Assembly and Operation Manual

Silver Seven

ACE R/C, Inc.

Designed by Fred Marks

ACE R/C, Inc.

BOX 511 116 W. 19TH ST. HIGGINSVILLE, MO. 64037

SERVING THE RADIO CONTROL HOBBYIST SINCE 1953

7:30 a.m. to 4:00 p.m.
Monday through Friday
(816) 584-7121

OVERVIEW

In celebration of its Silver Anniversary, Ace R/C is proud to make available the first in a series of competition radio system kits, the Silver Seven. Two years of development has produced one of the finest quality, most sensibly designed and engineered, truly economical, personally programmable radio system kits in existence. It represents the latest in a long line of successful kits manufactured by Ace, with its ancestry being the proud offspring of such designers as Walt Good, Howard McEntee, Ed Lorenz, Phil Kraft, plus many more, sounding like a "Who's Who" of R/C history! The Silver Seven's closest of kin is the Digial Commander series of kits, also designed by Fred Marks, which is currently being used by thousands of satisfied modelers.

Two things were continually kept in mind in the development of the Silver Seven. Mainly, the design was always kept "open-ended." That is, the critical functions of the transmitter and its options were kept as versatile as possible so, you, the builder, could select how a particular function would operate, plus physically position the switch, knob, button, lever, or whatever, wherever you think it should be according to your personal preference and habits; you are not locked in with what the designer thinks is best. It is truly a "custom" radio.

From the ground up, another thing was continually considered; this was to be a kit radio. "Will the modeler be able to put it together?" was a question asked in the designer's mind hundreds of times. The end result is a radio that you can enjoyably put together in a reasonable amount of time and produce a customized transmitter that is an extension of your personality and abilities, and that is second to none as far as performance and capabilities.

I would like to personally thank the following people for investing their precious time and considerable abilities into this project.

Tom Runge

Tom Runge, Ace R/C, Inc.

DESIGNER: Fred Marks
PROTOTYPE BUILDING AND TESTING: Paul Holsten, Bill Hershberger, Bert Belt.
INSTRUCTION DEVELOPMENT: Bob Aberle, Red Costlow, Carl Lindsey, Paul Edmunds, Bob Baugher
GRAPHICS: Robert Quarti, "Graphic End."

Plus the numerous modelers that have given their constructive inputs to the project over the phone and the rest of the Ace R/C staff for their hard work and support.

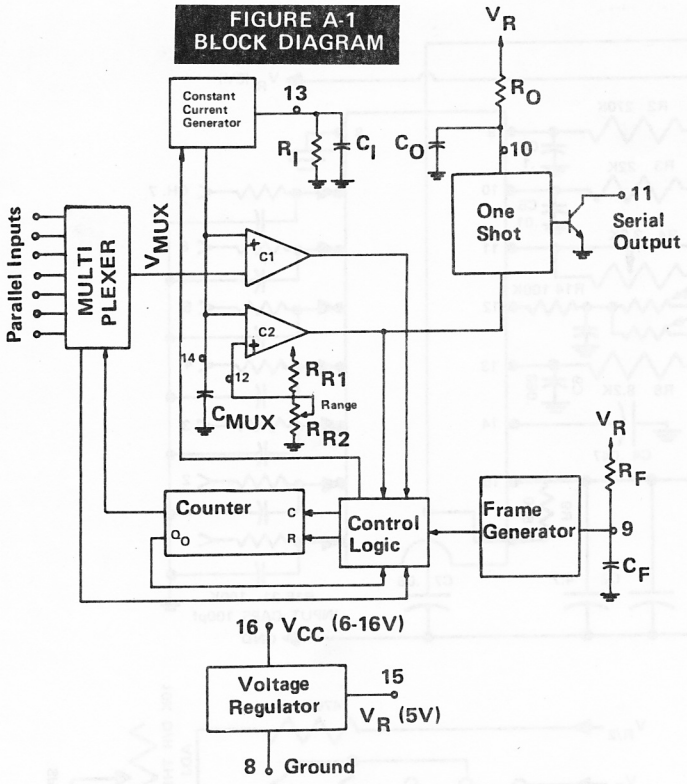
WARNING AND DISCLAIMER
PLEASE READ

Improper use of this unit may cause serious personal injury to yourself, to others, or result in property damage. The user is urged to read and understand the information contained herein before operating the equipment. Prudent and reasonable conduct when operating this radio system is requested by the manufacturer.

Ace R/C, Inc. assumes no responsibility for accident, injury, property damage, or death, incurred as a result of any use of this equipment whatsoever. The user accepts the responsibility to comply with all safety requirements, including, but not limited to, those established by all federal, state and local governmental agencies, the regulations of the FCC (Federal Communications Commission) Part 95, and to abide by the rules and recommendations of all non-governmental bodies related to the use of this equipment, including but not limited to, those set forth by the Academy of Model Aeronautics.

Ace R/C will not give refunds on any kits once assembly has begun.

FIGURE A-1
BLOCK DIAGRAM



I. THE ENCODER MAINFRAME-- CIRCUIT DISCUSSION

A. THE NE5044'S INNER WORKINGS

The heart of the Silver Seven transmitter is the Signetics NE5044 encoder integrated circuit. The following description of the internal workings is taken from Signetics' Application Notes for the device. Refer to the block diagram, Figure A-1 in the following discussion.

The NE5044 is a programmable parallel input, serial output encoder containing all the active circuitry necessary to generate a precise pulse width modulated signal. The number of channels is externally programmable by grounding unused control inputs. A multiplexed dual linear ramp technique is used to provide excellent linearity, minimal crosstalk and low temperature drift. An onboard 5 volt regulator eliminates power supply sensitivities and has up to 20 ma current capability for driving external loads.

The multiplexer functions as a strobed voltage follower so that each input, when active, appears as a high impedance input and transfers the input voltage to the output. Only one of the seven inputs is active at any time and when a given input is inactive, it appears as an open circuit. The high impedance multiplexer inputs eliminates loading on control inputs and simplifies mixing circuits where several controls may be mixed onto one input.

Internal voltage clamping prevents encoder malfunction if any input is shorted to supply, ground or open circuited. The remaining channels will continue to be encoded. This feature eliminates catastrophic failures due to control pot opens or shorts.

The constant current generator is a bidirectional current source whose current, I_C, is set by an external resistor R_I. The current generator alternately charges and discharges the capacitor C_{mux}. An internal feedback loop maintains a constant current and very high output impedance. This yields a typical linearity error of voltage input to pulse width output for the encoder of less than 0.1%. An external capacitor, C_I, is required to insure stability of the feedback loop, and sets the current rate in conjunction with R_I.

Two high gain comparators, C1 and C2, compare the voltage across C_{mux} with the multiplexer output voltage and the range input voltage. The comparators feed the counter control logic which in turn controls the counter and current generator. The operation of this loop is as follows;
When I_c is positive (sourced from the current generator into C_{mux}.) the capacitor linearily charges up until it reaches a voltage equal to the multiplexer output voltage, assume this to be the voltage at pin 1, V1. For the Silver Seven, this is 2.5V ± 0.5V. At this time the output of C1 goes high which reverses the direction of I_c (sinking into current generator from C_{mux}.) C_{mux} now linearily discharges until it reaches the voltage set on pin 12, V_{range}, determined by the divider network R_{R1} and R_{R2}. At this time the output of C2 goes high which again reverses the polarity of I_c, clocks the counter and triggers the output one shot. C_{mux} again charges up but now C1 goes high when C_{mux} reaches V2, the voltage on pin 2. The resulting voltage waveform on C_{mux} is a triangle wave whose positive peaks correspond to the voltages on pins 1 through 7 for the first through seventh peak and whose negative peaks are constant and equal to V_{range}. This waveform is shown in the first portion of Figure A-2.

Independent control of I_c and V_{range} allows the encoder to be tailored to the desired combination of input voltage changes and output pulse width changes.

The frame generator controls the encoder frame time. It can operate as an astable multivibrator. The encoder will generate a synchronizing pulse at the end of each frame. When C_{mux} reaches the seventh positive peak it reverses and discharges to V_{range}. The counter is clocked to the state where Q_0 is high when $V_{C_{mux}} = V_{range}$. C_{mux} again charges up but now the output of C1 is ignored, due to Q_0 being high, and charges up to V_{clamp} and remains there. The encoder will remain in this state until a pulse from the frame generator is received. The frame generator operates in the astable mode producing a narrow pulse output. This pulse allows C_{mux} to start discharging again. When C_{mux} reaches V_{range}, the counter is clocked to the state where Q1 is high (channel 1) and the entire process starts over. The frame period in this mode is .66 x $R_F C_F$ and is referred to as the fixed frame mode.

The output one-shot generates a positive pulse whose width is equal to $R_o C_o$. The output is an open collector, NPN transistor capable of sinking 25 ma. The waveforms produced are shown in Fig. A-2.

An internal voltage regulator gives a constant 5V (V_R) out of pin 15. Pins 8 (ground) and 16 (+6-16V) input the voltage source.

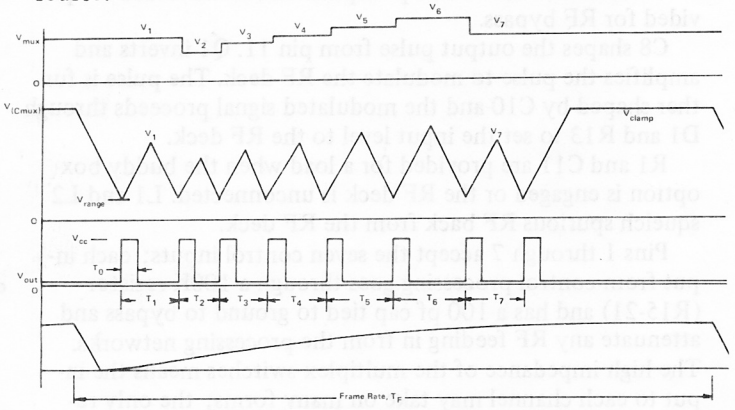


FIGURE A-2
ENCODER TIMING

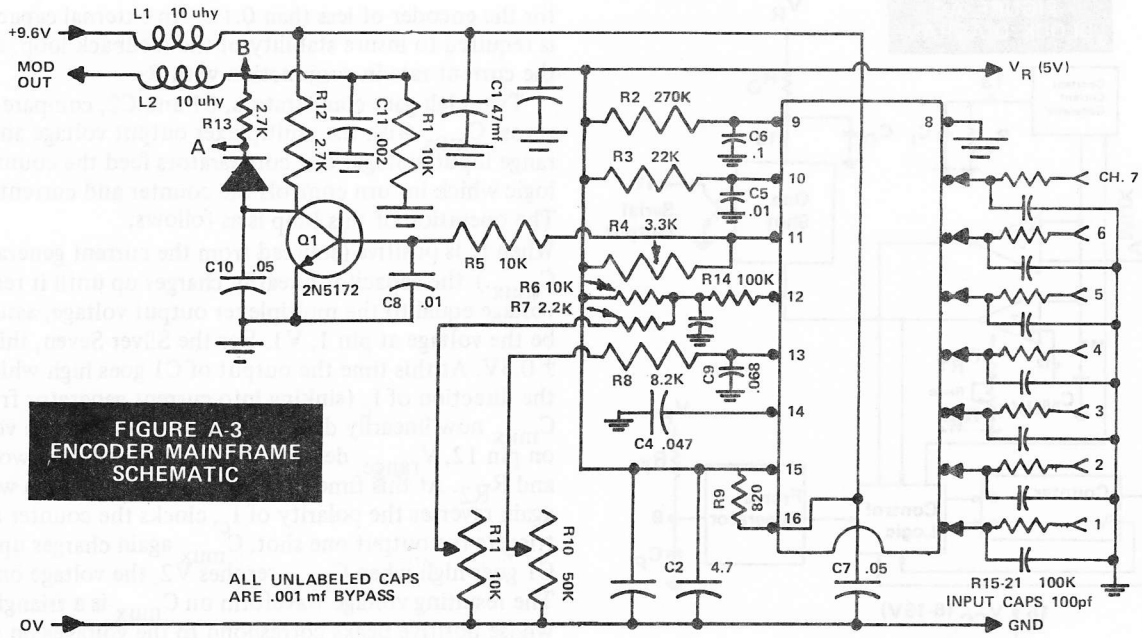


FIGURE A-3
ENCODER MAINFRAME SCHEMATIC

B. SILVER SEVEN ENCODER

In order to correlate between the block diagrams and the Silver Seven Mainframe Encoder schematic, the following chart is furnished:

$C_0 = C5$ $\quad C_F = C6$ $\quad R_{R1} = R6$

$R_0 = R3$ $\quad R_F = R2$ $\quad R_{R2} = R7/R11$

$C_I = C9$ $\quad C_{MUX} = C4$

$R_I = R8/R10$

Referring to Figure A-3, R2 and C6 set the duration of a frame at a fixed 20 milliseconds (ms). C5 and R3 set the output modulation pulse width at a nominal 250 microseconds (us). A 250 us ramp appears at pin 10 and the pulse appears as a full V_R (regulated 5V) amplitude square pulse at pin 11. At pin 11, R4 and R5 set a bias for the base of Q1.

The divider network formed by R6 and R7/R11 sets the desired throw range of 1.5 ms neutral $\pm$ 0.5 ms. The series resistance set by R8/R10 plus C9 at pin 13 interacts with C4 at pin 14 to set the nominal output control pulse width (not the modulation pulse) to a nominal 1.5 ms.

C1, C2 and C7 provide power supply filtering. R9 is a pull up resistor to insure proper regulator start-up.

Various .001 mf or 100 pf capacitors (unnumbered are provided for RF bypass.

C8 shapes the output pulse from pin 11. Q1 inverts and amplifies the pulse to modulate the RF deck. The pulse is further shaped by C10 and the modulated signal proceeds through D1 and R13 to set the input level to the RF deck.

R1 and C11 are provided for a load when the buddy box option is engaged or the RF deck is unconnected. L1 and L2 squelch spurious RF back from the RF deck.

Pins 1 through 7 accept the seven control inputs; each input from control processing goes through a 100K resistor (R15-21) and has a 100 pf cap tied to ground to bypass and attenuate any RF feeding in from the processing networks. The high impedance of the multiplex switches means the input to each channel may take on many forms; the only requirement is that they all be conditioned to have the same end voltages, nominally 2.5V $\pm$ 0.5V.

