
# I. INTRODUCTION

The Silver Seven Receiver is one of the finest state-of-the art receivers ever produced and should provide solid, glitch free performance in any normal circumstance. "Silver Seven" has grown to be associated with quality and performance – this receiver is no exception. If you have an assembled unit, refer to the Receiver Connector Wiring and the Tuning sections. Always be careful to maintain proper polarity in order to avoid dissappointment. If you have a kit, proceed through the instructions, step-by-step, taking your time. . .we think you'll enjoy the process and can then fully appreciate the quality of the unit you're building.

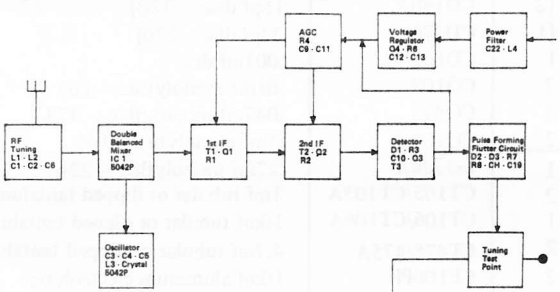



FIGURE 1
BLOCK DIAGRAM

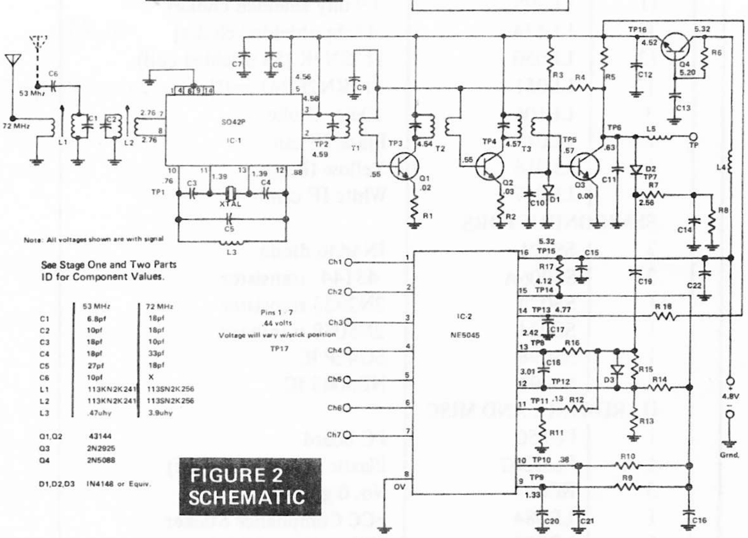



FIGURE 2
SCHEMATIC

# II. CIRCUIT DESCRIPTION

## A. RECEIVER SECTION DESIGN

The Silver Seven receiver employs a Siemens SO-42P double balanced mixer in conjunction with a shielded, double tuned front end for excellent consistency, resistance to intermodulation, and low parts count.

Refer to the block diagram, Figure 1, and schematic, Figure 2, for the discussion to follow. Please note that the mixer and active components of both the local oscillator and mixer are contained in the SO-42P. The RF tuning, i.e., front end, uses two parallel pass filters (L1, C1) and (L2, C2) which are inductively close coupled. This double tuned front end provides the proper front end selectively even when adjacent channel transmitters are nearby. Further, the RF tuning coils are enclosed in shielded cans for better interference rejection, reduced self-radiation, and consistency.

The output from the secondary of L2 is fed directly to the double balanced mixer, SO42P. The SO42P, XTAL, C3, C4, and C5 and L3 form the local oscillator. The local oscillator operates at one half the nominal receiver frequency. The second harmonic of that frequency is 455 KHz above the transmitted frequency. A complete description of superheterodyne receiver operation may be found in the book "Getting the Most from R/C Systems", published by Kalmbach and available from Ace (Catalog No. 108K12) and at local hobby shops.

Two frequencies are mixed or "heterodyned" within the SO42P; the transmitted signal and the local oscillator (LO) signal that is 455 KHz removed from the transmitted signal. For example, assume a transmitted frequency of 72.08 Mhz. plus 455 KHz or 72.535 MHz. The function of the double balancer mixer is to "mix" these two frequencies to produce a 455 KHz intermediate frequency (IF) that clearly is far removed from the transmitted signal. Thus, the simple use of heterodyning produces a tremendous increase in resistance to interference. Almost all R/C systems use a superhet receiver. When two separate frequencies are mixed, the following frequencies are produced:

+ the sum of the two frequencies (144.615 for our example)
+ the difference between the two frequencies or 455 KHz
+ the two original frequencies.

In order to provide the desired selectivity, we wish to work with only the 455 KHz IF frequency. By doing so, the selectivity of the receiver is increased from 100 KHz to 5 KHz. That is, it will reject all signals ± 2.5 KHz removed from the transmitted frequency, unless they are of a much higher amplitude than the transmitted signal. The mixed signals (all three) appear at the primary of T1.

The IF strip consists of T1, T2, T3, Q1, Q2, and the load resistors R1 and R2. T1, T2, and T3 are IF transformers that are sharply tuned to pass only the 455 KHz ± 2.5 KHz IF signal.

The output from T3 is rectified, or "detected" by D1, R3, and C10 to recover the audio envelope transmitted. Q3 amplifies the pulse to an amplitude which is dependent on the signal input to the receiver: i.e., amplitude increases as signal strength increases. One can visualize that the output amplitude of Q3 would fluctuate continually as range and aspect to the transmitter changes. This is highly undesireable and would result in glitching and/or swamping of the receiver.

The above is prevented by coupling back the detected signal out of Q3. The output from Q3 is a series of pulses whose amplitude varies as mentioned above. These pulses are filtered by C9, R4, and C11 to present an automatic gain control (AGC) voltage that biases Q1 and Q2. As Q3 output increases (strong received signal) the DC level on the AGC line increases biasing Q1 and Q2 more toward ground and vice versa to keep gain essentially proportioned to signal strength.

Q4, R6, C12, and C13 form a "capacitance multiplier" that provides an outstanding power line filter for the RF section of the receiver. C13 (10uf) tends to reflect any slight change in line voltage to the base of Q4 which amplifies the apparent capacitance from 10 uf by a factor of 60 to

100 to make C13 appear to be nearly 1000 uf. Any vestiges of ripple are then filtered by C12. The RF section and detector output are isolated by L4 and L5. L5 is used to prevent RF feedback when connected to an oscilloscope for tuning.

B. DECODER SECTION DESIGN

The detected output couples to the decoder via D2. The NE5045 is a special serial input, parallel output, decoder intended for application to R/C systems. The serial input is amplified and shaped before being fed to the counter/decoder. An integrating type synchronization separator detects pulses greater than the time constant for C20 x R9 in the schematic diagram to reset the counter. The NE5045 contains an internal voltage regulator that, in combination with filter capacitors C15, and C16, and C17, provides excellent isolation of the decoder logic from the power supply: i.e. greater than 40 db of power supply rejection.

The detected output from any receiver, as the signal level decreases at long range, contains thermal noise at low levels, varies in level with RF signal strength, and may contain flutter. The latter is usually present when strong adjacent channel signals are present. This happens when you taxi your airplane under the other flyers' antenna!

The thermal noise can be filtered with a simple R/C circuit. This filter has a cut off frequency of about 3 KHz which is close to the bandwidth of the receiver IF amplifier, The schematic shows the external connections for the decoder input in which the above mentioned conditions are handled. Diodes D2 and D3 charge the 1 uf coupling capacitor to the peak input voltage minus the fixed voltage at pin 12 and the diode drops thus, noise spikes are clipped well below the threshhold of the decoder amplifier. D3 also clamps the input signal reaching operational amplifier that is the internal input to the decoder. C14 forms a filter which allows the amplitude of the input to vary over a wide range and at high rates (as a result of the RF flutter mentioned earlier) without false triggering the decoder. C14 charges up to the average baseline voltage but R7 does not allow it to be charged by the information pulses. Thus, so long as the pulse peaks exceed the baseline voltage by greater than the drop accross diode D2, the system will be unaffected by baseline flutter, no matter what its rate is.

Positive feedback has also been incorporated in the decoder to provide 100 millivolts of hysteresis on the threshold. When the input at pin 13 is low, the current generator (internal to the IC and with its output available at Pin 11) is off and pin 11 is near ground. The threshold is determined by the ratio of R15 to R12 + R11. When pin 13 goes positive, the current generator turns on and approximately 150 microamperes is sourced. This raises pin 11 by 150 uA x R11 = 0.7V and the threshold is now V-12 – V-13 or 0.3V. The amplifier will not turn off until the input drops below 0.3V, adding greatly to the noise rejection capability of the decoder.

R16 and C18 form a 2.8 KHz low pass filter to further improve noise rejection. C21 and R10 set the minimum pulse width that the decoder will accept. Thus, this all IC decoder does three important things, as well as decoding the outputs:

–Clips all inputs that are less than 400 mv.
–Rejects flutter in the baseline and
–Filters noise spikes.

