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Assembly and Maintenance Instructions for the MODEL E530-T ECONO-FLITE Transmitter

DESCRIPTION

The Econo-Flite Digital Transmitter is housed in a durable vinyl-clad aluminum case with operating controls on the front or top (single stick only). Charging connections are accessible on the bottom of the case; a charge indicator lamp is visible through a red jewel on the case front. A 54" collapsible antenna screws into a plastic retainer on top of the transmitter case. An external meter indicates both RF output and battery condition.

EK Control sticks are standard in both 2-axis and 3-axis (single stick) models. Trims are provided for all channels except auxiliary (3-channel) and motor (single stick). Stick tension is adjustable to give desired stick "feel". On the 4-channel two-stick model Mode I or Mode II operation is obtained by selected installation of centering springs.

The 3-channel transmitter employs a total of 11 transistors; 4-channel models have 12. All parts, except charging resistor, are mounted on two glass epoxy boards: the Logic (encoder) board and the RF board. The RF assembly is furnished completely built and pretuned; the encoder must be aligned after assembly. Alignment instructions are included herein.

A 9.6 volt nickel-cadmium rechargeable battery supplies transmitter power. A built-in charging circuit, with indicator lamp, permits charging of both transmitter and receiver batteries simultaneously. Charging current is obtained from the 120 volt AC line. Charging cords are supplied with the complete system, not with individual units.

MODELS COVERED

These instructions cover construction of 3 and 4-channel transmitters with 2-axis sticks, as well as the 4-channel 3-axis (single stick) model. Units are available as full kits, half-kits and in factory assembled form.

All assembly instructions contained herein pertain to the full kit and the builder must perform each step. The half-kit contains assembled and soldered printed circuit boards, so assembly steps 1 through 78 can be omitted. All other information, except assembly procedures, is applicable to assembled transmitters.

FREQUENCIES AVAILABLE

Tx Frequency (MHz)	Tx Crystal (MHz)	Flag (Color)
26.995	26.995	Brown
27.045	27.045	Red
27.095	27.095	Orange
27.145	27.145	Yellow
27.195	27.195	Green
53.1	53.1	Black - Brown
53.2	53.2	Black - Red
53.3	53.3	Black - Orange
53.4	53.4	Black - Yellow
53.5	53.5	Black - Green
72.080	36.040	White - Brown
72.240	36.120	White - Red
72.400	36.200	White - Orange
72.960	36.480	White - Yellow
75.640	37.820	White - Green

NOTE

A class "C" operators license from the FCC (Federal Communications Commission) is required before this transmitter can be operated on the 27 and 72 MHz bands. A technician class (or higher) Amateur License is required to operate on the 53 MHz band. License application forms can be obtained from your local FCC office.

SPECIFICATIONS

Operating Voltage	9.6 volts
Batteries	8 series-connected 500 mah 1.2 volt nickel-cadmium cells
Power Input	1000 milliwatts (27 or 53 MHz) 450 milliwatts (72 MHz)
Power Output	750 milliwatts (27 or 53 MHz) 350 milliwatts (72 MHz)
Total Current Consumption	80 milliamps
Pulse Train Duration	(3 channel) 12.5 ms nominal (4 channel) 14 ms nominal
Frame Rate	(3 channel) 80 cps (4 channel) 70 cps
Pulse Width	Variable 1 to 2 milliseconds (1.5 milliseconds neutral)
Frame Type	Fixed
Off Time Pulse	300 microseconds
Frequency Tolerance	.005%
Operating Temperature Range	0° to +140°F
Dimensions	2 inches deep, 6-1/2 inches wide, 6-1/4 inches high
Antenna	54 inch collapsible whip
Total Weight (with antenna and battery)	1-7/8 pounds

BUDDY BOX PROVISIONS

Buddy Box (Trainer) wiring is not standard in the Econo-Flite transmitter, but provisions are made in the encoder board for simple modifications to incorporate this feature. A kit of parts, with instructions, is available separately at nominal cost.

SYSTEM THEORY (Figure 2)

A continuous train of pulses is generated in the Econo-Flite transmitter encoder and is used to pulse-modulate the RF carrier. Waveform A shows one complete pulse frame, which is transmitted approximately 70 times per second. Note that the five pulses produce four individual channel spacings of 1.5 milliseconds each, which are used to control the related channel servos. The 8 millisecond sync pause is used to synchronize the receiver-decoder circuit with each information frame so that the correct command will always go to the proper servo.

Waveform A shows channel spacings of 1.5 milliseconds, equivalent to servo neutral. When Channel 1 (aileron or rudder) control is moved fully to the right, pulse spacing is increased to 2 milliseconds as shown in waveform B. None of the other channel spacings are affected by this control change. The Channel 1 servo moves full right as the signal changes. Therefore, for any pulse spacing change, either wider or narrower, the servo will position itself relative to the width of the resultant pulse.

The modulated RF carrier waveform is shown at C. Carrier pulse spacing is controlled directly by spacing between the modulating pulses.

With a "fixed frame rate" encoder, total length of each frame remains constant, but the sync pause varies in length. A comparison of waveforms A and B shows this effect.

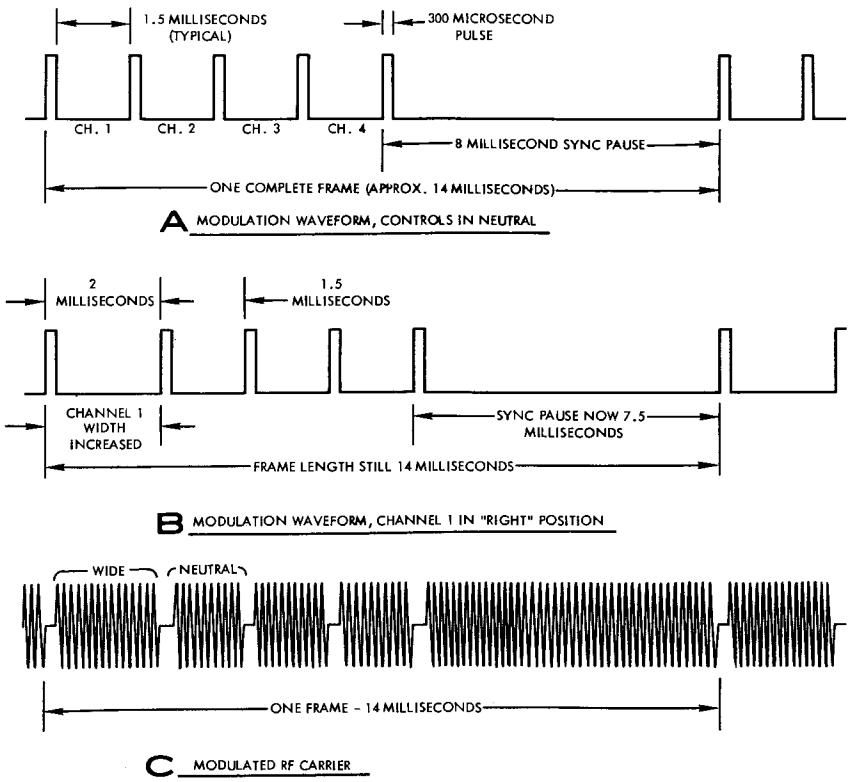


Figure 2. Modulation and Carrier Waveforms (4-Channel)

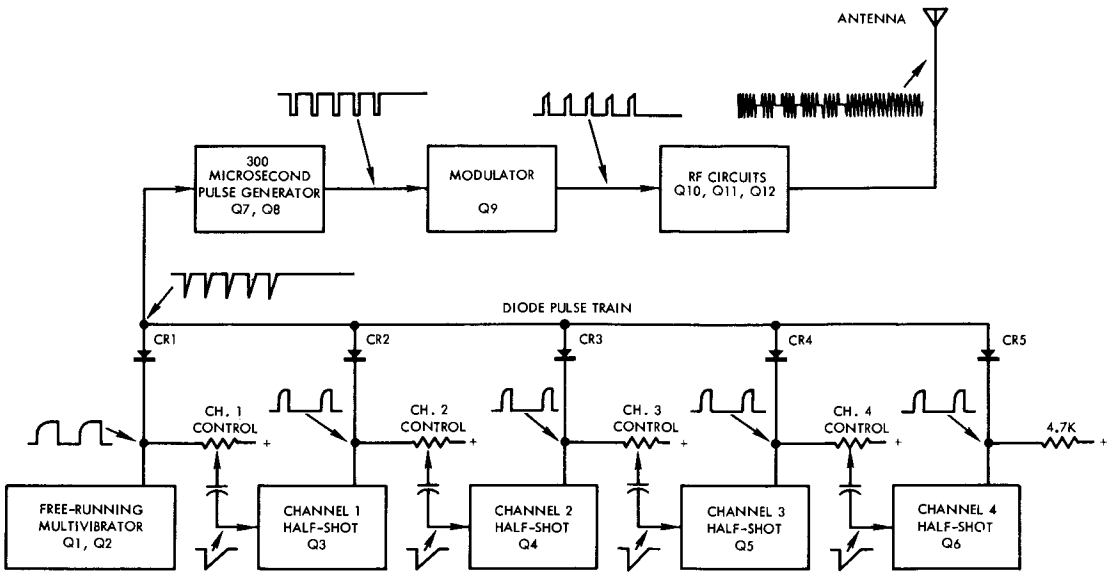


Figure 3. Transmitter Block Diagram (4-Channel)

The pulse-modulated RF signal from the transmitter is picked up by the receiver and demodulated to obtain the pulse spacing information generated in the transmitter logic section. In the Rx decoder these pulses are segregated by channel, and fed to the individual channel servos.

In each servo the pulse width is compared with that of a reference pulse generated within the servo. If the two pulses are of different widths, the servo moves until the internal reference generator variable pulse matches the width of the incoming pulse, at which point it stops. Thus, movement of a control stick changes the related output pulse spacing from the transmitter and positions the servo as desired.

TRANSMITTER THEORY (Figure 3)

A free-running multivibrator (Q1, Q2) produces a consecutive series of pulses which establish the frame rate in the transmitter at 70 cycles per second. The resulting starting pulse is passed through diode CR1 and becomes the first pulse in the diode pulse train. The same pulse passes through Channel 1 control pot and is used to trigger Channel 1 Half-Shot Q3, which is basically a monostable timing circuit.

Output of Q3 is a positive square wave whose width is variable from 1 to 2 milliseconds by means of Channel 1 control pot settings. Neutral position is 1.5 milliseconds. This pulse is fed through diode CR2 to form the second pulse in the diode pulse train, and provides pulse spacing equivalent to the pulse width of Q3 output.

Through Channel 2 control pot, the output of Q3 triggers Half-Shot Q4 and provides the third pulse in the pulse train. Channels 3 and 4 operate in a similar manner to complete the five pulses required for the four-channel pulse train. Note that the spacing between each of these pulses is exactly the same as that of each related channel waveform.

Monostable Multivibrator Q7, Q8 is a timing circuit with time constants selected to provide a 300 microsecond square wave output pulse for each trigger pulse from the incoming diode pulse train.

Modulator Q9 acts as a switch connected in the emitter circuit of oscillator transistor Q10 (27 and 53 MHz) or the frequency doubler transistor Q11 (72 MHz) of the RF section. Negative pulses from pulse generator Q7, Q8 turn modulator Q9 OFF, which in turn shuts off the transmitter RF output for the 300 microsecond period of each pulse. The resultant RF envelope follows exactly the pulse modulation waveform, with OFF periods corresponding in time and duration with the 300 microsecond pulses.

An oscillator and two parallel power output transistors are used in the 27 and 53 MHz RF sections. Control pulses are used to modulate crystal-controlled oscillator Q10. Dual power transistors provide approximately 750 milliwatts of power output. The meter circuit indicates RF power output as well as battery condition.

The 72 MHz RF section utilizes an oscillator, frequency doubler stage, and single-ended power output stage. Modulation is performed in the emitter circuit of the frequency doubler transistor. Power output is approximately 350 milliwatts.

A half-wave diode charging circuit for the nickel-cadmium batteries utilizes a No. 40 bulb as a charging indicator and to absorb voltage surges. A 1000 ohm dropping resistor insures correct charging current (50 milliamperes). Charging is performed with both Tx and Rx batteries connected in series. Transmitter switch must be OFF when charging, receiver switch ON.

TRANSMITTER PARTS PACKAGING

Kit and Half-Kit parts are shipped in plastic bags to permit rapid identification of parts groups. At the beginning of each phase of transmitter assembly, open only the bag (or bags) pertaining to that phase. In the event a part is left over, save it for future use in a succeeding step.

Listed below are the various packages supplied with your kit, together with quantities required for each system model.

Package No.	Contents	3-CH	4-CH	Single Stick
1 (Full Kit)	Logic Board & Components	1	1	1
or				
1A (Half-Kit)	Assembled Logic Board	1	1	1
2	4th Channel Logic Parts	0	1	1
3	Logic Board Wiring	1	1	1
4	Assembled RF Section	1	1	1
5	KEK Std Stick Components	1	2	0
or				
5A	KEK Single Stick Components	0	0	1
6	Batteries and Case	1	1	1
7	Tx Case and Parts	1	1	1
8	Mechanical Parts (screws, etc)	1	1	1
9	Pot and Bracket	1	0	1

TRANSMITTER ASSEMBLY PROCEDURES

PREPARATION FOR ASSEMBLY

a. Read these instructions and the General Assembly Instructions over thoroughly before starting transmitter assembly.

b. Kits are packaged to provide several component groups. At the beginning of each assembly phase a parts list is provided to cover the specific parts required during that operation. Packages are easily identified as to contents. Open only the package(s) needed for that assembly procedure. Check package parts against the parts list.

NOTE

In event of parts shortages, contact the factory for replacements. Kits are warranted only for completeness of parts. No parts exchange will be made after the part has been installed or soldered on.

c. Choose a smooth, clean work area so parts are not easily lost.

d. The following tools are required:

1. Needle nose pliers, 4" long
2. Diagonal cutters, 4" long, flush-cutting type preferred
3. Wire strippers for no. 26 wire
4. Soldering iron, 30 to 47-1/2 watts
5. Pencil and chisel tips for soldering iron
6. Damp cellulose sponge for cleaning soldering iron
7. Rosin-core solder, 60-40 type, .062" diameter
8. Small screwdriver, 1/8" flat metal blade
9. Small Phillips screwdriver
10. Allen wrenches, 3/64" and 1/8"
11. Wrench, with 1/16" square metal shaft on long end (suggest grinding a 3/32" Allen wrench to a square end)
12. Fine tooth metal files, assorted sizes
13. Small, stiff bristle brush
14. Lacquer thinner
15. X-acto knife
16. Eye loupe, 2-1/2" to 3" focal length

Logic Board Electronics

Package No. 1 Parts List (3-Channel)

QTY	ITEM	PRICE (ea)
1	P. C. board	$ 4.50
6	.001 UF disc capacitor	.20
5	.005 UF disc capacitor	.20
1	.015 UF mylar capacitor	.35
3	.02 UF disc capacitor	.20
3	.056 UF mylar capacitor	.35
1	.1 UF disc capacitor	.30
2	.15 UF mylar capacitor	.40
1	10 UF electrolytic capacitor	.45
1 ea	1/4 watt resistors, values 3.9K, 6.8K, 10K and 27K ohms, ±10%	.15
2 ea	1/4 watt resistors, values 4.7K, 68K, 100K ohms, ±10%	.15
5	1/4 watt resistors, 47K ±10%	.15
2	47K trim potentiometer	.50
1	100K trim potentiometer	.50
4	FDN601 silicon diode	.50
1	TS-2 charging diode	1.00
1	2N4123 transistor	1.25
7	2N5134 transistor	1.00
1	Solder, .062 diameter, 24" lg	.10 ft

LOGIC BOARD ASSEMBLY

a. Check printed circuit board as outlined in General Assembly Instructions.

b. Open package(s) 1 and 2 containing P. C. board and electronic components.

c. Check parts against the parts lists and figures 4 thru 7 for parts identification. If this is a Half-Kit, proceed directly to step 79.

d. Position printed circuit board E530T, metal side down, so that hole arrangement corresponds with layout in figure 4. Proceed with assembly steps in figure 4, then continue with steps in figures 5, 6 and 7. Omit steps 1 thru 78 on Half-Kits.

4th Channel Logic Parts

Package No. 2 Parts List (4-Channel Models)

1	.001 UF disc capacitor	.20
1	.005 UF disc capacitor	.20
1	.02 UF disc capacitor	.20
1	.056 UF mylar capacitor	.35
1 ea	1/4 watt resistors, values 47K and 68K ohms, ±10%	.15
1	47K trim potentiometer	.50
1	FDN601 silicon diode	.50
1	2N5134 transistor	1.00

1	P. C. logic board assembly, 3-channel, with all parts assembled and soldered in place	$13.00
1	P. C. logic board assembly, 4-channel, with all parts assembled and soldered in place	$15.00

These P. C. assemblies are supplied as Package 1A in Half-Kits in place of above separate components.

