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**J68386A AND J68386B TRANSMITTER-RECEIVER BAYS**  
**TRANSMITTER TRANSMISSION TEST**  
**TD-3 MICROWAVE RADIO**

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This section describes procedures for measuring and adjusting, if necessary, the gain and amplitude response of a TD-3 microwave radio transmitter. Procedures for checking and adjusting the IF carrier resupply are also included.

This section is reissued to add Chart 3 to document the new solid-state 660E and F integrated circuit [660( )IC] overall transmission test procedures. Chart 8 was also added to provide replacement procedures for the 660( )IC. Revision arrows are used to emphasize the more significant changes.

This reissue affects the Equipment Test List.

Section 411-400-501 should be performed prior to this section and the results used as a guide to possible sources of trouble. The preliminary checks in Section 411-402-500 must be completed before performing the tests in this section. The IF return-loss tests in Section 411-406-502, when required by the Equipment Test List, must be completed prior to these tests.

For location of components in the transmitter section, refer to Fig. 1.

***Danger: Waveguide joints must not be opened in the transmitter without first removing the IF carrier at the transmitter modulator.***

***Caution 1: These tests are performed on an out-of-service basis. A release must be obtained from the designated control office and the channel removed from service as directed by local practice.***

***Caution 2: These tests must be performed with the transmitter disconnected from the antenna system. (Section 411-402-500 references the proper procedure for terminating the transmitter).***

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**NOTICE**

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**CHART 1**  
**IF CARRIER RESUPPLY CHECKS**

**APPARATUS:**

- 1 — J68392A Transmitter-Receiver Test Set

STEP	PROCEDURE
<b>A. Frequency and Output Power Checks</b>	
1	Remove the cable from the IF IN jack of the limiter and connect the cable to a 19A 20-dB pad.
2	Prepare for test in accordance with Fig. 2.
3	Connect option (V), Fig. 2A, and measure the output power of the carrier resupply.  <b>Requirement:</b> -8.0 dBm ±0.2 dB  <b>Note:</b> This corresponds to a power at the IF OUT jack of -7.0 dBm ±0.2 dB.  If the requirement is not met, adjust the 70 MC LEV control on the carrier resupply. If the requirement still is not met, replace the carrier resupply with a spare unit.
4	Change connections from option (V) to option (Y) on Fig. 2A and measure the frequency.  <b>Requirement:</b> Between 69.996 and 70.004 MHz  If the requirement is not met, replace the carrier resupply with a spare unit.
5	Connect option (W), Fig. 2B.
6	Adjust the AMPL GAIN control on the control panel to obtain the same power meter indication as in Step 3; i.e., -8.0 dBm ±0.2 dB. (This calibrates the amplifier gain.)

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**CHART 1 (Contd)**


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STEP	PROCEDURE
7	Change option (W) to option (Z) on Fig. 2B
8	Set the POWER RANGE DBM switch to 0.
9	On the IF carrier resupply, note the number in the window labeled MC and perform (a) or (b) below. <p>(a) If the number in the window is 61, set ATTEN 2 to 0 and measure the power.</p> <p><b>Requirement:</b> 0 dBm <math>\pm</math>0.2 dB</p> <p>(b) If the number in the window is 63, set ATTEN 2 to 7.0 and measure the power.</p> <p><b>Requirement:</b> 0 dBm <math>\pm</math>0.2 dB</p> <p>If the requirement is not met, adjust the 61-63 MC LEV control on the carrier resupply.</p> <p>If the requirement still is not met, replace the carrier resupply with a spare unit.</p>
10	Connect AMPL OUT to CTR option (Y), Fig. 2B, leaving ATTEN 2 set as in Step 9, and measure the frequency. <p><b>Requirement:</b> For a 61-MHz resupply: between 60.996 and 61.004 MHz.</p> <p>For a 63-MHz resupply: between 62.996 and 63.004 MHz.</p> <p>If the requirement is not met, replace the carrier resupply with a spare unit.</p>
11	Return the carrier resupply connections to normal. <p><b>B. Carrier Resupply Trip and Restore Point Check</b></p>
12	Prepare the test set in accordance with Fig. 3.
13	Press the CRS SW VOLTS pushbutton on the transmitter control panel and note the panel meter indication. <p><b>Requirement:</b> Within 5 units of the recorded indication</p> <p>If the meter indicates 0, set ATTEN 1 to 0. If the meter still indicates 0, replace the carrier resupply.</p>
14	Slowly increase ATTEN 3 until the panel meter indication drops to 0 and measure the power.

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## CHART 1 (Contd)

## STEP

## PROCEDURE

**Requirement:**  $-13 \text{ dBm} \pm 0.5 \text{ dB}$

If the requirement is not met, adjust ATTEN 3 for  $-13 \text{ dBm}$  and adjust the TRIP control clockwise until the meter indicates upscale, then counterclockwise until the meter indicates 0 (trips).

- 15 Slowly decrease the attenuation of ATTEN 3 until the panel meter indicates upscale (restores) and measure the power.

**Requirement:**  $-10.0 \text{ dBm} \pm 0.5 \text{ dB}$

If this requirement is not met, adjust the RESTORE control clockwise if the power is less than  $-10.5 \text{ dBm}$  or counterclockwise if the power is greater than  $-9.5 \text{ dBm}$ . Repeat Steps 14 and 15 until the requirements are met.

If the requirements still are not met, replace the carrier resupply and repeat all carrier resupply tests.

- 16 Connect option (Y), Fig. 3.

- 17 Set ATTEN 1 at 15 dB, and record the power meter indication.

- 18 Remove the cable from the limiter MON jack.

**Requirement:** The power shall drop by at least 20 dB from that recorded in Step 17.

If the requirement is not met, the trouble could be in either the carrier resupply or the limiter; replace the limiter. If the requirement is still not met, replace the carrier resupply.

- 19 Reconnect the cable to the limiter MON jack.

- 20 Note the panel meter indications for positions CRS 70 MC LEV and CRS 61-63 MC LEV.

**Requirement:** Between 45 and 75

If this requirement is not met, remove the carrier resupply cover on the side nearest the power plug. Adjust R38 (70 MHz) or R21 (61-63 MHz) for an indication of 60 on the panel meter and replace cover.

- 21 Reconnect the cable from the limiter IF OUT jack to the carrier resupply IF IN jack.

- 22 Depress and hold the ALM RESET switch and note that no alarm is present.

- 23 Remove the cable from the IF IN jack on the limiter and hold the ALM RESET switch depressed until the TRMTR ALM lamp lights.

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**CHART 1 (Contd)**


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STEP	PROCEDURE
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**Requirement:** A TRMTR alarm shall occur between 40 and 60 seconds after the cable is removed.

If the requirement is not met, adjust the DELAY ADJ control. (Clockwise rotation increases the time delay.) If the requirement still is not met, replace the carrier resupply.

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**CHART 2**
**OVERALL TRANSMISSION TEST  
EQUIPPED WITH TWT**


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**APPARATUS:**

1 — J68392A Transmitter-Receiver Test Set

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STEP	PROCEDURE
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1 Observe the CATHODE CURRENT meter on the TWT power supply.

**Requirement:**  $40 \pm 0.5$  mA

Proceed with Step 2 even if this requirement is not met. However, observe the note associated with Step 3.

2 Prepare for test in accordance with Fig. 4 and connect option (Z).

3 Remove the MON 2 or MON 3 detector from the 24B directional coupler at the output of the TWT (Fig. 1) and measure the transmitter output power by connecting option (S) or (T) to option (V) of Fig. 4. Adjust, if necessary, the 31A attenuator (AT3 or AT4) ahead of the TWT to meet the requirement for transmitter output power.

**Requirement:** +37.0 dBm

Required power meter indication:

Option (S): +26.0 dBm  $\pm 0.2$  dB minus the calibrated loss of the 24B directional coupler.

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## CHART 2 (Contd)

## STEP

## PROCEDURE

Option (T): +27.5 dBm  $\pm$ 0.2 dB minus the calibrated loss of the 24B directional coupler.

