

# ASSEMBLY INSTRUCTIONS

## Controlaire "4" Super-Regen Tone Receiver

ALL TRANSISTOR 3 VOLT OPERATION

### INTRODUCTION:

Again satisfaction on the flying field has prompted the production of another Controlaire receiver in kit form. This time it is the super-regen "4", a single channel relay type receiver that has proven its worth by the testimonial of hundred of satisfied users. This combined with our own experience of factory assembly of the original units makes the receiver a natural for home construction. We now present the "4" in kit form. Assembly has been engineered to provide all needed information, however, one word of caution. The receiver is small and involves close soldering to a small circuit board. Do not rush the assembly but instead take your time and use common sense on the delicate work. Do so and your "4" will reward you with exacting service.

The instructions are presented in two separate manuals and a small pamphlet titled "Kit Assembly Tips". One manual is the standard "Operating Instructions" as supplied with factory assembled units and the other manual is the "Assembly Instructions" which you are now reading. It is of primary importance that before any assembly work is started that you initially read all three of these items to gain a preliminary understanding of all information involved.

As you study the manual you will notice that assembly is outlined by the step by step procedure and large pictorials which identify all parts and their exact placement to the circuit board. To understand the assembly procedure take notice of the main pictorial, Fig. 2. This is the pictorial about which the assembly text is centered. Notice that this is a top view of the receiver chassis and that all components are assigned specific hole numbers. The shaded area represents the etched copper circuit pattern and although on the underside of the board, the same pattern can be recognized on the receiver board by holding it up to a light source where the pattern will show through. By using the light on the actual receiver board specific holes can be identified by association with the pattern or individual copper lands as

shown in the pictorial.

Assembly of parts to the circuit board is quite conventional. Resistors and most other parts are mounted flush or upright as directed, however, if any specific positioning is required it will be mentioned in the step in which it is installed. As each part is installed bend its leads over slightly to hold it in position and then, after soldering, clip off the excess lead about 1/16" from the circuit copper.

### Preliminary Notes

After you have studied the pictorials and initially read all of the instructions, unpack your kit carefully and check each part as identified on the check list. By doing this you will become familiar with parts appearance that will help you during assembly. After the check has been made, group the parts, resistors, in one pile, condensers in another, until parts are generally separated for easy identification.

Occasionally, we may have to substitute a part to allow an even production of kits when a specific part is not available. This is done to prevent a delay in filling your order and in no way will the substitution effect normal operation. If this has been done in your kit a note, "Parts Substitution", will be included for your identification.

The use of the "Ungar Soldering Pencil" equipped with 37 1/2 watt heat element and small chisel pointed tip is considered mandatory in the construction of this kit. Similar irons may be used but none larger and of higher heat. The work on the etched circuit board is somewhat delicate so let a word to the wise be sufficient. If you do not have the small iron it should be purchased at your local radio or hardware store.

Common tools required are a small pair of dykes (wire snippers), long nose pliers, screw driver, penknife, file, pad of steel wool. Other items are a 1/8" screw driver shaped tuning tool and a 0-100 ma meter to be used for tuning purposes. The meter is available from World Engines for \$4.95 and the tool at 50c.

Start construction by referring to the assembly steps. During each step refer to the pictorials for necessary parts location and solder the lead of each part as it is installed. Place a check mark in the space provided after completion of each step. Good luck and may your experience be a pleasant one.

## ASSEMBLY INSTRUCTIONS

As parts are installed to the circuit board, bend over the leads only enough to hold the parts in place, then solder, unless otherwise noted in text. Do not flush bend lead to the circuit copper as, if removal is necessary, it cannot be done without damage to the part. After soldering, clip off excess leads about 1/16" from circuit copper.

