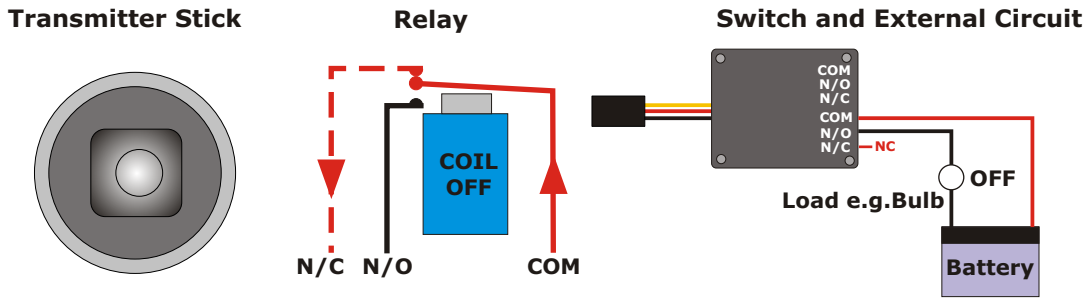

Fig 5 - Stick centred

(Path of current shown in RED)

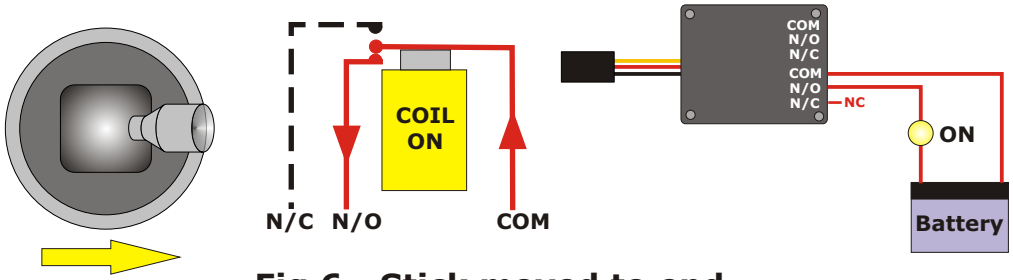

Fig 6 - Stick moved to end

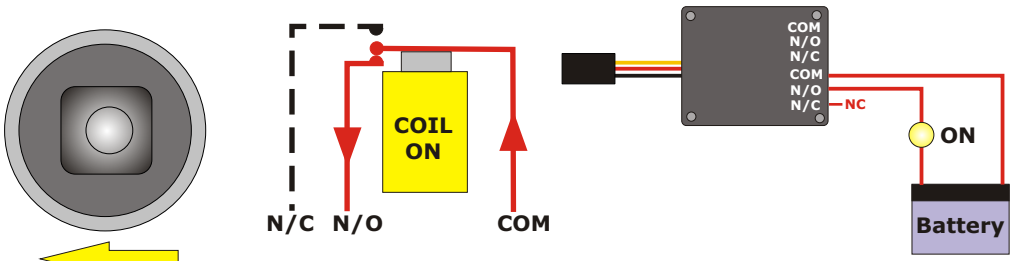

Fig 7 - Stick released

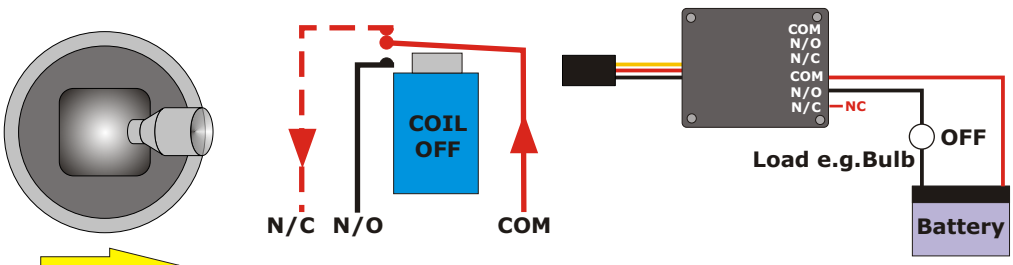

Fig 8 - Stick moved to end*

***Note: For P62, stick is moved in *opposite* directions to turn relays ON and OFF**

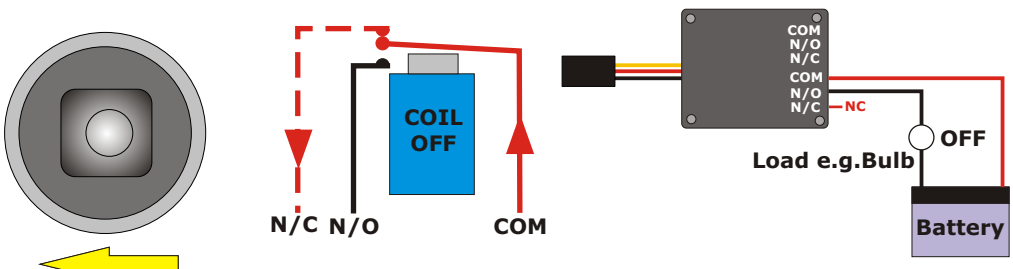

Fig 9 - Stick released

Figs 5 - 9 - Operation of Latching Relay Switch

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