11G500

SILVER SEVEN EXPONENTIAL RATE OPTION

Silver Series

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I. 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.

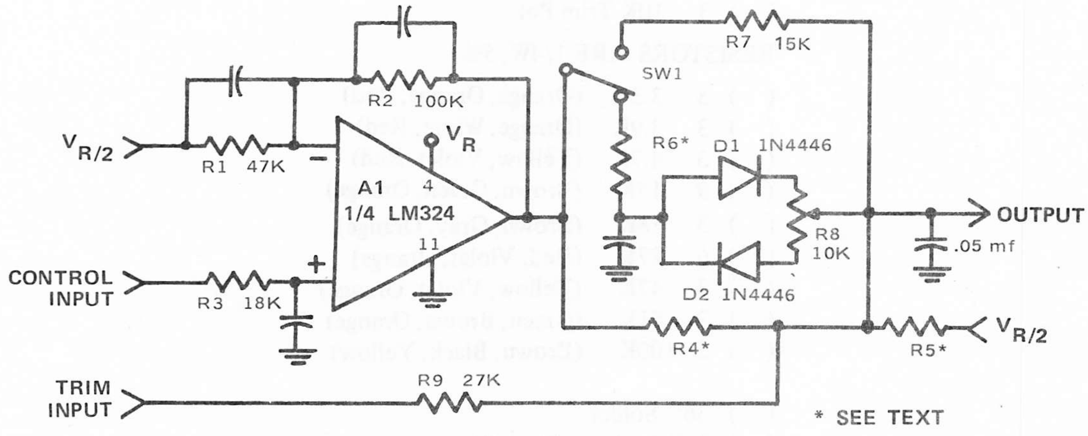
The slope of the curve then becomes higher by the ratio of nearly 10 to 1 after input exceeds 0.1 volts and continues at that slope to the end of stick travel.

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.



UNLABELED CAPS ARE .001 mf BYPASS

ONE SECTION SHOWN
OTHER TWO ARE IDENTICAL

FIGURE E-1
SCHEMATIC

COMPONENT	EFFECT	VALUE RANGE		COMMENTS
LR4	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.
LR5	Simultaneously changes the sensitivity of both the high and the low slope.	3K Minimum Sensitivity	10K Maximum Sensitivity	If too high, servo will overtravel.
LR6	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.

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--15K will give about 20° of throw.

Note that this circuitry is repeated three times for three channels; (channels one, two, and three). On the overlay construction drawing these are designated "A" for those components associated with channel one, "B", for two, and "C" for three.

II. PARTS LIST

( ) 1 PC Board (Log Amp)
( ) 1 LM324 IC
( ) 6 1N4446 Diodes
( ) 32 Mini Sockets
( ) 1 Push Pin
( ) 15 .001 mf Disc Cap
( ) 3 .05 mf Disc Cap
( ) 3 10K Trim Pot

RESISTORS ARE 1/4W, 5%

( ) 3 3.3K (Orange, Orange, Red)
( ) 3 3.9K (Orange, White, Red)
( ) 3 4.7K (Yellow, Violet, Red)
( ) 9 15K (Brown, Green, Orange)
( ) 3 18K (Brown, Gray, Orange)
( ) 6 27K (Red, Violet, Orange)
( ) 3 47K (Yellow, Violet, Orange)
( ) 3 51K (Green, Brown, Orange)
( ) 3 100K (Brown, Black, Yellow)

( ) 36" Solder
( ) 24" Red and Black Wire
( ) 8" Brown, Orange, and Yellow Wire

III. CONSTRUCTION

( ) Check the parts received against the parts list--familiarize yourself with the parts as you go.

( ) Install mini sockets for the plug-in resistors first. These are a pair of sockets for RA4, 5, and 6, RB4, 5, and 6; plus RC4, 5, and 6. (18 sockets in all) Their location is indicated by circles on the overlay drawing. Note that the mini sockets for RA5, RB5, RC5, and RA4 get soldered on the top of the board also.

