

**J68386G AND J68386H TRANSMITTER-RECEIVER BAYS**

**TRANSMITTER TRANSMISSION TESTS**

**TD-3 MICROWAVE RADIO**

CONTENTS	PAGE	CONTENTS	PAGE
1. GENERAL . . . . .	2	CHART 10—OVERALL TRANSMISSION TEST EQUIPPED WITH 660( ) IC USING THE J68428A TEST SET . . . . .	20
2. CHARTS . . . . .	4	CHART 11—IF LIMITER—CARRIER RESUPPLY TRANSMISSION ADJUSTMENT USING THE J68428A TEST SET . . . . .	22
CHART 1—OVERALL TRANSMISSION TEST EQUIPPED WITH TWT USING THE J68392A TEST SET . . . . .	4	CHART 12—IF DRIVER AMPLIFIER—TRANS- MITTER MODULATOR ADJUSTMENT EQUIPPED WITH TWT USING THE J68428A TEST SET . . . . .	23
CHART 2—OVERALL TRANSMISSION TEST EQUIPPED WITH 660( ) IC USING THE J68392A TEST SET . . . . .	7	CHART 13—IF DRIVER AMPLIFIER—TRANS- MITTER MODULATOR ADJUSTMENT EQUIPPED WITH 660( ) IC USING THE J68428A TEST SET . . . . .	24
CHART 3—IF LIMITER—CARRIER RESUPPLY TRANSMISSION ADJUSTMENT USING THE J68392A TEST SET . . . . .	8	CHART 14—TWT AMPLIFIER ADJUSTMENT USING THE J68428A TEST SET . . . . .	26
CHART 4—IF DRIVER AMPLIFIER—TRANS- MITTER MODULATOR ADJUSTMENT EQUIPPED WITH TWT USING THE J68392A TEST SET . . . . .	9	CHART 15—IF LIMITER—CARRIER RESUPPLY OPERATION CHECKS (FREQUENCY DIVER- SITY ONLY) USING THE J68428A TEST SET . . . . .	28
CHART 5—IF DRIVER AMPLIFIER—TRANS- MITTER MODULATOR ADJUSTMENT EQUIPPED WITH 660( ) IC USING THE J68392A TEST SET . . . . .	10	CHART 16—ALARM CHECKS AND ADJUST- MENTS USING THE J68428A TEST SET . . .	30
CHART 6—TWT AMPLIFIER ADJUSTMENT USING THE J68392A TEST SET . . . . .	12	CHART 17—660( ) IC TRANSMITTER AMPLI- FIER REPLACEMENT . . . . .	32
CHART 7—IF LIMITER—CARRIER RESUPPLY OPERATION CHECKS (FREQUENCY DIVER- SITY ONLY) USING THE J68392A TEST SET . . . . .	13	CHART 18—PREPARATION FOR TEST (Fig. 2) . . . . .	32
CHART 8—ALARM CHECKS AND ADJUST- MENTS USING THE J68392A TEST SET . . .	16	CHART 19—PREPARATION FOR TEST (Fig. 3) . . . . .	35
CHART 9—OVERALL TRANSMISSION TEST EQUIPPED WITH TWT USING THE J68428A TEST SET . . . . .	17	CHART 20—PREPARATION FOR TEST (Fig. 4) . . . . .	38

**NOTICE**

Not for use or disclosure outside the  
Bell System except under written agreement

CONTENTS	PAGE
CHART 21—PREPARATION FOR TEST (Fig. 5) .....	40
CHART 22—PREPARATION FOR TEST (Fig. 6) .....	43
CHART 23—PREPARATION FOR TEST (Fig. 7) .....	46
CHART 24—PREPARATION FOR TEST (Fig. 8) .....	47
CHART 25—PREPARATION FOR TEST (Fig. 9) .....	49
CHART 26—PREPARATION FOR TEST (Fig. 10) .....	52
CHART 27—PREPARATION FOR TEST (Fig. 11) .....	55
CHART 28—PREPARATION FOR TEST (Fig. 14) .....	58
CHART 29—PREPARATION FOR TEST (Fig. 15) .....	60
CHART 30—PREPARATION FOR TEST (Fig. 16) .....	61
CHART 31—PREPARATION FOR TEST (Fig. 17) .....	63
CHART 32—PREPARATION FOR TEST (Fig. 18) .....	64
CHART 33—PREPARATION FOR TEST (Fig. 19) .....	65

1. GENERAL

1.01 This section describes procedures for measuring and adjusting the gain and amplitude response of the radio transmitter in the J68386G and J68386H radio bays. Procedures for checking and adjusting the IF limiter—carrier resupply and for setting up transmitter alarms are also included, as well as instructions for hot standby only or hot standby/space diversity bays.

1.02 This section is reissued to add Charts 2, 5, 10, 13, and Preparation for Test Charts 18 through 33 which document the new solid-state 660E and F transmitter amplifier overall transmission test and IF driver amplifier—transmitter modulator adjustment procedures. Chart 17 was also added to provide replacement procedures for the 660E or F transmitter amplifier [660( ) integrated circuit (IC)]. Revision arrows are used to emphasize the more significant changes. The Equipment Test List is affected.

1.03 Section 411-500-501 (In-Service Checks) should be performed prior to performing this section, and the results should be used as a guide to any source of trouble. The preliminary checks in Section 411-502-500 should be completed before performing the tests in this section with the exception of Charts 7 and 15. The intermediate frequency (IF) return-loss test in Section 411-506-502, when required by the Equipment Test List, must be completed prior to these tests or after replacement of any transmitter unit.

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

1.05 Charts 1 through 8 are designed to be used with the J68392A test set. Charts 9 through 16 are for the J68428A test set. Charts 7 and 15 are omitted on hot standby only or hot standby/space diversity bays. The charts in either group must be performed in numerical order unless otherwise specified. The recommended maintenance interval is given in the Equipment Test List.

**DANGER 1: Energized waveguides should not be left unterminated. The radio frequency (RF) power density which may be encountered at output waveguide is potentially hazardous to the eyes and body tissue.**

**DANGER 2: Voltages inside the traveling-wave tube (TWT) power supply are much higher than those usually found in telephone power plants. Under no circumstances should the built-in interlock feature be defeated.**

**Caution 1: These tests are performed on an out-of-service basis. A release should be obtained from the authorized**

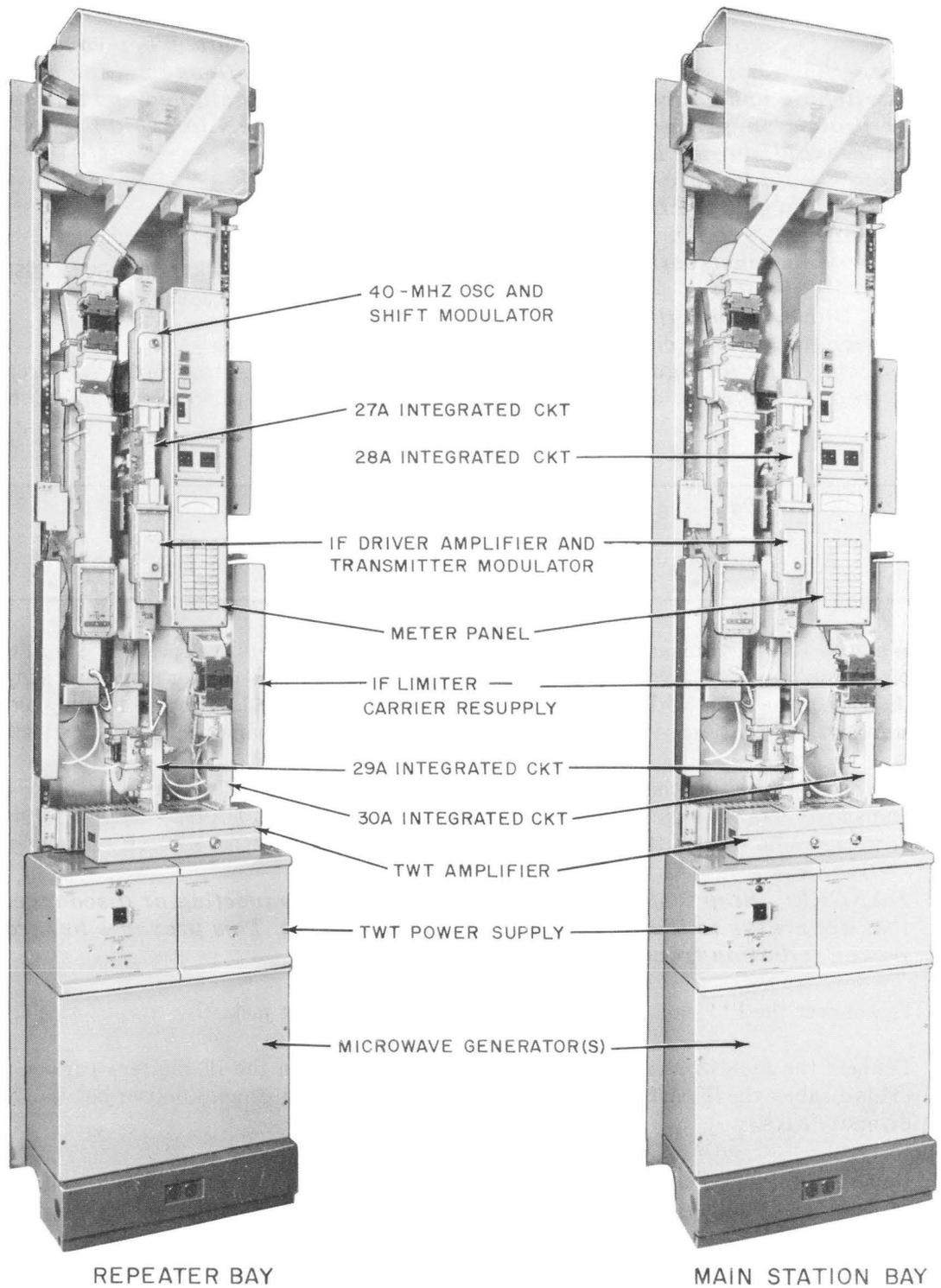


Fig. 1—Repeater and Main Station Bay—Transmitter Parts Location

*control office and the channel removed from service as directed by local practice.*

**Caution 2:** *Since hot standby/space diversity switching has no frequency allocated for protection, precautions should be taken to avoid service interruptions. The system should be force-switched to the radio bay in which the tests are NOT to be performed. Section 411-600-500 contains switching instructions.*

**Warning:** *During removal and replacement of waveguide units, care should be exercised to prevent foreign matter from entering the waveguide. All types of*

*waveguide should be carefully handled in order to prevent damage to flange mating surfaces and/or flexible waveguide segments. When connecting waveguide units, flange mating surfaces must be carefully aligned and all screws tightened securely to avoid RF leakage.*

2. CHARTS

CHART 1—OVERALL TRANSMISSION TEST EQUIPPED WITH TWT USING THE J68392A TEST SET

2.01 One J68392A transmitter-receiver test set is required to perform this procedure.

STEP	PROCEDURE
1	<p>When performing the main station (or hot standby/space diversity repeater station) transmitter test, disconnect the cable at the IF IN jack of the IF limiter—carrier resupply and terminate the end of the cable with a 188A adapter and a 20-dB 19A pad. (The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.)</p> <p><b>Note:</b> Terminating the cable is necessary to prevent reflections that might otherwise impair transmission in the signal (service-carrying) path back at the 100A transmitting IF switch bay or in the radio transmitter carrying service for hot standby/space diversity arrangements.</p> <p><b>DANGER:</b> <i>Step 2 should be performed prior to connecting or disconnecting the test apparatus to the 30A integrated circuit output. This prevents hazardous RF power radiation from the unterminated port.</i></p>
2	<p>Disconnect the P14 plug from the IF driver amplifier input jack.</p>
3	<p>Connect the P-48N309 cable assembly from TP1 to TP5 on the IF limiter—carrier resupply. (This disables the IF carrier resupply. Delete this step on hot standby only or hot standby/space diversity bays.)</p>
4	<p>Remove the 3-inch flexible waveguide from the transmitter, and connect a shorting plate to the exposed port leading to the 1432( ) transmitter channel combining network.</p>
5	<p>Connect the test set in accordance with Fig. 2; and complete Chart 18, Preparation for Test.</p>
6	<p>Terminate the coaxial TEST port on the 29A integrated circuit.</p>
7	<p>Reconnect the P14 plug to the IF driver amplifier input jack.</p>

## STEP

## PROCEDURE

- 8 Select COLL CUR on the meter panel.

**Requirement:**  $70 \pm 4$

If the requirement is not met, adjust the HELIX ADJ control on the power supply for a maximum power meter indication while maintaining the power meter indication at 70 with the ANODE ADJUST control. If the requirement is still not met, leave the ANODE ADJUST control in the counterclockwise position and adjust the HELIX ADJUST control for an indication of 70.

- 9 Measure the transmitter output power using the power meter.

**Requirement:** Greater than +35 dBm minus the calibrated loss of the 24B directional coupler, the RF attenuator, and the RF cable, if used.

If the requirement is not met, complete Charts 3, 4, and 5; then repeat this chart.

**Note:** The nut associated with the ATT, TUN 1, TUN 2, and MON ADJ controls on the 29A and 30A integrated circuits should exert some drag when the controls are being adjusted. When the nut is properly adjusted, it should be possible to adjust the controls with the fingers of one hand while the nut remains stationary. It is not necessary to lock the nut after making the adjustment.

- 10 Adjust the ATT control on the 29A integrated circuit while observing the power meter.

**Requirement:** +37 dBm

Required power meter indication equals +37 dBm [minus calibrated loss of the 24B directional coupler, plus RF attenuator, plus RF cable (if used)].

**Example:**

Calibrated 24B coupler loss	=	28.0 dB
Calibrated RF attenuator loss	=	10.0 dB
Calibrated RF cable loss (Option U only)	=	<u>1.5 dB</u>
Total Loss		39.5 dB
Transmitter output power	=	+37.0 dBm
Subtract total loss	=	<u>-39.5 dB</u>
Power meter indication	=	- 2.5 dBm

STEP	PROCEDURE
	<p><b>Note 1:</b> If the ATT control is set to deliver maximum power to the TWT (maximum counterclockwise), the TWT IN meter indication should be approximately 90.</p> <p>If the maximum output power obtainable from the transmitter is less than +37 dBm and the TWT IN meter indication is less than 90 (ATT maximum counterclockwise), the output power from the IF driver amplifier—transmitter modulator is too low. Perform Charts 3 and 4; then repeat this chart. If the maximum output power is less than +37 dBm and the TWT IN meter indication is approximately 90 (ATT maximum counterclockwise), the TWT gain is too low. Perform Charts 4 and 6; then repeat this chart.</p> <p><b>Note 2:</b> If the TWT IN meter indication is approximately 90 (ATT maximum counterclockwise) and the maximum output power from the transmitter is just +37 dBm, the TWT gain is low. This could occur if the input, output, and/or voltage adjustments associated with the TWT are significantly maladjusted or if the TWT is near its end of life.</p>
11	<p>Connect the test set in accordance with Fig. 3; complete Chart 19, Preparation for Test; and measure the amplitude response of the radio transmitter.</p> <p><b>Requirement:</b> The amplitude response shall be flat to within 0.30 dB between 8 MHz below and 8 MHz above the center frequency and to within 0.45 dB between 10 MHz below and 10 MHz above the center frequency.</p> <p>If the requirement is not met, check the IF limiter—carrier resupply gain and amplitude response in accordance with Chart 3, the driver amplifier and transmitter modulator gain and amplitude response in accordance with Chart 4, and the TWT amplifier gain and amplitude response in accordance with Chart 6; then repeat this chart. When the requirement is met in frequency diversity bays, proceed with Step 12. When the requirement is met in hot standby only or hot standby/space diversity bays, proceed to Step 13.</p>
12	<p>Disconnect the P-48N309 cable assembly connected in Step 3.</p> <p><b>Requirement:</b> There should be no evidence of IF limiter—carrier resupply switching from 10 MHz below through 10 MHz above the center frequency. (See Fig. 6B for an example of this condition.)</p> <p>If the requirement is not met, perform Chart 7; if the requirement is still not met, replace the IF limiter—carrier resupply unit and perform Charts 3 and 7.</p>
13	<p>After the requirements are met, perform Charts 7 and 8 for bays with frequency diversity protection switching and Chart 8 for hot standby only or hot standby/space diversity bays.</p> <p><b>Note:</b> If Chart 7 was performed satisfactorily in Step 12, repetition of Chart 7 is not necessary.</p>

**◆CHART 2—OVERALL TRANSMISSION TEST EQUIPPED  
WITH 660( ) IC USING THE J68392A TEST SET**

**2.02** One J68392A transmitter-receiver test set is required to perform this procedure.

STEP	PROCEDURE
	<p><b><i>DANGER:</i></b> The IF input drive power to the driver amplifier must be removed when making or changing the test connections to the monitor-shutter assembly.</p>
1	<p>When performing the main station (or hot standby/space diversity repeater station) transmitter test, disconnect the cable at the IF IN jack of the driver amplifier and terminate the end of the cable with a 20-dB 63A pad. (The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.)</p> <p><b>Note:</b> Terminating the cable is necessary to prevent reflections that might otherwise impair transmission in the signal (service-carrying) path back at the transmitting IF switch bay or in the radio transmitter carrying service for hot standby/space diversity arrangements.</p>
2	<p>Verify that the input to the IF IN jack on the driver amplifier-transmitter modulator is removed.</p>
3	<p>Remove the cover from the access slot on the ED-52277-30 monitor-shutter assembly.</p>
4	<p>Insert an ED-51568-( ) shorting plate into each of the three access slots (only one access slot on hot standby/space diversity transmitters).</p>
5	<p>Remove the cap from coaxial port A on the monitor-shutter assembly and insert the ED-51567-( ) probe assembly.</p>
6	<p>Perform Chart 20, Preparation for Test for Fig. 4.</p>
7	<p>With the input applied to the driver amplifier, options (W) and (D) of Fig. 4, calculate the output power.</p> <p><b>Note:</b> Adjust the PWR ADJ control on the 660( ) IC fully clockwise (ie, for maximum amplifier gain).</p> <p>Output power = loss of pads + loss of the KS-19986 cable + power meter indication.</p> <p><b>Requirement (Intermediate):</b> +37 dBm</p> <p><b>Note:</b> The 660E and F IC amplifiers are 4-stage units for use in 5-watt systems only. The E unit covers the 3700- to 3940-MHz range. The F unit covers the 3940- to 4200-MHz range.</p>

