MIXER OPTION

11G505

Silver Series

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INTRODUCTION

The mixer option is a very versatile, useful, and imaginative addition to the Silver Series concept of a totally programmable and personally adaptable radio system.

Mixing is very "mind-blowing" and requires some logical analysis, and frankly, some "diddling" around with it to realize its full potential and versatility. As with the rest of the Silver Series concept, it assumes you are a modeler with certain abilities and intelligence that allows you to visualize and put together something that, to a non-modeler, is overwhelming and unachievable.

It is a difficult task to put these instructions together in order to furnish in detail all the applications that might be possible with the mixer. We only hope that we can furnish you the starting blocks to get you on the way to successful completion of your desired goals.

First, let's define some terms concerning what the mixer can do, then let the designer, Fred Marks, go into the technical description of how it can do it. Next, we'll tell you how to put it together and then what can be done to work it into a specific application. Some common examples will be given--the rest is up to you and your imagination.

The mixer can blend together any two channels (except Ch. 5, retract) in one of two different ways, uni-directionally or bi-directionally. Uni-directional mixing is where one channel (call it "B") is mixed together with another (call it "A") and yet Channel A is to remain independent. Examples would be where aileron control would affect rudder for coordinated turns and yet the rudder can be controlled independently for ground handling, spins, etc. Another would be where flaps are to be actuated when the elevator is controlled for square or other similar maneuvers and yet remains discrete when flap commands are required for landing. Flaps versus elevator settings could be set up to do just the opposite as indicated in the previous example; that is, flaps could be set up to interact with elevator to compensate for engagement of flaps on landing and yet the elevator remains completely independent for all other maneuvers. Yet another would be when throttle settings in a helicopter would modify tail rotor pitch, yet tail rotor commands would not interfere with power settings. Any of these mixing functions can be engaged or disengaged by means of an optional switch so the flight regime can be modified at will.

Bi-directional mixing is where both "B" is mixed into "A" and "A" is mixed back into "B" which gives mutual interaction of any two controls. This application of the mixer is most commonly used where "V" tail gliders are being flown or "elevons" (combination elevators and ailerons) are used on a delta airplane. Also, "flaperons" might be incorporated where both flaps and ailerons are mixed together.

Many more usages are possible, limited only by our imagination. All of which eliminate cumbersome, power and space consuming electronic or mechanical devices on board the plane for the utmost in precise control.

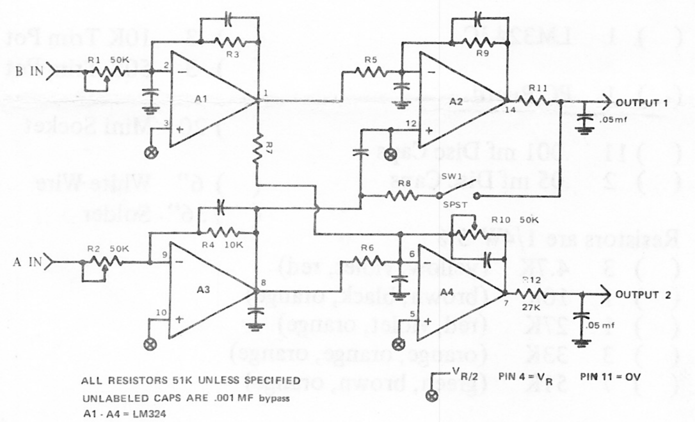


FIGURE 1
MIXER SCHEMATIC

CIRCUIT DESCRIPTION

Examining first the action that takes place from channel B input; A1, R1, and R3 act as an inverting amplifier with relative gain set by R1. The output from A1 is coupled to a second inverting amplifier formed by A2, R5 and R9 set at unity gain. This second amplifier reinverts the control voltage so that the servo moves in the same direction whether the mixer is switched in or out. R11 reduces the effect of control pot variations in linearity. The reader can visualize that if R1 were 51K, both amplifiers would produce unity gain and the input and output level would be the same.

The output from A1 is also routed to the other half of the mixer formed by A3, A4, and related components.

The channel A input is impressed on A3 which, with R2 and R4, forms another inverting amplifier with gains set by R2. However, the inverted output from A3 is routed via R8 to be summed with the output from A2 and the output from A2 is biased by the output from A3 to mix Channel A into Channel B.