( ) "Prime" the main sockets for insertion of the resistors using the furnished push pin.

( ) The appropriate resistors and jumpers can be installed into the mini sockets now. Study the three graphs in the circuit description section and choose which exponential curve you think would be best suited to your flying. Select the corresponding resistor values.

( ) Bend the resistor leads over perpendicular to the resistor body and shorten them to about 3/16". Make jumpers for the RA6, RB6, and RC6 slots out of scrap resistor leads.

( ) Plug the selected resistors or jumpers into the locations for RA4, 5, and 6; RB4, 5, and 6, plus RC4, 5, and 6.

( ) Next, install the LM324 IC, making sure the notch or hole is down toward the bottom of the board. There is one joint that gets soldered on the top of the board.

( ) Solder the rest of the resistors, capacitors, diodes, and trim pots to the board, working a few components at a time, going around the board in a clockwise manner. Solder on top where necessary.

( ) Make sure all joints on the top of the board have been made. (11 of them)

( ) Unplug the Trim Adj. Board from the Mainframe of your Silver Seven Transmitter and set aside.

( ) With the components facing you, lay the Log Amp over the black Deans connectors on the Mainframe Encoder PC board. Line up the bottom holes on the edges of the Log Amp 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 Log Amp so the pointed end engages in the bottom right socket of the Deans connector on the Mainframe. Keep the Log Amp board flat on the connector and using your thumbnail, push the pin on into the socket, leaving about 1/32" of the pin protruding through to top of the Log Amp board so you have something to solder to.

( ) Solder the pin to the Log Amp board.

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

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

( ) Install the remaining eight pins in the Log Amp board.

( ) Remove the Log Amp 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.

( ) If desired, the Exponential option can be wired up to switches so Exponential Rate can be engaged or disengaged during a flight sequence. It is recommended that you do this only if you have a specific need for it--normally, Exponential Rate is engaged for the whole flight, so the switches are not necessary.

( ) If you have decided not to install switches, using any color of hookup wire, strip, tin, and solder a jumper (don't make it any longer than necessary) between points "A2" and "A3" on the board--"A1" remains unoccupied. Repeat with a jumper between "B2" and "B3". Also install a jumper between "C2" and "C3". "B1" and "C1" remain open. This completes construction of your Exponential board.

( ) If you need to be able to switch Exponential in and out, you can either obtain three additional SPDT toggle switches (Ace Cat. No. 30K1) or use the existing Dual Rate switches. In either case, a .001 mf capacitor needs to be installed between ground and the middle terminal of each switch. You can solder to the threaded portion of the switch close to the body of the switch--solder won't "take" properly to the metal portion of the switch body. See the drawing furnished. (Fig. E-5) If you are using three additional switches, locate and drill holes for them where desired.

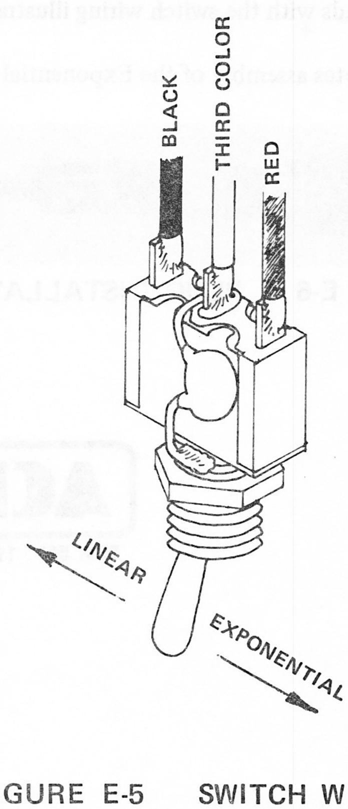


FIGURE E-5 SWITCH WIRING

( ) Three sets of three wire cables need to be installed on the Exponential board. Cut 3 - 8" pieces of red and black wire. Strip, tin, and solder a red wire into hole "A1". Solder a piece of black into "A3". Solder the 8" piece of brown wire into hole "A2". Twist these three wires together--they will go to the switch to engage or disengage Channel 1, (elevator).