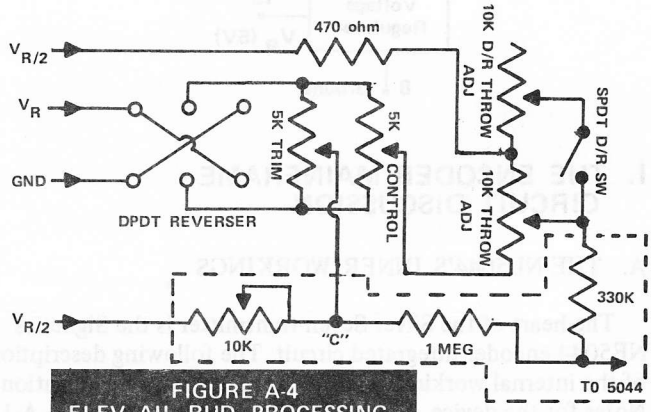


FIGURE A-4
ELEV.,AIL.,RUD. PROCESSING

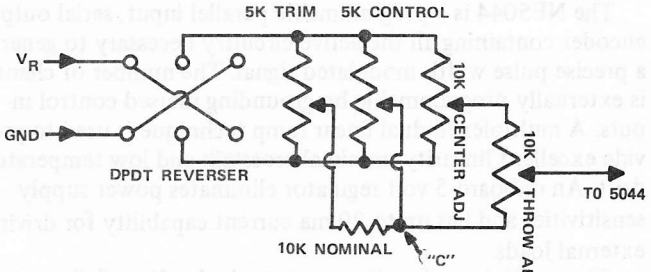


FIGURE A-5
THROTTLE PROCESSING

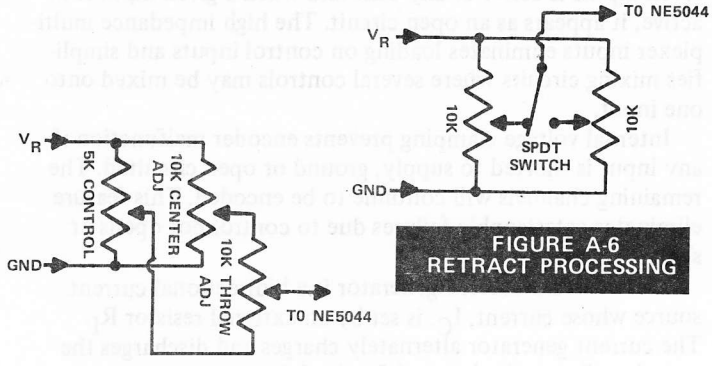


FIGURE A-6
RETRACT PROCESSING

FIGURE A-7
AUX. I, II PROCESSING

C. INPUT SIGNAL CONDITIONING

We have chosen four basic ways to condition the inputs, depending on the functions performed. Channels 1, 2 and 3 (elevator, aileron and rudder) have DPDT direction reversing switches, normal throw adjust pots, and dual rate throw adjust pots, which are engaged by a SPDT toggle switch--Figure A-4. Channel 4 has a DPDT reversing switch, a centering pot, and a throw adjust pot--Figure A-5. Channel 5 (retract) has a pot to adjust servo travel location in each SPDT switch position--Figure A-6. Channel 6 and 7 (Aux. I and Aux. II) have centering and throw adjust pots--Figure A-7.

Each of the four stick functions (Chs. 1, 2, 3, and 4) are supplemented by an additional 5K pot in parallel to provide trim. For Chs. 1, 2, and 3 a pot is provided on the Trim Adjust board to vary the amount of throw achieved when the trim lever is moved. A changeable fixed resistor is provided on Ch. 4 to vary the amount of trim authority.

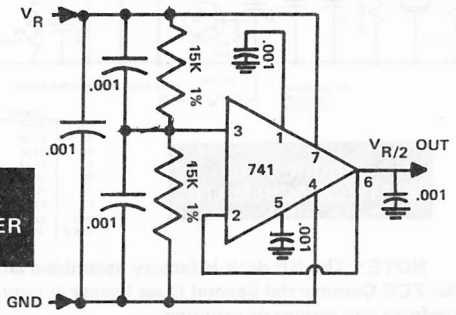


FIGURE A-8
$V_{R/2}$ DIVIDER

D. V_R DIVIDER CIRCUIT

In order to provide a precise division of V_R by 2 which gives absolute centering of channels 1, 2 and 3--mainly necessary when the exponential rate and mixing options are incorporated, the circuit shown in Figure A-8 is incorporated. Precision 15K resistors divide V_R to provide a reference for the positive input to the 741 op amp.

The output from the op amp is fed back to the minus input so the op amp acts as a high gain amplifier that keeps the output locked precisely to the positive reference input to hold $V_{R/2}$ true no matter what is happening beyond the output.

E. IMPLEMENTING THE OPTIONS

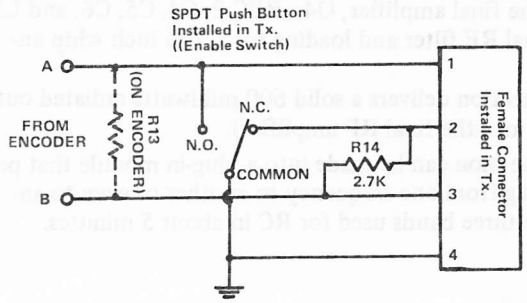
Connectors exist on the Mainframe board so that an option board can be plugged in; this allows the information (voltage) from the control processing (sticks, adjust pots, etc.) to be modified before it is inputted to the encoder IC. In this way, mixing of any channels can be achieved or features such as exponential rate (soft neutral) can be incorporated. If these options are not utilized, provisions are made so a jumper can be installed and the voltage from the processing network will go directly to the IC.

Complete descriptions of the option boards are furnished with the units.

F. BUDDY BOX CIRCUIT

If desired, buddy box capability may be introduced to the transmitter. NOTE: No parts are furnished for this modification, but a special parts package is available direct from Ace R/C that contains a female connector, two male connectors, the wire necessary to make up the interconnect cable, a 2.7K resistor, and a SPDT push button switch. (Cat. No. 11E707—Buddy Box Hardware, $8.50--add $1 handling.) Sufficient physical room is left for the connector in the lower left hand corner of the case as you face the rear of the transmitter--you will have to make the necessary cutouts in the case.

In an attempt to define terms, the transmitter called "Trainer" is the one held by the trainer but is actually owned by the student--it is the one doing the broadcasting so naturally, the receiver tuned to it will be the one in the student's plane. The student will be flying the transmitter called "Student", but this transmitter is owned by the instructor. Realize that, by mutual consent between the two people involved, both transmitters will have to be set up the same as far as servo travel direction, throw, neutrals, etc.



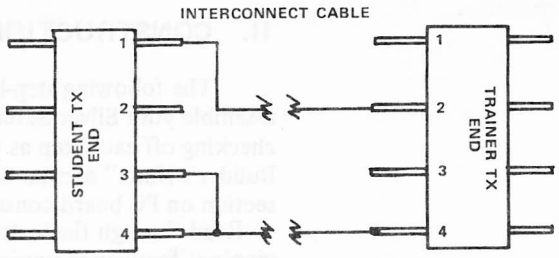


FIGURE A-9
BUDDY BOX OPTION

Referring to Figure A-9, note the wiring configuration for both transmitters; an additional 2.7K 1/4 watt resistor is added and can be physically placed in the circuit at the female connector. The interconnect cable has a "Student" end that plugs into the Student's transmitter and a "Trainer" end that plugs into the Trainer's transmitter.

Looking at the Student's transmitter, when the cable is plugged in, the modulation output to the RF deck ("B") shorts to ground, killing the radiation of RF. The encoder continues to operate with its output from point "A" being separated by a 2.7K resistor, R13. This encoder output is routed to pin one on the Student transmitter connector, and subsequently hooks to pin two on the Trainer transmitter. It must be kept in mind that the student must never depress the push button on his transmitter; to do so would kill both transmitters.

Looking at the Trainer Transmitter, input from the Student encoder arrives at Pin 2 where it connects R14 (2.7K) and is routed to the normally closed terminal of the "enable" switch. When the switch is not pushed (the trainer has command) the

student encoder input goes to ground and point "B" goes through R14 to ground via the switch, so the Trainer transmitter is operating as though there were no buddy box whatsoever.

When the enable switch is depressed, (student given control) output from the Trainer encoder is grounded via the normally opened connection of the switch and the Student encoder signal is routed via R14 to the Trainer RF deck, thus broadcasting the encoded signal of the student's transmitter. Remember, the student must never depress the buddy box button on his transmitter.

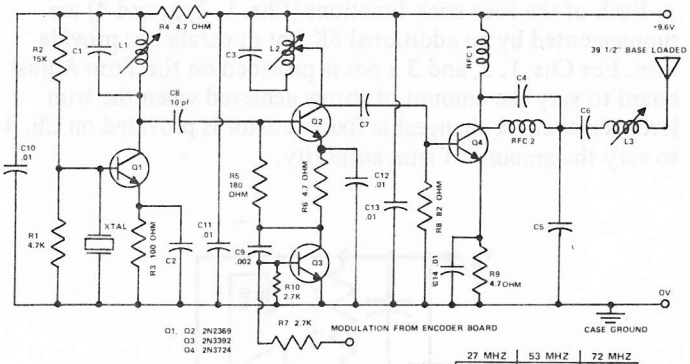
NOTE: The Buddy Box option will only work between two Silver Seven transmitters! It is not possible to interface a Silver Seven transmitter with another model or brand.

G. RF DECK CIRCUIT

The RF section (Figure A-10) is quite simple. A crystal oscillator operating at the desired frequency (no doubling or tripling, etc.) produces the unmodulated, unamplified RF. The oscillator is formed of R1, R2, R3, C1, C2, L1, Q1 and the crystal. R4 drops the supply voltage to the oscillator. The RF is coupled to an intermediate stage amplifier and modulator formed by Q2, Q3, L2, C3 and related loading resistors and shaping capacitors. From the modulator-amplifier, C7 couples the RF to the final amplifier, Q4. RFC-2, C4, C5, C6, and L3 form the final RF filter and loading for a 39½ inch whip antenna.

The RF section delivers a solid 600 milliwatts radiated output (1 watt into the final RF amplifier).

The RF section can be made into a plug-in module that permits changing from one frequency to another or even to another of the three bands used for RC in about 5 minutes.



	27 MHZ	53 MHZ	72 MHZ
C1	33 pf	15 pf	3.9 pf
C2	62 pf	33 pf	33 pf
C3	33 pf	20 pf	25 pf
C4	47 pf	10 pf	6.8 pf
C5	33 pf	20 pf	15 pf
C6	10 pf	10 pf	3 pf
C7	62 pf	62 pf	25 pf
RFC-1	22 uH	4.7 uH	4.7 uH
RFC-2	.15 uH	.22 uH	.22 uH

FIGURE A-10
RF DECK SCHEMATIC

NOTE: The RF deck is factory assembled and tuned. An FCC Commercial Second Class license is required to perform any service or retuning.

II. CONSTRUCTION

The following step-by-step instructions are furnished to assemble your Silver Seven transmitter. Follow them in order, checking off each step as you go. Please re-read the "Kit Builder's Hints" section before beginning, particularly the section on PC board construction!

Read through the instructions in their entirety before beginning; familiarize yourself with the parts--several hints are provided to help you organize them. If you put the instructions in a three ring binder, it is much easier to page through them to refer to various illustrations.

A. PARTS LIST

Check the parts you received against the parts list. Contact Ace R/C immediately in the case of any shortages.

MAINFRAME ENCODER

( ) 1 NE5044 IC
( ) 1 LM741 IC
( ) 1 1N4446
( ) 1 2N5172

( ) 2 10 uhy Chokes

( ) 7 100 pf Disc cap
( ) 11 .001 mf Disc Cap
( ) 1 .002 mf Disc cap
( ) 1 .01 mf Disc cap
( ) 3 .05 mf Disc cap
( ) 1 .068 mf Tantalum
( ) 1 0.1 mf Tantalum
( ) 1 4.7 mf Tantalum
( ) 1 10 mf Tantalum
( ) 1 47 mf Tantalum
( ) 1 .01 mf (103) Bluecap
( ) 1 .047 mf Mylar

RESISTORS ARE 1/4W 5% UNLESS SPECIFIED

( ) 3 470 ohm (yellow, violet, brown)
( ) 1 820 ohm (grey, red, brown)
( ) 1 2.2K (red, red, red)
( ) 2 2.7K (red, violet, red)
( ) 1 3.3K (orange, orange, red)
( ) 1 8.2K (grey, red, red)
( ) 4 10K (brown, black, orange)
( ) 2 15K 1% (labeled)
( ) 1 22K (red, red, orange)
( ) 8 100K (brown, black, yellow)
( ) 1 270K (red, violet, yellow)
( ) 15 10K Trim Pot
( ) 1 50K Trim Pot

( ) 10 Mini Sockets
( ) 4 Jumpers
( ) 2 "L" Brackets
( ) 4 4-40 X 1/4" Binder Head Screws
( ) 2 4-40 Nuts
( ) 2 No. 4 Lockwashers
( ) 4 CW DPDT Switches
( ) 1 PC Board

OUTBOARD MECHANICAL COMPONENTS

( ) 1 Case
( ) 2 Three Channel Stick Kits with Five 5K pots each
( ) 1 RF Deck w/frequency plate & FCC sticker
( ) 1 Charge Connector w/hdw.
( ) 4 SPDT Toggle Switches w/hdw.
( ) 1 39½" Antenna w/hdw.
( ) 1 Antenna Mount
( ) 1 4PDT Noble Switch w/hdw.
( ) 1 Noble Switch Front Cover

( ) 1 Four Pin Female Deans Connector
( ) 1 Six Pin Female Deans Connector
( ) 1 Eight Pin Female Deans Connector

( ) 1 9.6V Mini ESV
( ) 8 500 mah AA Ni-cd Battery Cells
( ) 2 Flat Battery Cases
( ) 18" 1/16" Double Sided Tape
( ) 8 Pressure Sensitive Transmitter Feet
( ) 1 set Pressure Sensitive Function Labels
( ) 6 Small Wrap 'n Ties
( ) 2 2-56 X 1/4" Binder Head Screws
( ) 1 Push Pin
( ) 9" each 3-wire cable: Red and Black plus Brown, Orange, Yellow, Green, Blue, Violet, Grey, White, Brown/White, Orange/White, Yellow/White, Green/White.
( ) 12" 2-wire cable: Red/Black
( ) 9" each 2-wire cable: Brown/Brown, Orange/Orange, Yellow/Yellow
( ) 7" White Wire
( ) 60" Solder

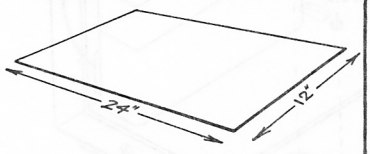
TRIM ADJ BOARD

( ) 1 Trim Adj. PC Board
( ) 3 10K Trim Pots
( ) 3 330K (Orange, Orange, Yellow)
( ) 3 1 MEG (Brown, Black, Green)
( ) 13 Mini Sockets

PARTS ORGANIZATION HINTS:

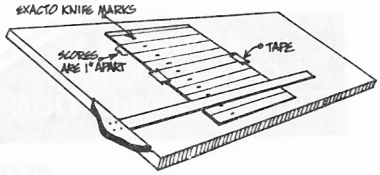
COMPONENT ORGANIZER

1. START BY CUTTING A RECTANGLE OF 24"X 12" FROM REGULAR POSTER BOARD STOCK. USE AN EXACTO KNIFE & STEEL STRAIGHT-EDGE TO ENSURE ACCURACY.