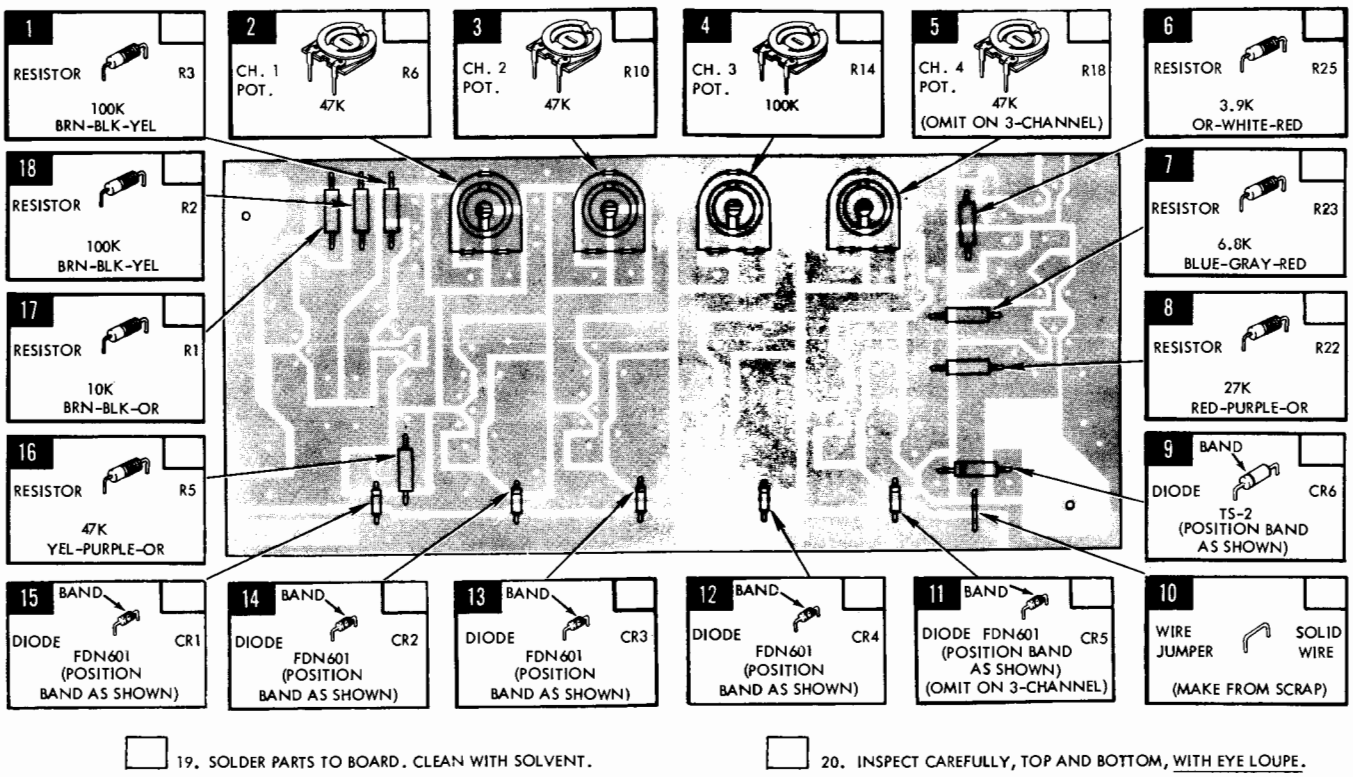


Figure 4. Logic Board Assembly (Sheet 1 of 4)

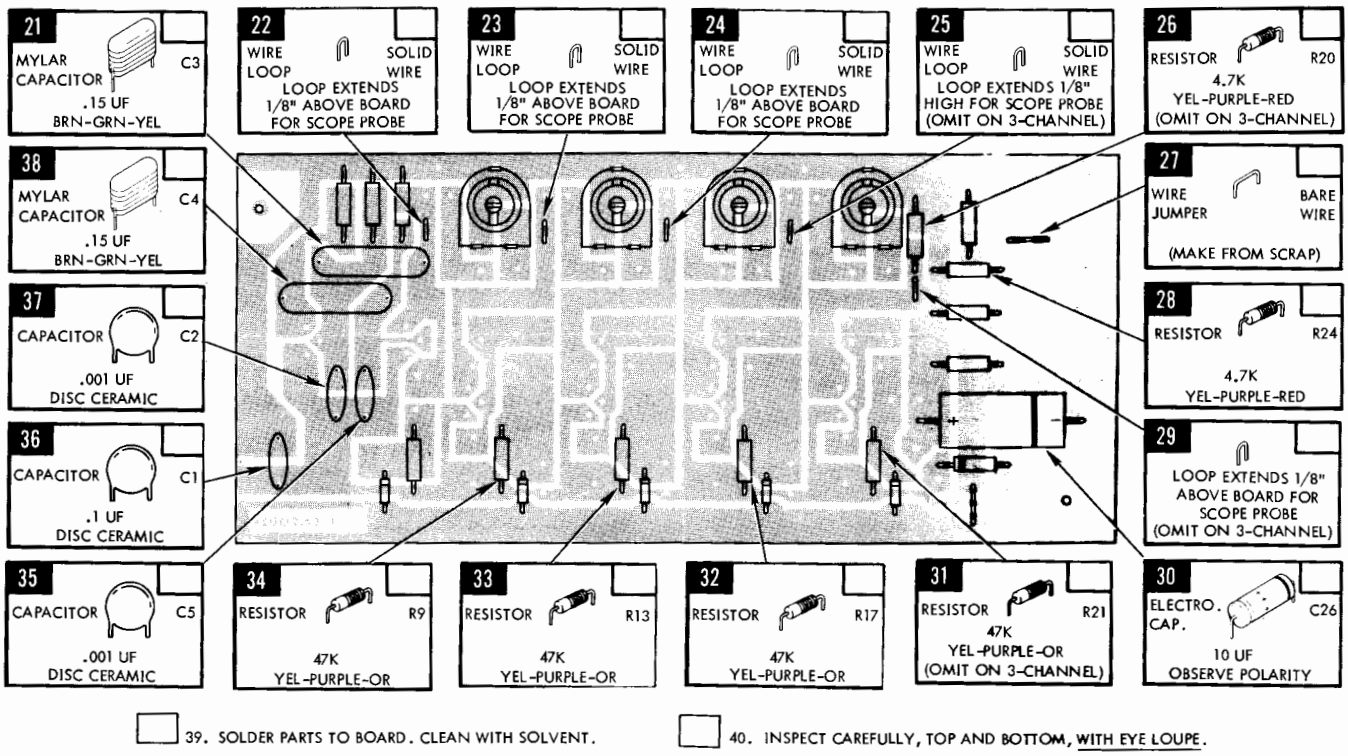


Figure 5. Logic Board Assembly (Sheet 2 of 4)

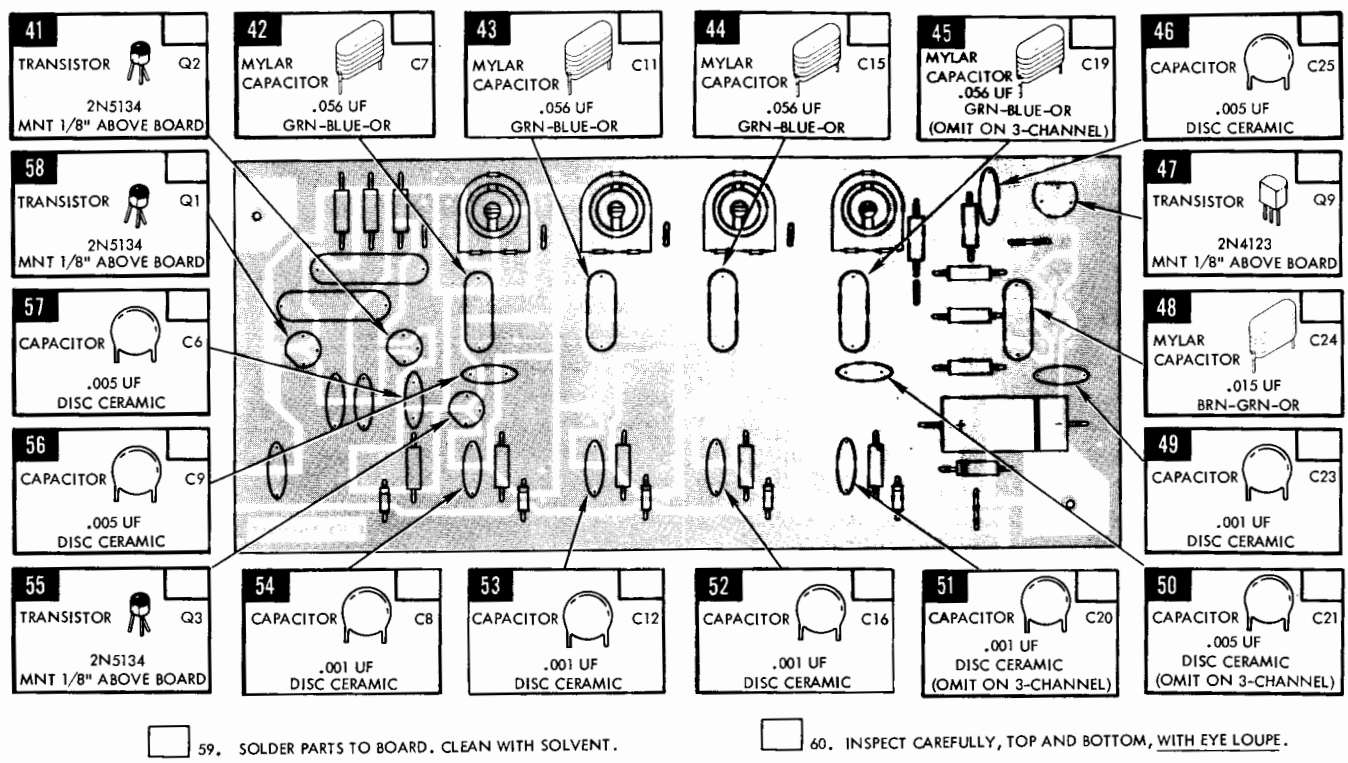


Figure 6. Logic Board Assembly (Sheet 3 of 4)

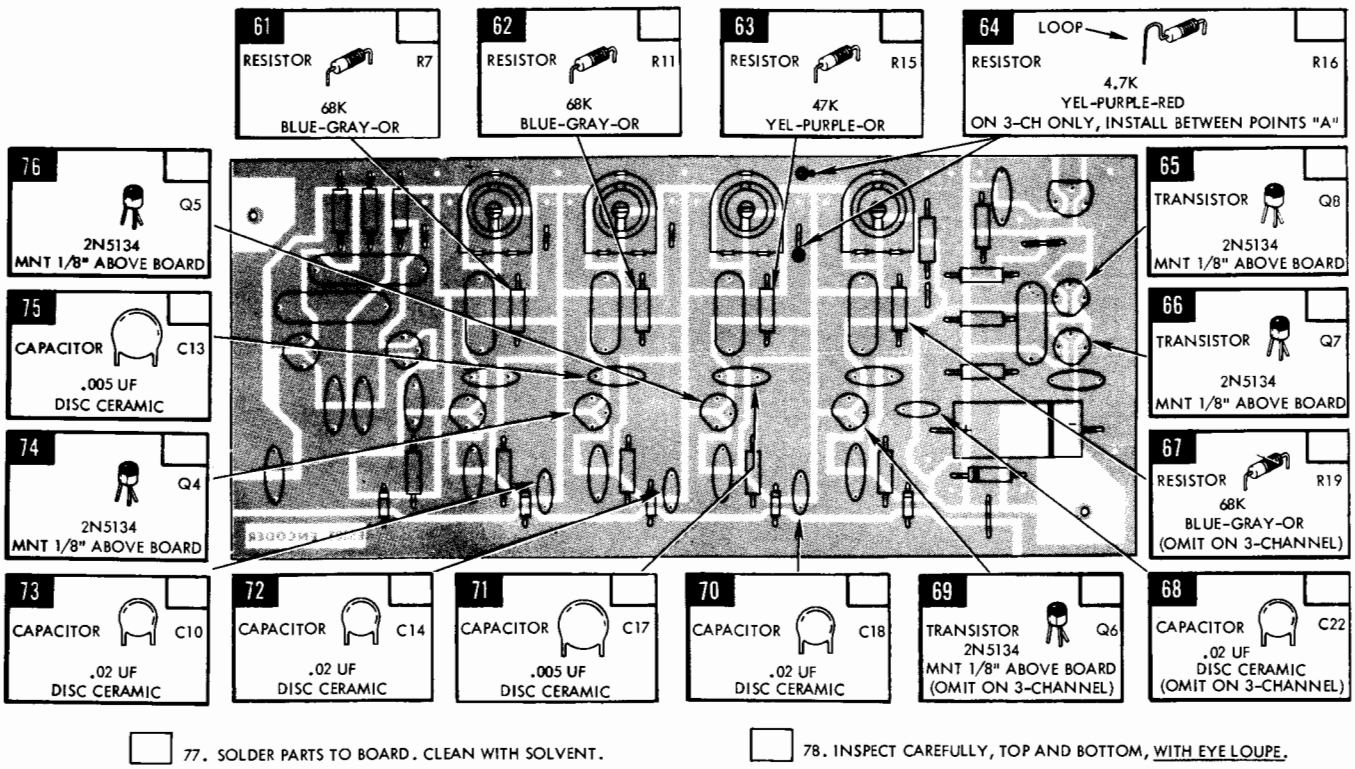


Figure 7. Logic Board Assembly (Sheet 4 of 4)

Logic Board Wiring

Package No. 3 Parts List

QTY	ITEM	LENGTH	PRICE (ea)
1	#26 red wire	28"	.05 ft
1	#26 white wire	24"	
1	#26 black wire	20"	
1	#26 yellow wire	24"	
1	3/32" shrink tubing	5"	.50 ft
1	Solder, .062 dia.	24"	.10 ft

INSTALLING LOGIC BOARD WIRING

☐ 79. Cut following lengths of #26 wire for the model you are building. Keep in separate groups for later use. Identify each group.

Group "A" - Ch 1 wiring (all models)
1 ea yellow, red, white wires; 2-3/4" lg

Group "B" - Ch 2 wiring (all models)
1 ea yellow, red, white wires; 4" lg

Group "C" - Ch 3 wiring (3-channel)
1 ea yellow, red, white wires; 4-1/2" lg

Group "C" - Ch 3 wiring (4-channel, 2-stick)
1 ea yellow, red, white wires; 3-1/2" lg

Group "C" - Ch 3 wiring (single stick)
1 ea yellow, red, white wires; 6" lg

Group "D" - Ch 4 wiring (3-channel)
No wires needed

Group "D" - Ch 4 wiring (4-channel, 2-stick)
1 ea yellow, red, white wires; 4" lg

Group "D" - Ch 4 wiring (single stick)
No wires needed

Group "F", "G", "H" - RF wiring (all models)
1 ea red, white, black wires; 6" lg

Miscellaneous wires (all models)

Ⓘ	1	black wire	2-1/2" lg
Ⓙ	1	black wire	2" lg
Ⓚ	1	red wire	4" lg
Ⓛ	1	yellow wire	2-1/2" lg
Ⓞ	1	black wire	1-3/4" lg

Meter wires (single stick)

1	black wire	4" lg
1	yellow wire	4-1/2" lg

Meter wires (3 and 4-channel)

1	black wire	3-1/2" lg
1	yellow wire	3" lg

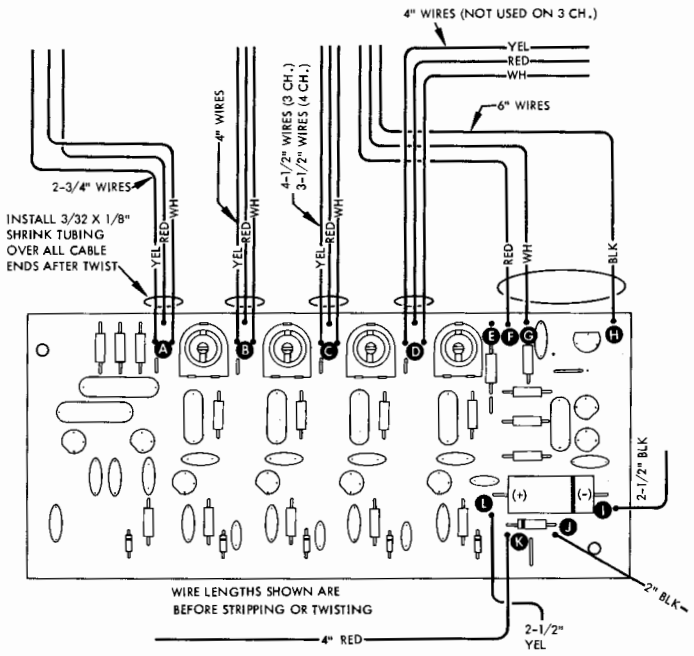


Figure 8. Logic Board Wiring (3 and 4-Channel)

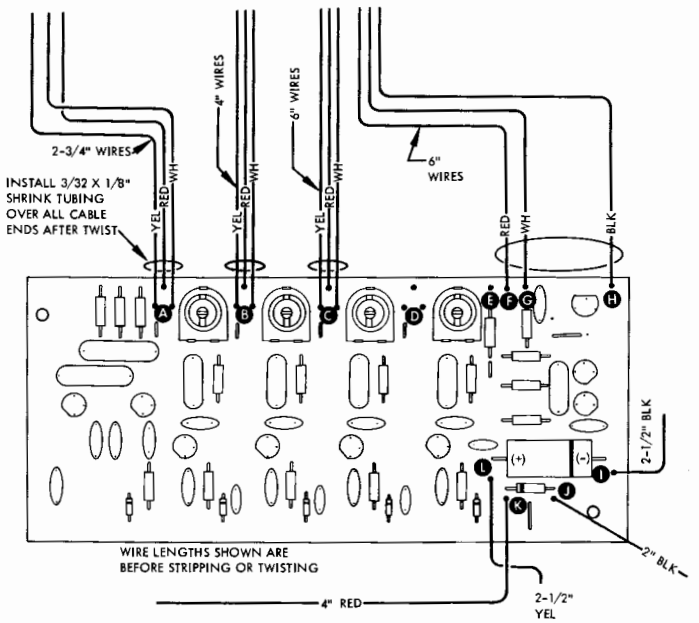


Figure 9. Logic Board Wiring (Single Stick)

☐ 80. Using wire strippers, remove 1/8" insulation from both ends of each wire above, except remove 1/2" from one end of 2-1/2" black wire Ⓘ.

☐ 81. Twist strands of exposed wire ends tightly, then tin both ends of all wires cut. Use as little solder as possible to avoid solder lumps on wires.

☐ 82. Insert one end of yellow, red and white wires from Group "A" into proper holes on logic board at posifion Ⓐ, and solder in place. (See figure 8.)

☐ 83. Solder Group "B" yellow, red and white wires into position Ⓑ holes.

☐ 84. Solder proper length Group "C" wires into position Ⓒ holes. (See figures 8 and 9 for positive wire length identification.)

☐ 85. On 4-channel, 2-stick model only, solder Group "D" wires into holes at position Ⓓ. (No wires connect here on 3-channel; wires from single stick rudder pot will be connected here later.)

☐ 86. Solder 6" red, white and black wires to board at positions Ⓕ, Ⓖ and Ⓗ.

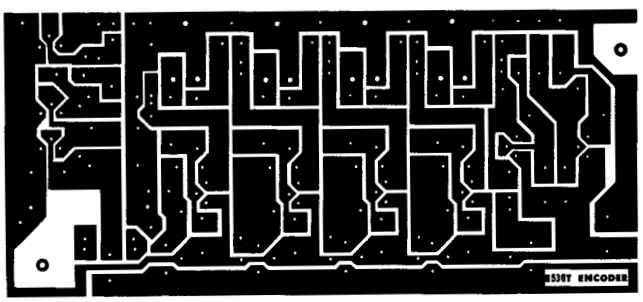


Figure 10. Logic Board Lands

☐ 87. Twist the three wires of each of these wire groups tightly together to form a neat wire cable.

☐ 88. Cut five 1/8" lengths from 3/32" shrink tubing. Slide one section of tubing over each cable and position it as close to board as possible. Shrink into place.

☐ 89. Solder the 1/8" stripped end of each of the four remaining short wires to logic board at positions Ⓘ, Ⓙ, Ⓚ and Ⓛ.

☐ 90. Clip protruding leads from bottom of board then use lacquer thinner to remove solder rosin. Inspect carefully, under magnification, for possible shorts between board lands. Compare with figure 10. Put logic board aside until final installation.

☐ 91. Solder yellow and black meter wires to RF board assembly (Package no. 4) at position Ⓟ. Clip excess leads below board. See figures 11, 27 and 28 for correct connections and wire lengths. Twist these wires, then shrink a 1/8" length of 3/32" shrink tubing over wires as close to board as possible.