( ) Make up another cable with red in "B1", black in "B3", and orange in "B2". Twist together--they will go to the switch for Channel 2 (aileron).

( ) Solder the remaining red into "C1", black into "C3", and yellow into "C2". Twist together--they will go to the switch for Channel 3 (rudder).

( ) Plug the Exponential board into the transmitter.

( ) If you are using three new switches, solder the wires to the switches as indicated. (Fig. E-6) The cable with the brown wire in it is for Ch. 1 (elevator); Orange for Ch. 2 (aileron); and Yellow for Ch. 3 (rudder). Make sure the .001 mf caps are still properly installed.

( ) If you are using 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 Exponential board to the switches as in the preceding step, or if you want to make the Exponential 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 Exponential 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 Exponential rate option is used or not. Make sure the hookup corresponds with the switch wiring illustration. (Fig. E-6)

( ) This completes assembly of the Exponential Board.

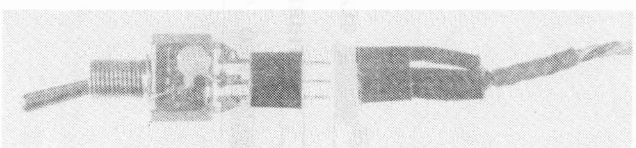


FIGURE E-6 PLUG INSTALLATION

IV. CALIBRATION AND OPERATION

( ) Adjust the three pots on the Exponential board to the center of their range.

( ) With the Exponential board plugged in and the switches in "Exponential" mode (if applicable) turn the system on with servos plugged into Chs. 1, 2, and 3.

( ) Work with the elevator (Ch. 1) first. (We are assuming everything worked properly without the Exponential option.) Move the stick to the extremes--you are probably getting more servo throw in one direction than the other. Adjust the symmetry pot labeled "A" on the Exponential board until the throw is equal in both directions. You should now be getting less servo throw around neutral and normal throw at the extremes which is the normal operation of the Exponential option. If you are getting too much throw, it may be necessary to decrease the throw on each individual channel.

( ) Repeat this adjustment procedure for Ch. 2, aileron, by adjusting the pot labeled "B" and adjust pot "C" for rudder, Ch. 3.

( ) Your Exponential rate option should now be fully operational. Play with it and see what it is doing--if desired, the values of R4, 5, and 6 can be experimented with if you want to try different logarithmic curves. If the amount of trim excursion is not enough, change R9 from 27K to 15K (extras are furnished).

We feel that the Exponential rate option is one of the most desirable features of the Silver Seven. Once you have used it, particularly with a high performance pattern ship or a racing airplane, we feel you, too, will be convinced of its merits.

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FIGURE E-2 GRAPHS

LINEAR RATE

(Exponential Option Not Engaged)