- (✓) 1. Try the circuit board for a proper fit into the bottom half of housing case. If it is too tight use a file and clean up the edges so a fit can be obtained.
- (✓) 2. Assembly is started by first cleaning the circuit board copper so soldering may be done easily and with the least amount of heat. To do this involves a certain procedure as the board is supplied to you with the tuning coil pre-installed. The best way is to lay the board flat against your work bench with the coil overhanging the edge. Hold board firm then scrub vigorously with steel wool until copper is bright and shiny. After cleaning, blow away any wool residue that may have entered coil form or remaining on circuit board.
- (✓) 3. Sometimes in the factory operation of cementing the coil to the board epoxy cement clogs some of the circuit board holes near the coil. Inspect your board and if any are clogged use a straight pin to clear.
- (✓) 4. Notice that the wire leads on the tuning coil are twisted together for a short length. This is done for shipping purposes and before the leads are inserted into circuit board they must be untwisted and any excess kinks removed. Be careful not to unwind the coil. Insert bottom lead into hole 66 and top lead into hole 65. The coil wire is of a type where the heat of the soldering operation removes the insulation. Soldering will be somewhat stubborn but as the insulation melts away you will note the proper flow of solder on both the wire and circuit copper. Be sure the wires are properly soldered.
- (✓) 5. Inspect the interstage transformers and note that one side is marked with either a RED dot or the letter "S". This means that the leads extending from this side of the transformer are of the secondary winding. Insert one transformer with secondary leads going into holes 28 and 29 and the other two leads into holes 32 and 33. Push transformer flush to circuit board with frame tabs going into holes 30 and 31. Bend tabs to secure transformer but do not solder to circuit copper. After installation inspect tab at hole 31 to insure it does not short to the nearest slanting copper land. If it does, bend it away or clip its length.
- (✓) 6. Using same procedure to identify secondary leads, insert the remaining transformer with secondary leads going into holes 4 and 5, and other leads into holes 8 and 9. Tabs going into holes 6 and 7 are bent over and again not soldered. Be sure that the tab at hole 7 does not short to any copper land when bent over.
- (✓) 7. Three identical resistors, 1 K ohm (brown, black, red) are installed in this step. One in holes 40 and 41, another in holes 49 and 50 and a third in holes 51 and 52
- (✓) 8. Install a 100 ohm resistor (brown, black, brown) in holes 12 and 13.
- (✓) 9. Install a 1.5K ohm resistor (brown, green, red) in holes 26 and 27.
- (✓) 10. Install a 15K ohm resistor (brown, green, orange) in holes 24 and 25.
- (✓) 11. Install a 470 ohm resistor (yellow, violet, brown) in holes 39 and 42.
- (✓) 12. Install a 4.7 ohm resistor (yellow, violet, red) in holes 47 and 48.
- (✓) 13. Install the RFC choke in holes 53 and 54. To identify, the RFC choke is a small resistor-like component that is wound with fine wire.
- (✓) 14. Install a 4 MMFD disc condenser in holes 67 and 68.
- (✓) 15. Install a <sup>18</sup>~~20~~ MMFD disc condenser in holes 63 and 64.
- (✓) 16. Install a <sup>205</sup>~~200~~ MF disc condenser in holes 60 and 61.
- (✓) 17. Install a 62 MMFD disc condenser in holes 55 and 56.

- (✓) 18. Install a .02 MF disc condenser in holes 62 and 70.
- (✓) 19. Two identical .01 mf disc condensers are installed in this step. One in holes 45 and 46, another in holes 10 and 11.
- (✓) 20. Notice the polarity markings on the body of the ~~20-mf~~ <sup>15mf</sup> electrolytic condenser. This identifies polarity of the leads. Install this condenser with plus lead going into hole 17 and minus lead into hole 18.
- (✓) 21. Install the 3 mf electrolytic condenser with plus lead going into hole 43 and minus lead in hole 44.

In the following steps the transistors are installed. To identify the leads, refer to Fig. 5. All transistors should be installed with bottom surface spaced about 3/16" from surface of circuit board. Do not flush mount.

- (✓) 22. Identify the leads of the <sup>15571</sup> T-2530 transistor. Install it with the collector going into hole 58, base in hole 57, and emitter in hole 59.
- (✓) 23. Install a <sup>7505</sup> T-2515 transistor with collector going into hole 36, base in hole 37 and emitter in hole 38.
- (✓) 24. Install a <sup>7506</sup> T-2515 transistor with collector going into hole 16, base in hole 15 and emitter in hole 14.
- (✓) 25. Install a 2N-229 transistor with collector going into hole 23, base in hole 22 and emitter in hole 21.

In the following steps the relay is wired and prepared for installation to the circuit board. Refer to Fig. 4 for pictorial information.

- (✓) 26. Install the two .05 mf disc (arc suppressor) condensers as shown. Notice the condenser on the right side of relay has a small piece of insulation on its bottom lead. This is obtained by stripping a 3/8" length of insulation from any of the other wires supplied and installing it on the condenser lead. At this time do not solder the relay terminal to which the bottom leads of the condensers are attached. It is to be soldered when the third connection to the terminal is made.
- (✓) 27. Strip 1/8" insulation from one end of the white, blue, green wires. Pre-tin each wire then attach and solder to the proper terminals as shown. Each wire should be at least 8" in length. Inspect after soldering to insure no shorts exist between terminals.