If the requirement cannot be met, perform Charts 4, 5, and 6 in sequence.

**Note:** If the requirement of Step 1 is not met, first adjust the TWT voltages in accordance with Step 6 of Chart 6 to obtain 40 mA of cathode current; then check that the output power meets the applicable requirement above.

- 4 Perform an amplitude response test in accordance with Fig. 5, options (X) and (Y). (The test trace displays the combined amplitude response of the limiter, carrier resupply, transmitter modulator, and TWT amplifier.)

**Requirement 1:** Flat to within 0.06 dB over the  $\pm$ 6 MHz band with the rolloff at  $\pm$ 10 MHz not to exceed 0.10 dB.

**Requirement 2:** There shall be no evidence of carrier resupply switching between 60 and 80 MHz. (See Fig. 6 for an example of this condition.)

If these requirements are not met, perform Charts 4, 5, and 6 in sequence. Do not be tempted to adjust any unit in order to meet the requirements because it may be compensating for some other trouble.

- 5 Reconnect the MON 2 or MON 3 detector and press the TRMTR OUT pushbutton.

**Requirement:** The meter indication shall be the same as that previously recorded on the control panel.

If the requirement is not met, erase the previously recorded indication, record the new indication, and perform the transmitter output alarm adjustment in Chart 7, Steps 6 through 13.

- 6 If all requirements in this chart have been met, remove the IF cable from the IF IN jack of the IF DRIVER-AMP to remove the transmitted carrier. Remove the 522A termination and shorting plate and replace the 1322- or 1336-type filter in the transmitter output circuit. Restore the IF cable connections to the IF DRIVER-AMP and IF limiter.

- 7 The transmitter can be placed in service.

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**CHART 3**
**OVERALL TRANSMISSION TEST  
EQUIPPED WITH 660( ) IC**


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**APPARATUS:**

1 — J68392A Transmitter-Receiver Test Set

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STEP	PROCEDURE
1	Prepare for test in accordance with Fig. 4 and connect option (Z).
2	Remove the MON 2 or MON 3 detector from the 24B directional coupler (Fig. 1) at the output of the 660 IC and measure the transmitter output power by connecting option (S) or (T) to option (V) of Fig. 4. [Adjust, if necessary, the 31A attenuator (AT3 or AT4) ahead of the 660( ) amplifier to meet the requirement for transmitter output power.]  <b>Requirement:</b> +37.0 dBm  Required power meter indication:  Option (S): +25.5 dBm $\pm$ 0.2 dB minus the calibrated loss of the 24B directional coupler.  Option (T): +27.0 dBm $\pm$ 0.2 dB minus the calibrated loss of the 24B directional coupler.  If the requirement cannot be met, perform Charts 4 and 5 in sequence. If the requirement is still not met, replace the 660 IC as instructed in Chart 8.
3	Perform an amplitude response test in accordance with Fig. 5 options (X) and (Y). [The test trace displays the combined amplitude response of the limiter, carrier resupply, transmitter modulator, and 660( ) IC amplifier.]  <b>Requirement 1:</b> Flat to within 0.06 dB over the $\pm$ 6 MHz band with the rolloff at $\pm$ 10 MHz not to exceed 0.10 dB.  <b>Requirement 2:</b> There shall be no evidence of carrier resupply switching between 60 and 80 MHz. (See Fig. 6 for an example of this condition.)  If these requirements are not met, perform Charts 4 and 5 in sequence. If the flatness requirement is still not met, adjust the HIGH SLOPE and LOW SLOPE controls on the IF driver amplifier. Adjust the GAIN control on the IF driver amplifier to maintain the coincidence of the traces.
4	Reconnect the MON 2 or MON 3 detector and press the TRMTR OUT pushbutton.  <b>Requirement:</b> The meter indication shall be the same as that previously recorded on the control panel.

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**CHART 3 (Contd)**


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**STEP****PROCEDURE**

If this requirement is not met, erase the previously recorded indication, record the new indication, and perform the transmitter output alarm adjustment in Chart 7, Steps 6 through 13.

- 5 If all requirements in this chart have been met, remove the IF cable from the IF IN jack of the IF DRIVER-AMP to remove the transmitted carrier. Remove the 522A termination and shorting plate and replace the 1322- or 1336-type filter in the transmitter output circuit. Restore the IF cable connections to the IF DRIVER-AMP and IF limiter.

The transmitter can be placed in service.♦

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**CHART 4****IF-TO-IF AMPLITUDE RESPONSE****APPARATUS:**

- 1 — J68392A Transmitter-Receiver Test Set
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**STEP****PROCEDURE**

- 1 Prepare for test in accordance with Fig. 6.

**Note:** Somewhat different test procedures are required for checking the amplitude response of the J68387H, L1 and L1A IF limiters. Proceed with Step 2 if the transmitter is equipped with a J68387H, L1 IF limiter or with Step 6 if the transmitter is equipped with a J68387H, L1A IF limiter. (The L1 limiter is the unit furnished originally with the transmitter and is equipped with a GAIN control. The L1A limiter is the L1 unit modified for reduced noise figure. In the L1A limiter, the GAIN control has been removed and a plastic rivet has been used to plug the GAIN control hole.)

**A. J68387H, L1 IF Limiter**

- 2 Remove the normal connections from the IF IN jack of the IF limiter and the IF OUT jack on the IF carrier resupply.
- 3 Make the option (V) and (Y) connections of Fig. 6 and observe the test trace on the oscilloscope. (This trace represents the amplitude response of the IF limiter and carrier resupply combination.)
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## CHART 4 (Contd)

STEP	PROCEDURE
	<p><b>Requirement 1:</b> The test trace shall coincide with the reference trace at 70 MHz and shall be flat to within 0.05 dB between 60 and 80 MHz.</p> <p><b>Requirement 2:</b> There shall be no evidence of carrier resupply switching between 60 and 80 MHz. (See Fig. 6 for an example of this condition.) If there is evidence of in-band switching, replace the carrier resupply.</p> <p>If these requirements are met, proceed to Step 14.</p> <p>If Requirement 1 is not met, adjust the GAIN, SLOPE 1, or SLOPE 2 control on the IF limiter to bring the test trace within limits. (GAIN controls the output power and is adjusted for trace coincidence at 70 MHz. SLOPE 1 controls the high-end slope. SLOPE 2 controls the slope across the band.) If Requirement 1 still is not met, proceed with Step 4.</p>
4	<p>Establish test connections as shown in Fig. 6, option (Z), and measure the amplitude response.</p> <p><b>Requirement:</b> The test and reference traces shall coincide at 70 MHz. (If not, adjust the IF limiter GAIN control.) The test trace shall be flat to within 0.03 dB between 60 and 80 MHz.</p> <p>If the requirement is met, proceed with Step 5.</p> <p>If the requirement cannot be met by adjustment of the controls as in Step 3, replace the IF limiter with a spare and repeat Step 3.</p>
5	<p>Change option (Z) to option (V) to determine the effect of adding the IF carrier resupply to the circuit. Note the separation between test and reference traces at 70 MHz and compare the amplitude response to that obtained in Step 4.</p> <p><b>Requirement 1:</b> The separation of traces at 70 MHz shall be less than 4 cm (0.2 dB).</p> <p><b>Requirement 2:</b> The amplitude response shall not differ from that of Step 4 by more than 0.02 dB between 60 and 80 MHz.</p> <p>If either of these requirements is not met, replace the cable between the limiter IF OUT jack and the carrier resupply IF IN jack and retest as in Step 3. If either requirement still is not met, replace the carrier resupply and repeat Step 3.</p> <p><b>B. J68387H, L1A IF Limiter</b></p>
6	<p>Remove the normal connections from the IF IN jack of the IF limiter and the IF OUT jack on the IF carrier resupply.</p>
7	<p>Connect options (V) and (W) of Fig. 6 and measure the power.</p>

## CHART 4 (Contd)

## STEP

## PROCEDURE

**Requirement:** Between  $-7.1$  and  $-8.8$  dBm

If this requirement is not met, disconnect the 19D pad and measure the power at the IF OUT jack of the IF limiter.