Assuming the optional switch SW1 is closed for bi-directional mixing, the inverted output from A1 is routed to A4 via R7. R7 and R6 are equal in values so the relative gain of A4 remains the same.

The output from A3 is also routed to A4, which, with R6 and R10 form another inverting amplifier. R10 permits varying the gain of this amplifier to adjust the differences in servo travel; i.e., balance the two servos. The reinverted output for channel B mixed into channel A leaves A4 via MR12. Again, the gain for channel A can be set to give unity or much less than unity gain.

If the optional switch SW3 is open, this latter mixing does not take place and we have a uni-directional mixer.

The mixer is engaged or disengaged by simply using a DPDT switch to route the inputs from the two desired channels either through the mixer or completely bypass the mixer and route these two inputs directly to the encoder IC. Because we can independently adjust the gain through the mixer of each inputted channel, we can set the desired amount of gain difference between the mix and the no mix mode.

PARTS LIST

( ) 1 LM324 IC

( ) 1 PC Board

( ) 11 .001 mf Disc Caps
( ) 2 .05 mf Disc Caps

( ) 3 10K Trim Pot
( ) 3 50K Trim Pot

( ) 20 Mini Socket

( ) 6" White Wire
( ) 36" Solder

Resistors are 1/4W 5%

( )	3	4.7K	(yellow, violet, red)
( )	1	10K	(brown, black, orange)
( )	1	27K	(red, violet, orange)
( )	3	33K	(orange, orange, orange)
( )	7	51K	(green, brown, orange)

CONSTRUCTION

( ) Check the parts received against the parts list to familiarize yourself with the parts and to check for any shortages. If there is a shortage contact Ace R/C immediately.

( ) Install the LM324 IC first, making sure it is oriented with pin 1 as indicated in the overlay drawing. There are five joints that require soldering on top of the board.

( ) Now install the three 50K trim pots and the three 10K trim pots as shown. Two pots have two solder joints on top, and one pot has three.

( ) Now install the various .001 mf and .05 mf disc capacitors. When a capacitor requires soldering on top (five of them do), use a knife to scrape away the wax-like insulating material off of the leg of the capacitor up to the main body of the capacitor so that you have some lead exposed to solder to. Make sure the five capacitors that require soldering on top have good secure joints.

( ) Next, install the resistors in the board, working around the board in a clockwise manner. Make sure you have soldered four of them on top.

( ) Take the back off of your Silver Seven transmitter and unplug the Trim Adjust board from the Mainframe and set the small board aside.

( ) With the components facing you, lay the Mixer over the black Deans connectors on the Mainframe encoder PC board. Line up the bottom holes on the edges of the Mixer board with the bottom socket on each Deans connector.

( ) In the following steps, mini sockets will be used as pins that engage the Deans connector sockets. They will be referred to as "pins".

( ) Press a pin through the bottom right hole in the Mixer so the pointed end engages in the bottom right socket of the Deans connector on the Mainframe. Keep the Mixer board flat on the connector and using your thumbnail push the pin into the socket, leaving about 1/32" of the pin protruding through the top of the Mixer board so you have something to solder to.

( ) Solder the pin to the Mixer board.

( ) Repeat for the bottom left pin, inserting it in the bottom left socket of the Deans connector and soldering it to the Mixer board.

( ) In the same manner, install the upper right and upper left pins on the Mixer board.

( ) Install all the remaining pins in the Mixer board.

( ) Remove the Mixer board from the encoder Mainframe. A small screwdriver may be necessary to pry the board out.