STEP	PROCEDURE
8	<p>Adjust the BIAS control on the transmitter modulator unit for maximum power output. Using the GAIN control on the transmitter modulator unit, increase the power to +37.3 dBm or until the output power shows no further increase, <b>whichever comes first</b>. Then, using the GAIN control, reduce the output power by 0.3 dB and note the power.</p> <p><b>Note 1:</b> If the power cannot be reduced to +37 dBm with the GAIN control fully counterclockwise, turn the PWR ADJ control on the 660( ) IC counterclockwise (increasing attenuation) to reduce the output power.</p> <p><b>Note 2:</b> The amplitude modulation/phase modulation (AM/PM) conversion coefficient of the modulator is very sensitive to the setting of the DIODE BIAS control. To minimize the AM/PM conversion, the DIODE BIAS control should only be adjusted for a maximum power output.</p> <p><b>Requirement (Final):</b> +37 dBm +0.1, -0.4 dB</p>
9	<p>Make test set connections as shown in Fig. 5, options (D) and (W); and complete Chart 21, Preparation for Test.</p>
10	<p>Measure the response.</p> <p><b>Requirement:</b> The amplitude response shall be flat to within 0.30 dB between 8 MHz below and 8 MHz above the center frequency and to within 0.45 dB between 10 MHz below and 10 MHz above the center frequency. The test trace shall have a smooth characteristic with no sharp discontinuities or steps over the 20-MHz band.</p> <p>If the requirement is not met, complete Charts 3 and 5; then repeat this chart.</p> <p>If the requirement still is not met, a 660( ) IC amplifier is defective and should be replaced as directed in Chart 17.</p>
11	<p>When the requirement is met, maintain the test arrangement and proceed to Chart 8, Alarm Adjustment.⬇</p>

**CHART 3—IF LIMITER—CARRIER RESUPPLY TRANSMISSION ADJUSTMENT USING THE J68392A TEST SET**

- |  |  |
|--|--|
| <p><b>2.03</b> The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.</p> | <p><b>2.04</b> If the requirements in this chart are not met, replace the IF limiter—carrier resupply unit.</p>                        |
|  | <p><b>2.05</b> One KS-20114, L2 adjusting tool and one J68392A transmitter-receiver test set are needed to perform this procedure.</p> |

STEP	PROCEDURE
1	<p>Connect the test set in accordance with Fig. 6; and complete Chart 22, Preparation for Test.</p> <p><b>Note:</b> For easy alignment, remove the unit and brackets by loosening the two screws which fasten the brackets to the bay. Hang the unit above its present location onto the bay frame post provided (use bracket hole to hang unit).</p>
2	<p>Connect options (Z) and (Y), and observe the test trace on the oscilloscope.</p> <p><b>Requirement:</b> The test trace and reference trace should coincide at 70 MHz and shall be flat to within 0.05 dB between 60 and 80 MHz.</p> <p>If the requirement is not met, adjust the GAIN and SLOPE controls until the requirement is met. If the requirement still cannot be met, replace the IF limiter—carrier resupply unit.</p>
3	Connect options (Z) and (W).
4	Adjust the IF SWEEP WIDTH control on the test set completely counterclockwise.
5	Record the power meter indication.
6	<p>Increase the ATTEN 2 setting by 5 dB.</p> <p><b>Requirement:</b> The power meter indication should be within 1 dB of that recorded in Step 5.</p>

**CHART 4—IF DRIVER AMPLIFIER—TRANSMITTER MODULATOR ADJUSTMENT EQUIPPED WITH TWT USING THE J68392A TEST SET**

**2.06** If the requirements in this chart are not met, refer to Section 411-506-503 for troubleshooting procedures.

**2.07** One KS-20114, L2 adjusting tool and one J68392A transmitter-receiver test set are required to perform this procedure.

STEP	PROCEDURE
1	<p>Remove the termination from the TEST port of the 29A integrated circuit. (The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.)</p>

STEP	PROCEDURE
2	Connect the test set in accordance with Fig. 2; and complete Chart 18, Preparation for Test.
3	Adjust the ATT control on the 29A integrated circuit for maximum power output at the TEST port. (Maximum power is obtained by turning the attenuator counterclockwise.)  <b>Requirement:</b> +9 dBm minus the calibrated loss of the RF attenuator and RF cable, if used.  If the requirement is not met, adjust the DIODE BIAS control on the IF driver amplifier for maximum output; then adjust the GAIN control.  <b>Note:</b> The AM/PM conversion coefficient of the modulator is very sensitive to the setting of the DIODE BIAS control. To minimize the AM/PM conversion, the DIODE BIAS control should only be adjusted for a maximum power output.
4	Connect the test set in accordance with Fig. 3; complete Chart 19, Preparation for Test; and measure the amplitude response of the IF driver amplifier—transmitter modulator.  <b>Requirement:</b> The amplitude response shall be flat to within $\pm 0.20$ dB between 8 MHz below and 8 MHz above the center frequency and to within $\pm 0.30$ dB between 10 MHz below and 10 MHz above the center frequency.  If the requirement is not met, adjust the SLOPE control to meet the requirement. If necessary, adjust the GAIN control to keep the traces coincident.
5	Select, in turn, TRMTR MOD BIAS and DR AMPL OUT and record the indication for each on the meter panel.
6	Remove the connection from the TEST port on the 29A integrated circuit, and replace the termination on the 29A integrated circuit.
7	Readjust the ATT control on the 29A integrated circuit for the TWT IN meter indication recorded on the meter panel.

**CHART 5—IF DRIVER AMPLIFIER—TRANSMITTER MODULATOR ADJUSTMENT EQUIPPED WITH 660( ) IC USING THE J68392A TEST SET**

**2.09** One J68392A transmitter-receiver test set and one 1/4-inch open-end wrench are needed to perform this procedure.

**2.08** If the procedures in this chart are not met, refer to Section 411-506-503 for troubleshooting procedures.

STEP	PROCEDURE
	<p><b>DANGER:</b> <i>The IF input drive power to the driver amplifier must be removed when making or changing the test connections to the 1431( ) network.</i></p>
1	Complete Chart 20, Preparation for Test for Fig. 4.
2	Verify that the input to the IF IN jack on the driver amplifier is removed.
3	Remove the flexible waveguide section between the support bracket and output of the 1431( ) network.
4	Connect a 24A transducer to the output of the 1431( ) network.
5	Terminate the input of the waveguide bend with a shorting plate.
6	Connect the test set in accordance with Fig. 4, options (W), (A), and (U) or (V).
7	Adjust the BIAS control on the driver amplifier for maximum power indication.
	<p><b>Note:</b> The AM/PM conversion coefficient of the modulator is very sensitive to the setting of the DIODE BIAS control. To minimize the AM/PM conversion, the DIODE BIAS control should only be adjusted for a maximum power output.</p>
8	Calculate the output power.
	<p>Output power = loss of pads + loss of the KS-19986 cable + power meter indication.</p> <p><b>Requirement:</b> +8 dBm <math>\pm</math>0.25 dB</p> <p>If the requirement is not met, adjust the GAIN control on the driver amplifier to meet the requirement.</p> <p><b>Note:</b> If the GAIN control has insufficient adjustment range to reduce the gain to the required power, replace the driver amplifier-transmitter modulator.</p> <p><b>Caution:</b> <i>The BIAS control must not be changed for transmission adjustments; otherwise, an adverse effect on the AM/PM conversion of the transmitting modulator will occur.</i></p>
9	Change the test arrangement to Fig. 5, using the 24A transducer, option (A); and perform Chart 21, Preparation for Test.
10	Measure the swept frequency response of the driver amplifier-transmitter modulator.
	<p><b>Requirement:</b> The amplitude response shall be flat to within 0.20 dB between 8 MHz below and 8 MHz above the center frequency and to within 0.30 dB between 10 MHz below and 10 MHz above the center frequency.</p>

STEP	PROCEDURE
11	<p>If the requirement is not met, adjust the SLOPE and GAIN controls to meet the requirement. If the requirement is still not met, replace the driver amplifier-transmitter modulator and repeat this chart.</p> <p>With tests completed, disconnect the IF input, remove the 24A transducer and shorting plate, and return the waveguide section.▲</p>

**CHART 6—TWT AMPLIFIER ADJUSTMENT USING THE J68392A TEST SET**

<p><b>2.10</b> The TWT should have been energized for at least 20 minutes so that it is at normal operating temperature, and the IF driver amplifier—transmitter modulator should have been checked in accordance with Chart 4 before performing any test in this chart. The hot standby only or hot standby/</p>	<p>space diversity bays must be switched off of the channel which is to be tested.</p> <p><b>2.11</b> If the requirements in this chart are not met, refer to Section 411-506-504 for troubleshooting procedures.</p> <p><b>2.12</b> One J68392A transmitter-receiver test set is required to perform this procedure.</p>
---	---

STEP	PROCEDURE
1	Connect the test set in accordance with Fig. 2; and complete Chart 18, Preparation for Test.
2	<p>Select COLL CUR on the meter panel, and adjust the HELIX ADJ control on the power supply for a maximum power meter indication while maintaining the power meter indication at 70 with the ANODE ADJUST control.</p> <p><b>Requirement:</b> 70 ±1 (panel meter)</p> <p><b>Note:</b> If a COLL CUR indication of 70 cannot be obtained by adjusting the ANODE ADJUST control, leave the ANODE ADJUST control in the counterclockwise position and adjust the HELIX ADJUST control for an indication of 70.</p>
3	Adjust the TUN 1 and TUN 2 controls on the 29A and 30A integrated circuits for maximum transmitter power output as indicated on the power meter.
4	<p>Adjust the ATT control on the 29A integrated circuit to meet the following requirement.</p> <p><b>Requirement:</b> +37 dBm minus the calibrated loss of the 24B directional coupler, the RF attenuator, and the RF cable, if used.</p>

STEP	PROCEDURE
5	Connect the test set in accordance with Fig. 3; and complete Chart 19, Preparation for Test.
6	Adjust the TUN 1 and TUN 2 controls on the 30A integrated circuit to meet the following requirement.  <b>Requirement:</b> The amplitude response shall be flat to within 0.20 dB between 8 MHz below and 8 MHz above the center frequency and to within 0.35 dB between 10 MHz below and 10 MHz above the center frequency.  <b>Note:</b> The test trace displays the combined amplitude response of the IF driver amplifier—transmitter modulator and TWT amplifier.
7	Connect the test set in accordance with Fig. 2; complete Chart 18, Preparation for Test; and check the transmitter output power.  <b>Requirement:</b> Greater than +36 dBm minus the calibrated loss of the 24B directional coupler, RF attenuator, and RF cable, if used.
8	With the ATT control in the 29A integrated circuit, adjust the transmitter output power to meet the requirement.  <b>Requirement:</b> +37 dBm (power meter indication equal to +37 dBm minus the calibrated loss of the 24B directional coupler, RF attenuator, and RF cable, if used).
9	Select TWT IN and COLL CUR on the meter panel, and record each meter indication.
<b>CHART 7—IF LIMITER—CARRIER RESUPPLY OPERATION CHECKS (FREQUENCY DIVERSITY ONLY) USING THE J68392A TEST SET</b>	
2.13	If the requirements in this chart are not met, replace the IF limiter—carrier resupply unit.
2.14	One KS-20114, L2 adjusting tool and one J68392A transmitter-receiver test set are required to perform this procedure.

STEP	PROCEDURE
<b>A. Carrier Resupply 70-MHz Frequency and Output Power Checks</b>	
1	Connect the test set in accordance with Fig. 7, option (X); and complete Chart 23, Preparation for Test.

STEP	PROCEDURE
2	Measure the 70-MHz output power.  <b>Requirement:</b> $-7 \text{ dBm} \pm 1 \text{ dB}$
3	Connect option (Y), and measure and record the output frequency.  <b>Requirement:</b> $70 \pm 0.006 \text{ MHz}$
<b>B. Carrier Resupply 61-MHz Frequency and Output Power Checks</b>	
4	Connect the test set in accordance with Fig. 8A, and perform Chart 24 Preparation for Test procedures to calibrate the test setup.
5	Connect the test set in accordance with Fig. 8B, option (X).
6	Adjust the 9 MHz LEV control of the IF limiter—carrier resupply to meet the following requirement.  <b>Requirement:</b> $-10 \text{ dBm} \pm 0.5 \text{ dB}$  <b>Note:</b> The requirement corresponds to $-42 \text{ dBm} \pm 0.5 \text{ dB}$ at the IF limiter—carrier resupply output.
7	Select CRS 9 MHz on the panel meter, and adjust the 9 MHz ALM V control to meet the following requirement.  <b>Requirement:</b> $59 \pm 5$
8	Connect option (Y) and measure the frequency. (Subtract this frequency from that recorded in Step 3.)  <b>Requirement:</b> $9 \pm 0.0015 \text{ MHz}$
<b>C. Carrier Resupply Trip and Restore Checks</b>	
9	Connect the test set in accordance with Fig. 9, option (Z); and complete Chart 25, Preparation for Test.
10	Select the CRS SW V on the meter panel and record the meter indication.
11	Slowly increase the attenuation of ATTEN 3 until the CRS SW V meter indication just drops to zero.
12	Connect option (X) and measure the power.  <b>Requirement:</b> $-16 \text{ dBm} \pm 0.5 \text{ dB}$

STEP	PROCEDURE
	If the requirement is not met, complete Steps 16 through 19.
13	Connect option (Z), and set the POWER RANGE DBM control to the -10 position.
14	Decrease the ATTEN 3 setting until the CRS SW V indication just returns to within $\pm 5$ units of the recorded value in Step 10.
	<b>Note:</b> An indication of approximately 0 on the meter panel shows that the IF limiter—carrier resupply has tripped. An indication of approximately 2/3 scale on the panel meter shows that the IF limiter—carrier resupply is restored.
15	Connect option (X) and measure the power.
	<b>Requirement:</b> Between -15 dBm and -12.5 dBm.
	If the requirement is not met and Steps 16 through 19 were performed in Step 12, replace the IF limiter—carrier resupply unit and repeat Chart 3 and this chart. If the requirement is not met and Steps 16 through 19 were not performed in Step 12, perform Steps 16 through 19 to meet the requirement. If the requirement still is not met, replace the IF limiter—carrier resupply unit and repeat Chart 3 and this chart.
	<b>D. Carrier Resupply Trip Point Adjustment</b>
16	Adjust the ATTEN 3 setting until the power meter indicates -16 dBm.
17	Connect option (Z).
18	Set the TRIP control fully clockwise.
19	Slowly rotate the TRIP control counterclockwise until the CRS SW V indication on the meter panel drops to zero.
20	Set the POWER RANGE DBM control to the -5 position.
21	Connect option (X), and adjust the ATTEN 3 setting for a power meter indication of -7 dBm.
22	Connect option (Z).
23	Record the meter panel indications for LIM CUR, LIM IN, CRS 70 MHz, CRS 9 MHz, and CRS SW V.

**CHART 8—ALARM CHECKS AND ADJUSTMENTS USING  
THE J68392A TEST SET**

2.15 One J68392A transmitter-receiver test set is required to perform this procedure.

STEP	PROCEDURE
<b>A. Carrier Resupply 9-MHz Alarm Checks (Frequency Diversity Only)</b>	
1	Adjust the 9 MHz LEV control counterclockwise until the CRS 9 MHz alarm lamp on the alarm panel just lights.
2	Select CRS 9 MHz on the meter panel.
<b>Requirement:</b> Between 18 and 42.	
3	Readjust the 9 MHz LEV for a CRS 9 MHz indication equal to the value recorded on the meter panel.
<b>B. Transmitter Output Power Alarm Checks and Adjustments</b>	
<b>Note:</b> The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.	
4	Connect the test set in accordance with Fig. 2, options (X), (Z) and (U) or (V), and complete Chart 18, Preparation for Test, for bays equipped with a TWT; or Fig. 4, option (X) only, for bays equipped with a 660( ) IC, and complete Chart 20, Preparation for Test.
5	Record the power meter indication.
6	Increase the ATTEN 2 setting until the TRMTR OUT alarm lamp just lights on the alarm panel.
7	Record the power meter indication.
<b>Requirement:</b> The difference in this indication and that of Step 5 shall be between 2 and 4 dB.	
If the requirement is not met, perform only Steps 8 through 10.	
8	Readjust the ATTEN 2 setting for the same power meter indication recorded in Step 5.
9	Increase the ATTEN 2 setting until the power meter indication drops by 3 dB.

STEP	PROCEDURE
10	<p>If the bay is equipped with a TWT, adjust the MON ADJ control on the 30A integrated circuit until the TRMTR OUT alarm lamp just lights. If the bay is equipped with a 660( ) IC, adjust the 76C detector until the TRMTR OUT alarm lamp just lights. To adjust the 76C detector, proceed as follows:</p> <ul style="list-style-type: none"> <li>(a) Loosen the large brass knurled locknut by turning it counterclockwise several turns.</li> <li>(b) Slightly loosen the stainless steel knurled nut to allow the brass knurled barrel to rotate smoothly.</li> <li>(c) While holding the body of the 76C detector to prevent it from rotating, turn the barrel to change the coupling to the detector—clockwise rotation decreases the coupling; counterclockwise rotation increases the coupling.</li> <li>(d) When the correct coupling is reached, tighten both locking nuts while keeping the barrel and detector body from moving.</li> </ul> <p><b>Note:</b> If the TRMTR OUT lamp is lit, adjust the MON ADJ or 76C detector control to extinguish the lamp.</p>
11	Readjust the ATTEN 2 setting for the same power meter indication as recorded in Step 5.
12	Record the TRMTR OUT meter indication.
13	Remove the P14 plug from the IF input jack on the IF driver amplifier.
14	Disconnect all test connections and apparatus from the transmitter.
	<b>DANGER:</b> To avoid potential RF power radiation, the P14 plug should be connected last.
15	Reconnect the normal transmitter connections, connecting the P14 plug to the IF input jack of the IF driver amplifier last.

**CHART 9—OVERALL TRANSMISSION TEST EQUIPPED WITH TWT USING THE J68428A TEST SET**

**2.16** One J68428A transmitter-receiver test set is required to perform this procedure.

## STEP

## PROCEDURE

- 1 When performing the main station (or hot standby/space diversity repeater station) transmitter test, disconnect the cable at the IF IN jack of the IF limiter—carrier resupply and terminate the end of the cable with a 20-dB 63A pad. The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.

**Note:** Terminating the cable is necessary to prevent reflections that might otherwise impair transmission in the signal (service-carrying) path back at the 100A transmitting IF switch bay or in the radio transmitter carrying service for hot standby/space diversity arrangements.

**DANGER:** *Step 2 should be performed prior to connecting or disconnecting the test apparatus to the 30A integrated circuit output. This prevents hazardous RF power radiation from the unterminated port.*

- 2 Disconnect the P14 plug from the IF driver amplifier input jack.
- 3 Connect the P-48N309 cable assembly from TP1 to TP5 on the IF limiter—carrier resupply. (Delete this step on hot standby only or hot standby/space diversity bays.)
- 4 Remove the 3-inch flexible waveguide from the transmitter, and connect a shorting plate to the exposed port leading to the 1432( ) transmitter channel combining network.
- 5 Connect the test set in accordance with Fig. 15; and complete Chart 29, Preparation for Test.
- 6 Verify that the coaxial TEST port on the 29A integrated circuit is terminated.
- 7 Reconnect the P14 plug to the IF driver amplifier input jack.
- 8 Select COLL CUR on the meter panel.