- (✓) 28. Attach relay to circuit board with attaching screw going through hole 19. Screw is supplied initially installed in bottom of relay.
- (✓) 29. Noting again Fig. 4, connect a solid bare wire, (excess resistor lead), between hole 3 of circuit board and right lower terminal of relay.
- (✓) 30. Connect a solid bare wire between hole 1 of circuit board and lower left relay terminal.
- (✓) 31. Strip 1/8" insulation from one end of an 8" length of black wire. Insert this end of the wire through hole 2 of circuit board so both the wire and its insulation extend through the hole for about 1/4". After insertion, bend down the bared end to circuit copper near hole 2 and solder. Installing the wire in this manner creates a strain relief to minimize future breakage.
- (✓) 32. As shown in Fig. 2, route a 10" length of red wire against top surface of circuit board inserting it into and through hole 34 for about one-half inch. Strip 1/8" insulation from this end of the wire and solder it to the bare copper land containing hole 38.
- (✓) 33. Strip 1/8" insulation from one end of a 30" length of wire (antenna). Insert this end of wire through hole 69 so both wire and insulation extend through hole for about 1/4". Bend down bared end of wire and solder it to copper land containing hole 69.
- (✓) 34. Screw tuning slug into tuning coil until it is about flush with top of coil form. If slug appears very tight rotate it back and forth to gradually loosen its threads.

At this point assembly of the receiver chassis is complete. Before it is installed in its housing case it must be given an operational test. The test is one of connecting the receiver to the batteries and with a companion "Mule" tone transmitter, tuning and adjusting the receiver to respond to the transmitter signal. Tuning is accomplished by use of a milliammeter to visually measure the receiver's current flow. The receiver's response is the operation of its miniature relay. When in the idle condition, no signal being received, the receiver will draw about 3 ma of current as registered on the milliammeter. Upon receipt of tone signal from transmitter the current will rise to about 55 ma. This in turn energizes the relay and operates its contacts. In your model airplane the relay acts as a switch to

turn on or off a separate battery circuit to control the operation of an escapement or control surface actuator. The following steps will show you how to perform the operational test.

- ( ) 35. Refer to Fig. 7, receiver wiring diagram, and proceed to connect receiver to the batteries as shown. The milliampmeter involved for visual test must be a moving coil type meter or else improper readings will result. Such a meter can be obtained from World Engines at \$4.95.
- ( ) 36. Turn receiver switch on and notice current reading on milliampmeter. Normal idle current should be about 3 to 4 ma, however, some receivers may idle with a nervous fluctuation up to about 15 ma. If yours is within these limits, continue the tuning steps. If the meter reads a steady high current or pegs the needle, immediately disconnect it and investigate the trouble. In most cases it will be an assembly mistake or solder short on circuit board, so double check the assembly to locate mistake.
- ( ) 37. With companion "Mule" transmitter, antenna installed but collapsed, key a tone signal and with insulated tuning wand adjust tuning slug to obtain highest current reading on milliampmeter. As adjustment tends to bring current to the maximum level of about 55 ma, weaken transmitted signal by moving transmitter further away from receiver until a fine tuning peak can be obtained. As a final adjustment repeat the peaking process with transmitter antenna removed. If your receiver is of average sensitivity, the antenna-less "Mule" should give operation up to a distance of 3" to 10" when pointed at end of receiver antenna. With antenna installed but collapsed, operating distance should increase to the 50 to 75 foot range. When fully extended receiver range should increase up to one mile with aircraft in the air.
- ( ) 38. As pointed out earlier the change in current flow in the receiver operates a sensitive relay but only if it is properly adjusted. As supplied in your kit the relay has had an initial adjustment but may require further adjustment assuming contact operation is not normal. For information on relay operation or adjustment refer to the receiver "Operating Instructions" paragraph titled "Relay

Adjustment". All kits are supplied with 50 ohm relays.

After operation has been checked the receiver may be installed in its housing case. Refer to Fig. 3 for pictorial information.

- ( ) 39. Install small rubber grommet in lower housing case.
- ( ) 40. Group together the five wires at the relay and starting near bottom of relay twist wires together for their entire length.
- ( ) 41. Tie a one loop knot in the antenna at a point  $\frac{5}{8}$ " from end of circuit board.
- ( ) 42. Mount chassis to lower housing case by initially threading five wire cable into grommet. Then as wires are pulled through slide chassis into position in the case.
- ( ) 43. Slide insulator board under receiver chassis then secure chassis to case with a No. 2 x 3/16 sheet metal screw. Do not over tighten screw.
- ( ) 44. Thread antenna into hole provided. The simple one loop knot serves as a strain relief.
- ( ) 45. Inspect wiring at relay to insure no shorts or wire breakage was created by installing receiver into case. If O.K., install top lid.
- ( ) 46. Peel protective backing from Controlaire label and affix label to top of receiver case.

