

TD-3 MICROWAVE RADIO
J68386G AND J68386H TRANSMITTER-RECEIVER BAYS
TRANSMITTER TESTS USING KRUSE 52011 IF/RF TEST SET
TRANSMISSION

This appendix supplements Section 411-506-501.

It describes procedures for measuring and adjusting the gain and amplitude response of the radio transmitter in the J68386G and J68386H radio bays using Kruse 52011 IF/RF Test Set. Procedures for checking and adjusting the IF limiter-carrier resupply and for setting up transmitter alarms are also included.

Section 411-500-501, In-Service Checks, should be performed prior to this appendix, and the results used as a guide to any source of trouble. The preliminary checks in Section 411-502-500 must be completed before performing the tests in this appendix. The 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.

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

The charts must be performed in the order listed, unless otherwise specified. The recommended maintenance interval is given in the Equipment Test List.

Caution 1: Those tests are performed on an out-of-service basis. Obtain a release from the authorized control office and remove the channel from service as directed by local practice.

Caution 2: When removing and replacing waveguide units, care should be exercised to prevent foreign matter from entering the waveguide. Handle all types of waveguide carefully 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.

Warning 1: DO NOT leave energized waveguides unterminated. The RF power density which may be encountered at output waveguide is potentially hazardous to the eyes and body tissue.

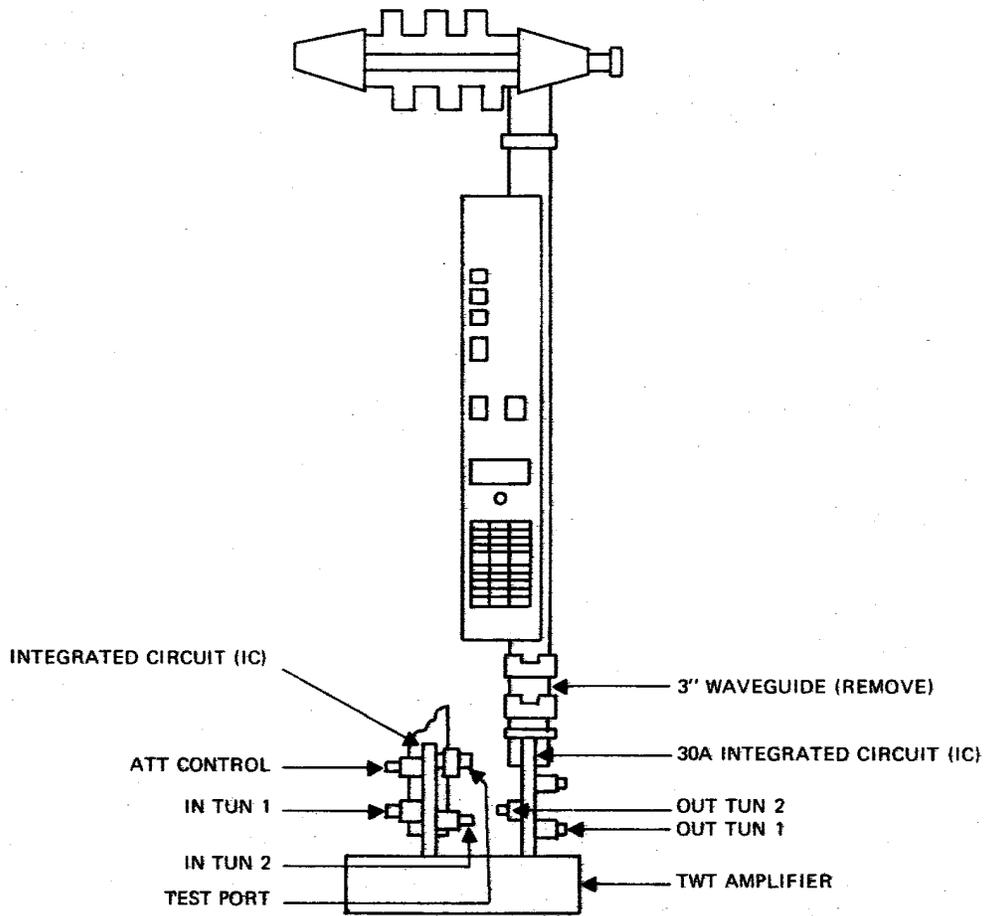
Warning 2: Voltages inside the TWT power supply are much higher than those usually found in telephone power plants. Under no circumstances should the built-in interlock feature be defeated.

CHART A
OVERALL TRANSMISSION TESTS

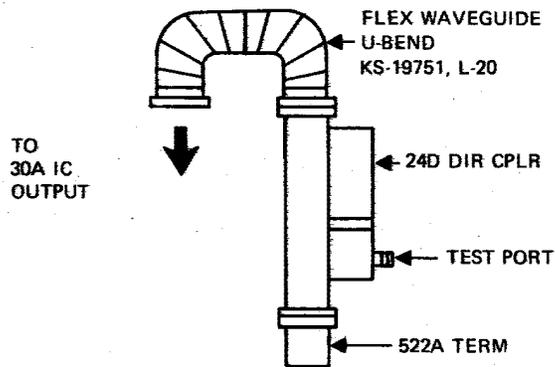
APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE
1	<p>When performing the main 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.</p> <p><i>Note:</i> 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.</p>
2	<p>Disconnect P14 plug from IF IN jack of IF driver amplifier.</p> <p><i>Caution:</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.</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.)</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>Prepare transmitter for test as shown in Fig. 1.</p>
6	<p>Connect test set in accordance with Fig. 2, Preparation for Test, Parts 1 and 2.</p>
7	<p>Terminate coaxial TEST port on the 29A integrated circuit.</p>
8	<p>Reconnect the P14 plug to the IF IN jack of IF driver amplifier.</p>
9	<p>Select COLL CURR on the meter panel.</p> <p><i>Requirement:</i> 70 ±4.</p> <p>If the requirement is not met, perform Step 3 of Chart D.</p>
10	<p>Connect option (Y).</p>
11	<p>Measure transmitter output power using the power meter.</p> <p><i>Requirement:</i> Not less than +35.0 dBm minus the calibrated loss of the 24D directional coupler, and RF pad.</p>