RF Section

Package No. 4 Parts List

QTY	ITEM	PRICE (ea)
1	Assembled RF Section	
	27 MHz	$ 14.00
	53 or 72 MHz	16.00
1	Type Acceptance Label (72 MHz only)	1.00

92. Clip leads; clean and inspect bottom of RF board, then put aside until later.

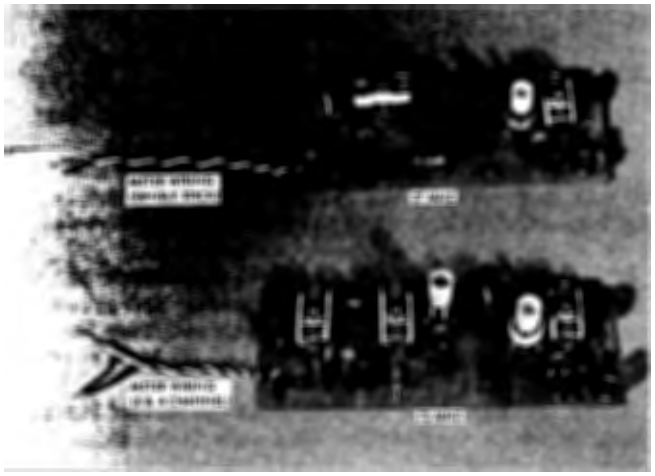


Figure 11. Wired RF Boards

ASSEMBLY OF KEK CONTROL STICKS

Control sticks in Package No. 5 are used in 3 and 4-channel models; No. 5A is for single stick use. Check contents of each bag against Parts List before proceeding with assembly.

Stick Assemblies

Parts List For Package Nos. 5 and 5A

P/N	Item	Qty Used On Std Stick (Package 5)	Qty Used On Single Stick (Package 5A)
CS-001	Stick Housing	1	1
CS-002	Ball Retainer	1	1
CS-003	Bail Support Slide	2	2
CS-004	Small Bail (white)	1	0
CS-004A	Small Bail (ivory)	0	1
CS-005	Large Bail (white)	1	0
CS-005A	Large Bail (ivory)	0	1
CS-006A	Pot Support Trim Guide	2	2
CS-007B	Trim Lever (black)	2	2
CS-008	Contact Support Housing	2	2
CS-009	Pot Wiper Assembly	2	2
CS-010	Spring Guide	2	2
CS-011	Spring Lever	2	2
CS-012	Centering Spring	2	2
CS-013	Motor Detent Bracket	1	0
CS-015	Pot Retainer Lever	2	2
CS-017B	Stick Tip	1	0
CS-018	Metal Washer	2	2
CS-019	1/4" Allen Set Screw	2	2
CS-020	Lever Bearing	2	4
CS-021	Chrome Bezel (Round)	1	1
CS-023	4K Pot Element	2	3
CS-024	Control Stick (2 axis)	1	0
CS-026	Cone Front Housing	0	1
CS-027	Rudder Slide Guide (with screws)	0	1
CS-028	Rudder Trim Lever	0	1
CS-029	Rudder Pot Support Lever	0	1
CS-030	Rudder Contact Support Shaft	0	1
CS-031	Knob Support Housing	0	1
CS-032	Rudder Spring Guide	0	2
CS-033	Rudder Spring	0	1
CS-034	Rudder Knob	0	1
CS-035	Front Disc	0	1
CS-036	4-40 x 1/8" Set Screw	0	2
CS-038	Control Stick (s. stick)	0	1
P-008	#2 x 1/4" S. M. Screw	4	4
P-009	#2 x 5/16" S. M. Screw	5	4
P-015	2-56 x 1/4" Mach Screw	8	8
P-020	2-56 x 1/4" flat hd Mach Screw	0	4
P-023	2-56 x 5/16" Mach Screw	4	4
P-032	4-40 x 3/16" Mach Screw	0	1
S-045	Rudder Contact Wiper Assembly	0	1
#26	Red Wire, 8" lg	0	1
#26	White Wire, 8" lg	0	1
#26	Yel Wire, 8" lg	0	1
3/32"	Shrink Tubing, 1" lg	0	1

Spare parts not priced separately.
Std Stick (Kit) ..... $15.00 assembled $17.95
Single Stick (Kit) .. $29.50 assembled $36.50

Steps 93 through 115 below cover instructions for basic assembly of both the two-axis (Package 5) and three-axis control sticks (Package 5A). Steps 116 through 130 are applicable only to the three-axis

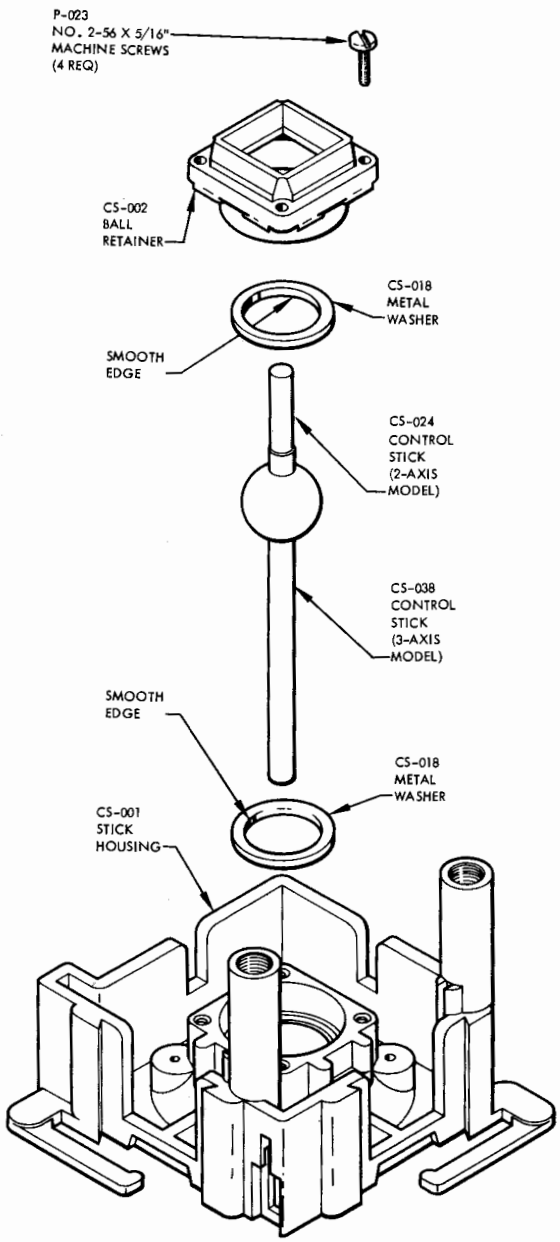


Figure 12. Assembly of Control Stick and Housing

stick. For 3-channel and 4-channel systems, build one standard stick with centering springs in both planes. Build another similar stick for 4-channel system, using motor control ratchet in the vertical plane. One single stick assembly is required for the Single Stick 4-channel transmitter.

ASSEMBLY OF CONTROL STICK AND HOUSING (Figure 12)

☐ 93. Clean off all flash and remove plastic thread bits from stick housing.
☐ 94. Insert metal washer, smooth inner edge up, into center recess in housing. Use a 11/16" round wooden dowel to press washer down into recess until firmly seated.
☐ 95. Insert second metal washer, smooth inner edge towards ball, into recess in ball retainer. Seat in same manner as above.
☐ 96. Place control stick, long shaft down, into recess in stick housing. Note: solid shaft stick is for two-axis stick; hollow shaft stick is for three-axis stick.
☐ 97. Position ball retainer over upper side of ball, align with retainer seat in housing, and press retainer firmly into position. Attach with four No. 2-56 x 5/16" machine screws. Do not tighten screws fully at this point.
☐ 98. To adjust stick for smooth operation, insert blade of small screwdriver into each of the slots, in turn, on each of the four sides of the ball retainer. Gently pry socket upwards evenly on all sides. Loosen the four screws fractional turns as necessary until stick and ball move smoothly in all directions, without drag or end play. Careful adjustment is necsary to insure smooth stick operation.

ASSEMBLY OF BAIL MECHANISM (Figure 13)

☐ 99. Slide "U" shaped end of small bail into recess in contact support housing until the "U" bottoms on the round boss on housing. Secure with two No. 2 x 1/4" sheet metal screws.
☐ 100. Position bail support slide over end of contact support housing attached to bail.
☐ 101. Insert pot wiper assembly into outer end of hole in contact support housing so that the flat (red dot) on pot wiper shaft mates with the internal flat inside the contact support housing shaft opening. Press pot wiper in until it seats fully. Bend both inner and outer wiper arms out slightly so that positive contact with potentiometer element is assured.
☐ 102. Attach pot support trim guide to outer face of bail support slide with two No. 2 x 3/16" sheet metal screws. Tighten screws so that trim guide can be moved with slight friction. Adjust screw tightness to provide trim lever friction desired.
☐ 103. Align large slot in edge of pot element with key in pot retainer lever recess. Seat pot inside lever.
☐ 104. Position lever and pot element over end of trim guide and pot wiper. Secure with two No. 2-56 x 1/4" machine screws. Tighten screws to prevent pot retainer lever from being moved unless positive force is applied. Friction on this lever should be greater than on the trim guide. This lever provides travel calibration and should remain in position once adjusted.
☐ 105. Slip trim lever over entire assembly to fit over pin on bail support slide. Be sure lever fits flat against bail support slide, with upper end of trim guide in lever slot.
☐ 106. Assemble second bail mechanism as in steps 99 through 105, using large bail.

INSTALLATION OF BAIL MECHANISMS (Figure 14)

☐ 107. Position housing assembly as shown. Align upper end of control stick with slot in small bail, and push small bail mechanism down so that bail support slide fits into matching slots in housing. Force bail mechanism down until slide snaps in place. Press hard on top of bail support slide to seat. It may be

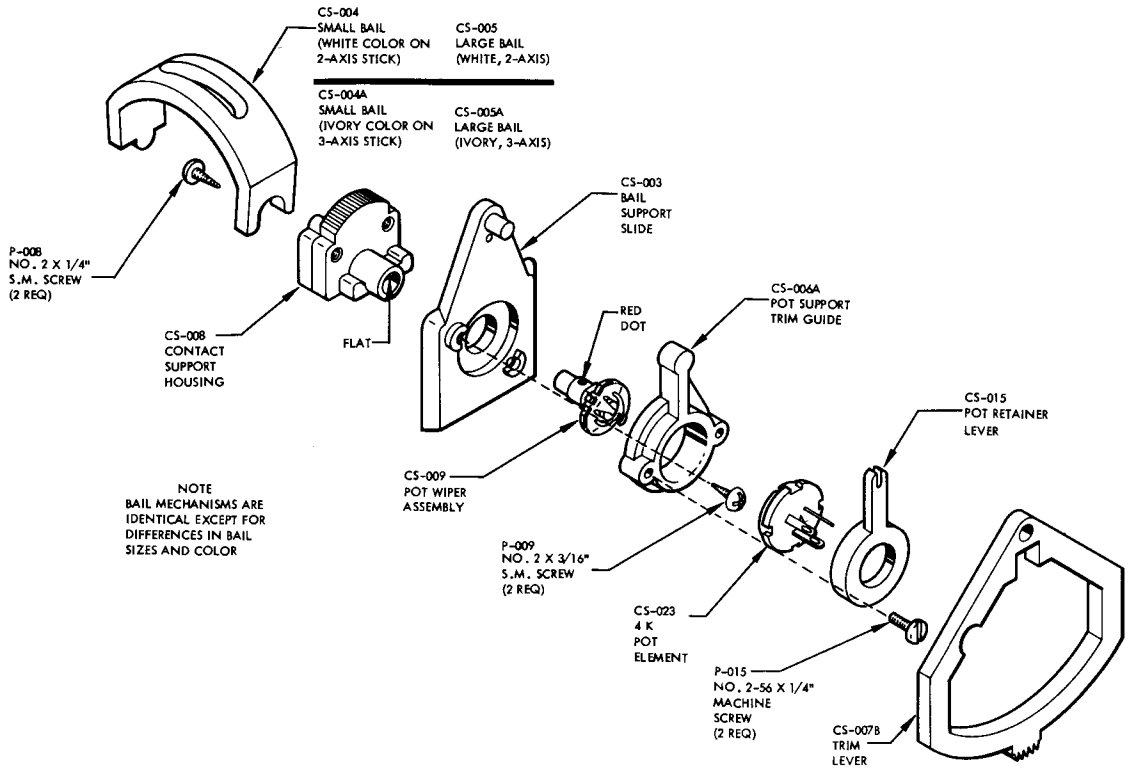


Figure 13. Assembly of Bail Mechanism

necessary to bend trim lever retainer very slightly to allow trim lever retainer to assume correct position and rub on side of trim lever.

☐ 108. Install large bail mechanism over small bail mechanism in same manner.

INSTALLATION OF CENTERING SPRINGS (Figure 15)

☐ 109. Slide bearing Ⓐ up into recessed slot in housing assembly until fully seated.

☐ 110. Install spring lever Ⓐ so that one end fits through bearing slot and other end fits into slot in spring post.

☐ 111. Drop spring guide Ⓐ into hole in spring post, then install spring Ⓐ over it. Secure with set screw Ⓐ. Spring lever should be pulled up to engage bearing, and stick should have centering action in one plane.

☐ 112. Adjust spring tension by turning set screw in or out to obtain desired stick "feel". Use 1/8" Allen wrench for adjustment.

☐ 113. On 3-axis sticks, and on 2-axis sticks where full centering is desired, install second bearing, lever, guide, spring and set screw in same manner. Omit these parts on stick to be used for motor control.

☐ 114. For motor control use, install motor detent bracket and secure with No. 2 x 3/16" sheet metal screw. Adjust bracket vertically to obtain detent action desired.

☐ 115. On 2-axis stick only, slide stick tip over outer end of control stick. Chrome bezel will be installed when stick assembly is mounted in transmitter case.

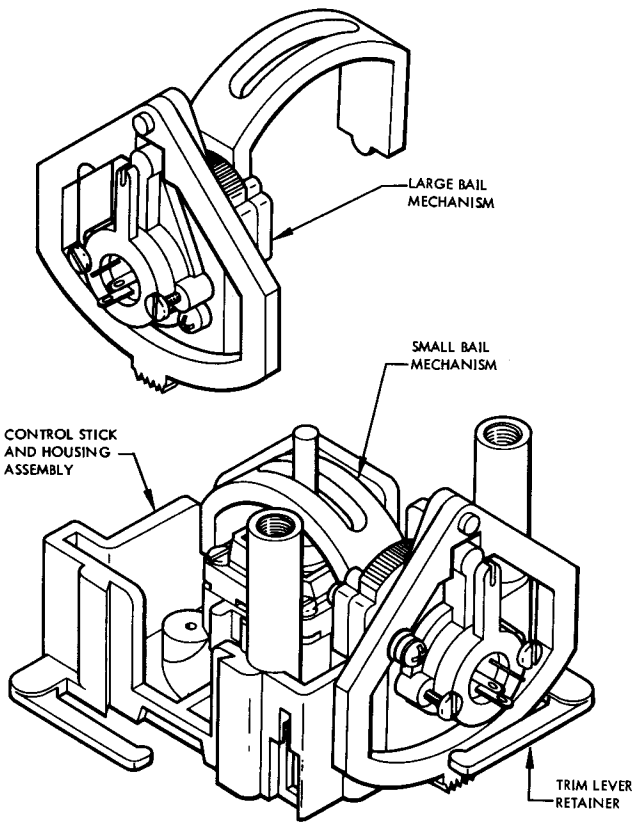


Figure 14. Installation of Bail Mechanisms

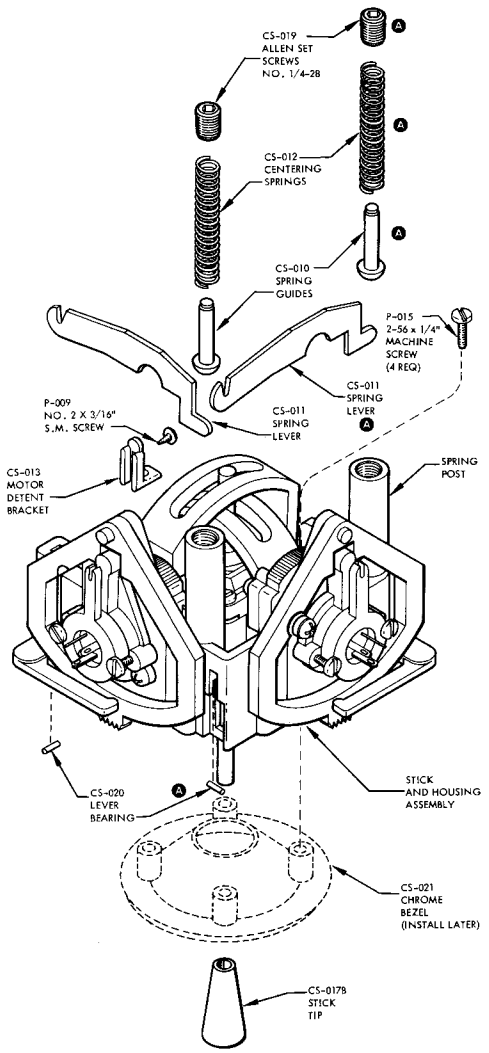


Figure 15. Installation of Centering Springs

NOTE

Mode I or Mode II operation on 2-axis sticks is obtained by installation of springs and/or motor detent bracket in desired positions.

ASSEMBLY OF RUDDER KNOB MECHANISM (Figure 16)

☐ 116. Press lever bearing Ⓐ into lower hole in front housing until it seats.

☐ 117. Fit rudder trim lever lower hole over this bearing until lever fits flush against housing face.

☐ 118. Insert second lever bearing into remaining hole in trim lever. Seat fully.

☐ 119. Solder three 8" wires (red, white, yellow) to pot terminals as shown. Install 3/32 x 1/4" length of shrink tubing over each terminal. Shrink into position with soldering iron tip.

☐ 120. Pass wires through hole in rudder pot support lever, align large notch in side of pot with key inside of lever, and press pot firmly into lever recess until it seats fully. Be sure surface of pot element is absolutely parallel with face of support lever.

☐ 121. Slide wires through hole in front housing until pot support lever fits flush against trim lever, with bearing Ⓑ in support lever slot.

☐ 122. Press rudder contact wiper assembly into hole in rudder contact support shaft until only 1/64" air gap is visible between the flanges. Bend contact wipers out slightly to insure proper contact with pot.

☐ 123. Insert shaft and wiper assembly into hole in knob support housing. Position wiper so that it will contact the pot element in approximately center of arc.

☐ 124. Fit this support housing assembly over the cone front housing assembly. Slight spring pressure should be evident to indicate that wipers are making contact with pot. Fasten these two sections together with four No. 2-56 x 1/4" flat head machine screws.

