

CLASSIC

() Mount the control sticks making minor adjustments for proper fit. The Micro stick is mounted with the screws provided as shown on the stick assembly drawing. Do not tighten the mounting screws permanently — just snug them up. The Bonner stick is mounted with two #4 sheet metal screws at the top inside and bottom outside holes. The top outside and bottom inside holes use

4-40 screws. These screws are also used to mount the PC board support posts. The holes in the stick assembly will have to be enlarged with a #33 drill to pass the 4-40 screws.

() Install the antenna mount. The solder lug may be soldered to the 4-40 x 9/16" mounting bolt for best reliability. If this is done let the bolt cool before inserting it into the plastic washer. A

small amount of Plio-bond cement can be used around the mounting hole if desired. Use the internal star lock washer under the mounting nut. A spintite wrench will be handy here for tightening. Align the solder lug so it points to the right side of the inside of the case and tighten the mounting nut securely.

- () Insert the meter through the front of the case and secure with the slide-on holder (see photo).
- () Mount the female battery charger jack, to the inside of the case, with 4-40 hardware provided. Use the lockwashers under the nuts.
- () Mount the four rubber feet with the #4 sheet metal screws provided.

Final Assembly of Transmitter and Encoder Alignment is Covered in the Following Steps: (Refer to photos and wiring drawings)

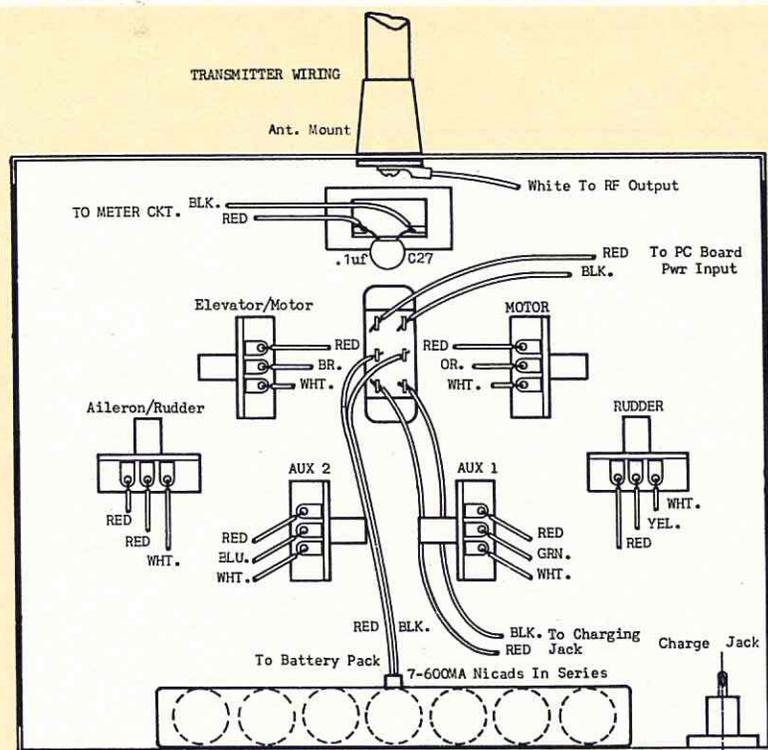
() Wire the battery pack. The battery pack consists of 7 each 600 MAH nickel cadmium cells wired in series. Two P&D 4-cell holders were used for the prototype with three cells used in one holder and four in the other. Two alternatives would be to use a commercially prepared pack or tape 7 cells side by side using thin cardboard on all sides to prevent electrical contact with the case. Plio-bond cement or servo mounting tape is used to hold the battery pack in place. Red & black 6" #20 hook-up wire is used for the leads.

() Wire the positive and negative battery pack leads to the center terminal of the switch. The positive (red) wire should go to the left-hand terminal. The switch should be in the down (off) position for the remainder of the steps and care should be used while working around the switch to prevent "shorting" the battery pack.

() Wire the charging jack to the switch with 7" pieces of red & black hook-up wire. The center terminal of the charging jack should be wired to the lower left switch terminal with red wire. The lower right switch terminal is wired to the other charging jack terminal with black wire. Insure that the wires cannot "short" at the charging jack, by bending the lugs apart or using heat-shrink tubing over the wires.