**Requirement:** Between  $-1.0$  and  $-2.5$  dBm

If this requirement is not met, replace the limiter with a spare and repeat Step 7. If this requirement is met, the tests indicate that the insertion loss of the 19D pad assembly (nominally  $6.0 \pm 0.1$  dB) or the IF carrier resupply (nominally less than 0.2 dB) is too high. Using the same test setup, measure the insertion loss of the pad assembly and the IF carrier resupply (from the IF IN jack to the IF OUT jack). Replace the defective unit and repeat Step 7.

8 Change option (W) to option (Y) of Fig. 6.

9 Using the TEST TRACE control, set the test trace coincident with the reference trace at 70 MHz. (The test trace represents the overall amplitude response of the IF limiter, 19D pad, and IF carrier resupply.)

**Requirement 1:** The test trace shall be flat to within 0.05 dB between 60 and 80 MHz.

**Requirement 2:** There shall be no evidence of carrier resupply switching between 60 and 80 MHz. (See Fig. 6 for an example of this condition.) If there is evidence of in-band switching, replace the carrier resupply.

**Note:** In Steps 8 through 13 the IF input to the IF detector is somewhat less than the  $-7$  dBm input used in Step 1 to calibrate the vertical sensitivity of the oscilloscope. As a result, the vertical sensitivity may be up to 20 percent less than the 0.05 dB per centimeter sensitivity that is being assumed. This error is being ignored in order to simplify the test procedure.

If these requirements are met, proceed to Step 14. If Requirement 1 is not met, adjust the SLOPE 1 or SLOPE 2 control on the IF limiter to bring the test trace within limits at the highest possible power. SLOPE 1 controls the high-end slope. SLOPE 2 controls the slope across the band. These adjustments affect the output power. The objective is to set the controls for the maximum output power at which the flatness requirement can be met. It is not necessary to maintain coincidence of the test and reference traces while making these adjustments. However, after adjustment, change option (Y) to option (W) and check that the output power requirement specified in Step 7 is still being met. If Requirement 1 cannot be met while still maintaining proper output power, proceed with Step 10.

10 Connect options (Z) and (Y) of Fig. 6.

11 Using the TEST TRACE control, set the test trace coincident with the reference trace at 70 MHz. (The test trace represents the amplitude response of the IF limiter and 19D pad combination.)

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**CHART 4 (Contd)**


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STEP	PROCEDURE
	<p><b>Requirement:</b> The test trace shall be flat to within 0.03 dB between 60 and 80 MHz.</p> <p>If this requirement is met, proceed with Step 12. If this requirement is not met, adjust the SLOPE 1 and SLOPE 2 controls, as described in Step 9, to obtain the required flatness. The test trace does not have to remain coincident with the reference trace. However, the power at the IF OUT jack of the IF limiter should remain within the limits specified in Step 7. If these requirements cannot be met, replace the IF limiter with a spare unit and repeat Steps 6 through 9.</p>
12	With the TEST TRACE control, adjust the test trace for coincidence with the reference trace at 70 MHz.
13	Connect options (V) and (Y) of Fig. 6 to determine the effect of adding the IF carrier resupply to the circuit. Note the separation between the test and reference traces at 70 MHz and compare the amplitude response displayed by the test trace with that obtained in Step 11.
	<p><b>Requirement 1:</b> The separation of the traces at 70 MHz shall be less than 4 cm (0.2 dB).</p> <p><b>Requirement 2:</b> The amplitude response shall not differ from that of Step 11 by more than 0.02 dB between 60 and 80 MHz.</p> <p>If either requirement is not met, replace the IF carrier resupply with a spare unit and repeat Steps 6 through 9.</p>
	<p><b>C. IF Limiter Compression Test</b></p>
14	Using the test setup in Fig. 6, option (X), calibrate the oscilloscope for 1 dB/cm sensitivity.
15	Reconnect option (V) and recoinide the traces with the TEST TRACE control.
16	Increase the attenuation of ATTEN 2 by 10 dB and observe the position of the test trace.
	<p><b>Requirement:</b> The test trace shall be within 3 cm (3 dB) of the reference trace at 70 MHz.</p>
17	Return ATTEN 2 to its original setting and remove the test set connections.
18	Restore the normal connection to the limiter IF OUT jack and the IF IN and IF OUT jacks on the carrier resupply.

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## CHART 5

## TRANSMITTER MODULATOR ADJUSTMENT

## APPARATUS:

- 1 — J68392A Transmitter-Receiver Test Set

STEP	PROCEDURE
1	Prepare for test in accordance with Fig. 4.  <i>Note:</i> The adjustment procedure for main and repeater station bays is the same; however, the filter, isolator, and attenuator designations are different. (See Fig. 1.)
2	Disconnect and remove isolator A7 (main) or A6 (repeater).
3	If the bay is equipped with a TWT, remove the flexible waveguide connected to tuner Z2. (See Fig. 1.)  <i>Note:</i> Cover Z2 to prevent foreign objects from entering.
4	Attach a 24A transducer to the output of attenuator AT4 (main) or AT3 (repeater) (Fig. 1).
5	Connect option (Z) and connect option (S) or option (T) to option (U) in Fig. 4.
6	On the transmitter control panel, record (in pencil in the space provided) the meter indications obtained for the TRMTR MOD 1 and TRMTR MOD 2 pushbuttons.  <i>Requirement:</i> Between 0 and 35.  If greater than 35, refer to Section 411-406-503.
7	Adjust AT4 (main) or AT3 (repeater) for a power meter indication of $-3.5$ dBm when using option (S) or $-2.0$ dBm when using option (T).  If this condition is not met, refer to Section 411-406-503.
8	Prepare for the test in accordance with Fig. 5.
9	Connect options (V) and (Y), Fig. 5 and measure the amplitude response displayed by the test trace. (This is the combined amplitude response of the limiter, carrier resupply, and transmitter modulator.)  <i>Requirement:</i> Flat within 0.05 dB over $\pm 10$ MHz about the RF channel center frequency with irregularities being less than 0.02 dB over $\pm 6$ MHz. (The objective here is to obtain the same amplitude response as seen at the output of the carrier resupply, Step 3, Chart 4.)

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**CHART 5 (Contd)**


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STEP	PROCEDURE
	<p>If the requirement is not met, adjust the HIGH SLOPE, LOW SLOPE, and GAIN controls on the IF driver amplifier. It may be necessary to adjust AT4 (main) or AT3 (repeater) to maintain coincidence of the traces. If the requirement still is not met, refer to Section 411-406-503.</p> <p><b>Note:</b> For channels 3 and 9 (early production), 1, 2, 7, and 8, the left half of the oscilloscope trace represents frequencies above the RF channel center frequency. For channels 3 and 9 (late production), 4, 5, 6, 10, 11, and 12, the left half of oscilloscope trace represents frequencies below the RF channel center frequency. The early and late production channel 3 and 9 bays can be determined from the microwave generator frequencies in Section 411-402-500.</p>
10	Remove the transducer connected to AT4 or AT3 and reconnect the isolator.
11	Replace the flexible waveguide if removed in Step 3.

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**CHART 6****TWT AMPLIFIER ADJUSTMENT****APPARATUS:**

- 1 —J68392A Transmitter-Receiver Test Set
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STEP	PROCEDURE
	<p><b>Note 1:</b> The TWT should have been on for at least 30 minutes in order that it be at normal operating temperature before performing any test in this chart.</p> <p><b>Note 2:</b> Figure 7 is a flow diagram for routine testing of the TWT amplifier.</p>
1	<p>Press the TRMTR OUT pushbutton and, if necessary, adjust the 31A attenuator AT3 or AT4 (Fig. 1) ahead of the TWT to obtain the recorded meter indication.</p> <p>If the recorded meter indication cannot be obtained, proceed to Step 4.</p>
2	Read the CATHODE CURRENT meter on the TWT power supply.
	<b>Requirement:</b> 40 ±0.5 mA

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## CHART 6 (Contd)

## STEP

## PROCEDURE

If the requirement is not met, proceed to Step 4.

