11G515
SILVER SEVEN
EXPONENTIAL RATE/MIXER OPTION

Silver Series
ACE R/C, Inc.
Box 511, 119 W. 19th., Higginsville, Mo. 64037 816 584-7121

I. INTRODUCTION

A. OPERATIONAL RESTRICTIONS

NOTE: Before beginning building, due to the complexity of the circuit, there are three characteristics of this product that may cause its performance to be unacceptable and make the builder consider alternatives. Of course, full refund credit will be extended to the builder from where it was purchased, as long long as construction hasn't started and none of the packages have been unsealed.

One, in the uni-directional mode (typically coupled elevator/flaps or aileron/rudder), there will be a minute movement of the primary channel - - 1 or 2 degrees . . . when the secondary channel is activated; i.e., elevator will change a bit when the flaps are dropped or aileron neutral will change minutely when rudder is moved. It is always in the properly coordinated direction, plus if the mixer is decoupled, it won't occur. Only in the most demanding of situations will it adversely affect performance and if it is detrimental, the discreet mixer (11G505) will solve it but the expo option will have to be given up.

In the coupled aileron/rudder mode, there will only be as much rudder control when the rudder stick is moved as there is when the aileron stick is moved. When the rudder is uncoupled, normal throw results. The usual procedure would be to perform the maneuvers that need the most rudder control (take off, landing, spins, snaps, etc.) in the uncoupled mode and couple the aileron and rudder for normal flight.

Also in the coupled flap/elevator scheme, there will be a slight shift in flap neutral if the mixer is engaged and disengaged. Here again, it is only a noticeable problem in the most demanding situations and only if the mixer is to be engaged and disengaged. The discreet mixer (11G505) will do away with it but the expo option is sacrificed.

B. OPERATIONAL OVERVIEW

With the Expo/Mixer Option Module, two out of the three neutralizing channels can have exponential rate (elevator, aileron, and rudder) that can be engaged or disengaged if desired and any two channels (except retracts) can be mixed together one of two ways: uni-directionally or bi-directionally.

Electronically, this is done by a module that is compatible with the Silver Seven that consists of three independent submodules: two exponential amps plus a mixer. The exponential amps each take an operational amplifier and the mixer takes two. Labeled A1 through A4, these op-amps are in a single integrated circuit, an LM324.

Specific applications and detailed circuit description follow. It is not necessary to fully understand such complexties of this project since all most commonly used configurations are "cookbooked", showing the proper hookups and calibration procedures for all conceivable applications. Of course, modelers are creative and will find other applications that we haven't visualized - for them we hopefully provide enough information for them to perform the task. Even if you are trying for the simplest of combinations, please carefully read all the material presented. It will make the task more understandable and hopefully, enjoyable.

II. EXPONENTIAL RATE

A. APPLICATION

In a convential R/C transmitter, the servos in a model will follow the stick movements faithfully (in a linear fashion). On very fast or highly manueverable models this becomes very tedious when a small amount of control near neutral is needed. By adding Exponential control (non-linear or logarithmic) the control near neutral is "softened." That is, a large amount of stick movement near neutral gives only a small amount of control at the servo. However, as the stick is moved further, the control response increases in sensitivity until at full stick movement, the servo has caught up with the stick.

In addition, the softness of the neutral, the width of the soft neutral, and how quick the servo responds after the soft neutral, can all be tailored to suit the modeller's taste be changing plug-in resistors on the module.

B. CIRCUIT DESCRIPTION

A1, R1, R2, and R3 form a non-inverting amplifier that increases the control input voltage of 0.5 volts (above or below $V_{R/2}$) to 2.5 volts for full stick throw. That amplification is linear. With SW1 in the position shown, the amplified signal is applied to the parallel path R4 and D1/D2. The forward breakdown voltage (the point at which the diode begins to conduct when plus is applied to the anode) is at about 0.5 volts. Thus, until the signal out of A1 exceeds 0.5 volts, the resistance to "ground" (in this case, $V_{R/2}$) via R5 is R4. Since the resistance of D1/D2 before breakdown is quite high (approximately 1 meg ohm) only about 10% of servo motion results from 20% of servo travel in this configuration. R5 acts as a shunt to reduce the slope of the output from A1 for both high and low slope.

When the input to A1 reaches 0.1 volts (representing about 20% of stick travel), the output from A1 reaches 0.5 volts and either D1 or D2 "breaks down". The parallel resistance between A1 and R5 now becomes the inverse sum of D1 and R4, with the breakdown resistance of D1 equal to a few hundred ohms.

The output from D1 and D2 is impressed upon R8, a pot, that is used to equalize the broken down resistance between D1 and D2 since such diodes are not noted for consistency. That path now contains a nominal 5K resistance (half of R8) in addition to the few hundred ohms for D1 or D2. Thus, if one assumes that D1, after breakdown, is 500 ohms and that the leg of the R8 pot on that side is 4500 ohms for a total of 5000 ohms, then the resistance between A1 and R5 becomes 4554 ohms.

The slope of the curve then becomes higher by the ratio of nearly 10 to 1 after input exceeds 0.1 volts and continues at that slope to the end of stick travel.

Again, remember that the function of R5 is to shunt the voltage so that the final output still does not exceed 0.5 volts, as for normal, linear operation.

The non-linear amplifier is flexible and can be tailored to fit the individual modeler's preference for:

--The "softness" about neutral that is determined by the lower slope of the curve of servo motion versus stick motion.

--The width of the soft neutral that is defined by the break point where the curve changes from "soft" to "steep slope".

--The "steepness" of the high sensitivity portion of the curve; ie, how quickly the servo moves after breaking from soft neutral.

It is recognized that the individual modeler will have his own unique preference for the above characteristics. Provisions have been made to permit tailoring by means of plug-in resistor sockets for R4, R5, and R6; their impact will be described by a table that is provided for reference to show the qualitative effects and to highlight the realistic limitations.

Several representative combinations of values and the corresponding control authority curves are presented to show what can be done.

Be aware of the limitations; they involve primarily the end travel of the servo. The balance adjust (R8) permits good symmetry. However, if one attempts to go too far with changes of the high slope, too much or too little travel will result unless reset of the channel range setting on the main frame is not objectionable.

When the total resistance between A1 and R5 equals about 8K, the slope of the output is about 1.5 degrees of servo motion per degree of stick motion, the same as for normal, linear operation. By including SW1 and R7, we can select, at will, to have a normal, linear output or non-linear (log) output, since the diodes are removed from the parallel path, and R7 is substituted.

Since we are not changing the gain of A1 amplifier, offset does not occur when the switch is made and there is no shift in servo position so long as the switch is made when the control is centered (ie, input = $V_{R/2}$).

If trim were introduced along with control-input at R3, then non-linear operation would be adversely affected. This is avoided by introducing trim after all non-linear amplification occurs.

If more or less trim authority is desired, the value of R9 can be changed. To increase trim throw, lower the value-- 47K will give about 20° of throw.

