# P94L

## DUAL ESC/MIXER MULTI CONTROLLER

**Type: Dual ESC and Mixer Module. Equivalent to two fully operational ESCs and a mixer, all in the same case. Will suit most types of DC brushed motor used in model boats, including 7+ pole types.**

**No of channels required:** **2**

**Motor voltage:** **6v to 24v**

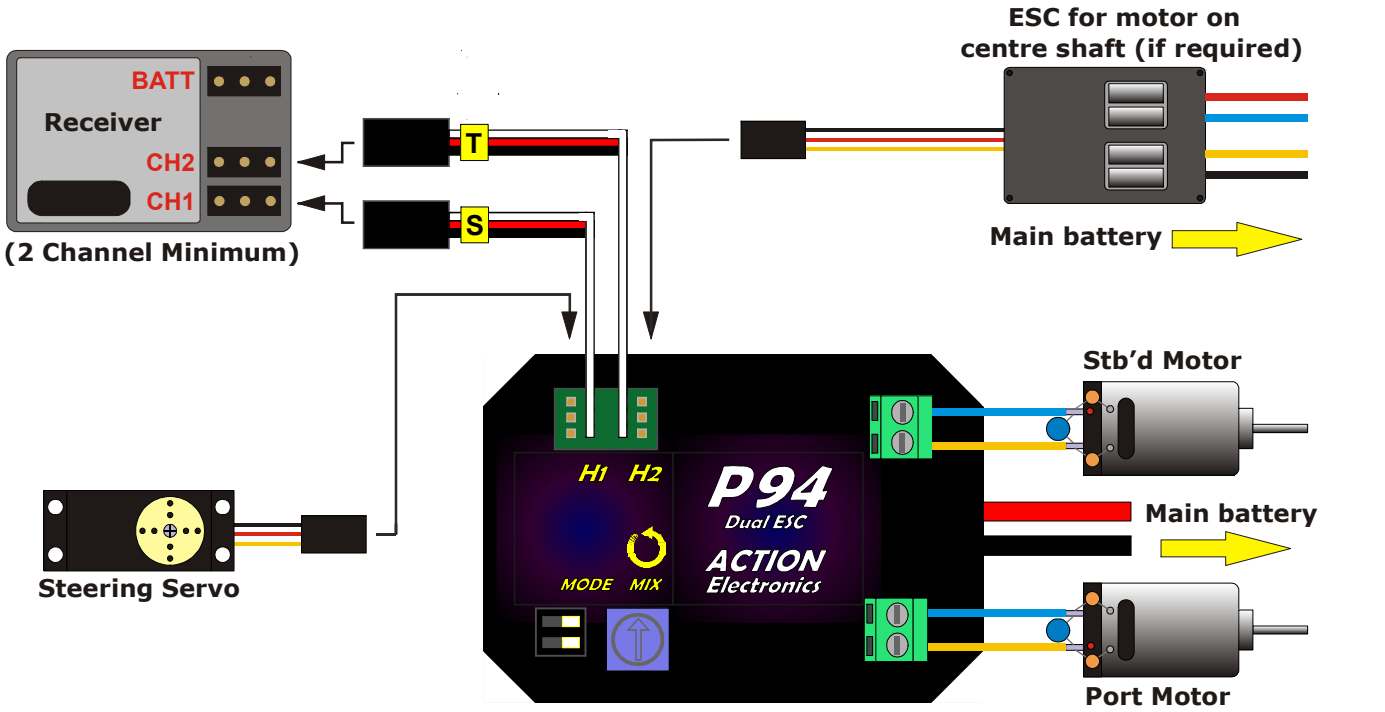
**Maximum continuous current rating:** **10A per ESC**

**Modes: 4 different modes of operation, selectable by user via on-board 2-way DIL switches:**

**Mode 1: Dual electronic speed controllers - Each ESC works from a separate channel i.e. "Tank Steering";**
**Mode 2: Dual thruster mode - Controls bow and stern thrusters. Skipper selects either Traverse (where thrusters work in the same direction and slew the model sideways) or Spin (where the thrusters work in opposite directions and spin the model on its own axis). Selection is done by "blipping" the rudder stick hard over and letting it go straight away. Both thrusters are also fully speed-controlled.**
**Mode 3: 0% - 100% Mixer. As Mode 4, except that inboard motor can be made to spin at full speed in reverse sense on full rudder command i.e. you can spin the model on its axis.**
**Mode 4: 0% - 50% Mixer. Applies differential speed control to the motors automatically as a rudder command is give. Adjustable from 0%, where there is no mixing of rudder and throttle signals, up to 50%, where the inboard motor just stops at full rudder command.**

**Other facilities:**

| | |
|---|---|
| **Battery Eliminator (BEC)** | **Built in 5V 2A (3A peak) battery eliminator** |
| **Autoset** | **P94L automatically sets neutral position of throttle & steering on powering up i.e. No "binding" or other setting up to do** |
| **Failsafe** | **ESCs shut down motors on loss of signal.** |
| **Central Motor & Rudder connections** | **3-pin headers provided for connecting the steering servo and a separate speed controller to operate a centre motor.** |
| **Adjustable thruster output** | **Allows the operation of commercial thrusters from higher-voltage main batteries.** |




## SCHEMATIC OF INSTALLATION IN TWIN-ENGINED MODEL

# P94L

## Dual ESC/Mixer Multi-controller

## Installing the P94

Because of the high power of the P94L Multi-controller, care should be paid to the installation of the unit. Each ESC circuit can deliver 10A continuously and the wiring installation should be designed with that in mind.