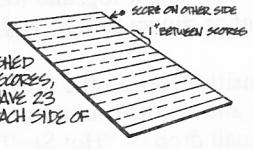
IF YOU HAVE ACCESS TO A DRAFTING TABLE & T-SQUARE, THIS PROJECT IS MUCH EASIER TO ACCOMPLISH. HOWEVER, A STRAIGHT-EDGE & A PIECE OF PLYWOOD WORK SATISFACTORILY.

2. PLACE THE POSTER BOARD ON A FLAT WOODEN BOARD AND TAPE THE SIDES AS SHOWN.
*MARK OFF THE LENGTH IN ½" INCREMENTS & LIGHTLY SCORE EVERY OTHER MARK THE FULL WIDTH OF THE BOARD.



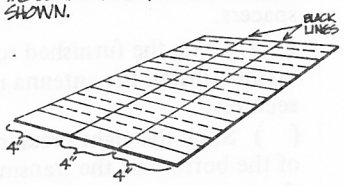
*MAKE MARKS BY PUSHING THE POINT OF THE EXACTO KNIFE THROUGH THE POSTER BOARD.

3. NEXT, TURN THE POSTER BOARD OVER & SCORE THE UNSCORED MARKS ON THE OTHER SIDE. YOU WILL SEE THE MARKS ON THE OTHER SIDE AS LITTLE HOLES MADE BY THE EXACTO KNIFE. REMEMBER, NOT TO CUT THROUGH THE POSTER BOARD WHEN MAKING YOUR SCORES.

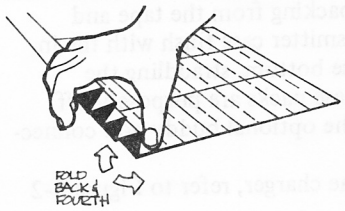


NOTE: WHEN YOU ARE FINISHED MAKING ALL SCORES, YOU SHOULD HAVE 23 SCORES ON EACH SIDE OF THE BOARD.

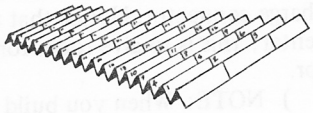
4. MAKE TWO MARKS 4" APART ACROSS THE WIDTH & USING A MARKING PEN, DIVIDE THE BOARD IN THREE EQUAL PARTS AS SHOWN.

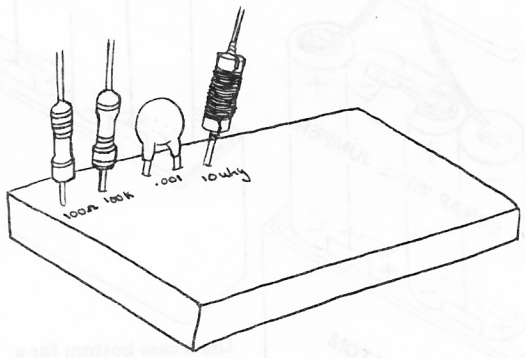


5. FOLD THE BOARD IN A FLIP-FLOP MANNER TO FORM AN ACCORDION-LIKE CONFIGURATION. THE SCORES YOU HAVE PREVIOUSLY MADE WILL FACILITATE THIS OPERATION.

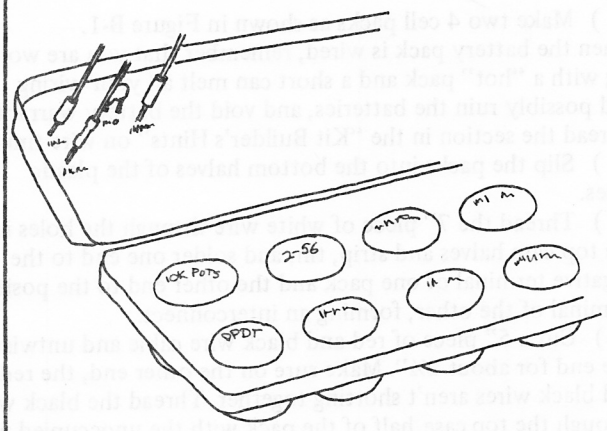


6. THE ORGANIZER YOU HAVE JUST MADE WILL BE DIVIDED INTO 69 DIFFERENT COMPARTMENTS. WE SUGGEST YOU NUMBER THE COMPARTMENTS TO COINCIDE WITH THE CONSTRUCTION STEPS OF YOUR ACE RADIO OR SERVO KIT. ORGANIZE THE COMPONENTS AS YOU READ THROUGH THE STEPS FOR THE FIRST TIME.





Parts can be stuck into scrap foam and the foam labeled with a felt tip pen as they are being checked against the parts list.

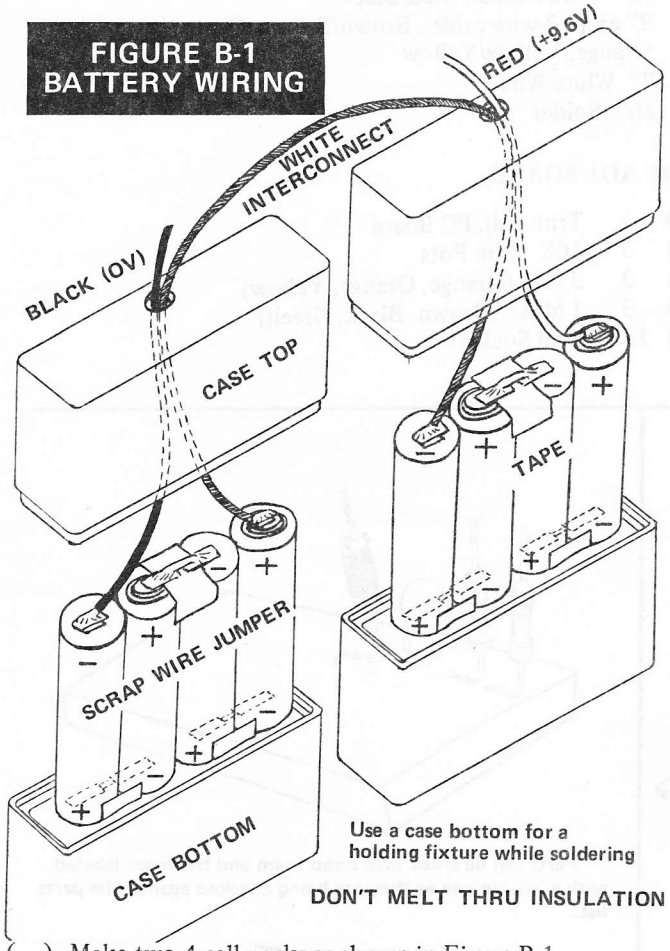


An egg carton is handy for organizing small parts--label "pockets" with a felt tip pen.

B. BATTERY AND CHARGE JACK WIRING AND INSTALLATION

( ) Care must be exercised when wiring the battery packs. To prevent shorts, don't work on a metal surface or have extraneous wire lying around. Always maintain proper polarity--the shouldered end of the battery is positive (+) and the flat end is negative (-). When wiring the cells together use scrap resistor leads or short pieces of wire to jumper the solder tabs and a piece of plastic tape under the tabs to prevent shorting and to hold the cells while soldering. Use a case bottom as a holding fixture to keep the batteries together while soldering. To prevent melting through the insulation, don't use excessive heat. Always "tin" the tabs and jumpers before soldering.

FIGURE B-1 BATTERY WIRING



( ) Make two 4 cell packs as shown in Figure B-1. When the battery pack is wired, remember that you are working with a "hot" pack and a short can melt all your wiring and possibly ruin the batteries, and void the battery warranty. Reread the section in the "Kit Builder's Hints" on wire tinning.

( ) Slip the packs into the bottom halves of the plastic cases.

( ) Thread the 7" piece of white wire through the holes in the top case halves and strip, tin, and solder one end to the negative terminal of one pack and the other end to the positive terminal of the other, forming an interconnect.

( ) Cut a 5" piece of red and black wire cable and untwist one end for about 2½". Make sure on the other end, the red and black wires aren't shorting together. Thread the black wire through the top case half of the pack with the unoccupied negative terminal and solder it to that negative terminal. Repeat with the red wire, soldering it to the unoccupied positive terminal.

( ) Snap the case halves together and secure with plastic tape. Set aside for now.

( ) Strip, tin and solder the remaining red and black wire cable to the female portion of the charge jack as shown in Figure B-2. Use plastic sleeving to cover the connections and make sure the red wire goes to the middle pin.

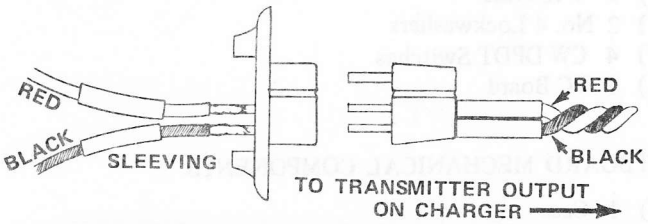


FIGURE B-2 CHG. JACK/PLUG WIRING

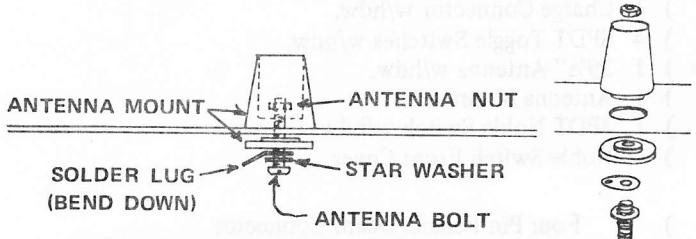


FIGURE B-3 ANTENNA MOUNT

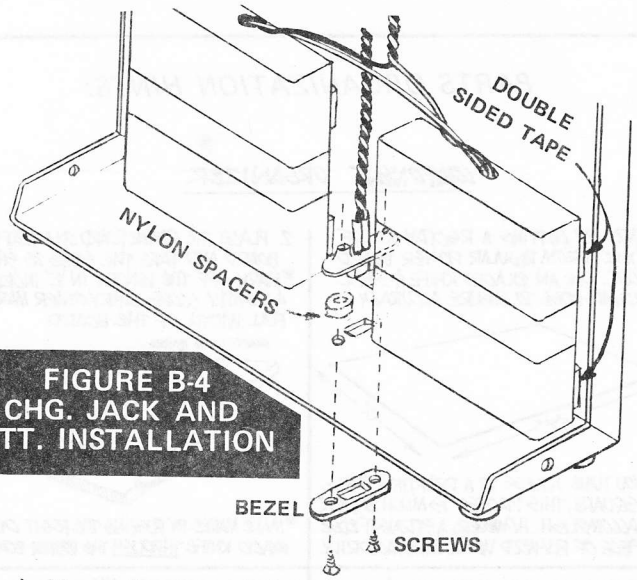


FIGURE B-4 CHG. JACK AND BATT. INSTALLATION

( ) Mount the charge jack in the transmitter case as shown in Figure B-4 using the bezel, two flat head screws, and two nylon spacers.

( ) Using the furnished screw, nut, solder lug, and lock washer, install the antenna mount as shown in B-3. Tighten securely.

( ) Stick the eight pressure sensitive feet on the four corners of the bottom of the transmitter and on the four corners of the transmitter back. Note: A small drop of "Hot Stuff" on each foot before it is installed will help prevent the feet being knocked off later.

( ) Put two 2" strips of double sided tape on the back of each battery pack. Remove the backing from the tape and mount the two packs in the transmitter case flush with the inside of the case front and the case bottom, straddling the charge connector. Notice that these packs are purposely off center; this is to give room for the optional buddy box connector.

( ) NOTE: When you build the charger, refer to Figure B-2 for proper plug wiring.

C. SWITCH AND METER WIRING

( ) Three capacitors need to be soldered to the switch before it is installed. Follow Figure C-1 for proper technique and location; keep the leads as short as possible and the caps tight to the switch body.

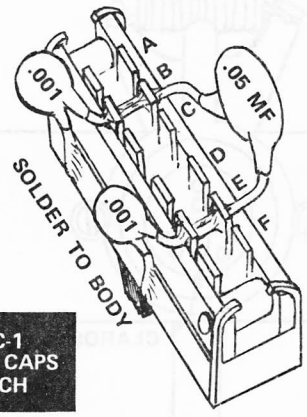


FIGURE C-1 MOUNTING CAPS ON SWITCH

LEADS GO THRU BOTH TERMINALS

( ) Install the switch and switch cover as shown (Fig. C-2), using two 3-48 X 1/4" screws. Have the switch off (down) and the cover closed while you are proceeding with wiring of the transmitter.

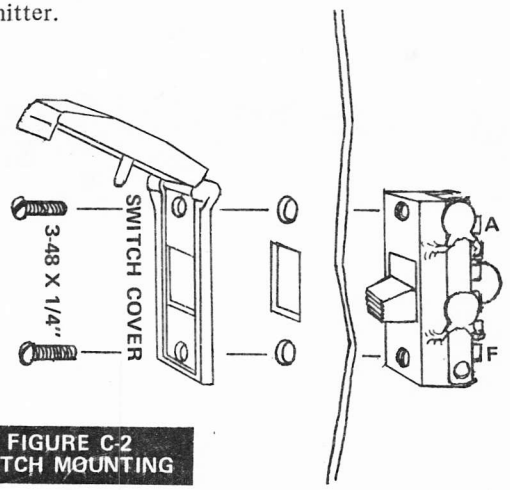


FIGURE C-2 SWITCH MOUNTING

( ) Mount the meter by removing the backing from the double sided tape on the meter and sticking it into place with the meter lugs on top so that when you face the front of the transmitter the meter needle will be to the left. It is a good idea to carefully apply a drop of "Hot Stuff" to each ear on the meter so it won't inadvertently come loose from the double sided tape.