The circuitry is repeated for the other exponential amplifier; on the actual PC board the 1st amp is designated "A" . . . R1A, R2A, etc., and the 2nd amp is designated "B" . . . R1B, R2B, etc.

A linear channel "trim adjust" network is provided for the third neutralizing input. It is the same as the circuit provided on the Trim Adjust Board (see basic instruction manual), except a fixed resistor on plug in sockets is provided instead of a pot to establish trim authority (R3C), in our case a 470 ohm resistor.

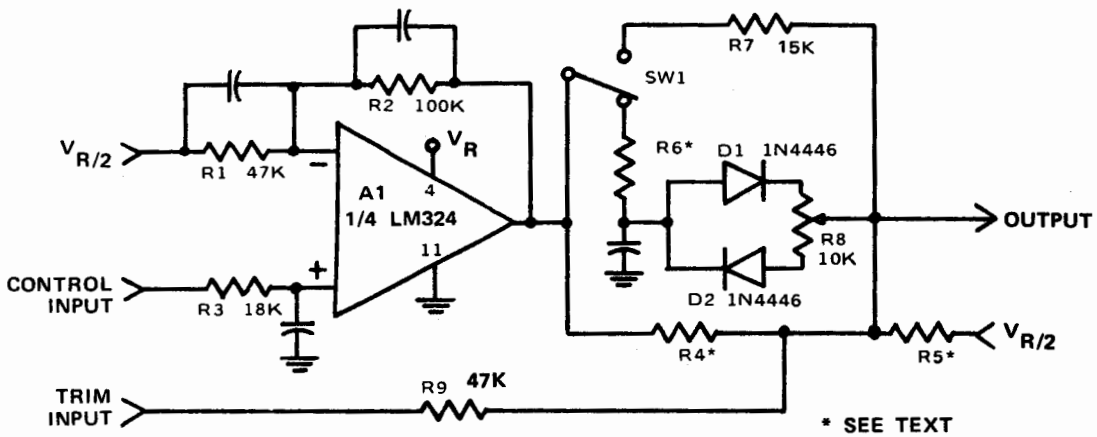


FIGURE 1
EXPO AMP SCHEMATIC

PARTS LIST

( ) 1 PC Board
( ) 1 LM 324 IC
( ) 4 1N4446 Diodes
( ) 36 Mini-Sockets
( ) 2 10K Trim Pots
( ) 2 50K Trim Pots
( ) 16 .001mf Disc Caps

RESISTORS ARE 1/4W, 5%

( ) 1 470 ohm (Yellow,Violet,Brown)
( ) 2 3.3K (Orange, Orange, Red)
( ) 2 3.9K (Orange, White, Red)
( ) 2 4.7K (Yellow, Violet, Red)
( ) 1 10K (Brown, Black, Orange)
( ) 4 15K (Brown, Green, Orange)
( ) 3 18K (Brown, Grey, Orange)
( ) 2 27K (Red, Violet, Orange)
( ) 5 47K (Yellow, Violet, Orange)
( ) 8 51K (Green, Brown, Orange)
( ) 3 100K (Brown, Black, Yellow)

( ) 48" Solder
( ) 12" Red, Black, White, Orange, and Yellow Wire
( ) 1 Push Pin
( ) 2 Pressure Sensitive "Dots"

IV. 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.
( ) Refer to the overlay drawing, Figure 3, for the following steps.
( ) NOTE: Make sure all joints on the top of the board are soldered as you proceed. Missing these joints is the most common mistake made.
( ) Begin by installing the mini-sockets for the plug in resistors: R4A, R5A, R6A, R9A, R4B, R5B, R6B, R9B, R3C, a total of 18 mini-sockets. About 3/32" of the open end of the socket should be above the top of the board after insertion. These locations are indicated by circles on the overlay drawing. Don't cut the mini-sockets off on the bottom of the board after soldering. (6 pins soldered on top)
( ) Using a scrap resistor lead, install the jumper under IC-1 and the interboard jumper which connects a land on top of the board with a land on the bottom of the board. It is right under the pot labeled R8B.
( ) Install the LM324 IC, making sure it is oriented with pin 1 as indicated in the overlay drawing. Make sure the joints are made on the top of the board!
( ) Install the four pots now: R8A and R8B (10K), RM4 and RM9 (50K). (one pot has top joint)
( ) Install the permanent resistors and diodes next working around the board in a clockwise manner, being sure to make all the joints on top of the board.
( ) Now install the various .001 mf disc capacitors. When a capacitor requires soldering on top, 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 capacitor that require soldering on top have good secure joint.
( ) 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 Expo/Mixer Board over the black Deans connectors on the Mainframe encoder PC board. Line up the bottom holes on the edges of the 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 Expo/Mixer so the pointed end engages in the bottom right socket of the Deans connector on the Mainframe. Keep the 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 Expo/Mixer board so you have something to solder to.
( ) Solder the pin to the Expo/Mixer board.
( ) Repeat for the bottom left pin, inserting it in the bottom left socket of the Deans connector and soldering it to the Expo/Mixer board.
( ) In the same manner, install the upper right and upper left pins on the board.
( ) Install all the remaining pins in the board.
( ) Remove the 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.
( ) Now it is time to install the plug-in resistors. Study Figure 4, the graphs for the various logarithmic curves, and select the values of resistors desired for R4, 5, and 6. (Two sets . . . "A" and "B")
( ) "Prime" the mini sockets for insertion of the resistors using the furnished push pin.
( ) Bend the resistor leads over perpendicular to the resistor body and shorten them to about 3/16". Make jumpers for the R6 slots out of scrap resistor leads.
( ) Plug the selected resistors or jumpers into the locations, R4A, R5A, R6A, R4B, R5B, and R6B.
( ) Also plug in the Trim Authority Resistors, R9A and R9B, (47K; Yellow, Violet, Orange) and R3C (470 ohm; Yellow, Violet, Brown) in the same manner.

COMPONENT	EFFECT	VALUE RANGE		COMMENTS
R4	Changes the softness about neutral and the break point. (Low slope)	10K Maximum Sensitivity	75K Minimum Sensitivity	Compensate for a change in overall sensitivity with LR5.
R5	Simultaneously changes the sensitivity of both the high and the low slope.	3K Minimum Sensitivity	10K Maximum Sensitivity	If too high, servo will overtravel.
R6	Changes the sensitivity of the high slope	OV (Jumper) Maximum Sensitivity	10K Minimum Sensitivity	Too large a value will not let servo reach full travel.

III. MIXER

A. APPLICATION

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 "X") is mixed together with another (call it "Y") and yet Channel Y 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 "Y" is mixed into "X" and "X" is mixed back into "Y" 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.

B. CIRCUIT DESCRIPTION

Operational Amplifiers A3 and A4 are set up as variable gain, non-inverting amplifiers that have their individual gains set by RM4 and RM9. X-In and Y-In may be any two channels the user selects (except retracts). Outputs 1 and 2 may be any two channels the user selects, with stipulation being that all channels must have an input.