() Place the transmitter case upright and with the interior facing you. Place the PC board copper side down with the control wires pointing upward toward the transmitter case interior. Maintain 1/2" spacing between the PC board and transmitter case while wiring. **Note:** The wiring diagram shows how the prototypes were wired. If you prefer other combinations of control stick functions feel free to alter the wiring. The center terminal wire color should match the control function as shown under control pot wiring list. For two channels the elevator would become motor control and aileron would become rudder. For three channels elevator would remain elevator, aileron would be rudder and motor would remain motor. Four through six channels would be as shown.

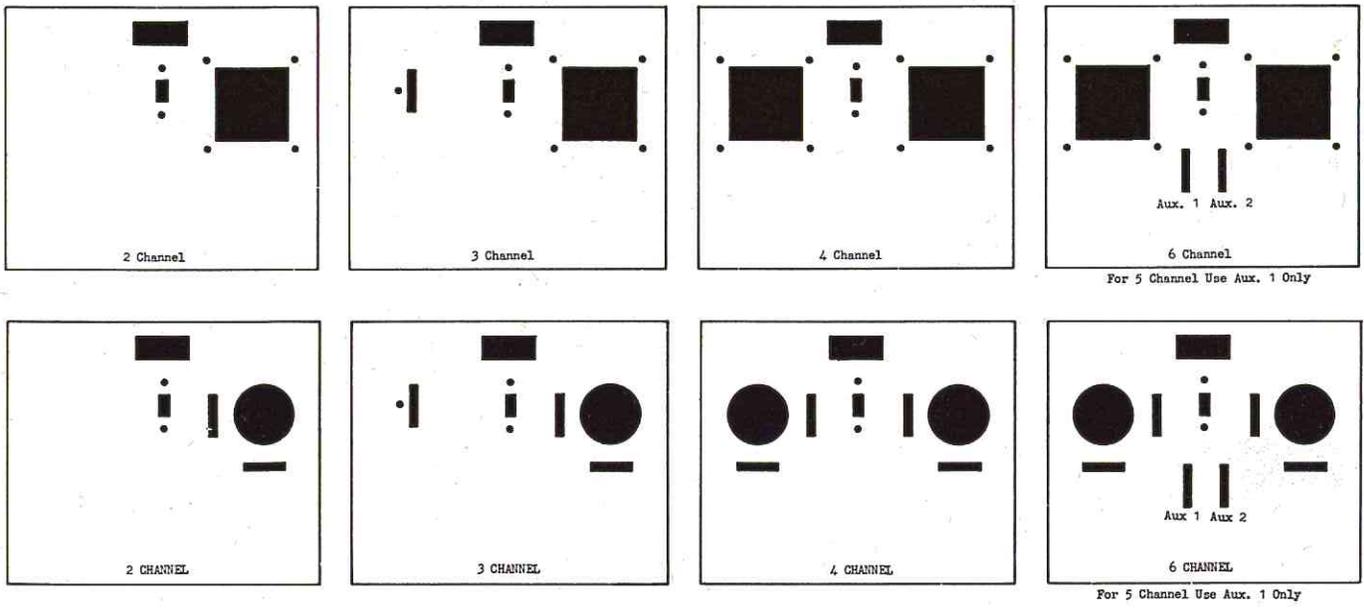
() Bring the control and PC board power wires together as a group and tie into



Pot Outer Terminals: Red wires to Positive P.C. Board Lead. White wire to half shot collectors.

Pot Center Terminals: Elevator/Motor Ch.#1 Brn.	Rudder Ch.#4 Yellow
(Wiper to Half Shot Aileron/Rudder Ch.#2 Red	Aux. 1 Ch.#5 Green
Coupling Capacitor) Motor Ch.#3 Org.	Aux. 2 Ch.#6 Blue

Transmitter Case Rear View With P.C. Board removed



Transmitter case configurations. Top row Bonner, bottom row Micro.

a bundle with 3" piece of insulation stripped from a piece of hook-up wire remnant. All control-pot wiring should be cut to length while wiring, allowing a little slack. Wiring diagram shows Bonner pot lug position, for Micro stick pot lug position, see photo. Mentally rotate the Micro pot lugs to agree with the wiring diagram while wiring. Position auxiliary pot lugs as shown on wiring diagram.

- () Starting with channel 1 cut all control wires to length, strip insulation $\frac{3}{16}$ ", tin and solder to appropriate pot lugs. Channel 2 has two red wires going to the same pot — insure that the red wire going to the center terminal goes to the following stage .047 coupling capacitor. This can be verified by comparing where it is inserted into the PC board in relation to the other center pot terminal wires.
- () Turn the auxiliary pots so that their lugs point downward after wiring (as in photo).
- () Connect red and black power input wires to upper terminal of the switch. Red (positive) wire goes to the left-hand terminal.