( ) Route the wire cable from the charge jack to the switch and, leaving some slack, solder the red wire to terminals CC of the switch. The wire should bridge over both terminals of the switch. (The switch is wired in this "redundant" manner so if one set of terminals fail--which would be quite rare--the other ones will do the job.)

( ) Repeat for the black wire from the charge jack, soldering it to FF.

( ) Do the same for the wire cable coming from the batteries, soldering the red wire to BB and black to EE.

( ) Shorten the red and black wire from the meter to an appropriate length so red will go to AA and black to DD on the switch. Strip and tin the ends.

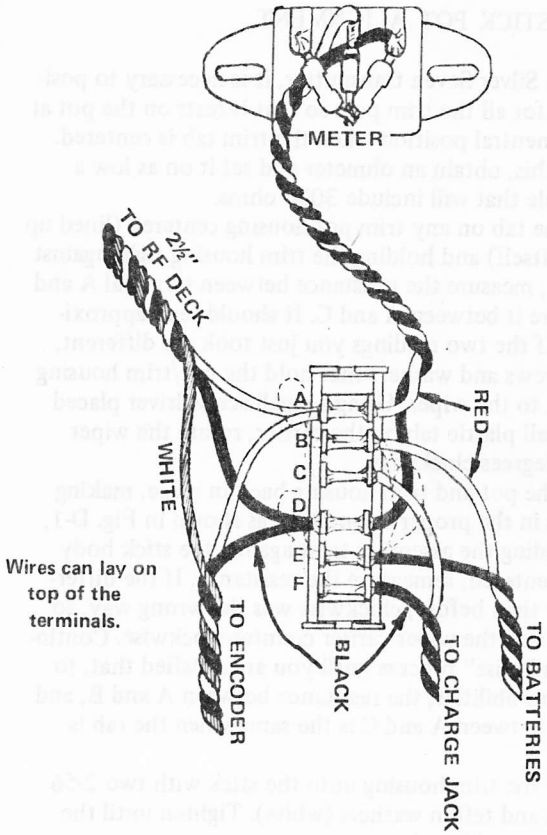
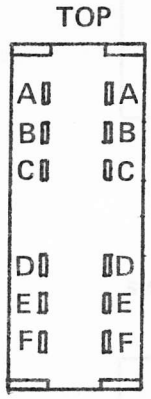


FIGURE C-3 SWITCH WIRING



AA = Red from encoder, RF deck, and meter.

BB = Red from batteries. Also one leg of .05 mf. Also has .001 mf to ground.

CC = Red from charge jack.

DD = Black from encoder, RF deck, and meter.

EE = Black from batteries. Also one leg of .05 mf. Also has .001 mf to ground.

FF = Black from charge jack.

( ) Measure 2½" from one end of the 9" twisted red, black, and white wire cable and cut only the red and black wire at this point. Strip about 3/16" insulation from the two ends of red wire where you just cut it and twist them together--now tin the wire. Repeat for the black wire.

( ) Solder both the red wire from the meter and the red pair from the red/black/white cable that you prepared earlier to terminals AA.

( ) Solder both the black wire from the meter and the black pair from the three wire cable to terminals DD.

( ) Make sure there are no frayed wires on any of the switch connections and that all the solder joints are secure.

D. INITIAL STICK POT ALIGNMENT

( ) For the Silver Seven transmitter, it is necessary to position the wiper for all the trim pots so that it rests on the pot at the electronic neutral position when the trim tab is centered.

To do this, obtain an ohmeter and set it on as low a range as possible that will include 3000 ohms.

( ) With the tab on any trim pot housing centered (lined up with the stick itself) and holding the trim housing tight against the stick body, measure the resistance between terminal A and B, then measure it between A and C. It should read approximately 2.5K. If the two readings you just took are different, remove the screws and washers that hold the pot/trim housing so you can get to the wiper. Using a small screwdriver placed against the small plastic tab on the carrier, rotate the wiper carrier a few degrees clockwise.

Place the pot and trim housing back in place, making sure the pot is in the proper orientation as shown in Fig. D-1, and, while holding the assembly tight against the stick body with the tab centered, remeasure the resistance. If the differance is greater than before, clockwise was the wrong way, so try again, rotating the wiper carrier counter clockwise. Continue this "hit and miss" process until you are satisfied that, to the best of your abilities, the resistance between A and B, and the resistance between A and C is the same when the tab is centered.

Secure the trim housing onto the stick with two 2-56 X 3/16" bolts and teflon washers (white). Tighten until the desired tension is achieved.

( ) Repeat for the other two trim pots.

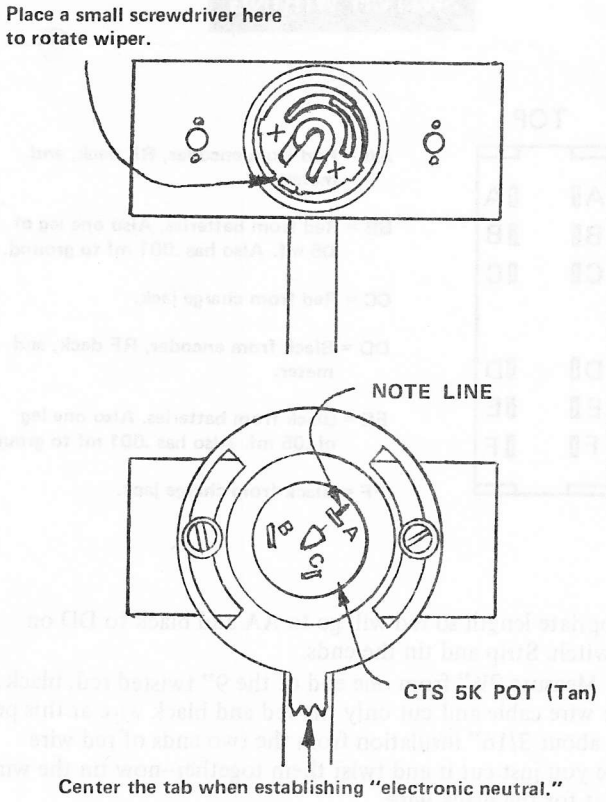


FIGURE D-1
TRIM POT ALIGNMENT

( ) While you've got the ohmmeter out, the control pots can be tested and pre-aligned. Check the resistance between D and E and between D and F. (About 2.5K) You should be able to move the lever on the pot retainer until the two readings are approximately the same.

( ) Follow the same procedure for the other stick assembly.

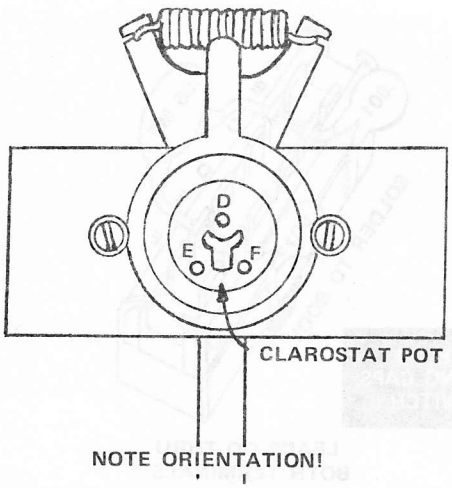
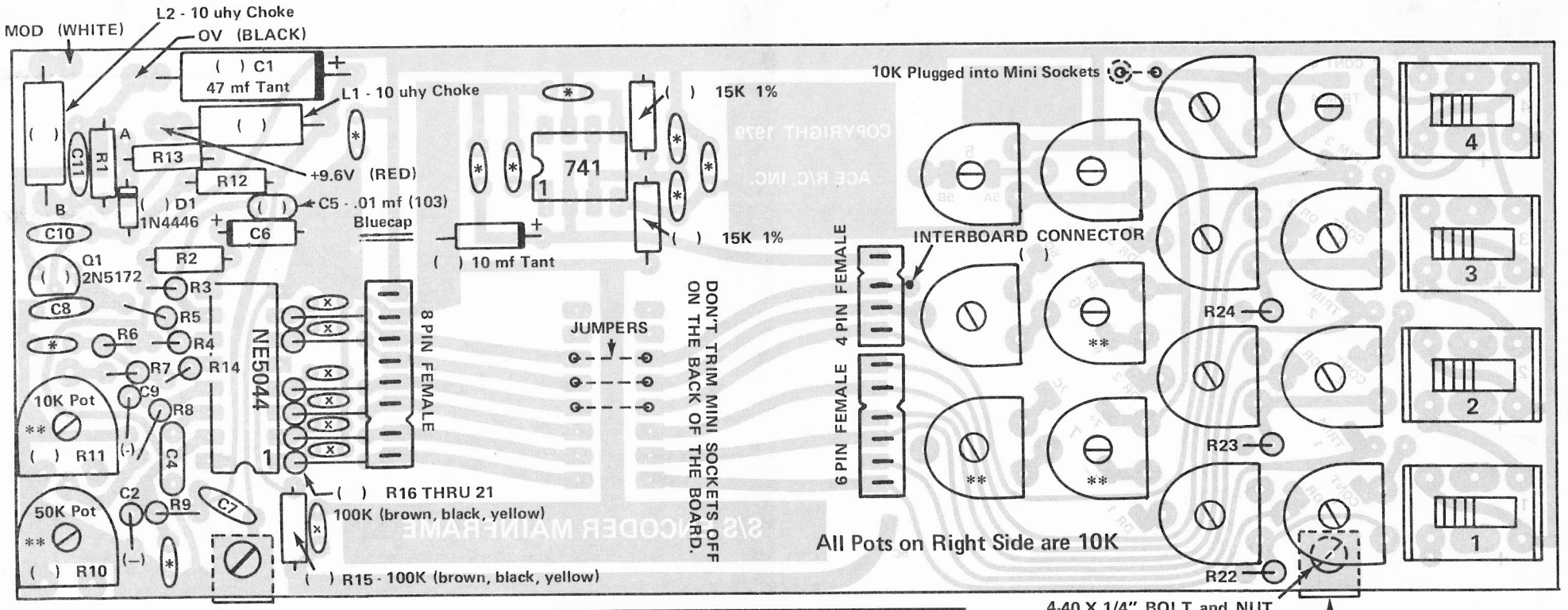


FIGURE D-2
CONTROL POT ALIGNMENT



A and B are hookup points for the optional buddy box.

FIGURE E-1
ENCODER MAINFRAME OVERLAY

PARTS ID

CAPACITORS

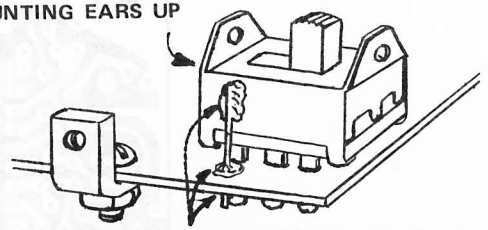
( ) C2: 4.7 mf Tantalum (+ end down)
( ) C4: .047 mylar
( ) C6: 0.1 mf Tantalum (+ end left)
( ) C7: .05 mf Disc
( ) C8: .01 mf Disc
( ) C9: .068 mf Tantalum (+ end down)
( ) C10: .05 mf Disc
( ) C11: .002 mf Disc

* = .001 mf Disc
X = 100 pf Disc
O = MINI SOCKETS

RESISTORS (All are 1/4 W 5%)

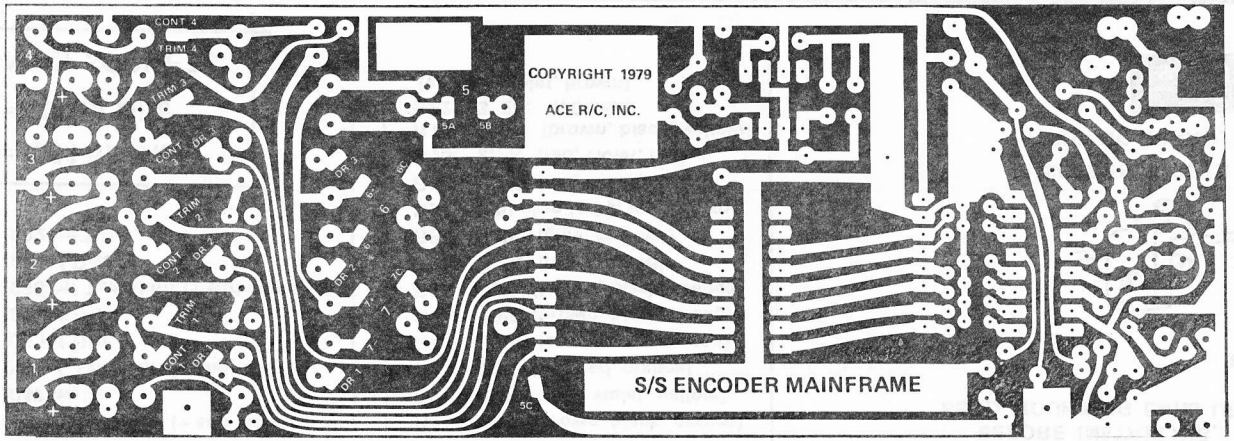
( ) R1: 10K (brown, black, orange)
( ) R2: 270K (red, violet, yellow)
( ) R3: 22K (red, red, orange)
( ) R4: 3.3K (orange, orange, red)
( ) R5: 10K (brown, black, orange)
( ) R6: 10K (brown, black, orange)
( ) R7: 2.2K (red, red, red)
( ) R8: 8.2K (grey, red, red)
( ) R9: 820 ohm (grey, red, brown)
( ) R12: 2.7K (red, violet, red)
( ) R13: 2.7K (red, violet, red)
( ) R14: 100K (brown, black, yellow)
( ) R22, 23, 24: 470 ohm (yellow, violet, brown)

BEFORE INSTALLING, BEND MOUNTING EARS UP



SOLDER JUMPER TO SIDE OF SWITCH, TOP OF BOARD, BOTTOM OF BOARD

FIGURE E-2
SWITCH PREPARATION


COPYRIGHT 1979
ACE R/C, INC.
S/S ENCODER MAINFRAME

E. MAINFRAME ENCODER PC BOARD ASSY.

( ) Gently clean both sides of the PC board with fine (0 or 00) steel wool to remove any oxidation.

( ) As construction proceeds, there are some components that require soldering on top of the board as well as on the bottom. Make sure this is done! The top connections are easy to miss. As you are building the PC board, refer to the overlay, Figure E-1.

( ) Clip 1/4" wire lead off the end of any resistor and solder on both top and bottom of the board where indicated for the "Interboard Connector". This connects a top land to a bottom land.