The op amps (A3, A4) inputs are used as summing junctions. The inverting (minus) inputs are tied firmly to VR/2 (precisely 2.5 volts above zero volts). All incoming control voltages appearing at X-In and Y-In will be at 2.5 volts ± 0.5 volts. Thus the signal at Y-In (say elevator) will appear at pin 10 and pin 12. Any variations in it will appear at both outputs 1 and 2 with amplification set by RM4 and RM9.

The X-In signal also appears at pin 12 and at pin 9. This latter input, via RM2 is left open or may be switched out for uni-directional mixing. RM2 ties to pin 9 so that the X input is inverted through the A3 amplifier to provide servo phasing for V-Tail and Elevon applications.

FIGURE 2
MIXER SCHEMATIC

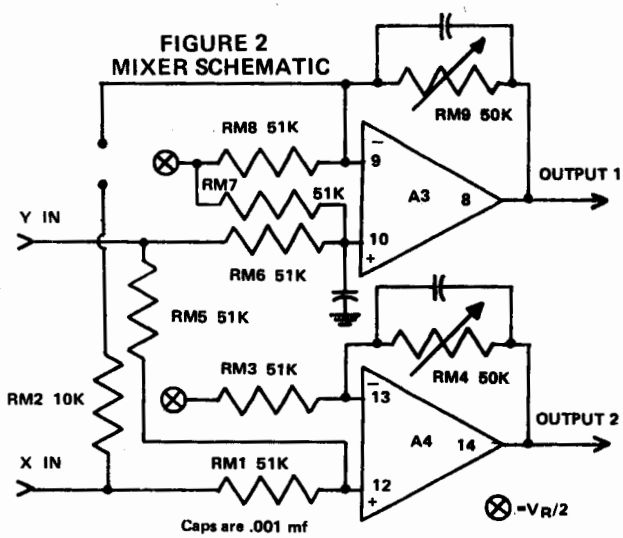
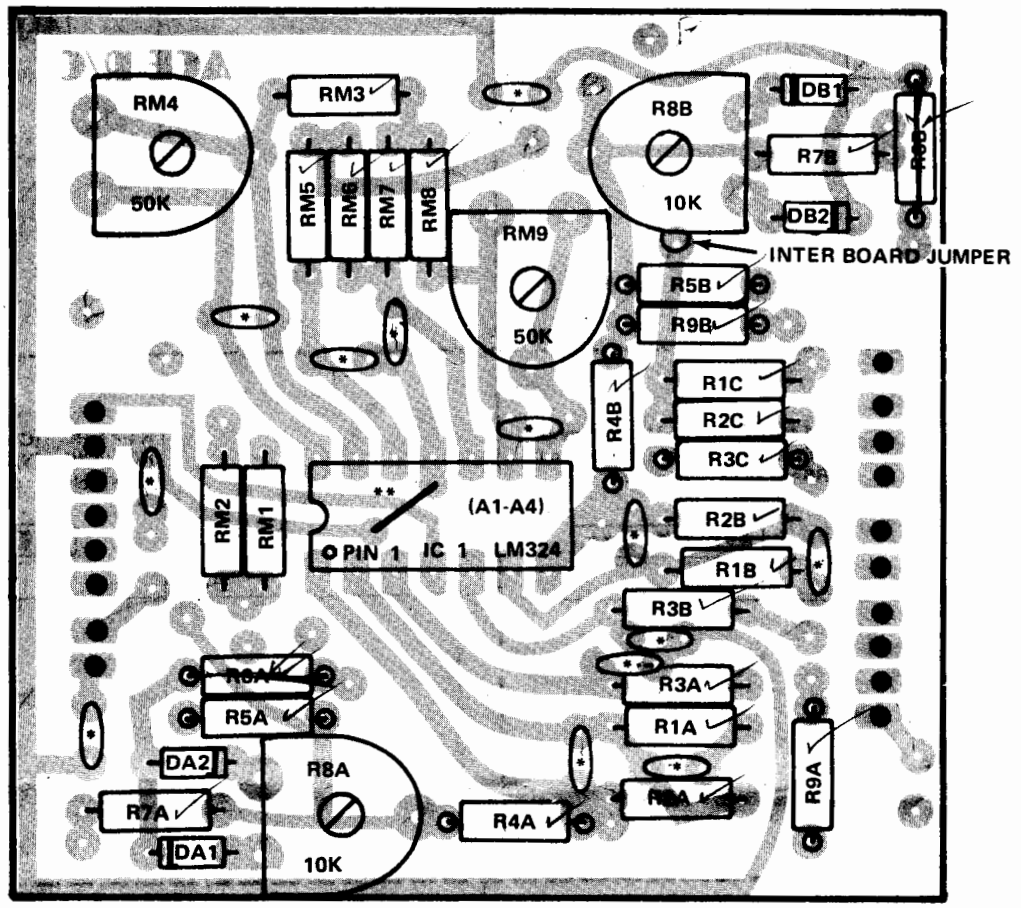


FIGURE 3 PARTS ID



● MINI SOCKETS USED AS PLUGS

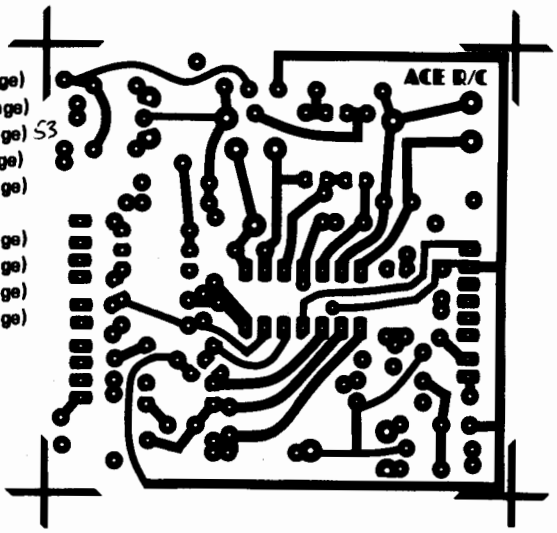
○ MINI SOCKETS USED AS SOCKETS

** NOTE: PERMANENT JUMPER UNDER IC-1

* .001 mf DISC CAPS

( ) R1A – 47K (Yellow, Violet, Orange)
( ) R1B – 47K (Yellow, Violet, Orange)
( ) R1C – 47K (Yellow, Violet, Orange)
( ) R2A – 100K (Brown, Black, Yellow)
( ) R2B – 100K (Brown, Black, Yellow)
( ) R2C – 100K (Brown, Black, Yellow)
( ) R3A – 18K (Brown, Grey, Orange)
( ) R3B – 18K (Brown, Grey, Orange)
( ) R3C – 470 Ohm (Yellow, Violet, Brown)
( ) R4A, R4B
( ) R5A, R5B — SEE TEXT
( ) R6A, R6B
( ) R7A – 15K (Brown, Green, Orange)
( ) R7B – 15K (Brown, Green, Orange)
( ) R8A – 10K Pot
( ) R8B – 10K Pot

( ) R9A – 47K (Yellow, Violet Orange)
( ) R9B – 47K (Yellow, Violet, Orange)
( ) RM1 – 51K (Green, Brown, Orange)
( ) RM2 – 10K (Brown, Black, Orange)
( ) RM3 – 51K (Green, Brown, Orange)
( ) RM4 – 50K Pot
( ) RM5 – 51K (Green, Brown, Orange)
( ) RM6 – 51K (Green, Brown, Orange)
( ) RM7 – 51K (Green, Brown, Orange)
( ) RM8 – 51K (Green, Brown, Orange)
( ) RM9 – 50K Pot
( ) DA1, DA2, DB1, DB2 – 1N4446
( ) IC-1 – LM324



Refer to this board view for any solder bridges.