This completes assembly of the receiver. Repeak tuning before using as the installation of the case may detune your original adjustment.



# CONTROLAIRE "4"

## PARTS CHECK AND PRICE LIST

### Hardware

[ ]	1 ea. Receiver Case, top and bottom	\$1.95
[ ]	1 ea. 3/16 Rubber Grommet	.03
[ ]	1 ea. No. 2 x 3/16" SM Screw	.03
[ ]	1 ea. Controlaire Label	.15
[ ]	1 ea. 24" length 60/40 Solder	.10

### Wiring

[ ]	5 ea. length, No. 26 Stranded	.15
	Red, Black, White, Green, Blue	
[ ]	1 ea. 30" length No. 26 Stranded (antenna)	.05

### Resistors

[ ]	1 ea. 100 ohm (Brown Black, Brown)	.12
[ ]	1 ea. 470 ohm (Yellow, Violet, Brown)	.12
[ ]	3 ea. 1K ohm (Brown, Black, Red)	.12
[ ]	1 ea. 4.7K ohm (Yellow, Violet, Red)	.12
[ ]	1 ea. 1.5K ohm (Brown, Green, Red)	.12
[ ]	1 ea. 15K ohm (Brown, Green, Orange)	.12

### Capacitors

[ ]	1 ea. 4 MMFD Disc	.25
[ ]	1 ea. 20 MMFD Disc	.25
[ ]	1 ea. 62 MMFD Disc	.25
[ ]	1 ea. .002 MF Disc	.25
[ ]	2 ea. .01 MF Disc	.25
[ ]	1 ea. .02 MF Disc	.25
[ ]	2 ea. .05 MF Disc	.25
[ ]	1 ea. 3 MF Electrolytic	.65
[ ]	1 ea. 20 MF Electrolytic	.75

### Transistors

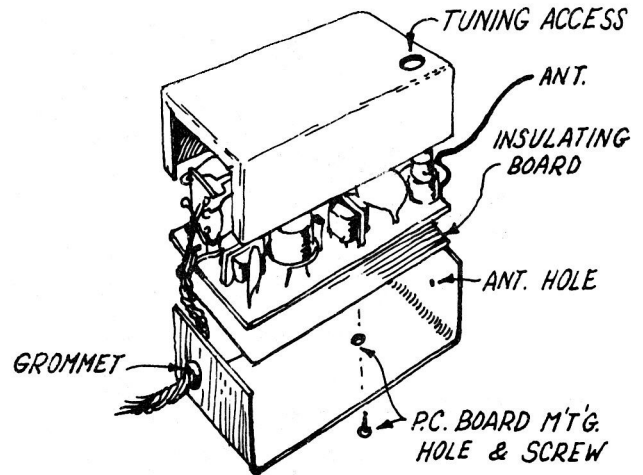
[ ]	1 ea. T-2530 RF Detector	1.95
[ ]	2 ea. T-2515 Audio	1.50
[ ]	1 ea. 2N-229 Audio	.90

### Transformers, Coils, Chokes

[ ]	1 ea. 12 Micro Henry RF choke	.35
[ ]	1 ea. RF Coil Assembly and Tuning Slug	.90
[ ]	2 ea. Interstage, 10K to 1K Transformers	1.20

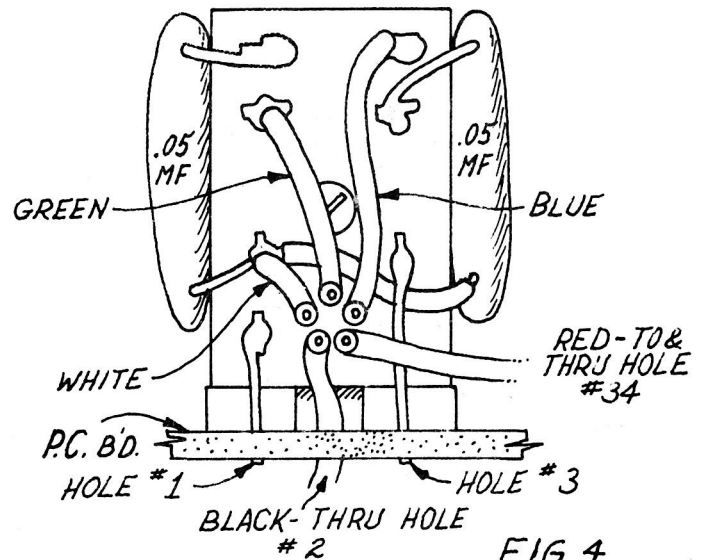
### Misc. Parts

[ ]	1 ea. Etched Circuit Board	1.95
[ ]	1 ea. Phenolic Spacer Board	.15
[ ]	1 ea. 50 ohm Relay	2.45
[ ]	1 ea. Kit Assembly Tips	.10
[ ]	1 ea. Assembly Instructions	.25
[ ]	1 ea. Operating Instructions	.15