The performance of the NE5045 decoder used in the Silver Seven receiver is such that it yeilds a noise rejection that increases the operating range of a given receiver by about 25 percent and provides solid operation, no matter what the attitude of the airplane.

## III. PARTS LIST

Parts in ( ) are for 72/75 MHz only. Parts in [ ] are for 50-53 MHz only.

| ✓ | QUAN. | ACE P/N | DESCRIPTION |
|---|---|---|---|
| | RESISTORS – All are ¼w 5% | | |
| | 2 | R4-271 | 270 ohm, red, violet, brown |
| | 1 | R4-681 | 680 ohm, blue, grey, brown |
| | 1 | R4-102 | 1K, brown, black, red |
| | 1 | R4-122 | 1.2K, brown, red, red |
| | 1 | R4-332 | 3.3K, orange, orange, red |
| | 1 | R4-472 | 4.7K, yellow, violet, red |
| | 1 | R4-562 | 5.6K green, blue, red |
| | 3 | R4-103 | 10K, brown, black, orange |
| | 2 | R4-473 | 47K, yellow, violet, orange |
| | 1 | R4-563 | 56K, green, blue, orange |
| | 1 | R4-104 | 100K, brown, black, yellow |
| | 1 | R4-224 | 220K, red, red, yellow |
| | 1 | R4-334 | 330K, orange, orange, yellow |
| | 1 | **R8-680** | **68 ohm, blue gray, black (1/8 watt)** |
| | CAPACITORS | | |
| | (1 | CD100 | 10pf disc – 100) |
| | (3 | CD180 | 18pf disc – 180) |
| | (1 | CD330 | 33pf disc – 330) |
| | [1 | CD068 | 6.8pf disc – 068] |
| | [2 | CD100 | 10pf disc – 100] .25x2=.50 |
| | [2 | CD180A | 18pf disc – 180] .25x2=.50 |
| | [1 | CD270 | 27pf disc – 270] .25 |
| | 1 | CD102 | .001mf disc |
| | 2 | CO103 | .01mf monolythic – 103 |
| | 2 | CO473 | .047mf monolythic – 473 |
| | 2 | CO104 | .1mf monolythic – 104 |
| | 1 | CO224A | .22mf monolythic – 224 |
| | 2 | CT105/CT105A | 1mf tubular or dipped tantalum |
| | 1 | CT106/CT106A | 10mf tubular or dipped tantalum |
| | 2 | CT475/475A | 4.7mf tubular or dipped tantalum |
| | 2 | CE106PI | 10mf aluminum electrolytic |
| | 1 | CE476PI | 47mf aluminum eltrolytic |
| | CHOKES AND COILS | | |
| | (1 | LL395 | 3.9 uhy shielded choke) |
| | [1 | LL474 | .47uhy shielded choke] -1.75 |
| | (2 | LL050 | 113SN2K256 shielded coil) |
| | [2 | LL051 | 113KN2K241 coil] 1.5x2 = 3.00 |
| | 3 | LL106 | 10uhy choke |
| | 1 | LL015 | Black IF can |
| | 1 | LL016 | Yellow IF can |
| | 1 | LL017 | White IF can |
| | SEMICONDUCTORS | | |
| | 3 | SS121 | IN4446 diode |
| | 2 | SS006A | 43144 transistor |
| | 1 | SS024 | 2N2925 transistor |
| | 1 | SS034 | 2N5088 transistor |
| | 1 | SS098 | SO42P IC |
| | 1 | SS094 | NE5045 IC |
| | HARDWARE AND MISC. | | |
| | 1 | PC150 | PC board |
| | 1 | PLA202 | Plastic case (for pigtails) |
| | 3 | RP003 | No. 0 grommet |
| | 1 | LB084 | FCC Compliance Sticker |
| | 1 | LB083 | "Silver Seven" Sticker |
| | 1" | TB025 | Heat shrink tubing |
| | 8" | | Brown, orange, yellow, green, blue, violet, grey, white wire |
| | 48" | | Red and black wire |
| | 48" | | No. 22 Solder |
| | 36" | | Antenna wire |
| | 1 | | Crystal |

# IV. CONSTRUCTION

## A. PC BOARD CONSTRUCTION

( ) Re-read the Kit Builders' Hints, especially the sections on component ID and PC board construction.

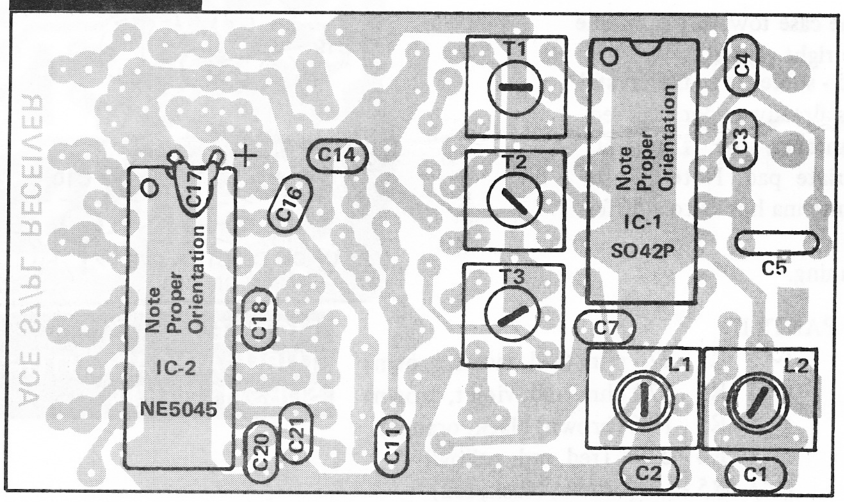
( ) Using the overlay drawings and parts ID legend, assemble the PC board two stages, following the suggested procedure and always observing the footnotes for items requiring special attention. Note the different values and antenna installation for 50/53 MHz receivers.

**FIGURE 3**
**CRYSTAL ID**

| Operating Frequency | Minus .455 | Divided By two | Plus .455 | Divided By two |
|---|---|---|---|---|
| 72.08 | 71.625 | 35.8125 | 72.535 | 36.2675 |
| 72.16 | 71.705 | 35.8525 | 72.615 | 36.3075 |
| 72.24 | 71.785 | 35.8925 | 72.695 | 36.3475 |
| 72.32 | 71.865 | 35.9325 | 72.775 | 36.3875 |
| 72.40 | 71.945 | 35.9725 | 72.855 | 36.4275 |
| 72.96 | 71.505 | 35.2525 | 73.415 | 36.7075 |
| 75.64 | 75.185 | 37.5925 | 76.095 | 38.0475 |

The crystal may be stamped with any of these numbers corresponding to the operating frequency.

**FIGURE 4**
**STAGE ONE**
**OVERLAY**



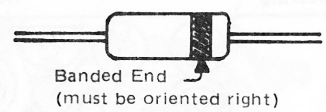

( ) Install and solder the IC's first, capacitors next, and then the IF cans and tuning coils. Make sure the IF's and coils are flat on the board and are perpendicular.

### STAGE ONE PARTS ID

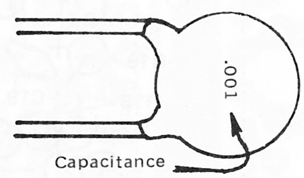
(✓) C1 - 18pf Disc - 180
(6.8pf for 50/53 MHz - 068)
(✓) C2 - 18pf Disc - 180
(10pf for 50/53 MHz - 100)
(✓) C3 - 10pf Disc - 100
(18pf for 50/53 MHz - 180)
(✓) C4 - 33pf Disc - 330
(18pf for 50/53 MHz - 180)
(✓) C5 - 18pf Disc -180
(27pf for 50/53 MHz -270)
(✓) C7 - .047mf monolythic - 473
(✓) C11 - .047mf Monolythic -473
(✓) C14 - .22mf Monolythic - 224
(✓) C16 - .1mf Monolythic - 104
(✓) C17 - 4.7 mf dipped tantalum
(Install as shown, note +)
(✓) C18 - .01mf Monolythic - 103
(✓) C20 -.1mf Monolythic - 104
(✓) C21 - .01 Monolythic - 103
(✓) L1 - 113SN2K256
(113KN2K241 for 50/53 MHz)
(✓) L2 - 113SN2K256
(113KN2K241 for 50/53 MHz)
(✓) T1 - Yellow IF Can
(✓) T2 - White IF Can
(✓) T3 - Black IF Can

**ID AID**

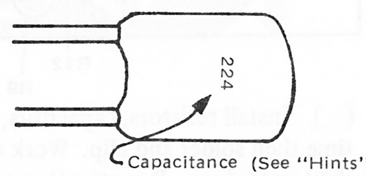
DIODE




DISC CAP

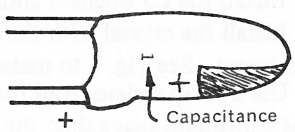



MONOLYTHIC CAP

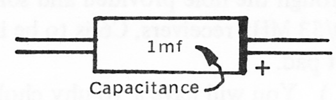



POLARITY MUST BE OBSERVED.