( ) Install the NE5044 and the 741 IC's, soldering both on top and bottom of the board. Make sure the notch or dot for pin 1 is oriented properly! The NE5044 has one joint on top of the board and the 741 has two.

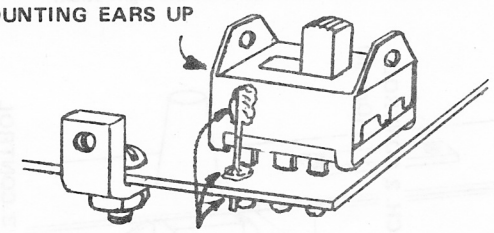
( ) Bolt the two mounting brackets in place using 4/40 X 1/4" nuts, bolts and lock washers. The bracket rests against the back (bottom) of the board and the head of the bolt is on the front (top). The threaded portion of the "L" bracket comes toward you as you face the front (top) of the board.

( ) As you face the bottom of the board, look at the bracket on the right. If it touches or comes close to the thin PC land that runs over the top of it, remove the bracket and file the portion of the bracket as necessary for clearance.

( ) Install R22, R23, and R24 on the right side of the board, making sure the top joints are soldered.

( ) Install the five pots marked with ** first. They need to be soldered on top. (Two of them have two connections on top). NOTE: All pots are 10K except R-10, which is a 50K, located in the lower left hand corner of the board. Install and solder R-10 before R-11.

( ) Install the rest of the 10K pots.



SOLDER JUMPER TO SIDE OF SWITCH, TOP OF BOARD, BOTTOM OF BOARD

( ) With a needle nose pliers, bend the mounting ears of the four CW DPDT switches straight up, so they form a "cradle" for the switch lever; this will help prevent inadvertently bumping the switch. Fig. E-2

( ) Before installing, "tin" the side of each DPDT switch where shown in Fig. E-2. It may be necessary to use some sandpaper to clean the metal on the switch so the solder will "take".

( ) Install the DPDT switch labeled "4". Put a scrap resistor lead grounding jumper in the hole indicated, soldering it in three places; ( ) the side of the switch, ( ) the top of the board, and ( ) the bottom of the board. Don't leave this step out!

( ) Repeat the preceding step for the switch label "3", then the one labeled "2", then the one labeled "1", in that order.

( ) Now install the rest of the encoder, resistors, capacitors, chokes, diode, and transistor. Install and solder two or three components at a time, working around the board in a clockwise manner. Clip the leads as you go. Refer to the Parts ID section for the proper values of the various components. Make sure that the tantalum capacitors are installed with the proper polarity, the diode is installed with the banded end as shown, and the transistor with the flat side properly oriented. Notice that C1 and C6 need to be soldered on top of the board as well as the bottom.

( ) Make sure you have the negative terminal of C1 and C6 soldered on top of the board and that each of the four switches has a wire jumper installed which is soldered on top of the board, on bottom of the board, and on the side of the switch. Also make sure the five pots marked with ** have joints soldered on top, and R22, 23, and 24 are soldered on top. Check that two joints on the 741 (pins 2 and 4) and one joint on the NE5044 (pin 8) are soldered on top.

( ) When all the electronic components are installed, clip any excess leads off the bottom of the board to less than 1/16" and take a file and gently file off any sharp points.

( ) Solder the eight gold "mini-sockets" in place. A couple extras are furnished in case you lose one.

NOTE: After soldering, don't cut the Mini Sockets off on the back of the board--leave them full length.

( ) Plug three jumpers (furnished) into the Mini Sockets in the middle of the board. They should fit tightly and make good contact.

10K (brown, black, orange)

( ) Take one 10K resistor (brown, black, orange) and bend one lead over. Cut both leads so there is 1/8" left below the resistor body. It plugs into the pair of mini-sockets on the right hand side of the board. To do so, "prime" the mini-socket by pushing the pointed end of the push pin (furnished) into the mini-socket to spread the opening a bit; now the resistor can be plugged in.

( ) Solder a 4, 6, and 8 pin female Deans connector where indicated--keep them flat on the board.

( ) Using an old toothbrush and denatured alcohol, clean the solder resin from the bottom of the board. Using a magnifying glass, inspect closely for cold or missed solder joints or solder bridges.

F. STICK/ENCODER WIRING

The following section is the most time consuming portion of the transmitter assembly but not necessarily the most difficult. Please take your time making sure the quality of the wiring is good (no frayed wires; solid connections), plus make sure the proper point-to-point hookups are made.

It is easy to get anxious now and to start rushing. Don't. Slow down and take your time.

DECISION TIME: Three things must now be decided.

( ) One--Trim/Aux I & II Locations. On the sticks, there are six trim lever locations for the four trims on Channels 1,2, 3 and 4, plus the Auxiliary Channels 6 and 7. Where each of these is located is your decision: you can have standard trims (trims on same stick as the control); crossed trims (trims on opposite sticks to the controls); or a combination of the two.

See Figure F-1 and the charts to help you decide--fill in the blank chart to help you when wiring commences.

( ) Two--Dual Rate Switch Location. It is up to you where you locate the three SPDT Dual Rate toggle switches. Determine where they would be most comfortable for your type flying. Keep in mind to leave room for any other options you might want to locate, especially the programmable push buttons. A suggested location is provided on Figure F-1.

( ) When you have decided where to locate the switches, put a piece of masking tape over the location on both the outside and inside of the case. Center punch for (a nail will work OK) and carefully drill a 1/4" hole for each switch.

( ) Three--Retract Switch (Ch. 5) Location. As with the Dual Rate switches, the location of the SPDT retract toggle switch is your choice. Again, keep in mind where any other options might go.

( ) In the same manner you did for the Dual Rate switches, drill a 1/4" hole where you decide.

( ) Before wiring, deburr the 1/4" holes and clean out any metal shavings that were a result of drilling.

SUGGESTED TRIM/AUX LOCATIONS

STANDARD TRIM

LOCATION	FUNCTION
M	AUX I
N	CH. 3 (RUD) TRIM
O	CH. 4 (THR) TRIM
P	CH. 1 (ELE) TRIM
Q	CH. 2 (AIL) TRIM
R	AUX II

Use this if you're used to standard trims and don't think you want to learn "new tricks."

FULL CROSSED TRIM

LOCATION	FUNCTION
M	AUX I
N	CH. 2 (AIL) TRIM
O	CH. 1 (ELE) TRIM
P	CH. 4 (THR) TRIM
Q	CH. 3 (RUD) TRIM
R	AUX II

Some manufacturers use this configuration

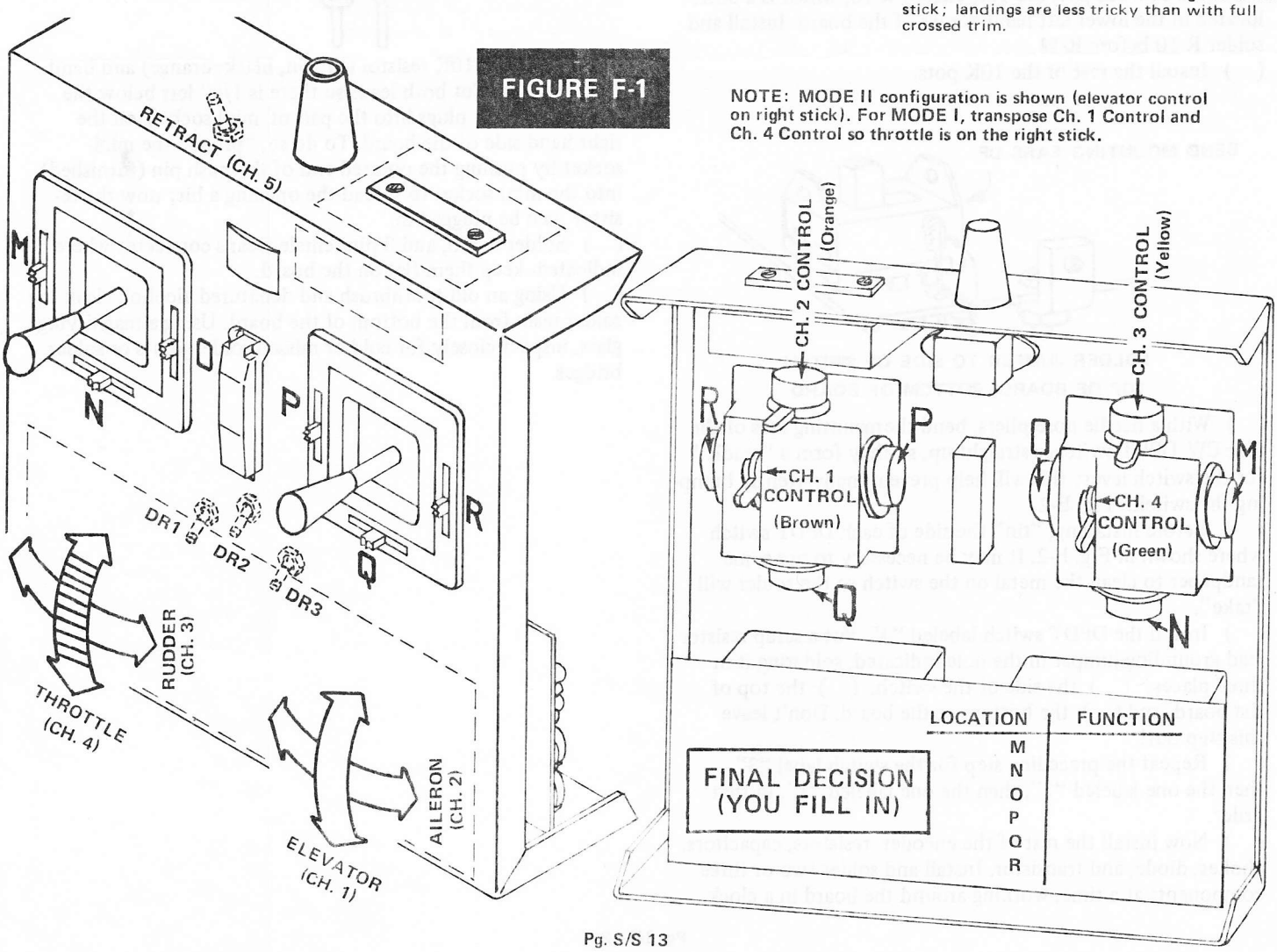
MODIFIED CROSSED TRIM

LOCATION	FUNCTION
M	CH. 1 (ELE) TRIM
N	CH. 2 (AIL) TRIM
O	CH. 4 (THR) TRIM
P	AUX I
Q	CH. 3 (RUD) TRIM
R	AUX II

We prefer this configuration. It allows going to low throttle trim without leaving the elevator stick; landings are less tricky than with full crossed trim.

FIGURE F-1

NOTE: MODE II configuration is shown (elevator control on right stick). For MODE I, transpose Ch. 1 Control and Ch. 4 Control so throttle is on the right stick.



STICK/ENCODER WIRING, CONT.

( ) For the sake of consistency and to aid in the wiring of the unit, the color code indicated in Figure F-2 needs to be adhered to religiously. As wiring proceeds, check and double check that the wire color code is being followed.

( ) Temporarily position the two sticks in the case; don't mount them yet. Note that the horizontal trims are on the bottom.

( ) Referring to the illustration of the inside of the case and the chart you made up, appropriately label each of the ten control, trim, and auxiliary pots by cutting up and putting one of the pressure sensitive labels on the pot housings.

( ) Remove the sticks from the case.

( ) If desired, the sticks can now be mounted to the OUTSIDE of the transmitter case--the case itself will be a holding fixture while you solder the wires to the various pots. Be careful, though, not to damage the outside of the case with the soldering iron or solder. A piece of thin cardboard between the pot and the case can serve to protect the case while soldering.

( ) Referring to Fig. F-3 and the wiring color code, F-2, wire cables to the pots, matching the proper color to the proper pot, making sure the correct wire goes to the terminals as indicated in F-3. Check and double check that the color code is being adhered to and that you are making good secure joints with no frayed wires. Plastic sleeving is to cover all joints except those on the Ch. 1 (elevator) and Ch. 4 (throttle) control pots.

NOTE: Refer to Fig. F-4 when wiring the control pots for Chs. 1 and 4 (elevator and throttle): Temporarily remove the spring on the horizontal function so the pot is easier to get to. Strip about 3/16" insulation off of one of the wires you need to solder to the pot. Make a small loop in the stripped wire and tin it. Tin the proper pot terminal. Slip the loop over the terminal and solder the joint. Repeat for the other wires. Use a nylon tie to secure the wire cable to the stick assembly (there is a hole in the side of the middle portion of the stick for that purpose). Move the stick back and forth, making sure everything clears properly and that the joints on the pot are not being flexed in any way. Reinstall the centering spring.

( ) When all ten pots are wired, mount both stick assemblies in the case using the faceplate and four 2-56 X 5/8" screws. Make sure the faceplate has snapped into the case cutout on all four corners so it is flat on the front of the case and all trims are centered before attempting to install the sticks, and that you have the proper stick in the proper location.

( ) For clearance, it will be necessary to bend the pot terminals over on all of the pots, especially the outer trim pots so they will clear the back of the case when it is installed.

( ) Solder the blue wire cable to the retract switch as illustrated (Figure F-5) and mount the switch in the case using the two nuts and lock washer furnished; discard the large washer.