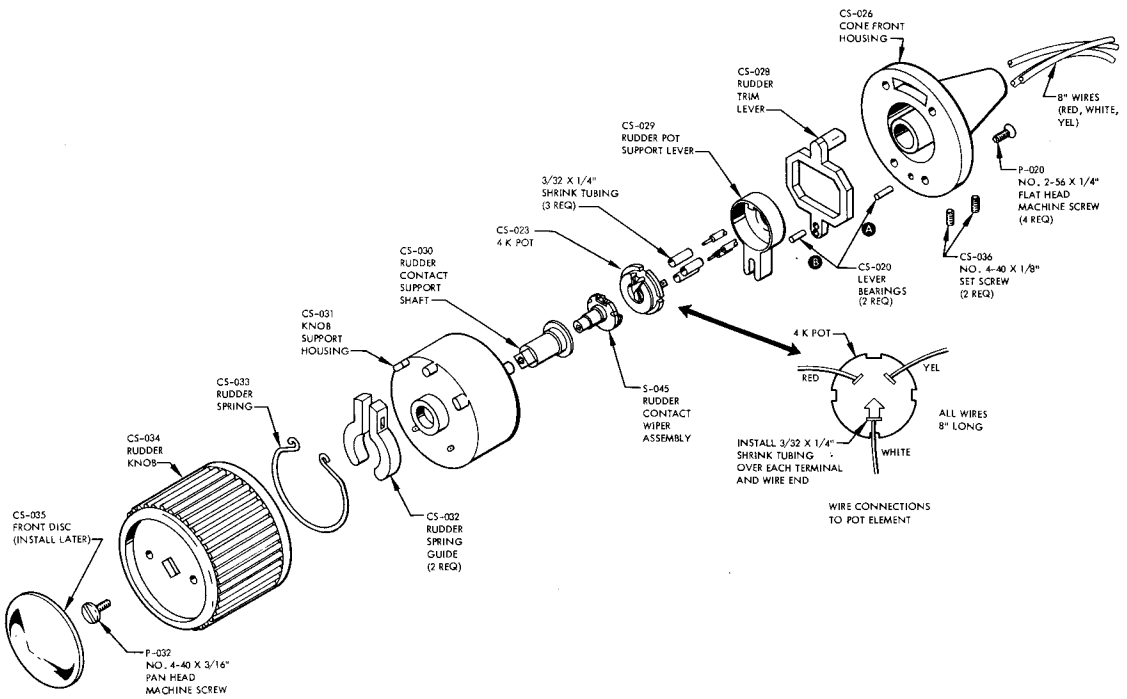


Figure 16. Assembly of Rudder Knob Mechanism

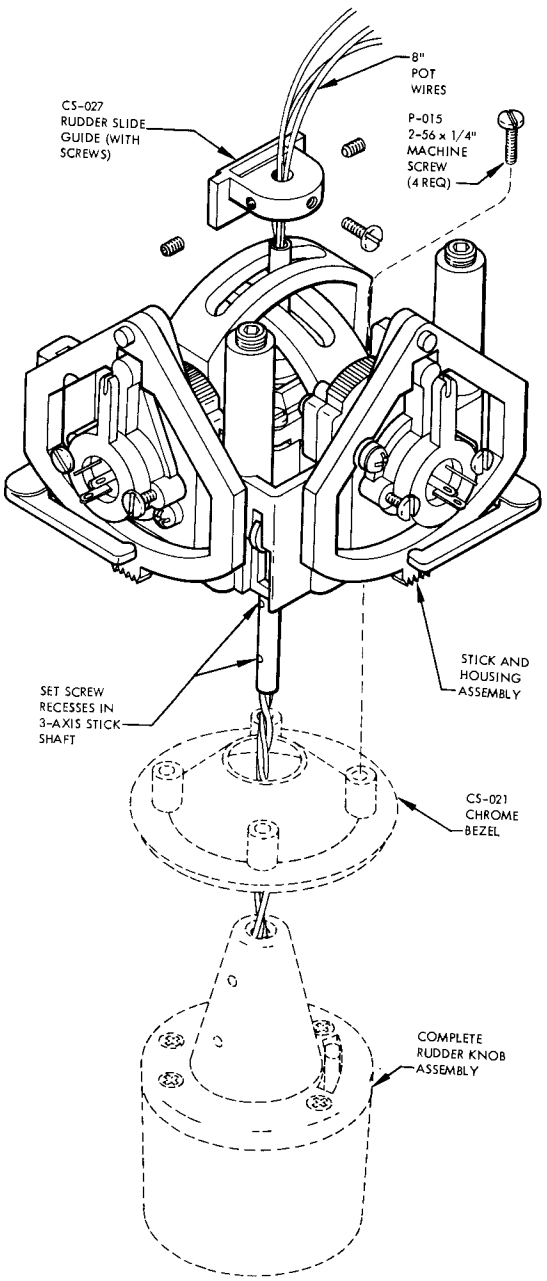


Figure 17. Final Assembly of Single Stick

☐ 125. Position the two rudder spring guides against front face of knob support housing. Spread rudder spring and fit ends into recesses on spring guides.

☐ 126. Install rudder knob so that the internal pin fits in slot between the two spring guides. Hold in place with No. 4-40 x 3/16" machine screw.

☐ 127. Insert two No. 4-40 x 1/8" set screws in holes on side of cone front housing.

☐ 128. Do not install chrome front disc until after transmitter calibration and check is complete.

☐ 129. Rotate stick shaft until set screw recesses are positioned as shown in figure 17. Place rudder slide guide over upper end of stick. Adjust position of guide so that side flange fits alongside large bail, but does not bind when stick is operated. Tighten retaining screws.

☐ 130. Rudder knob assembly and bezel will be installed when stick assembly is mounted in transmitter case.

BATTERY ASSEMBLY

Battery Components

Package No. 6 Parts List

QTY	ITEM	PRICE (ea)
1	Battery case	$ 2.00
8	500 ma nicad cells	2.50 (per cell) 5.00 (per pair) 10.00 (per four)
2	4-40 x 1-1/8" mach screws	.10
2	No. 4-40 hex nuts	.05
1	No. 26 red teflon wire, 5" lg	.10 ft
1	No. 26 black teflon wire, 12" lg	.10 ft

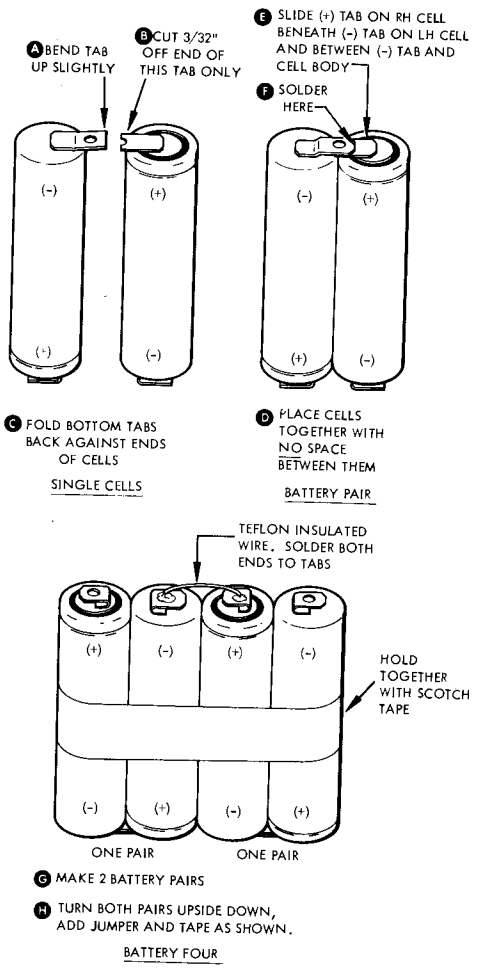
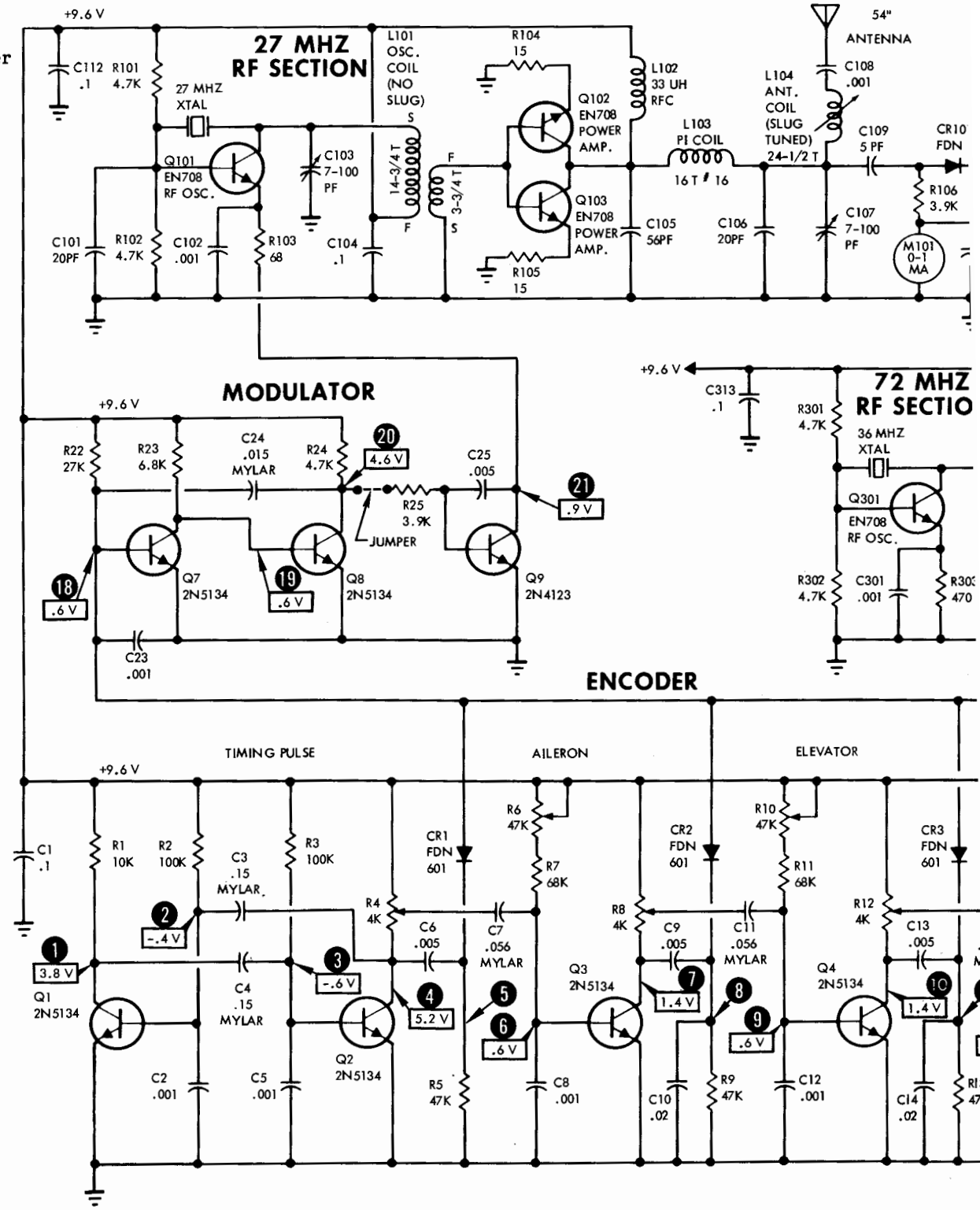


Figure 18. Making Battery Four-Cell Pack



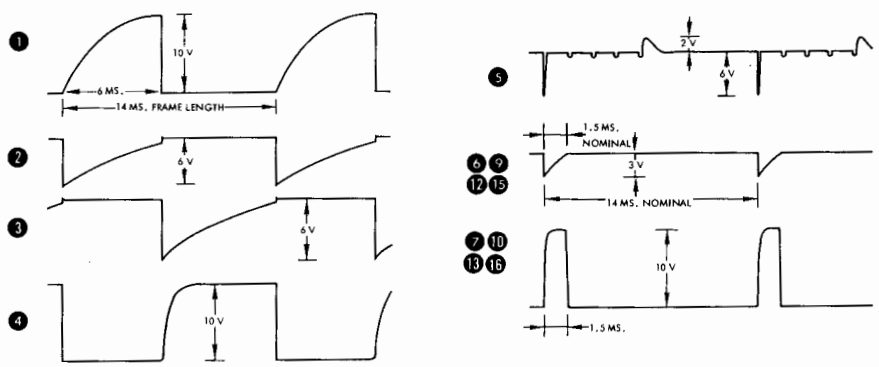
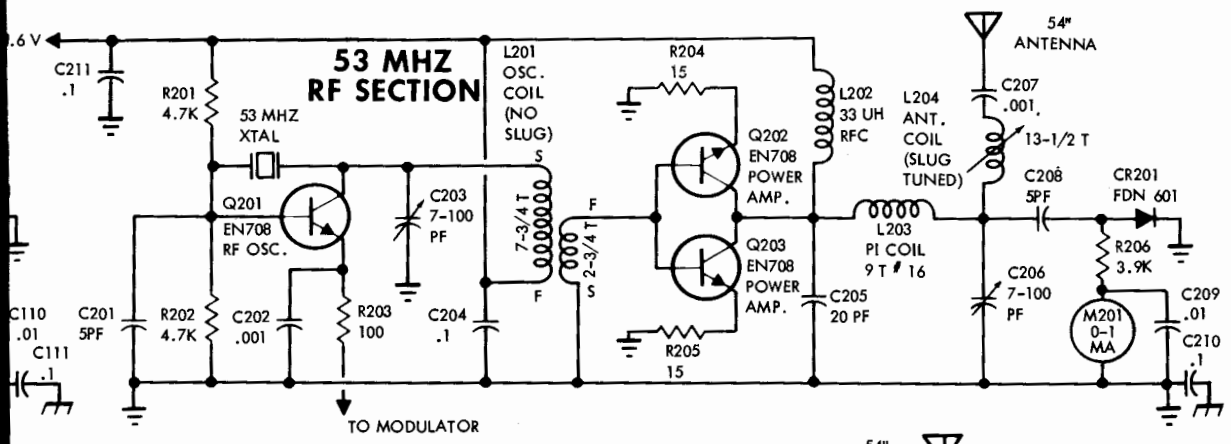
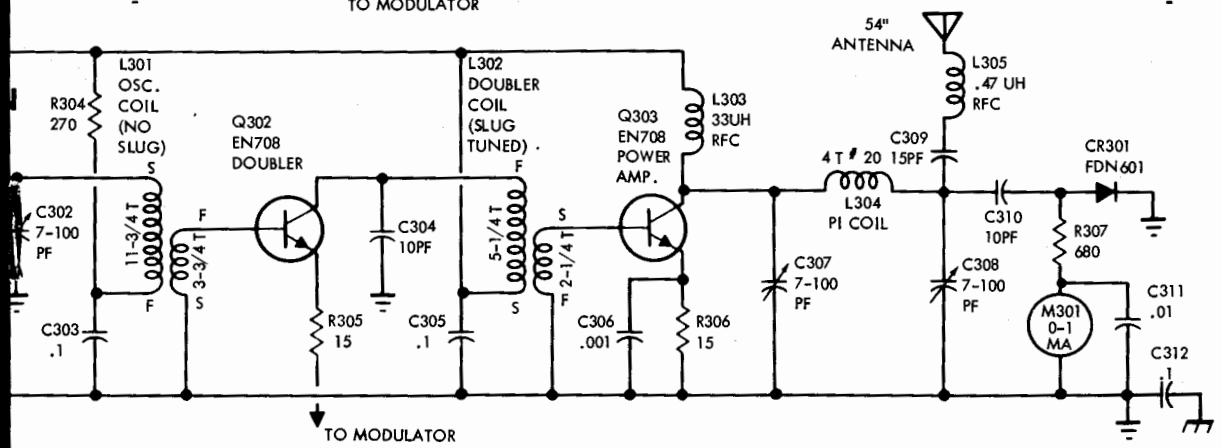
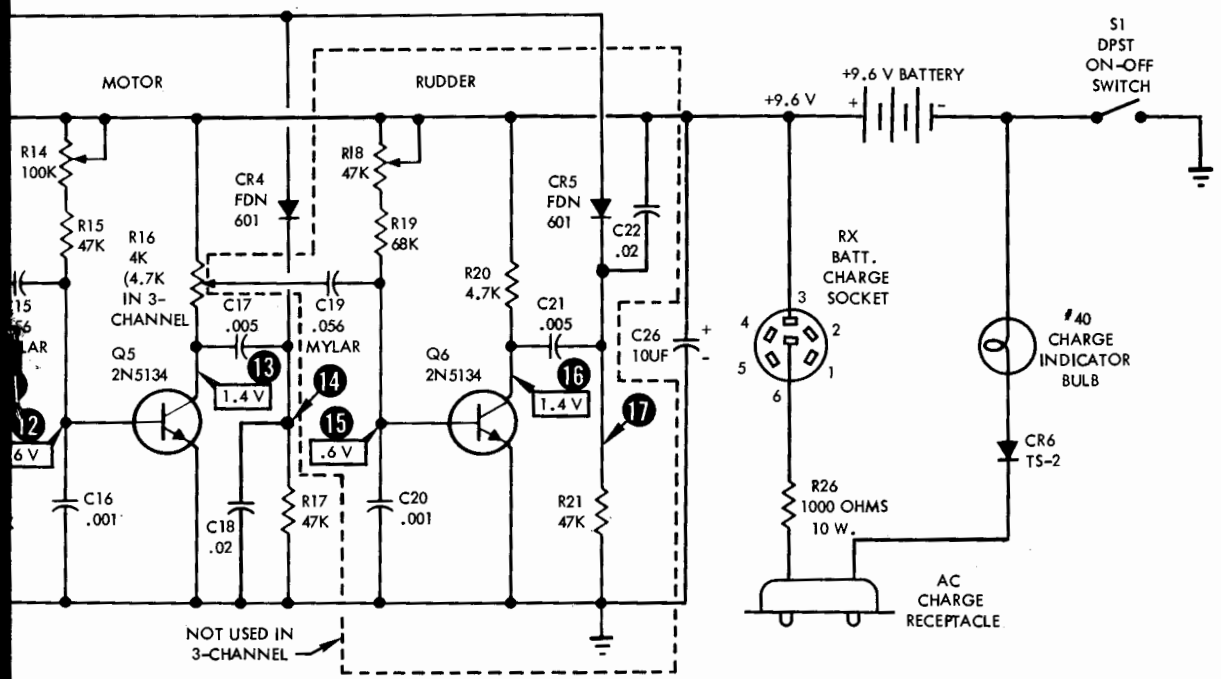
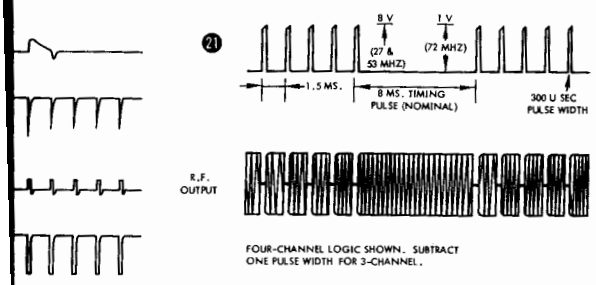


Figure 19. Transmit









NOTES

1. ALL MEASUREMENTS IN RESPECT TO NEGATIVE (-).
2. DC VOLTAGES SHOWN IN BOXES.
3. VOLTAGE READINGS TAKEN WITH 20K OHMS-PER-VOLT MULTIMETER.
4. VOLTAGES MAY VARY ± 20%.
5. VOLTAGES AND WAVEFORMS TAKEN WITH ALL CONTROLS IN NEUTRAL, AND FULL BATTERY CHARGE.
6. WAVEFORMS TAKEN WITH TEKTRONIX 503 OSCILLOSCOPE WITH CALIBRATED AMPLITUDE AND TIME BASE.
7. CAPACITOR VALUES IN MICROFARADS UNLESS NOTED.
8. PARTS NOT USED ON 3-CHANNEL MODEL SHOWN IN DOTTED BOX.
9. WAVEFORMS TAKEN WITH ANTENNA REMOVED.
10. FOUR-CHANNEL LOGIC SHOWN. FRAME LENGTH WILL BE 1.5 MILLISECONDS SHORTER FOR THE 3-CHANNEL.

er Schematic Diagram

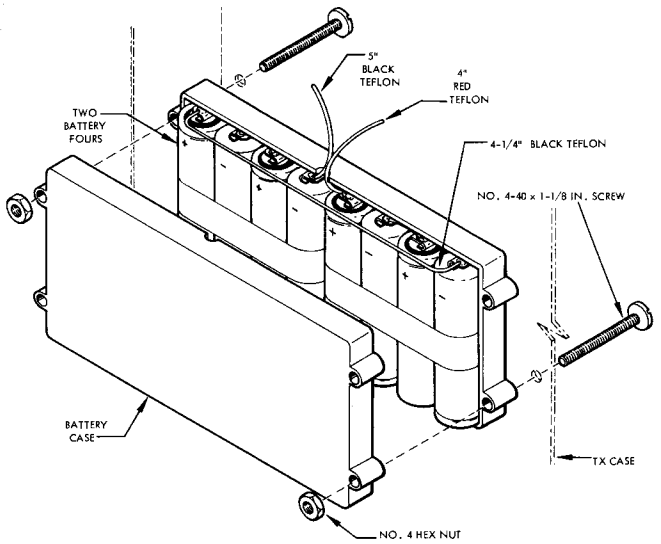


Figure 20. Assembling Transmitter Battery Pack

☐ 131. Nickel-cadmium batteries supplied with your kit may consist either of single cells, a welded pair of cells, or a welded pack of four cells. Two packs of four cells each are required for transmitter power. Figure 18 shows construction of four-cell packs starting with single cells. Using batteries supplied, fabricate two 4-cell packs as shown. If your kit contains welded four-packs, no fabrication will be necessary.

