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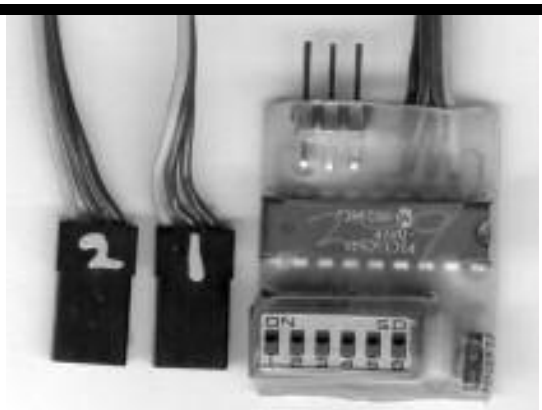
Custom Solutions for a Generic World

Elevon Mixer Mk1.0

Instruction Booklet

PREFACE



These instructions are intended to guide you through the basics of setting up an Elevon or V tail model using a simple two channel radio set and your new mixer.

Some of the information in this manual is of a very general nature and will help with any model building project. Please do take a few minutes to scan through the whole of the instructions, even if you do feel you don't need to. None of us are so clever we can't learn something each day.

SPECIFICATIONS

This bit is included to fill in space more than anything else, but it might make interesting reading.

Function	Two channel in, two channel out "Elevon" mixer.
Size	25 x 8 x 30mm (Not including connectors.)
Weight	8 grams
Working Voltage	3V to 6.00V
Power usage	2ma
Compatibility	Works with all modern 1.5 millisecond neutral pulse radio gear.
Reversing	Both channels independent
"Throw" adjustment	25, 50, 75 and 100% of input, independently adjustable for both channels.
Resolution	5us

Note: Although the operating voltage range for the mixer extends up to 6.00V it is not recommended that this unit be used on 5 Cell Nicad battery packs. The fully charged voltage of a 5 cell pack can be as high as 6.5 to 7 Volts, and could cause permanent damage to the microprocessor in the mixer.

HOW IT WORKS

The mixer takes the two signals from your standard receiver and 'mixes' them to create the signals to control two servos connected to non-conventional surfaces. So if you're building a 'flying wing' model that has elevons instead of ailerons this mixer will take your standard elevator and aileron servo signals and turn them into elevon signals.

In the case of elevons, when you pull back on the elevator stick both elevons move up. When you push forward they both move down. If you push the Aileron stick to the left, the left elevon goes up and the right goes down.

If your model has a V-tail the mixing is very similar except the surfaces are called 'ruddervators' and you are mixing rudder and elevator signals. The example pictures later in the manual are drawings of a "V-tail" glider tail, a some photos of a 'foamie' flying wing.

Without the use of the mixer you would either have to buy a computer transmitter or use a mechanical mixer. The computer radio option is often too expensive and the mechanical mixers can be too large to install in a particular model, and can be quite fiddly to get working just right.

The mixer performs it's task by measuring the signals from your receiver and calculating the positions of the elevons or ruddervators using some simple maths and then sending those signals out to your servos instead of the standard 'un-mixed' signals.

As well as the basic mixing function the mixer allows you to reverse the signals sent to your servos as well as adjust the amount of throw each input creates on the outputs. This ensures that you can use the mixer in a wide variety of models without too much difficulty.

TECHNICAL BITS

This is section is more for the people who have a technical bent with electronics, and to satisfy the never ending thirst for knowledge that some people have. If you are not remotely interested in electronics, skip to the next section about now.

The Mixer uses an Arizona Microchip PIC16C54 micro controller. The particular version is the 16C54A-04/P. The micro runs at 4Mhz, the oscillator locked by a ceramic resonator external to the processor. This processor has 25 bytes of RAM and 512 words of PROM. The processor executes 1 million instructions in a second.

All of the programming and development was done on a PC using a soft emulator and the process of "Crash and burn" using an EEPROM based PIC16C84 processor, and then a PIC16C54JW EPROM device for final code testing before moving to the one shot programmable PROM version of the IC for production.

The mixer uses software loops for all timing, and the resolution of measurement and the output pulses is 5us. The software counts 256 steps at 5us giving a range of +/- 640 us around a centre of 1.5ms.