FIGURE 4 GRAPHS

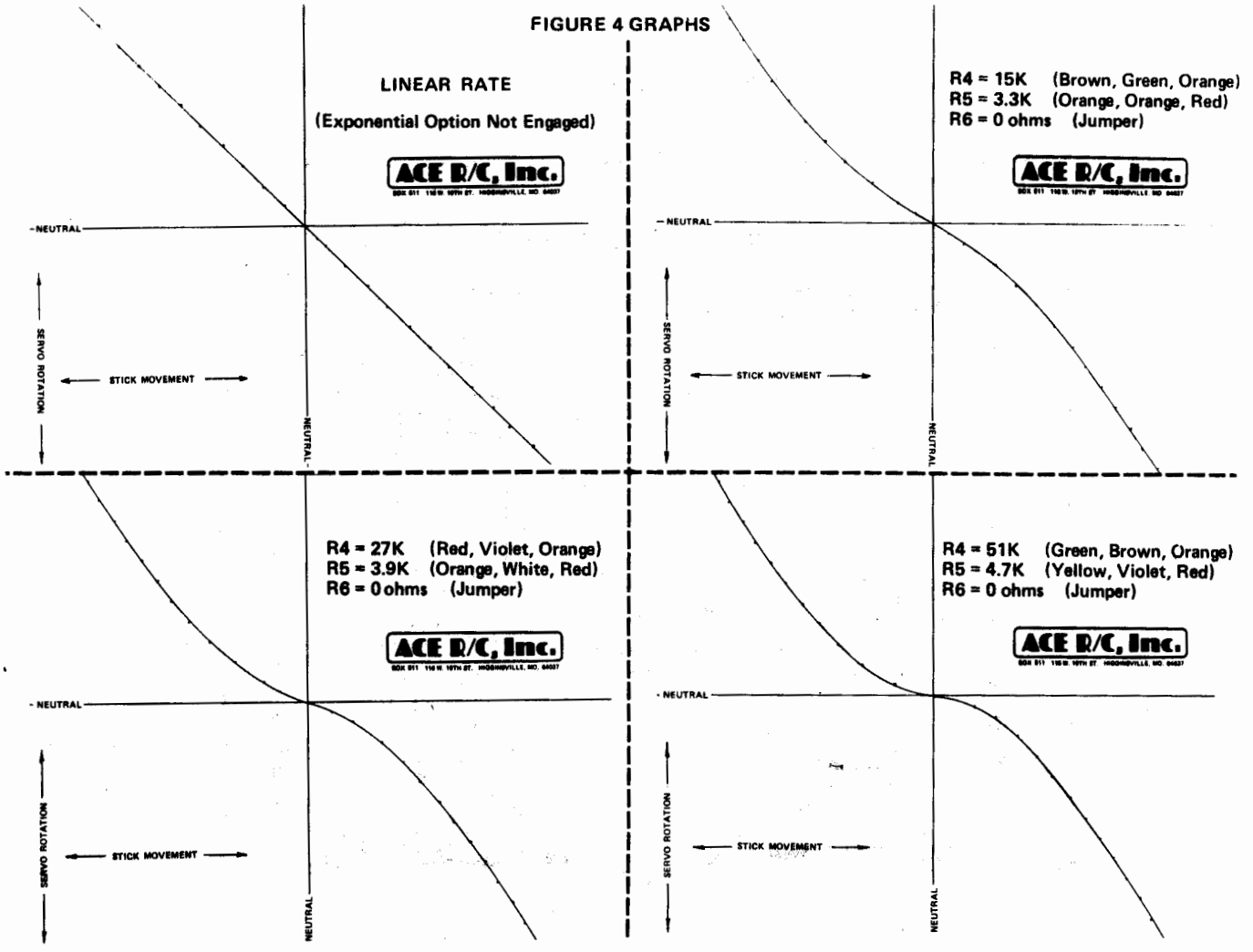


FIGURE 5
BLOCK DIAGRAM/BOARD LOCATION CHART

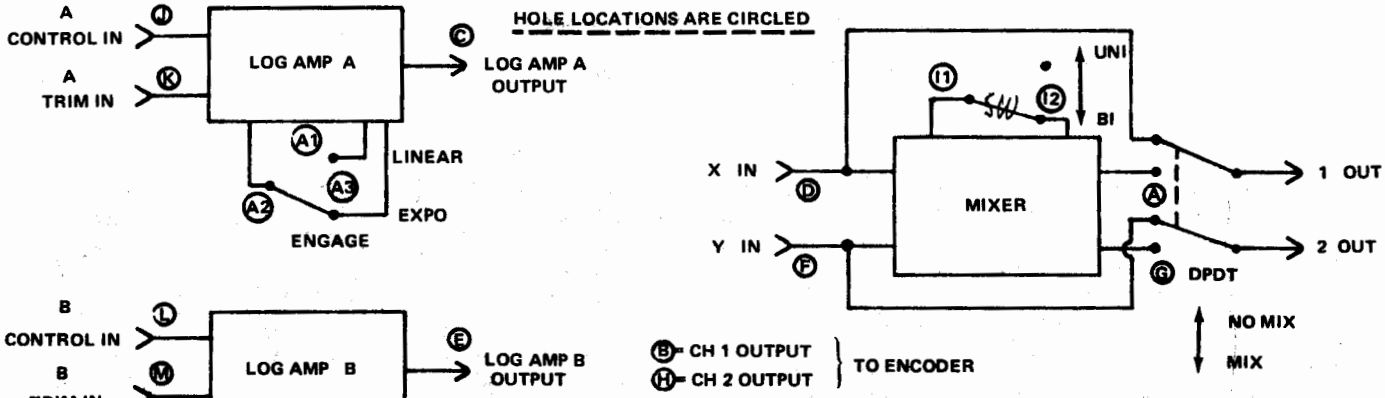


CHART 2 HOLE IDENTIFIER

A–MIXER 1 OUTPUT	H–CH 2 OUT TO ENCODER
A1,A2,A3–LOG AMP A ENGAGE	I1,I2–UNI VS. BI-DIRECTIONAL MODE
B–CH 1 OUTPUT TO ENCODER	J–LOG AMP A CONTROL INPUT
B1,B2,B3–LOG AMP B ENGAGE	K–LOG AMP A TRIM INPUT
C–LOG AMP A OUTPUT	L–LOG AMP B CONTROL INPUT
D–MIXER X INPUT	M–LOG AMP B TRIM INPUT
E–LOG AMP B OUTPUT	N–LINEAR CHANNEL C CONTROL INPUT
F–MIXER Y INPUT	O–LINEAR CHANNEL C TRIM INPUT
G–MIXER 2 OUTPUT	P–LINEAR CHANNEL C OUTPUT