- 3 Make an amplitude response test in accordance with Fig. 5, options (X) and (Y). (The test trace displays the combined amplitude response of the limiter, carrier resupply, transmitter modulator, and TWT amplifier.)

**Requirement:** Flat to within 0.06 dB over the  $\pm 6$  MHz band and the rolloff shall not exceed 0.09 dB at the  $\pm 10$  MHz points.

The objective here is that the TWT shall be flat to within 0.02 dB over the  $\pm 6$  MHz band. Since the output of the transmitter modulator was flat to within 0.03 dB, the combination of transmitter modulator and TWT should at least be flat to 0.05 dB. The ideal characteristic at this point would be the same response as was obtained at the output of the transmitter modulator.

If this requirement is met, proceed to Step 12. If the requirement is not met, proceed with Step 4.

- 4 Connect option (S) or (T) to option (V) in Fig. 4.
- 5 Connect option (Z) and adjust input tuner Z2 and output tuner Z3 (Fig. 1) for maximum power output.
- 6 Adjust the HELIX ADJ control on the inverter and heater regulator unit for maximum power output, while simultaneously adjusting the ANODE VOLTAGE ADJ control to keep the CATHODE CURRENT meter at 40 mA.

**Note:** For some tubes, the ANODE VOLTAGE ADJ control may run out of range against the counterclockwise stop during this adjustment. In these cases, it is recommended that the ANODE VOLTAGE ADJ control be left in the maximum counterclockwise position and the HELIX ADJ control be used to obtain a CATHODE CURRENT meter indication of 40 mA. This may not result in peak power output from the tube but will give the maximum power available under these conditions.

If the conditions of this step are not met, refer to Section 411-406-504 for TWT power supply test information. A check of the TWT power supply will permit determining whether the power supply or the TWT amplifier is at fault.

- 7 Adjust attenuator AT4 (main) or AT3 (repeater) to obtain (+26 -L) dBm when using option (S), Fig. 4, or (+27.5 -L) dBm when using option (T), Fig. 4. (L is the calibrated loss of DC3.)

If the required power output cannot be obtained with the attenuator at minimum and the requirements of Chart 5 have been met, either the TWT amplifier gain is too low or the power

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**CHART 6 (Contd)**


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**STEP****PROCEDURE**

supply is at fault. Refer to Section 411-406-504 for TWT power supply test information and for the TWT amplifier replacement procedure.

If the power output cannot be reduced to this value, repeat the test in Chart 5 with the following change: decrease the transmitter modulator output power as low as possible with the GAIN control while still maintaining the required transmission flatness using the HIGH SLOPE and LOW SLOPE controls.

If the attenuator has to be set to minimum to obtain this power output, it may not be possible to meet the final power output setting specified in Step 11. In some cases, it may be possible to defer the replacement of a low gain TWT by obtaining more power output from the transmitter modulator. To do this, readjust the transmitter modulator as in the previous paragraph, in this case using the GAIN control to increase the power output.

- 8 Set up for amplitude response tests as shown in Fig. 5, options (Y) and (X).
- 9 Using the TEST TRACE control, make the traces coincident at the band center.
- 10 Adjust output tuner Z3 to flatten the test trace.

**Note:** This adjustment will reduce the output power. Since the oscilloscope is calibrated for 0.05 dB per centimeter, the decrease in output power can be determined by the separation between the test and reference traces.

**Requirement 1:** The output power shall not be reduced by more than 1 dB.

**Requirement 2:** Flat to within 0.06 dB over the  $\pm 6$  MHz band and the rolloff shall not exceed 0.09 dB at the  $\pm 10$  MHz points.

If either of these requirements is not met, replace the TWT amplifier in accordance with Section 411-406-504 and repeat the tests of this chart.

- 11 Using AT3 (repeater) or AT4 (main), adjust the transmitter output power to the applicable requirement.

**Requirement:** +37.0 dBm. (Power meter indication for option (S) equal to +26.0 dBm minus the calibrated loss of the 24B directional coupler; for option (T), +27.5 dBm minus the calibrated loss of the 24B directional coupler.)

- 12 Disconnect option (X) and perform the transmitter output alarm adjustment in Chart 7 starting with Step 6.
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## CHART 7

## TRANSMITTER OUTPUT ALARM ADJUSTMENT

## APPARATUS:

1 — J68392A Transmitter-Receiver Test Set

STEP	PROCEDURE
1	Replace the MON 2 or MON 3 detector on the 24B directional coupler DC3 (Fig. 1).
2	Connect option (Z) of Fig. 4.
3	Adjust AT3 (repeater) or AT4 (main) to obtain the recorded meter indication for the TRMTR OUT position.
4	Remove the MON 2 or MON 3 detector from directional coupler DC3.
5	Connect option (S) or option (T) to option (V) in Fig. 4 and measure the power.  <b>Requirement:</b> +37.0 dBm  Required power meter indication:  Option (S): +26.0 dBm $\pm 0.2$ dB minus the calibrated loss of the 24B directional coupler.  Option (T): +27.5 dbm $\pm 0.2$ dB minus the calibrated loss of the 24B directional coupler.  If the requirement is met, it can be assumed that the 3-dB drop sensitivity of the alarm circuit has not changed; proceed to Step 14. If the requirement is not met, proceed with Step 6.
6	Adjust AT3 or AT4 to decrease the power meter indication by 3 dB.
7	Disconnect option (S) or option (T) and replace the MON 2 or MON 3 detector.
8	Adjust the TRMTR OUT ALM SET control until the Sensitrol just trips.
9	Disconnect the MON 2 or MON 3 detector and reconnect the power meter, option (S) or option (T).
10	Adjust AT3 or AT4 to increase the power meter indication by 3 dB. (This restores the transmitter output power to normal.)
11	Remove the cable connection to DC3 and replace the MON 3 or MON 2 detector.
12	Operate the ALARM RESET button.  <b>Requirement:</b> The transmitter alarm shall release.

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**CHART 7 (Contd)**


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STEP	PROCEDURE
13	Press the TRMTR OUT pushbutton on the transmitter control panel, record the meter indication in the space provided, and remove the test set connections.
14	Remove the transmitted carrier by disconnecting the cable from the IF IN jack of the IF DRIVER AMP.
15	Remove the 522A termination and shorting plate and replace the 1322- or 1336-type filter in the transmitter output circuit.
16	Reconnect the IF cable to the IF driver amplifier and restore the normal connections to the IF limiter input.

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**◆CHART 8**
**660( ) IC TRANSMITTER AMPLIFIER REPLACEMENT**


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**APPARATUS:**

1 —1/4-inch Open-End Waveguide Wrench

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STEP	PROCEDURE
1	Remove the IF drive from the transmitter modulator IF input.
2	Disconnect the power plug from the front of the 660( ) IC amplifier. (Release the slide lock first.)  <i>Note:</i> There is no power switch for the 660( ) IC amplifier. The power plug, in effect, is the switch.
3	Remove the 16 screws at the input and output flanges of the 660( ) IC amplifier unit.
4	Slide the 660( ) IC amplifier out of the bay.
5	Reverse the above procedure to install the replacement unit.◆