The total range of input and output pulses is therefore .86ms to 2.14ms which should cover all input scenarios and gives up to 128% of standard servo travel on the output. The software checks for under and over runs on the inputs, and limits travel on the outputs to this value to prevent over-driving the servos.

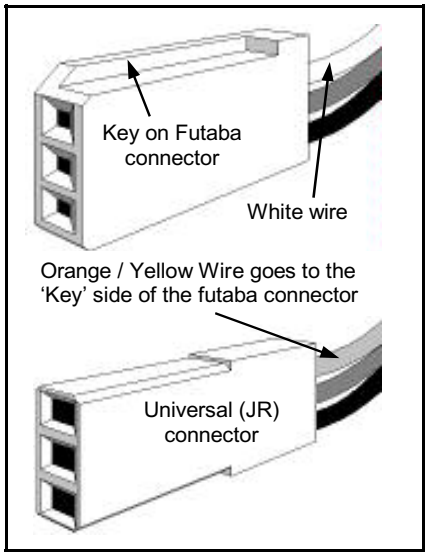
The processor uses an internal RC oscillator based watchdog circuit to ensure software lockups don't occur.

PLUGGING IT IN

There are four simple connections to make to get your mixer to work.

It is a good idea to plug everything in on the bench before you fit the radio to the model, just to get a feeling for how the system connects together, and to decide how you are going to fit it all into your plane.

Before you start, set both the reversing switches on your transmitter to be in the normal direction. Consult your radio gear manual to find out how to do this. Also set the trims to their middle position.



Plug the two input leads into the receiver. The input lead marked "1" goes into the channel one slot on your receiver and the one marked "2" fits into the channel two slot. Normally Channel one is the rudder or ailerons, and channel two is the elevator.

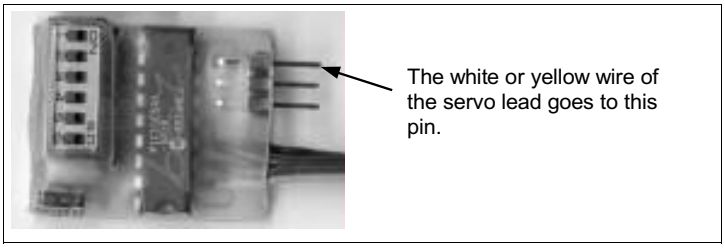
The mixer is fitted with universal connectors, which should fit 99% of modern radio gear without modification. These connectors are in fact 'JR' connectors, which will fit most radio gear, regardless of brand. The exception is Airtronics and Sanwa Gear. You may have purchased a Sanwa version of the mixer for this reason if you use Sanwa or Airtronics radio Equipment.

When plugging the mixer into your receiver, if it is not a JR unit, you will have to be careful about which way you plug the connector in, you cant damage the mixer or receiver by plugging them in backwards, but things wont work.

For Futaba receivers the yellow or orange wire on the mixer input lead should match up with where the 'Key' on the normal Futaba connectors is. For Hitec radio gear the connector is very similar to the normal Hitec ones and should not pose any problems.

Because the mixer allows you to reverse the outputs individually you can connect your servos to either output connector, and then set the mixer switches, and the switches on your transmitter, to get things moving in the right direction.

When you plug your servos into the mixer the white or yellow wire on the servo lead goes to the outside edge of the mixer. Plugging a servo in backwards will not harm the servo or mixer, it will simply not work. On Futaba servos the white wire corresponds with the 'key' on the connector. (See diagram). On most brands of servo the lead is the lightest colour, white, yellow and orange are the most common colours.



There is no need for a separate power connector for the mixer as it's power comes from the receiver and uses only a very small amount of battery power.

Try not to connect or disconnect any of the plugs in your radio gear while the power is on, including the mixer, as there is always a small chance that something could 'glitch' and cause damage to the servos or receiver.

Take care when connecting and disconnecting servo or radio gear leads that you don't pull on the cable, always try and take a good grip on the plastic body of the connector. The last thing you want is a damaged radio lead causing your new model to crash.

INSTALLING YOUR SERVOS

When you install the servos for an elevon or ruddervator controlled model you should treat the two servos and control surfaces as if they were a normal elevator or rudder. There is no special consideration needed for your linkages or servo placement.

