

FIGURE 3-1

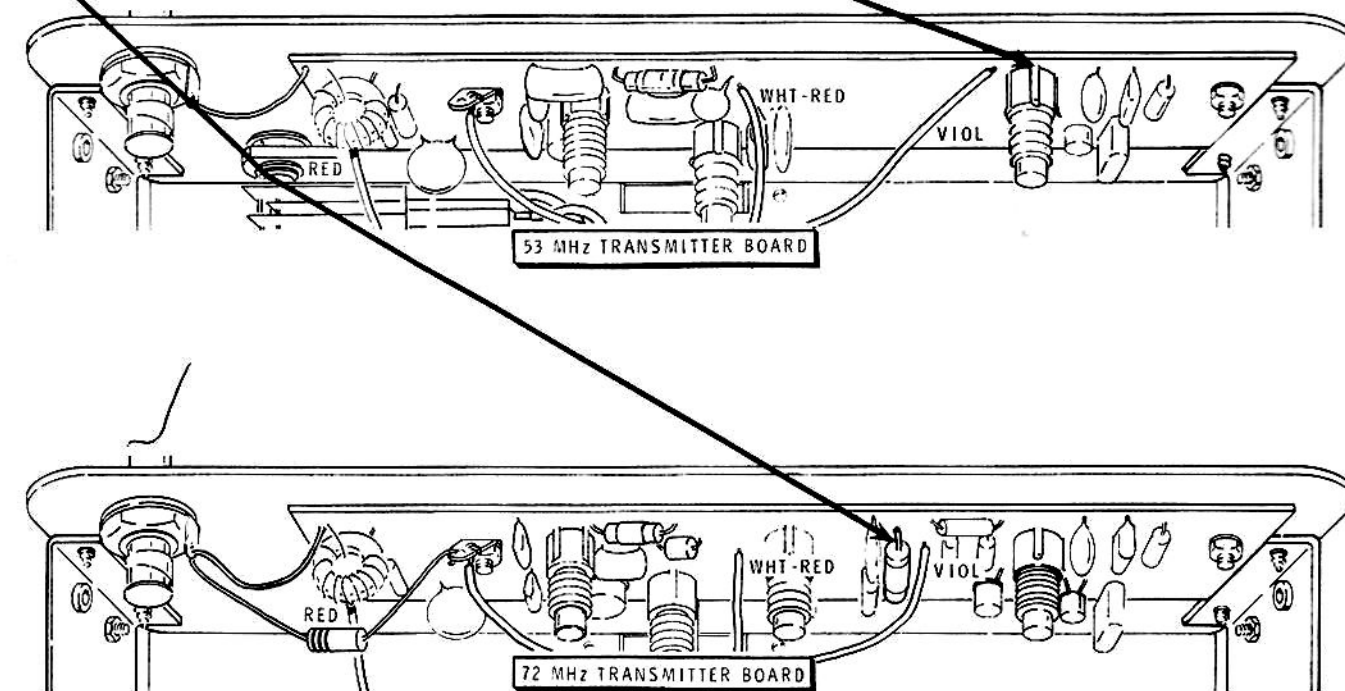
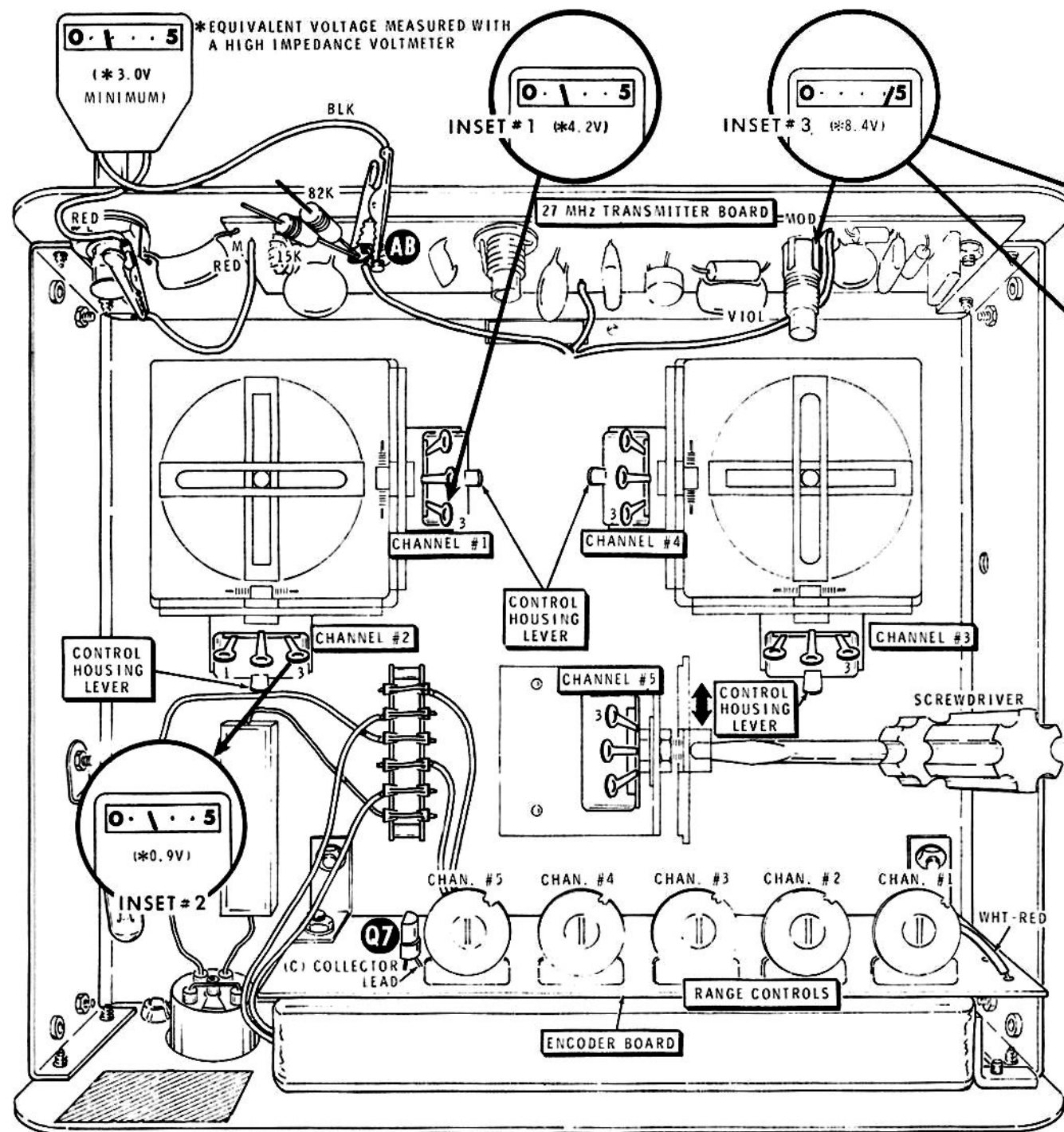