UNI-DIR. INDEPENDENT CHANNEL
USES MIXER INPUT Y ONLY

V. HOOKUP OVERVIEW

A. INTRODUCTION

In order for the builder to better understand how the expo/mixer board gets wired and for all the various combinations available, the following block diagram, hole identifier, and discussion is presented. This material is particularly useful if the builder wants to try a combination that we don't show a specific wiring/jumper diagram for.

B. DISCUSSION

Any two of the three neutralizing channels (elevator, aileron and rudder) can have exponential rate. The third is a linear channel. Normally, elevator and aileron control and trim inputs are fed into Log Amp A and Log Amp B and the rudder goes thru the Linear Channel C. Then the outputs of Log Amp A and B plus Linear Channel C are hooked up as desired. They need to go to either the Mixer Input or to the Encoder Input, depending upon the application. Note that a switch can be incorporated to engage or disengage the Log Amps for either Linear or Exponential control.

Any two channels (except retract) can be inputted for the Mixer. They can be mixed together either Uni-directionally or Bi-directionally and the mixing can be engaged or disengaged by means of a switch. The mixer output, in turn, is connected to the appropriate Input to Encoder.

Remember, CH1, CH2, CH3, CH4, CH6, and CH7 at the Encoder Input on left of the board must be occupied by an output, either from the expo/mixer board or via the three jumpers under the option board on the Mainframe. Control and Trim outputs from the sticks for Channels 1, 2, and 3 must go through Log Amp A, B, or Linear Channel C.

VI. SPECIFIC HOOKUP APPLICATIONS

A. INTRODUCTION

( ) The following specific applications are presented to cover all conceivable uses of this option. Pick the one that applies, install the jumpers and switches (optional), and proceed to the Calibration section. All jumpers are shown in black plus a chart is furnished to show the interconnects.

( ) Make the jumpers out of hookup wire and solder to the appropriate hole or pad. Keep them as short as possible . . if the jumper is very short, a scrap resistor lead will work. If required, make sure to solder on top of the board as well.

( ) You may want to install either SPDT or DPDT switches to engage or disengage various features. No switches are furnished for these applications but are available at Ace R/C (30K1 - SPDT Toggle or 30K20 - DPDT Toggle). If the switch is an SPDT and you don't want to retain Dual Rate function, you may want to use the existing Dual Rate switches. You can simply unsolder and completely remove the wires that come from the Encoder Mainframe for Dual Rate and solder the wires from the option board to the switches or if you want to make the mixer/expo board removeable, a male Deans three pin connector (Ace Cat. No. 19K54) can be soldered directly to the switch terminals and a female can be soldered to the wires from the option board plus another female connector can be wired to the pair of Dual Rate wires from the Mainframe so that one or the other can be plugged into the switch depending upon whether the option is used or not. You may also obtain and install separate switches. In any event, .001 mf disc capacitors first need to be installed between the middle switch terminals and case ground to prevent any RF interference. 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.

(Keep switches as far from the RF board as possible.)

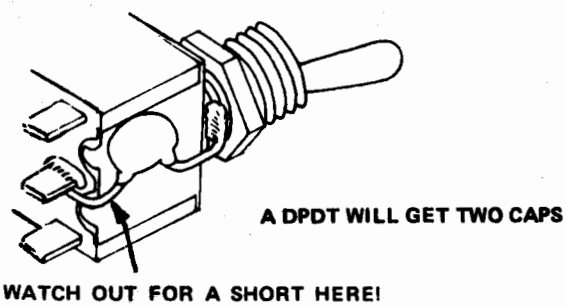
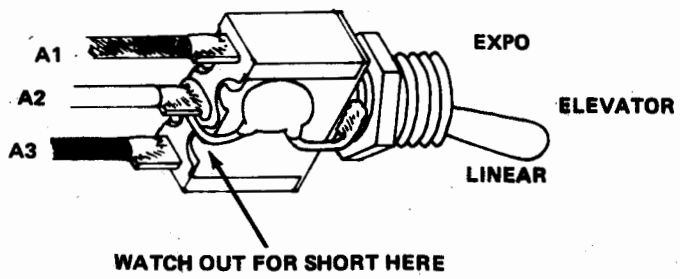
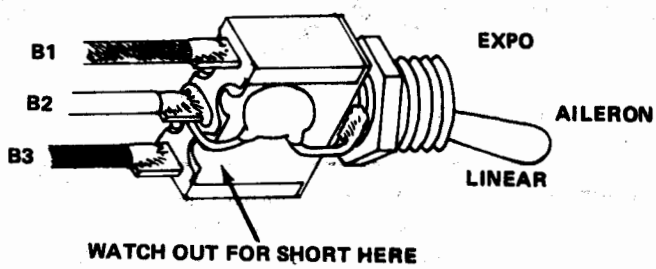


FIGURE 6

B. EXPO ENGAGE/DISENGAGE SWITCH

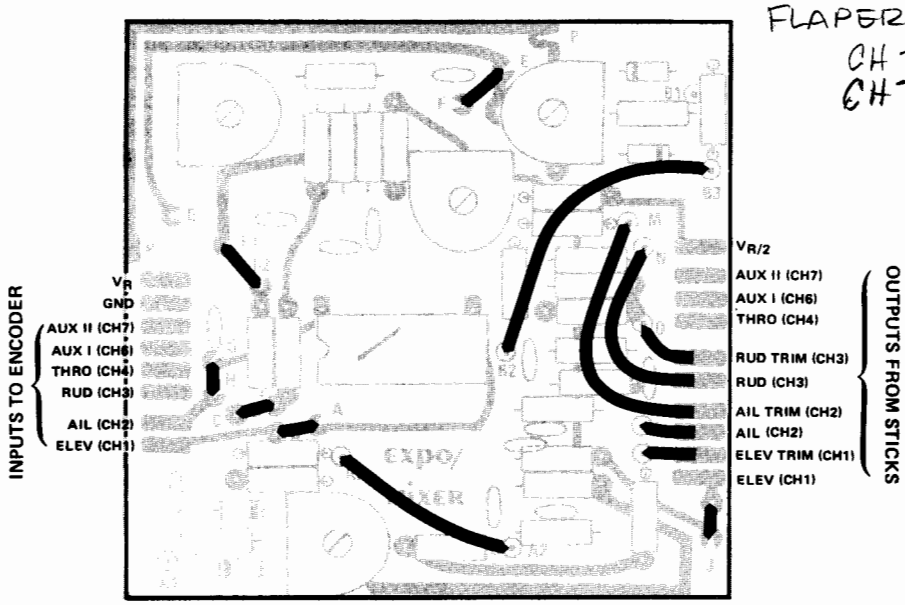
You may want to be able to disengage the Expo rate and go to regular linear rate. In all of the following applications, it is done in the same manner. You can use two SPDT's for the two separate expo amps or one DPDT to do both.





