TD-3 MICROWAVE RADIO

J68386A AND J68386B TRANSMITTER-RECEIVER BAY

RECEIVER TESTS

USING KRUSE 52011 IF/RF TEST SET

TRANSMISSION

This appendix contains the procedures for measuring and adjusting the gain and amplitude response of a TD-3 microwave radio receiver. The 40-MHz oscillator and shift modulator checks are also included.

Section 411-400-501, describing in-service checks, should be performed prior to this appendix and the results used as a guide to possible sources of trouble. The preliminary checks in Section 411-402-500 must be completed before performing the tests in this appendix. The IF return loss test in Section 411-404-502, when required by the Equipment Test List, must be completed prior to these tests.

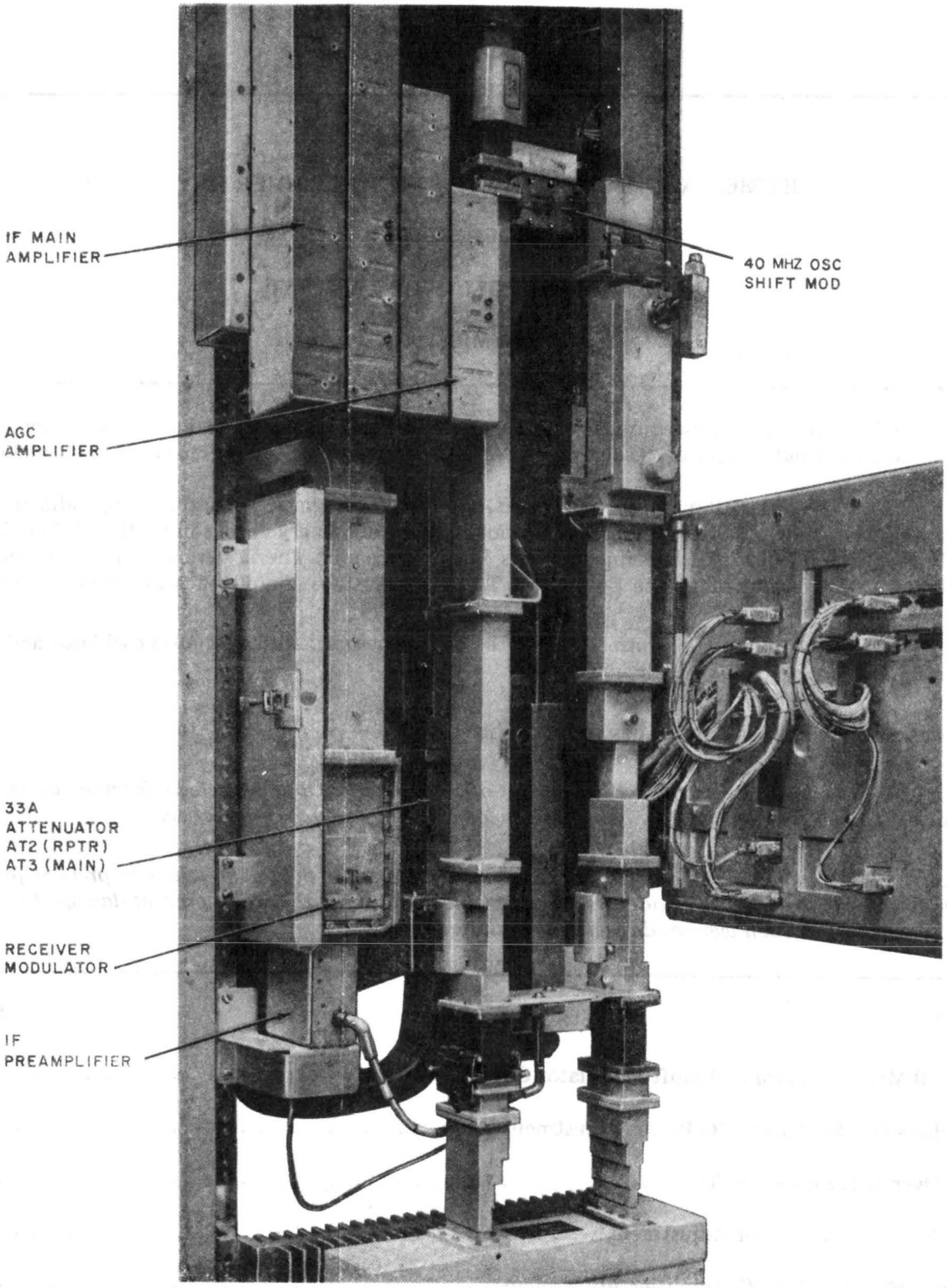
The tests in Chart A must be performed first if the bay is equipped with a 40-MHz oscillator and shift modulator.