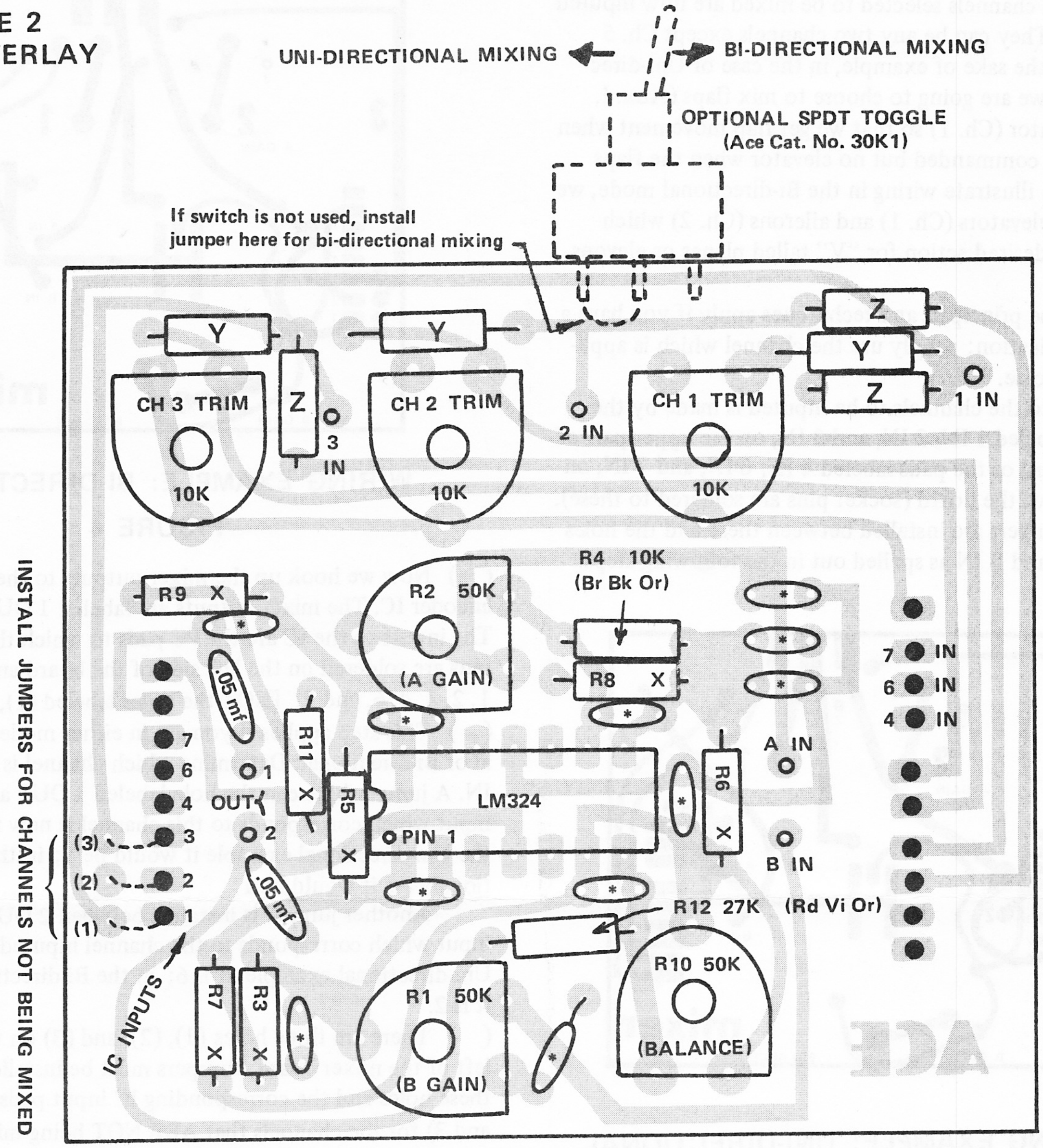
( ) Turn the board over and solder all of the pins to the bottom of the board. Be careful not to use too much solder on the pins so it builds up and doesn't allow it to be inserted into the female connector later.

( ) Thoroughly inspect the bottom and top of the board for missed or cold solder joints, solder bridges, and misplaced components. Excess solder resin should be cleaned off with denatured alcohol and a toothbrush.

( ) The selection of Bi-directional or Uni-directional can be made one of two ways: either solder an optional SPDT toggle switch (Ace No. 30K1 or similar) on top of the board and select the mode desired, or solder a small resistor lead jumper across the two PC pads as indicated for Bi-directional mixing--leave it off for Uni-directional.

( ) If it is required that mixing be engaged or disengaged during flight, an optional DPDT switch can be incorporated. This is to be done later, after the unit has been checked out and calibrated.