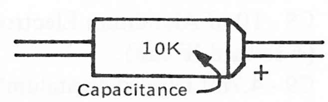
DIPPED TANTALUM



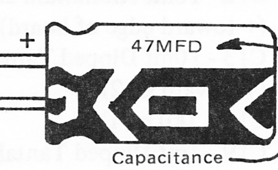

TUBULAR TANTALUM




TUBULAR TANTALUM

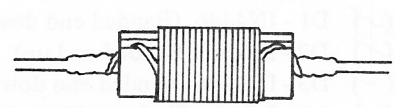



ALUMINUM ELECTROLYTIC




POLARITY MUST BE OBSERVED.

10 uhy CHOKE



.47 or 3.9 uhy CHOKE

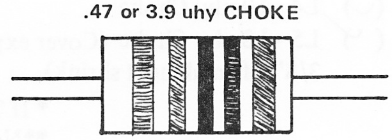


FIGURE 5 STAGE TWO OVERLAY

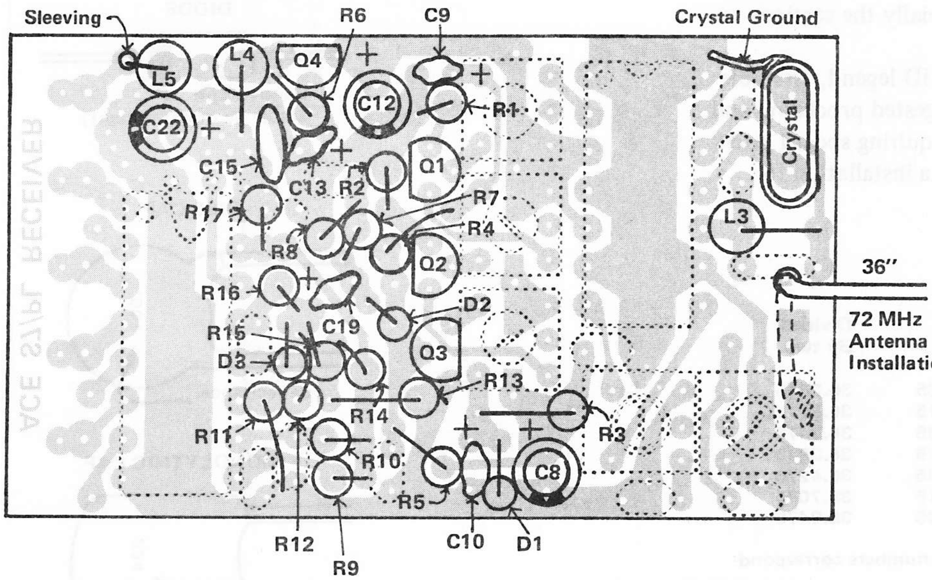
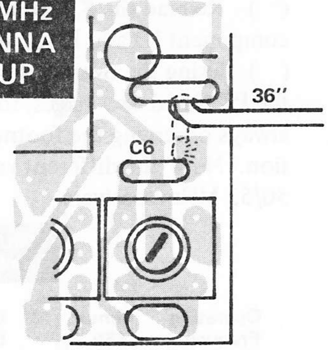



FIGURE 6 50/53 MHz ANTENNA HOOKUP




( ) Install C6 - 10pf disc or monolythic - 100

( ) Solder antenna as shown

( ) Install resistors, capacitors, diodes, and transistors three or four at a time then solder and clip. Work around board from top to bottom, left to right until done. Pay attention to special treatment and foot notes in the parts ID.

( ) Install the L3 shielded choke.

( ) Install the crystal with the solder that is on the case toward the middle of the board. See Fig. 3 to make sure you have the right crystal.

( ) Use a scrap resistor lead for the crystal ground - solder it to the crystal case at a different place than the spot where there is already solder exposed.

( ) Strip 1/8" insulation off one end of the 36" antenna wire. Thread it through the hole provided and solder to the appropriate pad. Note that for 50/53 MHz receivers, C6 is to be installed and the antenna hooks to a different pad.

( ) You will have a 10 uhy choke left - it is for tuning.

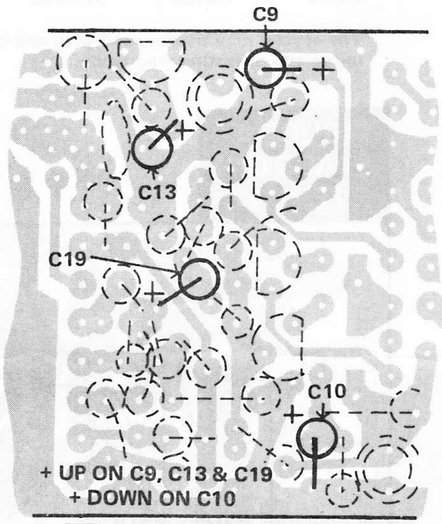



FIGURE 7 TUBULAR CAPACITOR SUBSTITUTION

STAGE TWO PARTS ID

(✓) C8 - 10mf Aluminum Electrolytic (+ toward IF can)
(✓) C9 - 4.7mf Dipped Tantalum* (+ toward IF can)
(✓) C10 - 1mf Dipped Tantalum* (+ toward IF can)
(✓) C12 - 10mf Aluminum Electrolytic (+ toward edge of board)
(✓) C13 - 10mf Dipped Tantalum* (+ toward C12)
(✓) C15 - .001mf Disc
(✓) C19 - 1mf Dipped Tantalum* (+ toward left or away from IF cans)
(✓) C22 - 47mf Aluminum Electrolytic (+ toward middle of board)
(✓) D1 - IN4446 (Banded end down)
(✓) D2 - In4446 (Banded end up)
(✓) D3 - IN4446 (Banded end down)
(✓) L3 - 3.9 uhy Choke (.47 for 50/53 MHz)
(✓) L4 - 10 uhy Choke
(✓) L5 - 10 uhy Choke (Cover exposed leg with 3/8" of small heat shrink)

(✓) R1 - 270 ohm (red, violet, brown)
(✓) R2 - 270 ohm (red, violet, brown)
(✓) R3 - 10K (brown, black, orange)
(✓) R4 - 220K (red, red, yellow)
(✓) R5 - 1K (brown, black, red)
(✓) R6 - 10K (brown, black, orange)
(✓) R7 -10K (brown, black, orange)
(✓) R8 - 100K (brown, black, yellow)
(✓) R9 - 47K (yellow, violet, orange)
(✓) R10-47K (yellow, violet, orange)
(✓) R11 - 4.7K (yellow, violet, red)
(✓) R12 - 330K (orange, orange, yellow)
(✓) R13 - 3.3K (orange, orange, red)
(✓) R14 - 1.2K (brown,red, red)
(✓) R15 - 56K (green, blue, orange)
(✓) R16 - 5.6K (green, blue, red)
(✓) R17 - 680 ohm (blue, grey, brown)
( ) R18 - 68 ohm (blue, gray,black) ***
(✓) Q1 - 43144**
(✓) Q2 - 43144 **
(✓) Q3 - 2N2925**
(✓) Q4 - 2N5088**

* If Tubular Tantalum is supplied, see Figure 7.
**Note orientation of flat side.
*** Will be installed later.

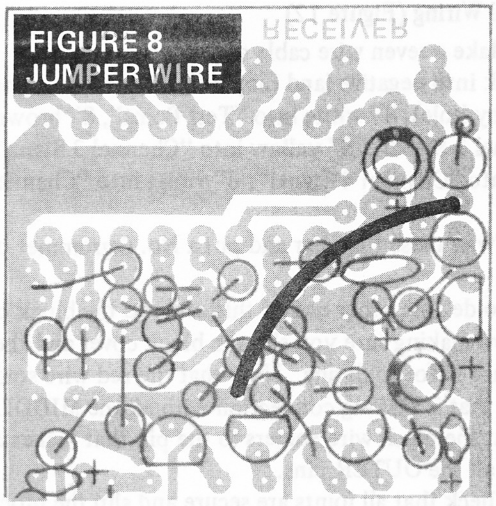


FIGURE 8
JUMPER WIRE

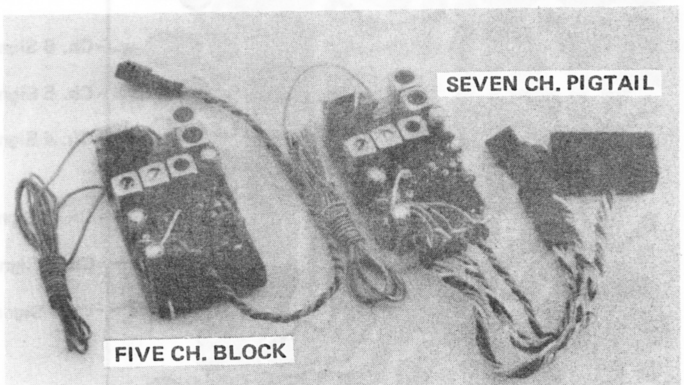
( ) Using a short piece of the black wire furnished, install a jumper wire between the two points shown in figure 8.