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

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

Caution 2: When removing and replacing waveguide units, care should be taken to prevent foreign matter from entering the waveguide. Handle waveguide sections with care to prevent damage to flange mating surfaces. All open waveguide sections should be capped.

CHART PAGE



Location of Components
Fig. 1

CHART A

40-MHZ OSCILLATOR AND SHIFT MODULATOR CHECKS

APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE
1	Remove the 368A plug from the OSC MON jack on the 40-MC OSC (Fig. 1).
2	Make test connections in accordance with Exhibit 1, option (X).
3	Observe frequency indicated by the meter. *Requirement:* 40 MHz ±400 Hz (limits: 39,999,600. to 40,000,400. Hz) If this requirement is not met, perform Step 4 and then proceed to Step 6.
4	Connect Exhibit 1, option (Y), and perform Preparation for Test Steps 1 and 2.
5	Measure the power. *Requirement:* —2.5 dBm ±0.2 dB If the requirements of both Steps 3 and 5 are met, proceed to Step 10. If either requirement is not met, proceed with Step 6.
6	On the 40-MC OSC turn the LEV control fully clockwise. Adjust the OSC TUN and AMPL TUN controls for maximum power output.
7	Adjust LEV control to obtain —2.5 dBm.
8	Change test connections to option (X). Adjust the FREQ ADJ control to obtain 40 MHz ±50 Hz (limits: 39,999,950. to 40,000,050. Hz).
9	Repeat Steps 7 and 8 until the requirements are met.
10	Replace the 368A plug in the OSC MON jack and reconnect the cables.
11	Press SHIFT OSC pushbutton on the receiver control panel and adjust the MTR CAL control on the 40-MC OSC for an indication of 50 on the control panel meter.
12	On the receiver control panel, press the SHIFT MOD 1 and SHIFT MOD 2 pushbuttons and observe meter indication. *Requirement:* 80 ±20 divisions for both positions If any of the requirements in Steps 3 through 12 are not met, refer to Section 411-402-503.

CHART B

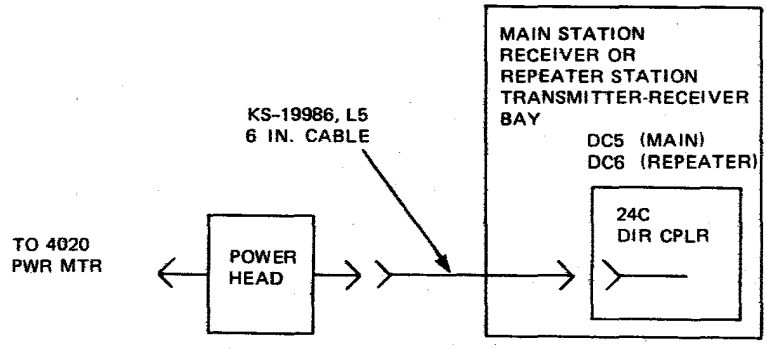
RECEIVER MODULATOR BO POWER ADJUSTMENT

The procedure in this chart establishes the correct BO power for the receiver modulator. For bays equipped with the J68387P receiver modulator and IF preamplifier and in which the J68387D 40-MHz oscillator and shift modulator *is not* installed, perform Step 4. For bays equipped with the J68387P receiver modulator and IF preamplifier and in which the J68387D 40-MHz oscillator and shift modulator *is* installed, perform Steps 1 through 5. For bays equipped with the J68387C receiver modulator and IF preamplifier, perform Step 5.

APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE
	J68387P Receiver Modulator
1	Connect the test setup as shown in Fig. 2 and perform the Preparation for Test



PREPARATION FOR TEST

1. 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.

Test Setup for Measuring the BO Power
Fig. 2

2	Adjust attenuator AT2 or AT3 (Fig. 1) for a power meter indication of —5.5 dBm.
3	Remove the test setup from the bay.
4	Press the RCVR MOD 1 pushbutton and note the panel meter indication.

CHART B (Contd)

STEP	PROCEDURE
	Requirement: Within ±0.5 of the recorded value. *Note:* The recorded value on the front panel shall be equal to the sum of the REF BIAS value stamped on the receiver modulator block and the correction factor given in Table A. If the requirement is not met, adjust the DIODE BIAS control on the IF preamplifier to obtain the correct value. If the requirement still is not met, refer to Section 411-404-503.
	J68387C Receiver Modulator
5	Press the RCVR MOD 1 and RCVR MOD 2 pushbuttons and note the meter indications. *Requirement:* The average of the two meter indications should be 42 and the difference between the two indications shall be no more than 16. If this requirement is not met, adjust attenuator AT2 or AT3 (Fig. 1). If the requirement still cannot be met, refer to Section 411-404-504.

CHART C

OVERALL TRANSMISSION TEST

The following comprises a check of the overall receiver transmission performance.

Note: It is necessary to know the actual or calculated value of the received carrier power at the drop arm of the channel dropping network. The typical nonfaded received carrier power will be in the range from −28 dBm to −22 dBm. Powers greater than −22 dBm should not be encountered since SD-50575-01 specifies the use of waveguide pads to measured value is available, a reasonable value to use for these tests is −26 dBm.

Caution: If any of the requirements in this chart are not met, do not attempt adjustments in order to bring the transmission response within requirements. Proceed with Charts D and E for the complete receiver alignment.

APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE
1	Connect test setup and perform Preparation for Test Steps in accordance with Exhibit 2.
2	Set up RF oscillator frequency and output power as shown in Exhibit 3.
3	Ensure that the AGC pushbutton is in the AGC position. (The switch lamp should be extinguished.)

CHART C (Contd)

STEP	PROCEDURE
4	If not already done, remove the 1322- or 1336-type bandpass filter and place a shorting plate on the flexible waveguide (which is attached to the separating network) as specified in Section 411-402-500. Connect the test setup in Exhibit 4, option (W), and perform Preparation for Test Steps 1 and 2.
5	Measure the power. *Requirement:* −0 dBm ±5 dB
6	Adjust RF CENTER FREQ control on the RF oscillator to obtain an indication of 70 ±0.5 MHz on the counter.
7	Measure power and note the actual value measured for later use. *Requirement:* Between 0.0 and −1.0 dBm
8	Press the RCVD SIG LEV pushbutton and note the meter indication. *Requirement:* 70 ±2 for bays equipped with the J68387P receiver modulator, or 56 ±2 for bays equipped with the J68387C receiver modulator.
9	Operate AGC pushbutton to MANUAL position and note the meter indication for RCVD SIG LEV. *Requirement:* Same as that in Step 8. If the requirement is not met, adjust the MANUAL GAIN control to obtain the same indication.
10	Measure power with sweeper MODE switch in the CW position. *Requirement:* 0.0 dBm ±1.0 dB
11	Operate sweeper MODE switch to WIDE F1-F2.
12	Measure the amplitude response as shown by the test trace. *Requirement:* The trace shall be flat to within 0.05 dB over the 64- to 76-MHz band and to within 0.1 dB over the 60- to 80-MHz band.
13	Change option (W) to option (T) in Exhibit 4 and measure power with sweeper MODE switch in the CW position. *Requirement:* Within 1.0 dB of that noted in Step 7.