**Requirement:**  $70 \pm 4$

If the requirement is not met, adjust the HELIX ADJ control on the power supply for a maximum power meter indication while maintaining the panel meter indication at 70 with the ANODE ADJUST control. If the requirement is still not met, leave the ANODE ADJUST control in the counterclockwise position and adjust the HELIX ADJUST control for an indication of 70.

- 9 Measure the transmitter output power using the power meter.

**Requirement:** For test sets equipped with J68428C and D panels: Greater than +35 dBm minus the calibrated loss of the 24B directional coupler and the RF attenuator. For test sets equipped with J68428F panel: Greater than +35 dBm minus the calibrated loss of the 10-dB RF pad and the 30-dB RF pad.

If the requirement is not met, complete Charts 11, 12, and 14; then repeat this chart.

STEP	PROCEDURE
------	-----------

**Note:** The nut associated with the ATT, TUN 1, TUN 2, and MON ADJ controls on the 29A and 30A integrated circuits should exert some drag when the controls are being adjusted. When the nut is properly adjusted, it should be possible to adjust the controls with the fingers of one hand while the nut remains stationary. It is not necessary to lock the nut after making the adjustment.

- 10 Adjust the ATT control on the 29A integrated circuit while observing the power meter.

**Requirement:** +37 dBm

For test sets equipped with the J68428C and D panels, the required power meter indication equals +37 dBm (minus calibrated loss of the 24B directional coupler plus RF attenuator). For test sets equipped with the J68428F panel, the required power meter indication equals +37 dBm (minus calibrated loss of 10-dB RF pad plus 30-dB RF pad).

**Example:** For test sets with J68428C and D panels, the calculation is:

Calibrated 24B coupler loss	=	28.0 dB
Calibrated RF attenuator loss	=	<u>10.0 dB</u>
Total Loss		38.0 dB
Transmitter output power	=	+37.0 dBm
Subtract total loss	=	<u>-38.0 dB</u>
Power meter indication	=	- 1.0 dBm

**Note 1:** If the ATT control is set to deliver maximum power to the TWT (maximum counterclockwise), the TWT IN meter indication should be approximately 90.

If the maximum output power that can be obtained from the transmitter is less than +37 dBm and the TWT IN meter indication is less than 90 (ATT maximum counterclockwise), the output power from the IF driver amplifier—transmitter modulator is too low. Perform Charts 11 and 12, and repeat this chart. If the maximum output power is less than +37 dBm and the TWT IN meter indication is approximately 90 (ATT maximum counterclockwise), the TWT gain is too low. Perform Charts 12 and 14, and repeat this chart.

**Note 2:** If the TWT IN meter indication is approximately 90 (ATT maximum counterclockwise) and the maximum output power from the transmitter is just +37 dBm, the TWT gain is low. This could occur if the input, output, and/or voltage adjustments associated with the TWT are significantly misadjusted or if the TWT is near its end of life.

- 11 Connect the test set in accordance with Fig. 16; and complete Chart 30, Preparation for Test.
- 12 Measure the amplitude response of the radio transmitter.

STEP	PROCEDURE
	<p><b>Requirement:</b> The amplitude response shall be flat to within 0.30 dB between 8 MHz below and 8 MHz above the center frequency and to within 0.45 dB between 10 MHz below and 10 MHz above the center frequency.</p> <p>If the requirement is not met, check the IF limiter—carrier resupply gain and amplitude response in accordance with Chart 11, the driver amplifier and transmitter modulator gain and amplitude response in accordance with Chart 12, and the TWT amplifier gain and amplitude response in accordance with Chart 14; then repeat this chart. When the requirement is met in frequency diversity bays, continue with Step 13. When the requirement is met in hot standby only or hot standby/space diversity bays, proceed to Step 14.</p>
13	<p>Disconnect the P-48N309 cable assembly connected in Step 3.</p> <p><b>Requirement:</b> There should be no evidence of IF limiter—carrier resupply switching from 10 MHz below through 10 MHz above the center frequency. (See Fig. 17 for an example of this condition.)</p> <p>If the requirement is not met, perform Chart 15; if the requirement is still not met, replace the IF limiter—carrier resupply unit and perform Charts 11 and 15.</p>
14	<p>After the requirements are met, perform Charts 15 and 16 for bays with frequency diversity protection switching, and Chart 16 for hot standby only or hot standby/space diversity bays.</p> <p><b>Note:</b> If Chart 15 was performed satisfactorily in Step 13, repetition of Chart 15 is not necessary.</p>

**▶CHART 10—OVERALL TRANSMISSION TEST EQUIPPED WITH 660( ) IC USING THE J68428A TEST SET**

**2.17** When performing the transmitter test, disconnect the cable at the IF IN jack of the IF driver amplifier and terminate the end of the cable using an 840543986 adapter cable and a 75-ohm termination plug.

**2.18** The cable must be terminated to prevent reflections. When performing main station transmitter tests, these reflections would impair

transmission in the signal path (the service-carrying path) in the frequency diversity switching IF switch bay. When performing repeater transmitter tests, the reflections would affect transmission in the transmitter that carries service for hot standby/space diversity operation.

**2.19** One J68428A transmitter-receiver test set is required to perform this procedure.

STEP	PROCEDURE
	<p><b>DANGER:</b> <i>The IF input drive power to the driver amplifier must be removed when making or changing the test connections to the monitor-shutter assembly.</i></p>
1	Verify that the input to the IF IN jack on the driver amplifier-transmitter modulator is removed.
2	Remove the cover from the access slot on the ED-52277-30 monitor-shutter assembly.
3	Insert an ED-51568-( ) shorting plate into each of the three access slots. (The hot standby only or hot standby/space diversity transmitters have only one access slot.)
4	Remove the cap from coaxial port A on the monitor-shutter assembly, and insert the ED-51567( ) probe assembly.
5	Perform Chart 26, Preparation for Test for Fig. 10.
6	Make the test connections as shown in Fig. 11, option (D); complete Chart 27, Preparation for Test; and calculate the output power.
	<p><b>Note:</b> Adjust the PWR ADJ control on the 660( ) IC fully clockwise (ie, for maximum amplifier gain).</p> <p>Output power = loss of pads (RF pads AT1 and AT3) + loss of RF power divider (6 dB) + power meter indication.</p> <p><b>Requirement (Intermediate):</b> +37 dBm</p> <p><b>Note:</b> The 660E and F IC amplifiers are 4-stage units for use in 5-watt systems only. The 660E unit covers the 3700- to 3940-MHz range. The 660F unit covers the 3940- to 4200-MHz range.</p>
7	Adjust the BIAS control on the transmitter modulator unit for maximum power output. Using the GAIN control on the transmitter modulator unit, increase the power to +37.3 dBm or until the output power shows no further increase, <b>whichever comes first</b> . Then, using the GAIN control, reduce the output power by 0.3 dB and note the power.
	<p><b>Note 1:</b> If the power cannot be reduced to +37 dBm with the GAIN control fully counterclockwise, turn the PWR ADJ control on the 660( ) IC counterclockwise (increasing attenuation) to reduce the output power.</p> <p><b>Note 2:</b> The AM/PM conversion coefficient of the modulator is very sensitive to the setting of the DIODE BIAS control. To minimize the AM/PM conversion, the DIODE BIAS control should only be adjusted for a maximum power output.</p> <p><b>Requirement (Final):</b> +37 dBm +0.1, -0.4 dB</p>
8	Set the IF MODE control on the sweep oscillator to the IF ΔF position.

STEP	PROCEDURE
9	Set the VOLTS/DIV control to the 1m position, and position the trace on the oscilloscope display with the TEST TRACE COARSE control on the control unit.
10	Adjust the oscilloscope horizontal POSITION and VERNIER controls such that the two end markers coincide with full horizontal deflection.
11	Decrease the RF variable pad loss by 0.4 dB. Adjust the VOLTS/DIV CAL control to bring the test trace up 4 centimeters from the center line.
12	Increase the RF variable pad loss by 0.4 dB. Adjust the vertical POSITION control to move the test trace back to the center horizontal line, if necessary.
13	Repeat Steps 11 and 12 until decreasing and increasing the variable pad loss by 0.4 dB shifts the test trace 4 centimeters up the center horizontal line and back again to the center horizontal line.
	<b>Note:</b> If the range of the VOLTS/DIV CAL control is insufficient, set the VOLTS/DIV knob to 2m if the trace separates too much or set it to the 0.5m position if it does not separate enough. Repeat Steps 11 through 13.
14	Observe the test trace (see Fig. 12).
	<b>Requirement:</b> The amplitude response shall be flat to within 0.30 dB between 8 MHz below and 8 MHz above the center frequency and to within 0.45 dB between 10 MHz below and 10 MHz above the center frequency. The test trace shall have a smooth characteristic with no sharp discontinuities or steps over the 20-MHz band.
	If the requirement is not met, complete Charts 11 and 13; then repeat this chart.
	If the requirement still is not met, a 660( ) IC amplifier is defective and should be replaced as directed in Chart 17.
15	When the requirement is met, proceed to Chart 16.♦

**CHART 11—IF LIMITER—CARRIER RESUPPLY TRANSMISSION ADJUSTMENT USING THE J68428A TEST SET**

**2.20** The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.

**2.21** If the requirements in this chart are not met, replace the IF limiter—carrier resupply unit.

**2.22** One J68428A transmitter-receiver test set and one KS-20114, L2 adjusting tool are required to perform this procedure.

STEP	PROCEDURE
1	<p>Connect the test set in accordance with Fig. 17; and complete Chart 31, Preparation for Test.</p> <p><b>Note:</b> For easy alignment, remove the unit and bracket by loosening the two screws which fasten the bracket to the bay. Hang the unit above its present location onto the bay frame post provided (use bracket hole to hang unit).</p>
2	Connect option (Z), and center the test trace on the oscilloscope with the TRACE control.
3	<p>Adjust the GAIN and SLOPE controls to meet the requirement.</p> <p><b>Requirement:</b> The test trace shall be coincident with the center graticule line on the oscilloscope screen to within 0.05 dB between 60 and 80 MHz. The power meter shall indicate <math>-23.3 \pm 0.2</math> dBm.</p>
4	Set the IF MODE switch on the sweep oscillator to continuous wave (CW).
5	Record the power meter indication.
6	<p>Increase the ATTEN setting by 5 dB (less signal). (Use ATTEN 2 if the test set is equipped with J68428C and D panels.)</p> <p><b>Requirement:</b> The power meter indication should be within 1 dB of that recorded in Step 5.</p>
<p><b>CHART 12—IF DRIVER AMPLIFIER—TRANSMITTER MODULATOR ADJUSTMENT EQUIPPED WITH TWT USING THE J68428A TEST SET</b></p>	<p><b>2.24</b> If the requirements in this chart are not met, refer to Section 411-506-503 for troubleshooting procedures.</p>
	<p><b>2.25</b> One J68428A transmitter-receiver test set and one KS-20114, L2 adjusting tool are needed to perform this procedure.</p>
<p><b>2.23</b> The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.</p>	

STEP	PROCEDURE
1	Remove the termination from the TEST port of the 29A integrated circuit, and disconnect P14 from the IF driver amplifier.
2	Connect the test set in accordance with Fig. 15; and complete Chart 29, Preparation for Test.

STEP	PROCEDURE
3	Adjust the ATT control on the 29A integrated circuit for maximum power output at the TEST port. (Maximum power is obtained by turning the attenuator counterclockwise.)  <b>Requirement:</b> +9 dBm minus the calibrated loss of the RF pad.  If the requirement is not met, adjust the DIODE BIAS control on the IF driver amplifier for maximum output; then adjust the GAIN control.  <b>Note:</b> The AM/PM conversion coefficient of the modulator is very sensitive to the setting of the DIODE BIAS control. To minimize the AM/PM conversion, the DIODE BIAS control should only be adjusted for a maximum power output.
4	Connect the test set in accordance with Fig. 16; complete Chart 30, Preparation for Test; and measure the amplitude response of the IF driver amplifier—transmitter modulator.  <b>Requirement:</b> The amplitude response shall be flat to within $\pm 0.20$ dB between 62 and 78 MHz and to within $\pm 0.30$ dB between 60 and 80 MHz.  If the requirement is not met, adjust the SLOPE control to meet the requirement. If necessary, adjust the GAIN control to keep the test trace on a reference line.
5	Select, in turn, TRMTR MOD BIAS and DR AMPL OUT on the meter panel and record the indication for each.
6	Remove the connection from the TEST port on the 29A integrated circuit, and replace the termination on the 29A integrated circuit.
7	Readjust the ATT control on the 29A integrated circuit for the TWT IN meter indication recorded on the meter panel.

**CHART 13—IF DRIVER AMPLIFIER—TRANSMITTER MODULATOR ADJUSTMENT EQUIPPED WITH 660 ( ) IC USING THE J68428A TEST SET**

**2.26** If the requirements in this chart are not met, refer to Section 411-506-503 for troubleshooting procedures.

**2.27** The following apparatus is required to perform this procedure:

- 1—J68428A Transmitter-Receiver Test Set
- 1—KS-20114, L2 Adjusting Tool
- 1—1/4-Inch Open-End Wrench.

## STEP

## PROCEDURE

**DANGER:** The IF input drive power to the driver amplifier must be removed when making or changing the test connections to the 1431( ) network.

- 1 Make the test connections shown in Fig. 10, and complete Chart 26, Preparation for Test.
- 2 Verify that the IF input to the driver amplifier is removed.
- 3 Remove the flexible waveguide section between the support bracket and output of the 1431( ) network.
- 4 Connect a 24A transducer to the output of the 1431( ) network.
- 5 Terminate the input of the waveguide bend with a shorting plate.
- 6 Make the test connections shown in Fig. 11, option (A); complete Chart 27, Preparation for Test; and connect the RF power divider to the 24A transducer.
- 7 Adjust the BIAS control on the driver amplifier for maximum power.

**Note:** The AM/PM conversion coefficient of the modulator is very sensitive to the setting of the DIODE BIAS control. To minimize the AM/PM conversion, the DIODE BIAS control should only be adjusted for a maximum power output.

- 8 Calculate the output power.

Output power = loss of pad (20 dB) + loss of RF power divider (6 dB) + power meter indication.

**Requirement:** +8 dBm  $\pm$ 0.25 dB

If the requirement is not met, adjust the GAIN control on the IF driver amplifier to meet the requirement.

**Note:** If the GAIN control has insufficient adjustment range to reduce the gain to the required power, replace the IF driver amplifier—transmitter modulator.

- 9 Set the IF MODE control on the sweep oscillator to the IF  $\Delta$ F position.
- 10 Set the VOLTS/DIV control to the 1m position, and position the trace on the oscilloscope display with the TEST TRACE COARSE control on the control unit.
- 11 Adjust the oscilloscope horizontal POSITION and VERNIER controls such that the two end markers coincide with full horizontal deflection.
- 12 Decrease the RF variable pad loss by 0.4 dB and adjust the VOLTS/DIV CAL control to bring the test trace up 4 centimeters from the center line.

STEP	PROCEDURE
13	Increase the RF variable pad loss by 0.4 dB and adjust the vertical POSITION control to bring the test trace back to the center horizontal line, if necessary.
14	Repeat Steps 12 and 13 until decreasing and increasing the variable pad loss by 0.4 dB shifts the test trace 4 centimeters up the center horizontal line and back again to the center horizontal line.  <b>Note:</b> If the range of the VOLTS/DIV CAL control is insufficient, set the VOLTS/DIV control to 2m if the trace separates too much or set it to the 0.5m position if it does not separate enough. Repeat Steps 12 through 14.
15	Observe the test trace (Fig. 13).  <b>Requirement:</b> The amplitude response shall be flat to within 0.20 dB between 62 and 78 MHz and to within 0.30 dB between 60 and 80 MHz.  If the requirement cannot be met, adjust the SLOPE control on the IF driver amplifier to meet the requirement while maintaining the 70-MHz point on the oscilloscope horizontal center line with the GAIN control on the driver amplifier. If the requirement still cannot be met, replace the IF driver amplifier—transmitter modulator unit and repeat this chart.  <b>Caution:</b> <i>The BIAS control must not be changed for transmission adjustments; otherwise, an adverse effect on the AM/PM conversion of the transmitting modulator will occur.</i>
16	Restore all connections to normal.⚡

#### CHART 14—TWT AMPLIFIER ADJUSTMENT USING THE J68428A TEST SET

**2.28** The TWT should have been energized for at least 20 minutes so that it is at normal operating temperature. The IF driver amplifier—transmitter modulator should have been checked in accordance with Chart 12 before performing any test in this chart.

**2.29** The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.

**2.30** If the requirements in this chart are not met, refer to Section 411-506-504 for troubleshooting procedures.

**2.31** One J68428A transmitter-receiver test set is required to perform this procedure.

STEP	PROCEDURE
1	Connect the test set in accordance with Fig. 15; and complete Chart 29, Preparation for Test.
2	Select COLL CUR on the meter panel, and adjust the HELIX ADJ control on the power supply for a maximum power meter indication while maintaining the panel meter indication at 70 with the ANODE ADJUST control.  <b>Requirement:</b> 70 $\pm$ 1 (panel meter)  <b>Note:</b> If a COLL CUR indication of 70 cannot be obtained by adjusting the ANODE ADJUST control, leave the ANODE ADJUST control in the counterclockwise position and adjust the HELIX ADJUST control for an indication of 70.
3	Adjust the TUN 1 and TUN 2 controls on the 29A and 30A integrated circuits for maximum transmitter power output as indicated on the power meter.
4	Adjust the ATT control on the 29A integrated circuit to meet the following requirement.  <b>Requirement:</b> For test sets equipped with J68428C and D panels: +37 dBm minus the calibrated loss of the 24B directional coupler and the RF attenuator. For test sets equipped with J68428F panels: +37 dBm minus the calibrated loss of RF pads.
5	Connect the test set in accordance with Fig. 16; and complete Chart 30, Preparation for Test.
6	Adjust the TUN 1 and TUN 2 controls on the 30A integrated circuit to meet the following requirement.  <b>Requirement:</b> The amplitude response shall be flat to within 0.20 dB between 62 and 78 MHz and to within 0.35 dB between 60 and 80 MHz.  <b>Note:</b> The test trace displays the combined amplitude response of the IF driver amplifier—transmitter modulator and TWT amplifier.
7	Connect the test set in accordance with Fig. 15; complete Chart 29, Preparation for Test; and check the transmitter output power.  <b>Requirement:</b> For test sets equipped with J68428C and D panels: Greater than +36 dBm minus the calibrated loss of the 24B directional coupler and the RF attenuator. For test sets equipped with J68428F panels: Greater than +36 dBm minus the calibrated loss of the RF pads.
8	With the ATT control on the 29A integrated circuit, adjust the transmitter output power to meet the requirement.  <b>Requirement:</b> +37 dBm

STEP	PROCEDURE
	For test sets equipped with J68428C and D panels, the power meter indication is equal to +37 dBm minus the calibrated loss of the 24B directional coupler and the RF attenuator. For test sets equipped with the J68428F panel, the power meter indication is equal to +37 dBm minus the calibrated loss of the 10- and 30-dB RF pads.
9	Select TWT IN and COLL CUR on the meter panel, and record each meter indication.