Location of Transmitter Components



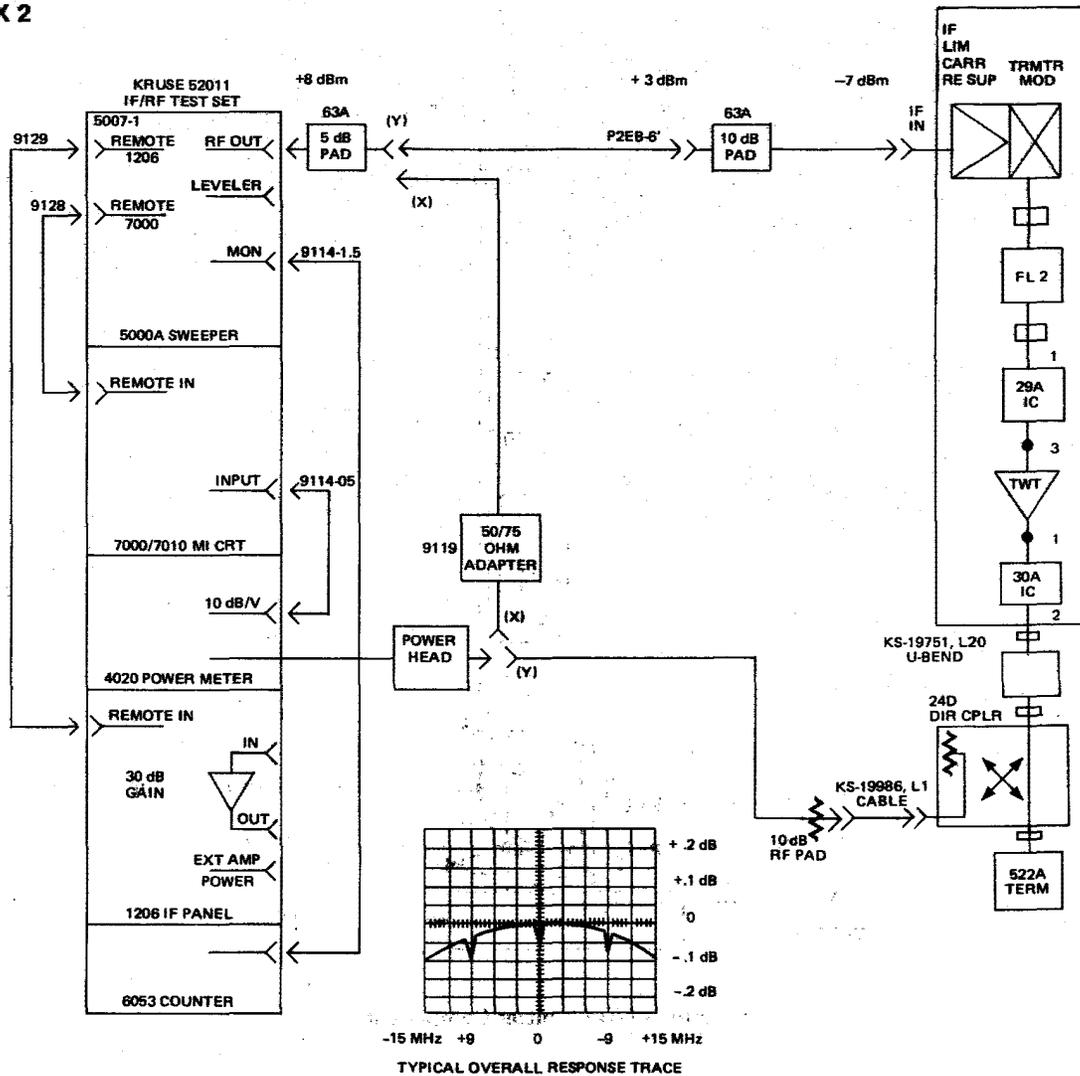
Note: The TEST PORT must be near to 522A TERM.

Transmitter Test Arrangement

Preparing Transmitter For Test

Fig. 1

SECTION 411-506-501PT
APPENDIX 2



PREPARATION FOR TEST

- Operate controls on the test set as follows, allowing 5 minutes warm-up.

UNIT	CONTROL	POSITION
5000A SWEEPER WITH 50007-1 IF PLUG-IN	F-1 START	55 MHz
	MARKER 1	61 MHz
	MARKER 2-Fc	70 MHz
	MARKER 3	79 MHz
	F-2 Stop	85 MHz
	VERNIER	MAX CCW
	RF LEVEL	+8 dBm
	1 kHz	OFF
	LEVELER	INT
	RETRACE	ON
	RECUR-TRIG-LINE	RECUR
	MODE	CW
	Fc ± ΔF VERNIER	MAX CW
	SWEEP SECONDS	.01
SWEEP SECONDS VERNIER	MAX CW	
EXT/INT'L SWEEP (REAR)	INT'L	
4020 POWER METER	LEVEL	10 DB/V
	GROUNDING	INT
	OFFSET	MID-SCALE
COUNTER	ATTENUATOR	X1
	RESOLUTION	1K
	EXT/INT (REAR)	INT

- Connect power meter head to CAL OUT jack. Depress DBM CAL key and adjust its control for +10.00 dBm reading. Depress ZERO key and adjust its control for 00.00±0.01 reading. Depress DBM 75 ohm key.
- Establish option X and adjust sweeper RF LEVEL control for +3 dBm power meter reading.

OSCILLOSCOPE CALIBRATION

- Set scope controls:

CONTROL	POSITION
OFFSET	MID-SCALE (DO NOT READJUST)
GAIN	X1
POLARITY	+UP
BW	30 kHz
INPUT	DC
DB/DIV AT 10 DB/V	.05 DB/DIV - 5 MV/DIV
VARIABLE (RED)	MAX CW DETENT

- Adjust sweeper MODE control to WIDE F1-F2 position.
- Adjust power meter OFFSET control to position trace on center of oscilloscope.
- Adjust HORIZONTAL POS and GAIN controls to position trace ends at each extreme of horizontal scale. The horizontal scale calibration is 3 MHz/div with markers at 61, 70, and 79 MHz.
- Switch vertical sensitivity control on scope to .05 dB/div - 5 mV/div. (This calibrates scope for 0.05 dB/div.)