FIGURE 2
MIXER OVERLAY



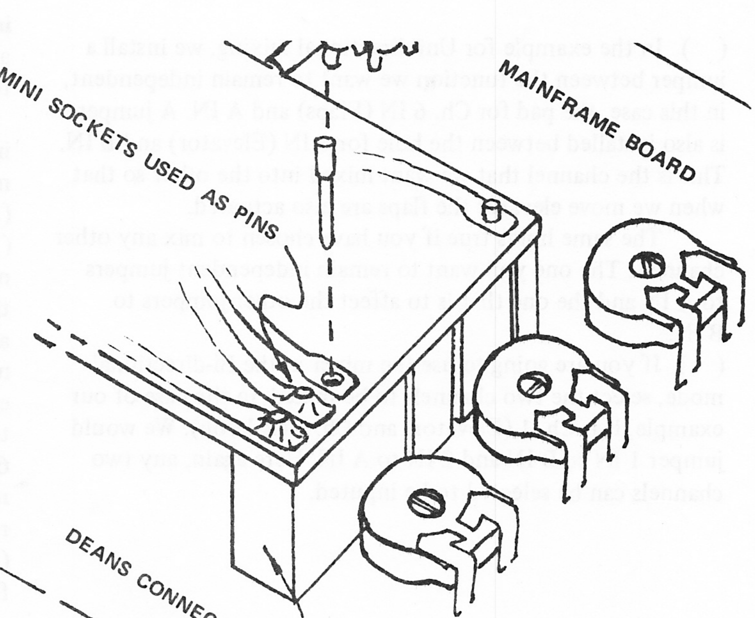
● = MINI SOCKETS USED AS PLUGS

* = .001 mf DISC CAPS

X = 51K (Green, Brown, Orange)

Y = 33K (Orange, Orange, Orange)

Z = 4.7K (Yellow, Violet, Red)



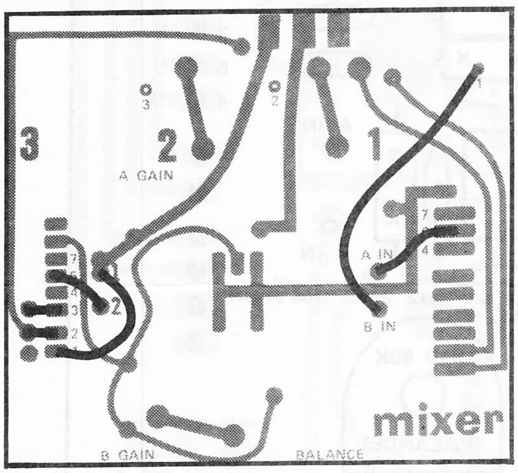
INSTALLING PINS

( ) The two channels selected to be mixed are now inputed to the mixer. They can be any two channels except Ch. 5 (retract). For the sake of example, in the case of Uni-directional mixing we are going to choose to mix flaps (Aux. I, Ch. 6) to elevator (Ch. 1) so that we get flap movement when the elevator is commanded but no elevator when the flaps are moved. To illustrate wiring in the Bi-directional mode, we chose to mix elevators (Ch. 1) and ailerons (Ch. 2) which would be the desired action for "V" tailed planes or elevons on deltas.

The same principals and techniques apply if you have a different application; simply use the channel which is applicable in your case.

( ) Access to the channels to be inputed is made by the three holes labeled 1 IN, 2 IN, and 3 IN, on the upper part of the mixer board or the pads labeled 4 IN, 6 IN, and 7 IN, on the right side of the board (socket pins are soldered to these).

Wire jumpers are installed between these and the holes labeled A IN and B IN as spelled out in the following steps.



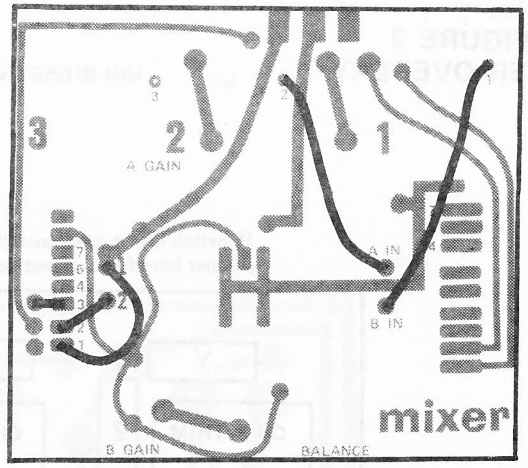
WIRING EXAMPLE: UNI-DIRECTIONAL

FIGURE 3

( ) In the example for Uni-directional mixing, we install a jumper between the function we want to remain independent, in this case, the pad for Ch. 6 IN (Flaps) and A IN. A jumper is also installed between the hole for 1 IN (Elevator) and B IN. This is the channel that we want mixed into the other so that when we move elevator the flaps are also actuated.