**CHART 15—IF LIMITER—CARRIER RESUPPLY OPERATION CHECKS (FREQUENCY DIVERSITY ONLY) USING THE J68428A TEST SET**

**2.33** One J68428A transmitter-receiver test set and one KS-20114, L2 adjusting tool are required to perform this procedure.

**2.32** If the requirements of this chart are not met, replace the IF limiter—carrier resupply unit.

STEP	PROCEDURE
	<b>A. Carrier Resupply 70-MHz Frequency and Output Power Checks</b>
1	Connect the test set in accordance with Fig. 14, option (Y); and complete Chart 28, Preparation for Test.
2	Measure the 70-MHz output power.
	<b>Requirement:</b> -7 dBm $\pm$ 1 dB
3	Connect option (X), and measure and record the output frequency.
	<b>Requirement:</b> 70 $\pm$ 0.006 MHz
	<b>B. Carrier Resupply 61-MHz Frequency and Output Power Checks</b>
4	Connect the test set in accordance with Fig. 18A or 18C; and complete Chart 32, Preparation for Test.
5	Connect the test set in accordance with Fig. 18B or 18D, option (X).

STEP	PROCEDURE
6	<p>Adjust the 9 MHz LEV control of the IF limiter—carrier resupply to meet the following requirement.</p> <p><b>Requirement:</b> <math>-10 \text{ dBm} \pm 0.5 \text{ dB}</math></p> <p><b>Note:</b> The requirement corresponds to <math>-42 \text{ dBm} \pm 0.5 \text{ dB}</math> at the IF limiter—carrier resupply output.</p>
7	<p>Select CRS 9 MHz on the panel meter, and adjust the 9 MHz ALM V control to meet the following requirement.</p> <p><b>Requirement:</b> <math>59 \pm 5</math></p>
8	<p>Connect option (Y), and measure the frequency. Subtract this frequency from that recorded in Step 3.</p> <p><b>Requirement:</b> <math>9 \pm 0.0015 \text{ MHz}</math></p>
<b>C. Carrier Resupply Trip and Restore Checks</b>	
9	Connect the test set in accordance with Fig. 19; and complete Chart 33, Preparation for Test.
10	Select CRS SW V on the meter panel and record the meter indication.
11	<p>Slowly decrease the IF AMPL GAIN control on the control unit until the CRS SW V meter indication just drops to zero. At this point, observe the power indication on the power meter.</p> <p><b>Requirement:</b> <math>-16 \text{ dBm} \pm 0.5 \text{ dB}</math></p>
If the requirement is not met, complete Steps 14 through 18.	
12	<p>Slowly increase the IF AMPL GAIN control until the CRS SW V indication just turns to within <math>\pm 5</math> units of the recorded value in Step 10.</p> <p><b>Note:</b> An indication of approximately 0 on the panel meter shows that the IF limiter—carrier resupply has tripped. An indication of approximately 2/3 scale on the panel meter shows that the IF limiter—carrier resupply is restored.</p>
13	<p>Observe the power meter indication.</p> <p><b>Requirement:</b> Between <math>-15 \text{ dBm}</math> and <math>-12.5 \text{ dBm}</math>.</p>
If the requirement in this step is not met and Steps 14 through 18 were not performed in Step 11, perform Steps 14 through 18 to meet the requirement. If the requirement is still not met, replace the IF limiter—carrier resupply unit and repeat Chart 11 and this chart.	
<b>D. Carrier Resupply Trip Point Adjustment</b>	
14	Adjust the IF AMPL GAIN control until the power meter indicates $-16 \text{ dBm}$ .

STEP	PROCEDURE
15	Set the TRIP control fully clockwise.
16	Slowly rotate the TRIP control counterclockwise until the CRS SW V indication on the meter panel drops to zero.
17	Adjust the IF AMPL GAIN control for a power meter indication of $-7$ dBm.
18	Record the meter panel indications for LIM IN, CRS 70 MHz, CRS 9 MHz, and CRS SW V.

**CHART 16—ALARM CHECKS AND ADJUSTMENTS USING THE J68428A TEST SET**

**2.34** One J68428A transmitter-receiver test set is required to perform this procedure.

STEP	PROCEDURE
<b>A. Carrier Resupply 9-MHz Alarm Checks (Frequency Diversity Only)</b>	
1	Adjust the 9-MHz LEV control counterclockwise until the CRS 9 MHz alarm lamp on the alarm panel just lights.
2	Select CRS 9 MHz on the meter panel.
<b>Requirement:</b> Between 18 and 42.	
3	Readjust 9 MHz LEV for a CRS 9 MHz indication equal to the value recorded on the meter panel.
<b>B. Transmitter Output Power Alarm Checks and Adjustments</b>	
<b>Note:</b> The hot standby only or hot standby/space diversity bays must be switched off of the channel which is to be tested.	
4	Connect the test set in accordance with Fig. 15, options (X) and (Z), and complete Chart 29, Preparation for Test, for bays equipped with a TWT; or Fig. 11, option (D), only for bays equipped with a 660( ) IC, and complete Chart 27, Preparation for Test.
5	Record the power meter indication.

STEP	PROCEDURE
6	Increase the ATTEN setting until the TRMTR OUT alarm lamp just lights on the alarm panel.
7	Record the power meter indication.  <b>Requirement:</b> The difference between this indication and the indication of Step 5 is 2 to 4 dB.  If the requirement is not met, perform Steps 8 through 10.
8	Readjust the ATTEN setting for the same power meter indication recorded in Step 5.
9	Increase the ATTEN setting until the power meter indication drops by 3 dB.
10	If the bay is equipped with a TWT, adjust the MON ADJ control on the 30A integrated circuit until the TRMTR OUT alarm lamp just lights. If bay is equipped with a 660( ) IC, adjust the 76C detector until the TRMTR OUT alarm lamp just lights. To adjust the 76C detector, proceed as follows:  (a) Loosen the large brass knurled locknut by turning it counterclockwise several turns.  (b) Slightly loosen the stainless steel knurled nut to allow the brass knurled barrel to rotate smoothly.  (c) While holding the body of the 76C detector to prevent it from rotating, turn the barrel to change the coupling to the detector—clockwise rotation decreases the coupling; counterclockwise rotation increases the coupling.  (d) When the correct coupling is reached, tighten both locking nuts while keeping the barrel and detector body from moving.
	<b>Note:</b> If the TRMTR OUT lamp is lit, adjust the MON ADJ or 76C detector control to extinguish the lamp.
11	Readjust the ATTEN setting for the same power meter indication as recorded in Step 5.
12	Record the TRMTR OUT meter indication.
13	Remove the P14 plug from the IF input jack on the IF driver amplifier.
14	Disconnect all test connections and apparatus from the transmitter.  <b>DANGER:</b> To avoid potential RF power radiation, the P14 plug should be connected last.
15	Reconnect the normal transmitter connections, connecting the P14 plug to the IF input jack of the IF driver amplifier last.

**CHART 17—660( ) IC TRANSMITTER AMPLIFIER REPLACEMENT**

2.35 One 1/4-inch open-end waveguide wrench is required to perform this procedure.

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.◆

**CHART 18—PREPARATION FOR TEST (Fig. 2)**

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table A.
2	With the power meter input disconnected, adjust the METER ZERO control for an indication of ZERO.
3	Set the POWER RANGE DBM control to the -5 position.
4	Set ATTEN 2 to 17 dB.
5	Connect option (S) and adjust the IF CENTER FREQ control until the counter indicates 70 ±0.2 MHz.

STEP

PROCEDURE

TABLE A

UNIT	CONTROL	POSITION
Control Panel	CTR IF SWEEP WIDTH	EXT Maximum CCW (off)
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF -25

- 6 Connect option (T).
- 7 Adjust ATTEN 2 to obtain -7 dBm on the power meter.
- 8 Connect options (Y) or (Z) and (U) or (V).

**Note:** Option (U) is used when an internal power head is used in the test set; option (V), when an external power head is used.

- 9 Disconnect option (T) and establish the options listed in Table B.♦

TABLE B

CHART	OPTIONS
1	(W) and (Z)
4	(X) and (Y)
6	(X) and (Z)
8	(X) and (Z)

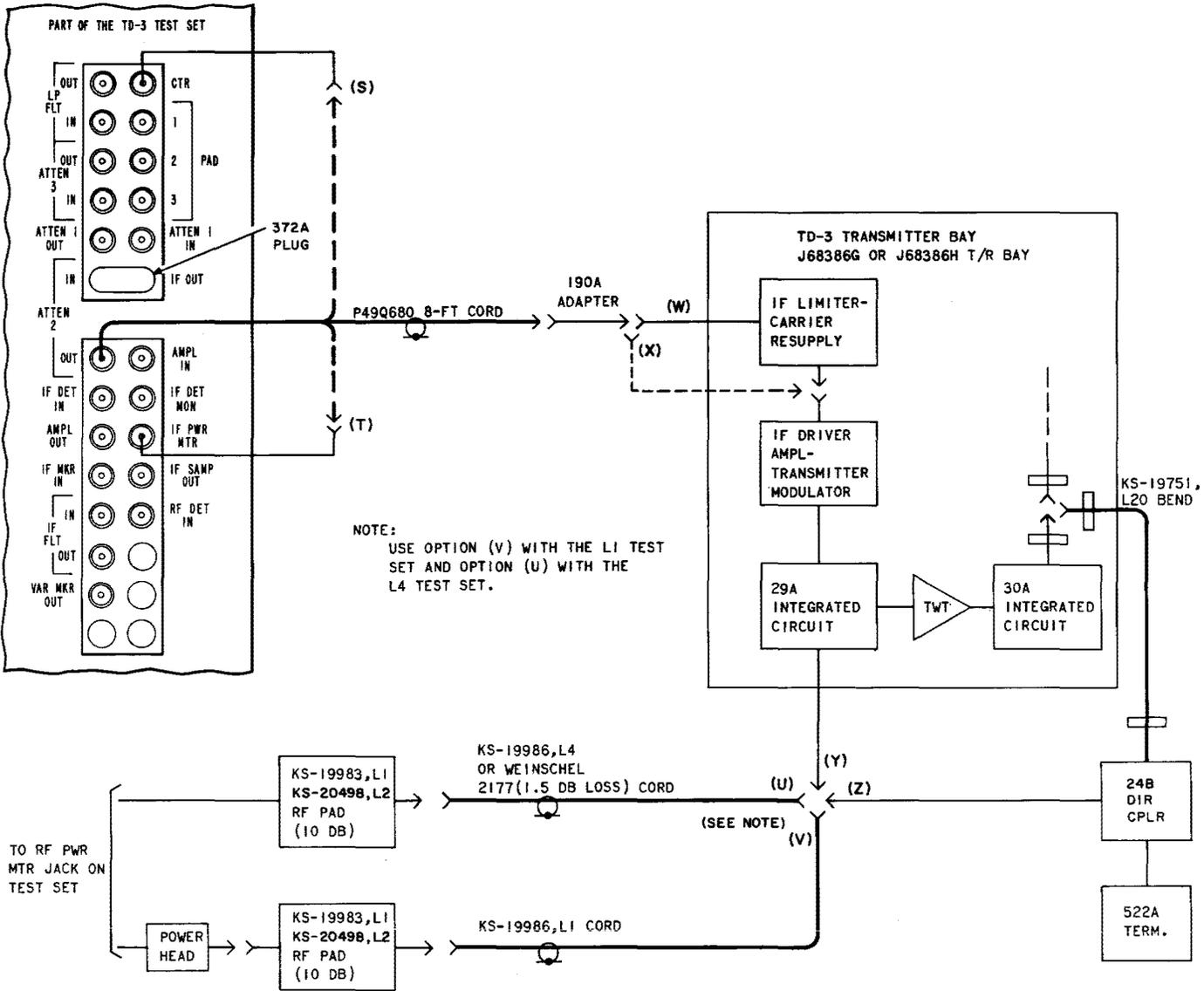


Fig. 2—Test Setups for IF-to-RF Gain Tests—J68392A Test Set

## CHART 19—PREPARATION FOR TEST (Fig. 3)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table C.
2	With the power meter input disconnected, adjust the METER ZERO control for an indication of ZERO.
3	Set the POWER RANGE DBM control to the -5 position.
4	Set ATTEN 2 to 17 dB.
5	Connect option (T).
6	Adjust ATTEN 2 to obtain -7 dBm on the power meter.
7	Connect option (R).
8	Adjust the TEST TRACE controls on the test set control panel to center the trace on the oscilloscope screen.

TABLE C

UNIT	CONTROL	POSITION
Control Panel	FUNCTION CTR IF SWEEP WIDTH	IF — IF MKR FREQ Midrange
Oscilloscope Time Base Unit	INTENSITY POSITION MAGNIFIER SWEEP TIME VERNIER SINGLE NORMAL	Midrange Midrange X10 EXT Midrange NORMAL
Differential Amplifier Unit	POSITION BANDWIDTH AMPLIFIER VERNIER SENSITIVITY AC-DC-OFF (+INPUT) AC-DC-OFF (-INPUT)	Midrange 4 DC Midrange 2 MV/CM DC OFF
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF -25

## STEP

## PROCEDURE

- 9 Adjust the SENSITIVITY, VERNIER, and POSITION controls on the oscilloscope time base unit for approximately 10 centimeters of horizontal deflection on the oscilloscope screen.
- 10 Adjust the IF MKR FREQ control on the test set control panel for a 70.1 MHz indication on the counter.
- 11 Adjust the IF SWEEP WIDTH and IF CENTER FREQ controls on the test set control panel to obtain the oscilloscope display as shown.
- Note:** An extraneous marker appears at 89 MHz.
- 12 Disconnect option (R) and establish the options listed in Table D.
- 13 Set the FUNCTION switch on the control panel to the IF—RF position.
- 14 Adjust the TEST TRACE and REF TRACE controls on the control panel so that the traces are coincident at 70 MHz.
- 15 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 of deflection between the traces. Return the variable pad to its previous setting. This calibrates the oscilloscope for 0.05 dB per centimeter.♦

TABLE D

CHART	OPTIONS
1	(W) and (Z)
4	(X) and (Y)
6	(X) and (Z)

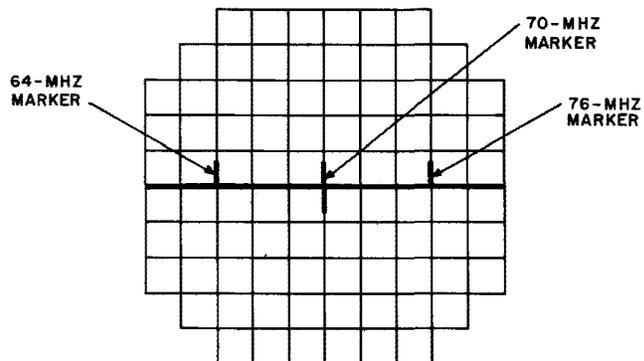
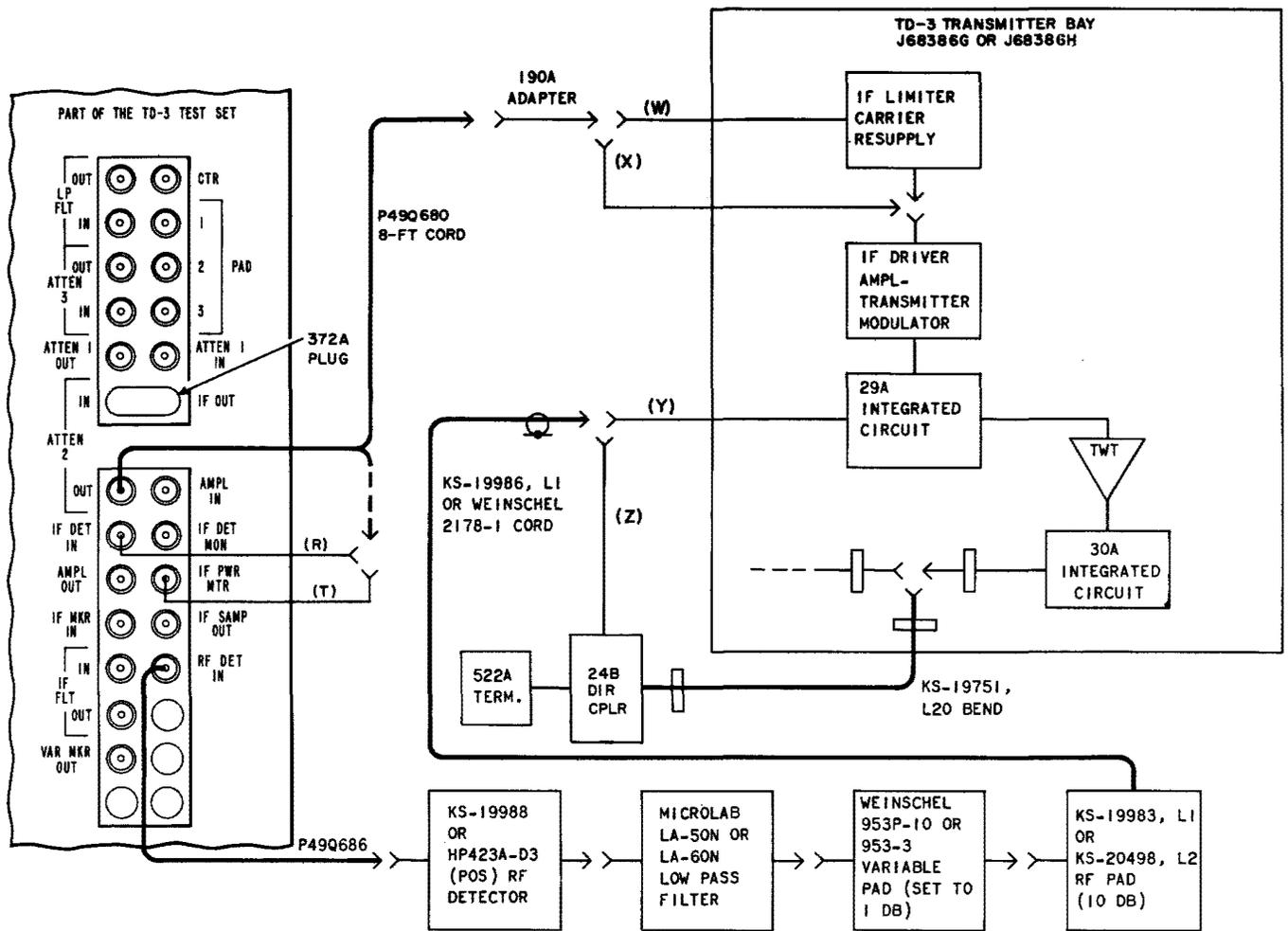