Overall Transmitter
IF to RF Test Setup
Fig. 2

CHART A (Cont)

STEP	PROCEDURE
15	<p><i>Requirement:</i> No evidence of IF limiter-carrier resupply switching from 10 MHz below to 10 MHz above the center frequency should be evident. (See Fig. 3 for an example of this condition.)</p> <div data-bbox="522 495 1182 892" style="text-align: center;"> <p style="text-align: center;">B</p> </div> <p style="text-align: center;">Trouble Condition Showing Inband Switching Due to Carrier Resupply Fig. 3</p> <p>If the requirement is not met, perform Chart E; if the requirement is still not met, replace the IF limiter-carrier resupply unit and perform Charts B and E.</p>
16	<p>After the requirements are met, perform Charts E and F.</p>

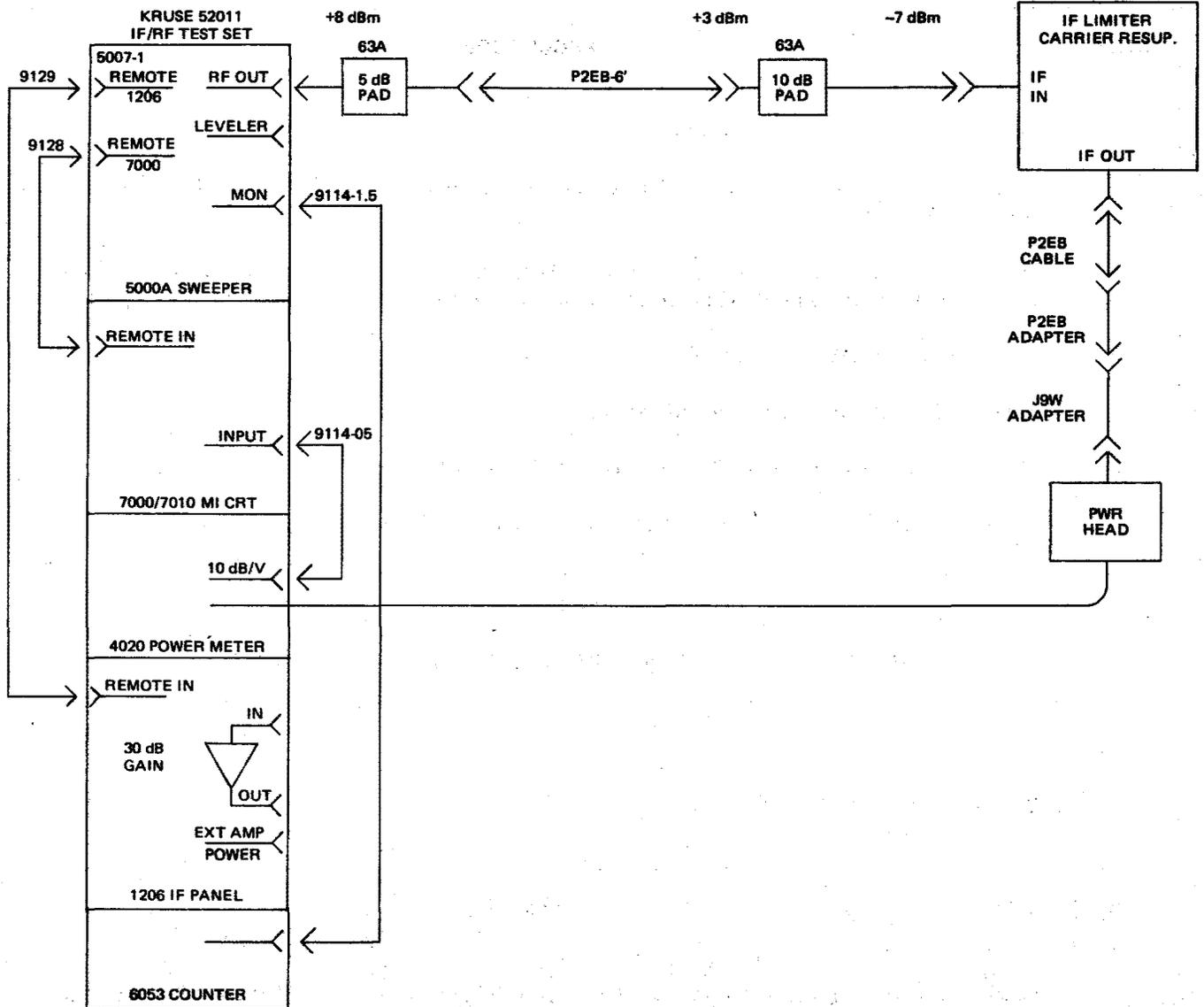
CHART B

IF LIMITER-CARRIER RESUPPLY TRANSMISSION ADJUSTMENT

APPARATUS:

- 1—KS-20114, L2 Adjusting Tool
- 1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE
1	<p><i>Note:</i> If the requirements are not met in this chart, replace the IF limiter-carrier resupply unit.</p> <p>Connect test set in accordance with Fig. 4 and perform Preparation for Test.</p> <p><i>Note:</i> 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>



Preparation for Test

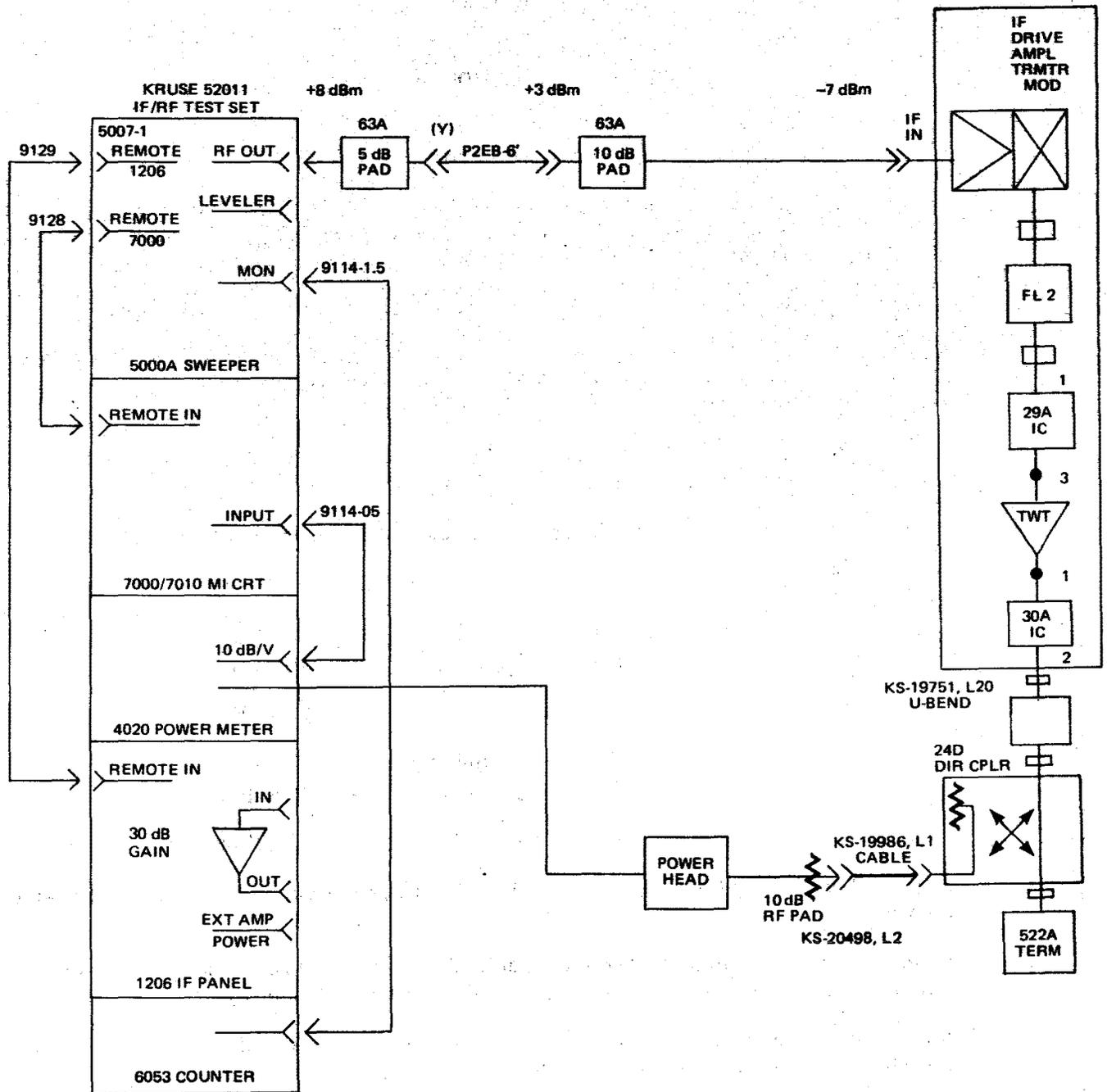
1. Perform test set preparation as shown in Fig. 2, Parts 1 and 2.
2. Set sweeper MODE control to WIDE F1-F2 position.
3. Set trace such that the 70 MHz (center marker) point on test trace is located on middle horizontal line with power meter OFFSET control.