FIGURE 3-2

TEST AND ADJUSTMENTS

NOTE: The meter furnished with the Transmitter is used as an indicating device throughout the Test And Adjustments section of the Manual. If you have a high impedance voltmeter, it can be used in place of the Transmitter meter. Above each of the meter drawings you will find the equivalent voltmeter reading in parentheses.

If you do not obtain the proper results when making a test or an adjustment, turn off the equipment and refer to the chart following the step. These charts list the Condition of the malfunction, and the Possible Cause. Review the items listed in the Possible Cause column

and correct the condition before proceeding to the next step. If a particular part or parts are mentioned (transistor Q2 for example, or resistor R6) as Possible Causes, check these parts to see if they were incorrectly installed, or were wired incorrectly, or to see if the improper part was installed at that location. It is also possible, on rare occasions, for a part to be faulty.

The information in the In Case Of Difficulty section (Page 97) of the Manual may also be helpful in locating trouble in the kit. Refer to the X-Ray Views and Chassis Photo (Pages 119 through 127) for the location of parts.

TRANSMITTER

Refer to Figure 3-1 (fold-out from Page 66) for the following steps.

WARNING: The transmitter circuit board has been prealigned and pretested. Under no conditions should its circuit or adjustments be changed. To do so will void the warranty of the unit, and also cause decreased overall performance. Only persons holding a second class or higher FCC radiotelephone license are qualified to adjust the transmitter circuit board.

() Disconnect the charging cable from the AC line, Transmitter, and Receiver Battery Pack if it is still connected.

() Extend the largest diameter section of the antenna until it hits the stop. Do not extend any of the remaining smaller diameter sections of the antenna.

() Set all Trim Tabs and the Auxiliary control to their center positions.

NOTE: Be sure you do not change the settings of the Auxiliary control and all Trim Tabs unless you are instructed to do so in a step.

TRANSMITTER RF CHECKOUT

Refer to Figure 3-2 (fold-out from Page 66) for the following steps.

NOTE: If a high impedance voltmeter is used to make the following tests, the next two steps may be disregarded. The common test lead of the voltmeter should be connected to solder lug AB for all tests in the Transmitter. The 15 k Ω and 82 k Ω resistors are only required when using the meter furnished with the Transmitter.

- () Cut both leads of the 15 k Ω (brown-green-orange) resistor and the 82 k Ω (gray-red-orange) resistor to 1/2". Save one of these cut off leads for use later.

NOTE: Do not proceed to the steps below until you complete the steps in the right-hand column.

- () Temporarily solder one lead of the 15 k Ω resistor and one lead of the 82 k Ω resistor to solder lug AB (S-2).
- () Clip the black meter lead to solder lug AB and the red meter lead to the end of the red wire coming from hole M on the transmitter circuit board.
- () While observing the meter, turn the ON-OFF switch of the Transmitter to its ON position. The meter should deflect to approximately the second dot or higher.
- () Turn the Transmitter OFF and disconnect the meter leads.

CONDITION	POSSIBLE CAUSE
Low or no meter indication.	<ol style="list-style-type: none"> 1. Weak battery. This should not be the case at this time, since the battery was just charged, unless the charging circuit is not operating properly. See Battery Charging on Page 36. 2. ON-OFF switch wired incorrectly. 3. Meter wired incorrectly. 4. White-red and violet wires incorrectly connected to the transmitter circuit board.

ENCODER CHECKOUT

- () Disconnect the white-red harness wire from the B+ location at the right-hand corner of the encoder circuit board. Be sure this wire does not touch any other leads.
- () Preset the five Range controls (channels 1-5) on the encoder circuit board to the center of their rotation.