Fig #4 shows a basic installation. The length of all wires should be kept to an absolute minimum, but not to the extent that they are tight, a small amount of slack will reduce the risk of them coming loose in use.

The fuse must be sized to be as small as possible without causing nuisance tripping. A 25A fuse (maximum) should be used to protect the unit.

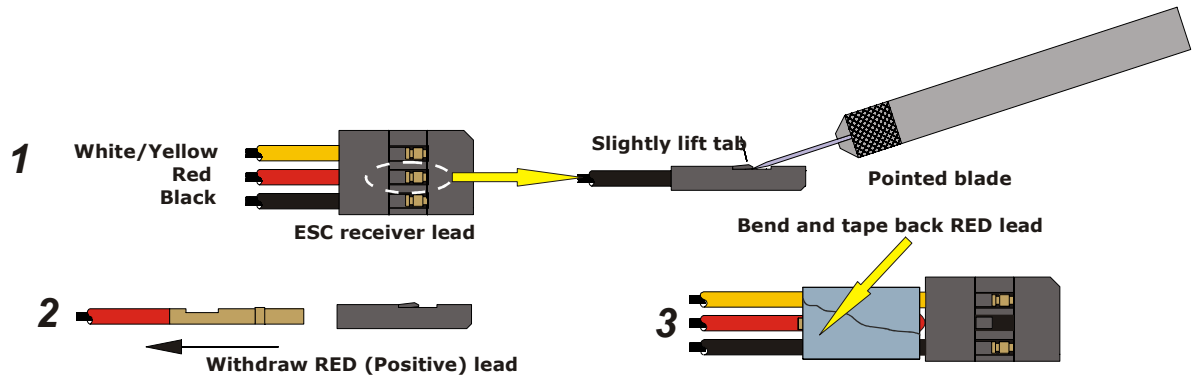
If more than one battery is being used for the installation, they should be connected in parallel. This is best done by using a P103 Parallel Power Board. This will handle up to 15v @ 20A and prevents any possibility of one battery discharging into the other and causing damage or even fire to the wiring. See Fig #6. If you are using >15v then first connect the two battery positive terminals together and the two battery negative terminals together and then connect each of the joined pairs to the P92 etc.

When connecting the motors, suitably rated cable must be used and the lengths kept as short as possible. We recommend multi-strand cable of at least $2mm^2$ (16AWG). The wiring of the two motor connections is reversed with respect to each other, so that they rotate in opposite directions when ahead or astern commands are given. It is also recommended that the outputs from the ESCs are individually fused. P95 is ideal for this purpose; See Figs #1 & #2. Each fuse must be no more than 10A.

Terminal block TB1 is used for one motor or the bow thruster, and TB2 is used for the other motor or the stern thrusters (depending on the operating mode).

When connecting the receiver to other servos or speed controllers there are two "straight-through" connections on the P94L in the form of 3-pin headers. See the Schematic Drawing on the Front Page of this manual. These eliminate the need for Y-leads from the receiver outputs. H1 would be used conventionally to connect the steering servo, while H2 will supply the throttle signal (unmixed) to a third electronic speed controller e.g. for a central motor. Header pins H2 can also be used to connect a digital engine sound unit to the system e.g. ACTion P110. The sound will then follow the throttle stick input and will not be affected by any degree of mixing.

The latest version of P94L has a switch-mode voltage regulator, or Battery Eliminator Circuit (BEC) fitted. This takes power from the main motor battery/batteries and reduces it to 5v to operate the logic circuit in P94L and to feed the power to the receiver, also @ 5v. ***Unless you want to run the receiver from a seperate battery (or the flylead from P92/P102/P107) then you MUST remove the red wires from the two leads marked T and S.*** If you leave either of them connected then the receiver will be at risk of serious damage due to being "fed" two different voltages at the same time. You can modify the plugs easily like this:






☎ 01248 719353

## Important!

**1. ALWAYS check your wiring before applying power to the circuit for the first time, and ALWAYS turn off ALL power before you make ANY changes to connections or any adjustments to switches etc. If you ignore this rule then you could cause damage to the unit.**
**2. Never work with a live battery in circuit, especially if the unit is out of its case. You risk shorting out the copper tracks on the reverse of the PCB.**
3. Turn on your transmitter before the receiver, and turn off the receiver before turning off the transmitter.
4. Always fit suppressor capacitors to your motors (ACTion can supply a suitable set of components).
5. When setting up Modes 3 and 4, first use the Tx Servo Reverse Switch if necessary so that the steering servo operates the rudder(s) in the correct sense. Once you're satisfied with this, leave this switch alone throughout the rest of the setting-up procedure. If you need to reverse the rotation of either motor then do it by swapping over the two connections from the motor to the ESC terminals. If you find that the "wrong" motor slows down when you apply a steering command then simply swap over the two motors between terminals blocks TB1 and TB2.
6. If your transmitter has any form of inter-channel mixing on the steering and throttle channels, make sure it is switched OFF for the operation of a model fitted with a P94. Also ensure that any servo throw adjustment is set to 100% movement in both directions. See the manual for your radio for further information.

## Modes of operation

As discussed earlier, P94 has four different modes of operation. These are selected with the small 2-way switch which is situated on the circuit board just below the microprocessor chip. Each of the two switches can be either ON or OFF. The unit is supplied in Mode 4 and the Mix control has been set to the optimum position for this mode. **You may need to adjust the rudder trim lever on your Tx slightly to ensure that the two motors start exactly together.** The indicator LEDs of P95/2 are very useful here.

