

ASSEMBLY INSTRUCTIONS

Controlaire "Mule Tone Transmitter"

All Transistor 9 Volt Operation

Introduction

Advancements in transistor technology has made possible the production of this transmitter in kit form. The RF oscillator and power amplifier employ the new silicon planar 2N-706 transistors and their uniformity coupled with precision circuitry gives most satisfying results. About the only main requirement is that the builder exercise common sense during construction.

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 transmitter 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 transmitter board by holding it up to a light source where the pattern will show through. By using the light on the actual transmitter 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 "Unger soldering pencil" equipped with 37½ 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, screwdriver, penknife, file, pad of steel wool. Other items are a hexagon 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. () Using steel wool, vigorously scrub circuit copper to remove photo resist material so soldering can be easily accomplished. Scrub until copper is bright and shiny.
2. () Prepare the push-button switch for mounting by first bending the tabs so they fit properly into circuit board slots 32 and 33. Next, disassemble the switch by removing the two hold-down screws and discard the metal plate that was installed directly under the screw heads. Reassemble the switch to the circuit board by inserting screws through holes 29 and 30. Align the switch so it is parallel with bottom edge of circuit board and tighten screws moderately.
3. () Install a 4/40 x 5/16" binder head screw, nut and lockwasher to the antenna mount bracket as shown. When tightening do not apply a twisting torque to bracket without support as this can loosen the attaching eyelets.
4. () Solder eyelet at hole 40 to both the circuit copper and antenna mount bracket to insure proper electrical contact. Do not allow a pile up of solder on the bracket as this will prevent proper antenna attaching clearance when it is installed later on.
5. () Cut the respective leads of the modulation transformer to the following lengths and strip 1/4" insulation from the end of each lead. Red to 1 1/2", Blue and Green to 2" and Black to 1 3/4".
6. () Orient and install modulation transformer to circuit board with red lead extending through hole 26, black through hole 27 and green through hole 28. The blue lead remains on top of circuit board. Fasten transformer to board by means of two 4/40 x 5/16" binder head screws and nuts at mount holes 25 and 31.
7. () Insert and solder transformer leads to the following hole positions. Blue from top of board to hole 36, black from bottom of board to hole 60, green from bottom to hole 59 and red from bottom to hole 66.
8. () Insert a 4.7K ohm resistor (yellow, violet, red) in holes 16 and 17.
9. () Insert a 27K ohm resistor (red, purple, orange) in holes 9 and 10.
10. () Insert a 180 ohm resistor (brown, grey, brown) in holes 11 and 12.
11. () Insert a 2.2K ohm resistor (red, red, red) in holes 57 and 58.
12. () Insert a 4.7K ohm resistor (yellow, violet, red) in holes 45 and 46.
13. () Insert a ^{4.7K}~~100K~~ ohm resistor (brown, black, yellow) in holes 38 and 39.
14. () Insert a .02 MF disc capacitor in holes 7 and 8.
15. () Insert a .02 MF disc capacitor in holes 20 and 21.
16. () Insert a .01 MF disc capacitor in holes 63 and 64.
17. () Insert a .05 MF disc capacitor in holes 53 and 54.
18. () Insert a 100 MMFD disc capacitor in holes 55 and 56.
19. () Insert a 50 MMFD capacitor in holes 1 and 2.
20. () Insert the R. F. C. choke in Holes 61 and 62.
- 20A () Inspect the terminals of the RF slug tuned coil assembly. Note that one terminal has a red coding mark. Install the coil terminals into holes 3, 4, 5, 6 with red marked terminal inserting into hole 3. The labels should be spaced about
21. () Refer to Fig. 3 to identify transistor leads. Identify and install 4JX1C1132 transistor with emitter lead going into hole 44, base to hole 43 and collector to hole 42. Stand bottom of transistor about 1/8" away from surface of circuit board.

To properly space the transformer above the screw heads of the push-button switch, use fiber washers under each mount lug of the transformer. Heads of the transformer mount screws should be on copper side of board.