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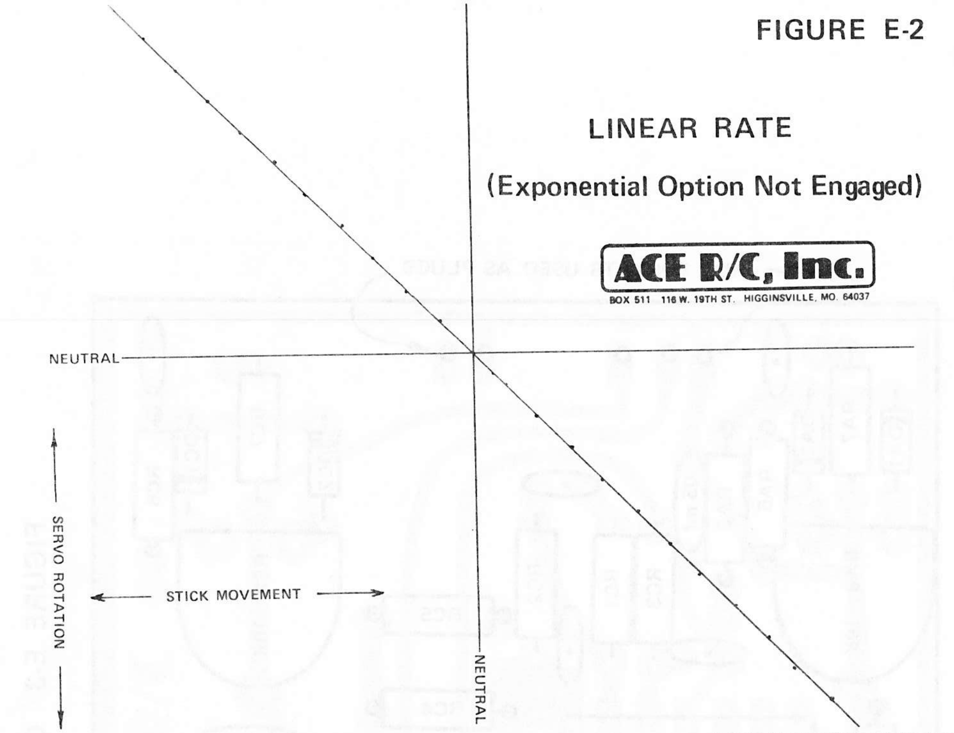

R4 = 15K (Brown, Green, Orange)
R5 = 3.3K (Orange, Orange, Red)
R6 = 0 ohms (Jumper)

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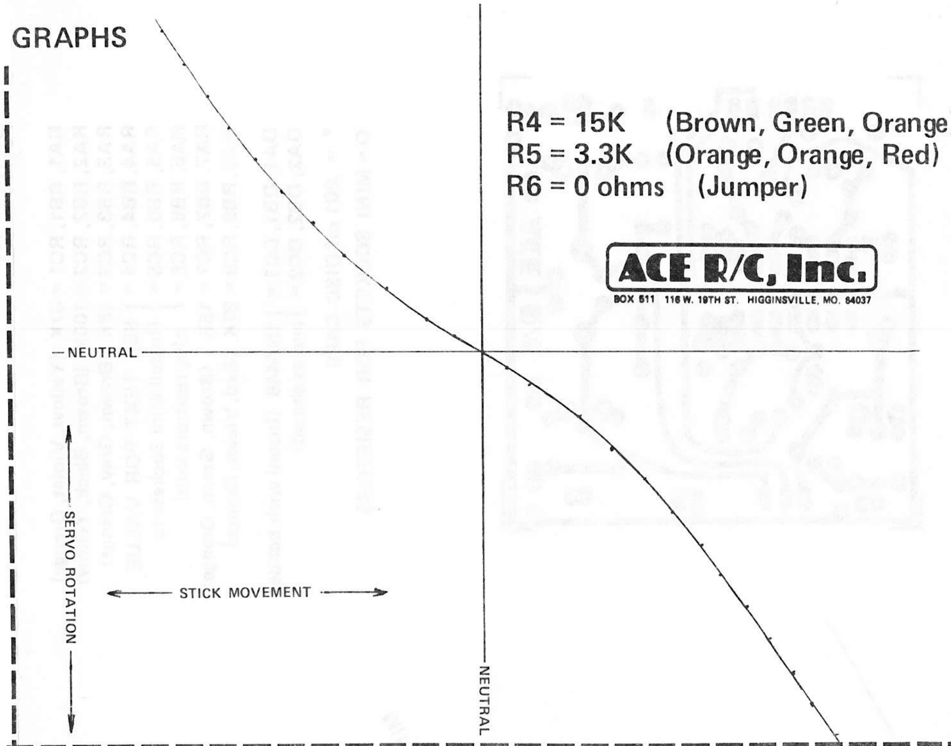