The "Mix" knob controls the 'degree' of mixing. I**f you turn it all the way clockwise then the mixing function in Modes 2-4 will be totally disabled.** The following sections describe the four modes of operation, in conjunction with Figs #6, 7 & 8. Note that the props are shown in outwards contra-rotating configuration when viewed from the rear. If your model uses inward-turning props then set up the P94 as shown and, as a last step, swap the connections between the P94 terminals and the motors to reverse their direction of rotation.

## Mode 1: Dual ESC Mode (See Fig #6) Switch 1 = ON, Switch 2 = ON

In this mode the system operates as two independent ESCs, each rated at 20A. This is frequently referred to as "Tank Steering" as it mimics the controls used by the driver of a tracked vehicle to control its direction and speed. Many boat modellers prefer this 'manual' mode of mixing twin motors, and it is also widely used by builders of large-scale model tanks. In this mode there is no interaction between the two channels, and the Mix control is not used.

## Mode 2: Thruster Mode (See Fig #7) Switch 1 = ON, Switch 2 = OFF

This mode is intended to control combined bow and stern thrusters. The thrusters can be run in the same direction to move the model sideways in the water ("slew"), or in opposite directions to rotate it around its own axis ("spin"). The output from terminal block TB1 is used to drive the bow thruster while TB2 controls the stern thruster. The thruster speed/direction channel is usually the LH Tx stick. Push it to the left for a rotation/slew to Port and to the right for a Starboard rotation/slew.

The RH side-to-side stick is the main steering control for the model and it is also used to switch the thrusters from Spin mode to Slew mode; the stick is "blipped" to the left with the thruster speed/direction control in the neutral position. To switch from Slew to Spin, the stick is blipped to the right. Note that the direction is only changed if the thruster speed control is at neutral (i.e. the thruster motors are not running) and the control is blipped to the limit for less than about 1 second. If it is held over for 1 second or more the direction is not changed. A P95/2 in the circuit will instantly show whether or not the directions have changed by the colour of its LEDs. Practise before you first sail the model! The changeover will only take effect when you apply an amount of thruster speed/direction i.e. it will not be indicated when you blip the Select stick.
The Mix control can be used to set the maximum voltage for the thrusters. This means, for example, that you can safely run 7.2v thruster units from 12v main motor drive batteries without causing them damage; See Fig#3. To set the thruster voltage, turn R7 fully clockwise. Connect a digital volt-meter across the brushes of the bow thruster motor; power the system up and move the thruster control to full speed (in either direction). Hold it there while you adjust the Mix until the meter reads the rated voltage of the thruster. Graupner and Raboesch thrusters units are generally 7.2v while the Robbe ones are generally 6v.

## Mode 3: 100% Mixer (See Fig #8) Switch 1 = OFF, Switch 2 = ON

The 100% Mixer mode is a "W-tail" type mixer. If turning to starboard, the port motor is speeded up and the starboard motor is slowed down. If turning to port the starboard motor is speeded up and the port motor slowed down. This mode allows the motors to reverse direction under the control of the steering

command. The amount by which the motors change speed is controlled by the Mix knob; turn it anti-clockwise to increase the degree of opposite rotation of the inboard motor at full rudder command. Note that if you apply a rudder command *without* any throttle then the motors will go to full speed in forward+reverse; this allows you to spin the model on its axis with no forward speed.

The main throttle output from the receiver connects to P94 lead marked "T" with the steering output connected to lead marked "S". The rudder servo itself should be connected to header pins H1. If the model has a three-motor setup, the ESC to drive the third motor should be connected to header pins H2. Note that both of these connections are made with the Black (negative) wire in the plug onto the outer pins i.e. nearest the edge of the circuit board. **100% mixing is more suited to slow moving vessels that require the maximum degree of manoeuverability e.g. tugs, ferries, fishing vessels and other work-boats.**

## Mode 4: 50% Mixer (See Fig #8) Switch 1 = OFF, Switch 2 = OFF

**The 50% Mixer mode is more complex than the 100% mixing function, and is more suited to faster vessels e.g. fast luxury cruisers, MTBs and modern lifeboats.** In this mode, the outer motor in the turn is not speeded up (unlike the 100% mix). The inner motor is slowed down - the amount by which is determined by the rudder input, but it is not allowed to change direction unless reverse throttle command is given. The sensitivity of the system to the rudder input is set using the Mix control; turn it anti-clockwise to increase the amount of mixing. The connections for Mode 4 are the same as for Mode 3. Note that rudder command with no throttle will NOT start the motors in this mode.