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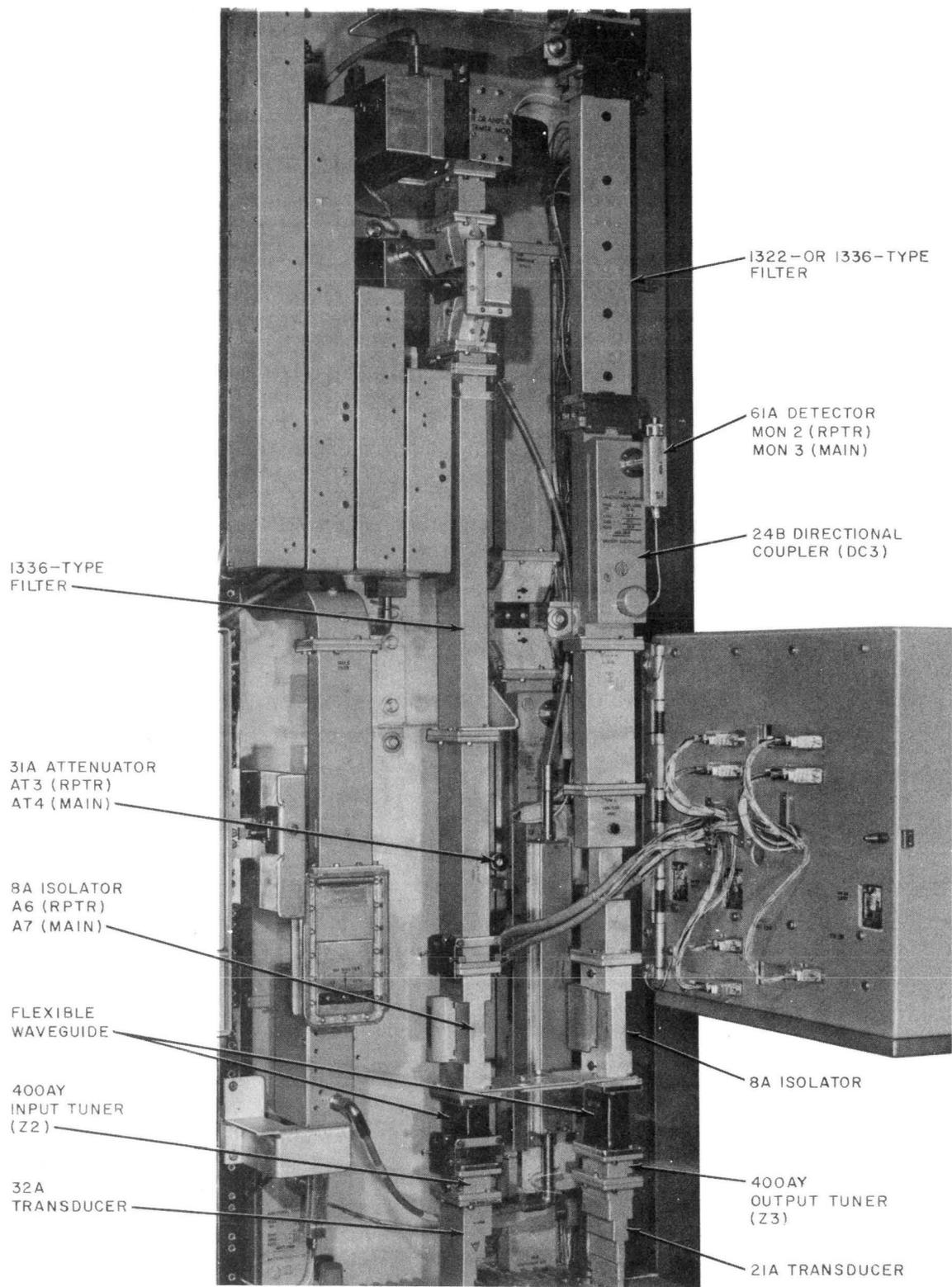


Fig. 1—Transmitter Component Location

PREPARATION FOR TEST

1. Operate the test set controls to the following positions:

UNIT	CONTROL	POSITION
Control Panel	AMPL GAIN CTR	Midrange EXT
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF * -5

2. Set ATTEN 2 to 45 dB.
3. Establish test connections using option (V) in A.

\* With the INPUT CHANNEL switch set to IF, determine that no input is connected; then zero the power meter by setting the POWER RANGE DBM switch to -25 and adjusting the METER ZERO control for an indication of ZERO on the meter. Return the POWER RANGE DBM switch to the position shown in Step 1.

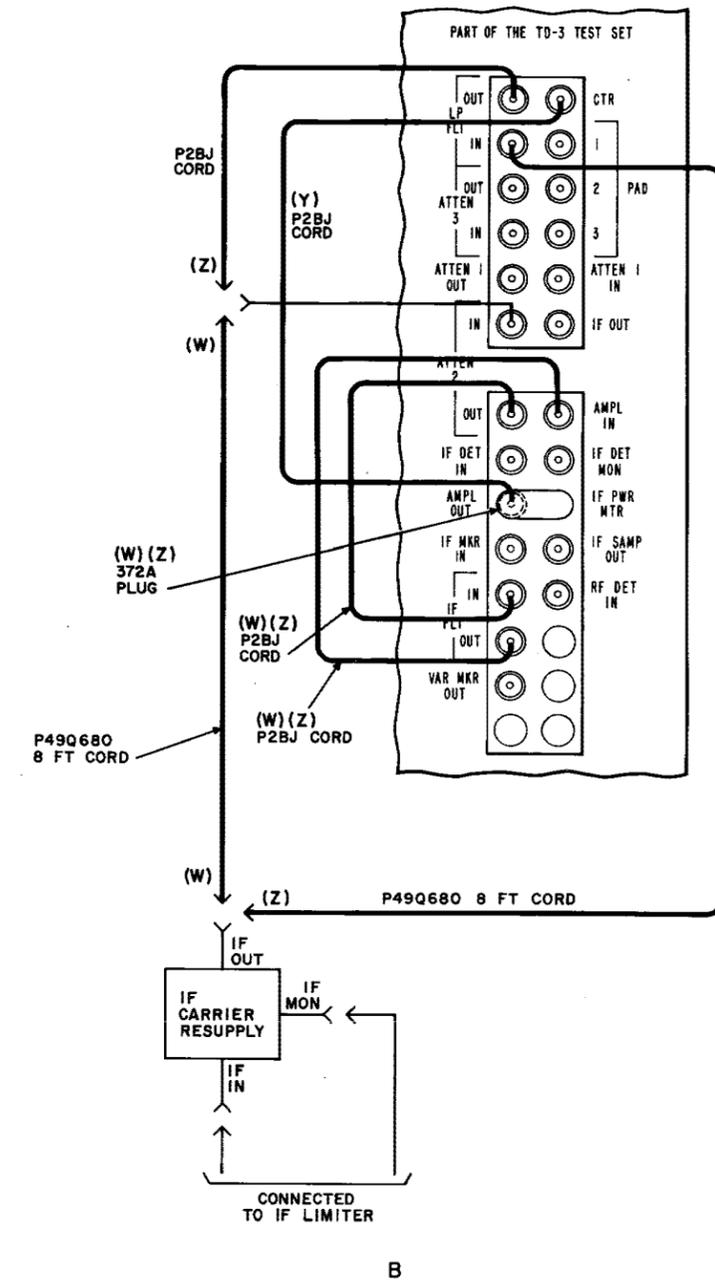
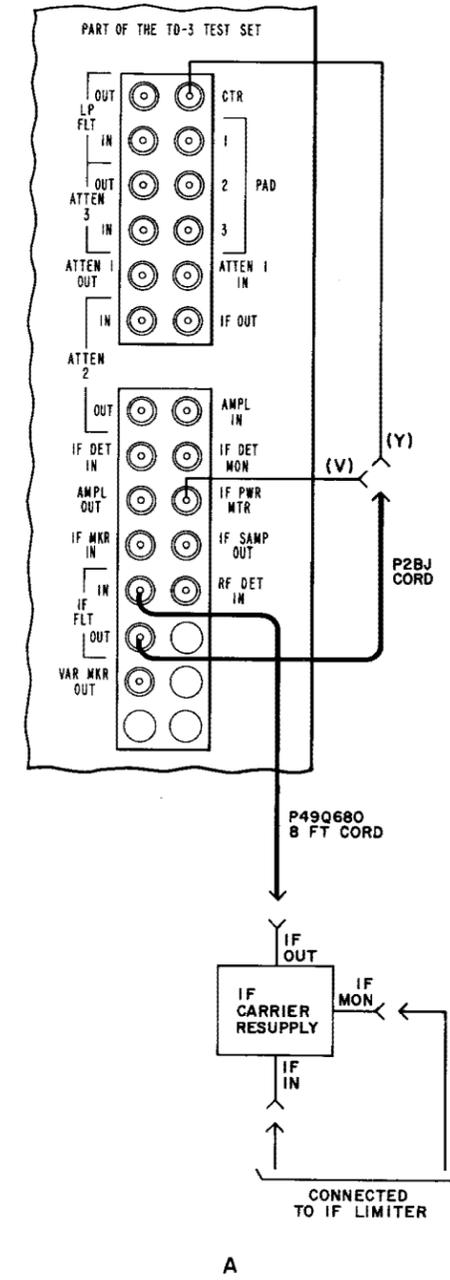


Fig. 2—IF Carrier Resupply Output Power and Frequency Test Setup

PREPARATION FOR TEST

1. Operate the test set controls to the following positions:

UNIT	CONTROL	POSITION
Control Panel	IF SWEEP WIDTH CTR	Max CCW EXT
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF * -10

2. Set ATTEN 1 to 6 dB and ATTEN 3 to MIN.
3. Connect the IF OUT jack to the CTR jack with a P2BJ cord.
4. Adjust the IF CENTER FREQ control for an indication 70 ±0.2 MHz on the counter.
5. Connect the test setup using option (X).