Aligning the Transmitter Encoder with a Multimeter:

- () Temporarily solder the test jumper in place between Q7's emitter and ground as shown on the construction overlay.
- () Check, by eye, to insure that all 47K trimmer resistors and control stick trim levers are centered — adjust if necessary.

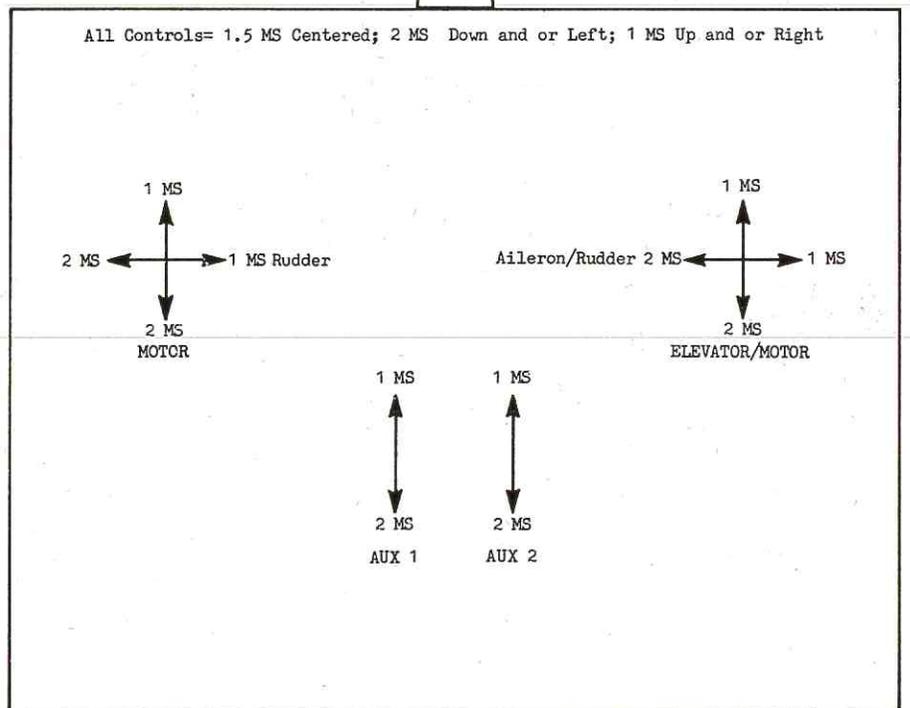
Note: Acceptable alignment of the transmitter encoder, by voltage measurement, requires a 20K ohm/volt multimeter of known good accuracy. It also requires that voltage measurements are within $\pm 1\%$ as read on the meter used for alignment. This measurement tolerance takes into account the overall meter tolerance (should be within $\pm 5\%$) and only means that accurate readings must be taken from the meter scale. All measurements are taken with a 4.7K resistor in series with the red lead at the probe tip. If

Micro sticks are used make sure the back plate, with center cutout, is in place and tightened.

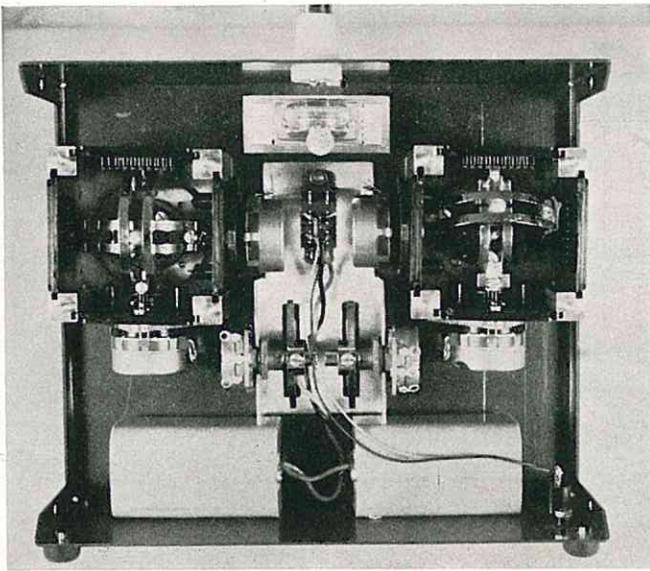
- () Connect the black test meter lead to the ground land of the PC board.
- () Apply power to the transmitter and measure the voltage at one of the outside control pot terminals that has a red wire connected to it.
- () The test meter should read 9.0 volts. If not, and it is low, the batteries must be charged before proceeding. If the voltage is high the battery pack's volt-

age must be reduced. This can be accomplished by discharging the battery pack through a low value resistor (25-100 ohms 2W) or using the battery pack to operate another transmitter, such as a single channel, until the voltage is lowered. A variable voltage power supply or well filtered variable voltage battery charger can be used if available — if either are used it should be checked frequently and corrections made for line voltage variations causing DC voltage changes.