## V. WIRING

### A. TECHNIQUE

Refer to the introduction for photos of proper wire preparation. When preparing a wire for installation in a PC board or soldering to a connector, strip 1/8" of the insulation from the wire, twist the strands together and apply a small amount of solder to the wire. This is called "tinning". Be sure not to cut any of the wires when you strip off the insulation.

The introduction shows an illustration on proper hook-up to Deans connectors. Before soldering up to the connector always slip the wire through the appropriate sleeving, heat shrink, and grommet to avoid unsoldering later. Don't use too much heat or you'll melt the plastic. It's a good idea to mate the plugs together when soldering: this will help dissipate heat, make sure you're soldering to the correct end of the pins, and help prevent wiring errors. If both the wire and connector pin are "tinned" before soldering, the joint forms quickly and little heat is needed. A clothespin is a handy holding fixture for the connectors.




### B. RECEIVER CONNECTORS

1. Deans Connectors

NOTE: The following assumes you have either a complete system kit or have obtained an Ace 19G701 connector package.

This receiver can be wired one of two ways with the Dean's connectors. . . either in an end-block configuration or a pig-tail type termination, depending on your preference. Wiring for seven channels is shown.

a. Block Connector Assembly.

( ) The Block is to be assembled one of two ways. Use the bent pins if you are going to use End-Block termination or the straight pins if you are doing the pigtail-type.

( ) Insert the pins as shown in Figure 9. Make sure they are inserted into the end of the plastic block that has the indented lip in it and that they are oriented as shown. Also note that on the left end there are three males; the rest are females.

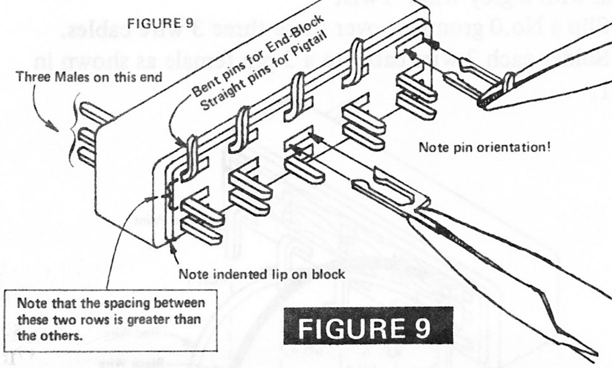



FIGURE 9

( ) Carefully install the interconnect PC board into place. Be careful, the board is fragile. Clip off the ends as shown for one or the other application. See Fig. 10.

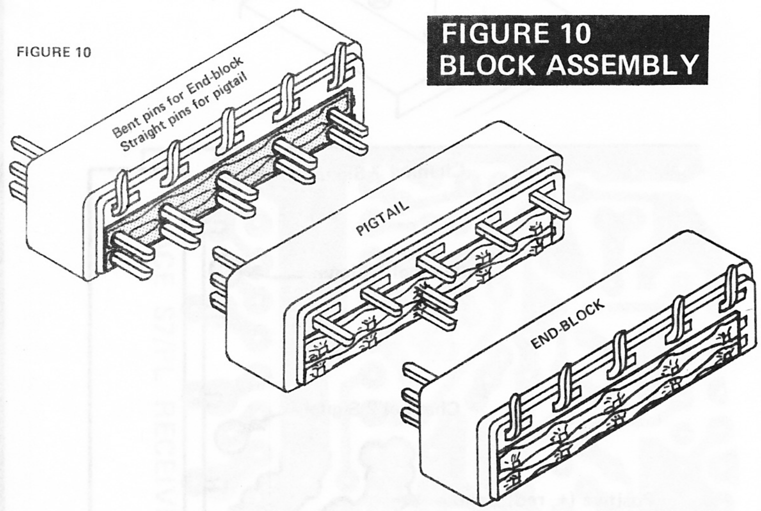



FIGURE 10
BLOCK ASSEMBLY

ACE R/C, Inc.

b. End-Block Wiring (Figure 11)

( ) Solder a 1¼" piece of black wire onto the outer PC land of the Block Connector as shown in figure 11.

( ) Solder a 1¼" piece of red wire to the middle PC land of the Block Connector.

( ) Insert the block connector into the receiver PC board and solder, making sure it lays flat on the board.

( ) Solder the loose end of the black wire from the block into any convenient hole in the negative land (fig. 11). Shorten the wire if necessary.

( ) Repeat for the red wire, soldering it into the positive land.

( ) Now make up three 3 wire cables for the descrete servo connectors as follows: Solder an 8" black wire into the negative land, 8" red wire into the positive land and an 8" orange wire into the channel 2 signal hole. Twist these three wires together. Solder an 8" black to negative, 8" red to positive and 8" blue to channel 5 signal. Twist. Repeat for channel 7 signal with a grey wire. Twist

( ) Slip a No.0 grommet over these three 3 wire cables.

( ) Solder each 3 wire cable to a 3 pin female as shown in Fig. 11.

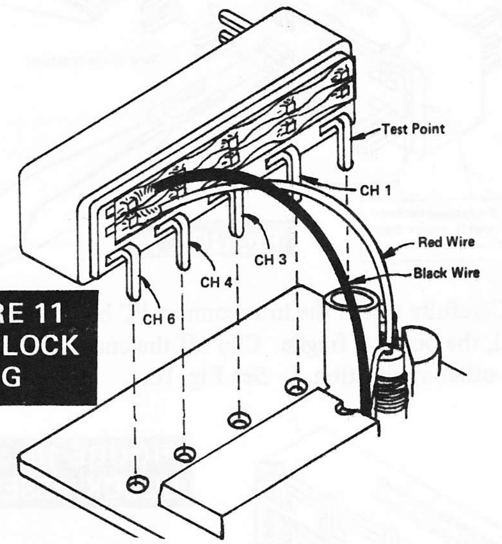
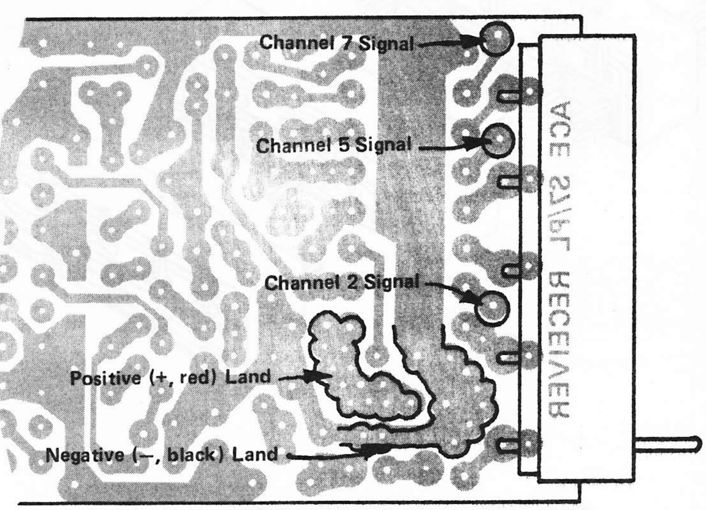
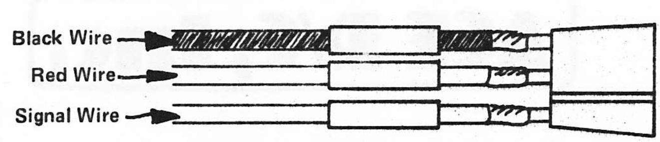



FIGURE 11
END-BLOCK
WIRING




DISCRETE SERVO CONNECTOR WIRING

c. Pigtail Wiring (Figure 12)

( ) Make a seven wire cable as follows:
8" black into negative land (any hole), 8" red into positive land (any hole), 8" white into "Test Point", 8" brown into "Channel 1 Signal", 8" yellow into "Channel 3 Signal", 8" green into "Channel 4 Signal", 8" violet into "Channel 6 Signal"

( ) Twist these together and put a No. 0 grommet over the cable.

( ) Solder the other end of this cable to the block connector as shown making sure you slip the block cover and the sleeving into place befor soldering. Note that the red wire solders to the pin that is making connection with all the MIDDLE pins and that the black wire solders to the pin that makes connection to all the OUTER pins.

( ) Check that all joints are secure and slip the block cover into place. Route and bundle as necessary to acheive a good fit with no undue stress on any joints. Later, after you are sure everything checks out and is OK, you may want to fill the block cover with some silicone for strain relief and/or join the cover to the block with a small amount of "Hot Stuff".