Fig. 3—IF-to-RF Amplitude Response Test Setup—J68392A Test Set

## ◆CHART 20—PREPARATION FOR TEST (Fig. 4)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table E.
2	With the power meter input disconnected, adjust the METER ZERO control for an indication of ZERO.
3	Set the POWER RANGE DBM control to the -5 position.
4	Set ATTEN 2 to 17 dB.
5	Connect option (S) and adjust the IF CENTER FREQ control until the counter indicates $70 \pm 0.2$ MHz.
6	Connect option (T).
7	Adjust ATTEN 2 to obtain -7 dBm on the power meter.
8	Connect option (U) or (V).
	<b>Note:</b> Option (U) is used when an internal power head is used in the test set; option (V), when an external power head is used.
9	Set the INPUT CHANNEL switch on the power meter to RF and zero the power meter.◆

TABLE E

UNIT	CONTROL	POSITION
Control Panel	CTR IF SWEEP WIDTH	EXT Maximum CCW (off)
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF -25

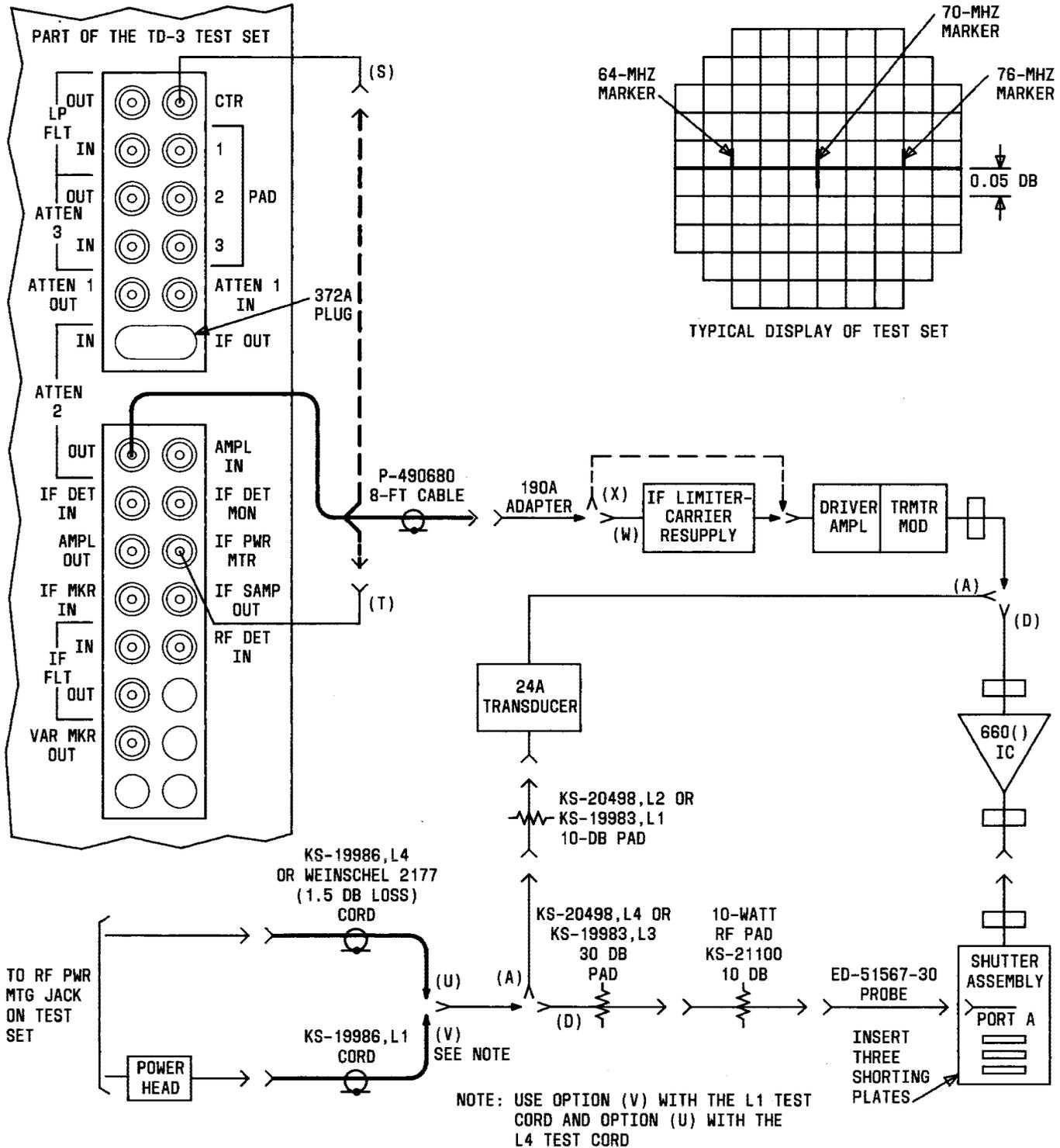


Fig. 4—Overall Transmitter Gain Test—J68392A Test Set

## ▶CHART 21 — PREPARATION FOR TEST (Fig. 5)

STEP	PROCEDURE
1	Set the test set controls to the positions shown in Table F.
2	Connect option (R).
3	Adjust the TEST TRACE controls on the test set control panel to center the trace on the oscilloscope.
4	Adjust the SENSITIVITY, VERNIER, and POSITION controls on the oscilloscope time base unit for approximately 10 centimeters of horizontal deflection on the oscilloscope screen.
5	Adjust the IF MKR FREQ control on the test set control panel for a $70 \pm 0.1$ MHz indication on the counter.
6	Adjust the IF SWEEP WIDTH and IF CENTER FREQ controls on the test set control panel to obtain the oscilloscope display as shown in Fig. 5.

**Note:** An extraneous marker appears at 89 MHz.

TABLE F

UNIT	CONTROL	POSITION
Control Panel	FUNCTION CTR IF SWEEP WIDTH	IF — IF MKR FREQ Midrange
Oscilloscope Time Base Unit	INTENSITY POSITION MAGNIFIER SWEEP TIME VERNIER SINGLE-NORMAL	Midrange Midrange X10 EXT Midrange NORMAL
Differential Amplifier Unit	POSITION BANDWIDTH AMPLIFIER VERNIER SENSITIVITY AC-DC-OFF (+INPUT) AC-DC-OFF (-INPUT)	Midrange 4 DC Midrange 2 MV/CM DC OFF
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF -25

---

STEP	PROCEDURE
7	Disconnect option (R) and establish option (W) at the driver amplifier input.
8	Set the FUNCTION switch on the control panel to IF—RF.
9	Adjust the TEST TRACE and REF TRACE controls on the control panel so that the traces are coincident at 70 MHz.
10	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 of deflection between the traces. Return the variable pad to its previous setting. This calibrates the oscilloscope for 0.05 dB per centimeter.⚡

---



## CHART 22—PREPARATION FOR TEST (Fig. 6)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table G.
2	Adjust the METER ZERO control so that the power meter indicates zero; then set the POWER RANGE DBM switch to the -5 position.
3	Set ATTEN 2 to 17 dB.
4	Connect options (W) and (X).
5	Adjust ATTEN 2 to obtain -7 dBm on the power meter.
6	Connect option (Y).
7	Adjust the TEST TRACE controls on the test set control panel to center the trace on the oscilloscope screen.
8	Adjust the SENSITIVITY, VERNIER, and POSITION controls on the oscilloscope time base unit for approximately 10 centimeters of horizontal deflection on the oscilloscope screen.

TABLE G

UNIT	CONTROL	POSITION
Control Panel	FUNCTION CTR	IF — IF MKR FREQ
Oscilloscope	INTENSITY	Midrange
Oscilloscope Time Base Unit	POSITION MAGNIFIER SWEEP TIME VERNIER SINGLE-NORMAL	Midrange X10 EXT Midrange NORMAL
Differential Amplifier Unit	POSITION BANDWIDTH AMPLIFIER VERNIER SENSITIVITY AC-DC-OFF (+INPUT) AC-DC-OFF (-INPUT)	Midrange 4 DC Midrange 2 MV/CM DC OFF
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF -25

---

STEP	PROCEDURE
9	Adjust the IF MKR FREQ control on the test set control panel for a $70 \pm 0.1$ MHz indication on the counter.
10	Adjust the IF SWEEP WIDTH and IF CENTER FREQ controls on the test set control panel to obtain the oscilloscope display as shown in Fig. 6(A).  <b>Note:</b> An extraneous marker appears at 89 MHz.
11	Adjust the REF TRACE controls on the control panel so that the traces are coincident at 70 MHz.
12	Adjust the IF DET SLOPE control on the control panel for a flat trace.
13	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 of deflection between the traces. Return ATTEN 2 to its previous setting. This calibrates the oscilloscope for 0.05 dB per centimeter.  <b>Requirement:</b> The test trace shall be flat to within 0.01 dB between 60 and 80 MHz.♦

---



## CHART 23—PREPARATION FOR TEST (Fig. 7)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table H.
2	With the power meter input disconnected, adjust the METER ZERO control for an indication of ZERO.
3	Set the POWER RANGE DBM control to the -5 position.

TABLE H

UNIT	CONTROL	POSITION
Control Panel	CTR	EXT
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF -25

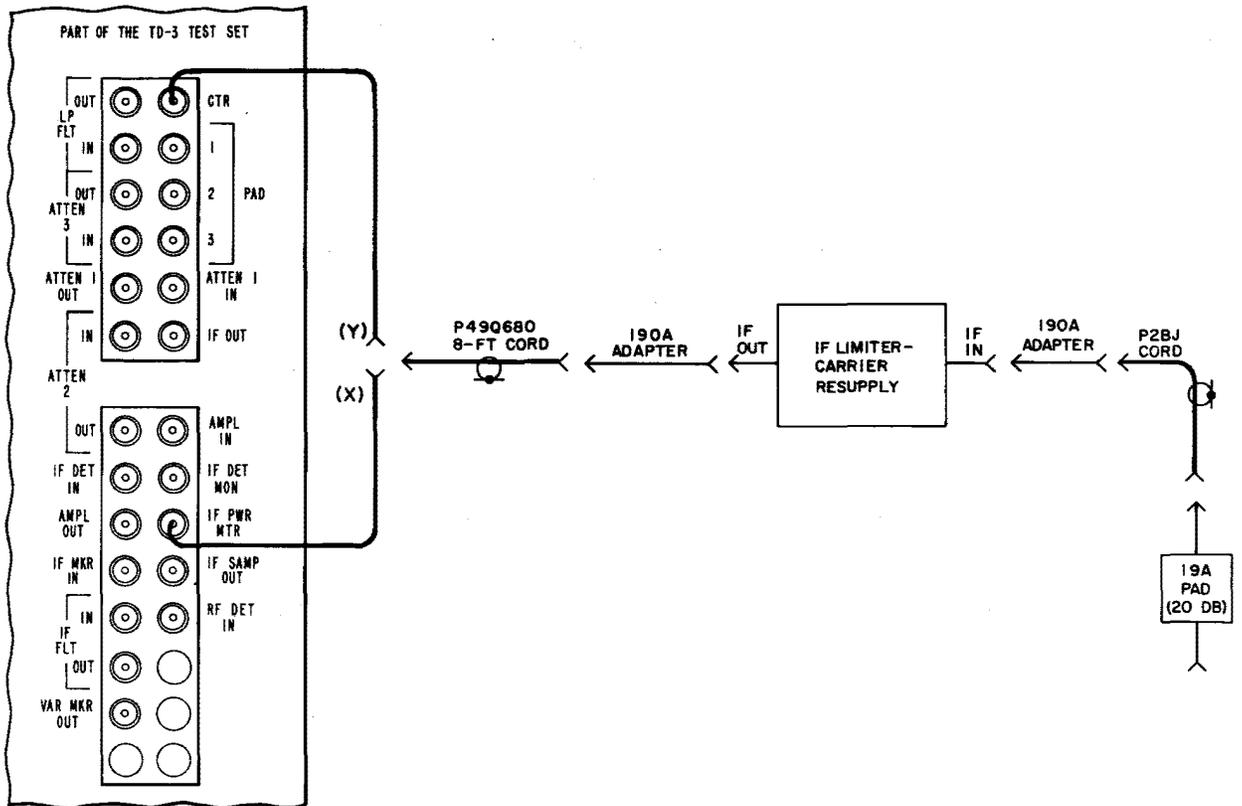


Fig. 7—IF Limiter—Carrier Resupply 70-MHz Output Power and Frequency Test Setup—J68392A Test Set

CHART 24—PREPARATION FOR TEST (Fig. 8)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table I.
2	With the power meter input disconnected, adjust the METER ZERO control for an indication of ZERO.
3	Set the POWER RANGE DBM control to the -5 position.
4	Set ATTEN 2 to 17 dB and connect the test set in accordance with Fig. 8A.
5	Connect "A" cord to option (Y) and adjust the IF CENTER FREQ control for a $61 \pm 0.5$ MHz indication.

---

**STEP****PROCEDURE**

---

**TABLE I**

UNIT	CONTROL	POSITION
Control Panel	IF SWEEP WIDTH AMPL GAIN CTR	Max CCW Max CCW EXT
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF -25

- 6 Connect the "A" cord to option (X) and adjust ATTEN 2 for a -7 dBm indication on the power meter.
  - 7 Increase the ATTEN 2 setting by 35 dB. (Use a 20-dB 19A pad, if necessary, to meet the 35-dB requirement.)◆
-

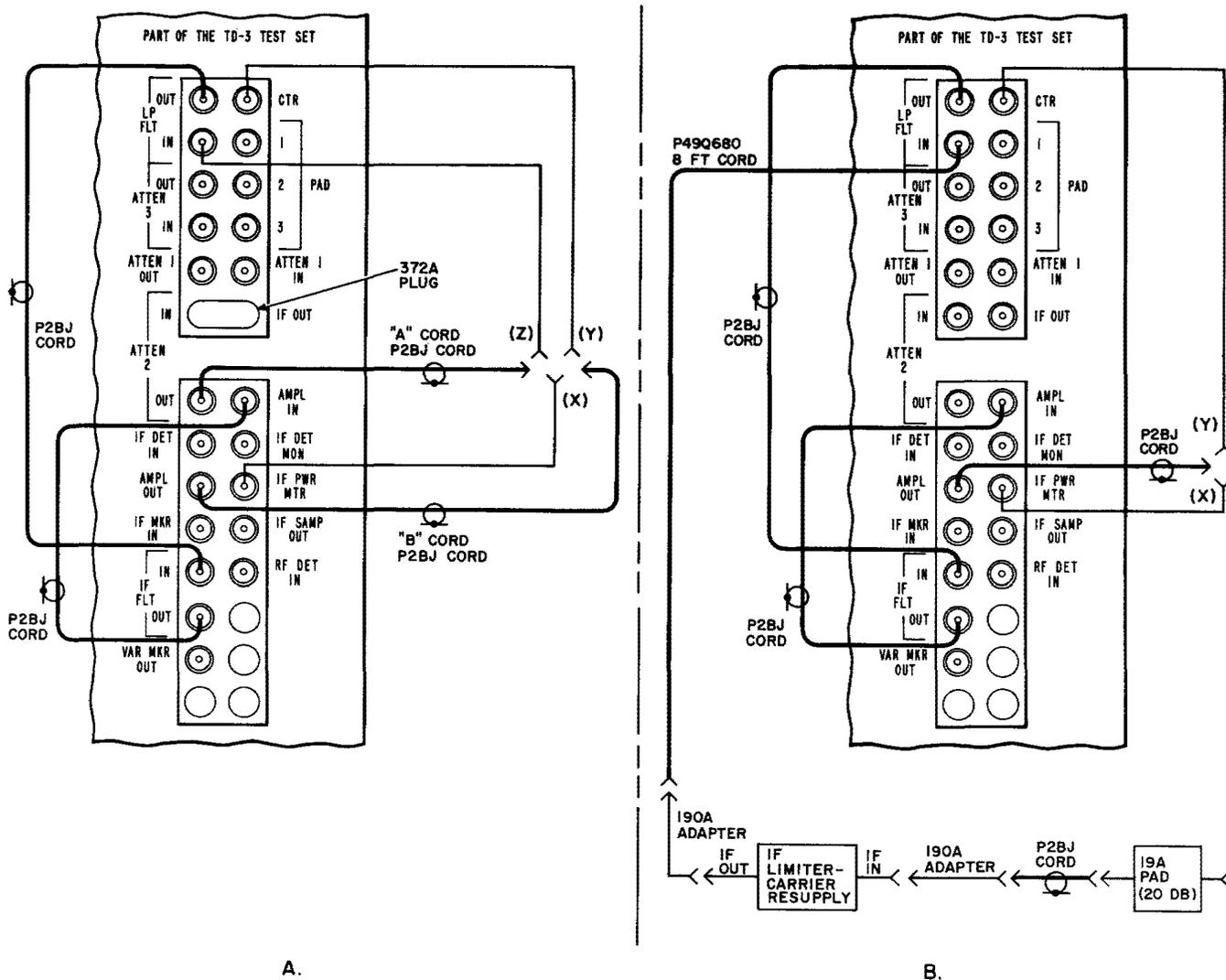


Fig. 8—IF Limiter—Carrier Resupply 61-MHz Output Power and Frequency Test Setup—J68392A Test Set

CHART 25—PREPARATION FOR TEST (Fig. 9)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table J.
2	With the power meter input disconnected, adjust the METER ZERO control for an indication of ZERO.