The same holds true if you have chosen to mix any other channels. The one you want to remain independent jumpers to A IN and the one that is to affect the other jumpers to B IN.

( ) If you are going to use the mixer in the Bi-directional mode, select the two channels to be mixed, in the case of our example, it is Ch. 1 (Elevator) and Ch. 2 (Aileron). We would jumper 1 IN to B IN and 2 IN to A IN. Here again, any two channels can be selected to be inputed.



WIRING EXAMPLE: BI-DIRECTIONAL

FIGURE 4

( ) Now we hook up the mixer outputs to the inputs to the encoder IC. The mixer outputs are labeled 1 OUT and 2 OUT. The inputs to the IC are the PC pads to which the connector pins are soldered on the left side of the board and are labeled 1, 2, 3, 4, 6, and 7. [NOT the holes labeled (1), (2), (3)]

( ) This step applies if you are in either mode, Uni-directional or Bi-directional. Determine which channel is inputed to B IN. A jumper between the hole labeled 1 OUT and the IC input which corresponds to this channel is now installed. In the Uni-directional example it would be 1; in the Bi-directional case it would be 1.

Another jumper is installed between 2 OUT and the IC input which corresponds to the channel inputed to A IN. In the Uni-directional example, it is 6; in the Bi-directional example it is 2.

( ) There are three holes (1), (2), and (3) on the far left of the mixer board. Jumpers must be installed between these holes and the corresponding IC input pads (labeled 1, 2, and 3) for the channels that ARE NOT being mixed--any channels that ARE inputed to the mixer don't get jumpers.

So, in the Uni-directional example, Channel 1 is being inputed to the mixed so no jumper is installed between (1) and 1. Channels 2 and 3 are not being mixed, so jumpers need to be installed between (2) and 2 plus between (3) and 3.

In the Bi-directional case, Channels 1 and 2 are going into the mixer so they don't need jumpers, but Channel 3 is not being mixed so a jumper needs to be installed between (3) and 3.

( ) Now look at the Mainframe encoder board in your transmitter. Between the two sets of Deans connectors, there are three jumpers plugged into pairs of mini-sockets labeled 4, 6, and 7. If one or two of these channels are being inputed to the mixer, the corresponding jumper needs to be removed. In the example of Uni-directional mixing, channel 6 is being inputed to the mixer so the jumper between the mini-sockets labeled 6 needs to be pulled out. In the case of Bi-directional mixing, neither channel 4, 6, or 7 are being mixed, so all jumpers remain in.

( ) Realize what we did in the last few steps. All inputs from the sticks (except Ch. 5) arrive at the Deans connectors on the right side of the Mainframe. These inputs need to be connected to the Deans connector on the left side of the board so these stick commands can be passed along to the encoder IC. This is done one of three ways.

The channel may go thru the mixer and then hook to the Deans connector on the left via a jumper. In the case of Chs. 4, 6, and 7, it may go thru a jumper on the Mainframe board. Or, in the case of Chs. 1, 2, and 3, it may be delivered to the IC by means of a jumper over on the left of the mixer board--holes (1), (2), and (3)--this is due to the Trim Adjustment circuitry on the mixer board. Channels 1, 2, 3, 4, 6, and 7 must arrive at the Deans connector on the left in one of these three ways. Note that if the channel is fed thru the mixer, either the jumper on the Mainframe (for 4, 6, or 7) or the jumper on the mixer board labeled (1), (2), and (3) must not exist.

CALIBRATION

( ) The following assumes that the transmitter was working properly before application of the mixer and all servos are properly centered and all throws are set at approximately $\pm 45^o$.

( ) Plug the mixer into the Mainframe. Rotate all 6 pots on the Mixer board counterclockwise. Turn the transmitter on and turn the receiver on with servos plugged into the channels that you are mixing.

If you install the optional switch for Bi-versus Uni-directional mixing, make sure it is in the proper position. If you didn't, make sure a jumper is installed as shown for Bi-directional or left out for Uni-directional.