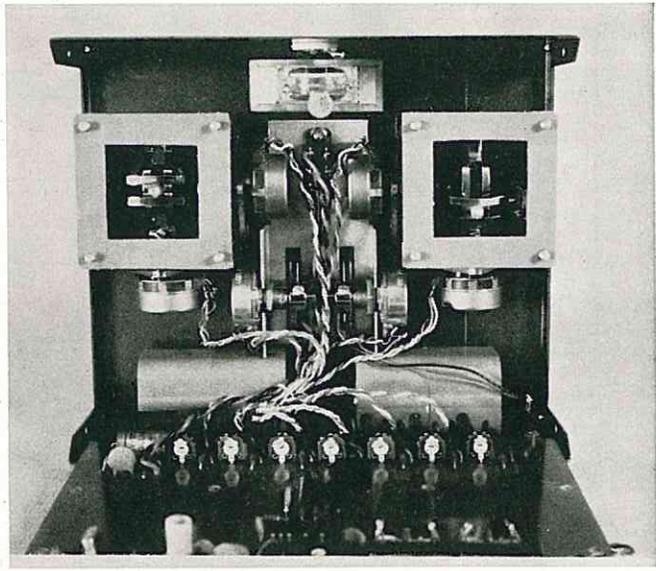
Transmitter Case Front View



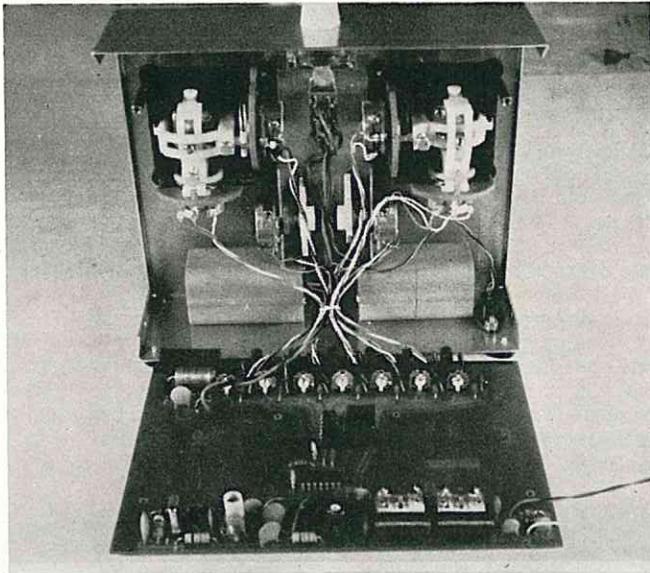
Pulse Width V.S. Stick Movement (As Viewed From Front of Case)



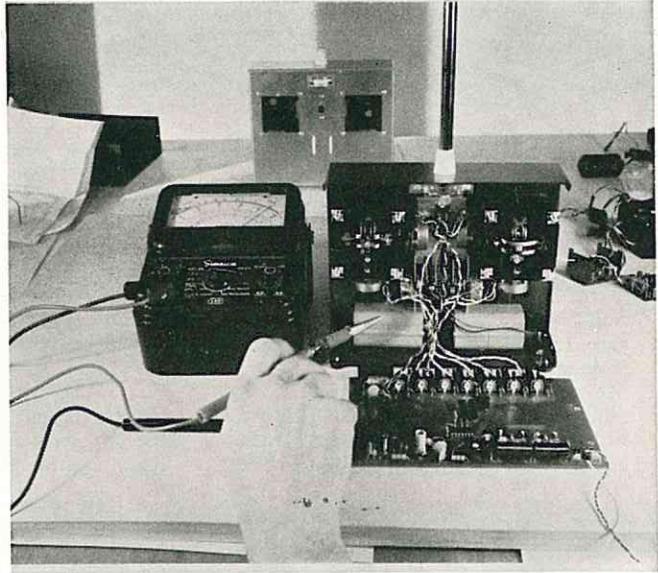
Micro stick version — hardware installed — battery pack and charging jack wired. Note pot lug positions.