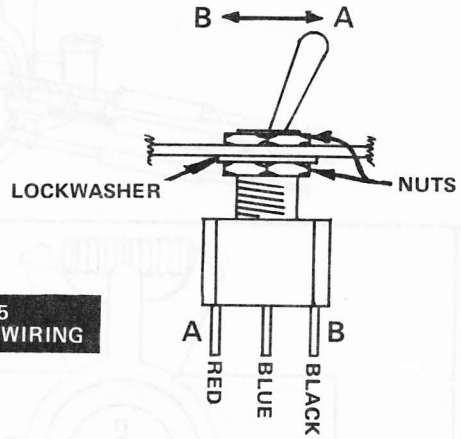
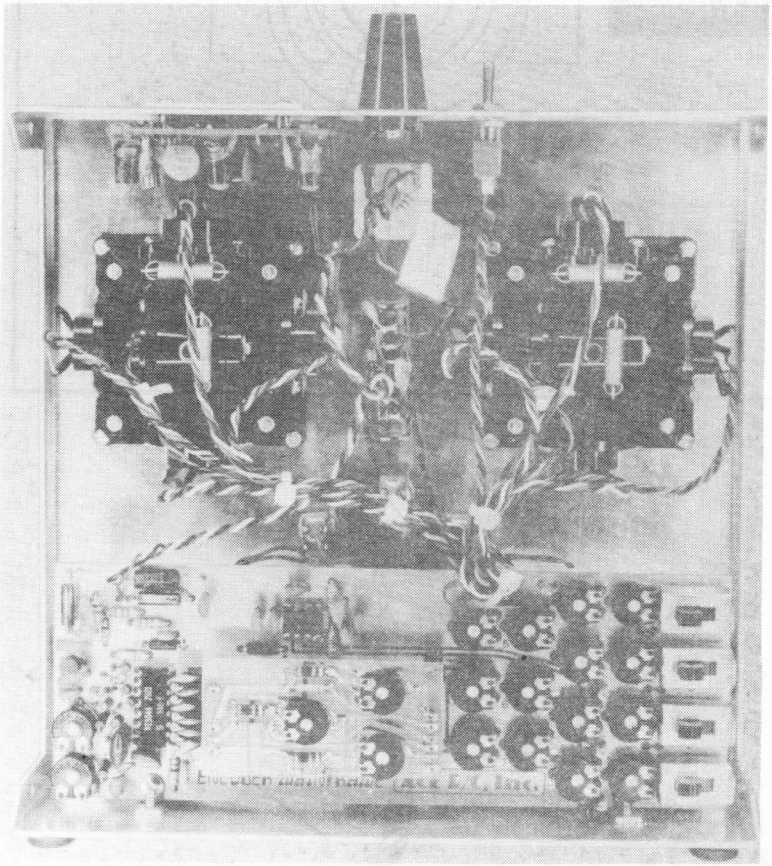


FIGURE F-5
RETRACT SWITCH WIRING



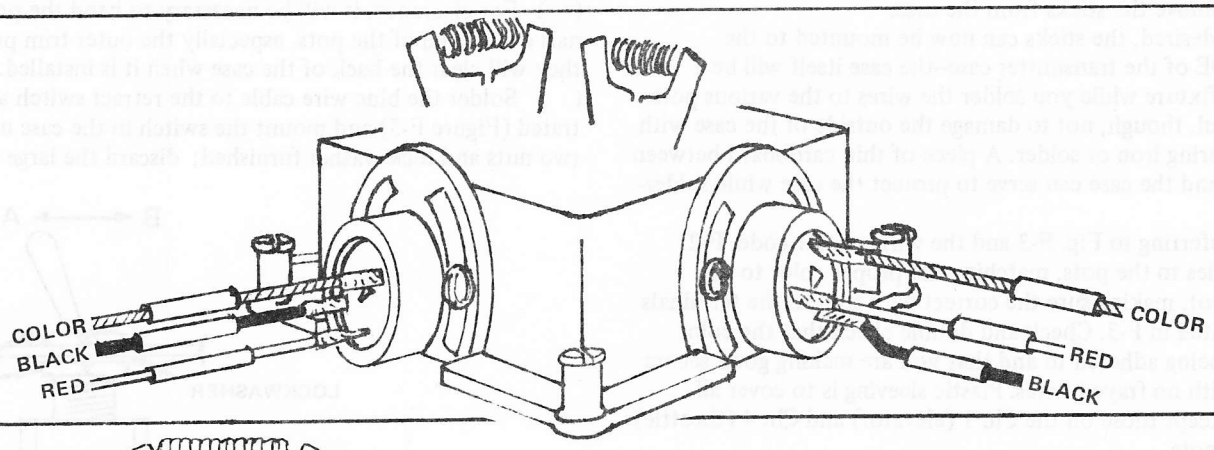
( ) Temporarily place the encoder board in position in the case. Route all five cables from one stick toward the square cutout in the encoder board. Repeat for the other stick, including the cable for the retract switch in one of the bundles. About 1" from each stick, use a nylon tie to keep the bundle of five or six cables together, making sure there is enough slack in all cables so the trim and stick motion is not impaired.

( ) Thread all the wire cables through the square cutout in the encoder board. With the encoder board in its approximate position and with enough slack in all the wire cables to the sticks, use another nylon tie around the wires and through the hole to keep them from moving in or out--there will be a lot of excess wire around the back of the board!

WIRING COLOR CODE

FIGURE F-2 COLOR CODE

CHANNEL	CONTROL FUNCTION CABLE COLOR (RED, BLACK, and :...)	TRIM FUNCTION CABLE COLOR (RED, BLACK, and : ....)	DUAL RATE CABLE COLOR
1 (elevator)	BROWN	BROWN/WHITE	BROWN, BROWN
2 (aileron)	ORANGE	ORANGE/WHITE	ORANGE, ORANGE
3 (rudder)	YELLOW	YELLOW/WHITE	YELLOW, YELLOW
4 (throttle)	GREEN	GREEN/WHITE	—
5 (retract)	BLUE	—	—
6 (Aux I)	VIOLET	—	—
7 (Aux II)	GREY	—	—



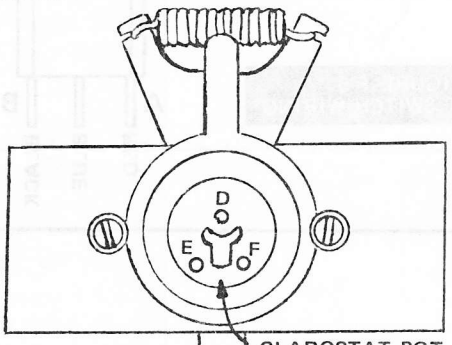
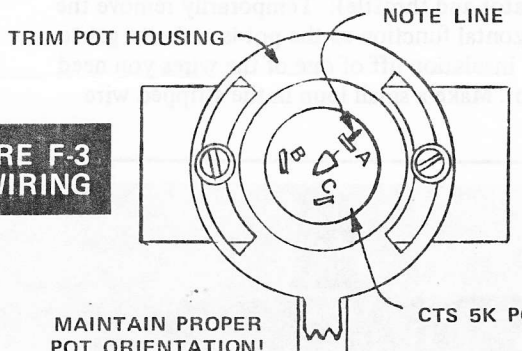


FIGURE F-3 POT WIRING



ALL CONTROL POTS

D = COLOR WIRE
E = RED WIRE
F = BLACK WIRE

TRIMS THAT FACE LEFT (0 and R)

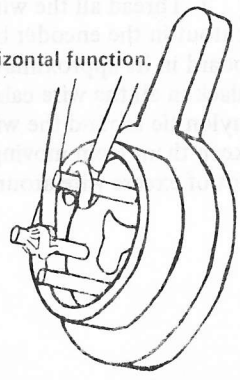
A = COLOR WIRE
B = BLACK WIRE
C = RED WIRE

ALL OTHER TRIMS (M, N, P, and Q)

A = COLOR WIRE
B = RED WIRE
C = BLACK WIRE

CH. 1 AND CH. 4 CONTROL POT WIRING

1. Remove spring from horizontal function.
2. Strip wire.
3. Make loop in wire.
4. Tin wire.
5. Tin terminal.
6. Make joint.



CHECK FOR FRAYED WIRE AND SHORTS!

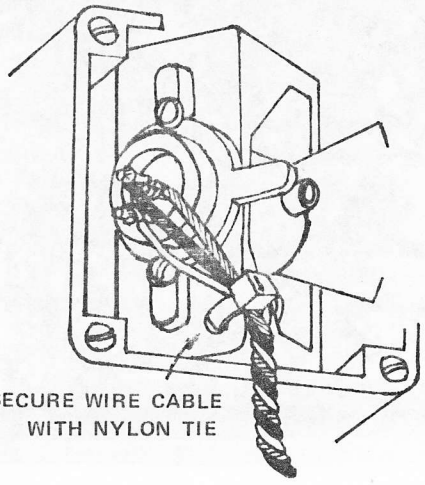


FIGURE F-4

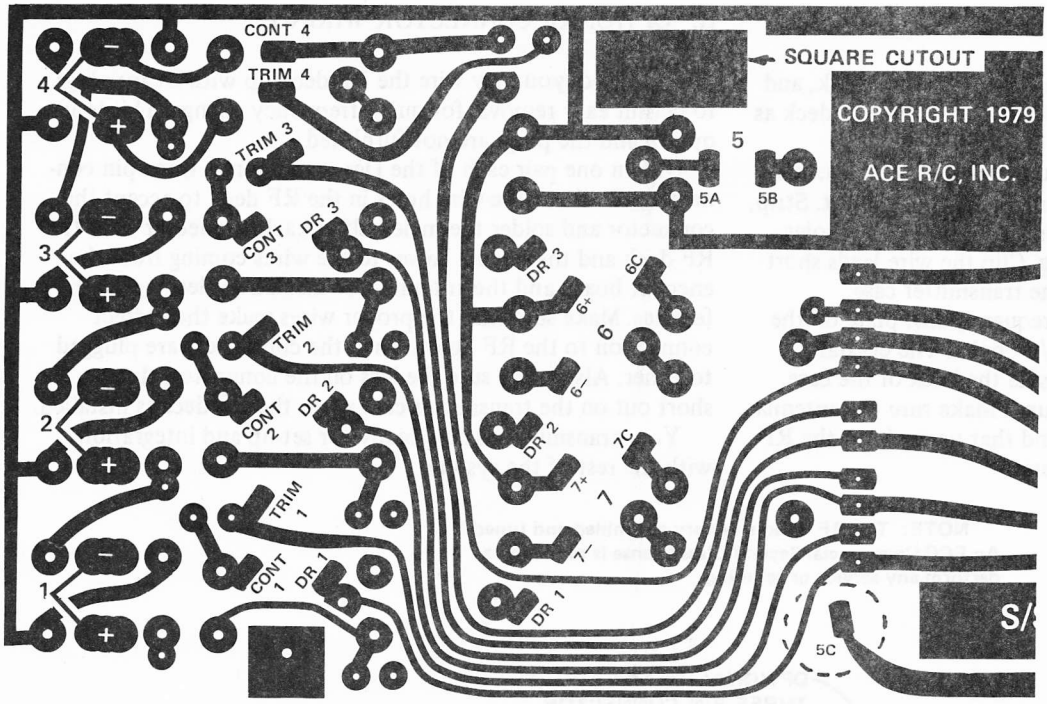


FIGURE F-6
ENCODER WIRING

( ) All of the stick pot hookups to the encoder board are done on the back of the board. Do your best to be neat and make good, solid joints with NO frayed wires that can short to adjacent pads in the following steps. Make sure you tin both the wire and the PC pad before making a connection.

Cut each wire fairly short so it runs directly to its appropriate pad; too much extra wire will get in the way as you proceed.

Observe the following order, checking off each step as you go and referring to Figure F-6.

( ) Cable from Retract Switch (Blue; Ch. 5)--Red to 5A, Black to 5B, and Blue to 5C.

( ) Cable from Aux. I (Violet; Ch. 6)--Red to 6(+), Black to 6(-), and Violet to 6C.

( ) Cable from Aux. II (Grey; Ch. 7)--Red to 7(+), Black to 7(-), and Grey to 7C.

( ) The following three Dual Rate Switch cables are just two wires--they don't thread through the square hole. Just solder one end of the cable to the board and let the other end dangle to be wired to the switches later.

( ) Dual Rate 3 Cable (Ch. 3)--One Yellow to DR3 and the other Yellow to the other DR3.

( ) Dual Rate 2 Cable (Ch. 2)--One Orange to DR2 and the other Orange to the other DR2.

( ) Dual Rate 1 Cable (Ch. 1)--One Brown to DR1 and the other Brown to the other DR1.

( ) In the following four steps, treat the cables coming from the control pot and its corresponding trim pot as pairs of cables (brown and brown/white; orange and orange/white; etc.). Each red wire from a pair of cables will go to one pad, a middle terminal of a reversal switch labeled (+) and each black wire solders to the other terminal of the switch labeled (-). Since there are two wires going to one pad, make doubly sure there are no stray or frayed wires shorting to an adjacent PC land.

( ) Channel 4 Cables--Green to CONT 4, Green/White to TRIM 4, Both Reds to Switch 4 (+), and Both Blacks to Switch 4 (-).

( ) Channel 3 Cables--Yellow/White to TRIM 3, Yellow to CONT 3, Both Reds to Switch 3 (+), and Both Blacks to Switch 3 (-).

( ) Channel 2 Cables--Orange/White to TRIM 2, Orange to CONT 2, Both Reds to Switch 2 (+), and Both Blacks to Switch 2 (-).

( ) Channel 1 Cables--Brown/White to TRIM 1, Brown to CONT 1, Both Reds to Switch 1 (+), and Both Blacks to Switch 1 (-).

( ) This completes the pot wiring.

( ) From the front of the board, wire the red, black, and white cable coming from the switch to the encoder board with the red in "POS", black in "NEG" and white in "MOD". Refer to the overlay drawing, Figure E-1.

( ) With a magnifying glass, thoroughly inspect the board on both sides for cold or missing solder joints, solder bridges, and misplaced components.

( ) Run the three Dual Rate cables (brown, orange, yellow) over to the switch locations and mount the encoder board in the case using two 4-40 X 1/4" bolts.

( ) Neatly route each Dual Rate switch cable over to its appropriate switch location and solder it to the switch as indicated in Figure F-7. Mount each switch in the case the same as you did for the retract switch.

If you have put the Dual Rate switches close to where the RF deck goes, install a .001 mf disc cap (not furnished) between the center contact on the switch and case ground for RF bypass.

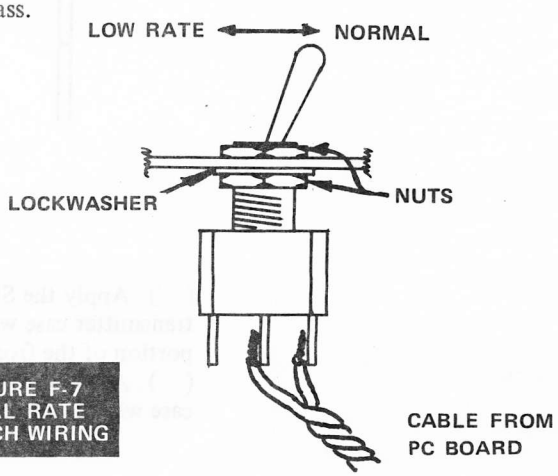


FIGURE F-7
DUAL RATE
SWITCH WIRING

G. RF DECK WIRING

( ) Strip, tin, and solder the short end of the red, black, and white wire cable from the switch in the holes of the RF deck as indicated in Figure G-1.

( ) Take two 1½" pieces of hookup wire and strip, tin, and solder them both to the solder lug on the antenna mount. Strip, tin, and solder the other ends of these wires in the two holes indicated on the RF overlay drawing. Clip the wire leads short to prevent them from shorting on the transmitter case.