- () Connect the black meter wire to the free end of the 82 k Ω (gray-red-orange) resistor at solder lug AB.
- () Clip the red meter wire to lug 3 of Channel #1 Stick Control and turn the Transmitter ON. The meter should deflect to a little less than 1/2 scale. See inset drawing #1 on Figure 3-2.

CONDITION	POSSIBLE CAUSE
Multivibrator not operating properly (improper indication).	<ol style="list-style-type: none"> 1. Transistors Q1 or Q2 and associated components. 2. Diode D1 or D2 faulty or installed backwards.

NOTE: Always turn the Transmitter OFF before changing the meter connection.

In the following tests, clip the red meter wire to the indicated tests, and observe the meter indication. If the meter indication is not correct, you will be instructed to adjust one of the Control Housing Levers. Be sure the Trim Tabs remain in the center position. See Figure 3-3.

- () Move the black meter wire to the free end of the 15 k Ω (brown-green-orange) resistor at solder lug AB. Leave the black meter lead connected to this point until instructed to move it to another point in a step.
- () Now connect the red meter wire to lug 3 of Channel #2 Stick Control. The meter needle should move to the second red dot. See inset drawing #2 on Figure 3-2. If it does not move to this area, adjust the Channel #1 (NOT Channel #2) Control Housing Lever to obtain the proper meter indication.

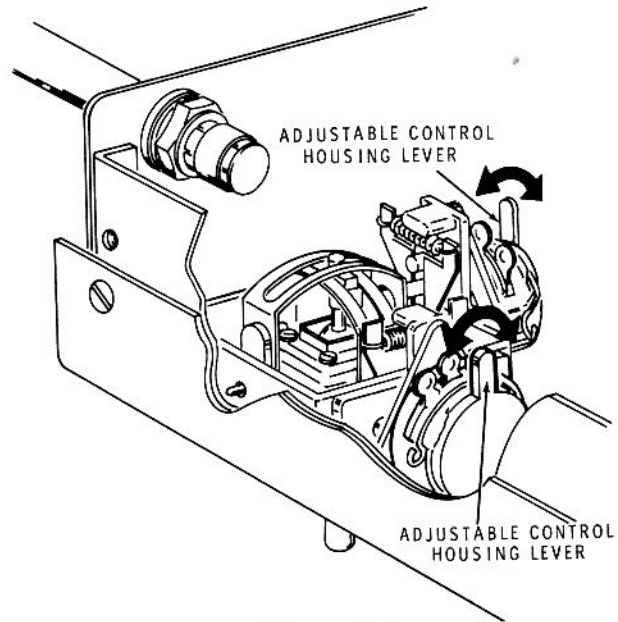


Figure 3-3

CONDITION	POSSIBLE CAUSE
Improper or no meter indication.	<ol style="list-style-type: none"> 1. Transistor Q3. 2. Control R202 or R203. 3. Control R5. 4. Capacitor C6 through C9. Resistor R6 or R7.

- () Move the red meter lead to lug 3 of Channel #3 Stick Control. The meter should deflect the same amount as it did in the last step. If it does not, adjust the Channel #2 Control Housing Lever until the proper meter reading is obtained.

CONDITION	POSSIBLE CAUSE
Improper or no meter indication.	<ol style="list-style-type: none"> 1. Transistor Q4. 2. Control R203 or R204. 3. Control R8. 4. Capacitor C11 through C14. Resistor R9 or R11.

- () Move the red meter wire to lug 3 of Channel #4 Stick Control and note the meter reading. If it is not the same as in the previous two steps, adjust the Channel #3 Control Housing Lever for the proper meter indication.

CONDITION	POSSIBLE CAUSE
Improper or no meter indication.	<ol style="list-style-type: none"> 1. Transistor Q5. 2. Control R204 or R205. 3. Control R12. 4. Capacitor C15 through C18, Resistor R13 and R14.

- () Move the red meter wire to lug 3 of Channel #5 Control. The meter reading should be the same as in the previous three steps. If it is not, adjust the Channel #4 Control Housing Lever for the proper meter indication.

CONDITION	POSSIBLE CAUSE
Improper or no meter indication.	<ol style="list-style-type: none"> 1. Transistor Q6. 2. Control R205 or R206. 3. Control R15. 4. Capacitor C19, C21, C22, and C23, Resistor R16 or R17.

- () Move the red meter wire to the collector (c) lead of transistor Q7 on the encoder circuit board. The meter reading should be the same as in the previous four steps. If it is not, adjust the Auxiliary (Channel #5) Control for the proper meter indication. Then place a

screwdriver into the control shaft slot, hold the shaft stationary with the screwdriver, and move the thumb knob back to its center position by slipping it on the control shaft. These steps may have to be performed more than once to obtain a desirable meter indication.

CONDITION	POSSIBLE CAUSE
Improper or no meter indication.	<ol style="list-style-type: none"> 1. Transistor Q7. 2. Control R206. 3. Control R18. 4. Capacitor C24 through C27, Resistor R19, R21, or R22.