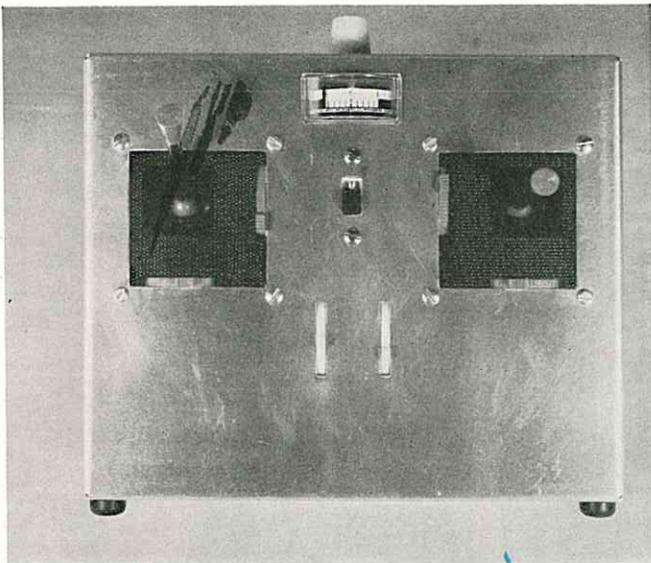
Micro stick version — power and control wires terminated — note cutouts in back plate to allow stick pot alignment.



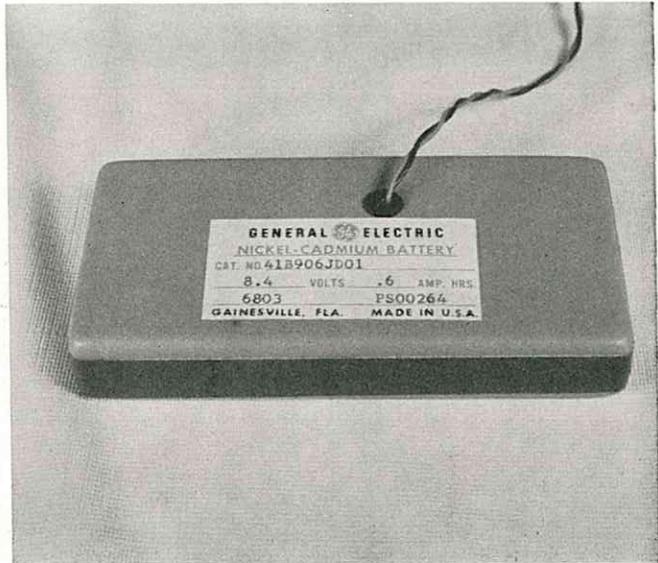
Rear view of Bonner stick version wired.



Just checking — 4.7K resistor in series with probe.



Front view of Bonner stick version.