( ) We will start by describing the set up procedures for our Bi-directional mixing example where we are mixing elevator (Ch. 1) and ailerons (Ch. 2). The same will apply if you have chosen different channels, you will just have to move the appropriate sticks.

Give either full up or full down and rotate the B GAIN pot clockwise until you achieve about 22.5^o of servo travel on the servo plugged into channel 1 of the receiver. The B GAIN pot sets the amount of gain or throw of the channel coming into the mixer at B IN. If the throw exceeds 22.5^o before you rotate B GAIN, back off on the throw pot for Ch. 1 on the Mainframe until you get proper throw. Realize that the mixer has to cut normal throw (45^o) in half (22.5^o). Otherwise when the two channels are summed together when the stick is moved to a corner, the throw would exceed the mechanical limits of the servo.

Next, rotate the BALANCE pot clockwise until you get the same amount of throw out of the servo plugged into channel 2 of the receiver as you do for the channel 1 servo (22.5^o) when the stick is in either the full up or full down position. The BALANCE pot controls only the throw of the servo hooked up to 2 OUT of the mixer, in this case, channel 2.

Now move the stick full left or full right and adjust the A GAIN pot until 22.5^o of throw is achieved on both servos. The A GAIN pot sets the amount of throw from the channel hooked to A IN, in this case aileron.

Now rotate the pot labeled 1 clockwise until the desired amount of trim throw is achieved on elevator, 2 for the trim throw on aileron, 3 for the trim throw on rudder.

That's all there is to it! Make sure the servos don't overtravel when the stick is moved to the corners with full trim. If so, back off on the gain.

Hook the servos up to the control surfaces and do some more adjusting if desired. If more elevator control is needed in relation to aileron control, simply increase B GAIN or decrease A GAIN. The servo reversal switches are still working--just realize they are reversing a function, not simply a servo.

( ) The same basic adjustment procedures apply for Uni-directional mixing, it's just that one channel will remain independent. Again, our example is for mixed elevator and flaps with flaps remaining independent. The same procedures apply for other applications, just use different stick commands.

Rotate B GAIN until the desired amount of throw achieved on the elevator servo--if it is already too much, back off on the throw for channel 1 on the Mainframe. The B GAIN pot sets the throw on the channel coming into the mixer at B IN. Now rotate the Balance pot until the desired amount of flap throw relative to elevator throw is achieved. The BALANCE pot only affects the servo plugged into the channel hooked to 2 OUT of the mixer, in this case channel 6.

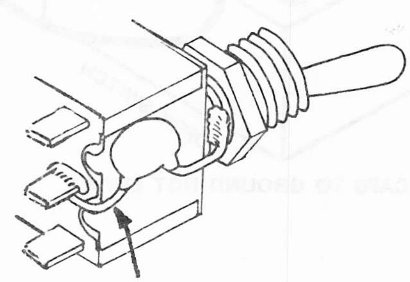
Now rotate A GAIN clockwise until the desired amount of throw is achieved when the flap lever is moved (Ch. 6). A GAIN sets the throw of the channel coming into the mixer at A IN. In this case, Ch. 6 flaps. Since we are in the Uni-directional mode, this channel remains independent. If more or less throw is needed, it may be necessary to change the throw pot for Ch. 6 on the Mainframe.

Rotate the pots labeled 6, 1, and 3 until the desired amount of trim throw is achieved on channels 1, 2, and 3 (elevator, aileron, and rudder).

Realize the reversal switches still are operational. They will allow you to get the proper direction of servo travel relative to one another.

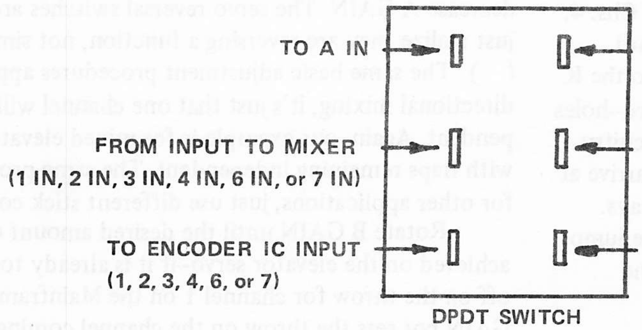
( ) In certain cases, particularly when using the mixer in the Uni-directional mode, the mixer may be needed to be engaged or disengaged during flight. To do this, an optional DPDT switch (Ace No. 30K20 or similar) is incorporated.