- () Turn the Transmitter OFF.
- () Resolder the white-red harness wire to the B+ location on the encoder circuit board.
- () Move the black meter wire to the free end of the 82 k Ω (gray-red-orange) resistor at solder lug AB.
- () Turn the Transmitter ON.
- () Touch the red meter wire to lug #1 of Channel #2 Stick Control and note the meter indication. The meter should indicate approximately 5 (approximately 9.6 volts on high impedance voltmeter) or slightly higher.
- () Connect the red meter wire to the indicated coil lug next to the MOD connection on the transmitter circuit board. The meter should indicate slightly less (approximately 1 volt) than the battery voltage in the previous step. See inset drawing #3 on Figure 3-2.

CONDITION	POSSIBLE CAUSE
Too high or too low a meter indication.	<ol style="list-style-type: none"> 1. Transistors Q8, Q9, or Q10. 2. Capacitors C28, C29, and C31 through C35. Resistors R23 through R27.

- () Turn the Transmitter OFF.
- () Disconnect the meter and set it aside temporarily.
- () Unsolder the 82 k Ω (gray-red-orange) resistor and the 15 k Ω (brown-green-orange)

resistor connected to solder lug AB. Save the 15 k Ω resistor for use later.

This completes the Transmitter checkout. Do not change any of the Trim Tabs or the Auxiliary control from their center positions. Also leave the antenna in its present position.

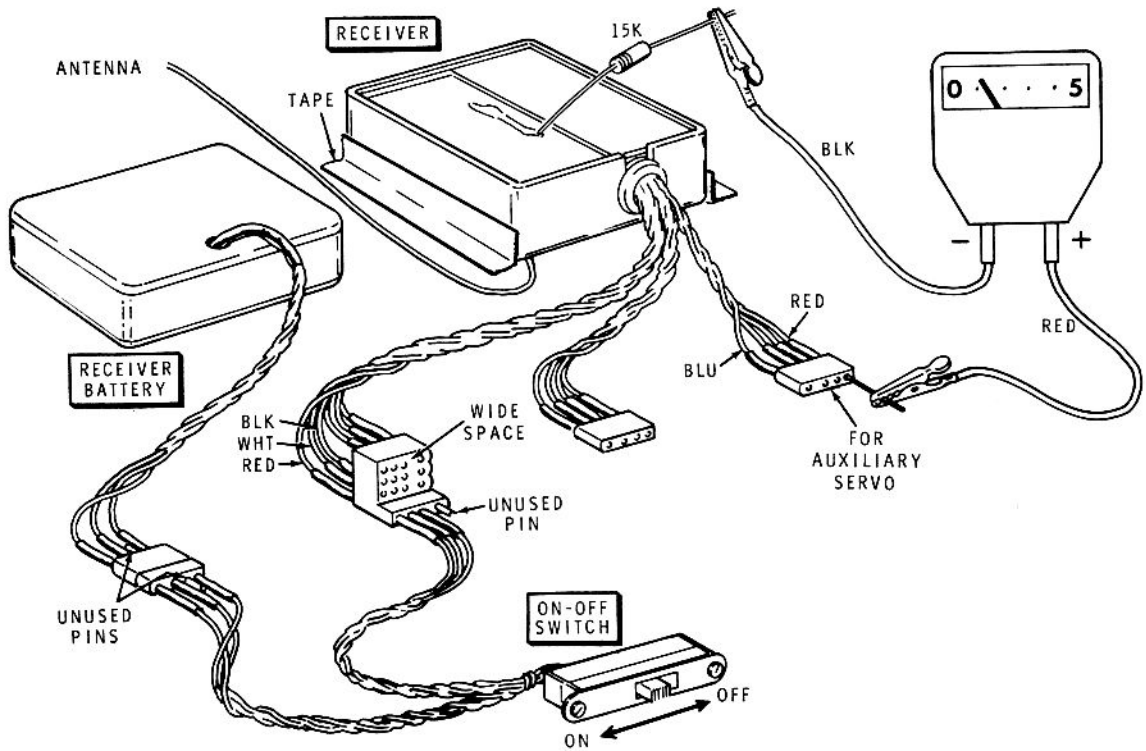


Figure 3-4

RECEIVER

In the following steps, the Receiver will be aligned for maximum sensitivity using the Transmitter as the signal source with the meter as a peaking indicator.

Refer to Figure 3-4 for the following steps.

- () Remove the receiver case bottom.
- () Carefully solder one end of a 15 k Ω (brown-green-orange) resistor to the test point on the foil side of the receiver circuit board (S-1). See Figure 3-5 for this test point.

NOTE: A high impedance voltmeter, if available, may be used for the following steps in place of the meter furnished with the Transmitter.

- () Clip the black meter wire to the free end of this 15 k Ω resistor.