---

**STEP****PROCEDURE**

---

**TABLE J**

UNIT	CONTROL	POSITION
Control Panel	IF SWEEP WIDTH CTR	Max CCW EXT
Power Meter	INPUT CHANNEL POWER RANGE DBM	IF -25

- 3 Set the POWER RANGE DBM control to the -5 position.
  - 4 Set ATTEN 1 to 10 dB and connect the test set in accordance with option (Y).
  - 5 Adjust the IF CENTER FREQ control for an indication of  $70 \pm 0.2$  MHz on the counter.
  - 6 Connect option (X).
  - 7 Adjust ATTEN 3 to obtain -7 dBm on the power meter.
  - 8 Disconnect option (X) and set the POWER RANGE DBM control to the -10 position.♦
-

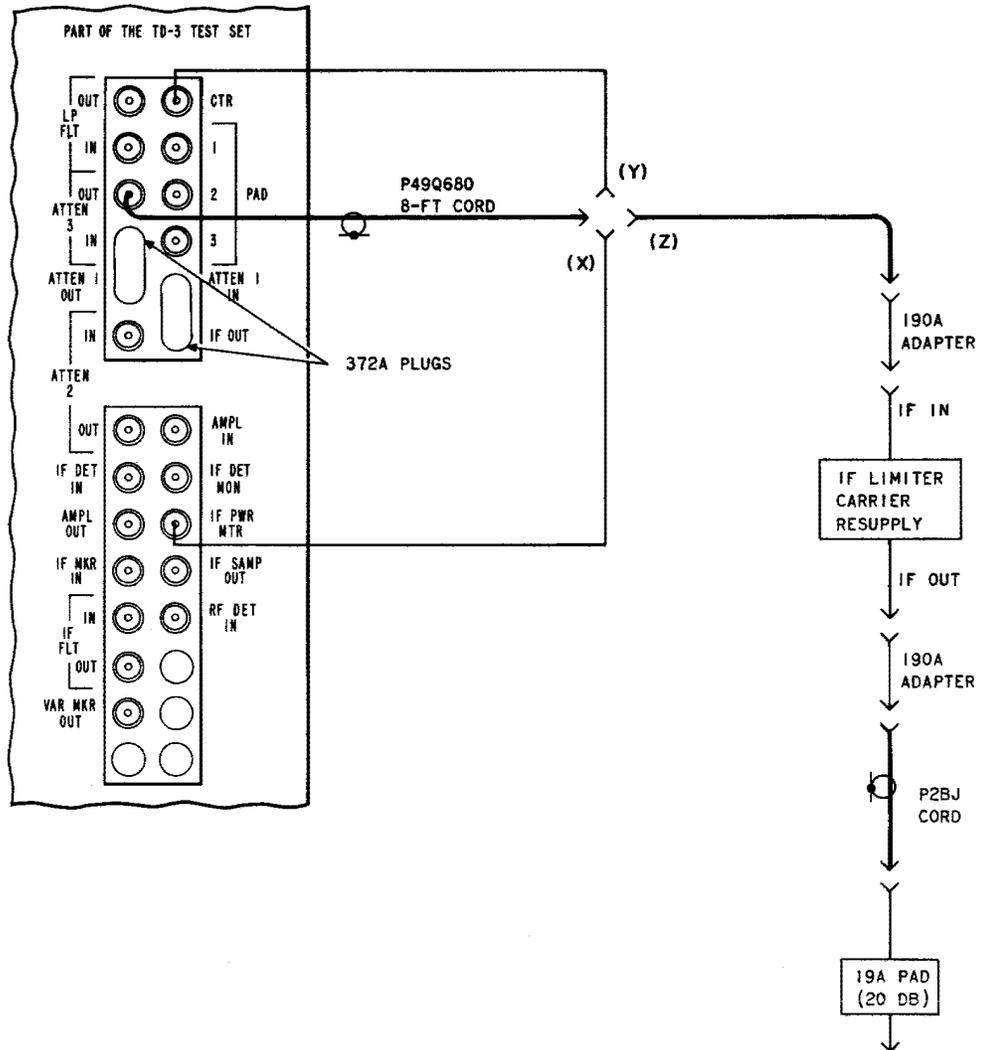


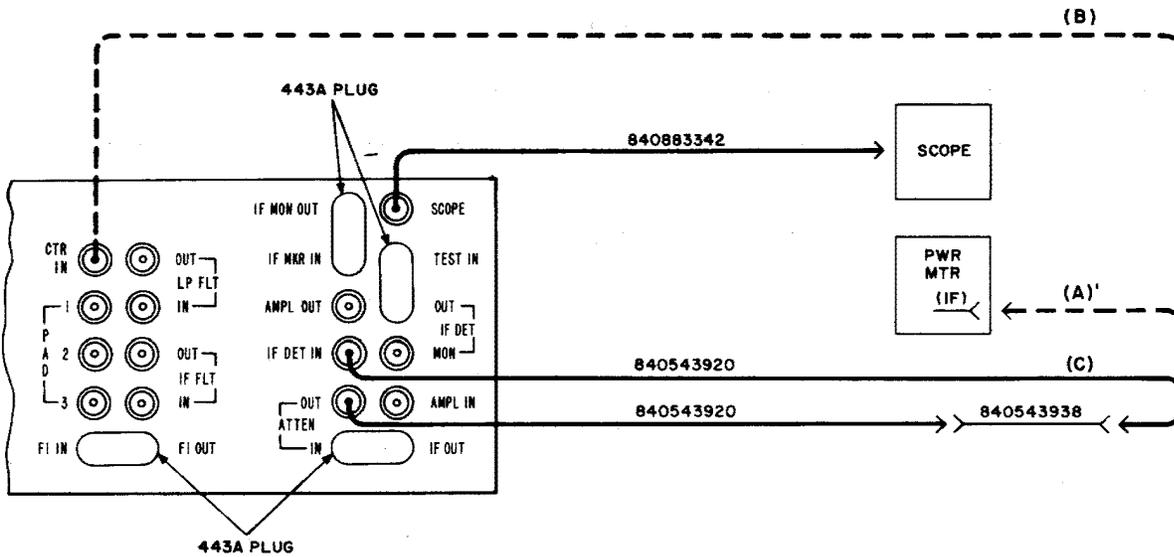
Fig. 9—IF Limiter—Carrier Resupply Trip and Restore Point Test Setup—J68392A Test Set

## ▶CHART 26—PREPARATION FOR TEST (Fig. 10)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table K.
2	On the power meter, temporarily remove the cable from the IF jack, set the MODE switch to ZERO, and adjust the ZERO control for an indication of 000 on the digital display. Then set the MODE switch to POWER METER.
3	Connect option (A).
4	Adjust ATTEN to obtain $-7 \text{ dBm} \pm 0.1 \text{ dB}$ on the power meter.
5	Connect option (B).
6	Adjust the IF CENTER FREQ control on the oscillator until the counter indicates $70 \text{ MHz} \pm 0.5 \text{ MHz}$ .
7	Connect option (C).
8	Set the IF MODE control on the oscillator to the IF $\Delta F$ position and IF $\Delta F$ to 20.
9	On the control unit, set the COUNTER INPUT switch to F1 and adjust the MARKERS F1 control for a $60 \text{ MHz} \pm 0.1 \text{ MHz}$ counter display.
10	Set the COUNTER INPUT switch to F2, and adjust MARKERS F2 for an $80 \pm 0.1 \text{ MHz}$ counter display.
11	Set the oscilloscope VOLTS/DIV switch to 1m.
12	Adjust the TEST TRACE COARSE control until the trace appears on the oscilloscope. Adjust the oscilloscope vertical POSITION control to position the trace on the middle horizontal line.  <b>Note:</b> Press the BEAM FINDER button on the oscilloscope if a display cannot be obtained. Adjust the horizontal POSITION control to center the trace horizontally while holding the BEAM FINDER operated, and adjust the vertical POSITION control until the trace is midway between its two extreme positions.
13	Adjust the horizontal POSITION and VERNIER controls for 10 divisions of horizontal deflection.
14	Adjust the MARKERS AMPLITUDE control for a convenient marker reading.
15	Adjust the horizontal POSITION and VERNIER controls such that the two end markers coincide with full horizontal deflection as shown in Fig. 10.
16	Adjust the IF DET SLOPE control on the control unit until the test trace is as flat as possible.▶

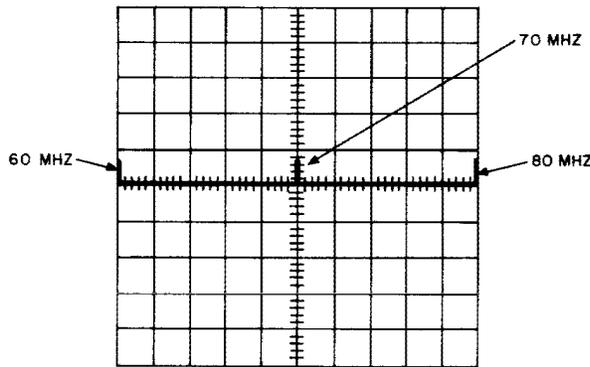
TABLE K

UNIT	CONTROL	POSITION
Counter	FUNCTION SAMPLE RATE DISPLAY BLANKING	135 MHz Counterclockwise Depress the three buttons from the right.
Power Meter	INPUT	IF
Control Unit	IF AMPL GAIN COUNTER INPUT ATTEN	CCW 135 MHz MAX 17 dB
IF/RF Sweep Oscillator	IF CENTER FREQ IF MODE	70 IF CENTER FREQ



NOTE:  
 THIS FIGURE SHOWS THE J68428F PATCH FIELD;  
 EARLIER MODELS MAY BE EQUIPPED WITH THE J68428C CONTROL UNIT.  
 FOR BOTH UNITS, THE JACK DESIGNATIONS ARE SIMILAR. THIS FIGURE  
 CONNECTION CAN BE USED FOR BOTH PATCH FIELDS.

A



B

Fig. 10—Calibration Test Setup for IF Transmission Tests—J68428A Test Set

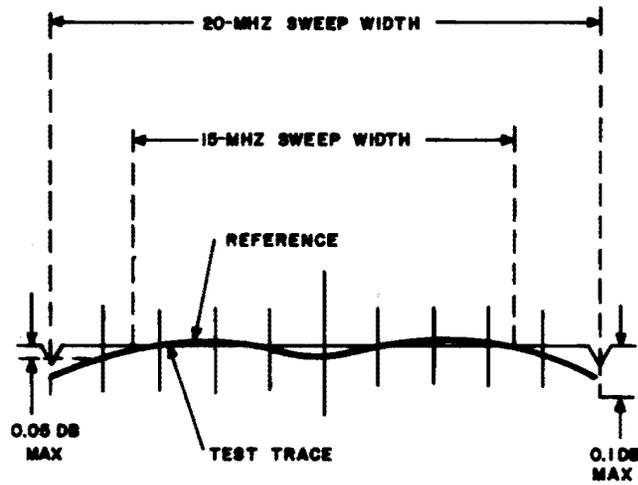
## ▶CHART 27—PREPARATION FOR TEST (Fig. 11)

---

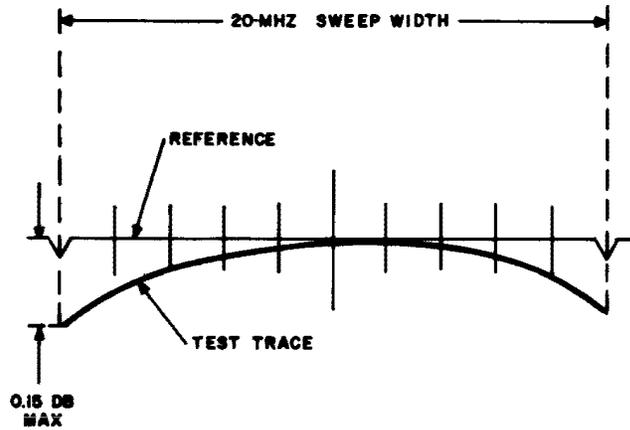
STEP	PROCEDURE
1	Set the IF MODE control on the oscillator to the IF CENTER FREQ position.
2	Set the power meter INPUT switch to RF.
3	With no termination connected to the RF power head, zero the power meter. Set the power meter MODE switch to ZERO, and adjust the ZERO control for a 000 display. Operate the MODE switch to the POWER METER position.▶

---





◆Fig. 12—Frequency Response Display at Port A of Monitor-Shutter Assembly◆



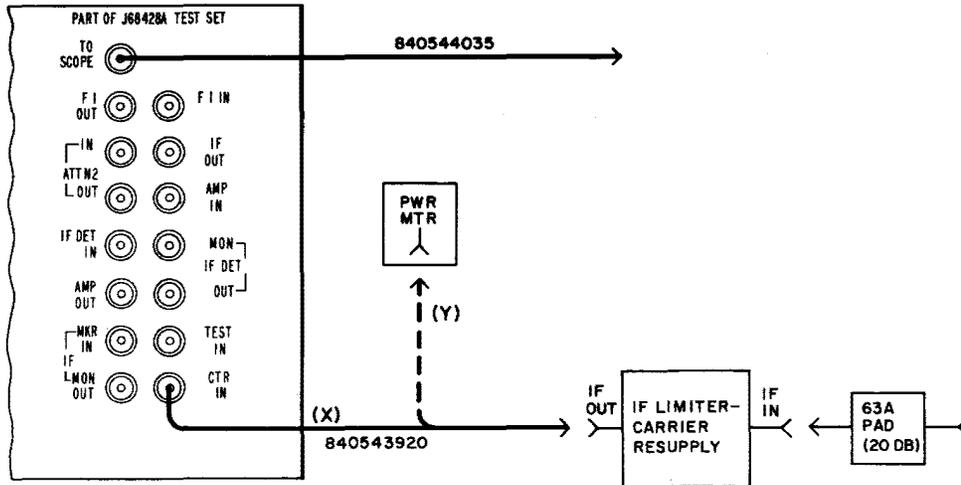
◆Fig. 13—Frequency Response Display at Output of IF Driver/Transmitter Modulator◆

◆CHART 28—PREPARATION FOR TEST (Fig. 14)

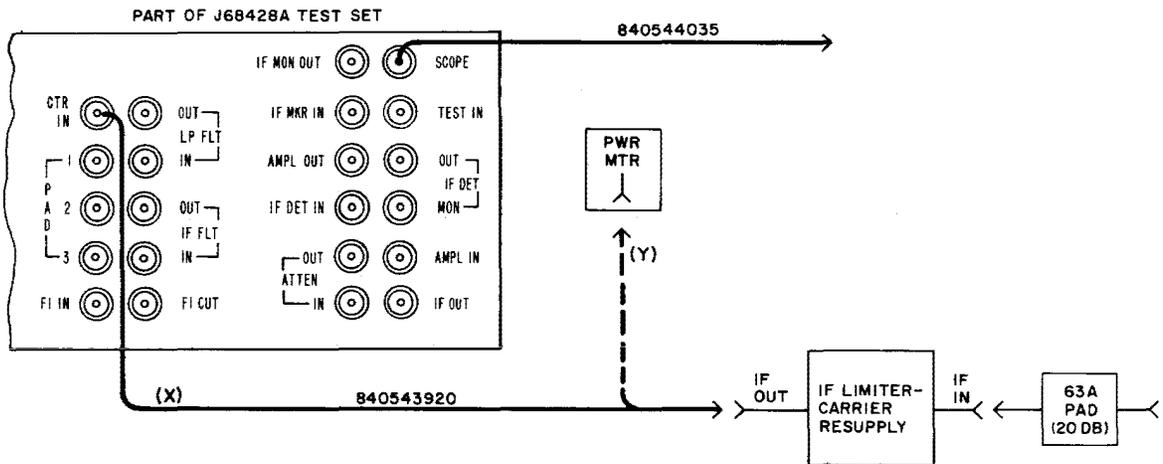
---

STEP	PROCEDURE
1	On the counter, set the FUNCTION switch to 135 MHz and the SAMPLE RATE control to CCW. With the power ON, push in the DISPLAY BLANKING on the extreme right.
2	On the power meter, set the INPUT switch to IF (see Step 4).
3	On the control unit, set COUNTER INPUT to 135 MHz.
4	With no IF cable connected to the power meter, set the MODE switch to ZERO and adjust the ZERO control for an indication of 000 on the digital display. Then set the MODE switch to POWER METER.◆

---



A. TEST SETUP USING TEST SET EQUIPPED WITH J68428C AND D PANELS



B. TEST SETUP USING TEST SET EQUIPPED WITH J68428F PANEL

Fig. 14—IF Limiter—Carrier Resupply 70-MHz Output Power and Frequency Test Setup—J68428A Test Set

## CHART 29—PREPARATION FOR TEST (Fig. 15)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table L.
2	Connect option (S) and adjust the IF CENTER FREQ control until the counter indicates 70 ±0.2 MHz.
3	On the power meter, set the MODE switch to ZERO and adjust the ZERO control for an indication of 000 on the digital display. Then set the MODE switch to POWER METER.
4	Connect option (T).
5	Adjust ATTEN to obtain -7 dBm on the power meter.
6	Set the power meter INPUT switch to RF.
7	On the power meter, set the MODE switch to ZERO and adjust the ZERO control for an indication of 000 on the digital display. Then set the MODE switch to POWER METER.
8	Disconnect option (T) and establish the options listed in Table M.♦

TABLE L

UNIT	CONTROL	POSITION
Counter	FUNCTION SAMPLE RATE DISPLAY BLANKING	135 MHz Counterclockwise* Depress the BLANKING DISPLAY pushbutton at the extreme right.
Power Meter	INPUT	IF
Control Unit	IF AMPL GAIN COUNTER INPUT ATTEN†	CCW 135 MHz MAX 10 dB
IF/RF Sweep Oscillator	IF CENTER FREQ IF MODE	70 CW

\* On some units, the power switch is combined with the SAMPLE RATE control. Make sure that the power is ON.

† On those test sets equipped with the J68428C and D panels, use ATTEN 2.

STEP	PROCEDURE
------	-----------

TABLE M

CHART	OPTIONS
9	(W) and (Z)
12	(X) and (Y)
14	(X) and (Z)
16	(X) and (Z)

▶CHART 30—PREPARATION FOR TEST (Fig. 16)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table N.
2	Remove the cable from the input jack to the oscilloscope, and center the test trace using the vertical and horizontal POSITION control and DISPLAY WIDTH. Replace the cable. Do not change the vertical POSITION control during the remainder of the test.
3	Connect the test set as shown in option (T).
4	Adjust ATTEN for a power indication of $-7$ dBm.
5	Connect option (R).
6	Adjust the TEST TRACE controls on the control unit to center the trace on the oscilloscope.
7	Adjust the MARKERS F1, F2, and AMPLITUDE controls on the control unit to obtain an oscilloscope display as shown. (Set COUNTER INPUT on the control unit to appropriate marker for counter display. Adjust IF CENTER FREQ and IF $\Delta F$ .) Leave the control unit COUNTER INPUT switch in the F2 position.
8	Disconnect option (R) and establish the options listed in Table O.
9	Adjust TEST TRACE on the control unit to center the trace.
10	Insert 0.5-dB attenuation at the variable pad and note the trace.

TABLE N

UNIT	CONTROL	POSITION
Oscilloscope	VOLTS DIV	1m*
Counter	FUNCTION SAMPLE RATE DISPLAY BLANKING	135 MHz Counterclockwise† Depress the BLANKING DISPLAY pushbutton at the extreme right.
Power Meter	INPUT	IF
Control Unit	COUNTER INPUT ATTEN‡	F1 0
Sweep Oscillator	IF CENTER FREQ IF MODE IF ΔF	70 ΔF 20

\* When performing Chart 12 with test sets equipped with J68428F panel, use 0.2m.

† On some units, the power switch is combined with the SAMPLE RATE control. Make sure that the power is ON.

‡ Use ATTEN 2 on test sets equipped with J68428C and D panels.