**Note:** An indication of approximately 0 on the transmitter control panel meter indicates that the IF carrier supply has tripped. An indication of approximately 2/3 scale on the transmitter control panel indicates that the IF carrier resupply has restored.

\* With the INPUT CHANNEL switch set to IF, determine that no input is connected, then zero the power meter by setting the POWER RANGE DBM switch to -25 and adjusting the METER ZERO control for an indication of ZERO on the meter. Return the POWER RANGE DBM switch to the position shown in Step 1.

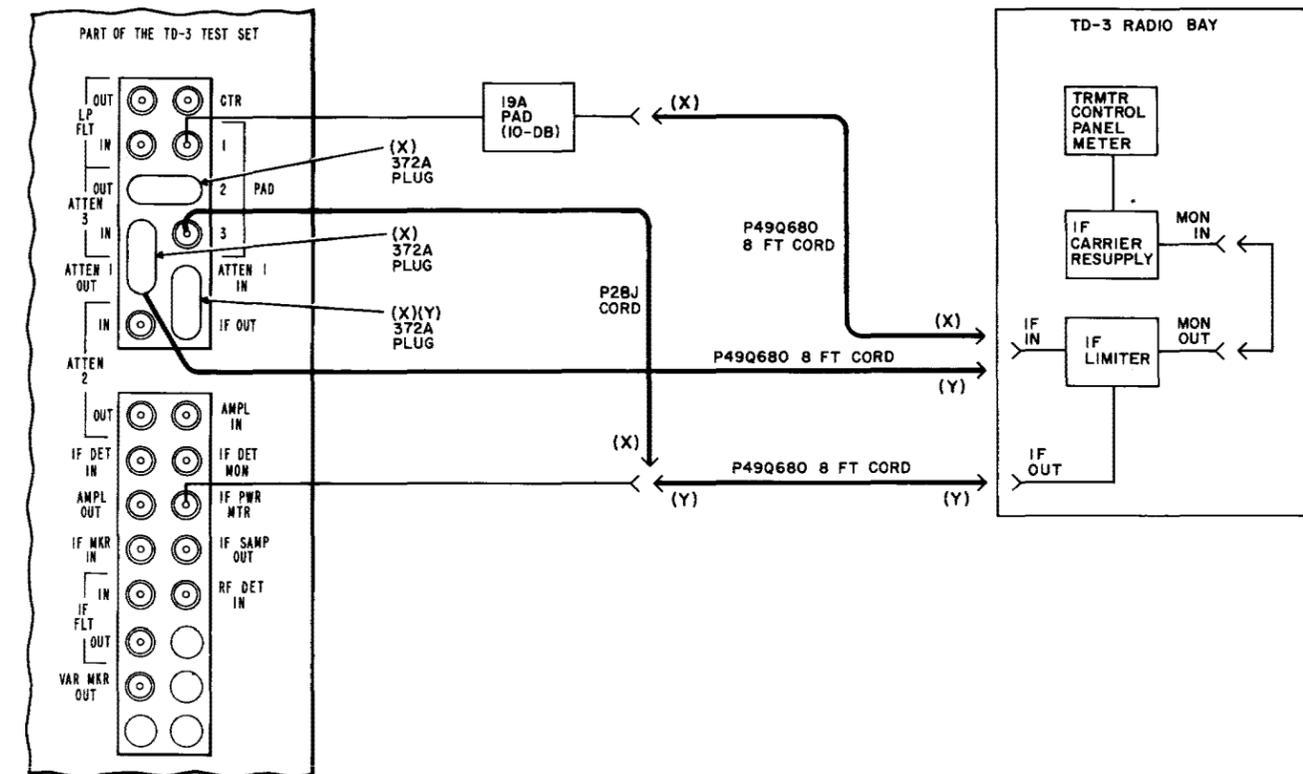


Fig. 3—IF Carrier Resupply Trip and Restore Point Test Setup

PREPARATION FOR TEST

1. Operate the test set controls to the following initial positions:

UNIT	CONTROL	POSITION
Control Panel	IF SWEEP WIDTH CTR	Max CCW EXT
Power Meter	INPUT CHANNEL POWER RANGE DBM *	IF* -5

- Set ATTEN 2 to 17 dB.
- Establish test connections using option (Y).
- Adjust the IF CENTER FREQ control panel for a  $70 \pm 0.2$  MHz indication on the counter.
- Change option (Y) to option (X).
- Adjust ATTEN 2 to obtain -7 dBm.
- Operate the INPUT CHANNEL switch on the power meter to RF (see footnote). Set the POWER RANGE DBM switch to 0.

\* With the INPUT CHANGE switch set to IF or RF, determine that no input is connected, then zero the power meter by setting the POWER RANGE DBM switch to -25 and adjusting the METER ZERO control for an indication of ZERO on the meter. Return the POWER RANGE DBM switch to the position shown in Step 1, or Step 7, whichever is being used.