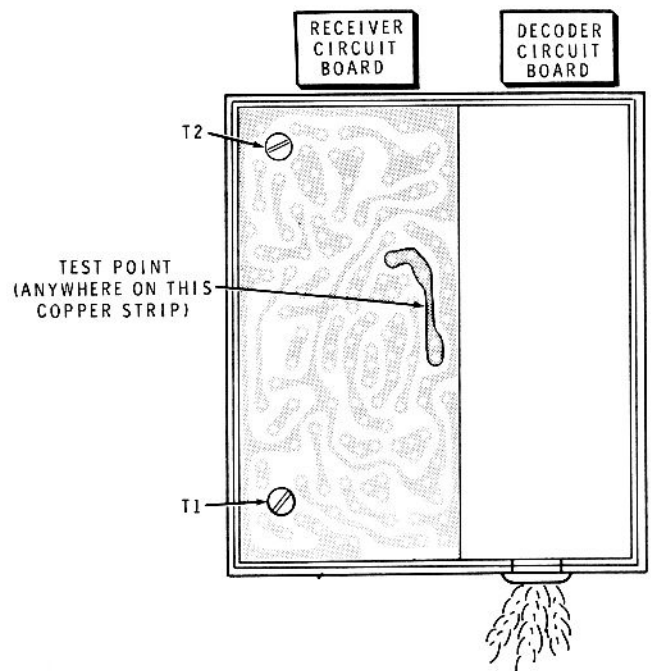


Figure 3-5

NOTE: In the next step (and in similar steps later), the meter will be connected to one of the five output connections of the Receiver. Each of the five channels has an identifying colored wire.

If you use a high impedance voltmeter for the following measurements, use a 1000 Ω or larger resistor in place of the cut-off resistor lead in the following steps.

- () Locate the output connector with the blue wire connected to it.
- () Push the previously saved resistor lead into the connector terminal with the red wire connected to it.
- () Clip the red meter wire to this lead.

- () Stretch the antenna (white wire of the Receiver out straight, keeping it away from any metal objects.
- () Be sure the receiver battery switch is in the OFF position.

NOTE: There is only one correct way to connect the receiver switch to the large receiver black connector. Refer to Figure 3-4 for proper installation.

- () Plug the receiver switch assembly into the Receiver and receiver battery.
- () Turn the Receiver on. The meter should deflect only a slight amount. See the meter drawing on Figure 3-4.

CONDITION	POSSIBLE CAUSE
Incorrect or no meter indication.	<ol style="list-style-type: none"> 1. Weak battery. This should not be the case at this time, as the battery was just charged, unless the charging circuit in the Transmitter is not operating properly. See Battery Charging on Page 36. 2. Battery switch. 3. Transistors Q1 through Q5. 4. Diode D2. 5. Transformer T1 or T2. 6. Components associated with stages Q1 through Q5.

NOTE: As you perform the following steps, increase the distance between the Transmitter and Receiver to keep the meter reading between the second and fourth red dots. Do not touch the Receiver or any of its leads when making the following adjustments. Tape the Receiver to a nonmetallic surface to hold it securely in place as shown. Do not use any metallic tape. Use the plastic alignment tool to make all adjustments.

- () Push the transmitter antenna completely into the case. Then turn the Transmitter ON and move it to a location where the meter gives an indication at about the third red dot.

NOTE: Use the screwdriver end of the alignment tool for the following steps. Do not turn any slug more than one turn in either direction. If the

end of the alignment tool will not fit into the slot, taper the end of the blade with a file.

- () 1. Adjust transformer T1 for a maximum indication on the meter.
- () 2. Adjust transformer T2 for a maximum indication on the meter.
- () Repeat the previous two steps until no further improvement can be made.
- () Turn both the Receiver and Transmitter OFF.
- () Unclip both meter leads from the Receiver.
- () Unsolder the 15 k Ω resistor from the receiver circuit board. Save the resistor for use later.
- () Reinstall the case bottom on the Receiver.

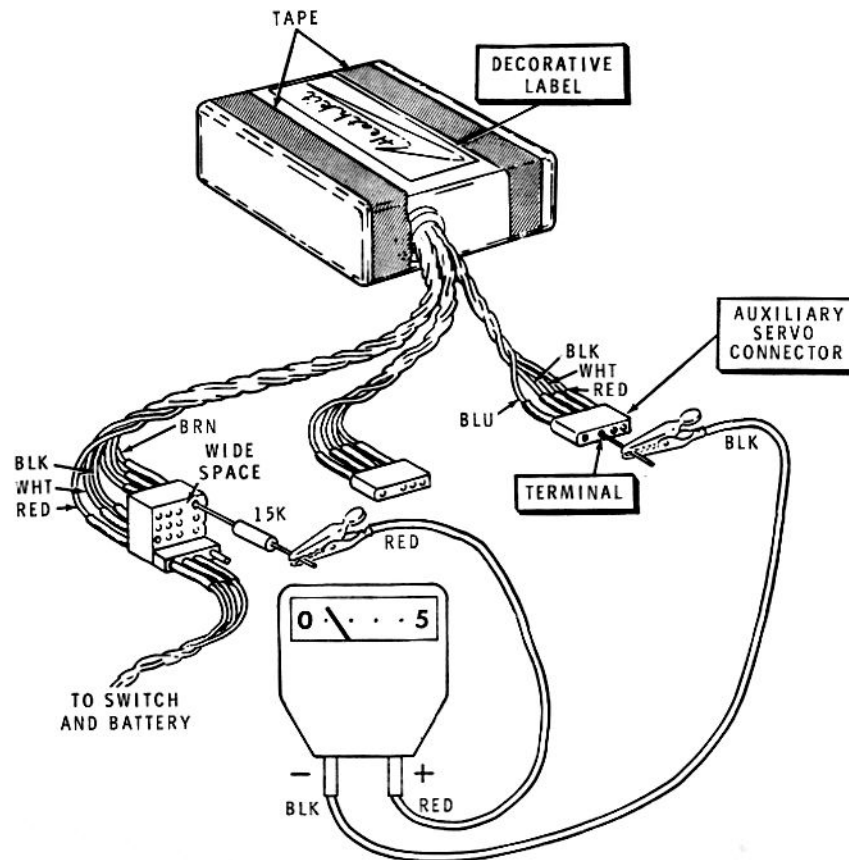


Figure 3-6

DECODER CHECKOUT

Refer to Figure 3-6 for the following steps.