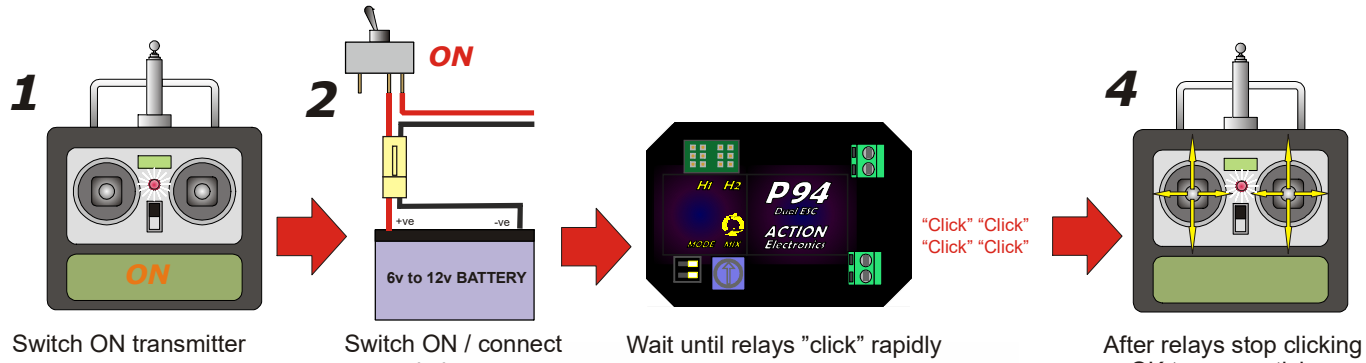
## Autoset operation - Overview

Your P94L is fitted with software which now includes full ACTion 'Autoset'. This means that P94L will automatically detect the positions of the transmitter throttle and rudder sticks when you switch on your system, and then lock onto them as its own neutral positions for that sailing session. The effect of this is that you will not need to adjust the transmitter trim levers (as with earlier versions of P94L) in order to stop the motors at "dead stop" command or to start them together when you apply some throttle. It also allows the user to operate P94 with the cheaper 2.4GHz systems which have non-standard neutral signal values. We strongly recommend the fitting of spring-centring to the throttle stick of your transmitter; your radio dealer can advise on obtaining the requisite parts or you can contact the RC manufacturer's local service agent to have the job done for you.
NB THIS UNIT WILL NOT OPERATE WITH FUTABA 6J OR 2.4ghz SKYSPORT RADIOS. These sets have a different way of transmitting their signals which cannot be read by P94. The older Futaba 6EX 2.4GHz sets and the 40MHz Skysports are both OK.

Since introducing the Autoset software to P94L it has been apparent that the back-EMF caused by the two motors suddenly changing direction can, in some extreme circumstances, cause the power supply to the receiver to momentarily dip below its critical value. While this has no adverse effect on the receiver it does mean that the P94L software "thinks" that the receiver has been switched off and then back on again. It therefore goes through its full Autoset routine all over again. Unless the transmitter sticks are in the same positions as they were when you first switched on then this will change the neutral stick positions and make the model difficult to control.
To avoid this:
Only move the sticks gently and smoothly, especially in Mode 3 where the motors change direction very quickly between neutral and full steering commands. Avoid just letting go of the sticks and allowing them to spring back to neutral, or suddenly applying full throttle in one direction from either neutral or the opposite direction;
If you still have problems then we can supply a DIY-fit microprocessor with non-Autoset software. This simply replaces the plug-in microprocessor already fitted and will be free of charge if you return the original chip afterwards. Illustrated instructions are included to help you do what is a very straightforward job. Contact ACTion for details.

## Autoset operation - Procedure

Follow the procedure shown in the diagrams below. Note that P94L will Autoset every time you switch on the radio; it isn't a one-off "binding" or "setting up" procedure. It is important not to move the transmitter sticks while the autoset is running or the system may not work correctly. After a few seconds - depending on how long your receiver and transmitter take to 'bind' - the relays will click rapidly several times and it is then OK to operate the transmitter as normal. If the model goes out of range then P94L will stop both of the motors, but when the model comes back into range then P94 will resume *with the same neutral positions that it had when you first switched on* i.e. It will NOT autoset again.