Generally you should "Dry Fit" your radio gear, including the batteries and receiver, to the model before you mount things permanently. This will allow you to balance the model on the correct Centre of Gravity before cutting the foam or balsa to mount the radio gear. You should always try and balance the model as close as possible to the Centre of Gravity on the plans before adding any extra balancing weight. A light plane will always fly better than a heavy one.

To dry fit the radio gear, plug everything together as it will be when the model is finished and place the servos, receiver, mixer and battery on top of the model, or inside it, to get an idea where you will mount everything. Lift the model up on your finger tips at the balance point to see how close the Centre of Gravity is to being correct.

Servo mounted in a 'Foamie' flying wing. Quick and simple.

As with all servo installations try and make sure that there is a minimum of slop in the link between the servo output horn and the horn on the control surface. A precise control set up will always improve the flying characteristics of a model.

When you have your servos installed physically in the model plug the m into the mixer and turn on the transmitter and receiver. The servos should move into their centre position. The first time you turn on the radio gear in the model don't have the servo output horns connected, either remove them from the servo, or at least disconnect the pushrods from them. If you have the horns too far off centre when you turn on the radio gear you may cause the servo to travel far enough to damage the linkage, servo, or model.

Moving either of the sticks on your transmitter should cause both servos to move.

If only one or neither of the servos moves turn off the receiver and check that all of your connectors are plugged in correctly. Check your batteries are charged or that they are fresh if you don't use rechargeable batteries. Check that your transmitter is turned on and the batteries are charged or fresh if you don't use rechargeable batteries in your Transmitter.

If you can't find anything wrong unplug the mixer and plug both servos into the receiver directly. When you do this moving each stick on the transmitter should move one servo. Carefully reconnect the mixer, making sure that the white (or yellow) wire on the servo connectors are to the outside of the mixer circuit board, and that you have them pushed right on.

You should now have both servos moving when each stick on the transmitter is moved individually. Connect your servo horns back onto the servos and install your control linkages.

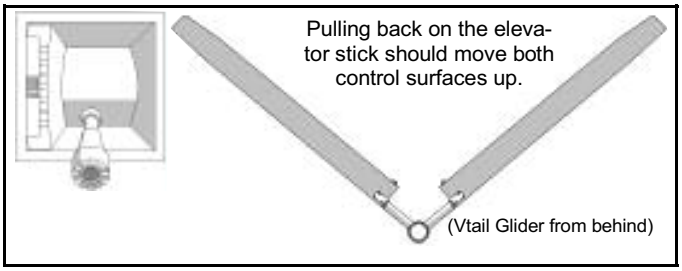
SETTING THE DIRECTION OF YOUR SERVOS

The Switches are numbered left to right looking from this direction.

Switch 2 sets this output

Switch 1 sets this output

When you have both servos moving you need to set up the reversing switches on the mixer to get them moving in the correct direction. Refer to the picture on the left for which switch is which. Use a small screwdriver or ball point pen to move the switches. Don't use a craft knife as you may damage the switches.



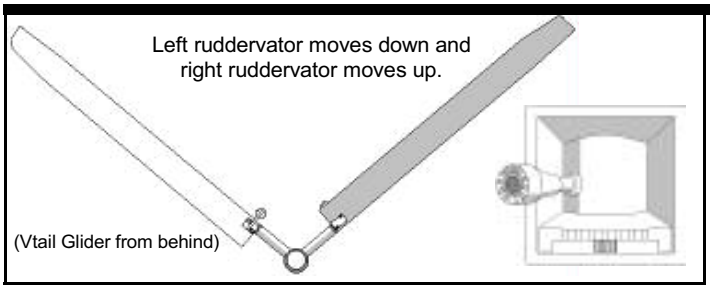
Pulling back on the elevator stick should move both control surfaces up.

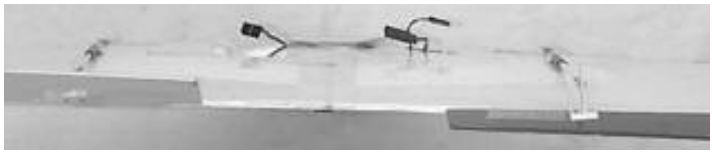
(Vtail Glider from behind)

Now push the elevator stick on the transmitter down (up elevator) and both of your elevons or ruddervators should move upwards. If they do not move in the correct direction change switch one and/or two to get both surfaces moving up when up elevator is applied. You can change the switches at any time, you don't need to turn off the receiver or transmitter. Both surfaces should move up, weather your setting up a Vtail or Flying wing model.