TABLE O

CHART	OPTIONS
9	(W) and (Z)
12	(X) and (Y)
14	(X) and (Z)

STEP	PROCEDURE
11	Adjust the VERNIER control on the oscilloscope vertical amplifier so that the attenuation results in a deflection of 10 major divisions. The oscilloscope is now calibrated for 0.05 dB/centimeter (major division).
12	With no IF cable connected to the power meter, set the MODE switch to zero and adjust the ZERO control for an indication of 000 on the digital display. Then set the MODE switch to POWER METER.⚡

⚡CHART 31—PREPARATION FOR TEST (Fig. 17)

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table P.
2	Remove the cable from the input jack to the oscilloscope, and center the test trace using the vertical and horizontal POSITION controls. Replace the cable. Do not change the vertical POSITION control during the remainder of the test.
3	Connect the test set as shown in option (X).
4	Adjust ATTEN for a power indication of $-23.3$ dBm.
5	Adjust the TEST TRACE controls on the control unit to center the trace on the oscilloscope.
6	Adjust the MARKERS F1, F2, and AMPLITUDE controls on the control unit to obtain an oscilloscope display as shown in Fig. 17. Also use the IF CENTER FREQ and IF $\Delta$ F controls, if necessary.
7	Insert 0.1-dB attenuation with ATTEN and note the trace.
8	Adjust the VERNIER control on the oscilloscope vertical amplifier so that the attenuation results in a deflection of 2 major divisions. The oscilloscope is now calibrated for 0.05 dB/centimeter (major division). Adjust the IF DET SLOPE control on the control unit for a flat test trace.
9	With no IF cable connected to the power meter, set the MODE switch to zero and adjust the ZERO control for an indication of 000 on the digital display. Then set the MODE switch to POWER METER.⚡

TABLE P

UNIT	CONTROL	POSITION
Oscilloscope	VOLTS/DIV	1m
Counter	SAMPLE RATE FUNCTION DISPLAY BLANKING	Counterclockwise* 135 MHz Depress the BLANKING DISPLAY pushbutton at the extreme right.
Power Meter	INPUT	IF
Control Unit	COUNTER INPUT ATTEN†	F1 0
Sweep Oscillator	IF CENTER FREQ IF MODE IF ΔF	70 ΔF 20

\* On some units, the power switch is combined with the SAMPLE RATE control. Make sure that the power is ON.

† On those test sets equipped with the J68428C and D panels, use ATTEN 2.

---

◆CHART 32—PREPARATION FOR TEST (Fig. 18)

---

STEP	PROCEDURE
1	Operate the test set controls to the positions shown in Table Q.
2	Connect the "A" cord to option (Y), and adjust the IF CENTER FREQ to $61 \pm 0.5$ MHz as indicated on the counter.
3	Connect the "A" cord to option (X), and adjust ATTEN for a power meter indication of $-7$ dBm.
4	Increase the attenuation by 25 dB.
5	Connect the "A" cord to option (Z) and the "B" cord to option (X).

STEP

PROCEDURE

TABLE Q

UNIT	CONTROL	POSITION
Counter	SAMPLE RATE FUNCTION DISPLAY BLANKING	Counterclockwise* 135 MHz Extreme right pushbutton pushed in
Power Meter	INPUT	IF
Sweep Oscillator	IF MODE	CW
Counter Unit	IF AMPL GAIN COUNTER INPUT ATTEN†	Maximum CCW 135 MHz MAX 0

\* On some units, the power switch is combined with the SAMPLE RATE control. Make sure that the power is ON.

† On those test sets equipped with J68428C and D panels, use ATTEN 2.

- 6 Adjust IF AMPL GAIN control on the control unit for a power meter indication of  $-10$  dBm.
- 7 With no IF cable connected to the power meter, set the MODE switch to ZERO and adjust the ZERO control for an indication of 000 on the digital display. Then set the MODE switch to POWER METER.⚡

◆CHART 33—PREPARATION FOR TEST (Fig. 19)

STEP

PROCEDURE

- 1 Operate the test set controls to the positions shown in Table R.
- 2 Connect option (X).
- 3 Adjust IF AMPL GAIN on the control unit for a power meter indication of  $-6$  dBm.
- 4 Adjust IF CENTER FREQ on the sweep oscillator for a counter indication of  $70 \pm 0.2$  MHz.

STEP

PROCEDURE

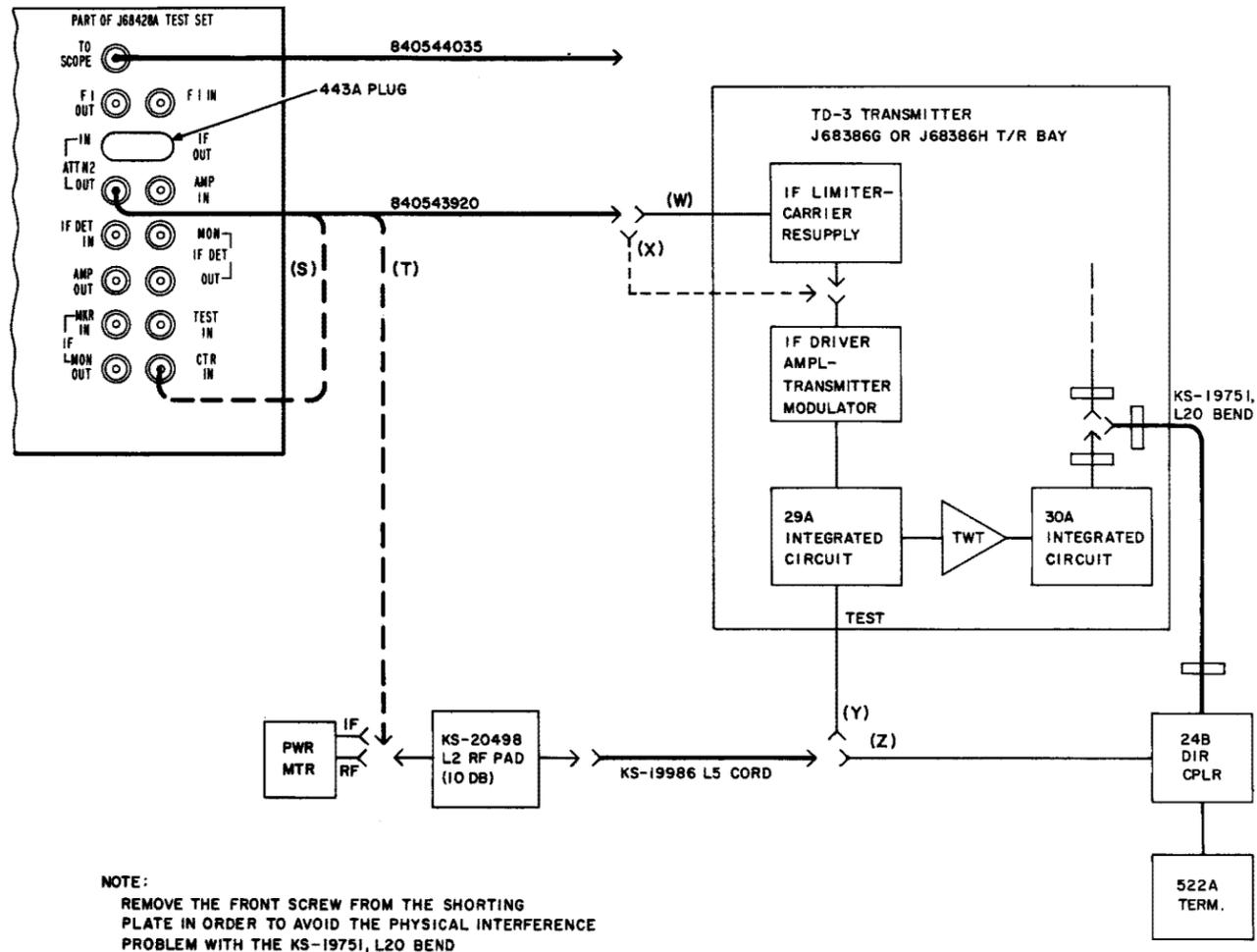
TABLE R

UNIT	CONTROL	POSITION
Counter	SAMPLE RATE FUNCTION DISPLAY BLANKING	Counterclockwise* 135 MHz Pushbutton on extreme right pushed in
Power Meter	INPUT	IF
Sweep Oscillator	IF MODE	CW
Control Unit	IF AMPL GAIN COUNTER INPUT ATTEN†	Counterclockwise 135 MHz MAX 50 dB

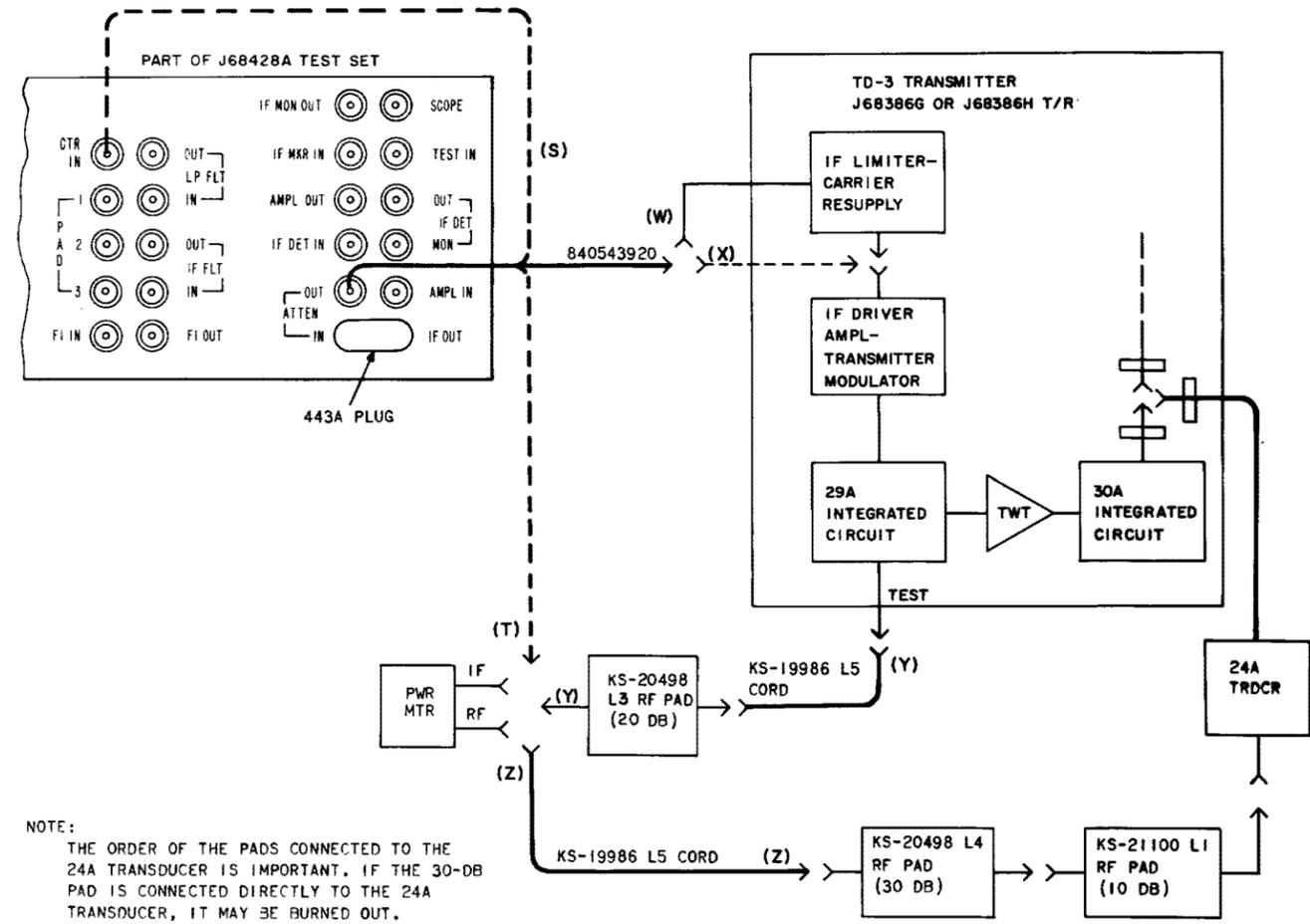
\* On some units, the power switch is combined with the SAMPLE RATE control. Make sure that the power is ON.

† On those test sets equipped with J68428C and D panels, use ATTEN 2.

- 5 Connect option (W).
- 6 With no IF cable connected to the power meter, set the MODE switch to ZERO and adjust the ZERO control for an indication of 000 on the digital display. Then set the MODE switch to POWER METER.⚡

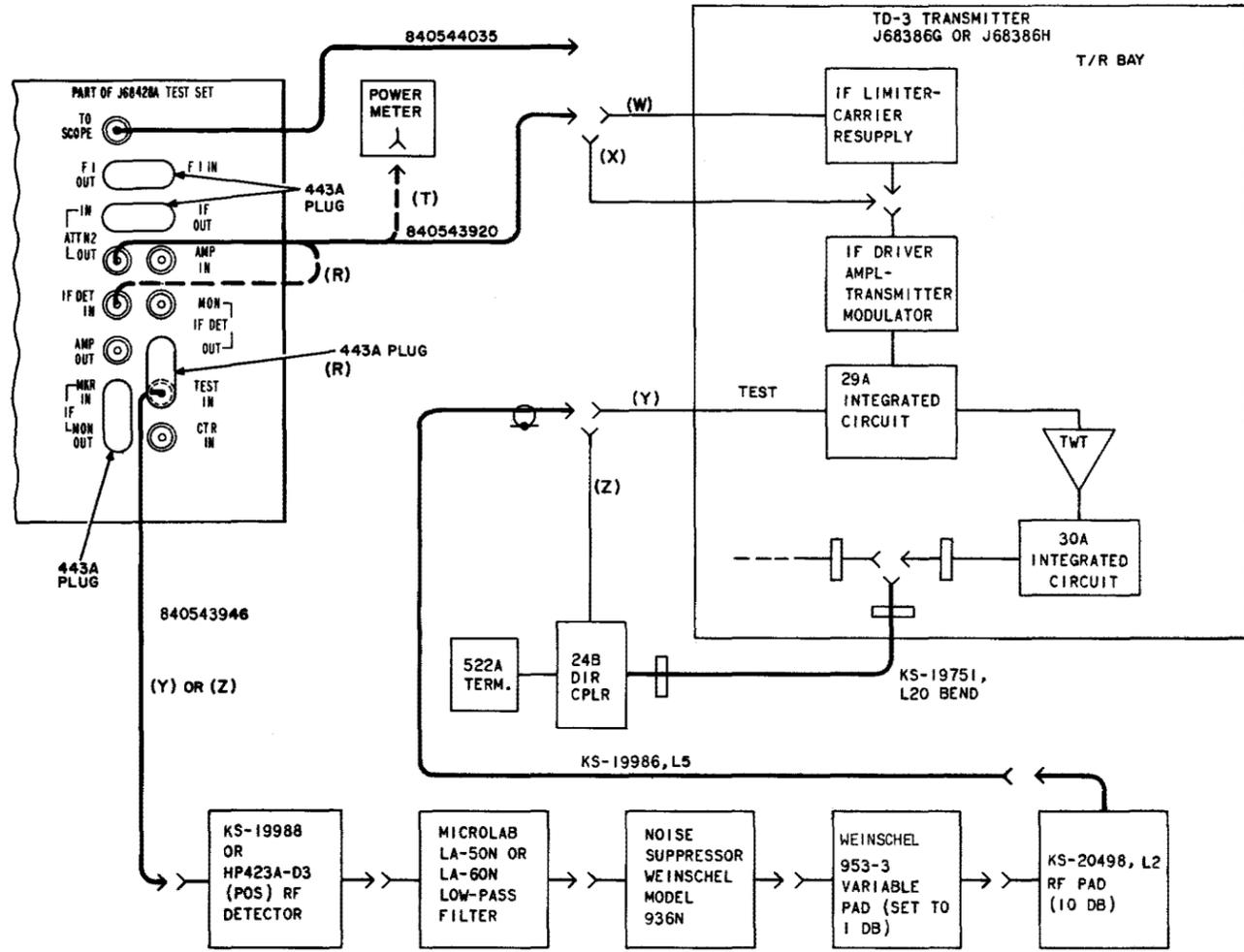


A. TEST SETUP USING J68428C AND D PANELS

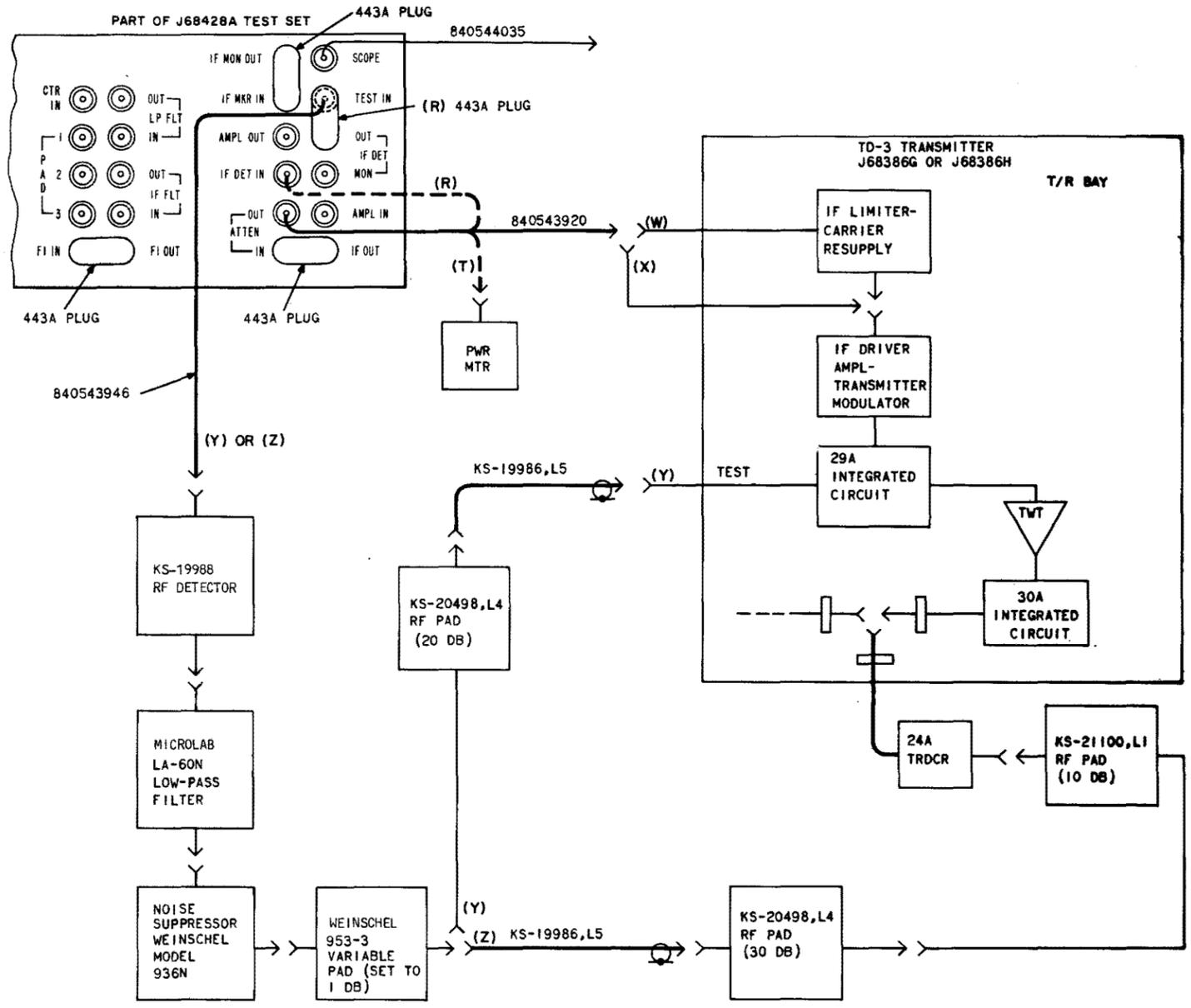
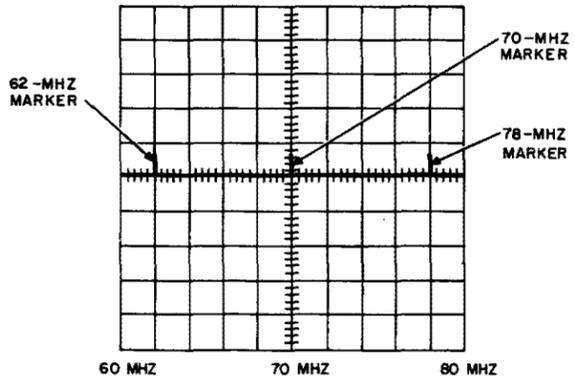