22. () Again refer to Fig. 3. Install a 2N-705 transistor with emitter lead in hole 13. Base in hole 15 and collector in hole 14. Stand bottom of transistor about $\frac{1}{4}$ " away from surface of circuit board.
23. () Install the heat sink, which is a press fit, over the top of the remaining 2N-706 transistor. If the fit is too tight and trouble is encountered, use a screw driver to wedge the heat sink open by inserting it at its split side. Install the transistor with emitter lead going into hole 24, base to hole 23 and collector to hole 22.
24. () Notice the eyelets installed at hole positions 48 through 52. To insure a positive electrical contact to the circuit copper solder each eyelet to the copper at its outside perimeter. Do not allow solder to flow within eyelet hole. To do so will prevent later installation of the slide switch.
25. () Install the slide switch with its terminals going into eyelet holes 48 through 52. Push the terminals through the eyelets until they protrude exactly $\frac{1}{32}$ " above eyelets on top side of circuit board. Be sure that the switch is installed straight and parallel with respect to surface of circuit board. If it is crooked it will prevent proper installation of chassis into housing case. Soldering to the eyelets and switch terminals is done from the top of the board. Allow solder to flow into the eyelets thus securing the terminals.
26. () Cut a piece of black wire to a length of 5" and strip $\frac{1}{4}$ " insulation from each end. On one end crimp and solder the male battery snap. The other end is soldered to board at hole 35.
27. () Cut a piece of red wire to a length of $3\frac{1}{2}$ " and strip $\frac{1}{4}$ " insulation from each end. On one end crimp and solder the female battery snap. Solder other end to board at hole 65.
28. () Insert leads of .47 MF tubular condenser in holes 34 and 37.
29. () Insert the terminal pins of the crystal into holes 18 and 19. Do not push all the way in but rather allow pins to protrude only about $\frac{1}{16}$ " through copper. Solder quickly and avoid excessive heating.
30. () At this point assembly of the circuit board is complete. To install board into the housing case place it in position then use two $\frac{4}{40} \times \frac{5}{16}$ " binder head screws to secure the slide switch. Use a $\frac{3}{8}$ " nut and washer to secure the push switch.
31. () Fit rubber grommet to hole in top of transmitter case. The antenna is then passed through grommet and threaded down on the antenna bracket screw.

General Information

This completes assembly of your transmitter. At this time it must be tuned. In accordance with docket 12902 of the Federal Communications Commission, the tuning adjustment of this transmitter must be made either under the direct supervision of, or by, a person holding a valid commercial radio operators license. You, personally, are not allowed to make this adjustment unless you hold a valid license as stated above. This may create some minor problem but usually in a radio control area such a person can be located. It is a matter of contacting your R/C acquaintances for such information. If you cannot locate a valid licensee you may return your completed unit to the factory for this service. Fee for tuning transmitter is \$2.00 plus return postage. This does not include repair service if required. Before any attempt is made to tune or operate this transmitter the standard Mule operating instructions should be read.

MULE

PARTS CHECK AND PRICE LIST

Hardware		Price
[]	1 ea. Transmitter Case Front and Back	Each \$2.95
[]	1 ea. D.P.D.T. Slide Switch.....	.50
[]	1 ea. Push Switch .....	.75
[]	6 ea. No. 6 x 1/4" S.M. Screws.....	.02
[]	5 ea. 4/40 x 5/16" B. H. Screws....	.01
[]	3 ea. 4/40 Nuts and Lockwasher....	.01
[]	4 ea. Fiber Washers .....	.01
[]	2 ea. Battery Snaps, Male and Female .....	.12
[]	1 ea. 3/8" Nut and Washer.. .....	.04
[]	1 ea. Transistor Heat Sink .....	.65
[]	1 ea. 1/2" Rubber Grommet.....	.03

Resistors		
[]	1 ea. 180 ohm (brown, grey, brown) .....	.10
[]	2 ea. 4.7K ohm (yellow, violet, red) .....	.10
[]	1 ea. 2.2 K ohm (red, red, red).....	.10
[]	1 ea. 27K ohm (red, purple, orange) .....	.10
[]	1 ea. 47K ohm (brown, black, yellow) .....	.10