Switch ON transmitter

Switch ON / connect main battery

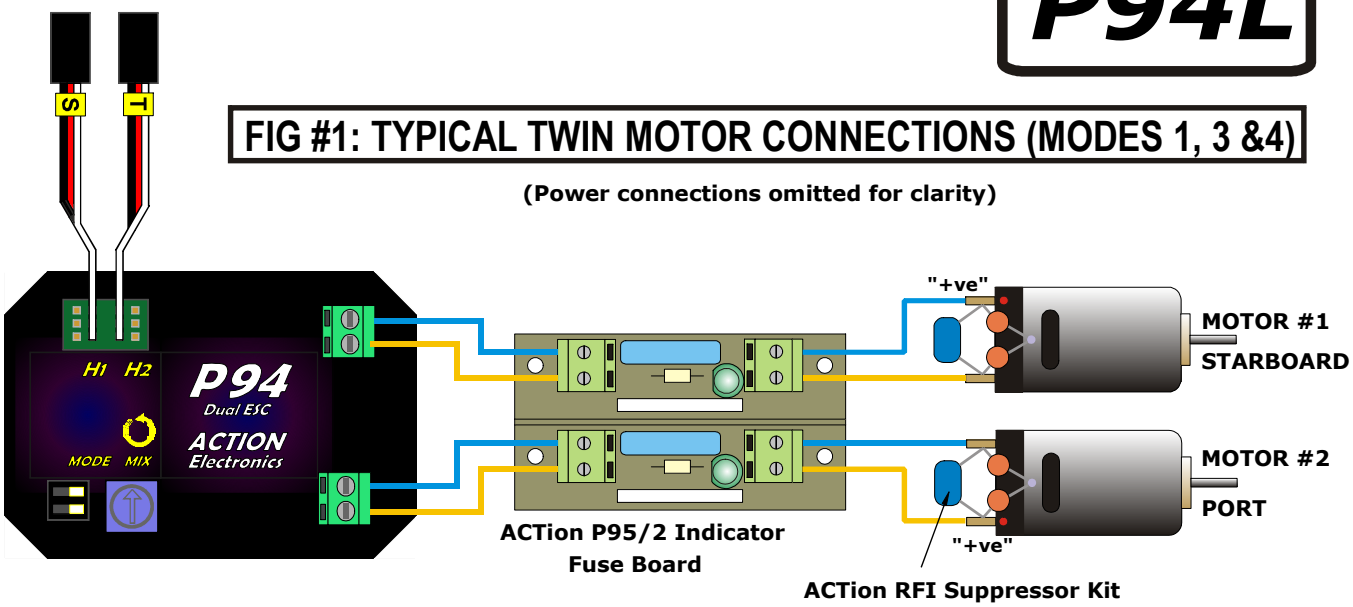
Wait until relays "click" rapidly

After relays stop clicking OK to move sticks

# P94L

## FIG #1: TYPICAL TWIN MOTOR CONNECTIONS (MODES 1, 3 &4)

**(Power connections omitted for clarity)**



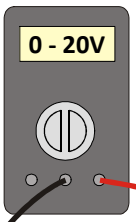

**When connected as shown, the LEDs will both glow the same colour when the main drive motors rotate in opposite direction e.g. At Full Ahead speed.**

**Adjust rudder trim lever of transmitter until the two LEDs "fire up" together when slight forward throttle command is given (does not apply to Mode 1).**

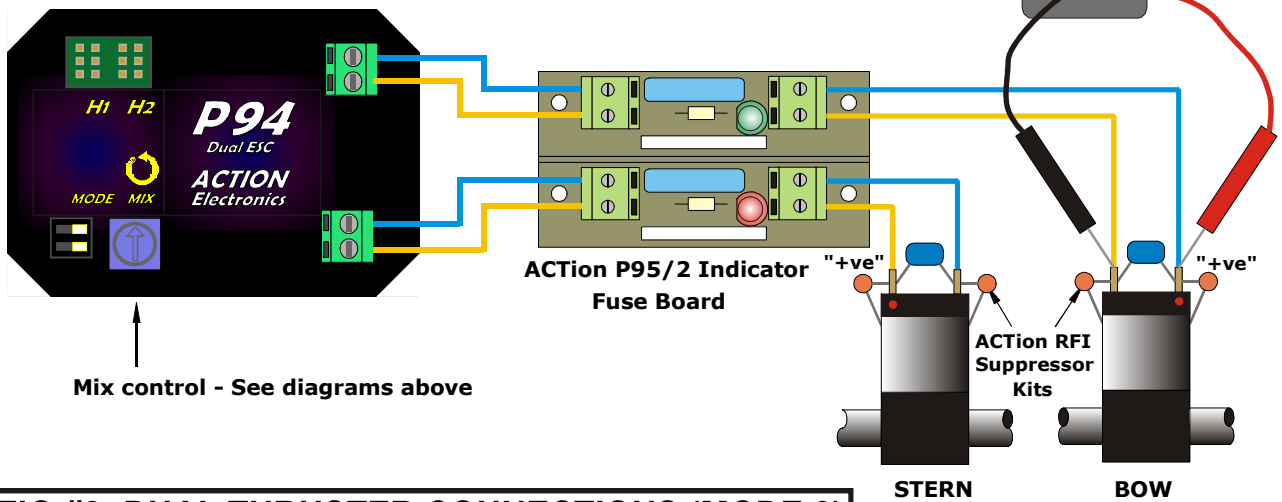
**Start with Mix turned fully clockwise**

**Apply full stick movement to thruster and adjust Mix slowly until Voltage reaches that specified for the thruster e.g. Graupner = 7.2v, Robbe = 6v**

**ADJUSTING Mix control where Main battery voltage is greater than bow thruster voltage.**




**Connect digital multimeter across thruster motor brushes; set scale to read 0v - 20v**




**Mix control - See diagrams above**

## FIG #2: DUAL THRUSTER CONNECTIONS (MODE 2)

**(Power connections omitted for clarity)**

**Commercial thruster units**

***Recovery Service.***
A recovery or repairs service means that you will not be left with a dead unit for any reason.
The cost of this service (as of March 2023) is £19.95 which includes the return shipping costs to any UK address.
Should you need a repair, please contact us before sending your unit & we will explain the steps.
Either contact us by phone, or e-mail to info@component-shop.co.uk