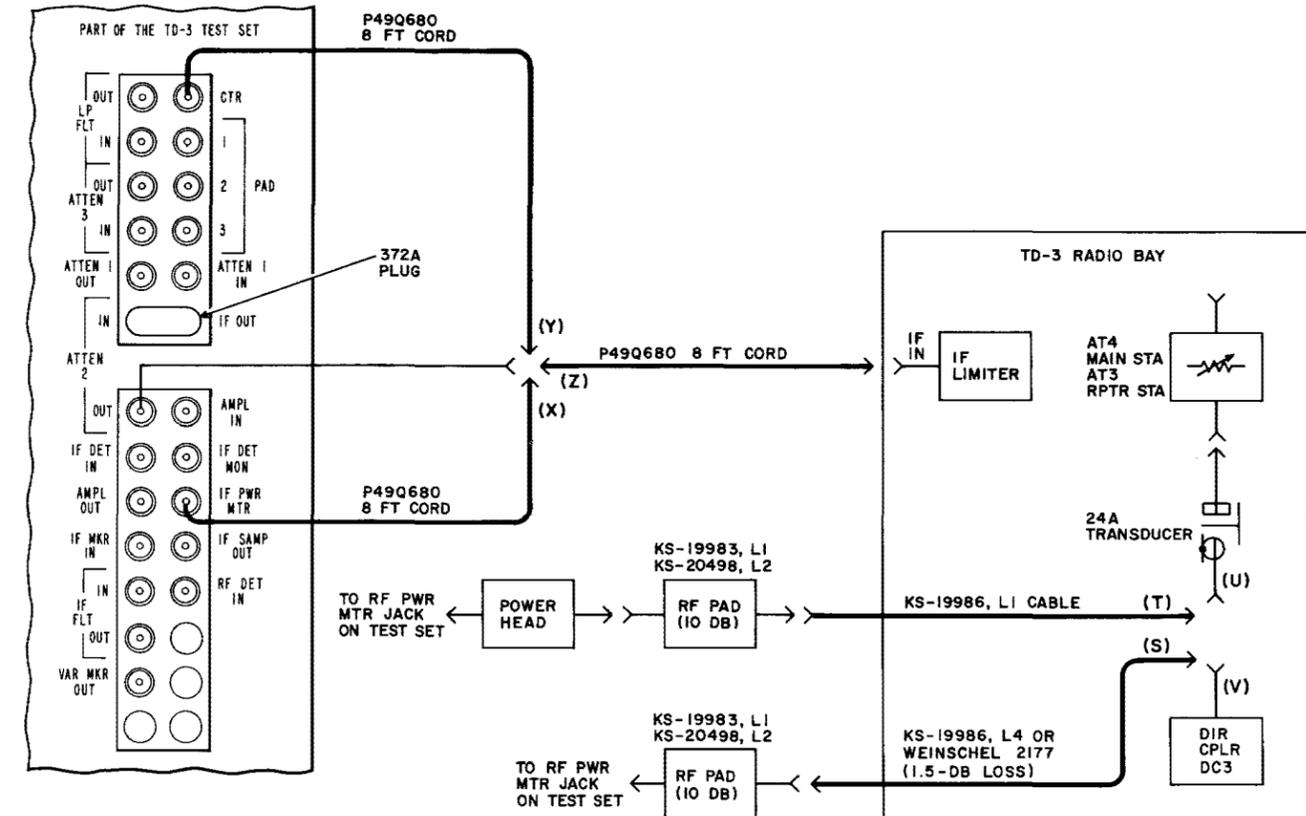


Fig. 4—Transmitter Power Measurement Test Setup

PREPARATION FOR TEST

1. Operate the test set controls to the following positions:

UNIT	CONTROL	POSITION
Control Panel IF SWEEP WIDTH	FUNCTION CTR Midrange	IF-IF MKR FREQ
Oscilloscope	INTENSITY	Midrange
Time Base Unit	POSITION MAGNIFIER SWEEP TIME VERNIER SINGLE-NORMAL	Midrange ×10 EXT Midrange NORMAL
	POSITION BANDWIDTH AMPLIFIER SENSITIVITY VERNIER AC-DC-OFF (+INPUT) AC-DC-OFF (-INPUT)	Midrange 4 DC 2 MV/CM Midrange DC OFF
Differential Amplifier Unit	INPUT CHANNEL POWER RANGE DBM	IF * -5

- Set ATTEN 2 to 17 dB.
- Establish test connections using option (U).
- Adjust ATTEN 2 to obtain -7 dBm.
- Change option (U) to option (W).

- Adjust the TEST TRACE controls on the test set control panel to center the trace on the oscilloscope screen.
  - Adjust the SWEEP TIME, VERNIER, and POSITION controls on the oscilloscope time base unit for approximately 10 centimeters horizontal deflection on the oscilloscope screen.
  - Adjust the IF MKR FREQ control on the test set control panel for a  $70 \pm 0.1$  MHz indication on the counter.
  - Adjust the IF SWEEP WIDTH and IF CENTER FREQ controls on the test set control panel to obtain the oscilloscope display shown in A.
- Note:** An extraneous marker appears at 89 MHz.
- Change connections to options (Y) and (V) or (X) according to which one is being measured.
  - Set the FUNCTION switch on the control panel to IF-RF.
  - Adjust the TEST TRACE and REF TRACE controls on the control panel so that the traces are coincident at 70 MHz.
  - Increase the attenuation of the variable pad by 0.5 dB and adjust the SENSITIVITY, VERNIER, and POSITION controls on the oscilloscope differential amplifier for 10 centimeters deflection between the traces. Return the variable pad to its previous setting. This calibrates the oscilloscope for 0.05 dB per centimeter.

**Note 1:** Frequency scale on the oscilloscope may be reversed for some units under test.

**Note 2:** An ac ripple cause by ground currents may appear on the test trace when option (X) or (V) is connected. The Weinschel Model 936N noise suppressor (supplied with the test set) inserted between the variable pad and low-pass filter usually is effective in eliminating a ripple of this type.

\* With the INPUT CHANNEL switch set to IF, determine that no input is connected; then zero the power meter by setting the POWER RANGE DBM switch to -25 and adjusting the METER ZERO control for an indication of ZERO on the meter. Return the POWER RANGE DBM switch to the position shown in Step 1.

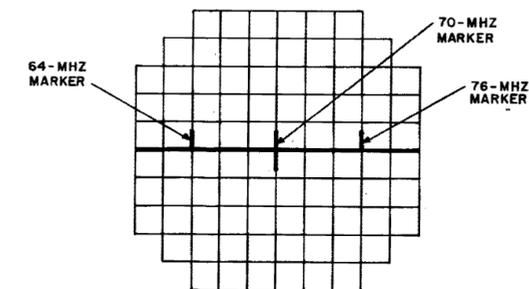
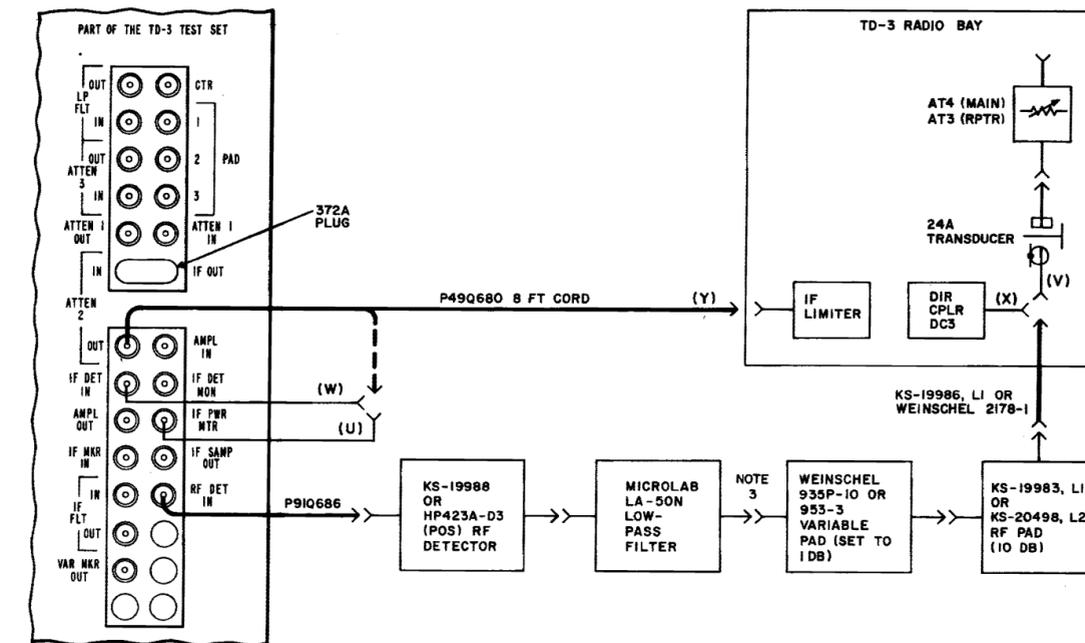


Fig. 5—IF-to-RF Amplitude Response Test Setup

PREPARATION FOR TEST

1. Operate the test set controls to the following positions:

UNIT	CONTROL	POSITION
Control Panel	FUNCTION CTR	IF-IF MKR FREQ
Oscilloscope	INTENSITY	Midrange
Time Base Unit	POSITION	Midrange
	MAGNIFIER	×10
	SWEEP TIME	EXT
	VERNIER	Midrange
Differential Amplifier Unit	SINGLE-NORMAL	NORMAL
	POSITION	Midrange
	BANDWIDTH	4
	AMPLIFIER	DC
	VERNIER	Midrange
	SENSITIVITY	2 MV/CM
	AC-DC-OFF (+INPUT)	DC
	AC-DC-OFF (-INPUT)	OFF
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF * -5

- Set ATTEN 2 to 17 dB.
- Establish test connections using options(W) and (X).
- Adjust ATTEN 2 to obtain -7 dBm.