R4 = 27K (Red, Violet, Orange)
R5 = 3.9K (Orange, White, Red)
R6 = 0 ohms (Jumper)

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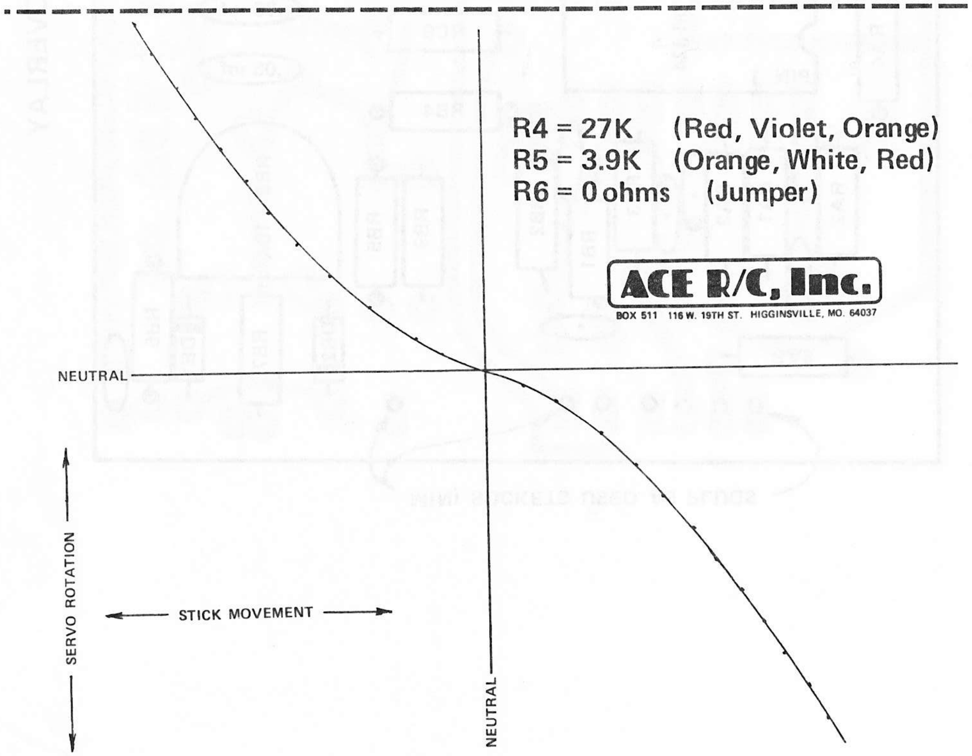

R4 = 51K (Green, Brown, Orange)
R5 = 4.7K (Yellow, Violet, Red)
R6 = 0 ohms (Jumper)