NOTE: In the following steps the black meter wire will be connected to the auxiliary servo connector terminal with the black wire. The red meter wire and 15 k Ω resistor will connect to each of the different colored wire terminals (brown, orange, yellow, green, and blue).

- () Cut both leads of the 15 k Ω resistor to 1/4" and connect one end to the red meter wire.
- () Insert the other end of this resistor into the terminal with the brown (channel #1) wire connected to it.
- () Move the cut off resistor lead from the red wire terminal to the black wire terminal of the auxiliary connector.
- () Clip the black meter wire to this lead.

NOTE: The servo-controlling signal which is present at these connectors is produced by the Transmitter and picked up by the Receiver in the following channel sequence: channel #1, 2, 3, 4, and 5. If any one of the channels operates erratically (in the Transmitter or Receiver), usually all the remaining channels in the sequence will also be affected. For example, if channel #2 fails to operate properly, it is quite likely that channels #3, 4, and 5 will also be erratic in operation. Therefore, when checking the Receiver and Transmitter channels, you must correct any malfunction in the first channel affected in the sequence before the remaining channels can be expected to work properly. This can be an important observation if proper operation is not obtained.

- () Turn the Receiver ON.
- () Turn the Transmitter ON. The meter should deflect to approximately the first red dot.

- () Now operate the Channel #1 Stick on the Transmitter. See Figure 3-1 (fold-out from Page 66). The meter should move slightly above and below the first meter indication as the stick is moved through its entire range. Moving the stick up should cause a decrease and moving the stick down should cause an increase in the meter indication. The meter should return to the first meter setting when the stick is returned to its center position.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when moving the channel #1 control stick.	<ol style="list-style-type: none"> 1. Transistors Q101, Q102, Q104, or SCS101. 2. Diode D101. 3. Components associated with the above stages.

Now repeat the preceding steps and check each output channel in the same manner as channel #1. The channels should be checked in the following sequence:

- () Move the 15 K Ω resistor to channel #2 (terminal with orange wire). Moving the stick to the left should cause an increase and moving it to the right should cause a decrease in the meter indication.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when moving the channel #2 control stick.	<ol style="list-style-type: none"> 1. SCS102. 2. Diode D102. 3. Components associated with stage SCS102.

- () Move the 15 K Ω resistor to channel #3 (terminal with yellow wire). Moving the stick to the left should cause an increase, and moving it to the right should cause a decrease in the meter indication.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when moving the channel #3 control stick.	<ol style="list-style-type: none"> 1. SCS103. 2. Diode D103. 3. Components associated with stage SCS103.

- () Move the 15 kΩ resistor to channel #4 (terminal with green wire). Moving the stick up should cause a decrease, and moving it down should cause an increase in the meter indication.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when moving the channel #4 control stick.	<ol style="list-style-type: none"> 1. SCS104. 2. Diode D104. 3. Components associated with stage SCS104.

NOTE: In the following step, be careful not to short the two meter leads together.

- () Move the 15 KΩ resistor to channel #5 (terminal with blue wire). Moving the AUX control up should cause an increase, and moving it down should cause a decrease in the meter indication.

CONDITION	POSSIBLE CAUSE
No meter indication, or meter indication does not change when the AUX (channel #5) control is moved.	<ol style="list-style-type: none"> 1. SCS105. 2. Diode D105. 3. Components associated with stage SCS105.

- () Turn the Transmitter and Receiver OFF.
- () Disconnect the meter wires and remove the 15 kΩ resistor and the cut off resistor lead.

This completes the Receiver adjustments.

NOTE: The blue and white label shows the Production Series number of your kit. Refer to this number in any communications with the Heath Company; this assures you that you will receive the most complete and up-to-date information in return.

Do not put this label on your receiver case or the tuning of your Receiver may be affected.

- () Remove the backing from a blue and white label. Then press this label onto the top of Page 97 of this Manual or you may prefer to place it on the inside back cover of the Transmitter.

Refer to Figure 3-6 (on Page 74) for the following steps.

- () Carefully peel away the backing paper from the Heathkit decorative label. Then press the label onto the outside of the Receiver case top.
- () Tape the receiver case closed. This will increase the ruggedness of the Receiver.

TRANSMITTER TO SERVO

In the following steps, the stick controls will be adjusted for proper centering and travel by using the Receiver and Servo.

- () Mark one of the Servos with a piece of tape. This Servo will be used as a reference for adjusting purposes.

- () Refer to Figure 3-7 (fold-out from Page 85) and plug the connector of the marked Servo into channel #1 of the Receiver (the terminal with the brown wire). Note that the connectors are polarized and will fit correctly only one way.

Refer to Figures 3-1 and 3-2 (fold-out from Page 66) for the following steps.

- () Be sure the AUX control and the trim tabs of the Transmitter are in their centered positions.
- () Turn on the Transmitter and Receiver. NOTE: The Servo may start to run then stop. This is normal.