.001 mf disc capacitors first need to be installed between all six switch terminals and case ground to prevent any RF interference with the mixer. The caps can be soldered between the side of the switch or the threaded portion of the switch and the terminals to accomplish this. A drawing is furnished to give an idea of how to do this. Do the same on all six terminals.

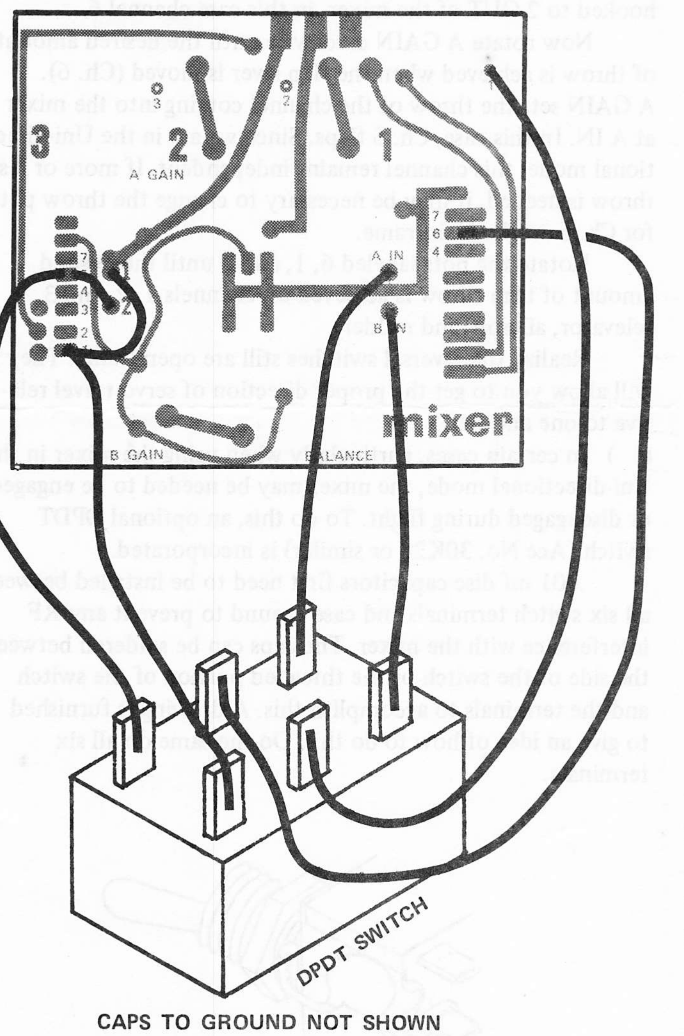


WATCH OUT FOR A SHORT HERE!

FIGURE 5



ENGAGE/DISENGAGE SWITCH WIRING EXAMPLE
FIGURE 6



CAPS TO GROUND NOT SHOWN

The switch is wired so the desired channels to be mixed are switched between either the mixer input (A IN/B IN) or the Encoder IC input. If they go through the mixer, of course, they are mixed. If they bypass the mixer, no mixing occurs.

So, in the case of our example, we need to hook wires from 1 IN and 6 IN to the middle terminals on the switch. On one set of end terminals on the switch, we would have wires from A IN and B IN so that A IN is in line with the wire from 6 IN and B IN is in line with 1 IN. On the other end of the switch we have wires coming from the pads over on the left side of the mixer board labeled 1 and 6, so that 1 lines up with 1 IN and 6 lines up with 6 IN. Note that the jumpers between these pads and 1 OUT and 2 OUT are still to be kept in place. The switch can be mounted in the case in any convenient place--it is best to keep it away from the RF deck if possible.

So there is no servo excursion when the mixer is switched in and out, A GAIN and B GAIN will need to be adjusted so the throws are the same between mix and no mix.

This completes the wiring and calibration of your mixer. We hope this gives you enough material to achieve your goal. In any event, it will take some thinking and playing with the adjustments available to visualize all the possible uses and all the imaginable versatility that can be obtained from this project.

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