- Change option (W) to option (Y).
  - Adjust the TEST TRACE controls on the test set control panel to center the trace on the oscilloscope screen.
  - Adjust the SWEEP TIME, VERNIER, and POSITION controls on the oscilloscope time base unit for approximately 10 centimeters horizontal deflection on the oscilloscope screen.
  - Adjust the IF MKR FREQ control on the test set control panel for a  $70 \pm 0.1$  MHz indication on the counter.
  - Adjust the IF SWEEP WIDTH and IF CENTER FREQ controls on the test set control panel to obtain the oscilloscope display shown in A.
- Note:** An extraneous marker appears at 89 MHz.
- Adjust the REF TRACE controls on the control panel so that the traces are coincident at 70 MHz.
  - Adjust the IF DET SLOPE control on the control panel for a flat trace.
  - Increase the attenuation of ATTEN 2 by 0.1 dB and adjust the SENSITIVITY, VERNIER, and POSITION controls on the oscilloscope differential amplifier for 2 centimeters deflection between the traces. Return ATTEN 2 to its previous setting. This calibrates the oscilloscope for 0.05 dB per centimeter.

**Requirement:** The test trace shall be flat to within 0.01 dB between 60 and 80 MHz.

If requirement is not met, adjust the IF DET SLOPE control on the control panel for a flat test trace, then reincident the traces with the TEST TRACE controls.

\* With the INPUT CHANNEL switch set to IF, determine that no input is connected; then zero the power meter by setting the POWER RANGE DBM switch to -25 and adjusting the METER ZERO control for an indication of ZERO on the meter. Return the POWER RANGE DBM switch to the position shown in Step 1.

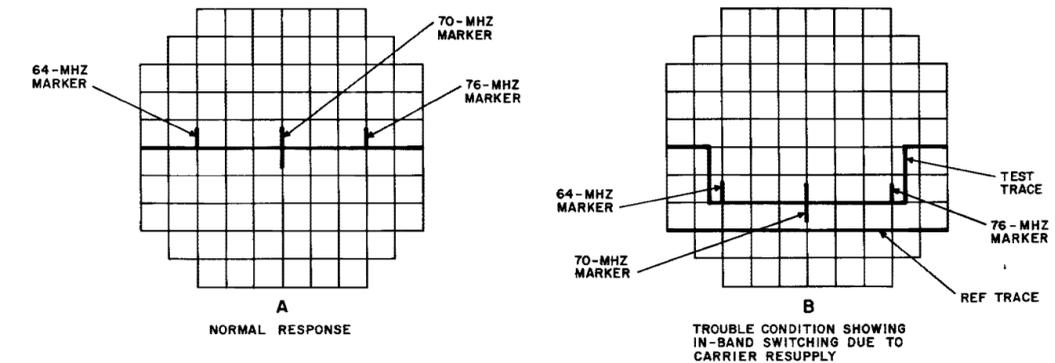
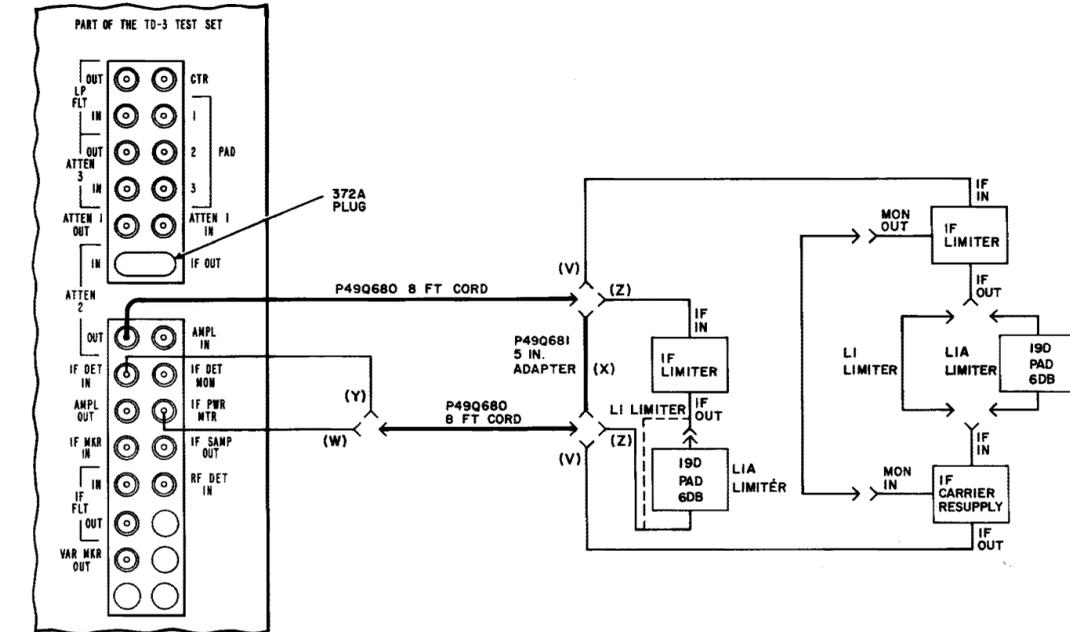
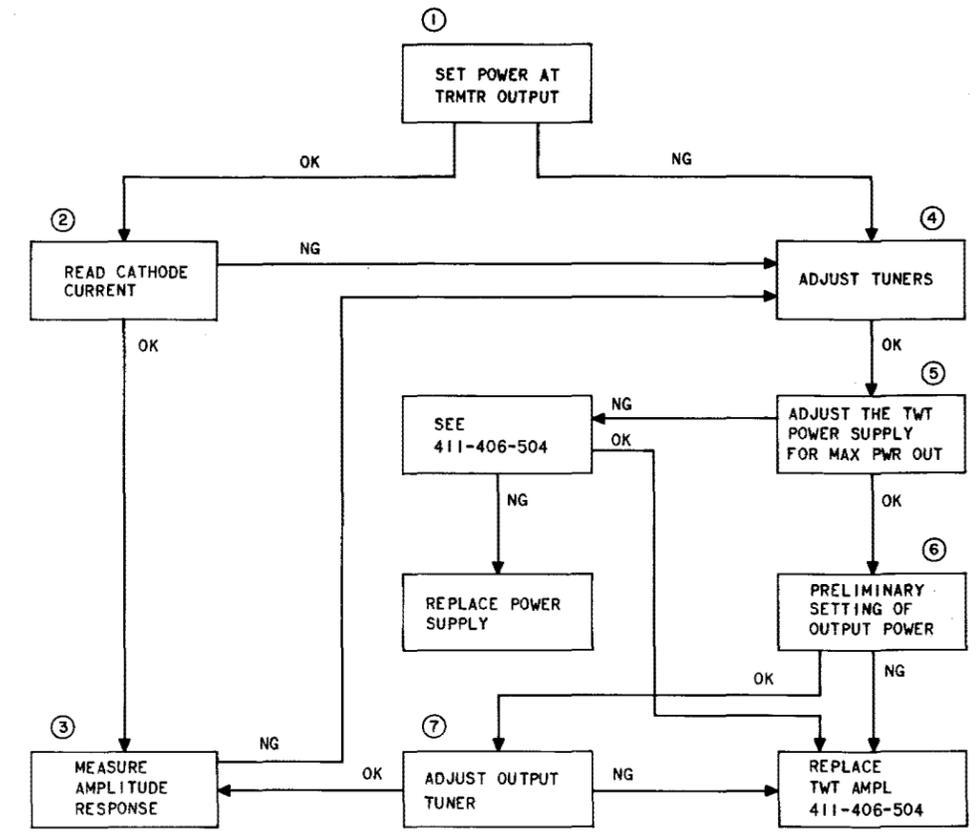


Fig. 6—IF-to-IF Amplitude Response Test Setup



NOTE:  
 THIS CHART IS AN AID FOR ROUTINING THE TWT AMPLIFIER. NUMBERS IN CIRCLES CORRESPOND TO THE STEPS OF CHART 6

Fig. 7—TWT Amplifier Test Chart