APPLICATION 1: ELEVATOR AND AILERON EXPONENTIAL RATE AND MIXED TOGETHER FOR "V" TAILED GLIDERS OR ELEVONS.

BI-DIRECTIONAL FLAPERONS
CH 2 - AILERON
CH 6 - FLAPS (AUX 2)



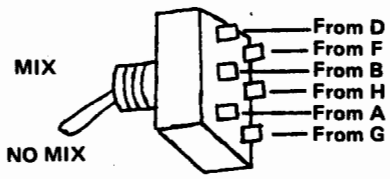
MAINFRAME JUMPER STATUS: All jumpers are to be in place.

MIXER ENGAGE/DISENGAGE SWITCH

In this mode, this switch is not recommended, mainly because it should never be necessary to disengage the mixer in flight. If you change to a plane where mixing is not required, remove the option and replace with a Trim Adjust Board or Expo Option.

In case you absolutely need the switch, we are showing how to do it:

CAPS ON SWITCH NOT SHOWN

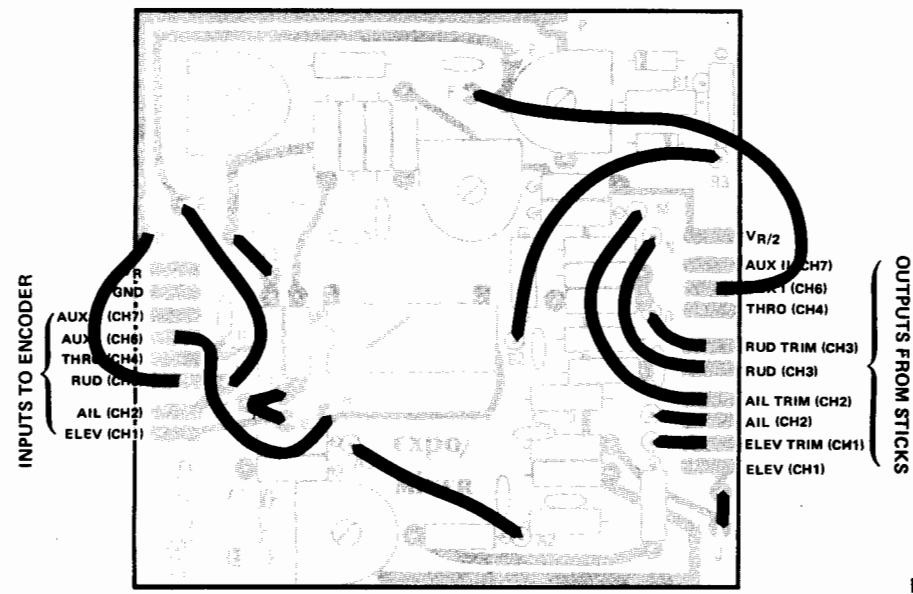


OPTION BOARD JUMPERS:

( ) A – B
( ) C – D
( ) E – F
( ) G – H
( ) I-1 – I-2
( ) A2 – A3 (or switch)
( ) B2 – B3 (or switch)
( ) J – CH 1 from stick
( ) K – CH 1 Trim from stick
( ) L – CH 2 from stick
( ) M – CH 2 Trim from stick
( ) N – CH 3 from stick
( ) O – CH 3 Trim from stick

( ) 1 - Remove jumper from A-B.
( ) 2 - Remove jumper from G-H.
( ) 3 - Install a .001 cap on the board from A to Gnd.
( ) 4 - Install a .001 cap on the board from G to Gnd.
( ) 5 - Wire switch as shown.
( ) 6 - Mount switch in case.

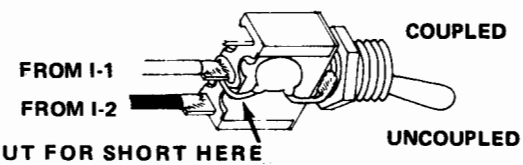
APPLICATION 2: AILERON AND ELEVATOR EXPONENTIAL RATE; UNI-DIRECTION MIXING OF FLAPS (CH 6) AND ELEVATOR (CH 1) FOR COUPLED FLAPS & ELEVATOR.



MAINFRAME JUMPER STATUS: Remove jumper for CH 6.

COUPLE/UNCOUPLE SWITCH

It is recommended that this switch be installed. Some maneuvers will benefit from having the flaps uncoupled.



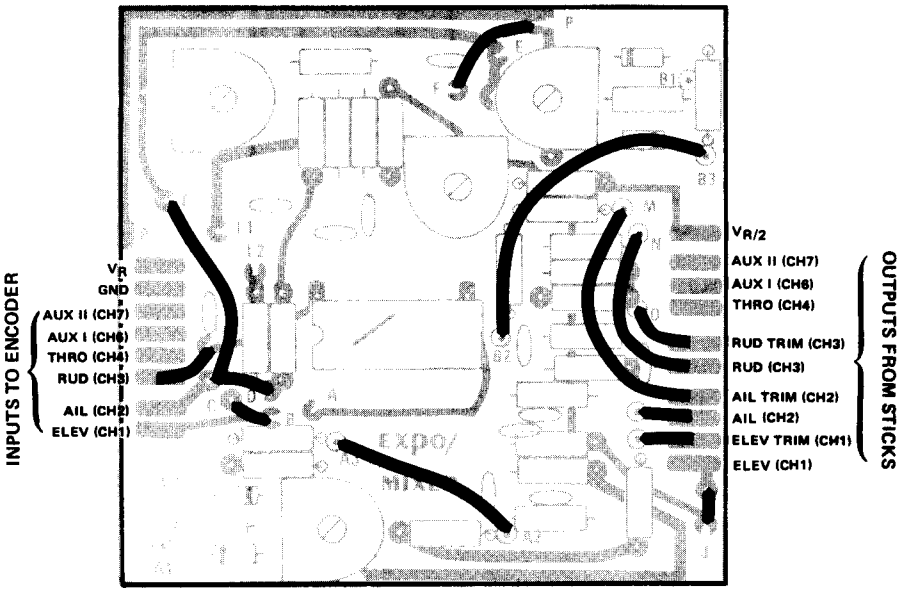
OPTION BOARD JUMPERS

( ) A2 – A3 (or switch)
( ) B2 – B3 (or switch)
( ) E – H
( ) B – C
( ) C – D
( ) A – CH 6 to Encoder
( ) J – CH 1 to Stick
( ) K – CH 1 Trim to Stick
( ) L – CH 2 to Stick
( ) M – CH 2 Trim to Stick
( ) N – CH 3 to Stick
( ) O – CH 3 Trim to Stick
( ) F – CH 6 to Stick
( ) I-1 – I-2 (or switch)
( ) P – CH 3 to Encoder

WATCH OUT FOR SHORT HERE

( ) 1 – Remove jumper from I-1 – I-2.
( ) 2 – On the board, install a .001 mf cap from I-2 to Gnd. This may be accomplished either on the top or the bottom of the board.
( ) 3 – Wire the switch as shown.
( ) 4 – Mount the switch.