☐ 132. Cut one piece no. 26 black teflon wire 5" long, another piece 4-1/4" long.

☐ 133. Cut one piece no. 26 red teflon wire 4" long.

☐ 134. Using wire strippers, remove 1/8" insulation from both ends of 4-1/4" black wire, and from only one end of each of the other two wires. Twist and tin exposed wire ends.

☐ 135. Position two battery four-packs, with polarities as shown in figure 20, in front half of battery case.

☐ 136. Solder 4-1/4" black teflon wire to plus and minus tabs on batteries on extreme outer ends.

☐ 137. Solder 4" red teflon wire to + terminal tab of center cell. Solder 5" black wire to negative tab on adjacent cell.

☐ 138. Dress wires so that the two single-ended wires fit through hole in battery case, and long jumper wire tucks away along inside of case.

☐ 139. Install case cover, place battery assembly inside transmitter case front, and attach battery assembly with two no. 4-40 x 1-1/8" machine screws through case front. Tighten hex nuts securely.

Transmitter Case and Parts

Package No. 7 Parts List

QTY	ITEM	PRICE (ea)
1	E530-T Tx Case	$ 8.00
1	Antenna, 54" lg	2.95
1	Frequency Flag	.25
1	Assembly Instructions	1.50

TRANSMITTER MECHANICAL ASSEMBLY

Check contents of packages 8 and 9, as applicable to your model, against following parts lists.

Mechanical Components

Package No. 8 Parts List

QTY	ITEM	PRICE (ea)
1	Antenna fitting (2 parts)	$1.25
1	AC socket	.35
1	Rx socket, 6 pins	.80
1	1000 ohm, 10W resistor	.35
1	Meter (1 ma) and mtg. clip	3.50
1	Lamp socket, screw type	.35
1	#40 lamp	.25
1	Red indicator lens	.25
1	DPST switch	.50
1	Switch, lock	.25
8	Rubber mounting feet	.10
1	Cannon label	.25
4	No. 4 x 1/4" S.M. screws	.05
7	4-40 x 5/16" screws	.05
1	4-40 x 1/2" screw	.05
1	4-40 x 1-1/8" screw	.05
6	#4 internal tooth lockwasher	.05
9	No. 4-40 hex nut	.05
1	Brass spacer, 1/8 x 1/4" lg	.10
1	Plastic tie, 3" lg	.10

Package No. 9 Parts List (Single-Stick, 3-Channel)

QTY	ITEM	PRICE (ea)
1	5K potentiometer (includes nut and washer)	$1.50
1	Pot bracket	.60
1	Control arm	.50
1	1/4" rubber grommet	.05
2	No. 4 x 1/4" S.M. screws	.05

Figure 21. Interior View, 3-Channel Mechanics

Figure 22. Interior View, 4-Channel Mechanics

☐ 140. Install the 8 rubber feet in 1/4" holes in bottom and back of transmitter case.
☐ 141. Check fit of meter into meter slot in transmitter case front. If necessary, file slot for correct fit.
☐ 142. Install meter, with spring clip on back side as shown in figure 24. Press serrated flanges down with a screwdriver until meter is locked in.
☐ 143. Very carefully bend solder tabs on meter parallel with meter face. (See figure 23.)
☐ 144. Position ON-OFF switch in Tx case, solder lugs up. Secure with two No. 4-40 x 5/16" machine screws through front of case. Note that upper screw also holds switch lock in place. (Figure 25)
☐ 145. Screw No. 40 lamp securely into charging lamp socket. (Figure 26). Secure bulb to socket with a dab of fingernail polish or RTV.

Figure 23. Interior View, Single-Stick Mechanics

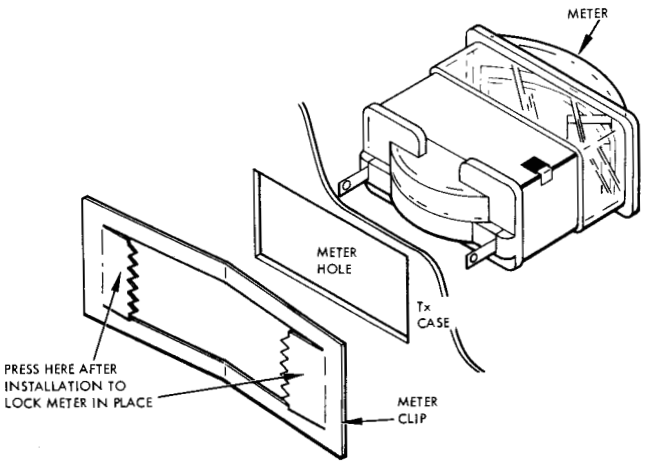


Figure 24. Meter Installation

☐ 146. Using pliers, bend charging socket bracket at such an angle that, when socket is correctly positioned over mounting hole in Tx base, end of lamp aligns perfectly with viewing hole in front of case.
☐ 147. Attach socket to case with No. 4-40 x 5/16" screw, lockwasher and hex nut. Make certain bulb is correctly aligned with hole. Snap red indicator lens into front side of viewing hole.
☐ 148. Install RH stick assembly in all models, selected in standard four-channel model for Mode I or Mode II operation as desired. Stick fits into case from rear, chrome-bezel from the front, and four No. 2-56 x 1/4" machine screws (supplied with stick) pass through the rear side of the stick and into the tapped bosses on bezel.

NOTE

On single-stick model, the rudder knob assembly and wires must be removed from stick

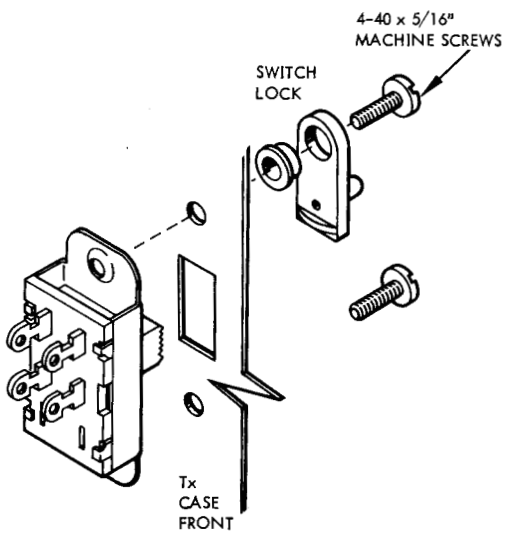


Figure 25. Switch Installation

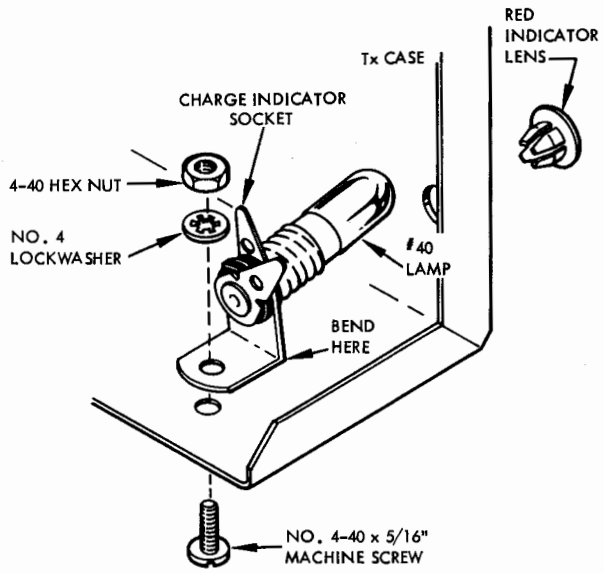


Figure 26. Charge Indicator Lamp Installation

to permit installation. After stick is mounted in case and bezel secured, slide rudder pot wires through hollow stick shaft until rudder knob set screws align with screw recesses in shaft. Tighten setscrew with 3/32" Allen wrench. Do not overtighten or plastic threads will strip.

☐ 149. Install LH stick in four-channel Tx. For Mode II operation, this should have ratchet action on the vertical control (motor).
☐ 150. On three-channel and single-stick models, a third channel assembly is required. (Figures 21 and 23) Assemble 5K pot to bracket with lockwasher and nut. Be sure pot is mounted to bracket in the same relative position shown. Steps 151 through 153 apply to installation of this control.
☐ 151. Using a sharp razor blade, slice the 1/4" rubber grommet to reduce thickness to one-half.
☐ 152. Slide 1/2-grommet over end of pot shaft, then press control arm into place so that friction exists between arm and grommet.
☐ 153. Attach pot and bracket assembly to case front with two No. 4 x 1/4" sheet metal screws.
☐ 154. Check all control sticks, trims and control arms for operation without binds. Realign or adjust as necessary.
☐ 155. Turn Tx switch OFF. Solder one end of 1-3/4" black wire from Group O to outer lug on lamp socket. (Figure 27). Connect other end of wire to upper RH switch terminal. Do not solder.
☐ 156. Strip 1" insulation from end of black teflon wire from battery box. Tin wire, slide it through both upper switch terminals at position Ⓜ, then solder both wires to switch. Cut off excess wire.
☐ 157. Check your transmitter against parts arrangement in figures 21, 22 or 23 for possible errors or omissions.

TRANSMITTER FINAL ASSEMBLY
(See Figures 27 and 28)

☐ 158. Position logic board over transmitter battery. Cut and slide a single 1/8" length of 3/32" diameter shrink tubing over outer end of cable formed by the three Group Ⓐ wires, then slip a 3/32" x 1/4" section of shrink tubing over each wire end. Tin CH. 1 pot terminals, then solder these three wires to pot terminals as shown. Position shrink tubing to cover terminals and hold cable end securely, then shrink into position.
☐ 159. In like manner, connect Group Ⓑ wires to CH. 2 pot.
☐ 160. Similarly, connect Group Ⓒ wires to CH. 3 pot.
☐ 161. Similarly, on 2-stick 4-channel transmitter, connect Group Ⓓ wires to CH. 4 pot. On single-stick unit, solder the three rudder wires coming from the stick shaft to proper holes at position (D). Observe wire color coding carefully. On 3-channel unit, no connections are made here.
☐ 162. Cut 1/2" from end of red wire from battery pack. Strip 1/8" insulation from end. Tin and solder this wire to logic board at position Ⓔ. Clip off excess wire.
☐ 163. Solder black wire from Ⓘ to both switch terminals, position Ⓝ. Clip off excess wire.
☐ 164. Solder wire from Ⓙ to front solder lug on lamp socket.
☐ 165. Recheck solder connections on bottom side of logic board, then position board over mounting screws on rear of battery box. Secure with two No. 4 lockwashers and hex nuts.
☐ 166. Route cable made of wires F, G and H towards top of case as shown in appropriate illustration (31, 32, or 33). Slide 1/8" length of shrink tubing over wires, then solder red, white and black wires to RF board assembly. Clip off excess wire. Shrink the tubing over wires as close to board as possible.
☐ 167. Attach RF board to inside top of transmitter case as shown in figure 29. Tighten hardware securely with screwdriver.

NOTE

A hex nut insert within the upper antenna fitting will hold nut in place while threading fitting on by hand.

☐ 168. Add 1/8" shrink tubing, then solder black and yellow wires from RF board to meter lugs. Use as little heat as possible to avoid melting plastic meter case. Shrink the tubing over wires as close to meter as possible.
☐ 169. Install AC socket on inside bottom of Tx case. Position terminal as shown. Attach with two 4-40 x 5/16" screws, lockwashers and nuts. (Figure 30)
☐ 170. Fasten receiver charging socket to case bottom with two 4-40 x 5/16" screws and nuts.
☐ 171. Mount large 10 watt charging resistor between pin 6 (center pin) of Rx charging socket and closest pin of AC socket. Loop and bend resistor wire leads through these contacts until mechanically secure. Solder in place; cut off extra lead length. When in-

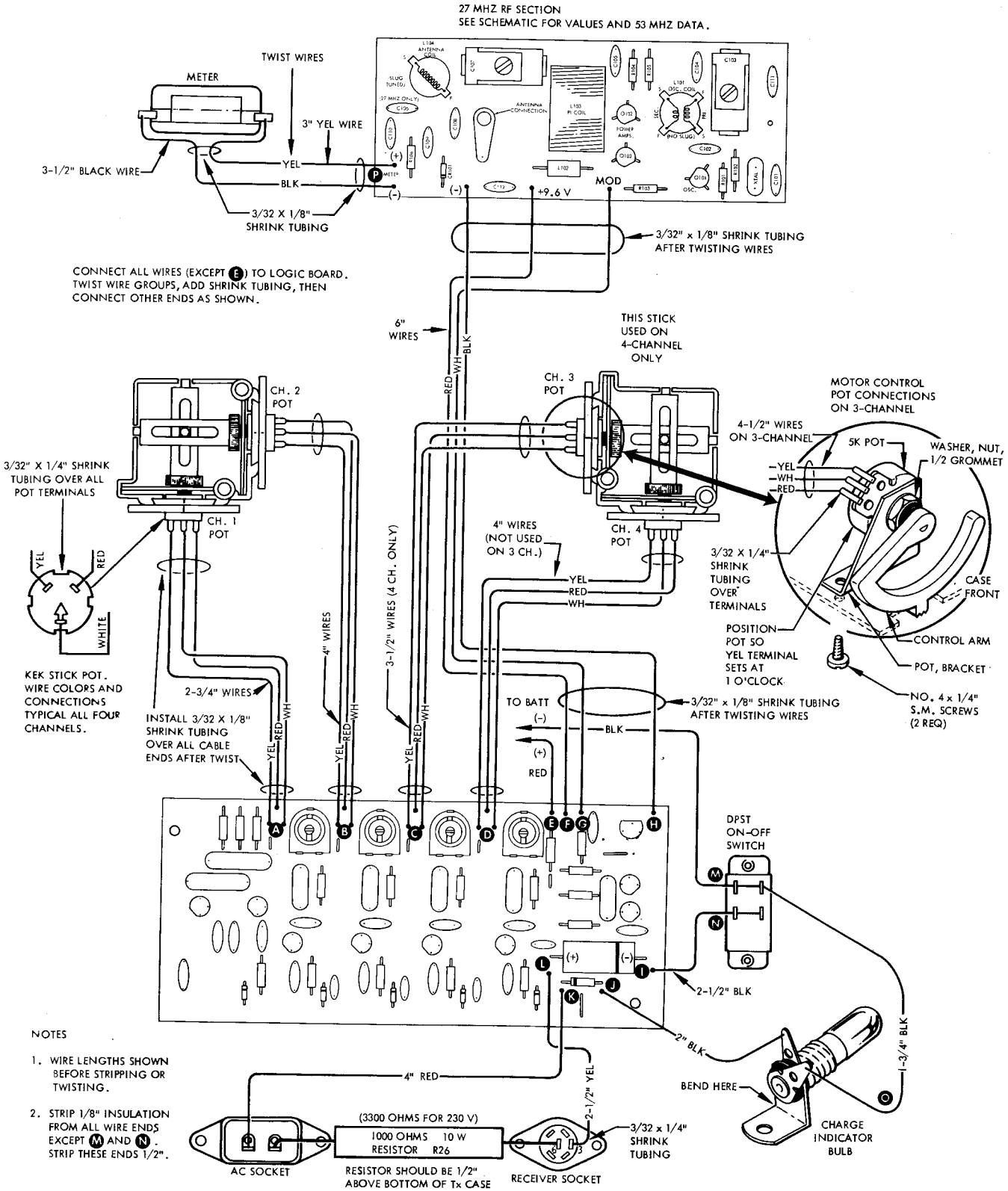


Figure 27. Transmitter Wiring (3 and 4-Channel)