**IF Limiter-Carrier Resupply Unit Transmission Tests
Fig. 4**

CHART B (Cont)	
STEP	PROCEDURE
2	<p>Observe test trace on oscilloscope.</p> <p><i>Requirement:</i> The test trace and reference trace 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	Set sweeper MODE control to CW.
4	Read and record power meter indication.
5	<p>Replace 63A 5 dB pad with 63A 10 dB pad at sweeper.</p> <p><i>Requirement:</i> The power meter indication should be within 1 dB of that recorded in Step 4.</p>
<p>CHART B</p> <p>IF DRIVER AMPLIFIER-TRANSMITTER MODULATOR ADJUSTMENT</p>	
<p>APPARATUS:</p> <p>1—KS-20114, L2 Adjusting Tool 1—Kruse 52011 IF/RF Test Set</p>	
STEP	PROCEDURE
1	<p><i>Note:</i> If the requirements are not met in this chart, refer to Section 411-506-503 for troubleshooting procedures.</p> <p>Remove the termination from the TEST port of the 29A integrated circuit and insert 10 dB RF pad as shown in Fig. 5.</p>
2	Connect the test set in accordance with Fig. 5 and Preparation for Test.
3	<p>Adjust ATT control on the 29A integrated circuit for maximum power output at the TEST port. (Maximum power is obtained by turning the attenuator counterclockwise.)</p> <p><i>Requirement:</i> +9 dB.</p> <p>If the requirement is not met, adjust the DIODE BIAS control on the IF driver amplifier for maximum output; then adjust the GAIN control.</p>

CHART C (Cont)	
STEP	PROCEDURE
4	<p><i>Note:</i> If the GAIN control has insufficient adjustment range to obtain the required power, readjust the DIODE BIAS control to meet the requirement.</p> <p>Measure the amplitude response of the IF driver amplifier-transmitter modulator.</p> <p><i>Requirement:</i> The amplitude response shall be flat to within 0.15 dB between ± 8 MHz of center frequency, and 0.23 dB between ± 10 MHz of center frequency.</p> <p>If the requirement is not met, adjust the SLOPE control (coarse adjustment) and the DIODE BIAS control (fine adjustment) until the requirement is met. If necessary, adjust the GAIN control to keep the trace coincident.</p>
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 ATT control on the 29A integrated circuit for TWT IN meter indication recorded on the meter panel.
<p>CHART D</p> <p>TWT AMPLIFIER ADJUSTMENT</p>	
<p>APPARATUS:</p> <p>1—Kruse 52011 IF/RF Test Set</p>	
STEP	PROCEDURE
1	<p><i>Notes:</i></p> <ol style="list-style-type: none"> 1. 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 C before performing any test in this chart. 2. If the requirements are not met in this chart, refer to Section 411-506-504 for troubleshooting procedures. <p>Remove 3-inch flexible waveguide from transmitter and connect a shorting plate to exposed port leading to 1432() transmitter channel combining network. Prepare transmitter for test in accordance with Fig. 1.</p>

CHART D (Cont)																			
STEP	PROCEDURE																		
1	Connect test set in accordance with Fig. 6 and Preparation for Test.																		
3	<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><i>Requirement:</i> 70 ±1 (panel meter).</p> <p><i>Note:</i> 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>																		
4	Adjust TUN 1 and TUN 2 controls on the 29A and 30A integrated circuits for maximum transmitter power output as indicated on the power meter.																		
5	<p>Adjust ATT control on the 29A integrated circuit to meet the following requirement.</p> <p><i>Requirement:</i> +37.0 dBm minus the calibrated loss of the 24D directional coupler and RF pad.</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td style="padding-right: 20px;"><i>Example:</i> Calibrated 24D coupler loss</td> <td>=</td> <td style="text-align: right;">-28.0 dB</td> </tr> <tr> <td style="padding-right: 20px;">Calibrated RF pad loss</td> <td>=</td> <td style="text-align: right;">-10.0 dB</td> </tr> <tr> <td></td> <td></td> <td style="text-align: right; border-top: 1px solid black;">-38.0 dB</td> </tr> <tr> <td style="padding-right: 20px;">Requirement</td> <td>=</td> <td style="text-align: right;">+37.0 dBm</td> </tr> <tr> <td style="padding-right: 20px;">Calibrated Loss</td> <td>=</td> <td style="text-align: right;">-38.0 dBm</td> </tr> <tr> <td></td> <td></td> <td style="text-align: right; border-top: 1px solid black;">- 1.0 dBm</td> </tr> </table>	<i>Example:</i> Calibrated 24D coupler loss	=	-28.0 dB	Calibrated RF pad loss	=	-10.0 dB			-38.0 dB	Requirement	=	+37.0 dBm	Calibrated Loss	=	-38.0 dBm			- 1.0 dBm
<i>Example:</i> Calibrated 24D coupler loss	=	-28.0 dB																	
Calibrated RF pad loss	=	-10.0 dB																	
		-38.0 dB																	
Requirement	=	+37.0 dBm																	
Calibrated Loss	=	-38.0 dBm																	
		- 1.0 dBm																	
6	<p>Adjust TUN 1 and TUN 2 controls on the 30A integrated circuit to meet the following requirement.</p> <p><i>Requirement:</i> The amplitude response shall be flat to within 0.20 dB between ±8 MHz of center frequency, and 0.35 dB between ±10 MHz of center frequency.</p> <p><i>Note:</i> The test trace displays the combined amplitude response of the IF driver amplifier-transmitter modulator and TWT amplifier.</p>																		
7	<p>Connect test set in accordance with Fig. 6, option (A) and check transmitter output power.</p> <p><i>Requirement:</i> Greater than +36.0 dBm minus the calibrated loss of the 24B directional coupler, RF attenuator, and the RF cable, if used.</p>																		
8	Adjust the ATT control on the 29A integrated circuit to equal +37.0 dBm minus the calibrated loss of the 24D directional coupler, RF pad.																		
9	Select TWT IN and COLL CUR on the meter panel and record each meter indication.																		