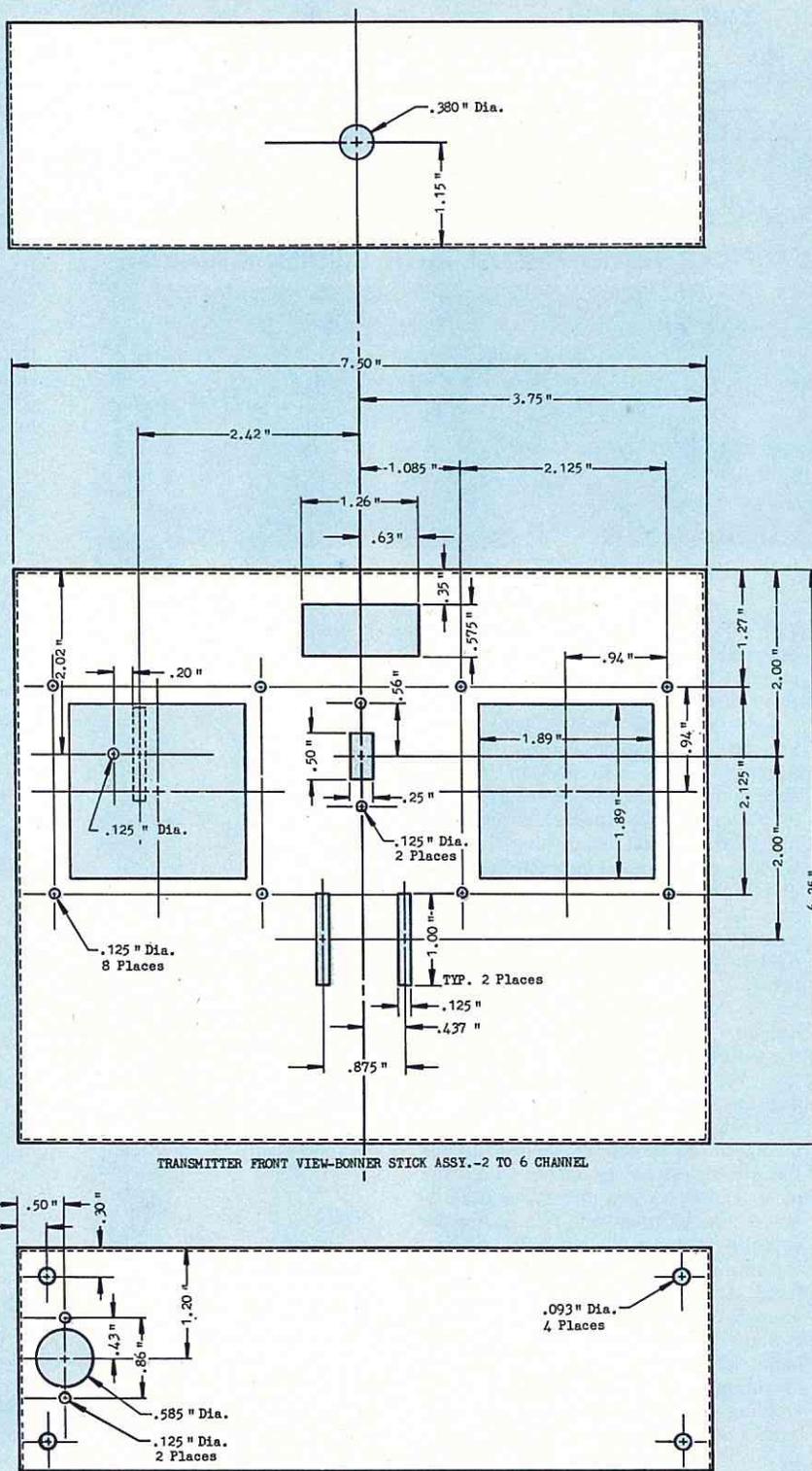
7 cell G.E. battery pack.

the position of the arms. The control arms must be centered visually.

- () Repeat the encoder alignment steps making any corrections necessary before proceeding.
- () Turn the transmitter off and remove the test jumper. **Note:** Alignment of the encoder with an oscilloscope is highly recommended. If an oscilloscope is not available you may skip the oscilloscope alignment steps. The transmitter may be operated as previously aligned by the multimeter, however you will not be taking advantage of the precise nature of the design.

Aligning the Transmitter Encoder with an Oscilloscope:

- () Perform the multimeter alignment steps if you have not already done so. It will not be necessary to be as precise since this is the purpose of aligning with an oscilloscope. The finished alignment will be only as good as your oscilloscope's sweep frequency calibration. Accurate calibration using line voltage as a standard will allow completely acceptable results. Your scope can be calibrated to line voltage by remembering that each alternation at 60 cycles equals 16.66 MS — therefore $\frac{1}{2}$ alternation equals 8.33 MS and three alternations equal approximately 50 MS etc. Our European friends have it a little easier with 50 cycle power since each alternation is equal to 20 MS. If you are in doubt about your own or your scope's ability to do the job right seek qualified assistance. The battery pack should deliver 8.5 to 9.0 volts for alignment.
- () Connect the scope ground lead to PC board ground.
- () Connect the scope probe to pins 8 or 14 of the MC717P I. C. (either of the top outside pins as viewed on the construction overlay).
- () Apply power to the transmitter and adjust the scope to present two or more complete pulse trains. Adjust R2 until the leading pulse of each pulse train is 20 MS apart.
- () Adjust the scope to view the spacing between individual pulses. Starting with pulses #1 and #2 adjust the appropriate control pots (R5) to obtain 1.5 MS between the leading edge of all adjacent pulses in the pulse train with control sticks/trim levers centered.
- () Starting with pulse #2 check the total throw of each channel. If you are using control sticks with electrical trim, i.e., Micro or Kraft, the total throw should include extreme movement of the trim levers. When checking, place the trim lever in its extreme position to match the direction the stick is deflected. With mechanical trim sticks such as Bonner the trim will not affect extreme pulse widths and need not be disturbed from a center setting while checking. You should obtain 1 MS and 2 MS spacing at extreme movements of the controls. If you do not obtain proper throw R6, of the half shot following the pot you are moving, can be adjusted to obtain the correct results as follows:
 - (a) If the throw is wider, center the control stick and adjust R6 of the following $\frac{1}{2}$ shot approximately 5°



TRANSMITTER FRONT VIEW-BONNER STICK ASSY.-2 TO 6 CHANNEL

clockwise (adjusting from the rear) to cause a decreased spacing between the pulse you are checking and the one preceding it. Readjust the control pot (R5) for 1.5 MS spacing and recheck the throw. Continue until the throw is correct.