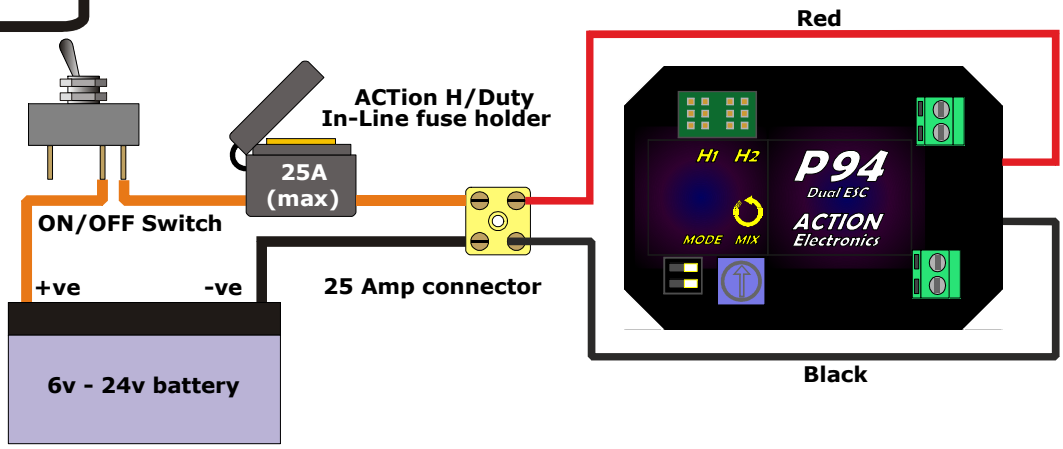


☎ 01248 719353

Original drawing by Dave Milbourn
2023 updates by Iain Lewis

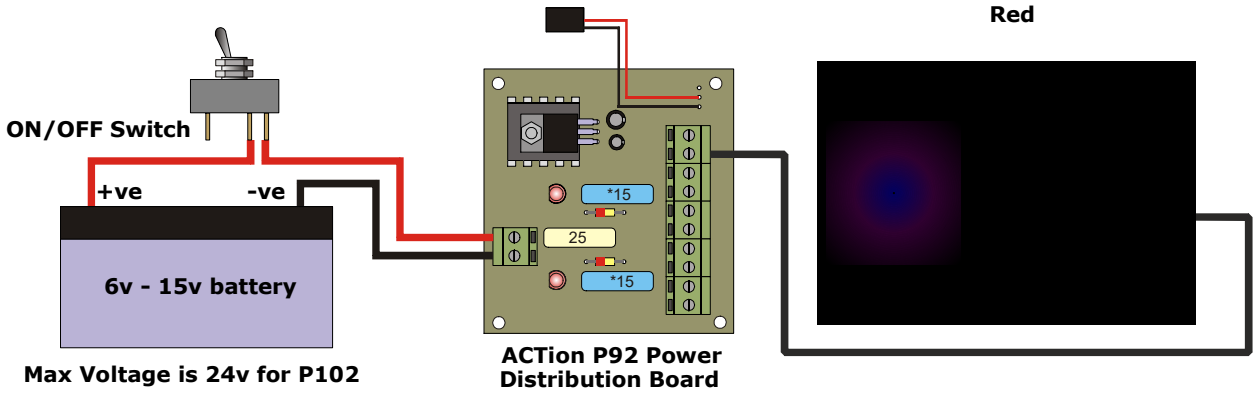
# P94L

Page 2



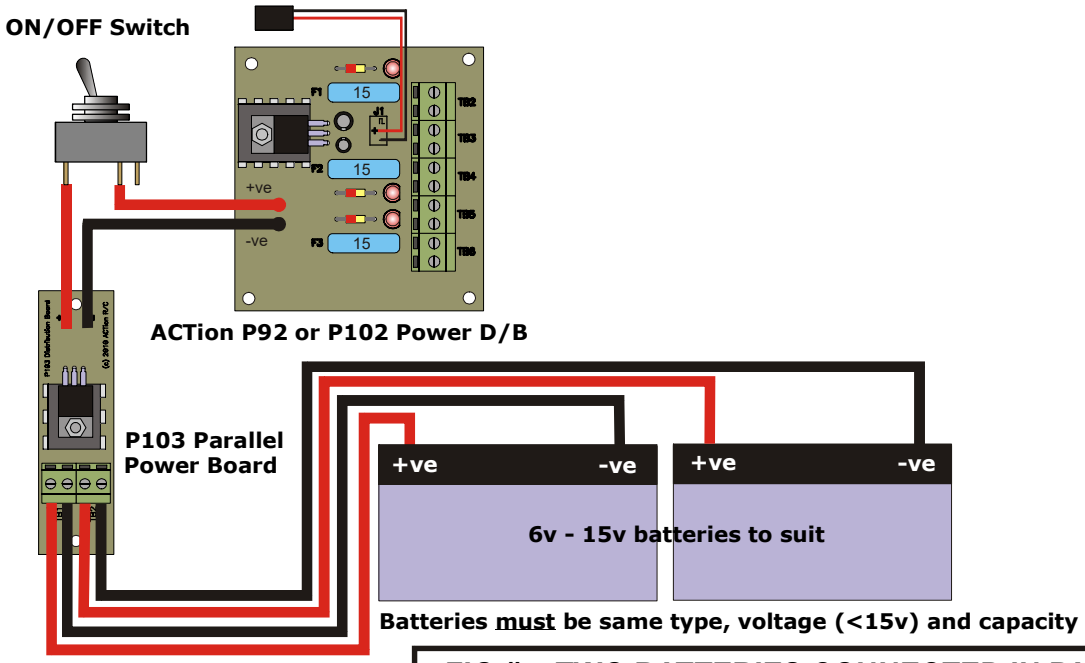

## FIG #3: BASIC INSTALLATION WITH SINGLE BATTERY

(Receiver & motor connections omitted for clarity)




## FIG #4: USING POWER DISTRIBUTION BOARD P92 OR P102

(Receiver & motor connections omitted for clarity)




Batteries must be same type, voltage (<15v) and capacity

## FIG #5: TWO BATTERIES CONNECTED IN PARALLEL

(Receiver & motor connections omitted for clarity)



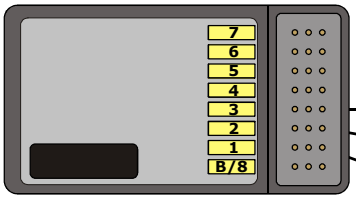
Original drawing by Dave Milbourn
2023 updates by Iain Lewis