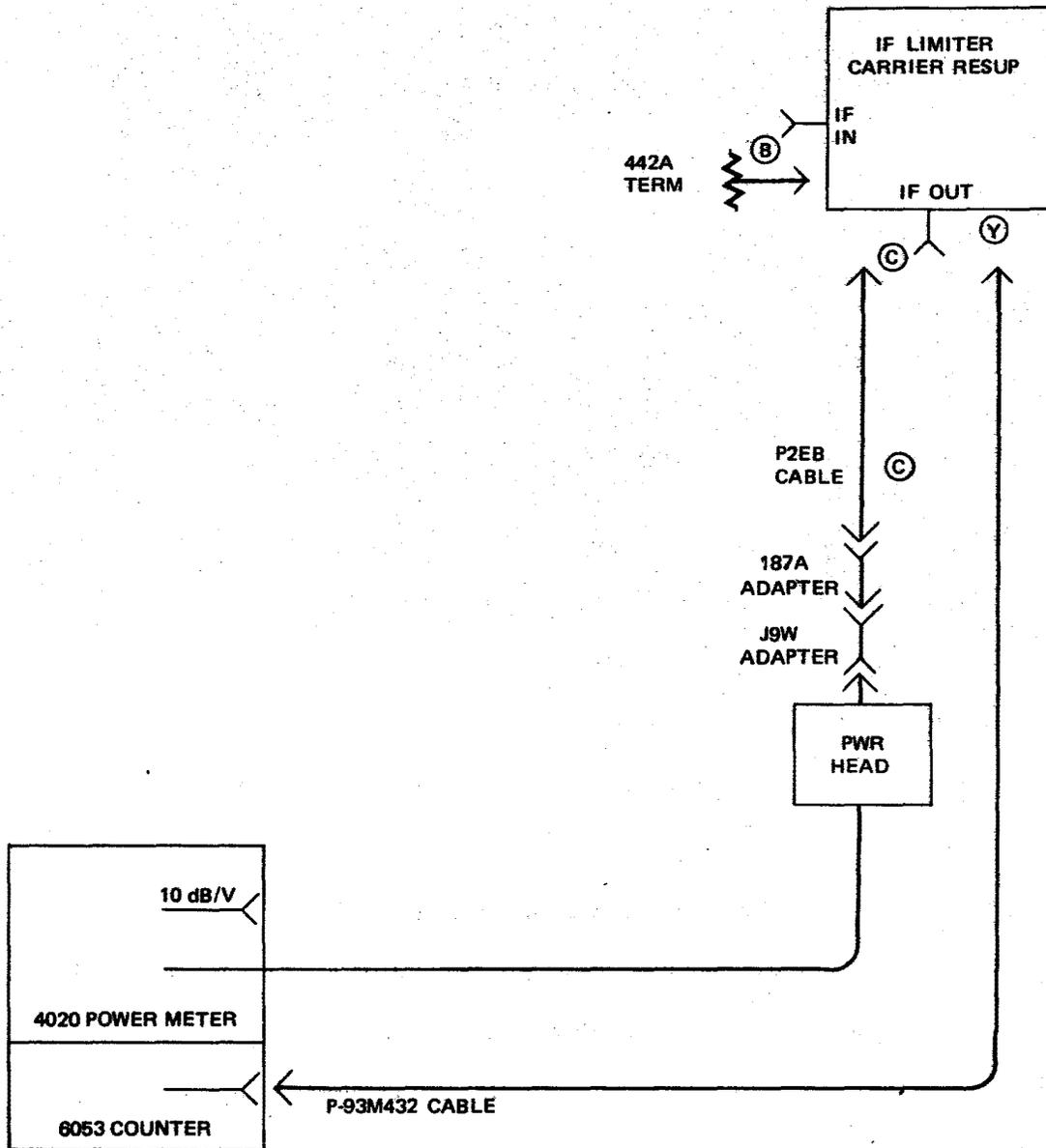


PREPARATION FOR TEST

1. Prepare test setup in accordance with Fig. 2, Parts 1 and 2.
2. Set sweeper MODE control to WIDE F1-F2 position.

**Test Setup for TWT Amplifier Adjustment
Fig. 6**

CHART E	
IF LIMITER-CARRIER RESUPPLY OPERATION CHECKS	
APPARATUS:	
1—KS-20114, L2 Adjusting Tool 1—Kruse 52011 IF/RF Test Set	
STEP	PROCEDURE
	<p><i>Note:</i> If the requirements are not met in this chart, replace the IF limiter-carrier resupply unit.</p> <p>Carrier Resupply 70 MHz Frequency and Output Power Checks</p> <p>1 Connect test set in accordance with Fig. 7, option (C) and (B).</p> <p>2 Measure the 70 MHz output power.</p> <p><i>Requirement:</i> -70 dBm \pm1 dB.</p> <p>3 Connect option (Y), and measure and record output frequency.</p> <p><i>Requirement:</i> 70 \pm0.006 MHz.</p> <p>Carrier Resupply 61 MHz Frequency and Output Power Checks</p> <p>4 Connect test set in accordance with Fig. 8 and perform the Preparation for Test procedures.</p> <p>5 Connect test set in accordance with Fig. 8, option (X).</p> <p>6 Adjust the 9 MHz LEV control of the IF limiter-carrier resupply to meet the following requirement.</p> <p><i>Requirement:</i> -12 dBm \pm0.5 dB.</p> <p><i>Note:</i> The requirement corresponds to -42 dBm \pm0.5 dB at the IF limiter-carrier resupply output.</p> <p>7 Select CRS 9 MHz on the panel meter and adjust the 9 MHz ALM V control to meet the following requirement.</p> <p><i>Requirement:</i> 59 \pm5.</p> <p>8 Connect option (Y) and measure the frequency. Subtract this frequency from that recorded in Step 3.</p> <p><i>Requirement:</i> 9 \pm0.0015 MHz.</p>