- () Move the stick of Channel #1 through its entire range. The linear output arms should turn in one direction with the stick to one end limit. Then as the stick is moved toward the other end limit, the arms should stop and begin turning in the opposite direction for the rest of the stick movement to the other end limit. NOTE: If the Servo did not operate as described, refer to the chart below.

- () Turn off the Transmitter and Receiver. Unplug the Servo.
- () Temporarily remove both linear output arms.

CONDITION	POSSIBLE CAUSE
Servo completely dead. Motor will not turn in either direction.	<ol style="list-style-type: none"> 1. Faulty connection between Receiver and Servo. 2. Receiver battery run down. 3. Servo transistors Q8 and Q9 interchanged. 4. Servo transistors Q4 through Q9. 5. Faulty component in one of the above stages.
Servo motor runs when the Transmitter is turned off.	<ol style="list-style-type: none"> 1. Faulty positive (red wire) connection between Receiver and Servo. 2. Capacitor C5. 3. Transistors Q1 through Q9.
Output rotary arm turns only in a clockwise direction, when viewed from shaft end.	<ol style="list-style-type: none"> 1. Servo transistor Q5, Q7, or Q9. 2. Control Housing Lever misadjusted in Transmitter.
Output rotary arm turns only in a counterclockwise direction, when viewed from shaft end.	<ol style="list-style-type: none"> 1. Servo transistor Q4, Q6, or Q8. 2. Control Housing Lever misadjusted in Transmitter.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the Service and Warranty section of the "Kit Builders Guide," and to the "Factory Repair Service" information on Page 134 of this Manual.

TRAVEL AND CENTERING

In the following steps, each of the five Transmitter channels will be checked and adjusted to make sure its servo will center properly and travel the proper distance in each direction. Use the following seven-step Procedure to adjust each channel. Refer to Figure 3-2 (fold-out from Page 66) and Figure 3-7 (fold-out from Page 85).

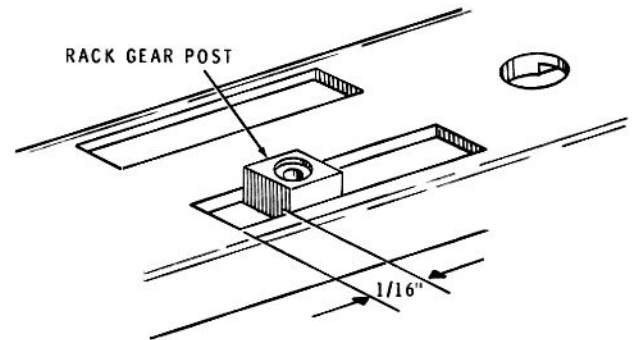


Figure 3-8

ADJUSTMENT PROCEDURE

1. Connect the marked servo to the output connector of the channel referred to in the step. Then turn on the Transmitter and Receiver.
2. Adjust the proper channel Control Housing Lever to center the rack gear posts in the center of the case top-section slots.
3. Operate the proper stick slowly through its entire range. Be sure the Trim Tab is in the center position. The rack gear posts on the servo should move in each direction. They should move each way until approximately $1/16''$ exists between the leading edge of the rack gear post and the end of the slot in the case top section. See Figure 3-8.
4. If the posts travel the correct distance in each direction, proceed to step #7.
5. If the posts do not travel far enough, turn the Range control (on the encoder circuit board in the Transmitter) for that channel clockwise a small amount. Then readjust the Control Housing Lever to bring the posts back to their center position. Repeat steps 3 and 5 until the posts travel the correct distance.

6. If the posts travel too far, turn the Range control for that channel counterclockwise a small amount. Then readjust the Control Housing Lever to bring the posts back to their center position. Repeat steps 3 and 6 until the posts travel the correct distance.

7. Move the Trim Tab to one end and then the other while operating its stick through its entire range. Check to be sure that the rack gear posts do not touch the ends of the slots of the servo case as this will cause excessive drain on the receiver battery. If they do touch, repeat step 6 and then step 3.

NOTE: The Servo may chatter if picked up. This is due to hum picked up from your hand. This will not interfere with proper operation when the Servo is mounted in a model.

ADJUSTMENTS

Check and adjust each of the following channels in order, using the Procedure just described.

- () Channel #1 (brown wire).
- () Channel #2 (orange wire).

- () Channel #3 (yellow wire).
- () Channel #4 (green wire).

- () Channel #5 (blue wire).

- () Turn off the Transmitter and Receiver.

After all five channels have been checked and any necessary adjustments made, no further adjustments are required in the Transmitter or the Servo used in making these adjustments.

SERVO TO TRANSMITTER

CENTERING

The following adjustments are only for the remaining unmarked (no tape) Servos. Do not attempt these adjustments unless the Transmitter has been completely adjusted with one of the Servos according to the instructions in the Travel and Centering Section. Do not make any of these adjustments on the marked Servo (marked with the piece of tape).

Refer to Figure 3-7 (fold-out from Page 85) for the following steps. Repeat these steps for each Servo.

- () Connect the Servo to be adjusted to channel #1 (brown wire) of the Receiver.
- () Turn the Receiver Battery switch on.
- () Turn the Transmitter ON. Be sure the channel #1 Trim Tab is in its center position.

Move the Channel #1 stick in one direction and then the other direction. The output arms should move, stop, and then move in the reverse direction along with the control stick.