☎ 01248 719353

# P94L



**RECEIVER CONNECTIONS FOR MODE 1 (Futaba convention for numbering channels is shown)**

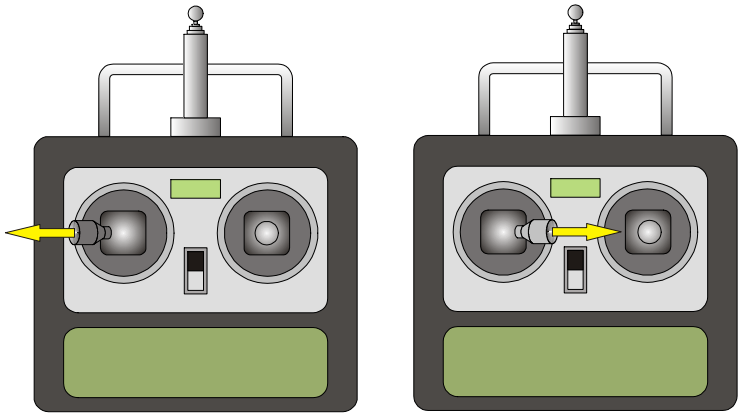



**P94L "T" connection**
**P94L "S" connection**
**Steering Servo**

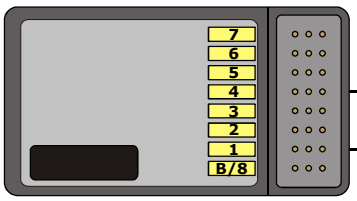
**Steering = RH stick Side/Side**
**Port Throttle = LH stick Up/Down**
**Stb'd Throttle = RH stick Up/Down**




**FIG #6: MODE 1 "TANK STEERING"**

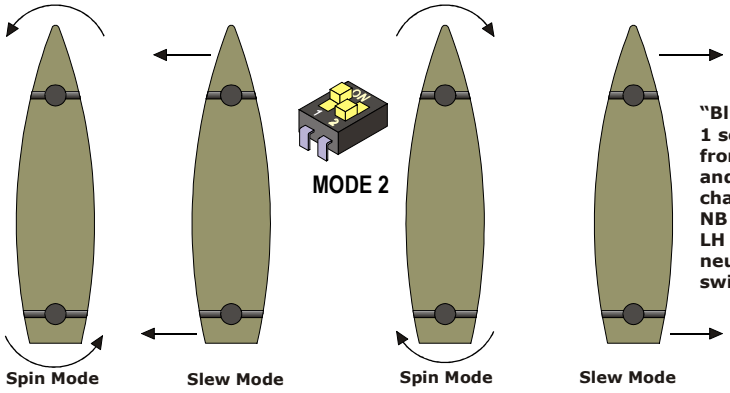


**RECEIVER CONNECTIONS FOR MODE 2 (Futaba convention for numbering channels is shown)**




**P94L "T"**
**P94L "S"**

**Spin/Slew Select = RH stick Side/Side**
**Speed & Direction = LH stick Side/Side**
**Connect Steering Servo to H1 on P94L**




**"Blip" Tx stick to Left < 1 second to change from Spin to Slew mode and to the Right to change back.**
**NB Thruster speed on LH stick MUST be at the neutral position when switching modes.**

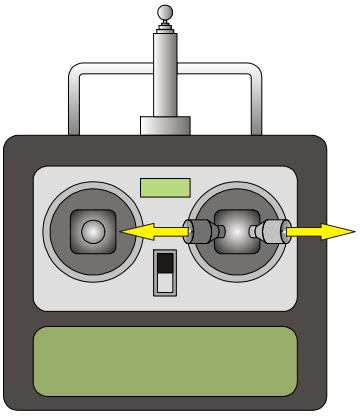


**FIG #7: MODE 2 DUAL THRUSTERS**



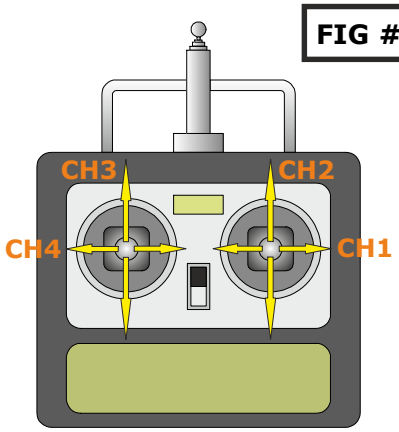
☎ 01248 719353

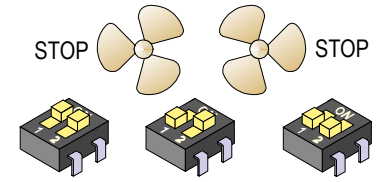
*Original drawing by Dave Milbourn*
*2023 updates by Iain Lewis*