PREPARATION FOR TEST

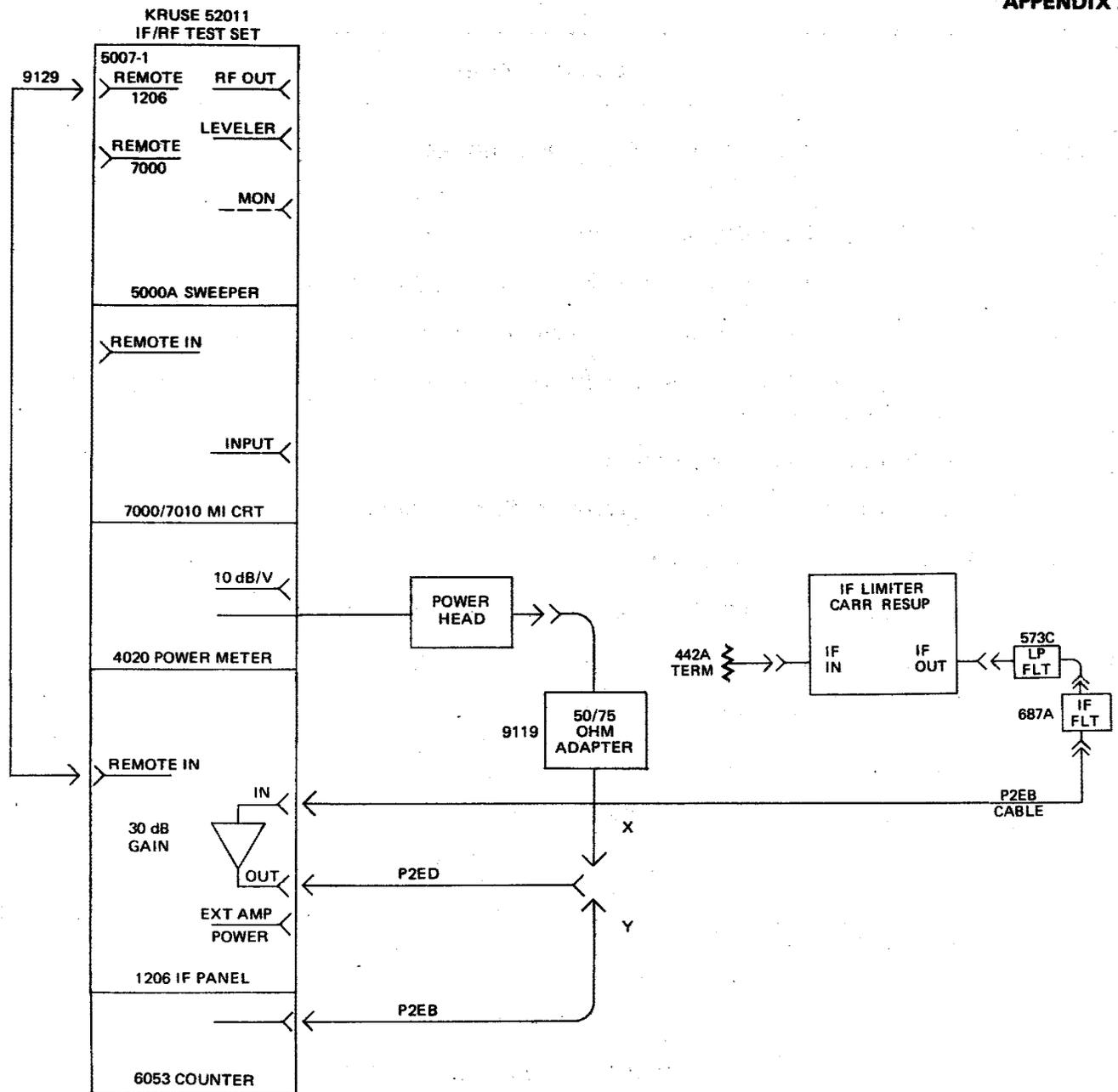
- Operate controls on the test set as follows, allowing 5 minutes warm-up.

UNIT	CONTROL	POSITION
4020 POWER METER	LEVEL	10 DB/V
	GROUNDING	INT
	OFFSET	MID-SCALE
COUNTER	ATTENUATOR	X1
	RESOLUTION	1K
	EXT/INT (REAR)	INT

- Connect power meter head to CAL OUT jack. Depress DBM CAL key and adjust its control for +10.00 dBm reading. Depress ZERO key and adjust its control for 00.00 ± .01 reading. Depress DBM 75 ohm key.