( ) Refer to the "End-Block wiring" section and make up three 3 wire cables for the descrete servo connectors on ch. 2, 5, and 7. **Slip a No. 0 grommet over the cables for Chs. 2 &5 and one over the cable for Ch. 7 before installing the connectors.**

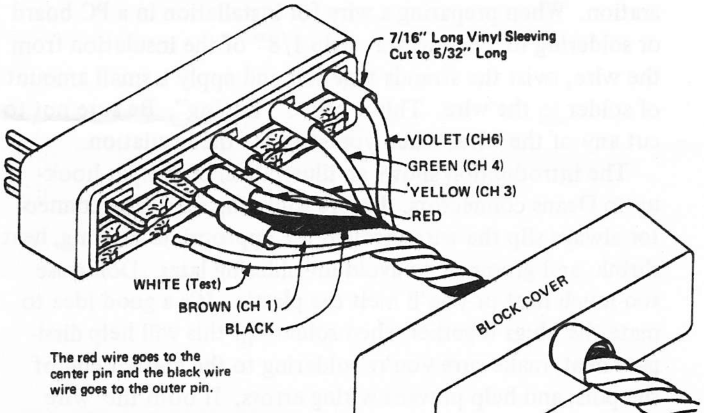
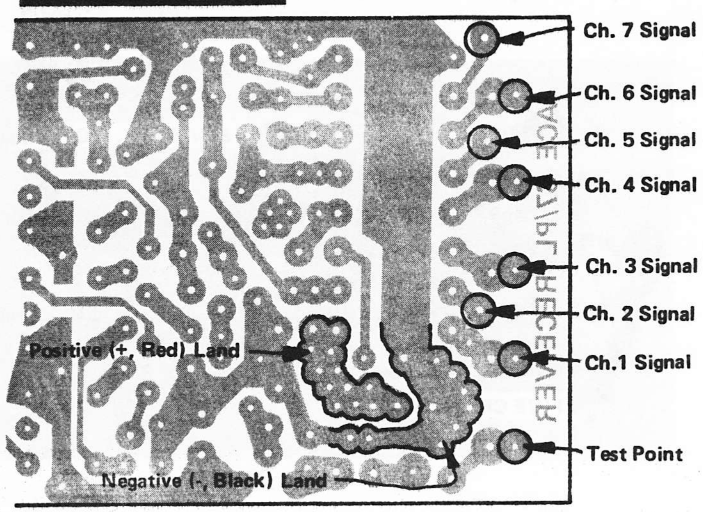



FIGURE 12
PIGTAIL WIRING



2. Using Other Connectors.

This receiver will operate any three wire, positive pulse servos. When using connectors other than Deans, it is necessary to determine which wire is positive (+), negative (–) and signal. Usually, the cable will consist of a red, black, and third color wire so this determination is easy. If it deviates from this, use a voltmeter to check the wires coming from the original receiver that the servo was used with to establish proper polarity.

( ) Putting No. 0 grommets over the cables (you can use up to three), install the servo connector wires in the receiver with the positive to the positive land, negative to the negative land and signal to appropriate signal land (ch. 1 thru7) refer to figure 12.

( ) Install a power connector so negative (OV) goes to the negative land and positive (+4.8V) goes to the positive land.

Four wire servos usually have a white wire that supplies battery center tap power (+2.4V) to all the servos; again, if in doubt, use a voltmeter to be sure of color code. If you are using four wire servos, you will have to devise a way to deliver +2.4V to all the servos. This can be done by bringing +2.4V from the battery pack into the receiver case with the other power wires and then solder the center tap leads from all the servo connectors to this wire – no connection to the receiver is required. Make sure these connections are well insulated and can't short to anything.

If you are using negative pulse servos, a pulse inverter (14G18) will have to be used on each servo to work with this receiver.

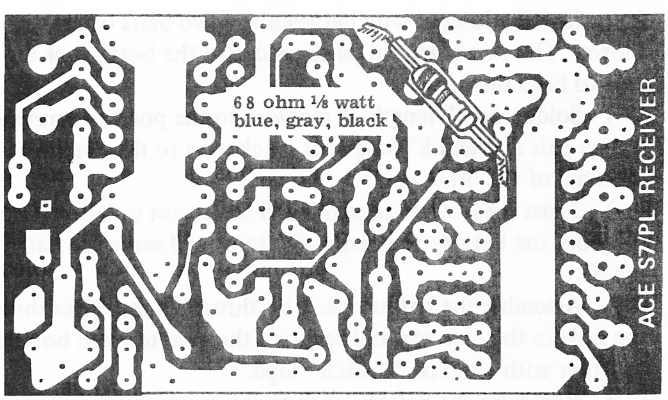
C. R18 INSTALLATION

( ) Gently file off all sharp points on solder side of PC board and clean board with denatured alcohol and an old toothbrush.

( ) Cut small heat shrink to ½" and slip over resistor.

( ) Shrink tubing and cut leads to 1/8" past tubing.

( ) Solder resistor to board where shown, watch out for shorts.




NOTE: Solder side of PC board shown.

FIGURE 12A
R 18
INSTALLATION

D. SWITCH HARNESS WIRING

The following assumes you have a complete system kit or have obtained the 19G702 Switch Harness kit.

( ) Prepare three 8" cables of twisted red and black wire. Slip a 1" piece of 3/16" heat shrink over them.

( ) Solder to the Noble switch as shown in Fig. 13, following appropriate illustration for switch supplied. Make sure you have good joints with no frayed wires. It would be helpful to use a piece of masking tape to label the opposite end of the cables: "battery", "receiver", "charger". Slide the tubing up to the terminals and shrink down with a lighter or heat gun.

( ) Refer to Figure 14 and solder the appropriate connector onto each of the proper cables from the switch.

( ) Install switch cover into place, it may be necessary to apply a small drop of Hot Stuff to hold in place. Be very careful not to get any in switch.

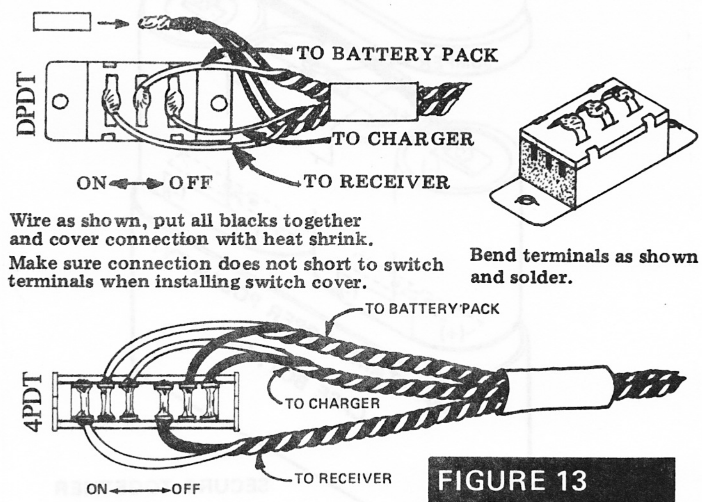



FIGURE 13
SWITCH WIRING

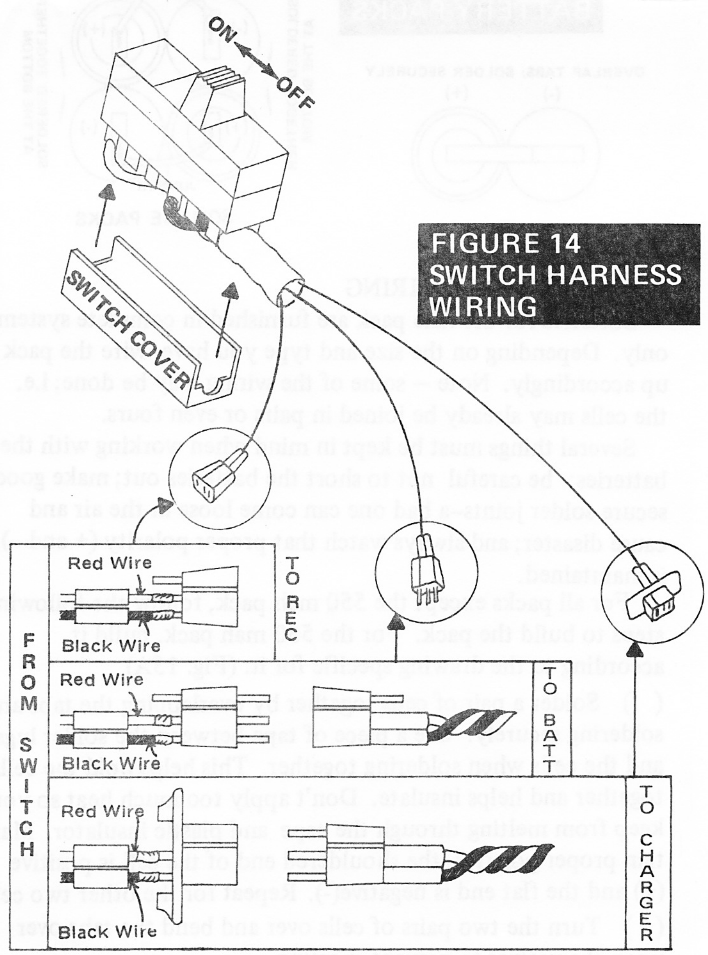
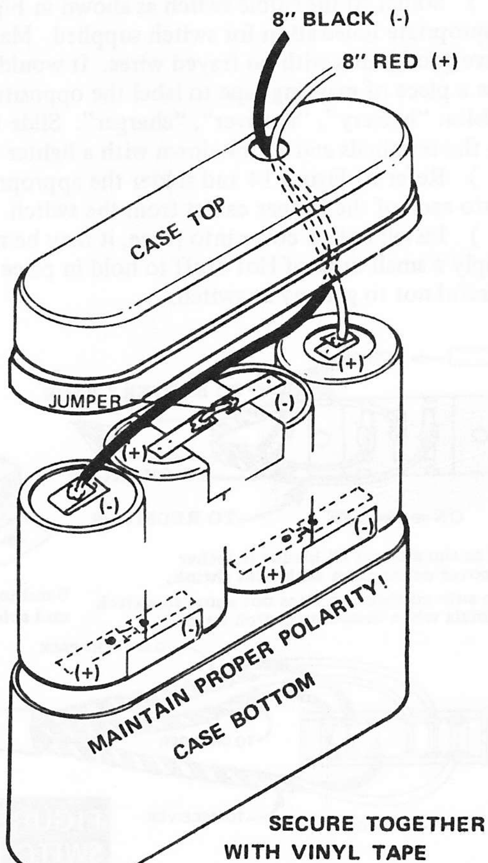