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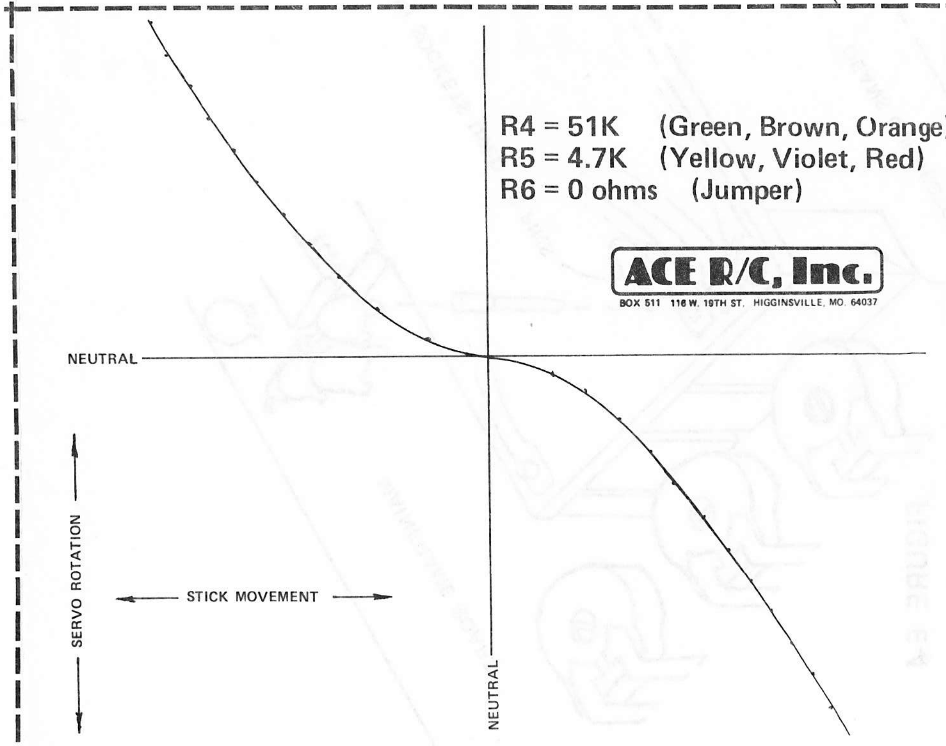
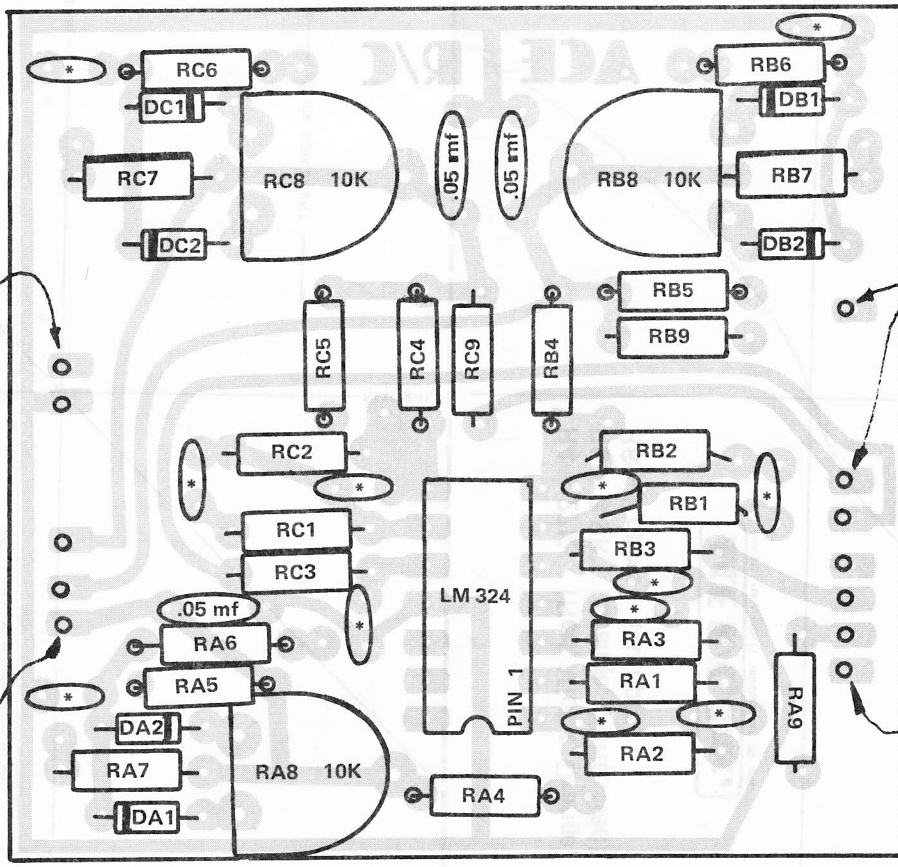