**IF Limiter Carrier Resupply
70 MHz Output Power and Frequency Test Setup**

Fig. 7



PREPARATION FOR TEST

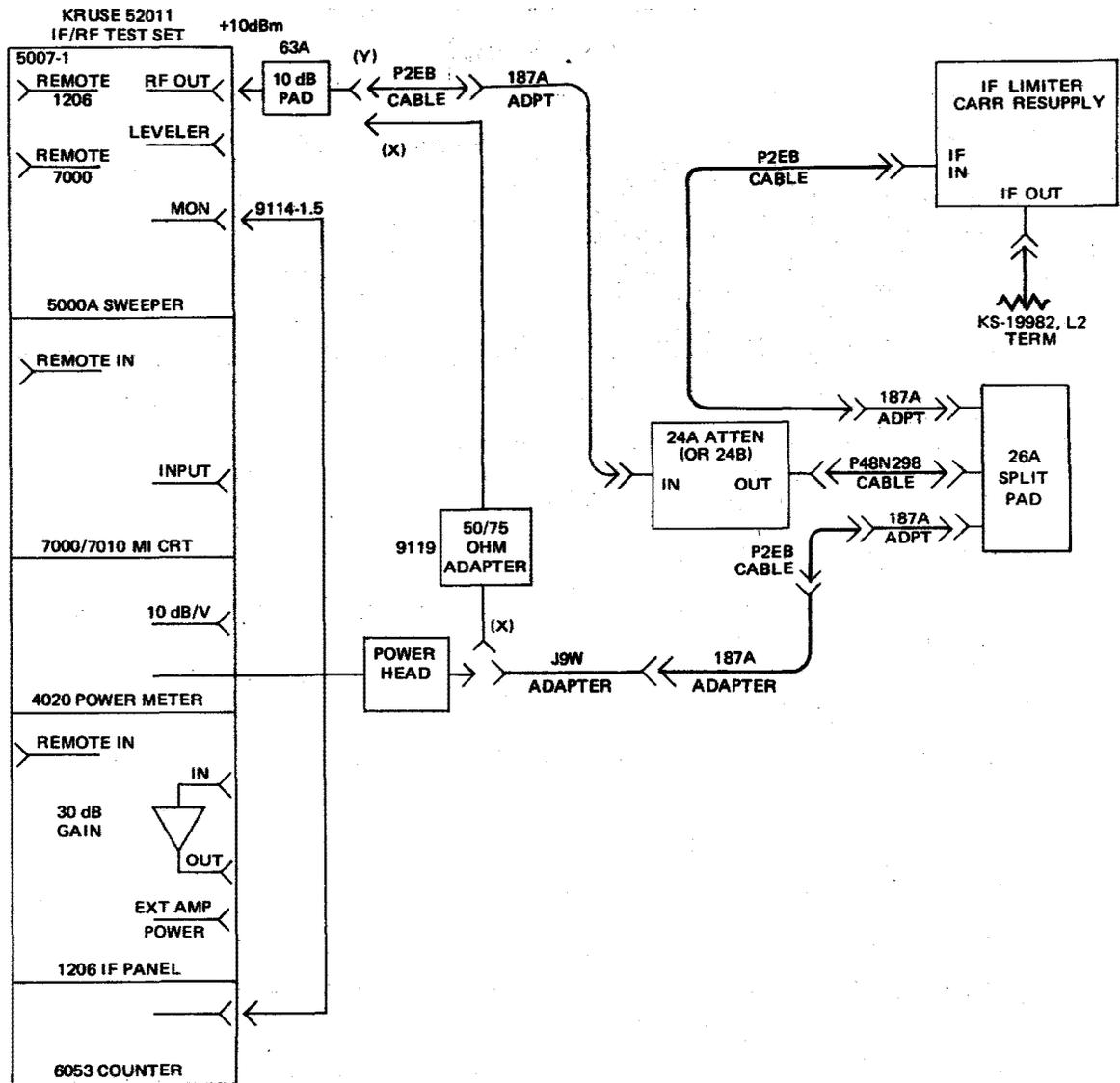
1. Operate controls on the test set as follows, allowing 5 minutes warm-up.

UNIT	CONTROL	POSITION
4020 POWER METER	LEVEL	10 DB/V
	GROUNDING	INT
	OFFSET	MID-SCALE
COUNTER	ATTENUATOR	X1
	RESOLUTION	1K
	EXT/INT (REAR)	INT

2. Connect power meter head to CAL OUT jack. Depress DBM CAL key and adjust its control for +10.00 dBm reading. Depress ZERO key and adjust its control for 00.00 ± .01 reading. Depress DBM 75 ohm key.

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

CHART E (Cont)	
STEP	PROCEDURE
	<p>Carrier Resupply Trip and Restore Checks</p> <p>9 Connect test set in accordance with Fig. 9 and Preparation for Test.</p> <p>10 Select CRS SW V on the meter panel and record the meter indication.</p> <p>11 Slowly increase 24A or 24B ATTEN until the CRS SW V meter indication just drops to zero and measure power.</p> <p><i>Requirement: -16.0 dBm; ±0.5 dB.</i></p> <p>If the requirement is not met, proceed to Steps 12 to 15.</p> <p>12 Set TRIP control fully clockwise.</p> <p>13 Adjust 24A or 24B ATTEN for a -16 dBm power measurement.</p> <p>14 Slowly rotate TRIP control counterclockwise until CRS SW V indication on the meter panel drops to zero.</p> <p>15 Slowly increase input power to unit by decreasing ATTEN until meter reading jumps up scale.</p> <p><i>Requirement: Between -15.0 dBm and -13.5 dBm.</i></p> <p>If requirement is not met, replace IF limiter-carrier resupply unit and repeat Charts B and F.</p> <p>16 Record meter panel indications for LIM CUR, LIM IN, CRS 70 MHz, CRS 9 MHz, and CRS SW V.</p>
<p>CHART F</p> <p>ALARM CHECKS AND ADJUSTMENTS</p>	
<p>APPARATUS:</p> <p>1—Kruse 52011 IF/RF Test Set</p>	
STEP	PROCEDURE
1	<p>Carrier Resupply 9 MHz Alarm Checks</p> <p>Adjust the 9 MHz LEV control counterclockwise until the CRS 9 MHz alarm lamp on the alarm panel just lights.</p>



PREPARATION FOR TEST

1. Operate controls on the test set as follows, allowing 5 minutes warm-up.

UNIT	CONTROL	POSITION
5000A SWEEPER WITH 50007-1 IF PLUG-IN	F-1 START	55 MHz
	MARKER 1	81 MHz
	MARKER 2-Fc	70 MHz
	MARKER 3	79 MHz
	F-2 STOP	85 MHz
	VERNIER	MAX CCW
	RF LEVEL	CCW
	1 KHz	OFF
	LEVELER	INT
	RETRACE	ON
	RECUR-TRIG-LINE	RECUR
	MODE	CW
	Fc±ΔF VERNIER	MAX CW
	SWEEP SECONDS	.01
	SWEEP SECONDS VERNIER	MAX CW
EXT/INT'L SWEEP (REAR)	INT'L	