APPLICATION 3: AILERONS AND ELEVATOR EXPONENTIAL RATE; UNI-DIRECTIONAL MIXING OF AILERONS AND RUDDER FOR COUPLED AILERONS AND RUDDER.



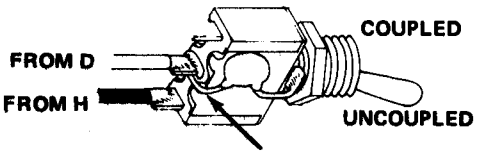
MAINFRAME JUMPER STATUS: All jumpers are in place

OPTION BOARD JUMPER STATUS:

( ) A2 – A3 (or switch)
( ) B2 – B3 (or switch)
( ) J – CH 1 from Stick
( ) K – CH 1 Trim from Stick
( ) L – CH 2 from Stick
( ) M – CH 2 Trim from Stick
( ) N – CH 3 from Stick
( ) O – CH 3 Trim from Stick
( ) P – F
( ) C – B
( ) E – CH 2 to Encoder
( ) G – CH 3 to Encoder
( ) D – H or switch

COUPLE/UNCOUPLE SWITCH

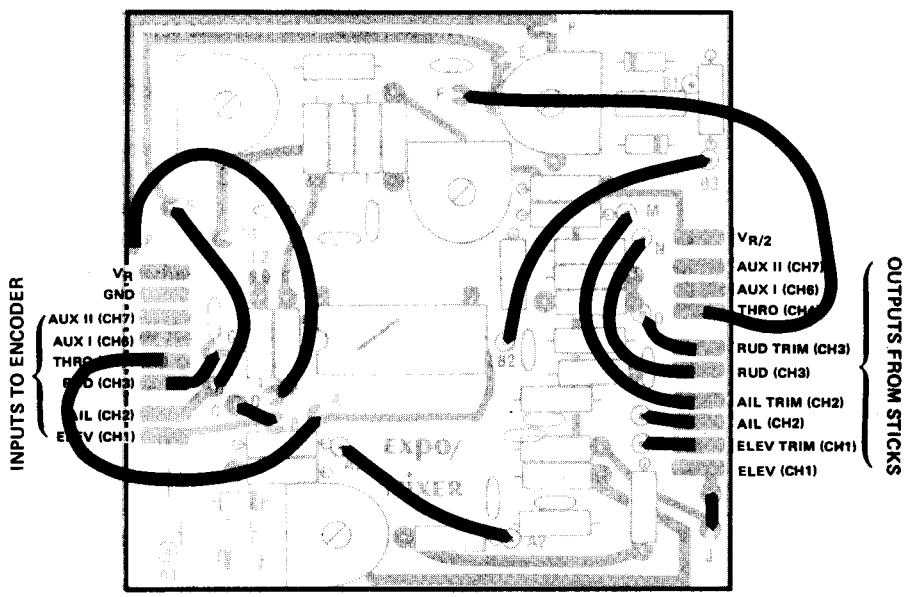
It is recommended that this switch be installed. Some maneuvers will benefit from having the rudder uncoupled.



WATCH OUT FOR SHORT HERE

( ) 1 – Remove jumper from D–H
( ) 2 – Wire the switch as shown.
( ) 3 – Mount the switch.

APPLICATION 4: AILERON AND ELEVATOR EXPONENTIAL RATE; UNI-DIRECTIONAL MIXING OF THROTTLE AND TAIL ROTOR PITCH

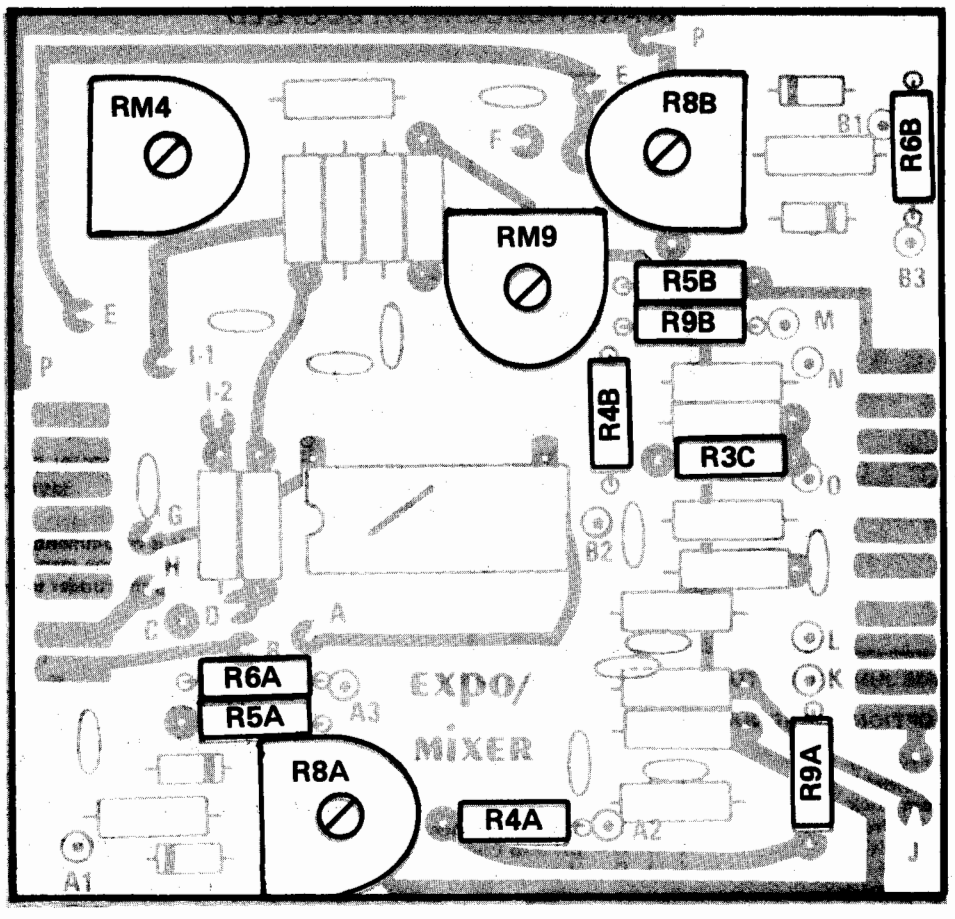


NO SWITCH

MAINFRAME JUMPER STATUS: Remove jumper for CH 4.