FIGURE E-3 OVERLAY



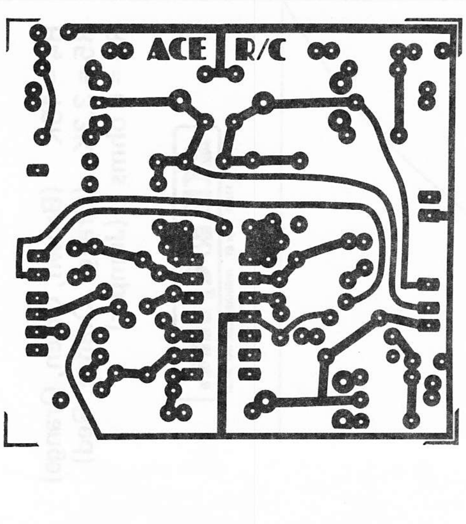
PARTS ID

RA1, RB1, RC1 = 47K (Yellow, Violet, Orange)
RA2, RB2, RC2 = 100K (Brown, Black, Yellow)
RA3, RB3, RC3 = 18K (Brown, Grey, Orange)
RA4, RB4, RC4 = } SEE TEXT FOR VALUE
RA5, RB5, RC5 = } (Install Mini Sockets to
RA6, RB6, RC6 = } plug resistors into)
RA7, RB7, RC7 = 15K (Brown, Green, Orange)
RA9, RB9, RC9 = 27K (Red, Violet, Orange)

DA1, DB1, DC1 = } 1N4446 (Install with banded
DA2, DB2, DC2 = } end as shown)

* = .001 mf DISC CAPS

O = MINI SOCKETS FOR RESISTORS



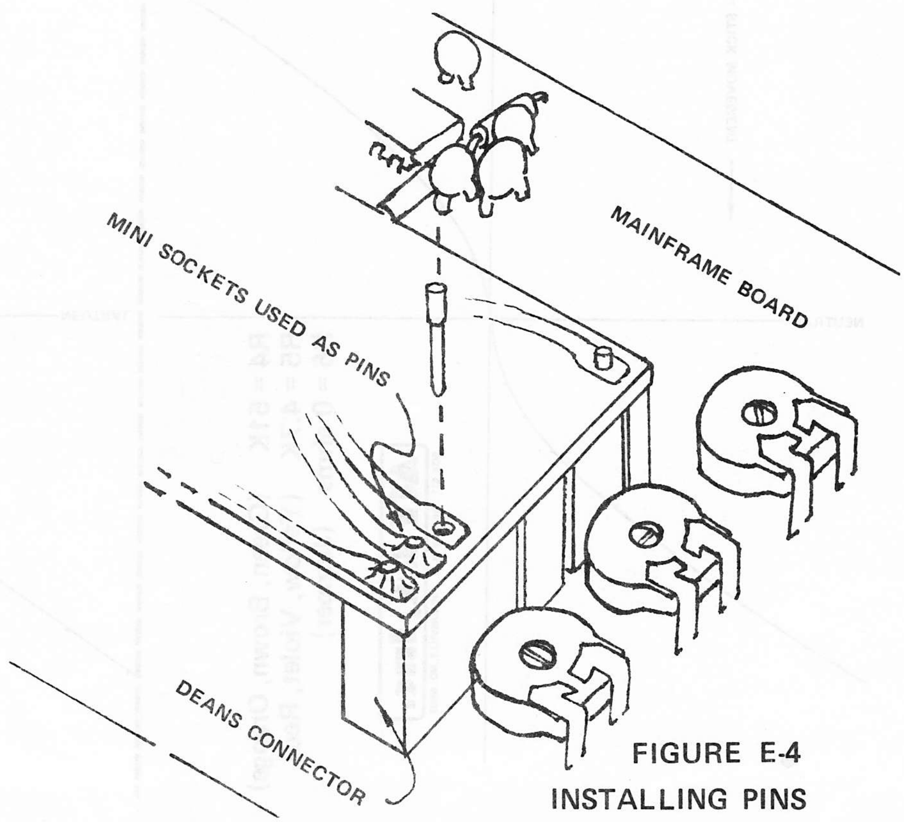


FIGURE E-4
INSTALLING PINS