If the Servo does not operate as described, refer to the "In Case Of Difficulty" section on Page 97.

NOTE: If the rotary output arm is now parallel to the end of the Servo case, turn the Transmitter and Receiver Off and disregard the next three steps.

- () 1. Remove the case bottom section by removing the two 2-56 x 11/16" screws.

NOTE: Picking up the Servo to make the following adjustment can cause the Servo motor to chatter. This is normal due to hum pickup from your hand. After an adjustment, the Servo should be set down on the work surface to be sure the correct amount of adjustment has been made. Make all adjustments with a screwdriver or alignment tool.

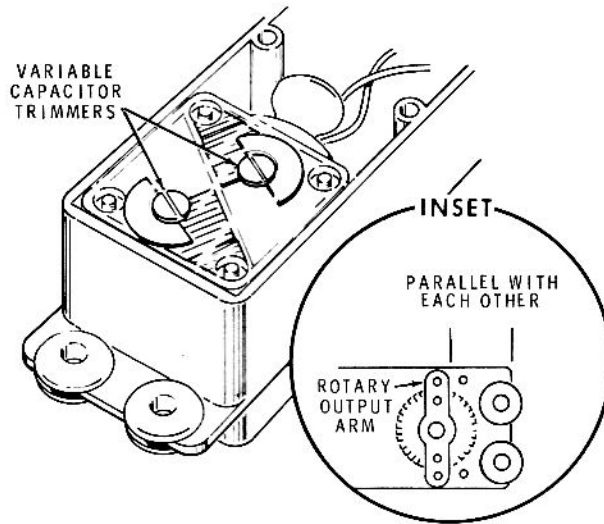


Figure 3-9

- () 2. Adjust (one or both) the trimmer(s) on the rear of the variable capacitor until the rotary output arm is perfectly parallel to the end of the Servo case. See Figure 3-9.
- () 3. Mount the case bottom section on the case center section of each Servo with 2-56 x 11/16" screws. Be sure that no wires are pinched between the two sections of the case and that the rubber grommet is positioned properly.

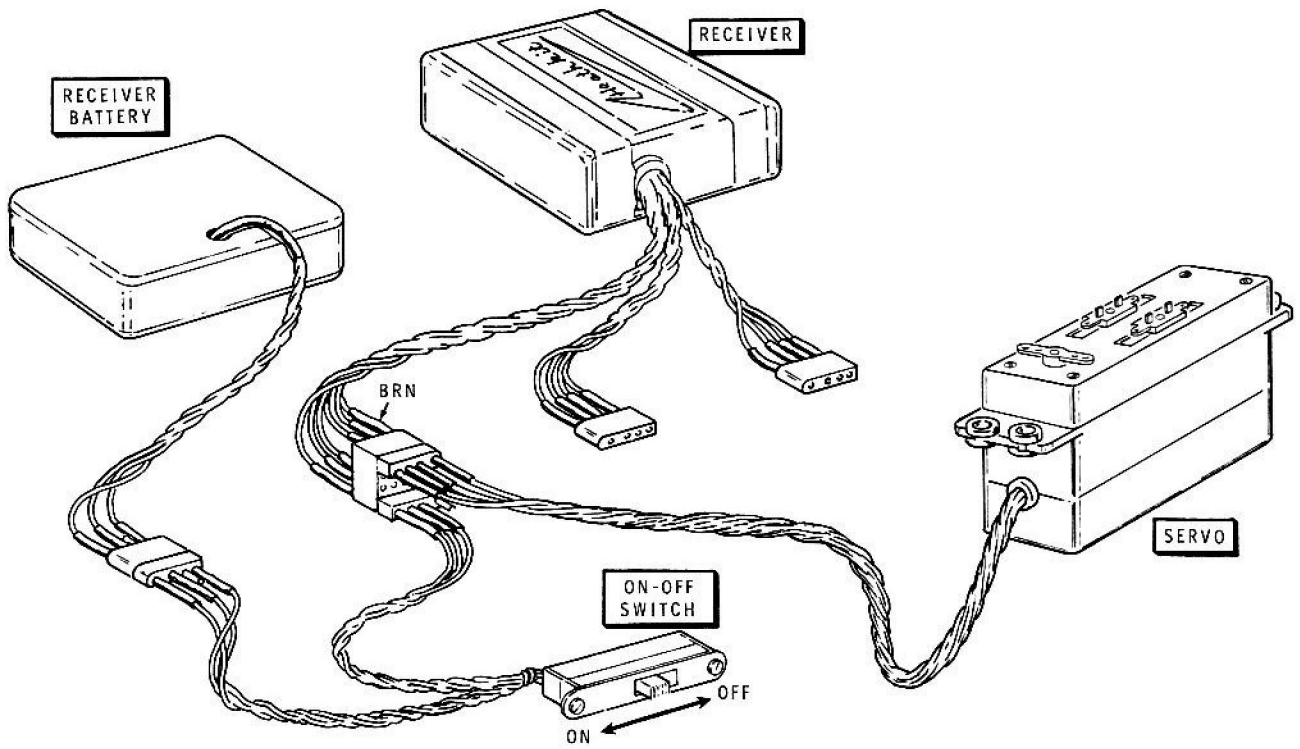


FIGURE 3-7