(b) If the throw is shorter follow the same procedure except adjust R6 c.c.w. for increased spacing between the pulse you are checking and the one preceding it. Readjust the control stick pot at center and recheck the throw.

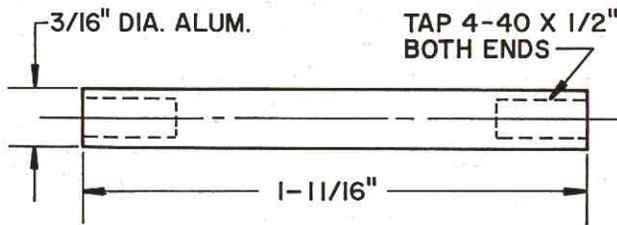
Since the auxiliary and motor control channels are not self centering, adjust

the spacing to 1 MS in the narrow extreme position, and check the throw at the other extreme.

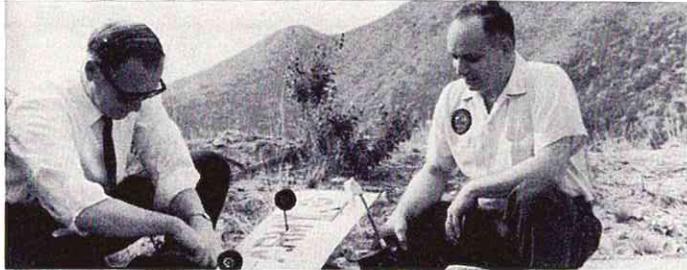
- () Turn the transmitter off and remove all test equipment.

Final Transmitter Wiring/Assembly:

- () Install $1\frac{1}{4}$ " red jumper between positive 9V land and RF section as shown on six channel overlay.
- () Install $\frac{3}{4}$ " blue modulation jumper as shown on six channel overlay.
- () Cut output meter leads to 5" strip $\frac{1}{4}$ " and tin.
- () Cut antenna lead to 5" strip $\frac{1}{4}$ " and tin.
- () Cut the meter lugs to $\frac{1}{4}$ " and reinstall



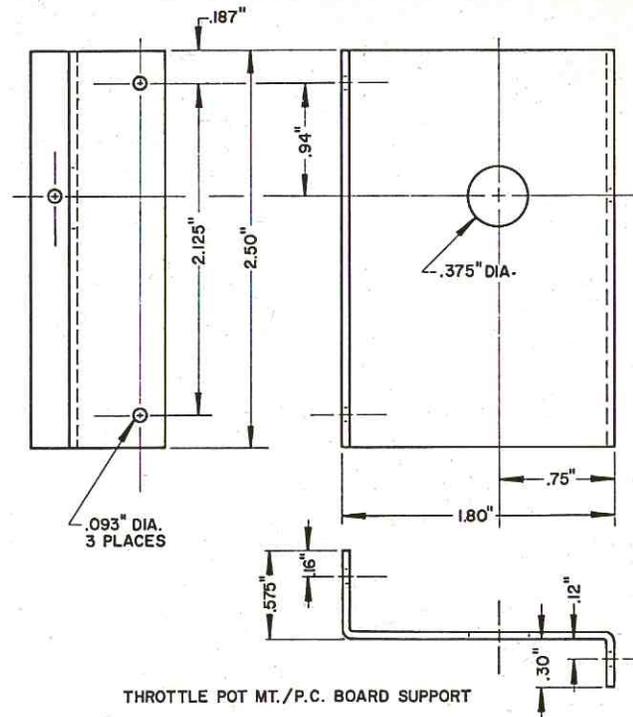
PC SUPPORT POSTS FOR USE WITH BONNER STICKS