Switch one changes the direction of the servo plugged into the connector closest to the mixer circuit board, or the 'Bottom' connector if you like. Switch two changes the direction of the servo plugged into the connector 'on top'.

Once you have both control surfaces moving up when you pull back on the elevator stick, quickly check that they both move down when you push forward on the stick. Your elevator is now set for action.




On a flying wing the left Elevon should go up, and the right down.

Now move the rudder/aileron stick to the left. On a Vtail model the left ruddervator will move down, and the right will move up. Or, both of them move to the left, depending on how you look at it.

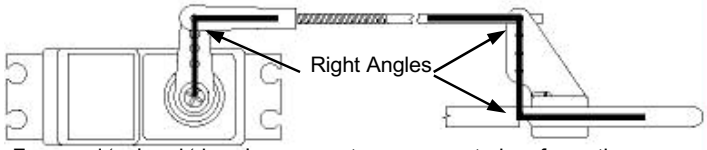
With a flying wing model the left control surface should move up and the right one should move down.

If the directions are reversed, change the reversing switch for channel one on your transmitter to be in the reverse position. You should now have your elevons or ruddervators all working in the correct direction.

If your transmitter does not have reversing available you can achieve the same goal by swapping the two servos over on the output connectors. Connect the servo that is plugged into output one to connector two and visa-versa. If you do need to do this you will also need to go back to the beginning of this section and re-set the reversing switches on the mixer, as they will now more than likely be wrong.

The next step is to centre your control surfaces properly.

To centre the control surfaces check that the trims on your radio are centred and then pop the output horn off the servos and place them so that they are at right angles to the pushrod which runs to the surface. Then adjust the length of the pushrod so that the control surfaces is at it's centre position as recommended in the plans for the model aircraft. Generally one end of your pushrods should have an adjustable "Clevis" which fits onto the threaded end of the control rod to achieve this.



For equal 'up' and 'down' movement on your control surfaces these angles should be 90° when the surface is centred.

You may not be able to get the set up exactly right by moving the horn on the servo output shaft. Don't worry, just adjust the trim on your transmitter to give the correct centring.

Ideally you should have both the Servo horn and control surface horn pivot points at right angles to the push rod. Some times this is not the case, as a given model may need 'differential' control surface travel. Check the plans for the model you are building.

With a 'Vtail' model you would normally set the centre position so that the ruddervators are flat. On a flying wing it is quite common to have the centre position slightly offset. Consult the instructions for your particular model to check.

SETTING CONTROL SURFACE THROWS

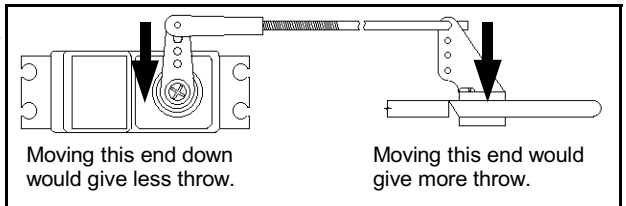
Control surface throw refers to how far up and down the control surface moves when you move the sticks on the transmitter to either end of their available travel. The mixer allows you to change the amount of travel each function has individually for maximum flexibility. You can select 100%, 75%, 50% or 25%.

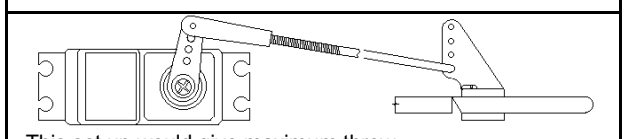
What this means in real terms is that if you set the elevator (input channel 2) function to be 50% and the aileron (input channel 1) to be 100% you will have half as much elevator travel as you have Aileron travel. Consult the instructions that came with your model aircraft for the recommended amount of travel. Generally the supplier of the kit will have done some experimentation to find the optimum amount of travel for the model, and their recommendations will be right for most cases.

In general you should start with the channel which is meant to have the largest travel according to the kit instructions and set that channel so that 100% on the mixer gives the correct amount of travel. This is done by moving the clevis on the control surface horn between holes, or shifting the link at the servo end.