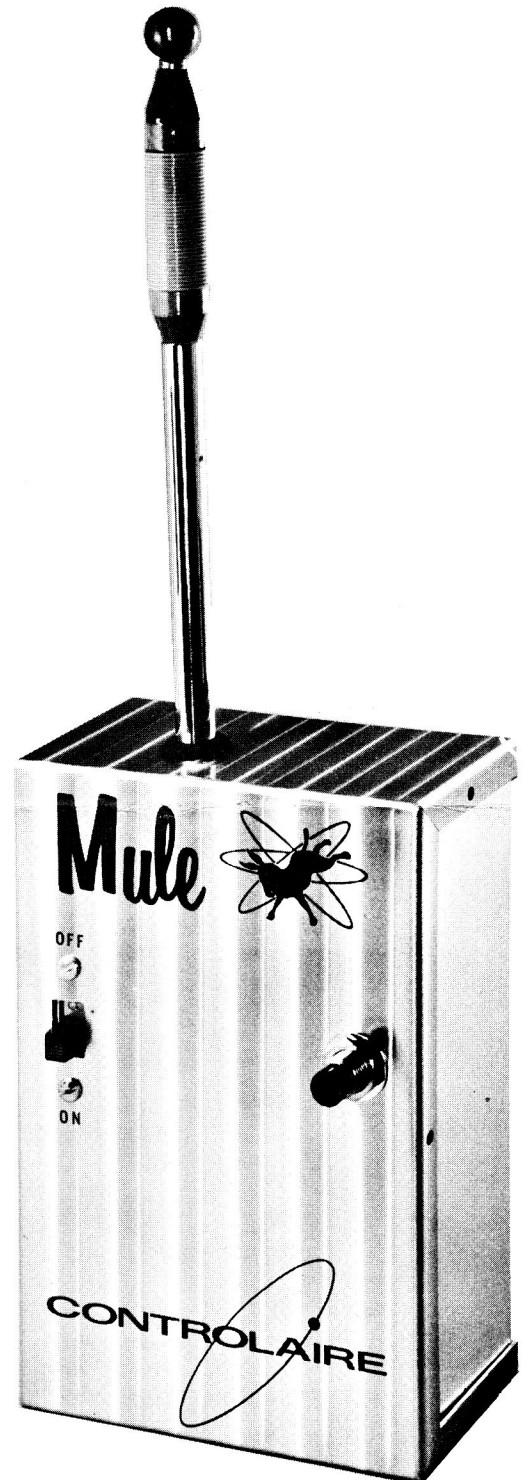
Transformers, Coil, Choke		
[]	1 ea. Modulation Transformer	1.90
[]	1 ea. RF Coil Assy.	1.90
[]	1 ea. RF Choke .....	.35