**FIG 3**

Controlaire "4" CASE ASSEMBLY



**FIG 4**

Controlaire "4" RELAY WIRING

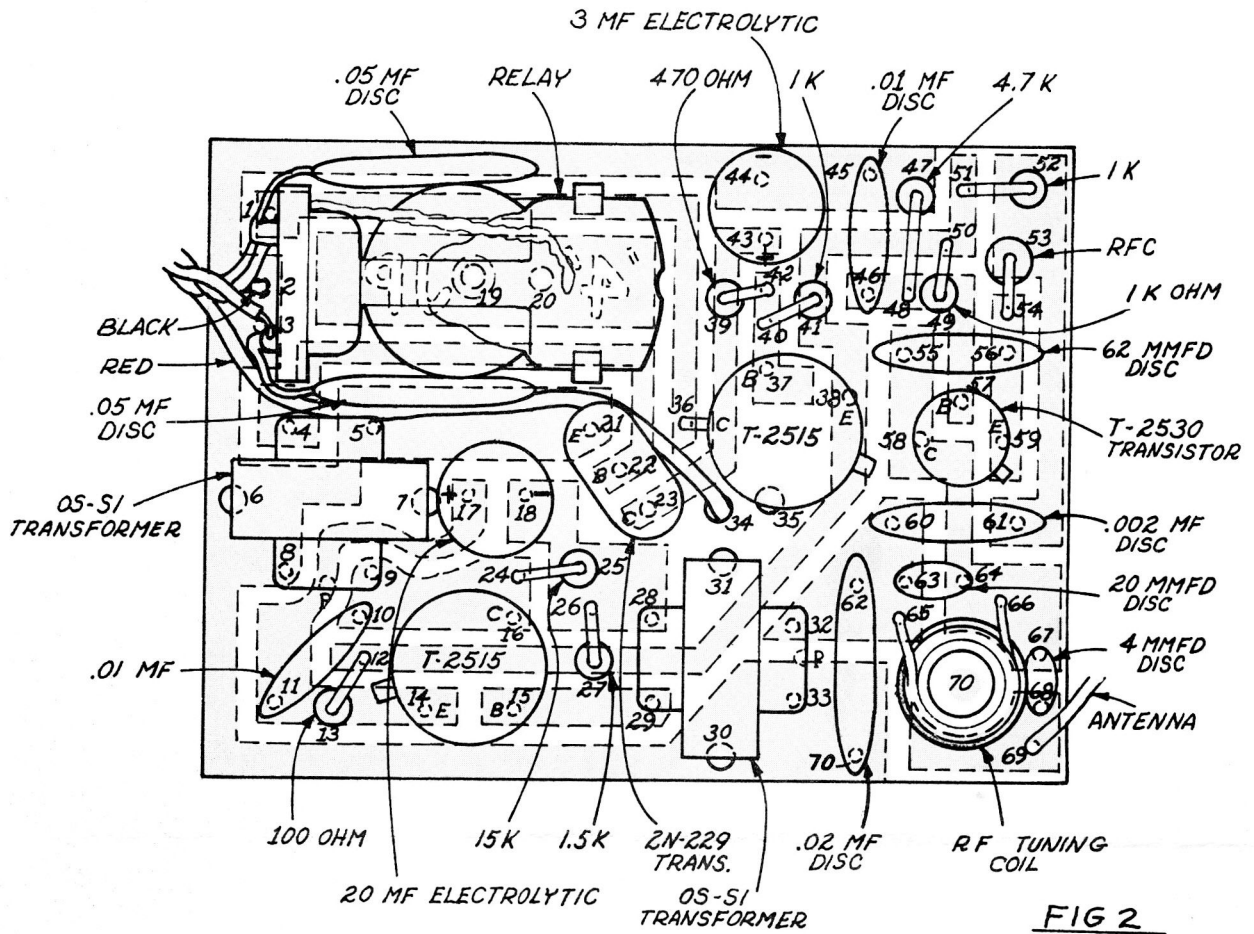
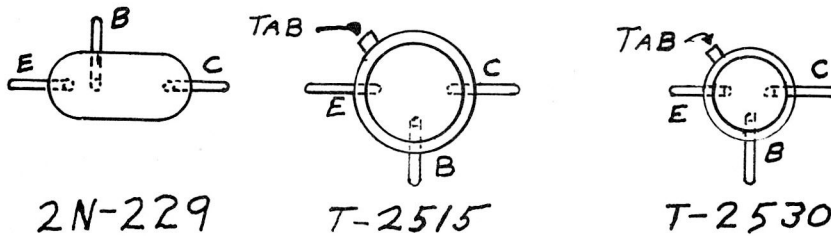