When setting up the controls on any model you can adjust the amount of travel at the control surface for 100% travel on the servo by moving the clevis or 'Z Bend' on the servo output horn or control surface horn. Having the control rod in the hole closest to the centre on the servo and furthest from the centre on the control surface end will give the least throw. Always start with both in the outermost holes, and work inwards as appropriate. Having the linkage connected as far out as possible will give a tighter linkage than having the clevis's or Z Bends close to the centres.

(Continued overleaf)




This set up would give maximum throw.
(Note the Right Angle has been kept at the servo end for equal travel up and down)

After you have set the first channel up for 100% then use the switches to set the second one up to 75% or 50% to get roughly the correct amount of travel. It is often not possible to get just the right amount as specified in the instructions, don't be too concerned here, but consider that too little can be better than too much on a flying wing, and on a Vtail glider you shouldn't have too many problems with too much throw, as long as you have some experience flying rudder/elevator gliders.

The table below shows how the switches should be set to get the desired level of throw.

Channel 1 (Rudder/aileron)	Switch 3	Switch 4	Channel 2 (Elevator)	Switch 5	Switch 6
100%	OFF	OFF	100%	OFF	OFF
75%	ON	OFF	75%	ON	OFF
50%	OFF	ON	50%	OFF	ON
25%	ON	ON	25%	ON	ON

The photo on page 3 shows the switches, on is towards the top of that picture, and the switches are numbered from left to right.

Final Checks

Now that you're all ready to go, you should go back over your connections, make sure everything is plugged in correctly, and that the control surfaces do move in the correct direction.

Left Stick on a Vtail model should move both ruddervators to the left. Left Stick on a flying wing should move the left elevon up and the right one down. When you put in up elevator, by pulling back on the elevator stick on your transmitter both surfaces on a Vtail for flying wing model should move up.

You should also do a range check. Your radio gear instructions should describe how to do a range check, and will give you an idea of what range to expect when doing the check. The mixer should not effect the range of your radio gear at all. Some older AM sets may be affected however, if you place the mixer right on top of the receiver. If this happens, move the mixer 30-40mm away from the receiver and all should be well.

If you're going to be flying at the beach, or from cliffs over the sea it would be a good idea to put a small plastic bag around the mixer, and your reciever to protect them from the salty air. The mist that comes from the surf can do a great deal of damage to the sensitive electronics of the mixer and your radio gear.

Finally, if you have not flown a model aircraft before, please do have an experienced model pilot test fly the model for you, and give you at least a couple of lessons. Flying model aircraft is a great hobby, but many a potential pilot has been put off when their first model came into sudden contact with the ground.

Warranty and Servicing

Ohmark Electronics warrants this mixer to be free from defects in material and workmanship under normal use for a period of 90 days after the date of purchase and will repair or replace the unit free of charge, should it become defective in this period, within the bounds of the exceptions listed below. The unit should be returned to Ohmark Electronics or the place of sale for warranty servicing.

This warranty is limited to the mixer, and under no circumstances shall Ohmark Electronics be liable in the case of any incidental or consequential damages.

This warranty does not cover crash damage, corrosion due to exposure to salt or fresh water, or damage to the input leads incurred during the modification of the input leads to connect to other than the intended devices.

If your mixer should become faulty after the warranty period of 90 Days Ohmark will service the mixer and return it to it's original state for not more than half the purchase price paid for the unit, accept where the fault is caused by crash damage or corrosion due to exposure to salt or fresh water.

Feedback

If you have any comments regarding this manual, or the mixer itself, please don't hesitate to pass these comments directly back to Ohmark Electronics, or to your hobby dealer. Through user feedback we can improve this product for all modelers.

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GLOSSARY

This quick glossary is to explain some terms used in this instruction manual that possibly don't make too much sense to a new modeler, or some more experienced ones for that matter!

Centre of Gravity: The 'balance' point of the model. When you balance the model on the 'C of G' it should sit slightly nose down, or level. The plans for the model should describe where the correct balance point for your model is.

Clevis: The small plastic "clip" that connects the servo control rod to the servo or control surface horn.

Control Rod: The wire, plastic, wood or metal rod that runs from your servos to your control surfaces.

Horn: The plastic arm on your servos, and that connects to the control surface, generally with a series of small holes in it.

Z Bend: A double bend in the end of a wire control rod used in place of a clevis.