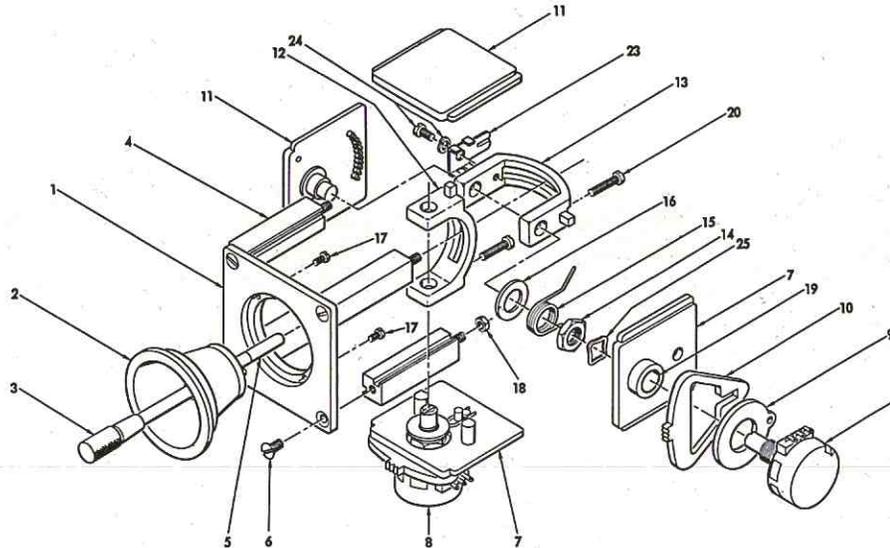
- the .1 mfd cap if necessary.
- () Lift PC board enough to solder black and red meter leads to the meter terminals. The red lead goes to the left hand terminal.
 - () Solder the white antenna lead to the antenna mount soldering lug.
 - () Arrange all wires to prevent interference with controls and secure PC board in place with appropriate hardware. If using Micro sticks insure that the plastic back cover is used between PC board and stick assembly. The Micro sticks may be twisted slightly for PC board mounting hole alignment. After fitting, tighten stick mounting screws permanently.
 - () Insert the antenna in its mount and tighten. Extend the antenna fully. If the antenna bottom has a raised portion, file it off so the bottom is flat.

Tuning the Transmitter:

- () Turn on the transmitter. The output meter can be viewed and adjust the distance between it and the transmitter for at least 1/2 scale meter deflection.
- () Holding the transmitter case with one hand, adjust the slug in L1 for maximum F. S. meter deflection.
- () Holding the transmitter case with one hand, adjust tuning capacitor C22 for maximum F. S. meter deflection.
- () Holding the transmitter case with one hand, adjust loading capacitor C23 c.c.w. 1/8 turn and readjust C22 for maximum F. S. reading. Continue until adjustment of C23 does not allow increased F. S. meter reading when C22 is peaked. Stop at that point — the transmitter is now optimum tuned. When finished the output meter should read in the upper 25% of the scale when held as if you were flying. Remember the meter reading for future reference of battery/output conditions.
- () Slide rear case cover in place. Insert and tighten the #4 sheet metal holding screws. Note: The transmitter is now complete. If you didn't align the encoder by the oscilloscope method make arrangements to do so while waiting for next month's article, for a precise system.



THROTTLE POT MT./P.C. BOARD SUPPORT



**Parts List For
Micro-Avionics Stick Assembly**

REF. NO.	PART NO.	DESCRIPTION OF PART	NO. REQD.
	5000	STICK ASSEMBLY COMPLETE	1
1	5001	BASEPLATE	1
2	5002	MOUNTING CONE	1
3	5003	STICK WITH BEARING	1
4	5004	STAND OFF	4
5	5005	STICK BUSHING, NYLON	1
6	5006	6-32 x 1/4" FHMS	4
7	5007	POT MOUNTING PLATE	2
8	5008	POT, 5K	2
9	5009	TRANSFER FUNCTION RING	2
10	5010	TRIM LEVER	2
11	5011	END PLATE	2
12	5012	GIMBAL - INSIDE	1
13	5013	GIMBAL - OUTSIDE	1
14	5014	POT MOUNTING NUT	2
15	5015	CENTERING SPRING	2
16	5016	WASHER, POT	2
17	5017	MOUNTING SCREW	2
18	5018	6-32 RETAINING NUT	4
19	5019	BUSHING, POT	2
20	5020	4-40 x 1/2" SET SCREW	2
21	5021	AUXILIARY LEVER (NOT SHOWN)	
22	5022	SET SCREW (NOT SHOWN)	
23	5023	ENGINE CONTROL RATCHET	1
24	5024	RATCHET SCREW AND WASHER	1
25	5025	WAVE WASHER	2

FULL SIZE MOUNTING TEMPLATE