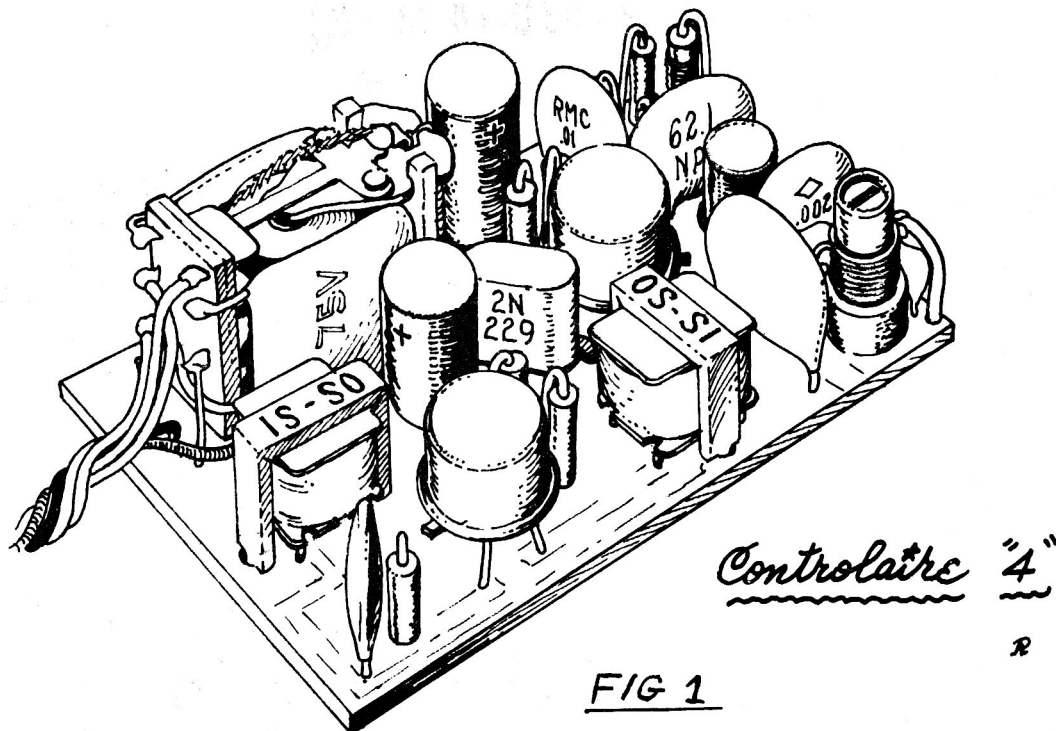
FIG 2

Controaire "4" Receiver



2N-229      T-2515      T-2530  
 TRANSISTORS VIEWED FROM  
 TOP WITH LEADS EXTENDING DOWN

FIG 5



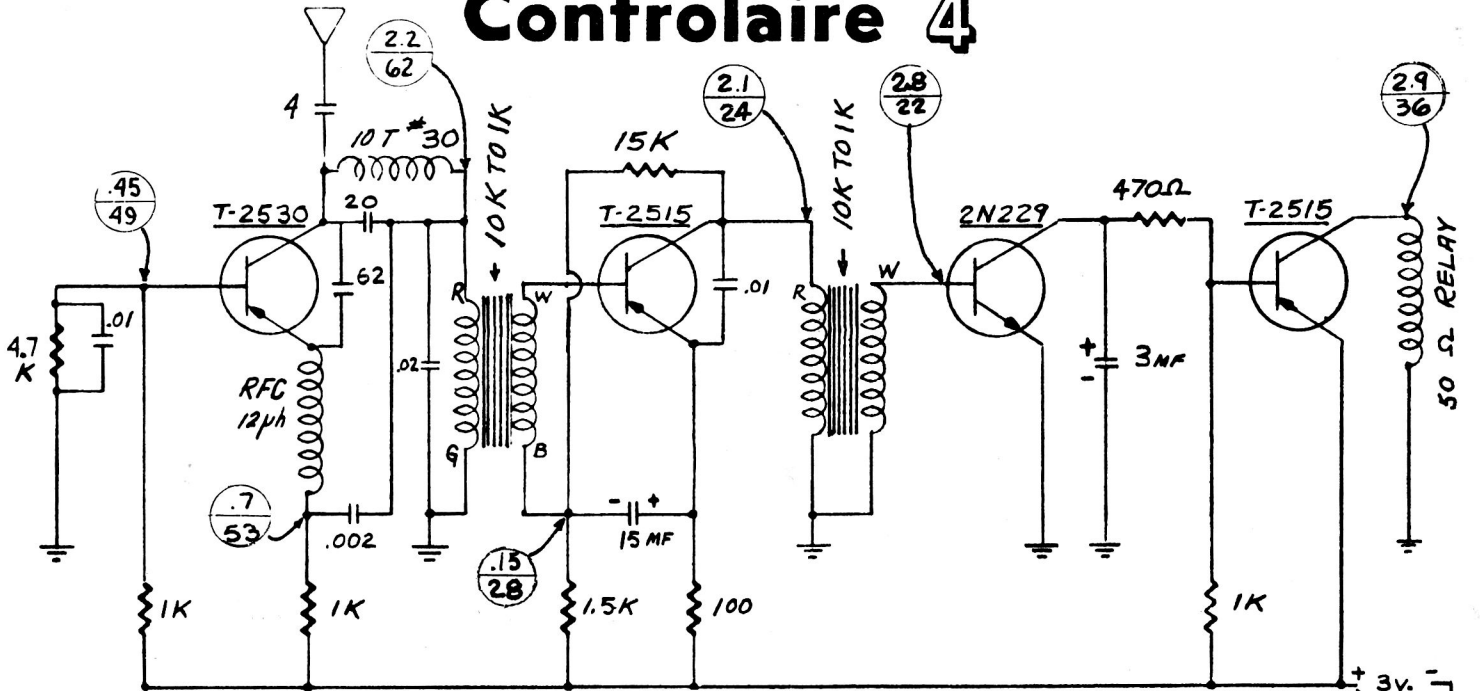
# TROUBLE-SHOOTING TIPS

Occasionally, someone experiences trouble in the completion of his receiver. Whatever your problem, first review your assembly steps to insure proper assembly. Secondly, check all solder joints and the board for possible solder shorts between copper lands. If this reveals no mistake, the following procedure can be applied to isolate the trouble to a particular stage.

The receiver involves four stages. One, a super-regen detector, followed by three stages of audio amplification. When operating properly at idle, the detector (T-2530) generates a noise signal commonly referred to as super-regen "hiss". The hiss is then fed by transformer coupling to the first audio stage (T-2515) where it is amplified. From here by means of transformer coupling to the second audio (2N-299) where it again is amplified but changed in the output of this stage from an AC noise signal to a DC current level. This is done by the 3MF filter capacitor. From here the DC current level is direct coupled to the fourth stage (T-2515) where it is amplified as a DC level only to actuate the relay.

The idle hiss as described above and directed through the stages, is of a very low amplitude. As a simple means of isolating trouble a common high impedance earphone can be used to listen to the signal. To use the earphone as well as other equipment you might have, oscilloscope, etc., connect one lead to the negative battery connection and with a .01 to .05 MF condenser in series with the other lead touch it to the following points. First, to copper land containing hole 62. See Fig. 6 circuit diagram and note this is output point for the T-2530 detector stage. A very slight hiss