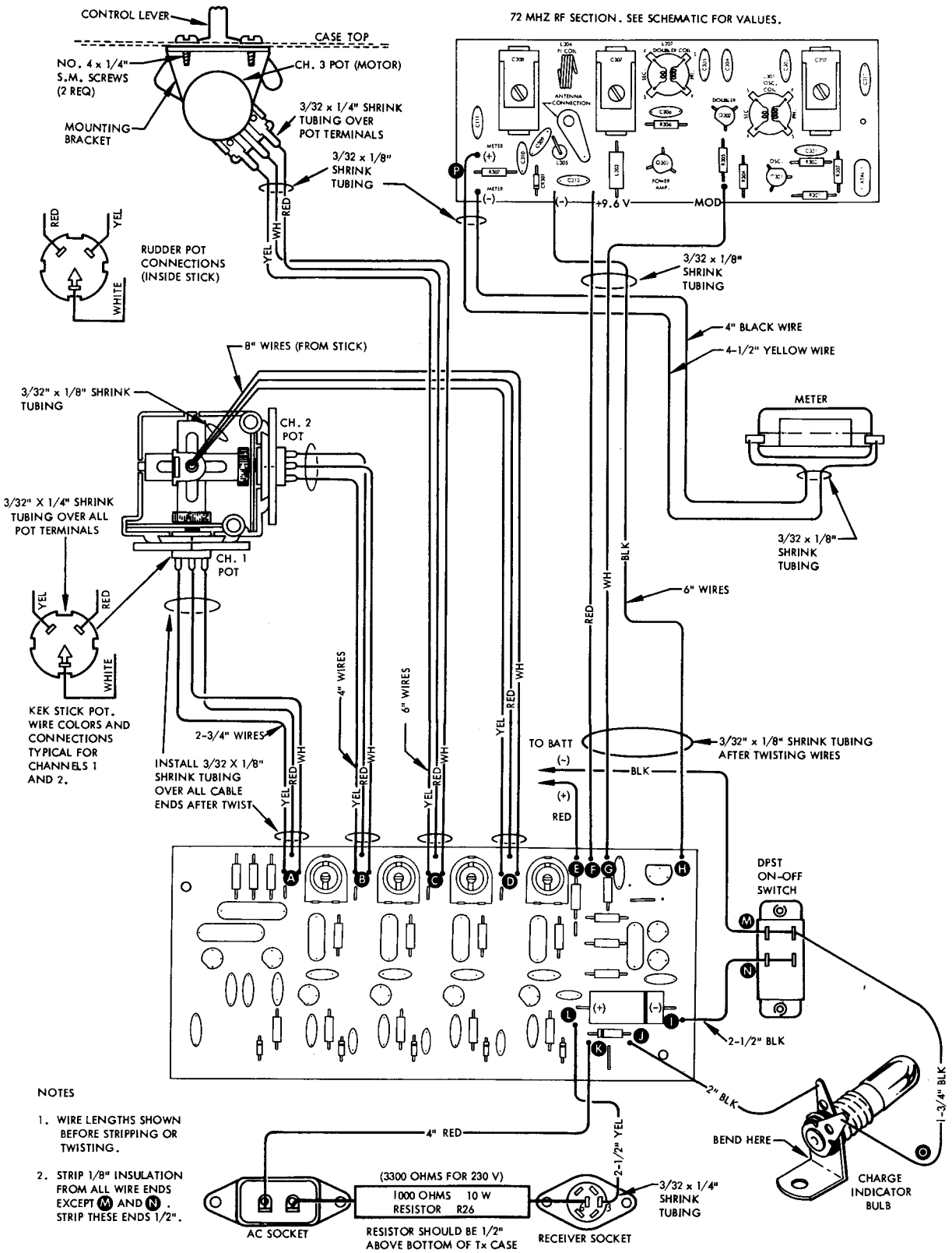


Figure 28. Transmitter Wiring (Single Stick)

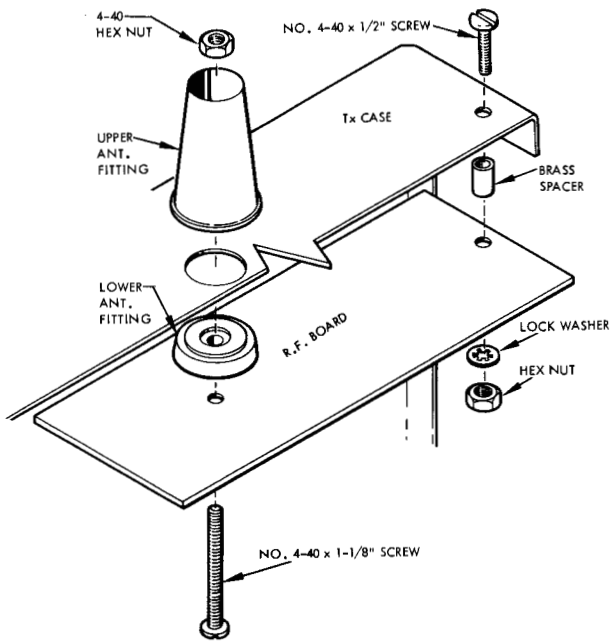


Figure 29. Installation of RF Board

stalled, resistor should be in free air for heat dissipation, approximately 1/2" from back and bottom of Tx case.

☐ 172. Solder 4" red wire from Ⓚ on logic board to end terminal on AC socket.

☐ 173. Solder 2-1/2" yellow wire from Ⓛ on logic board to pin 3 of Rx charge socket. Use shrink tubing over this connection.

☐ 174. Dress wires as shown. We recommend at least one wiring tie point for neatest appearance. Use linen cord or plastic tie for this purpose.

☐ 175. Check your completed transmitter against the appropriate illustration (figure 31, 32, or 33). See that all parts agree with the photo and that all wiring appears correct.

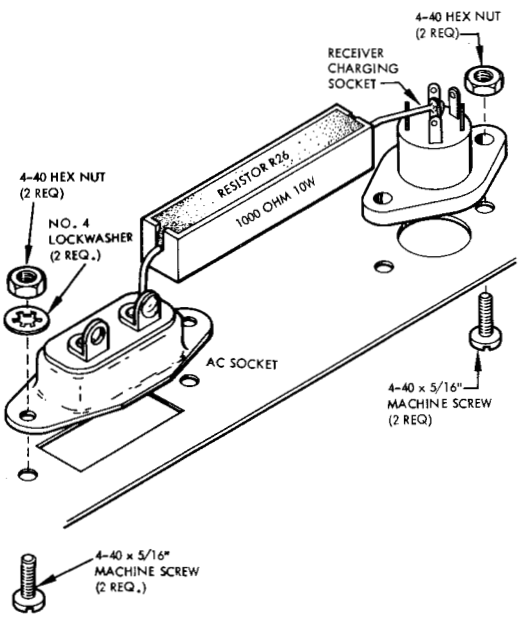


Figure 30. Installation of Charging Resistor

Figure 31. Complete 3-Channel Transmitter (Interior)

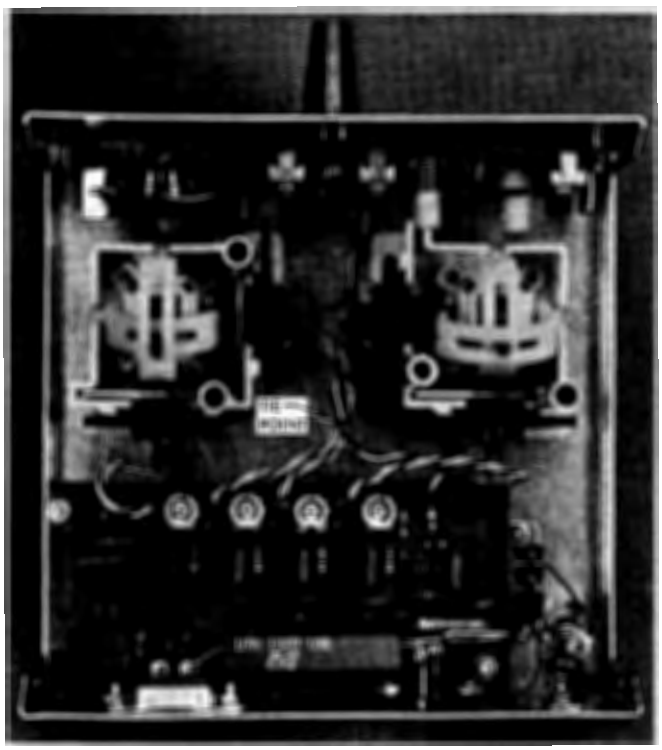


Figure 32. Complete 4-Channel Transmitter (Interior)

TRANSMITTER LOGIC CALIBRATION (Figure 35)

Calibration of transmitter logic is necessary to provide proper output pulse spacing and control stick action for each channel. This calibration basically consists of adjustment of two controls (not control stick positions) within each channel.

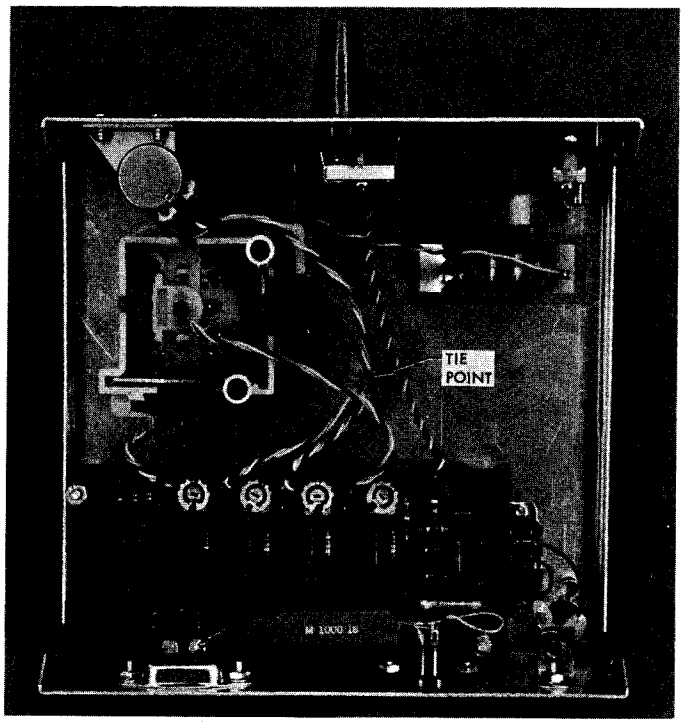


Figure 33. Complete Single-Stick Transmitter (Interior)

A small trim lever on each stick control potentiometer inside the transmitter is used to position that pot to obtain correct total width of the related channel pulse. Total swing width variation of the pulse is set by a variable trim pot on the logic board.

For example, trim lever Ⓐ is set to obtain neutral pulse width of 1.5 milliseconds, and trim pot Ⓑ is adjusted for a variation of exactly .5 millisecond each way when the control stick is moved to its extremes. Lever and pot settings are interrelated, making alternate adjustments necessary until correct settings of both are obtained. Final correct adjustment of each channel will provide output pulses which vary from one to two milliseconds, with 1.5 milliseconds neutral, when control sticks or levers (including trims) are moved to their extremes.

Timing values are arbitrary, and slight variations from these figures are not important provided all channels are similarly calibrated. Otherwise, servos will not interchange between channels without considerable adjustment.

Two calibration methods are given herein: the first, and most accurate, involves use of an oscilloscope with a calibrated time base; the second method requires no test equipment at all but is based upon use of a pre-calibrated servo for adjusting all channels, and permitting servo interchangeability between channels.

Instructions are included for calibration of three-channel, four-channel and single stick (three-axis) models. Unless otherwise indicated, each calibration step applies to all models.

The following pulse width variations should be obtained with the stick movements indicated.

Channel	Function	Command	Pulse Variation
1	Aileron	Right	Wide
2	Elevator	Up	Wide
3	Motor	High throttle	Wide
4	Rudder	Right	Wide

PREPARATION FOR CALIBRATION

☐ 176. Charge transmitter and receiver batteries for 24 hours before use.
☐ 177. Use a multimeter to check battery voltage with Tx ON. It should read approximately 10 volts DC.
☐ 178. Set front transmitter controls, including trims, to neutral. Place trim levers Ⓐ, Ⓒ, Ⓔ and Ⓖ in straight up position, and set trim pots Ⓑ, Ⓓ, Ⓕ and Ⓗ to 12 o'clock positions. (See figures 34, 35 and 36.)
☐ 179. Omit antenna for oscilloscope calibration. Install antenna (down position) if calibrating with servo.

Proceed with transmitter logic calibration, using your choice of either of the following two methods. Basic alignment instructions are primarily for the standard two-stick, four-channel unit. Variations for the 3-channel and single-stick (3-axis) transmitters are specifically noted as they occur. Figures 34, 35 and 36 provide location and identification of all controls used in logic calibration.

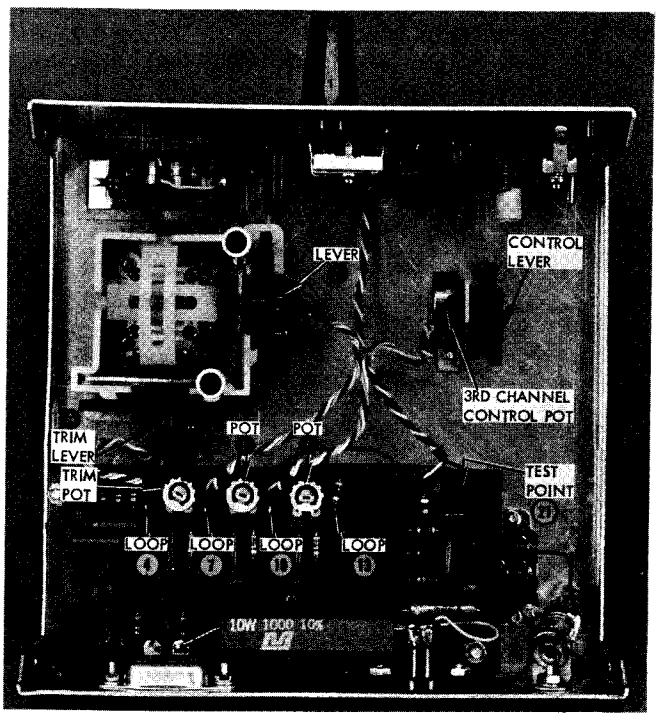


Figure 34. Logic Calibration Points (3-Channel)

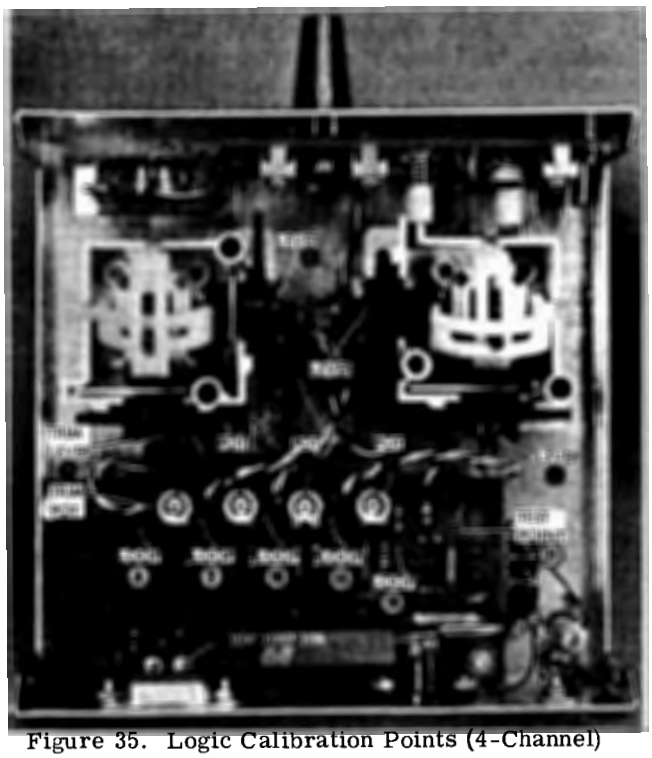


Figure 35. Logic Calibration Points (4-Channel)

Figure 36. Logic Calibration Points (Single-Stick)

LOGIC CALIBRATION USING AN OSCILLOSCOPE

For this operation, an oscilloscope with a calibrated time base is required. It should be capable of accurately measuring units as low as 100 microseconds. Basic calibrations require readings of 1 - 1.5 - 2 milliseconds. If scope accuracy is doubtful, use the calibrated servo procedure for logic alignment.

☐ 180. Turn Tx ON. Connect scope probe between battery minus (on switch) and loop ④ on logic board. Waveform should appear as ④ on schematic diagram, to denote correct operation of multivibrator Q1, Q2.

☐ 181. Connect scope probe to loop ⑦. Set sweep time to 0.5 msec/cm. Adjust scope controls for stable picture. Compare result with waveforms shown on schematic figure 19 and those on figure 37.

☐ 182. Adjustments will now be made to obtain waveform timing shown in figure 37. With Channel 1 (aileron) controls, including front trim, in neutral, pulse width should be 1.5 milliseconds. If not, reposition trim lever Ⓐ by hand slightly left or right until this width is obtained on scope. Make sure front controls remain at neutral.

☐ 183. Move Channel 1 control stick and front trim lever fully to the right and note pulse width reading on scope. We are looking for a wide pulse of exactly two milliseconds.

☐ 184. Move front control stick and trim fully to the left. Observe scope reading. Our objective is a narrow pulse of exactly one millisecond.

☐ 185. If the difference in pulse width between steps 183 and 184 exceeds one millisecond total, rotate trim pot Ⓑ clockwise a few degrees until total swing with full control movement is about one millisecond. Rotate trim pot Ⓑ counterclockwise if pulse width swing is less than one millisecond.

☐ 186. Center Channel 1 front controls, then readjust trim lever Ⓐ for 1.5 millisecond neutral pulse.

☐ 187. Check Channel 1 pulse again with controls in each extreme. Continue adjustment of trim pot Ⓑ until total pulse swing is one millisecond, and trim lever Ⓐ until correct pulse travel of one to two milliseconds is obtained.

☐ 188. Connect scope probe to loop ⑩. In same manner as above, adjust trim lever Ⓒ and trim pot Ⓓ until Channel 2 calibration is obtained.

☐ 189. On 2-stick, four-channel transmitter, similarly align Channel 3 by using loop ⑬, lever Ⓔ and trim pot Ⓕ. Use loop ⑯, lever G and trim pot Ⓗ to calibrate Channel 4.

☐ 190. To adjust Channel 3 control on single-stick and 3-channel transmitters, connect scope probe to loop ⑬. Observe pulse width variation while moving Channel 3 control lever from one extreme to the other. Trim pot Ⓕ is used as before to obtain correct one millisecond pulse swing. To adjust for proper 1 - 1.5 - 2 ms throw, loosen brass nut holding 3rd channel pot, reposition pot slightly in direction desired, then tighten nut.