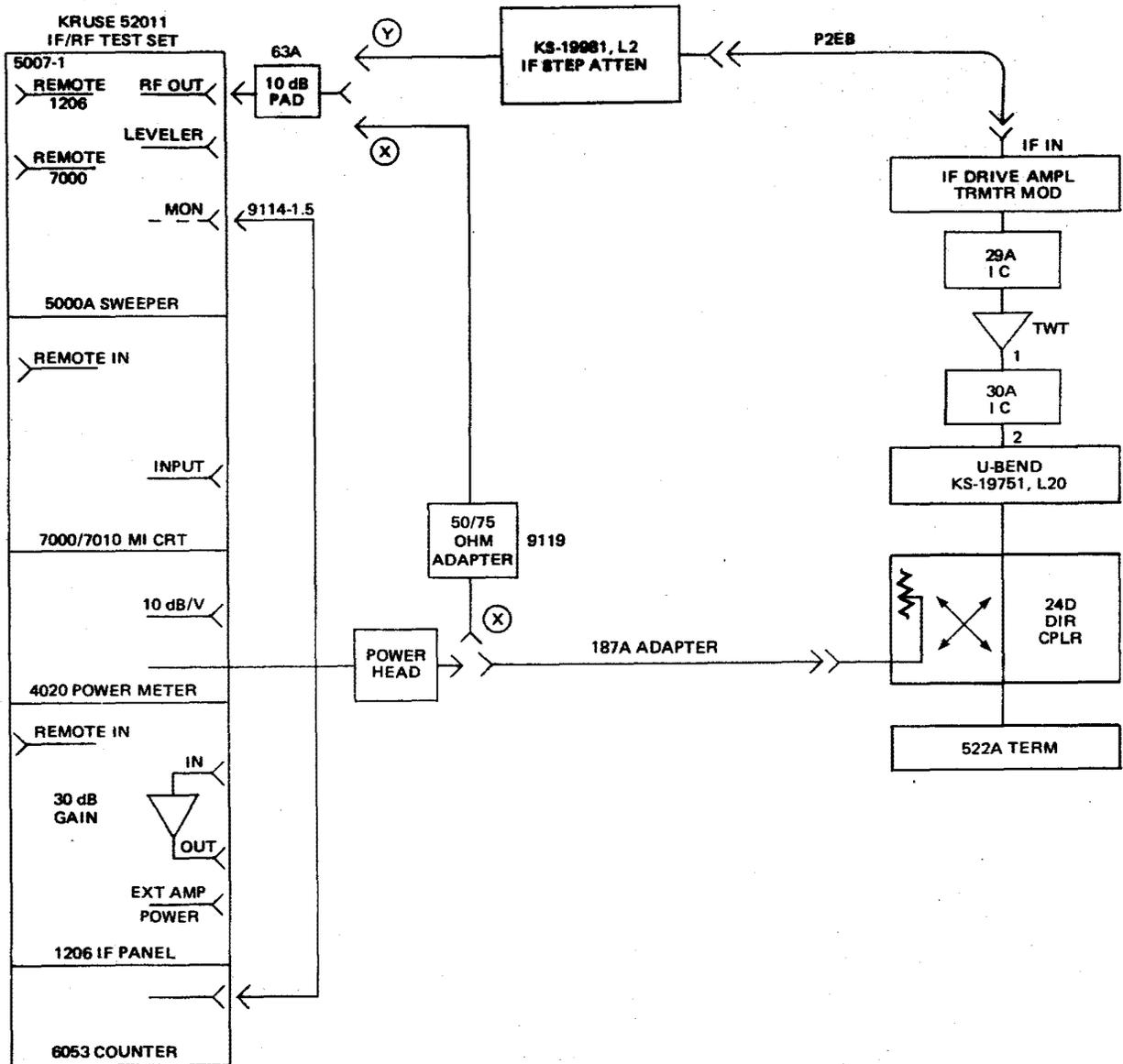
UNIT	CONTROL	POSITION
4020 POWER METER	LEVEL	10 DB/V
	GROUNDING	INT
	OFFSET	MID-SCALE
COUNTER	ATTENUATOR	X1
	RESOLUTION	1K
	EXT/INT (REAR)	INT

2. Connect power meter head to CAL OUT jack. Depress DBM CAL key and adjust its control for +10.00 dBm reading. Depress ZERO key and adjust its control for 00.00 ± .01 reading. Depress DBM 75 ohm key.
3. Establish option (X) and adjust sweeper RF LEVEL control for 0 dBm power meter reading.
4. Set 24A or 24B ATTEN for minimum attenuation (fully counterclockwise).

**IF Limiter-Carrier Resupply
Trip and Restore Point Test Setup
Fig. 9**

CHART F (Cont)

STEP	PROCEDURE
2	Select CRS 9 MHz on the meter panel. <i>Requirement: Between 18 and 42.</i>
3	Readjust the 9 MHz LEV for a CRS 9 MHz indication equal to the value recorded on the meter panel. Transmitter Output Power Alarm Checks and Adjustments
4	Connect test set in accordance with Fig. 10.
5	Record power meter indication.
6	Increase KS-19981, L2, 0-10 dB ATTEN control until the TRMTR OUT alarm lamp just lights on the alarm panel.
7	Record power meter indication. <i>Requirement: The difference in this indication and that of Step 5 shall be between 2 and 4 dB.</i> If the requirement is not met, perform only Steps 8 through 10.
8	Readjust KS-19981, L2, 0-10 dB ATTEN control for the same power meter indication recorded in Step 5.
9	Increase KS-19981, L2, 0-10 dB ATTEN control until the power meter indication drops by 3 dB.
10	Adjust MON ADJ control on the 30A integrated circuit until TRMTR OUT alarm lamp just lights. <i>Note: If TRMTR OUT lamp is lit, adjust MON ADJ control to extinguish the lamp.</i>
11	Readjust KS-19981, L2, 0-10 dB ATTEN control for the same power meter indication as recorded in Step 5.
12	Record TRMTR OUT meter indication. <i>Caution: Prior to disconnecting the test apparatus from the transmitter as directed in Step 13, temporarily remove the P14 plug from the IF input jack of the IF driver amplifier.</i>
13	Disconnect all test connections and apparatus from the transmitter.
14	Reconnect the normal transmitter connections, connecting the P14 plug to the IF input jack of the IF driver amplifier last. <i>Caution: To avoid potential RF power radiation, the P14 plug should be connected last.</i>



PREPARATION FOR TEST

1. Operate controls on the test set as follows, allowing 5 minutes warm-up.

UNIT	CONTROL	POSITION
5000A SWEEPER WITH 50007-1 IF PLUG-IN	F-1 START	55 MHz
	MARKER 1	61 MHz
	MARKER 2-Fc	70 MHz
	MARKER 3	79 MHz
	F-2 STOP	85 MHz
	VERNIER	MAX CCW
	RF LEVEL	CCW
	1 KHz	OFF
	LEVELER	INT
	RETRACE	ON
	RECUR-TRIG-LINE	RECUR
	MODE	CW
	Fc ± ΔF VERNIER	MAX CW
	SWEEP SECONDS	.01
	SWEEP SECONDS VERNIER	MAX CW
	EXT/INT'L SWEEP (REAR)	INT'L

UNIT	CONTROL	POSITION
4020 POWER METER	LEVEL	10 DB/V
	GROUNDING	INT
	OFFSET	MID-SCALE
COUNTER	ATTENUATOR	X1
	RESOLUTION	1K
	EXT/INT (REAR)	INT

2. Connect power meter head to CAL OUT jack. Depress DBM CAL key and adjust its control for +10.00 dBm reading. Depress ZERO key and adjust its control for 00.00 ± .01 reading. Depress DBM 75 ohm key.
3. Establish option (X) and adjust sweeper RF LEVEL control for 0 dBm power meter reading.
4. Connect option (Y).

Test Setup for Checking and Adjusting Transmitter Output Power Alarm

Fig. 10