should be heard. If not, it indicates detector is inoperative. If OK, next touch probe lead to land hole position 24. This is output of first audio (T-2515) and hiss should be substantially louder. Next to land hole position 23. This is output of second audio (2N-229). This time the noise will be weaker but still audible due to filtering of the 3 MF capacitor. As to hiss in last stage as touched to land position 36, there is barely an audible sound due to filter action of this stage. Actually, if any problem was involved in last stage it could be only a defective transistor or open or shorted relay as these are the only two components involved. The point in the earphone test was tracing the hiss noise from its origin, the detector through the stages to determine proper operation of the stages. If not present at detector, stop and check components of this stage. Probable cause aside from assembly mistakes, is T-2530 transistor or open or shorted coils, choke or transformer. The same would apply if hiss disappeared at a succeeding stage. From this point in trouble-shooting location of an exact cause of trouble may involve use of V.T.V.M. measuring the voltage points as shown on the circuit diagram. If you have such an instrument you probably know how to use to isolate a component trouble. One last point. Sensitivity of the detector (T-2530) is controlled by value of resistor installed in hole 49 and hole 50. To increase sensitivity, decrease value no more than 30% and vice versa.

# Controilaire 4



Voltage measurements taken with Heathkit V7A, V.T.V.M. 5 volt, minus DC scale. Common lead to plus 2.9 volts receiver battery. Receiver idling, no signal from transmitter. Note divided circles on diagram, top No voltage measured, lower No is circuit board hole that identifies copper land to which place DC probe. Normal measurement can vary plus or minus 20% due to component tolerances.