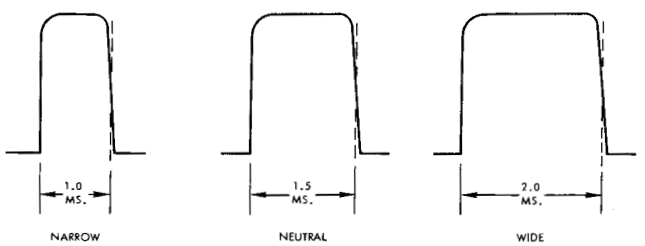


Figure 37. Channel Waveform Adjustments

☐ 191. Recheck Channel 3 controls; continue adjustment of both pots as necessary to obtain full one millisecond swing and 1 to 2 millisecond throw with lever in extremes (no trim on this channel).
☐ 192. To adjust rudder (Channel 4) on single-stick transmitter, follow procedure as outlined for Channel 1, observing waveform at loop (16). Trim pot Ⓗ provides for adjustment of 1 ms pulse swing. Pulse width adjustment is made by using special 1/16" square wrench (described in tool list).
☐ 193. To adjust pulse width, first remove pan head screw holding rudder knob to shaft (see figure 16). Insert 1/16" square end of tool through hole in front of rudder knob until it bottoms in mating hole in contact wiper S-045. Rotate wrench in direction required to obtain correct pulse width as shown on scope.
☐ 194. Continue adjustments between trim pot Ⓗ and 1/16" wrench until the standard 1 - 1.5 - 2 ms throw is obtained with full rudder knob and trim travel. (Trim lever is mounted on rear face of rudder knob.)
☐ 195. Connect scope probe to test point (21) (collector of Q9). Adjust scope controls to show at least one full information frame. Check against waveforms on schematic diagram, figure 19. For a four-channel transmitter, a total of five pulses should be observed at this point, followed by a long timing pulse (four pulses for three channels).
☐ 196. Expand the scope controls and measure the width of one of these individual pulses. It should approximate 300 microseconds at the widest point.
☐ 197. Using the oscilloscope on each channel in turn, recheck accuracy of your calibration. Readjust as required for perfect alignment. When complete, install rudder knob retaining screw and chrome front disc. Completed servos must be centered to each transmitter channel.

LOGIC ALIGNMENT USING CALIBRATED SERVO

Included with your kit is one preassembled and calibrated servo for use in aligning your transmitter. Do not make any adjustments to this servo, or system calibration will be incorrect.

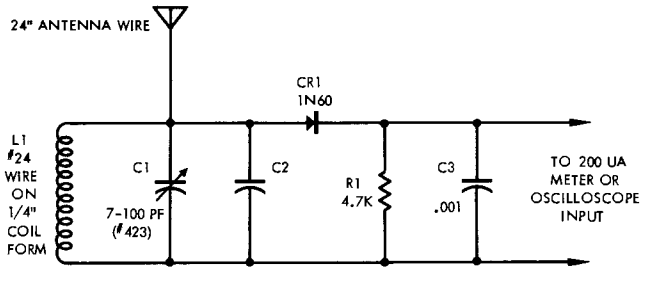
In addition to the assembled servo, an operating receiver and Rx battery pack are needed for this transmitter alignment procedure. Receiver must be on same frequency as transmitter, and operating and aligned sufficiently to provide outputs from all decoder channels.

☐ 198. Perform steps 176 through 179.
☐ 199. Connect receiver to Rx battery. Connect calibrated servo to Channel 1 plug on receiver.
☐ 200. Turn receiver switch ON. Turn transmitter ON. Servo should move to a given position, then stop.
☐ 201. Operate Channel 1 (aileron) control stick on transmitter and verify that servo follows stick movement. If not, a fault must exist in your transmitter, receiver, battery or wiring. Determine and correct source of trouble before continuing with calibration.
☐ 202. If servo responds properly to transmitter commands, hold front aileron trim control and adjust position of trim lever Ⓐ until servo output arms are centered. See figures 34, 35 and 36 for logic calibration adjustment points.
☐ 203. Move aileron control stick and front trim lever fully to the right and then to the left extremes. Note travel distance of servo output arms (or wheel). For correct adjustment, arms on linear servos should move to within 1/16-inch of ends of slots; rotary output wheels should have a maximum travel of ±50 degrees (100 degrees total).
☐ 204. If servo travel is excessive in one or both directions, rotate trim pot Ⓑ clockwise a few degrees. If travel is too little, rotate pot counterclockwise.
☐ 205. Set control stick and front trim to neutral, then readjust trim lever Ⓐ until servo centers.
☐ 206. Again move control stick and front trim to extremes and recheck servo travel. If travel is still incorrect rotate trim pot Ⓑ a little further in the direction indicated above, and reset lever Ⓐ for servo neutral.
☐ 207. Check servo travel once more. If total travel is correct, but servo moves slightly farther one way than the other, adjust trim lever Ⓐ until servo travel each way is equal. Trim neutral should now also be correct.
☐ 208. If necessary, continue with minor adjustments until servo travel and centering are perfect.
☐ 209. With same servo plugged into the proper receiver channel outputs, repeat steps 202 through 208 for the remaining three channels, using the matching trim lever and trim pot for the channel being calibrated. If adjustments are properly made, the servo should work equally well in all channels. This completes the logic calibration of the 2-stick, four-channel transmitter.

NOTE

Three other system servos, when complete, must be centered to match the transmitter.

☐ 210. Channel 3 on both the 3-channel and single-stick transmitters does not have an adjustable trim lever, either front or rear. Correct adjustment of this channel is obtained by loosening the pot mounting nut and rotating the entire pot body slightly until proper servo movement is achieved. Trim pot Ⓕ must be adjusted as described above to provide correct travel.
☐ 211. On the single-stick transmitter, use the 1/16" square metal wrench as a tool to adjust the pot on the rudder channel. Insert the 1/16" end of this wrench through the hole in the center of the rudder knob until fully seated.
☐ 212. Rotate tool to adjust pot wiper until servo centers. Check for total servo travel as before, making adjustments between trim pot Ⓗ and the rudder pot until correct servo action is obtained. Be sure to include travel of the rudder trim lever on back of rudder knob in checking servo operation.



ITEM	27 MHZ	53 MHZ	72 MHZ
L1	7-1/2 TURNS (OPEN WOUND)	7-1/2 TURNS (OPEN WOUND)	2-1/2 TURNS (OPEN WOUND)
C2	56 PF	OMIT	OMIT

Figure 38. Demodulator Circuit Diagram

TRANSMITTER RF ALIGNMENT

GENERAL INFORMATION

The transmitter RF section is factory-assembled and tuned and should normally not require adjustment. However, for those occasions where it may be needed, RF tuning procedures are given below.

NOTE

FCC regulations require that transmitter RF tuning be performed by a licensed first or second class commercial radio operator.

Minimum equipment requirements for RF tuning include a field strength meter covering the frequency band being tuned. For more accurate results, we recommend use of a tuned demodulator circuit as shown in figure 38. When connected to an oscilloscope, output waveforms and RF peak tuning points can be observed visually on the scope.

TUNING 27 AND 53 MHZ RF SECTION (See Figure 40.)

☐ 213. Turn adjusting screws on variable capacitors ① and ② clockwise until seated, then rotate both screws counterclockwise two full turns.

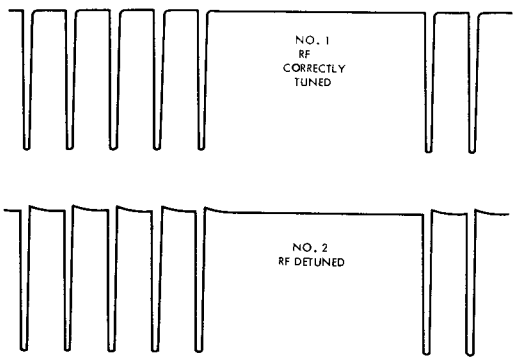


Figure 39. Demodulated RF Output Pattern

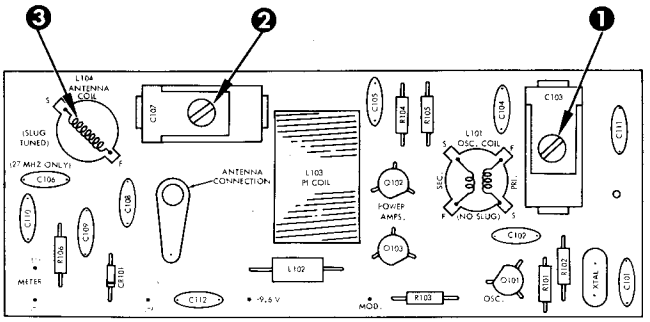


Figure 40. 27 and 53 MHz RF Tuning Points

☐ 214. Using a plastic hexagon tuning wand, set tuning slug on antenna coil ③ flush with outer end of coil.

☐ 215. With antenna fully extended, turn transmitter ON. While observing oscilloscope for wave patterns, turn screw on oscillator capacitor ① clockwise until the oscillator starts. Adjust for peak signal on scope, and turn screw approximately fifteen degrees more clockwise beyond peak to "lock" oscillator in (until power output begins to fall off).

☐ 216. Adjust tuning capacitor ② clockwise until waveform peaks and approximates the output of figure 39.

☐ 217. Alternately adjust tuning slug ③ and capacitor ② until definite peaks are obtained and the observed waveform is similar to the illustration.

☐ 218. If positive peaks or slopes appear on the top of the waveform, transmitter is not properly tuned. Touch up all adjustments (including oscillator) until waveform shows a clean flat top and bottom. When properly tuned, output meter reading should be approximately full scale.

☐ 219. When tuning is complete, hold transmitter in both hands and press it tightly against the body. Turn switch OFF and ON several times to make certain oscillator starts each time. If not, turn capacitor ① clockwise slightly more to "lock" in oscillator.

☐ 220. Using a frequency meter, check transmitter output to insure correct operating frequency within the .005% tolerance permitted. Transmitter is now tuned.

TUNING 72 MHZ RF SECTION (See Figure 41.)

☐ 221. Turn adjusting screws on variable capacitors ①, ③ and ④ clockwise until seated, then rotate all three screws counterclockwise two full turns.

☐ 222. Using a plastic hexagon tuning wand, set tuning slug on doubler coil ② flush with outer end of coil. Then rotate coil slug clockwise six full turns until slug is positioned approximately 1/4-inch down inside coil form.

☐ 223. With antenna fully extended, turn transmitter ON. While observing oscilloscope for wave patterns, turn screw on oscillator capacitor ① clockwise until the oscillator starts. Adjust for peak signal on scope, then rotate capacitor screw approximately five degrees more clockwise beyond peak to "lock" oscillator in (until power output begins to fall off).

☐ 224. Alternately adjust capacitors ③ and ④ very carefully for peak output. Adjust slug ② for

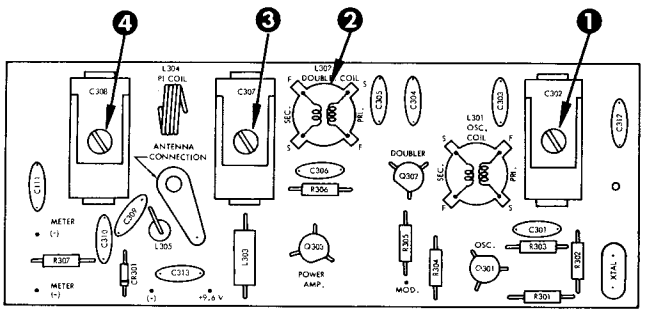


Figure 41. 72 MHz RF Tuning Points

peak, then readjust capacitors ③ and ④ until definite peaks are obtained and the observed waveform is similar to the illustration.

☐ 225. If positive peaks or slopes appear on the top of the waveform, transmitter is not properly tuned. Touch up coil ② and capacitors ③ and ④ until waveform shows a clean, flat top.

☐ 226. When properly adjusted, tuning peaks for all controls should be very definite and waveform should be clean. Maximum transmitter output meter reading (approximately full-scale) should coincide with optimum scope picture.

☐ 227. When tuning is complete, hold transmitter in both hands and press it tightly against the body. Turn switch OFF and ON several times to make certain oscillator starts each time. If not, turn oscillator capacitor ① clockwise slightly more.

☐ 228. Using a frequency meter, check transmitter output to insure correct operating frequency within the .005% tolerance permitted. Transmitter is now tuned.

FINAL STEPS OF ASSEMBLY

☐ 229. Peel backing from CANNON label and apply self-adhesive sticker to lower right front of transmitter case.

☐ 230. On 72 MHz model, apply type acceptance sticker to rear side of case.

☐ 231. Slide case back into position and attach to case front with four No. 4 x 1/4" sheet metal screws. Transmitter is now complete.

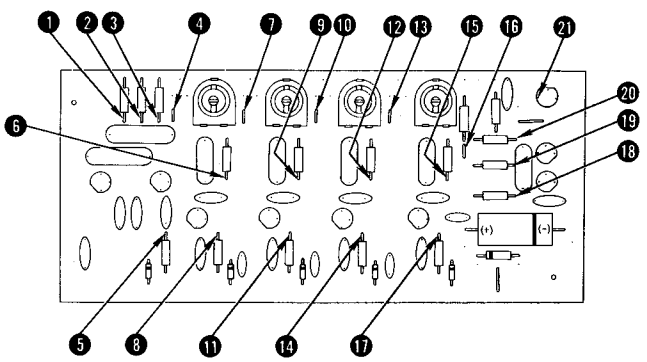


Figure 42. Transmitter Test and Calibration Points

MAINTENANCE AND ADJUSTMENT

GENERAL MAINTENANCE TIPS

a. Should transmitter case become dirty, clean exterior with mild soap and water.

b. After a period of use, control sticks may become "sticky". If mechanically tight, loosen and adjust as required. If dirty, use silicone cleaner lubricant on ball joint to loosen it.

c. Trim pots on logic board may be erratic when adjusting. If so, clean with silicon cleaner and lubricant.

d. After a period of time, vibration and use may cause minor changes in transmitter calibration and alignment. We recommend that logic calibration and RF alignment be rechecked every 6 months of use.

e. Keep an eye on battery condition. Occasionally check battery voltage after charge. If low, open battery box and check each individual cell. Replace those defective.

f. After a period of use, it is possible for the stick pot wipers, especially on rudder, to lose their tension and fail to make solid contact. In such a case, disassemble stick, clean pot element and wiper, and restore spring tension to wiper contacts. Recalibrate logic.

g. In the event transmitter fails to show a charge indication, check tightness of indicator bulb in socket. Occasionally this bulb may need replacement.

TROUBLESHOOTING AND REPAIR

GENERAL

Following are a number of tips and techniques describing methods of locating circuit faults, isolating troubles, basic repair procedures, etc. A troubleshooting chart is included as an aid in isolating and locating a defect.

SECTIONAL ANALYSIS

a. For service, consider your transmitter logic as being a multivibrator (Q1, Q2) followed by a number of sequentially triggered half-shots (see figure 3). A diode is used to couple each of their outputs to a pulse generator (Q7, Q8) which feeds a modulator circuit. This in turn controls output from the RF section.

b. Test points on figure 41 correspond with those on the schematic diagram, figure 19. By using an

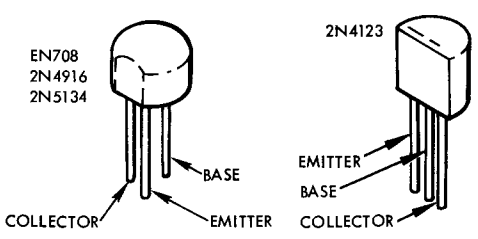


Figure 43. Transistor Identification

TROUBLESHOOTING CHART

TROUBLE	POSSIBLE CAUSE	REMEDY
No RF output	RF oscillator improperly tuned	Tune RF section
	Defective oscillator or output transistor	Locate and replace transistor
	Batteries dead	Charge or replace as necessary
	Broken wires to RF board	Check, repair wires
	Defective modulator transistor Q9	Check, replace transistor
Weak RF output	Batteries low	Check, charge, replace as necessary
	RF not aligned properly	Retune RF
	Weak oscillator or output transistor	Check, replace as necessary
Logic inoperative	Parts installed incorrectly	Check each part carefully
	Short in P.C. board	Inspect carefully, remove shorts
	Q1 or Q2 defective	Check, replace
	Battery voltage low or dead	Check, charge batteries
Some logic channels inoperative	Trim adjustment pot dirty	Clean pot, calibrate
	Half-shot transistor bad	Check, replace transistor
	Short in half-shot P.C. section	Inspect, remove short
	Defective control pot or pot wiring	Check, repair or replace part
	Control pot wiper not making contact	Open pot, increase wiper tension
	Defective coupling diode (CR1 thru CR5)	Replace defective diode
All channels operate, but centering varies	RF logic alignment off	Recalibrate logic
	Loose trim adjustments on stick, causing alignment shift	Tighten trim levers, recalibrate logic
	Batteries weak	Check, replace
Transmitter will not charge	Charge indicator lamp loose or defective	Tighten or replace lamp
	Battery cell(s) defective	Check and replace if necessary

oscilloscope for signal tracing it is very easy to locate a non-operative circuit.

c. When checking your transmitter, a correct waveform appearing at test point ④ will indicate that the multivibrator section is working normally.

d. An incorrect waveform (or absence thereof) at point ⑥ would indicate a possible defect in R4 (the control pot), C7, R6, R7, C8 or a shorted Q3. Similarly, incorrect signals in the base circuits of any of following half-shot transistors can be analyzed in the same manner.

e. Should waveform at ⑥ be normal, but incorrect or missing at ⑦, things to check would be transistor Q3, control R8, capacitor C9 and associated circuit wiring. Likewise, on all following stages, signal correlations of input to output can be used to analyze and locate the defective part.

f. Please note that, because of sequential triggering, should one half-shot become non-operative, all following half-shots will also perform incorrectly. Therefore, in such a case, the basic problem will usually be with the first inoperative stage.

g. As long as the multivibrator and all half-shots are operative, diodes CR1 through CR5 will each couple one pulse to the input of pulse generator Q7, Q8. Absence of one of these pulses is usually indicative of a defective diode or diode coupling capacitor.

h. With correct input to Q7, no signal at ⑳ usually indicates Q7 or Q8 defective. Presence of a pulse at this point appreciably shorter than 300 microseconds would be due to a defective C24 or transistor Q7 or Q8.

i. Absence of positive modulator output (with correct input) indicates a defective Q9 or related transistor in the RF section.

j. Once built and tuned, problems in RF sections are usually limited to transistor replacement or misalignment because of rough treatment. Low RF output can be due to weak or defective oscillator or output transistor.

k. Meter circuit problems are usually limited to a defective meter or meter diode.

l. Major problems are batteries. If trouble is suspected, open battery box and check voltage of each cell with transmitter ON. Replace cells if 1 volt or below. Recharge fully after cell replacement.

CIRCUIT BOARD REPAIR

a. After bent over and soldered in place, parts are difficult to remove without damage to circuit board lands.

b. When a part must be removed, if possible use a solder "sucker" to remove excess solder from joint. Otherwise, heat the joint until solder melts, then "flip" the board to throw solder off.

c. Using diagonal cutters, clip off part leads below board. With application of a small amount of heat, parts should be easily taken out. We recommend use of small size surgical clamps to assist in removing parts.

d. Open holes with soldering iron or small drill (no. 60) before installing new parts.