OPTION BOARD JUMPERS:

( ) J – CH 1 to Stick
( ) K – CH 1 Trim to Stick
( ) L – CH 2 to Stick
( ) M – CH 2 Trim to Stick
( ) N – CH 3 to Stick
( ) O – CH 3 Trim to Stick
( ) A2 – A3 (or switch)
( ) B2 – B3 (or switch)
( ) C – B
( ) E – H
( ) P – D
( ) F – CH 4 to Stick
( ) G – CH 3 to Encoder
( ) A – CH 4 to Encoder



VII. CALIBRATION

( ) Each application requires a different calibration procedure so follow the specific section for your case. Before beginning, set the four pots on the option board to the middle of their range.

( ) Check that the gold jumpers on the Mainframe are either in place or not in place as required for your application .... this is spelled out in the "Jumper Status" section of the wiring diagrams.

( ) Plug the Expo/Mixer into your transmitter.

A. APPLICATION NO. 1 (BI-DIRECTIONAL, CHANNELS 1 AND 2, V-TAIL, ETC.)

( ) Plug a servo into CH. 1 (elevator). Move the elevator stick full travel up and down and adjust RM9 for about ± 45° throw. CENTER TRIMS

( ) Adjust R8A for equal travel both directions.

( ) Now re-adjust RM9 for about 22 1/2° each way (1/2 the normal throw) when the elevator stick is moved to the extremes.

( ) Plug in a servo to CH. 2 (aileron). Move the aileron and adjust RM4 for maximum throw (not more than ± 45°). Now set R8B so equal travel is achieved in both directions.

( ) Using the two enclosed pressure sensitive "dots", cover pots R8A and R8B so you can't inadvertently adjust them.

( ) Now adjust RM4 for 22 1/2° throw.

( ) Using the Channel Throw Adjust Pots on the Mainframe for Channels 1 and 2, plus RM9 (sets the throw of the servo plugged into CH.1) and RM4 (sets the throw of the servo plugged into CH. 2), you should be able to balance the mixer for desired operation. Realize the reversal switches are still working – they reverse a function now, not just one servo.

B. APPLICATION 2 (COUPLED FLAPS AND ELEVATOR)

( ) Plug a servo into the Elevator Channel. Adjust R8A to give equal travel on both sides as full up and down elevator is given. Plug a servo into the Aileron Channel and do the same for aileron using the pot R8B. Cover these two pots with the pressure sensitive "dots" to prevent inadvertent moving later.

( ) Disengage the mixer by opening the switch or removing the jumper between I1 and I2. Plug a servo into Channel 6 and adjust for desired center and throw using the pots on the Mainframe.

( ) Reinstall the I1-I2 jumper or throw the switch to re-engage the mixer. Rotate the pot RM9 fully clockwise. Now move the elevator stick full up and down; rotate RM9 counter-clockwise until the desired amount of coupled flap throw is achieved, normally 25% to 50% of full travel.

( ) If elevator and flaps are not co-ordinated, swap the pushrod to the other side of the elevator servo and throw the elevator reversal switch.

C. APPLICATION 3 (COUPLED AILERONS AND RUDDER)

( ) Uncouple the mixer by throwing the switch or removing the jumper.
( ) Plug servos into Elevator and Aileron receiver outputs.
( ) Move the elevator stick full up and down and adjust pot R8A for equal servo throw in both directions.
( ) Repeat for the aileron by adjusting R8B for equal servo throw.
( ) Cover pots R8A and R8B with the pressure sensitive "dots" to prevent inadvertent adjusting later.
( ) Now plug a servo into the Rudder output.
( ) Adjust the Main Channel Throw pot on the mainframe for the desired amount of rudder throw when the stick is moved.
( ) Engage the mixer by throwing the switch or installing the jumper.
( ) Move the aileron stick and adjust pot RM4 for the desired amount
( ) Move the aileron stick and adjust pot RM4 until the desired amount of rudder coupling is achieved. If the direction of rudder travel is wrong for proper coordination, match the pushrod placement on the rudder servo output so you get proper direction of rudder movement when the aileron stick is moved. Then, throw the reversal switch for the rudder channel so it moves properly when the rudder stick is moved.
( ) If, when coupled, the amount of rudder travel is not enough for ground handling or other maneuvers, it will be necessary to disengage the mixer for these sequences; this procedure is normally the way it's done.

In the coupled mode, more rudder can be added to an aileron command by moving the rudder stick. Watch out that servo overtravel doesn't occur.

D. APPLICATION NO. 4 (COUPLED THROTTLE/ TAIL ROTOR

( ) Plug servos into Channels 1 and 2 (Forward/Backward, Left/Right Cyclic)
( ) Move the transmitter stick full forward and backward and adjust pot R8A for equal servo travel in both directions.
( ) Move the stick full left and right and adjust pot R8B for equal servo travel.
( ) Cover R8A and R8B with the pressure sensitive "dots" to prevent inadvertent adjustments later. Set the throttle throw and centering as desired.
( ) Move the throttle stick from low to high and adjust pot RM4 until the desired amount of mixed tail rotor pitch is achieved. Realize that at neutral tail rotor (low throttle), the servo will be biased off center.

If the tail rotor goes backwards when the throttle stick is moved, change the linkage to suit and then throw the reversal switch for Channel 3 so you get the proper direction when the stick is moved left and right.
( ) Now, working with the main Channel Throw Adjust pot for Channel 3 on the Mainframe and RM4, get the desired amount of throw for the tail rotor when the stick is moved left and right. Make sure the servo doesn't overtravel when the throttle is at low or high and the Yaw stick is full right or left.

E. TRIM AUTHORITY

If the amount of trim needs to be changed, the values of the plug in resistors R9A (for elevator), R9B (for ailerons), and R3C (for rudder) can be raised for less throw or lowered for more throw. Any 1/4W resistor will work. Go in standard value increments: 56K, 33K, 27K, etc.

F. MODIFICATION OF THE EXPO SLOPE

If the exponential slope is not ideal, it can be modified to match the modeler's preference. Re-read the section on Exponential and change resistors R4, R5, and R6 for Expo amps A and/or B.

VIII. CONCLUSION

If the unit fails to operate, there is very little to go wrong. Check board closely for proper component and jumper placement, for bad or missed joints, and for solder bridges. An ohmeter will check for open or shorted resistors or pots. The IC is about the only thing left to be bad.

If you find you can't get the servos to have equal throw on both sides when adjusting R8A and R8B, make sure the control and trim pots on the stick are set at exactly electronic neutral - - check the main instruction manual.

We hope that this option fulfills your needs. If not, or you have other things that you'd like to see your Silver Seven do, please drop us a note and let us know. We need your input and will listen!

ACE R/C, Inc.
BOX 511 116 W. 19TH ST. HIGGINSVILLE, MO. 64037