Fig 6.

Common Lead V.T.V.M. 2.9v

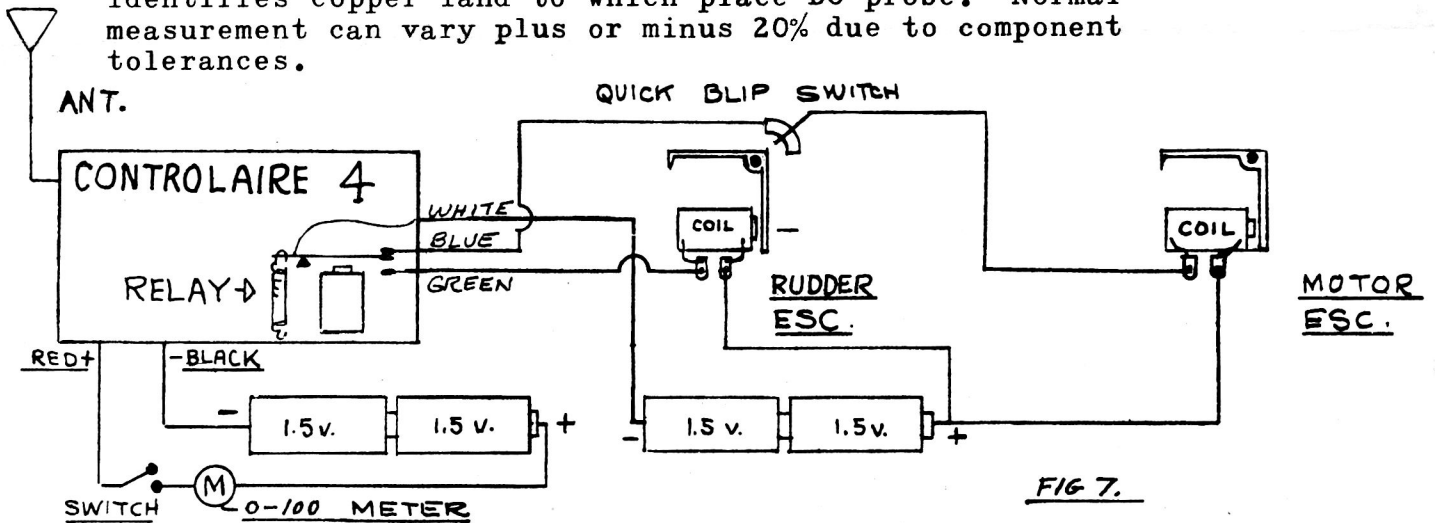


FIG 7.

THIS WIRING FOR INDEPENDENT BATTERIES + QUICK BLIP MOTOR



**World Engines Inc.**

**Controilaire Division**  
8206 BLUE ASH ROAD CINCINNATI 36, OHIO

## SUBSTITUTION NOTICE

### CCNTROLAIRE 4 RECEIVER KIT

The following parts have been substituted in this kit as original parts for which the instructions were written are no longer available. The substitution will in no way effect assembly or operation except your identification for exact use. Because of this we are listing at the end of each part the assembly step in which the substituted part is used. Please correct your assembly manual and parts list to show the substitution.

1. An eleven turn coil has been substituted but is installed on the kit circuit board. Correct your circuit diagram to show this change. No step change is involved.

.005

2. ~~.01~~ mf disc condenser substituted for the .002 mf as called for by Step 16. Install the ~~.01~~ mf in holes 60 and 61 as directed.

.005

3. 155T1 transistor substituted for the T2530 as called for in Step 22. Lead identification and electrical characteristic are the same.

4. Either of the following transistors may be substituted in your kit for the T-2515 transistor as called for by Steps 23 and 24. 2N-508 or 4JX1C1132. All have the same lead identification and electrical characteristics.

5. 15 mf electrolytic substituted for 20 mf electrolytic condenser as called for by Step 20.

6. An 18 m m Fd disc condenser has been substituted for the 20 m m Fd as called for by step 15.

## N O T I C E

Our Service Department has notified us that 90% of the service problems on kits returned for repair is due to poor soldering by the kit builder. In most cases it is a complete disregard of the assembly steps that tells the builder to vigorously scrub his circuit board with steel wool before assembly. As supplied, the etched circuit board copper is protected with a thin layer of plastic. Although almost invisible, if not removed by steel wool it will create a soldering problem. Again, be reminded of the importance of this cleaning step. Do not disregard it.

CONTROLAIRE ELECTRONICS DIV., WORLD ENGINES, INC., CINCINNATI, O.