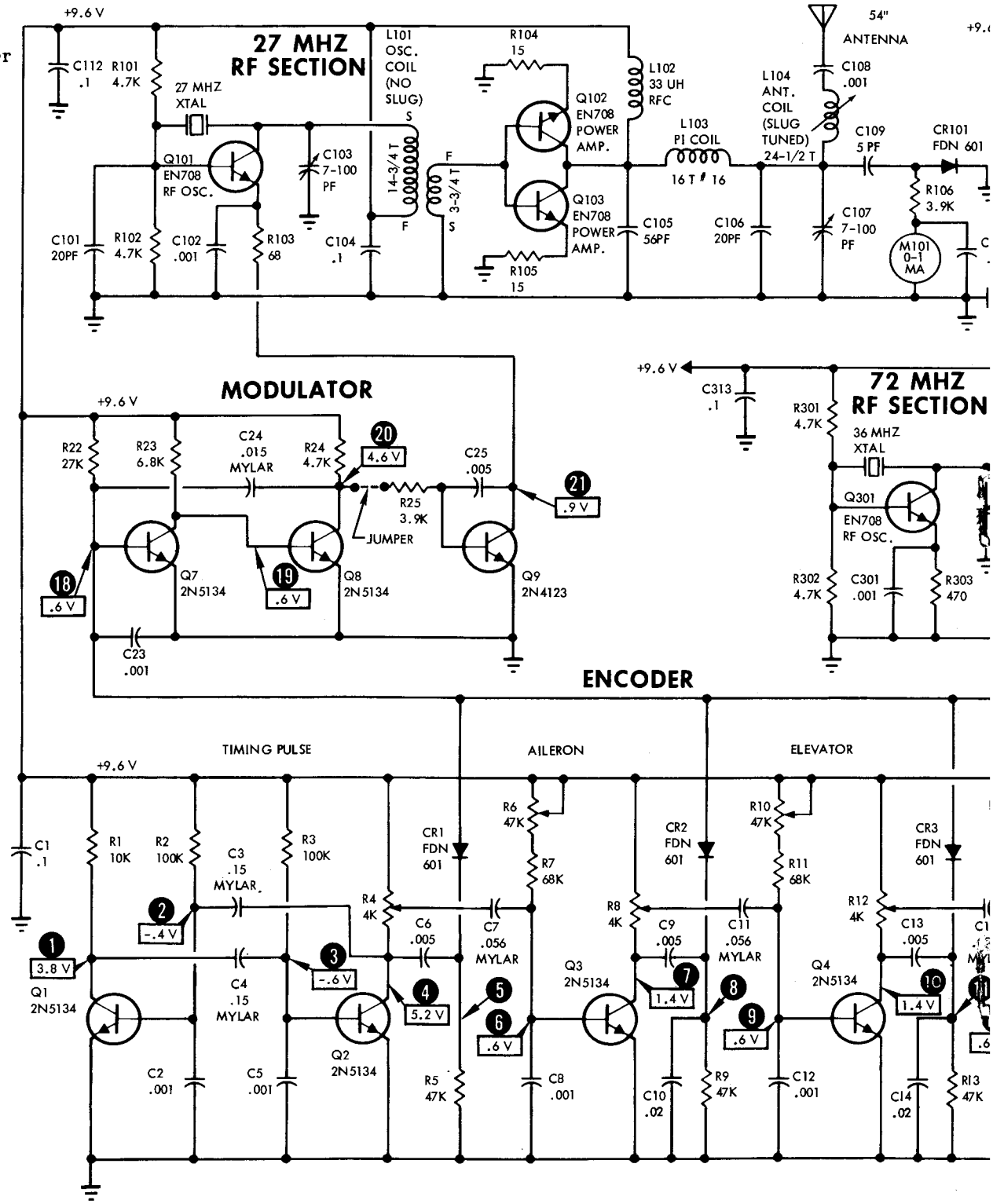
ORDERING INFORMATION

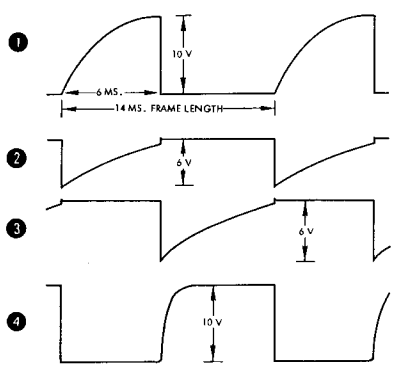
On all transmitter parts orders under $10.00, include .50 for cost of shipping and handling. Minimum order $1.00 (+.50). No C.O.D.'s.

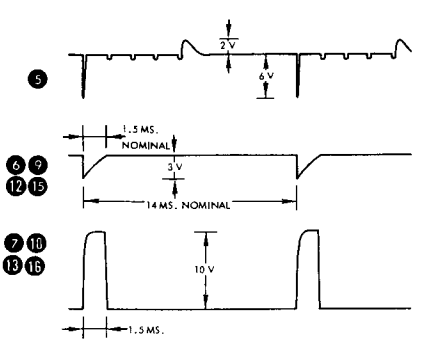
REPAIR SERVICE

In event of trouble send unit direct to the factory, NOT to the dealer. Repairs are not priced for dealer discounts. Equipment will be serviced and returned within a few days. Be sure and include detailed information on the problem. After repair is completed, you will be notified regarding cost and shipping.

KITS ARE WARRANTED ONLY FOR COMPLETENESS OF PARTS. NO PARTS EXCHANGE WILL BE MADE AFTER THE PART HAS BEEN INSTALLED OR SOLDERED ON.







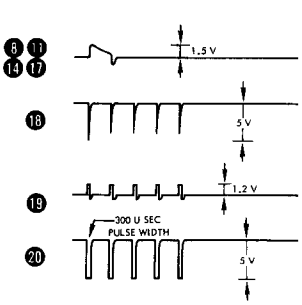
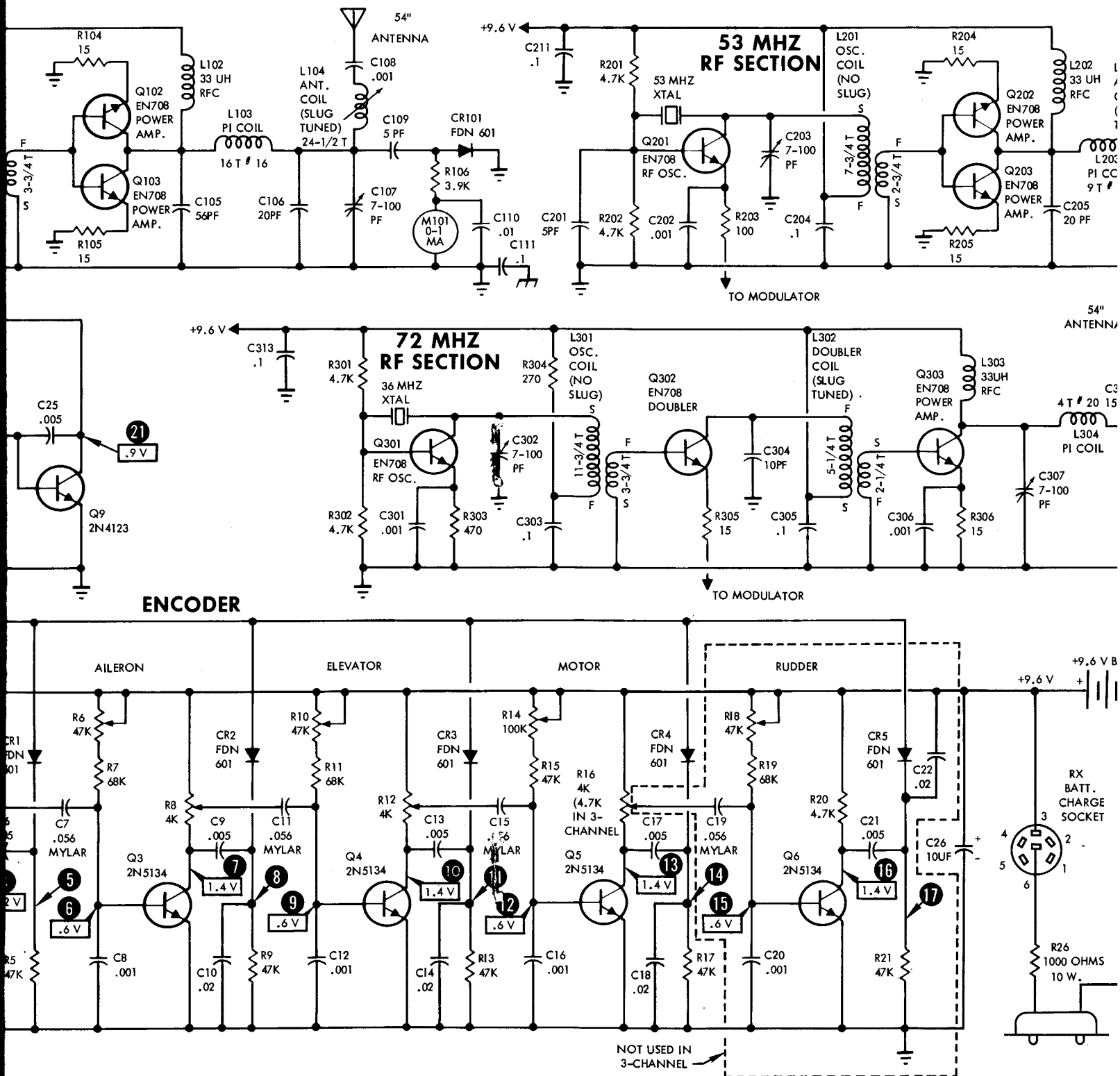
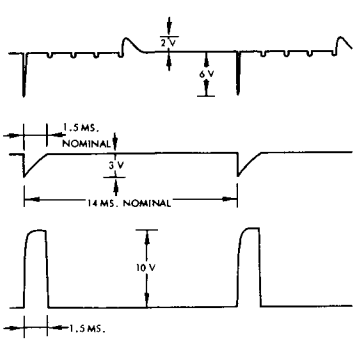
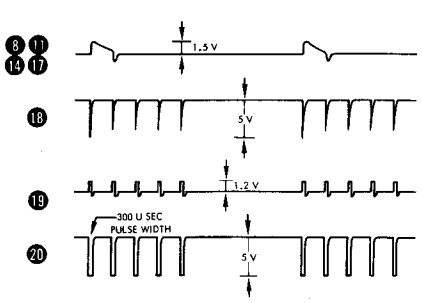


Figure 19. Transmitte







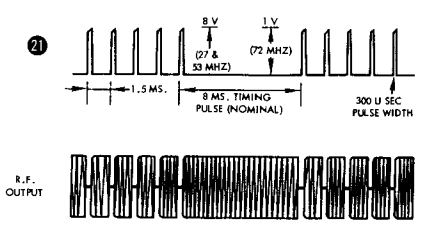
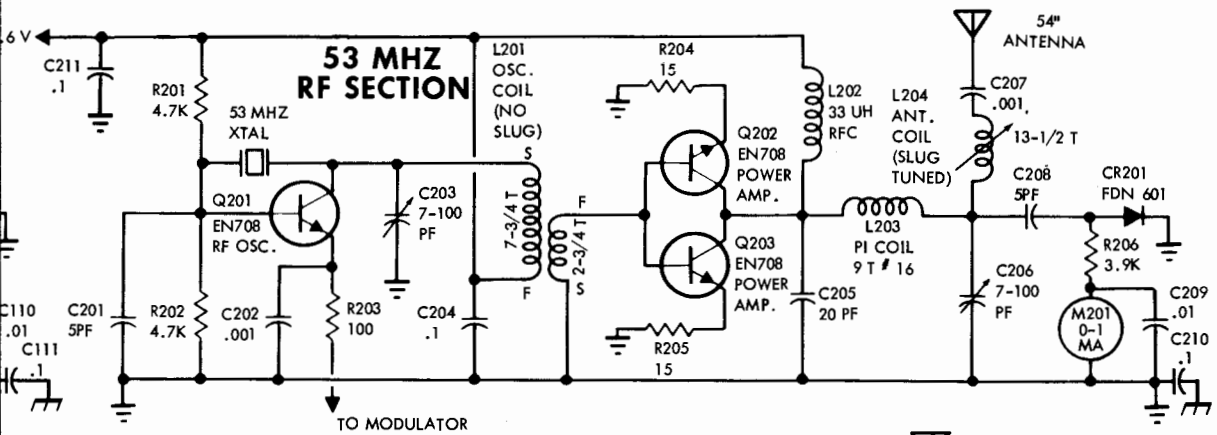
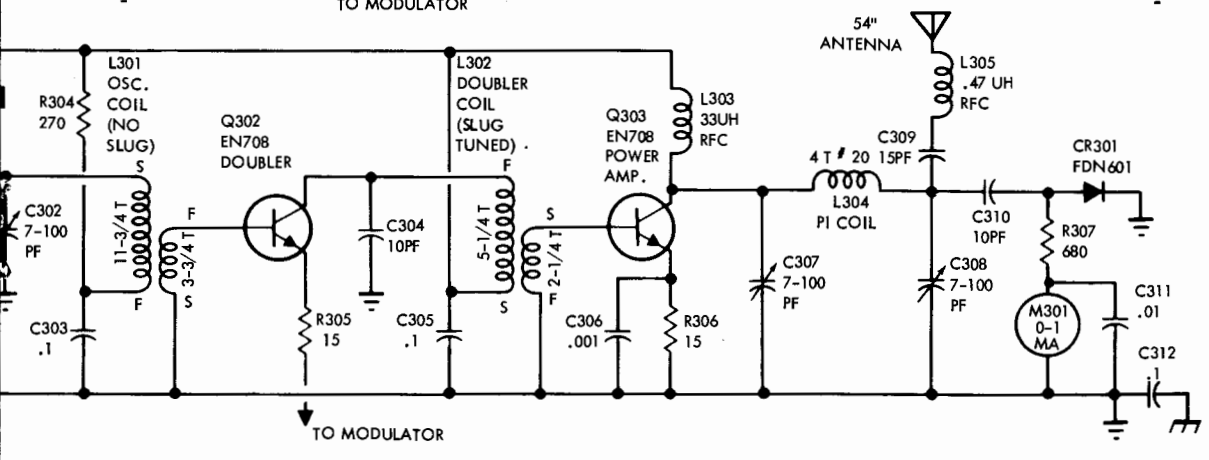


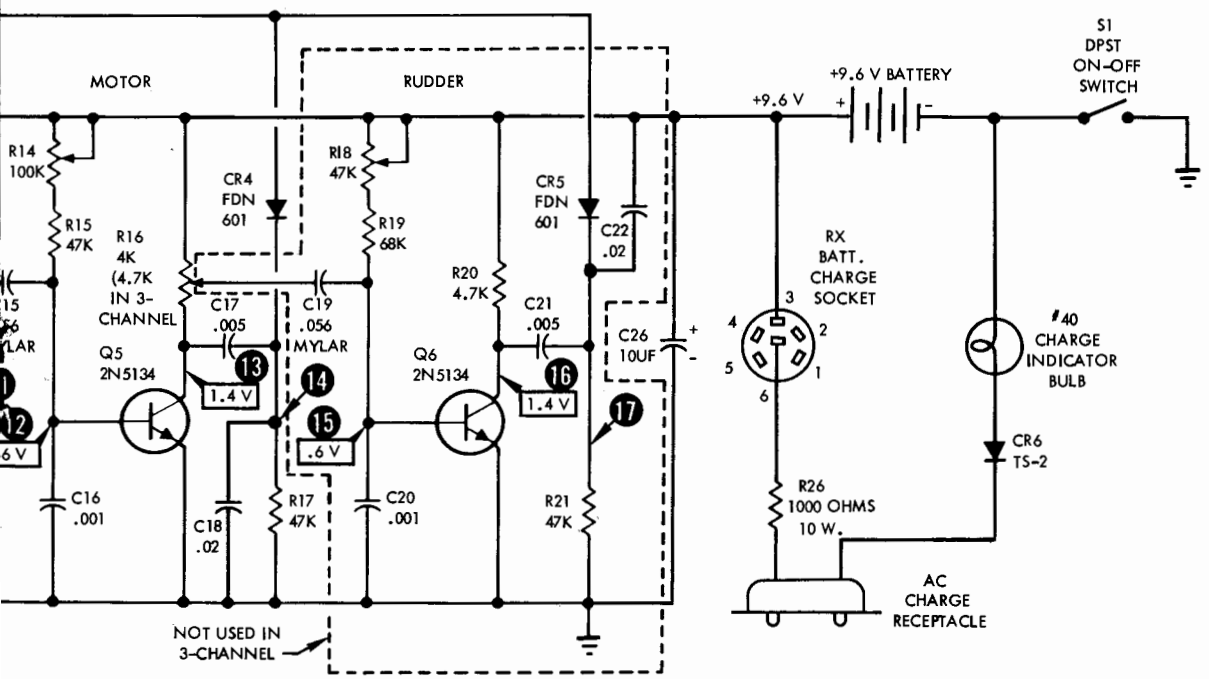
Figure 19. Transmitter Schematic Diagram

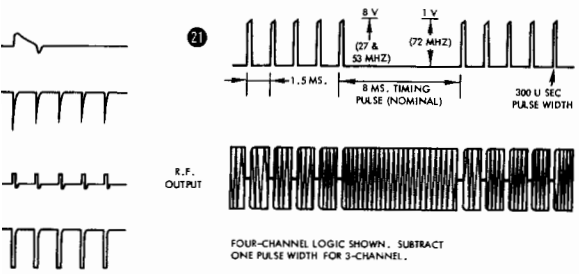
NOTES

1. ALL MEASUREMENTS IN RESPE
2. DC VOLTAGES SHOWN IN BC
3. VOLTAGE READINGS TAKEN MULTIMETER.
4. VOLTAGES MAY VARY ± 20%
5. VOLTAGES AND WAVEFORMS IN NEUTRAL, AND FULL B
6. WAVEFORMS TAKEN WITH TE WITH CALIBRATED AMPLIT
7. CAPACITOR VALUES IN MICR
8. PARTS NOT USED ON 3-CHAN DOTTED BOX.
9. WAVEFORMS TAKEN WITH AN
10. FOUR-CHANNEL LOGIC SHO WILL BE 1.5 MILLISECOND 3-CHANNEL.









er Schematic Diagram

NOTES

1. ALL MEASUREMENTS IN RESPECT TO NEGATIVE (-).
2. DC VOLTAGES SHOWN IN BOXES.
3. VOLTAGE READINGS TAKEN WITH 20K OHMS-PER-VOLT MULTIMETER.
4. VOLTAGES MAY VARY ± 20%.
5. VOLTAGES AND WAVEFORMS TAKEN WITH ALL CONTROLS IN NEUTRAL, AND FULL BATTERY CHARGE.
6. WAVEFORMS TAKEN WITH TEKTRONIX 503 OSCILLOSCOPE WITH CALIBRATED AMPLITUDE AND TIME BASE.
7. CAPACITOR VALUES IN MICROFARADS UNLESS NOTED.
8. PARTS NOT USED ON 3-CHANNEL MODEL SHOWN IN DOTTED BOX.
9. WAVEFORMS TAKEN WITH ANTENNA REMOVED.
10. FOUR-CHANNEL LOGIC SHOWN. FRAME LENGTH WILL BE 1.5 MILLISECONDS SHORTER FOR THE 3-CHANNEL.