( ) Mount the RF deck and the frequency I.D. plate on the transmitter case using two 2-56 X 1/4" bolts. The crystal should be on the left as you look inside the back of the case. Tighten securely to insure good ground. Make sure the antenna lug is not shorting to the RF deck and that no leads on the RF deck are touching the transmitter case.

H. OPTIONAL CONNECTOR WIRING

If desired, you may wire the RF deck up with Deans plugs to permit easy removal for quick frequency change. This is an option and the plugs are not furnished.

Obtain one pair each of the Deans two pin & three pin connectors. Drill out the wire holes in the RF deck to accept the connector and solder the male half of each connector onto the RF deck and the female halves to the wires coming from the encoder board and the antenna--use insulation sleeving on the females. Make sure that the proper wires make the correct connection to the RF board when the connectors are plugged together. Also make sure the legs on the connectors don't short out on the transmitter case when the RF deck is installed.

Your transmitter is now ready for set-up and integration with the rest of the system.

NOTE: The RF deck is factory assembled and tuned. An FCC Commercial Second Class license is required to perform any service or retuning.

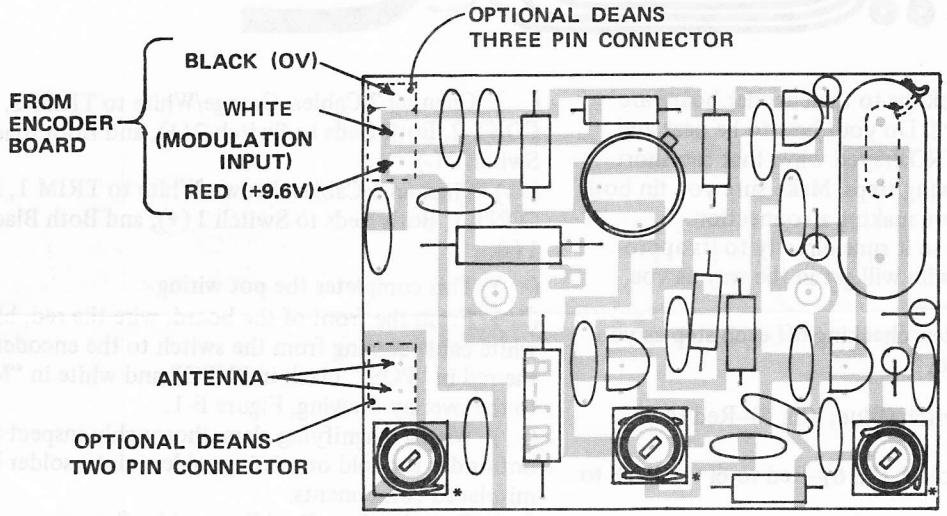
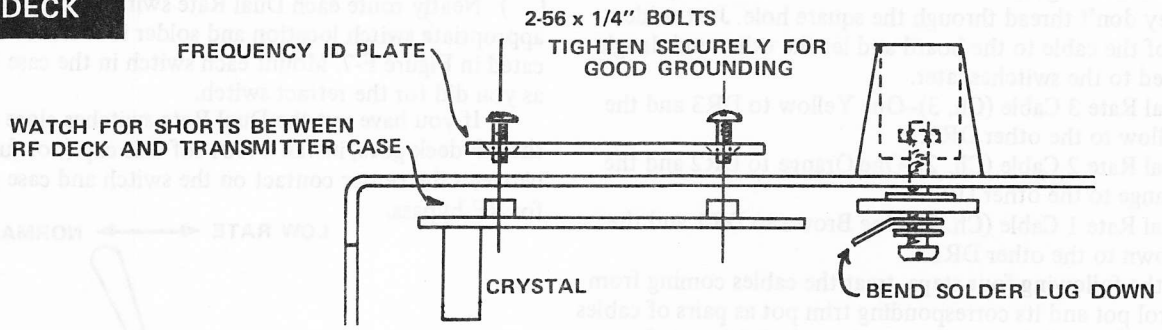


FIGURE G-1
RF DECK



( ) Apply the Silver Seven nameplate on the outside of the transmitter case where desired. In the center of the bottom portion of the front is recommended.

( ) Apply the FCC compliance sticker to the outside of the case where desired. We suggest either the bottom or the back.

I. TRIM ADJUST BOARD ASSEMBLY

( ) Gently clean the Trim Adj PC Board with fine steel wool.
( ) Note: all parts on the Trim Adj board go on the foil (copper) side--there are no copper PC lands or solder joints on the bottom of the board. All solder joints are to be made on the top of the board.
( ) Referring to Fig. I-1, solder the three 10K trim pots into place; remember, all joints are on top of the board.
( ) Solder the six resistors into place.
( ) Clip all the excess leads flush with the bottom of the board.
( ) With the components facing you, lay the Trim Adj board over the black Deans connectors on the Mainframe Encoder PC board that is installed in the transmitter. Line up the bottom holes on the edges of the Trim Adj board with the bottom socket on each Deans connector. (Fig. I-2)
( ) 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 Trim Adj board so the pointed end engages in the bottom right socket of the Deans connector on the Mainframe. (Fig. I-2) Keep the Trim Adj 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 Trim Adj board so you have something to solder to.
( ) Solder the pin to the Trim Adj board.
( ) Repeat for the bottom left pin, inserting it in the bottom left socket of the Deans connectors and soldering it to the Trim Adj Board.
( ) In the same manner, install the upper right and upper left pins on the Trim Adj board.
( ) Install the remaining seven pins in the Trim Adj board.
( ) The Trim Adj board should now be complete and removeable from the Mainframe--a small screwdriver may be necessary to pry the Trim Adj board loose.
( ) Remove the Trim Adj board and set it aside.

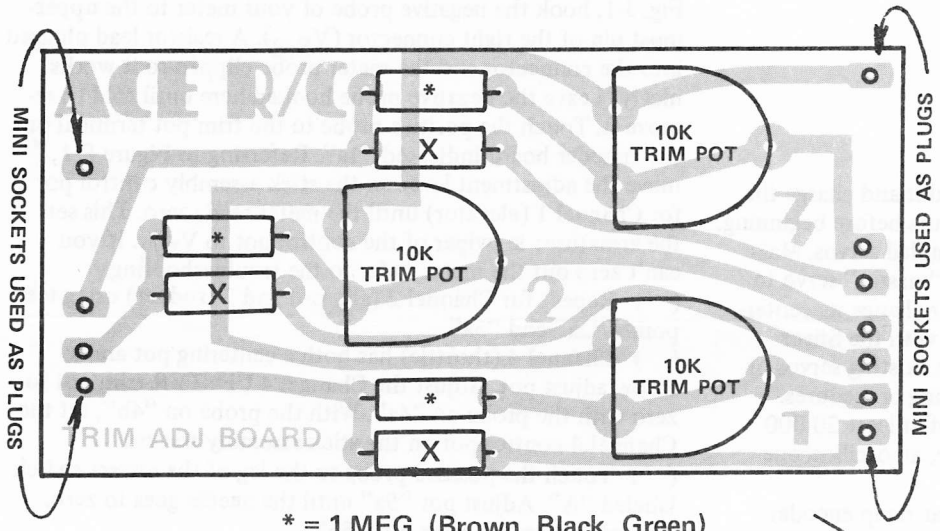


FIGURE I-1
TRIM ADJ BOARD OVERLAY

* = 1 MEG (Brown, Black, Green)

X = 330K (Orange, Orange, Yellow)

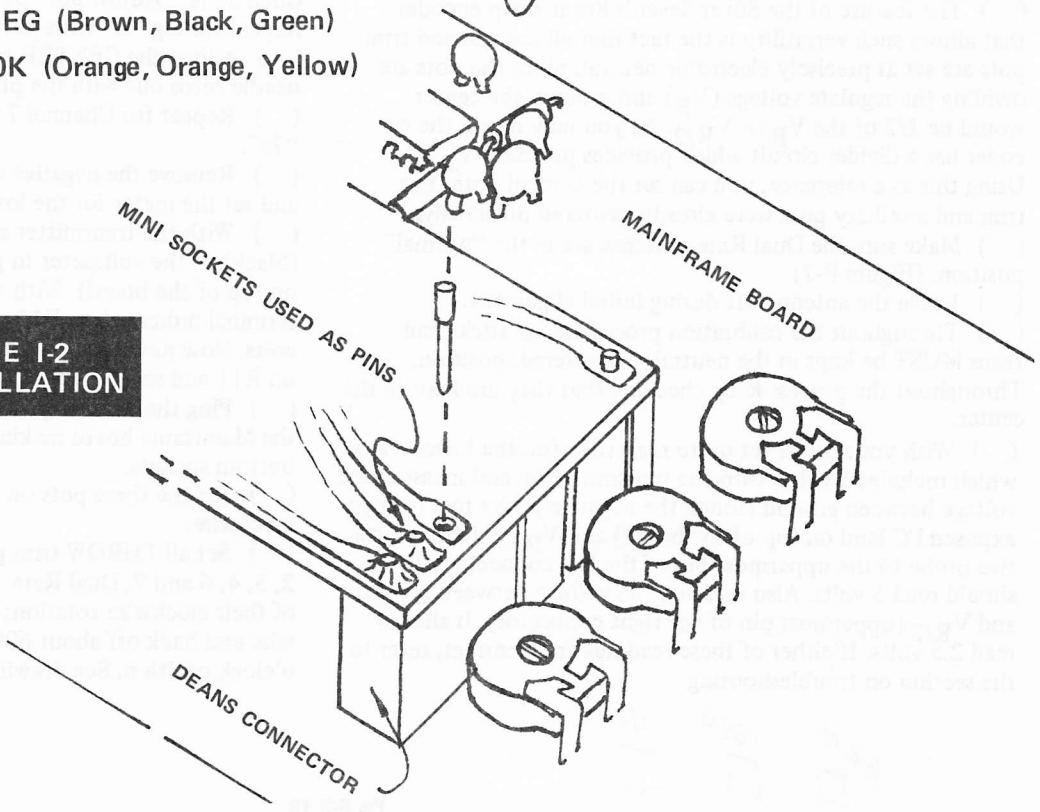


FIGURE I-2
PIN INSTALLATION

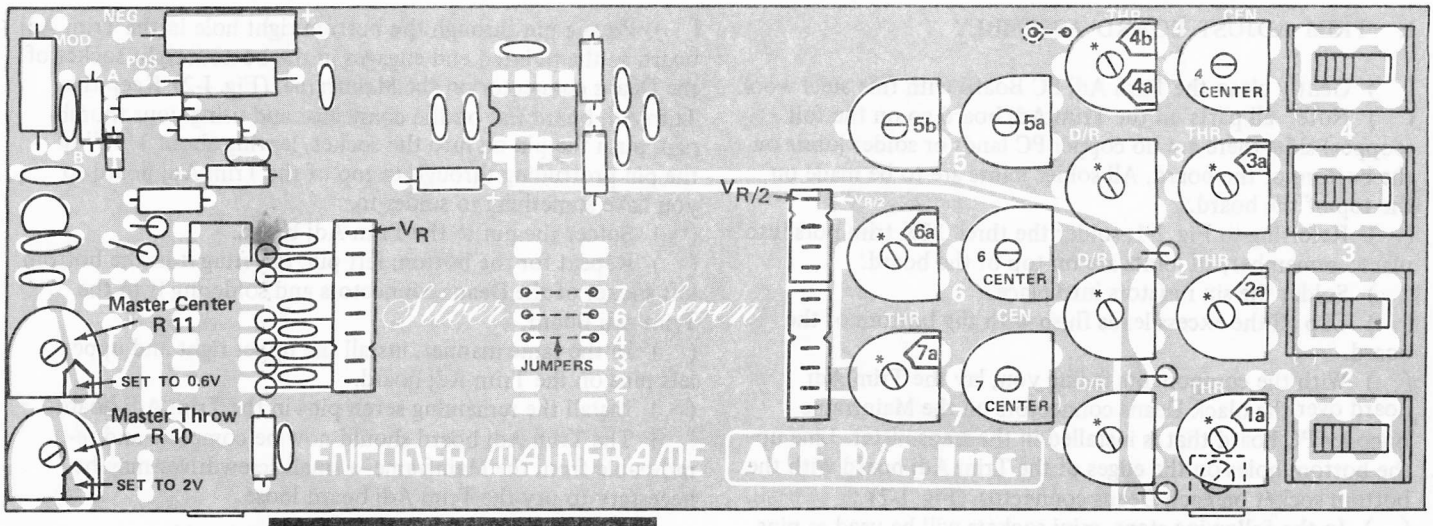


FIGURE J-1
INITIAL CALIBRATION

* Set to 11:00 o'clock position for calibration

III. SET-UP AND CALIBRATION

A. INITIAL ALIGNMENT

( ) If the charger isn't already built, build it and charge the transmitter and receiver batteries for 24 hours before beginning. Build and wire the receiver and the unassembled servos. Make sure you label the factory assembled servo "master" servo to keep it separate from the others; don't ever change its centering. If you are using an existing flight pack with the Silver Seven Transmitter, you will have to use the existing servos or an oscilloscope as a time base in the following procedures.

( ) Obtain a VTVM or VOM voltmeter of at least 20,000 ohms per volt. If you know how to use one, an oscilloscope can be helpful but not necessary.

( ) The feature of the Silver Seven's linear ramp encoder that allows such versatility is the fact that all control and trim pots are set at precisely electronic neutral. Since the pots are dividing the regulate voltage (V_R) and ground, the center would be 1/2 of the V_R or $V_{R/2}$. As you may recall, the encoder has a divider circuit which provides precisely $V_{R/2}$. Using this as a reference, you can set the control pots. The trim and auxiliary pots were already centered previously.

( ) Make sure the Dual Rate switches are in the "normal" position. (Figure F-7)

( ) Leave the antenna off during initial alignment.

( ) Throughout the calibration procedure, all sticks and trims MUST be kept in the neutral, or centered, position. Throughout the process keep checking that they are kept in the center.

( ) With your meter set up to read volts (on the lowest range which includes 5 volts) turn the transmitter on and measure the voltage between ground (touch the negative probe to any large exposed PC land on top of the board) and V_R (touch the positive probe to the uppermost pin of the left connector). It should read 5 volts. Also measure the voltage between ground and $V_{R/2}$ (uppermost pin of the right connector). It should read 2.5 volts. If either of these readings are incorrect, refer to the section on troubleshooting.