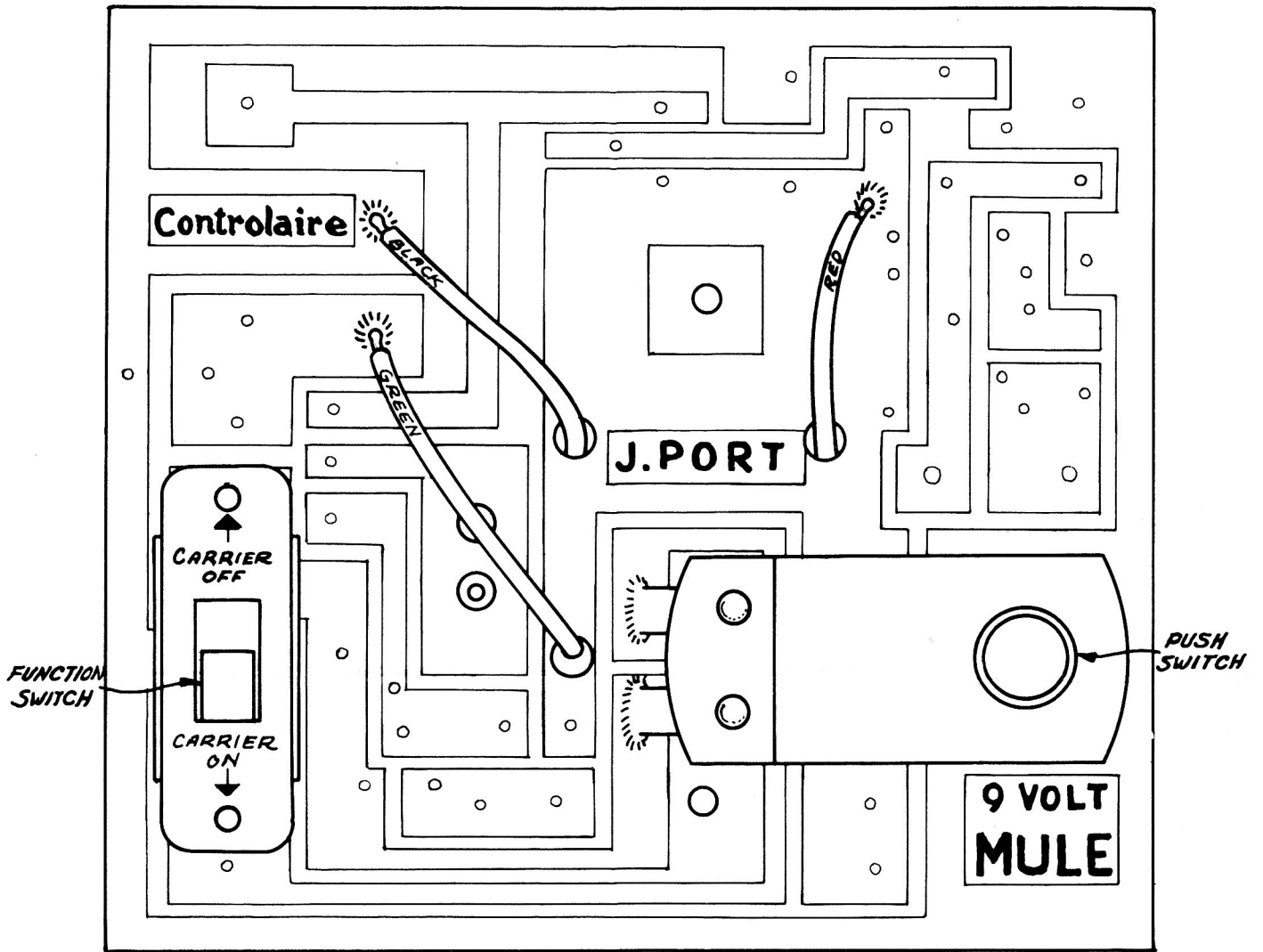
Wiring		
[]	1 ea. 6" Length No. 22 Black.....	.01
[]	1 ea. 4" Length No. 22 Red.....	.01

Transistors		
[]	2 ea. 2N-706 RF	2.75
[]	1 ea. 4JX1C1132 Audio	1.95

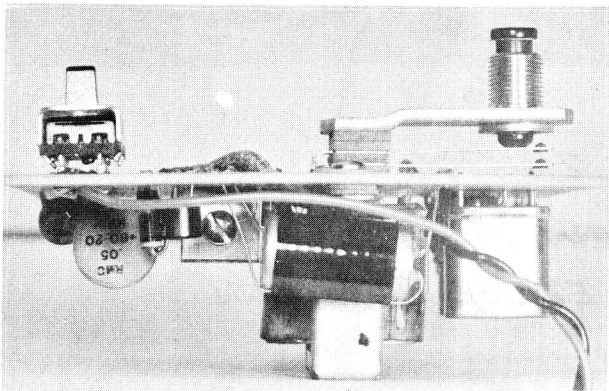
Misc. Parts		
[]	1 ea. Etched Circuit Board	1.75
[]	1 ea. Operating Instructions .....	.15
[]	1 ea. Kit Assembly Tips .....	.10
[]	1 ea. Assembly Instructions .....	.25
[]	1 ea. Center Loaded Antenna	6.95
[]	1 ea. 1/2" Rubber Grommet.....	

Capacitors		
[]	2 ea. .02 MF Disc .....	.20
[]	1 ea. .01 MF Disc .....	.20
[]	1 ea. .05 MF Disc ..	.25
[]	1 ea. 100 MMFD Disc .....	.20
[]	1 ea. 50 MMFD Disc .....	.20
[]	1 ea. .47 MF Tubular .....	.95





BOTTOM VIEW - MULE Fig. 1



World Engines Inc.

8206 Blue Ash' Road Cincinnati 36, Ohio