FIGURE 14
SWITCH HARNESS
WIRING



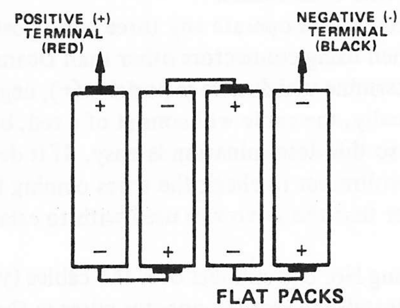
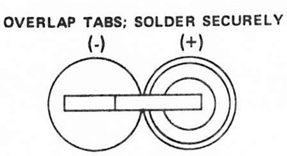
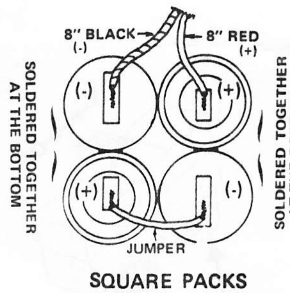




**FIGURE 15**
**BATTERY PACKS**



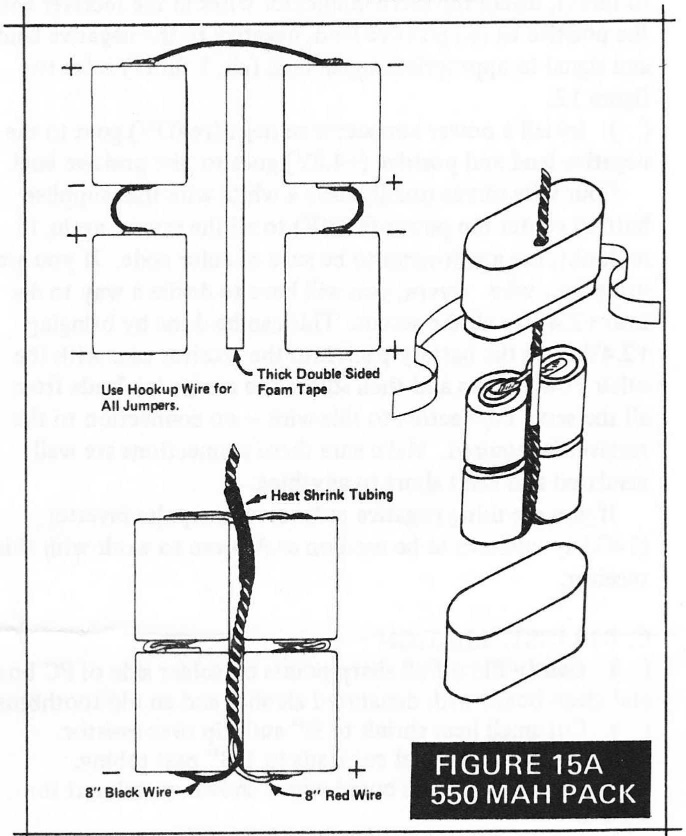




**FIGURE 15A**
**550 MAH PACK**

## E. BATTERY PACK WIRING

Batteries for the flite pack are furnished in complete systems only. Depending on the size and type you have, wire the pack up accordingly. Note – some of the wiring may be done; i.e. the cells may already be joined in pairs or even fours.

Several things must be kept in mind when working with the batteries: be careful not to short the batteries out; make good, secure solder joints--a bad one can come loose in the air and cause disaster; and always watch that proper polarity (+ and–) is maintained.

For all packs except the 550 mah pack, follow the following steps to build the pack. For the 550 mah pack, build it according to the drawing specific for it. (Fig. 15A)

( ) Solder a pair of cells together by overlapping the tabs and soldering securely. Use a piece of tape between the solder lugs and the cells when soldering together. This helps hold the cells together and helps insulate. Don't apply too much heat so you keep from melting through the tape and plastic insulator. Maintain proper polarity--the shouldered end of the cell is positive (+) and the flat end is negative(-). Repeat for the other two cells.

( ) Turn the two pairs of cells over and bend the tabs over upon themselves to prevent shorting.

( ) Install a jumper wire between the two pairs of cells as shown. The two pairs can be slipped into the bottom of the case to hold them.

( ) Solder an 8" length of red wire to the positive terminal of one pair and and 8" length of black wire to the negative terminal of the other pair.

( ) Twist these wires together and tie a knot in them about ½" from the battery terminals--this knot will serve as strain relief.

( ) Assemble the battery pack by threading the wires through the hole in the case top and securing the case top and bottom together with vinyl or "Scotch" tape.

( ) Now wire the battery pack to the appropriate connector as shown in figure 14. MAKE SURE proper polarity is maintained. If it is not you can damage the batteries, receiver, and/ or servos!

Although these batteries will accept a quick charge (4-6 hrs.) or a fast charge (15 min.), Ace R/C recommends that for all normal operation, they be charged at the overnight rate (12 to 16 hrs.) which is a 45 - 50 ma charge rate (C/10). This way you don't run the risk of damaging the batteries by overcharging them.

For the first charge in the battery pack's life, leave it on for a full 24 hours. Subsequent charges can be 12 - 16 hrs.

## VI. TUNING

( ) Double check the overlay drawings for proper parts placement. Make sure all leads are clipped short. Scrub the bottom of the board with alcohol or dope thinner and an old toothbrush to remove the solder rosin. Use a magnifying glass to inspect the bottom of the board for bad solder joints and solder bridges. Take your time! Double check now to avoid dissappointment later.

The tools required to tune the Silver Seven Receiver are a small non-metalic tuning wand and either a voltmeter (VOM) or oscilloscope or both.

( ) Connect the VOM and/or oscilloscope to the test point on the receiver as shown in Figure 16 or Figure 18.

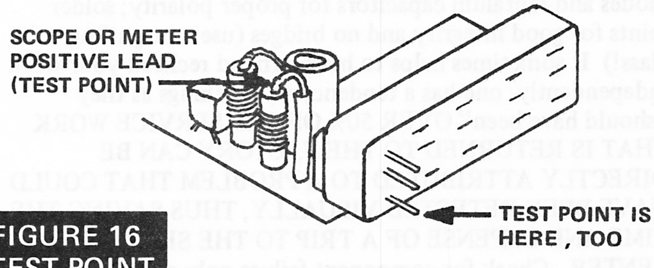
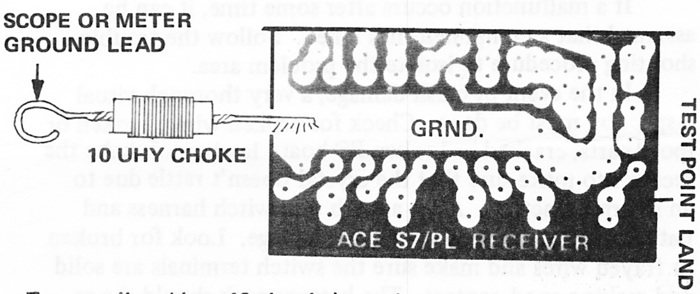



FIGURE 16
TEST POINT




**Temporarily solder a 10 uhy choke to the ground land as shown. Clip the meter and/or scope ground (negative) lead to the end of the choke. Clip the meter and/or scope positive lead to either the exposed lead of L5 or the appropriate male pin on the block connector.**

( ) Set your VOM to the 0 – 5 volt or the lowest scale that will read 5 volts. Set the oscilloscope to .5 volts per division vertical and 1 ms horizontal.

( ) Apply power to the receiver. You should see a voltage reading of approximately 4.3 volts with no transmitted signal.

( ) Place transmitter next to the receiver (transmitter antenna on but collapsed) and turn on transmitter. The voltage will drop on your VOM and the waveform as shown in Figure 17 will be displayed on the scope. Adjust T1 yellow IF, T2 white IF, and T3 black IF in that order for the lowest voltage reading on the VOM and the largest waveform on the oscilloscope.