# FIG #8: MODES 3/4; 100% & 50% MIXERS

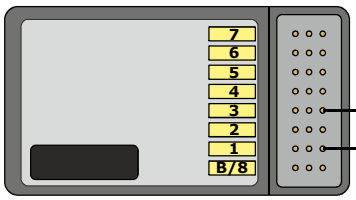
**P94L**



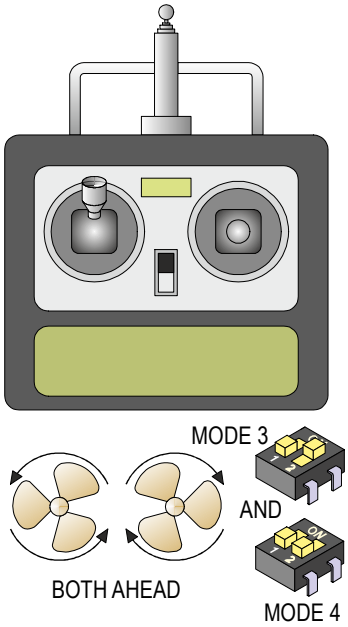


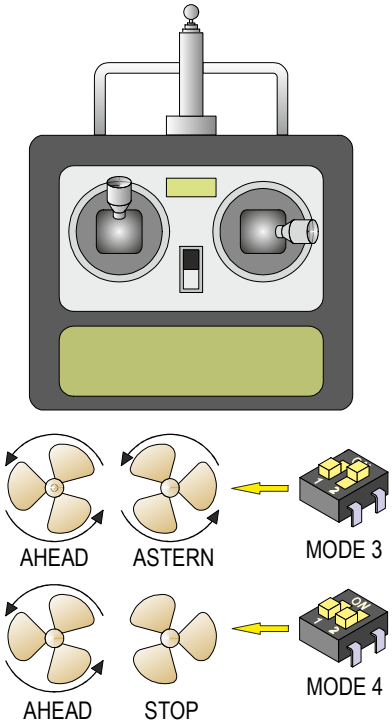



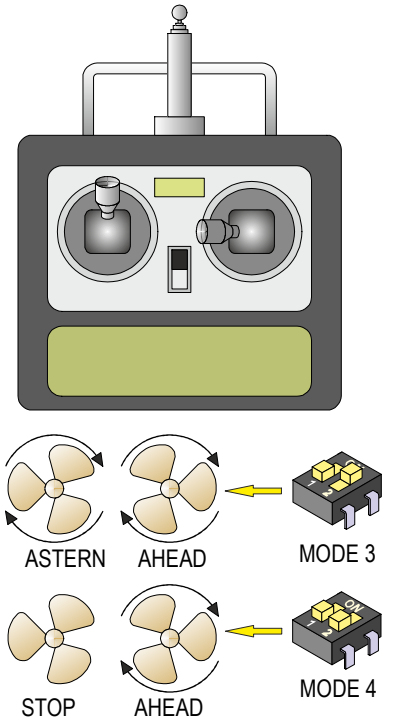

## RECEIVER CONNECTIONS FOR MODES 3 and 4 (Futaba convention for numbering channels is shown)

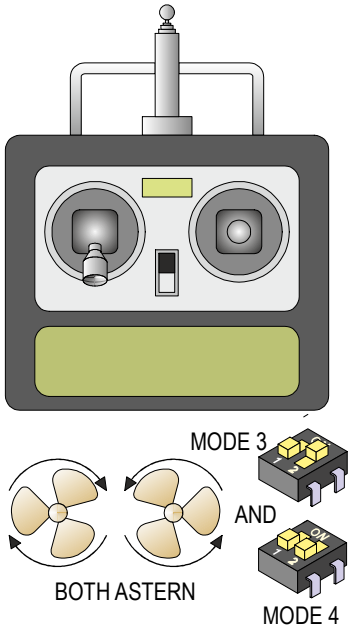


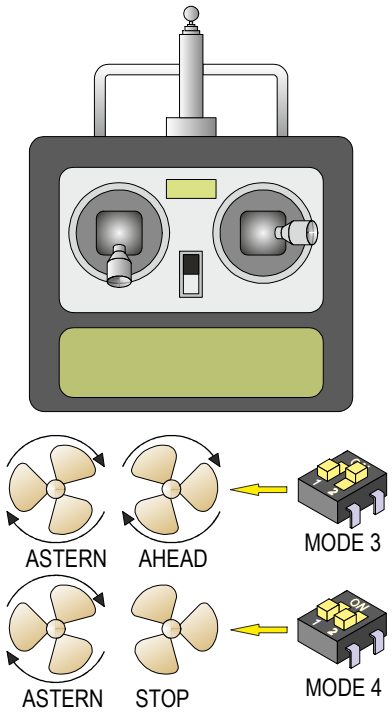

**Steering = RH stick Side/Side**
**Throttle = LH stick Up/Down**

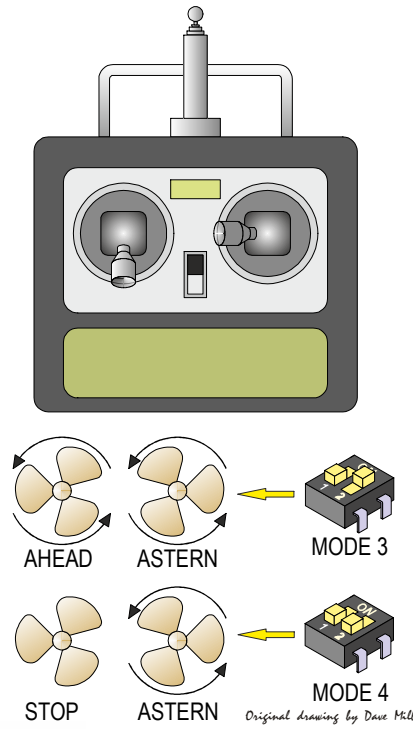



Original drawing by Dave Milbourn
2023 updates by Iain Lewis



☎ 01248 719353