B. TEST SETUP USING TEST SET EQUIPPED WITH J68428F PANEL

Fig. 15—Test Setup for IF-to-RF Gain Tests—J68428A Test Set

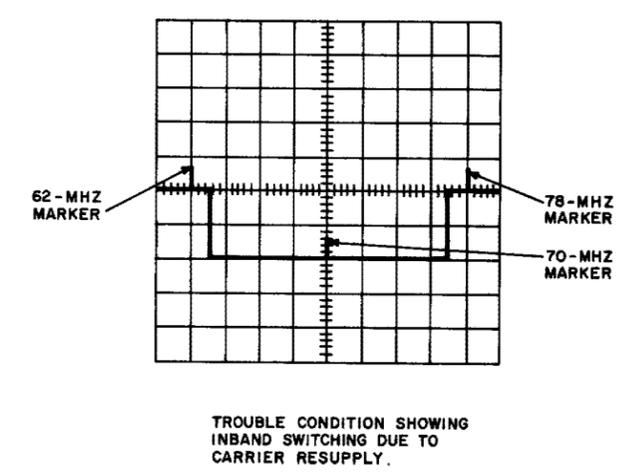
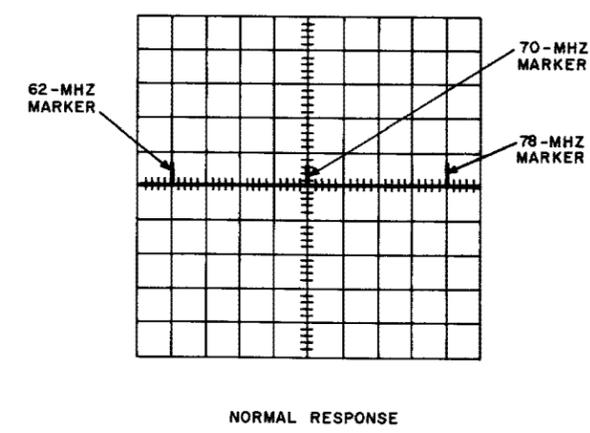
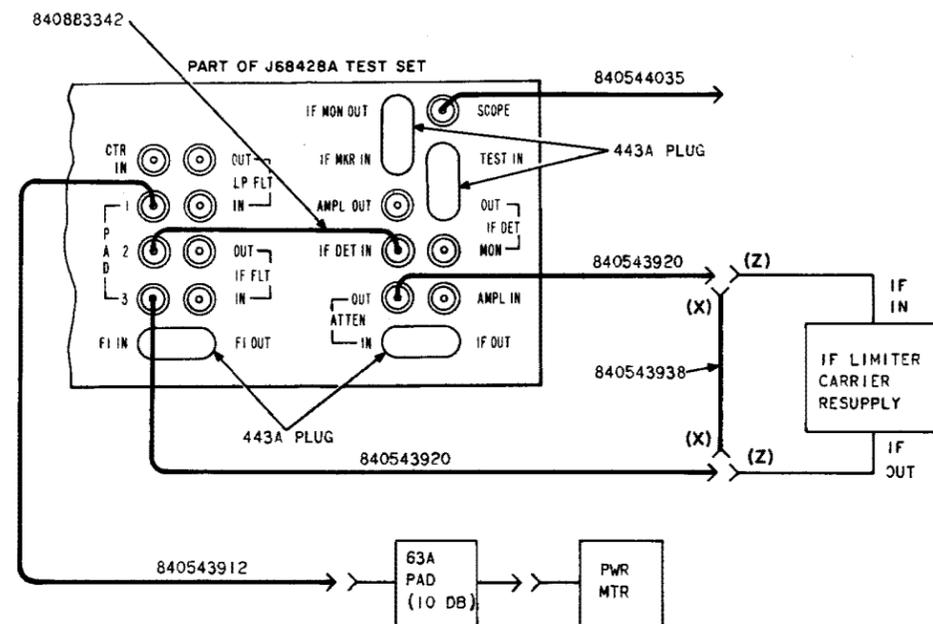
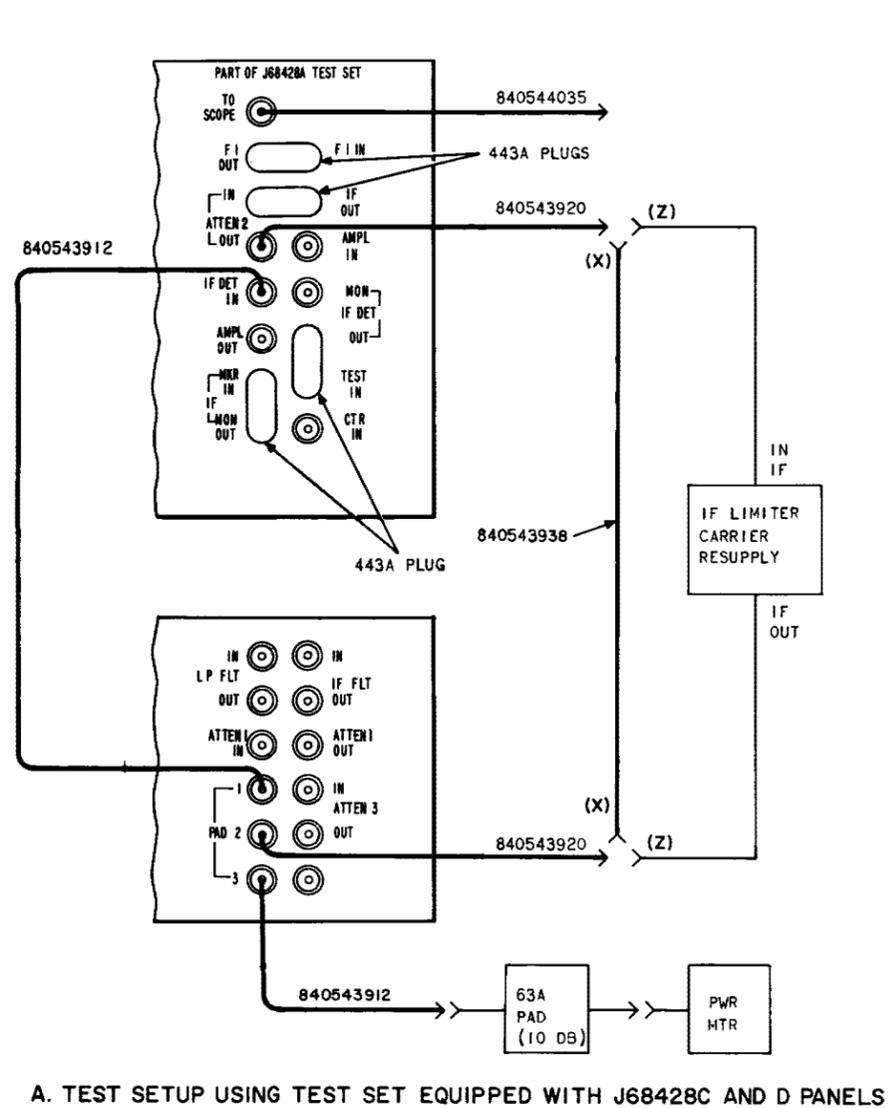


A. TEST SETUP USING TEST SET EQUIPPED WITH J68428C AND D PANELS

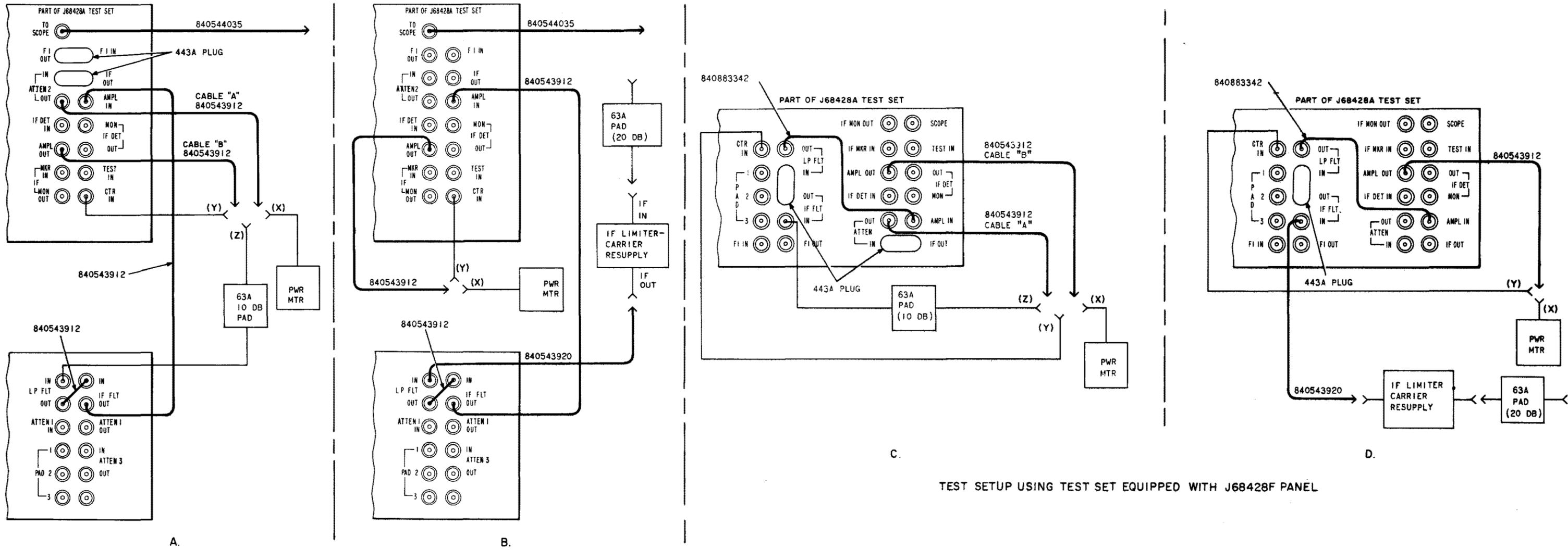


B. TEST SETUP USING TEST SET EQUIPPED WITH J68428F PANEL

Fig. 16—IF-to-RF Amplitude Response Test Setup—J68428A Test Set



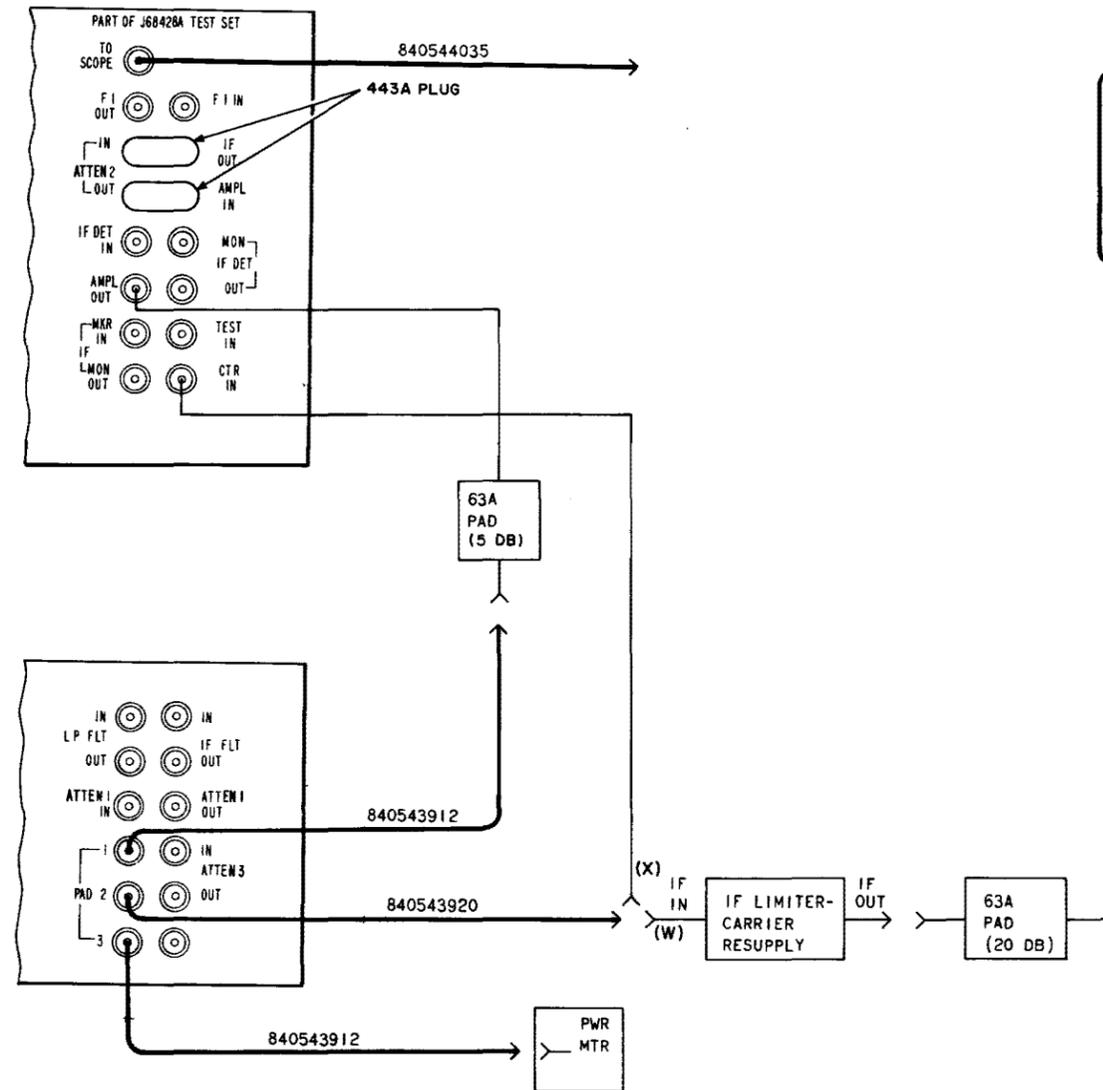
**Fig. 17—IF-to-IF Amplitude Response Test Setup—J68428A Test Set**



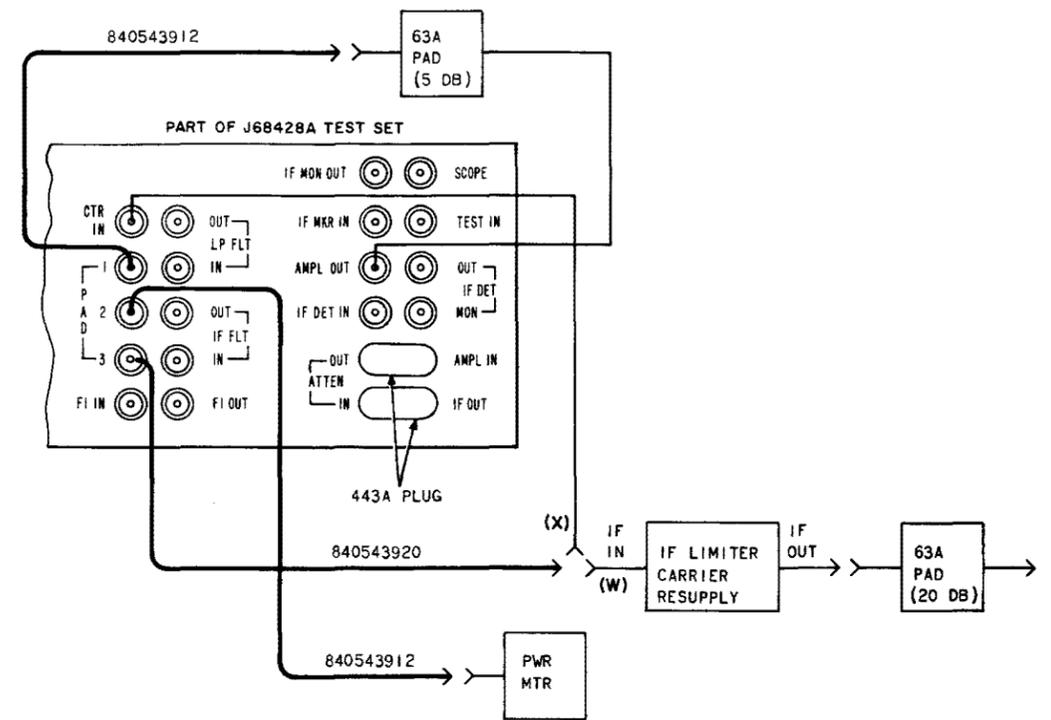
J68428A TEST SET EQUIPPED WITH J68428C AND D PANELS

TEST SETUP USING TEST SET EQUIPPED WITH J68428F PANEL

Fig. 18—IF Limiter—Carrier Resupply 61-MHz Output Power and Frequency Test Setup—J68428A Test Set



A. TEST SETUP USING TEST SET EQUIPPED WITH J68428C AND D PANELS



B. TEST SETUP USING TEST SET EQUIPPED WITH J68428F PANEL

Fig. 19—IF Limiter—Carrier Resupply Trip and Restore Point Test Setup—J68428A Test Set