BRN ORG YEL

( ) Set your meter to the lowest voltage range. Referring to Fig. J-1, hook the negative probe of your meter to the uppermost pin of the right connector ($V_{R/2}$). A resistor lead plugged into the connector and the meter probe clipped to it works nicely. Leave the negative probe hooked here until told to remove it. Touch the positive probe to the trim pot terminal on the encoder board indicated "1a". Referring to Figure F-1, move the adjustment lever on the stick assembly control pot for Channel 1 (elevator) until the meter reads zero. This sets the armature; ie, wiper of the control pot to $V_{R/2}$. If you can't zero out the meter, refer to the troubleshooting.

( ) Repeat for Channel 2 (aileron) and 3 (rudder) using test points "2a" and "3a".

( ) Channel 4 (throttle) has both a centering pot and a throw adjust pot. Adjust the Channel 4 CENTER trim pot to zero with the probe on "4a". With the probe on "4b", set the Channel 4 control pot on the stick assembly to zero.

( ) Touch the positive probe to the leg of the retract switch labeled "A". Adjust pot "5a" until the needle goes to zero. Repeat for leg "B" with pot "5b".

( ) Adjust the CENTER trim pot for Channel 6 until the needle zeros out with the probe on point "6a".

( ) Repeat for Channel 7 using Channel 7 CENTER and "7a".

( ) Remove the negative voltmeter probe from the connector and set the meter for the lowest setting which includes 2 volts.

( ) With the transmitter still on, touch the negative probe (black) of the voltmeter to ground (any large area of PC land on top of the board). With the positive probe touching the terminal indicated on R10, set the pot so the meter reads 2 volts. Now move the positive probe to the terminal indicated on R11 and set the pot to read 0.6V.

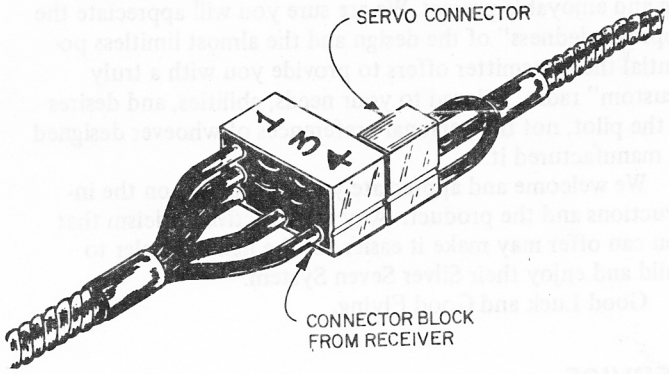
( ) Plug the Trim Adj. board into the Deans connectors on the Mainframe board making sure the bottom pins are in the bottom sockets.

( ) Set the three pots on the Trim Adj. board all the way clockwise.

( ) Set all THROW trim pots on the encoder board (Chs. 1, 2, 3, 4, 6 and 7, Dual Rate 1, 2 and 3) to approximately 80% of their clockwise rotation; ie, turn the pot all the way clockwise and back off about 60° so the slot is in about the 11:00 o'clock position. See drawing, J-1.

B. FINAL ALIGNMENT

( ) It would be a good idea to label all the connectors on the receiver as to which channel they are; it will make things easier both now and later. To do so, get some "Liquid Paper" or similar typewriter correction fluid and paint one side of each female servo connector, including the block. After it dries, use a fine line felt tip pen to write 1, 2, 3, etc. on the connector which corresponds with output 1, 2, 3, etc. from the receiver decoder IC. Coat with clear lacquer or equivalent for protection.



( ) Tune the receiver to the transmitter as indicated in the receiver instructions.

( ) Plug the master servo into Channel 1 output of the receiver. The master servo is calibrated to be centered at 1.5 milliseconds pulse width and to move through $\pm$ 45^{o} with $\pm$ 0.5 ms pulse width variation. Turn the system on.

NOTE: If you are using an existing flight pack to match the transmitter to, follow this same procedure; i.e., use only one servo plugged into the Channel 1 output from the receiver.

If you are going to use another manufacturer's receiver with less than seven channel capability, the Silver Seven encoder will have to be modified to produce only the number of channels required. Do this by grounding unused inputs to the NE5044 (Pins 4, 5, 6, and/or 7). The receiver must have at least three channel capability to work.

( ) Adjust the Master Center pot (R11) on the encoder until the servo is neutralized.

( ) Moving the stick for Channel 1 (elevator) to its extremes, note the amount of servo travel. It needs to be normal travel, or $\pm$ 45^{o} rotation. If it is too little, rotate the Master Throw (R10) trim pot a few degrees clockwise and recenter the servo with the Master Center pot and check the travel again. Repeat as necessary until normal throw is achieved--clockwise on R10 for more throw; counter clockwise for less. Each time R10 is adjusted, the servo will have to be recentered with R11.

( ) Using the master servo, plug into Channels 2 (aileron), 3 (rudder), 4 (throttle), 6 (Aux. I), and 7 (Aux. II). The servo should center and move through about 45^{o} with full stick or lever deflection.

( ) Plug the servo into Channel 5, the Retract channel. Flip the Retract switch back and forth; the servo, if it moves at all, should move only a little bit. With the switch in position "A" (Fig. F-5), pot "A" will adjust the servo location--caution; the adjustment is fairly sensitive so move the pot only a little. Pot "B" sets the servo location when the switch is in position "B".

( ) Plug each of the servos you have assembled into Channel 1 of the receiver. Center them and check for proper operation using the elevator control.

( ) Now plug all four servos into Channels 1, 2, 3, and 4. Double check that all trims are in neutral and switch the reversal switch for Channel 1 back and forth. If the servo neutral shifts when the switch is thrown, the control pot on the stick is slightly out of center. Using the adjustment lever on the control pot, "tweak" the pot a slight bit one way or another until neutral doesn't shift when the reversal switch is thrown. A bit of "twitch" is normal. When you achieve it, gently tighten down the screws on the pot retainer and double check that nothing shifted by throwing the switch back and forth again, making sure the neutral doesn' change.

( ) Repeat for Channels 2, 3, and 4.

( ) Now it is time to make the throttle function non-neutralizing. Remove the spring which centers the throttle function. Tighten the screw down which engages the ratchet plate (it is opposite the throttle control pot--on the other side of the middle portion of the stick) until the desired amount of tension is achieved. If a smooth drag is desired instead of a ratchet, remove the screw and ratchet plate, turn the ratchet plate around, reinstall, and tighten until the desired tension is achieved.

( ) Your basic Silver Seven Transmitter is now complete and should be fully operational. The following operation manual is to summarize the utilization of the basic features of the transmitter. Any of the optional features (mixing, exponential rate, programmable buttons, etc.) are covered in their individual manuals.

IV. TRANSMITTER OPERATION

A. BATTERY MONITORING AND CARE

Battery condition is monitored by an ESV (Expanded Scale Voltmeter). It is calibrated as follows: As long as the needle is in the green it is safe to operate. As the needle moves into the LARGE red segment, the voltage has reached a critical level (9.4V) and it's time to recharge before resuming operation.

9.6V 500 mah AA nickel cadmium cells furnish the power and will provide safe operation for approximately three hours after a fresh charge. They should be charged at 45/50 ma for 14-16 hours (overnight) after every use. If the transmitter has been sitting for a month or so, recharge the batteries before using the unit.

For optimum battery dependability and life, they can be cycled using an Ace Digipace I or similar product. Follow the instructions included with the unit.

B. SERVO REVERSING SWITCHES

The direction of servo travel on the four functions on the sticks are reversed by simply flipping the switch. This feature alone makes the whole project worthwhile. BUT be careful! It can also be a pitfall because it is easy to have a switch in the wrong position at the wrong time causing a disaster. Check and double check.

C. SERVO THROW & CENTER ADJUSTING POTS

On the encoder mainframe there are adjustment pots which can set the desired amount of servo travel for any ular application. They are identified by imprinting on the top of the PC board, plus the drawing Figure K-1, which can be affixed to the inside of the back of the case for reference, using rubber or contact cement.

Servo Throw on Channels 1, 2, and 3 is controlled by three separate pots; changing the throw will not affect the neutral of the servo. On all throw pots for all channels, clockwise rotation increases throw. An arrow which indicates this is etched into the PC board just to the left of the square cutout which the wires go through. Throw can be changed from almost zero to almost lock-to-lock travel.

In addition to throw pots, Channels 4, 6, and 7 also have centering pots to change the neutral position of the servo so the exact servo requirements for a particular operation can be set. Note that once the center adjust pot is used, the throw pot will affect the neutral of the servo and re-centering will be required by adjusting the centering pot. In other words, these pots interact so some "twiddling" will be required to achieve the desired set up.

Channel 5 (Retract) has a pot ("A") to set servo location when the switch is in one location, and another pot ("B") to control servo location when the switch is in the other position. One word of caution: these adjustments are fairly sensitive and a small amount of pot rotation causes quite a bit of servo travel; be gentle!

Spend some time familiarizing yourself with these features by working with them--learn their advantages and shortcomings so you feel comfortable with the system. If, due to a sequence of gross mis-adjustments, the transmitter stops functioning properly, it may be necessary to go through the alignment procedures again to get the encoder back in operation.

D. TRIM AUTHORITY PROGRAMMABILITY

The amount of servo travel achieved when the trim lever is moved is programmable. On Chs. 1, 2, and 3 (elevator, aileron, and rudder) there are three pots on the Trim Adj. Board that determine this. They are labeled 1, 2, and 3 to correspond with the channels. Full clockwise rotation will produce maximum throw; full counter clockwise will produce minimum throw.

Trim throw for Ch. 4 (throttle) is determined by a fixed resistor that is plugged into mini sockets. The 10K (brown, black, orange) furnished will give a normal amount of throw. If more throw is desired, plug in a lower value, say 6.8K. For less throw, increase the value, say 12K. Experiment with different values to determine what is best for your application. Any 1/4W resistor will work and they are readily available at Radio Shack.

A small plastic box stuck to an unoccupied spot inside the case is handy to store the unused resistors, plus extra jumpers, etc. Otherwise, it is easy to lose them.

E. DUAL RATE ADJUSTMENT

Switches are provided to engage Dual Rate on the first three channels (elevator, aileron and rudder). Adjustment pots are furnished to get the desired amount of servo throw when the Dual Rate switch is in the "LO" position. (Fig. F-7). Again, experiment with these adjustments to familiarize yourself with the operation of this feature.

The trim authority remains the same whether the Dual Rate is engaged or disengaged; otherwise, if the trim lever wasn't directly in the center or neutral, the servo would move when Dual Rate is engaged, which would be undesirable.

F. LABELING SYSTEM

In order to aid you in the learning process, pressure sensitive labels are provided to identify various features and their locations. Cut them apart and affix them to the outside of the transmitter case where desired.

CONCLUSION

We hope that building your Silver Seven has been a rewarding and enjoyable project. We are sure you will appreciate the "open-endedness" of the design and the almost limitless potential the transmitter offers to provide you with a truly "custom" radio, tailored to your needs, abilities, and desires as the pilot, not the personal preferences of whoever designed or manufactured it.

We welcome and appreciate your comments on the instructions and the product. Any constructive criticism that you can offer may make it easier for the next modeler to build and enjoy their Silver Seven System.

Good Luck and Good Flying.

SERVICE

If it should be necessary to have the unit serviced, refer to the last page of the "Kit Builders Hints" for policies and procedures, plus a list of Authorized Service Centers.

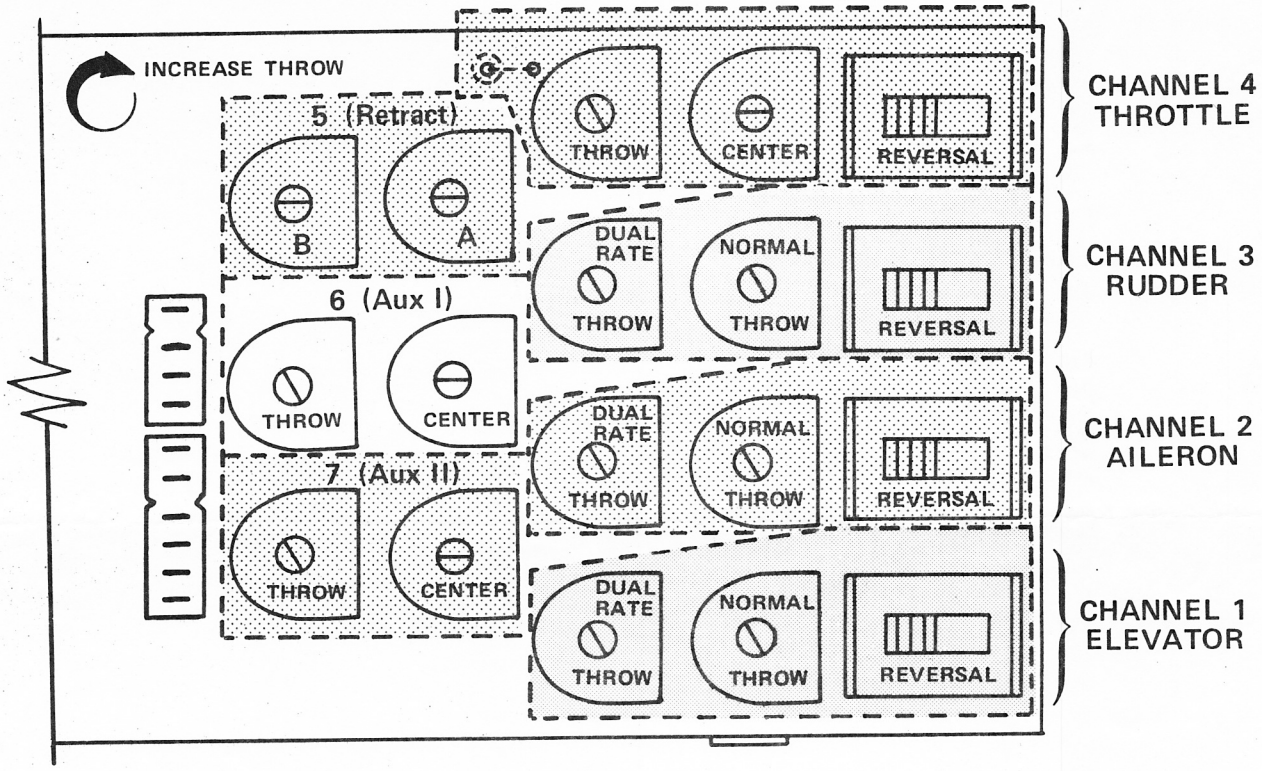


FIGURE K-1
ADJUSTMENT POTS