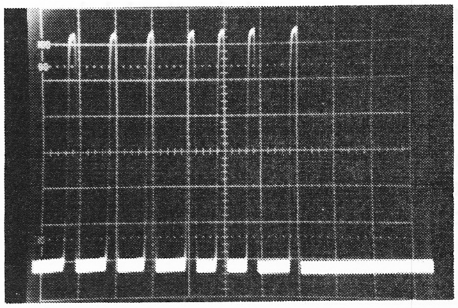


FIGURE 17
SCOPE TRACE

( ) Remove the transmitter antenna and retune the three IF s again. Now tune the coils L1 and L2 for the lowest voltage reading and the largest waveform.

( ) The receiver in now ready to be fine tuned by placing the transmitter away from the receiver to a point where you still are receiving a signal but the signal level is quite small. Now adjust T1, T2, T3, L1, L2 and again for the lowest voltage reading and the largest waveform.

Your system is now tuned and the cans should be sealed with either bees wax or candle wax to keep them from detuning due to vibration.

When range checking a system, always do this in an open area away from duct work, fences, and other objects that could cause reflections.

When properly tuned and installed in your aircraft and using an Ace transmitter, you should get about 50 feet range with the transmitter antenna removed and about 150 feet range with the transmitter antenna on but collapsed. Realize these range figures are relative and can vary considerably from brand of radio to brand.

Realize that when using Deans Connectors, you can access the tuning test point while the receiver is still in the case. See figure 18.

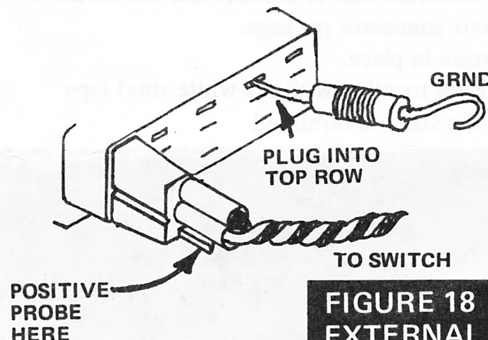



FIGURE 18
EXTERNAL TEST POINT
DETAIL

## VII. FINAL ASSEMBLY

A. TRANSPOSING CHANNELS 1 AND 2

If you are using this receiver with a transmitter other than a Silver Seven, you may find that the connector for ailerons is on the block rather than on a separate pigtail as it should be. This is because that transmitter puts ailerons on channel One rather than Two.

If you have wired your receiver for pigtail-type termination, it is an easy matter of swapping the signal wires for channels 1 and 2 (brown and orange) at the receiver (see figure 12).

If your receiver is End-block wired, some simple surgery will be required. Refering to figure 11, remove the aileron pigtail signal wire from the hole it is in for channel two (orange wire). Now carefully cut the PC land as indicated on figure 19. Install a resistor lead jumper as shown which now puts channel two signal on the block. Now reinstall the orange signal wire in the hole indicated on figure 19 for ch. 1 output. Now Ch. 1 signal is on the separate pigtail connector.

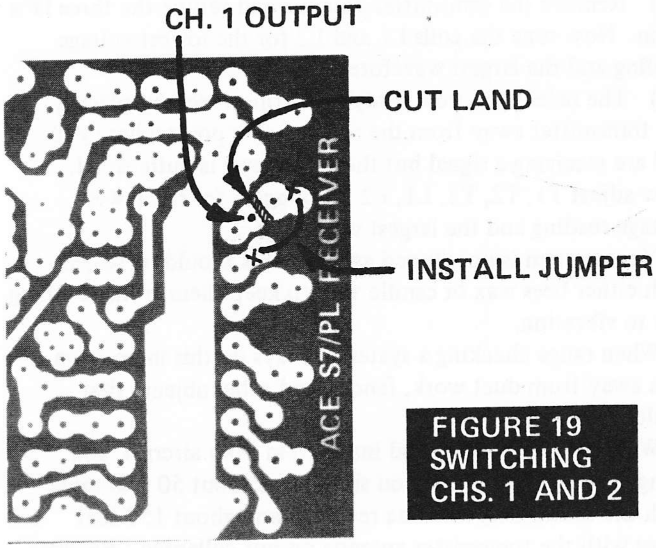



FIGURE 19
SWITCHING
CHS. 1 AND 2

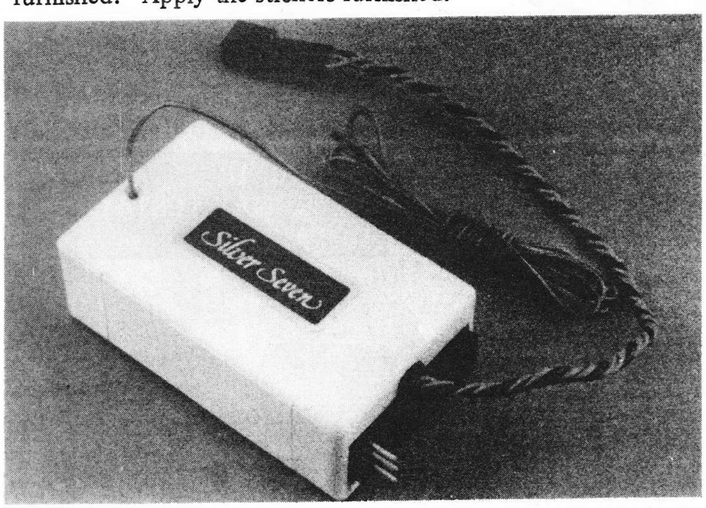
B. INSTALLATION IN THE CASE

( ) Thread the antenna wire through the hole in the top of the case.

( ) Slip the receiver into the top of the case, putting the wiring grommets into the "U" slots in the case. Note – the End-Block receiver requires a different case to accomodate the block. It was furnished in your connector package.

( ) Snap the bottom in place.

( ) Secure the halves together with the white vinyl tape furnished. Apply the stickers furnished.




## VIII. OPERATION

There is nothing out of the ordinary about the operation of your Silver Seven receiver. The following cautions apply to this receiver as any other. Don't subject the receiver to undo vibration... in any installation, isolate it with foam. Try to prevent temperature extremes; they can damage sensitive parts. Don't expose the receiver to reverse polarity or excessive voltage. Since you know how to do it and how easy it is, retune the receiver after several hours of operation.... if any components are going to shift, it usually happens early, in the "burn-in" stage.

You can expect years of dependable service from your Silver Seven receiver if treated properly. We hope you enjoy it!

## IX TROUBLESHOOTING

A. GENERAL SERVICE INFORMATION

This section is provided to help the kit builder troubleshoot the Silver Seven receiver.

When soldering or desoldering components on the receiver, work carefully making sure you don't use excess heat which will cause the small PC lands to lift from the board. Excess solder should be removed with a bulb type solder sipper or solder wick.

Trouble can occur either at initial start up or after the equipment has been in operation for awhile. If the malfunction is at the start, the very first thing to do is to make a very thorough visual check of the mechanical condition of the unit: recheck all wiring for breakage and proper connection; components for proper placement; transistors for proper basing; diodes and tantalum capacitors for proper polarity; solder joints for good integrity and no bridges (use a magnifing glass!) It sometimes helps to have a friend recheck your work independently; one has a tendency to see things as they "should have been" OVER 50% OF THE SERVICE WORK THAT IS RETURNED TO THE FACTORY CAN BE DIRECTLY ATTRIBUTED TO A PROBLEM THAT COULD HAVE BEEN DETECTED VISUALLY, THUS SAVING THE TIME AND EXPENSE OF A TRIP TO THE SERVICE CENTER. Check for component failure only after making sure the unit is constructed properly.

If a malfunction occurs after some time, it can be assumed that a component has failed. Follow the troubleshooting procedure to isolate the problem area.

In the event of crash damage, a very thorough visual inspection must be done. Check for broken wires, broken or loose parts, cracked or broken PC board lands, and shake the receiver to make sure that the crystal doesn't rattle due to an internal fracture. After a crash the switch harness and battery pack must be checked for damage. Look for broken or frayed wires and make sure the switch terminals are solid and making good contact. The battery pack should be removed from its' case and each cell inspected for damage. Look for dents in the cells, making sure all solder connections are solid, and that the cells are not leaking or corroded. If there is evidence of any of the above, the cell or cells must be replaced.

It is also a good idea to inspect the servos for gear damage after a crash.

In the following sections you will be instructed to check a component or components. You can use an ohmeter to test for shorted capacitors, open IF cans, open resistors, or shorted or open diodes; use a transistor checker for testing transistors. The only suitable test for IC's is substitution -- do this only as a last resort because they are the least likely to fail unless a building error has occured and power applied, causing a given IC to be shorted.

B. LOCALIZING THE PROBLEM

The key to fast and accurate troubleshooting is being able to locate the area of the receiver that is malfunctioning. Refer to figure 1 and note that the receiver has been laid out in block form to show the various stages plus the component numbers as well. Use this figure to aid you in checking the components in the malfunctioning stage. It will be very helpful if you read and study the circuit description on pages S7RX 1 and S7RX 2 of the receiver instructions to learn what each component does in the circuit.

C. TROUBLESHOOTING THE SILVER 7 RECEIVER

The basic equipment required for a kit builder to troubleshoot the receiver is a VOM and/or an oscilloscope. Refer to waveforms (pg. S7 Rx. 12), voltage chart (Fig. 20 ), PC test point overlay (Fig. 21) the the block diagram (Fig. 1) when troubleshooting.

( ) Step 1. Always make sure that power (4.8Volts) is at the receiver. Check test points 14 - 15- 16.
( ) Step 2. Install meter and or scope to test point 6 (tuning point) to see if receiver is working to the detector. If the receiver isn't working at the detector , go to step No.3. If the detector is OK go to step No. 8.
( ) Step 3. Check the voltages on the SO42PIC also check waveform at TP 1 to see if oscillator is working. If problem is in the oscillator, check parts in the oscillator/mixer circuit, see fig. 1.
( ) Step 4. Check waveform on TP 2 pin 2 of IC 1 for output of mixer, (Note: waveform amplitude will vary with signal strength) if you don't have this waveform check mixer and 1st IF.
( ) Step 5. Check the voltages on the transistor Q 1 and the waveform at TP 3, (collector of Q 1). If receiver isn't working at this point check components in 1st and 2nd IF stages plus AGC.
( ) Step 6. Check the voltages on the transistor Q 2 and the waveform at TP 4 (collector of Q2) if the receiver isn't working at this point check the components in the 2nd IF, Detector and AGC stages.
( ) Step 7. Check the voltages on the transistor Q3 and the waveform at TP6 (collector of Q3). If the receiver isn't working at this test point, check the components in the detector, pulse forming flutter circuit, TP 7.
( ) Step 8. Check the voltages on IC2 NE5045 IC also check the waveform on test points 9 thru 15, these voltages and waveforms will aid in locating the defective component in the decoder section. Refer to page S7RX 2 for the function of each decoder component.
( ) Step 9. The waveforms on TP17 pins 1 - 7 of the NE5045 IC are the 1.5 ms output pulses, if you are using a 5 channel transmitter you will have a waveform on pins 1 - 5. A seven channel transmitter will have a waveform on pins 1 - 7 on this IC.
( ) Step 10. If all of the above steps check out and there is no action from the servos, make sure that the receiver plugs are wired the same as the servo plugs.

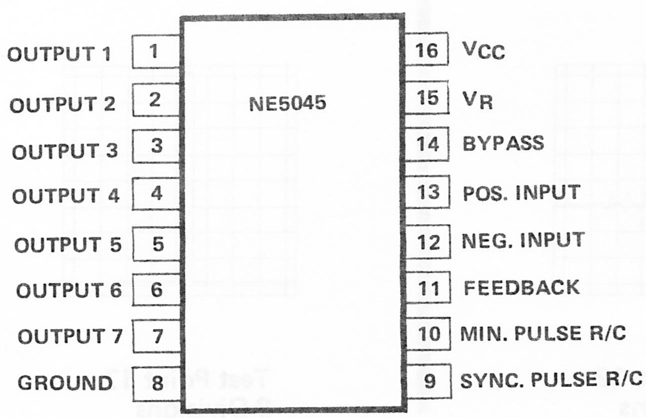


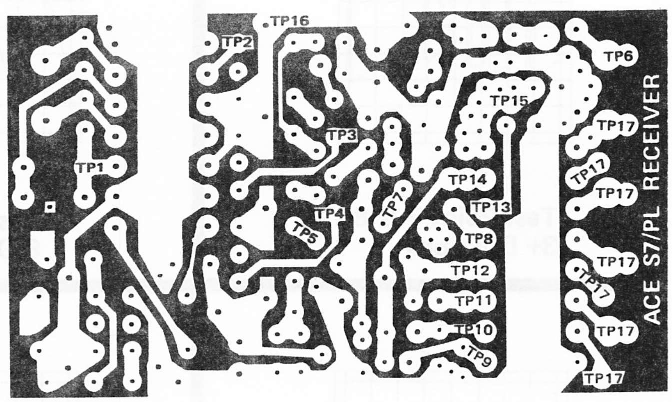

**FIGURE 20**
**VOLTAGE CHART**

## VOLTAGE CHART

| Test Point | Location | wo/Signal | with signal |
|---|---|---|---|
| TP 1 | Pin 10 IC 1 = | | .76 volts |
| TP 2 | Pin 2 IC 1 = | | 4.59 volts |
| TP 3 | Collector Q1 = | | 4.54 volts |
| TP 4 | Collector Q2 = | | 4.57 volts |
| TP 5 | Base Q3 = | | .57 volts |
| TP 6 | Collector Q3 = | (4.43 wo/signal) | .63 volts |
| TP 7 | Cathode D2 = | (4.12 wo/signal) | 2.56 volts |
| TP 8 | Pin 13 IC 2 = | | 2.42 volts |
| TP 9 | Pin 9 IC 2 = | (4.09 wo/signal | 1.33 volts |
| TP 10 | Pin 10 IC 2 = | | .38 volts |
| TP 11 | Pin 11 IC 2 = | | .13 volts |
| TP 12 | Pin 12 IC 2 = | | 3.01 volts |
| TP 13 | Pin 14 IC 2 = | | 4.77 volts |
| TP 14 | Pin 15 IC 2 = | | 4.12 volts |
| TP 15 | Pin 16 IC 2 = | | 5.32 volts |
| TP 16 | Emitter Q4 = | | 4.52 volts |
| TP 17 | Pins 1 - 7 IC 2 = | | .44 volts* |

*Voltage will vary with stick position.

**FIGURE 21**
**TEST POINT**
**OVERLAY**

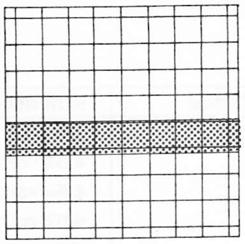




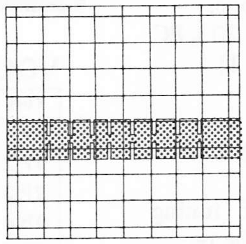
ACE R/C, Inc.
Box 511, 116 W. 19th St., Higginsville, MO 64037
(816) 584-7121

## WAVEFORMS

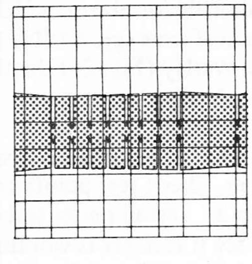
## ALL READINGS TAKEN AT .5 VOLTS PER DIVISION



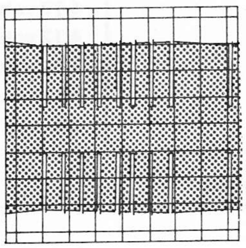
Test Point 1
1-1/3 Divisions



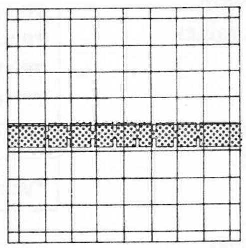
Test Point 2
1-1/2 Divisions



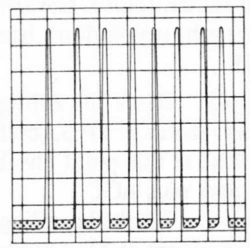
Test Point 3
3 Divisions



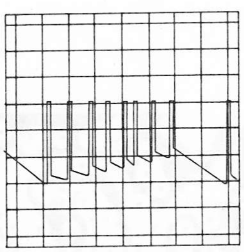
Test Point 4
6-1/2 Divisions



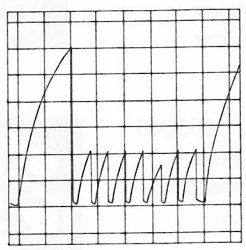
Test Point 5
Less than 1 Div.



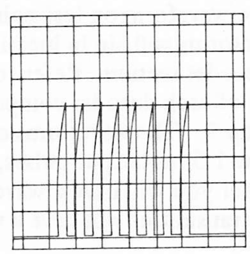
Test Point 6
7-1/2 Divisions



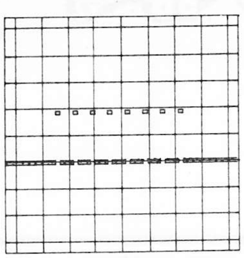
Test Point 7 & 8
3+ Divisions



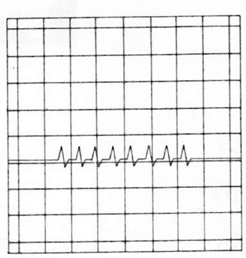
Test Point 9
6 Divisions



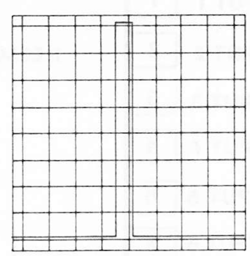
Test Point 10
5 Divisions



Test Point 11
2 Divisions



Test Point 12
.4 Divisions



Test Point 17
8 Divisions