CHART C (Contd)

STEP	PROCEDURE

If the requirement is not met, check the filters, equalizers, and cables in the interconnection circuit. Typical losses of the IF components at 70 MHz are:

400A—2.1 dB

400B—2.1 dB

747A—0.6 dB

745A—2.6 dB

1080A—4.5 dB

793A—5.4 dB

794A—5.0 dB

14 Adjust LEVEL control on the IF preamplifier to obtain 0.0 dBm.

15 Operate AGC pushbutton to AUTO position. Remove the cable from the IF IN jack of the IF main amplifier and note the RCVD SIG LEV meter indication.

Requirement: 0 ±2

16 Reconnect the cable to the IF IN jack of the IF main amplifier and restore all other IF cable connections to normal. Remove the shorting plate and 24A transducer and reconnect the 1322- or 1336-type bandpass filter at the input to the receiver. This completes all tests on the receiver.

Note: As stated previously, if any of the requirements are not met, proceed with Charts D and E for receiver alignment.

CHART D

RECEIVER MODULATOR ADJUSTMENT

APPARATUS:

1—Kruse 52011 IF/RF Test Set

STEP	PROCEDURE

The following is the adjustment for both the J68387P and J68387C receiver modulator and IF preamplifier units. It is assumed that the power meter has been calibrated as outlined in Exhibit 2 and that the RF oscillator has been adjusted to the proper power and frequency and connected to the radio bay as shown in Exhibit 3.

CHART D (Contd)

STEP	PROCEDURE
1	Connect the test setup and perform Preparation for Test steps in accordance with Exhibit 4, option (X).
	J68387P Modulator
2	Adjust LEVEL control on the IF preamplifier for a −0.3 dBm indication on the power meter.
3	Connect a 7 dB pad between the IF preamplifier and the power meter.
4	Calibrate the oscilloscope as follows: (a) Operate sweeper MODE switch to WIDE F1-F2. (b) Align highest point of the test trace with center of the graticule using the power meter OFFSET control. (c) Adjust oscilloscope controls to display the 64- and 76-MHz markers as shown in Exhibit 4.
5	Measure transmission response as shown by the test trace. *Requirement:* The test trace shall be flat to within 0.03 dB over the 64- to 76-MHz band and to within 0.05 dB over the 60- to 80-MHz band. If the requirement is not met, adjust SHAPE and SLOPE controls while keeping the test trace and the reference line coincident at 70 MHz with the LEVEL control. If the requirement cannot be met, refer to Section 411-404-503.
6	Proceed to Chart E.
	J68387C Modulator
7	Connect Exhibit 4, option (X). Adjust the LEVEL control on the IF preamplifier for a −7.3 dBm indication on the power meter.
8	Calibrate the oscilloscope as outlined in Step 4 of this chart.
9	Measure transmission response as shown by the test trace. *Requirement:* The test trace shall be flat to within 0.03 dB over the 64- to 76-MHz band and within 0.1 dB over the 60- to 80-MHz band If the requirement is not met, adjust the LOW SLOPE, HIGH SLOPE, and GAIN controls to obtain the required flatness and gain. If the requirement still cannot be met, refer to Section 411-404-504.
10	Proceed to Chart E.

CHART E

IF MAIN AND AGC AMPLIFIER ADJUSTMENT

The following procedure is used for adjusting the gain and amplitude response of the IF main amplifier and AGC amplifier combination. For bays equipped with the J68387P receiver modulator, the objective is to establish a gain of 9 dB with −8.0 dBm in and +1.0 dBm out, an AGC range of 35 dB, and an amplitude response flat to within 0.01 dB over the 60- to 80-MHz band.

For bays equipped with the J68387C receiver modulator, the objectives are a gain of 16 dB with −15 dBm in and +1 dBm out, an AGC range of 28 dB, and an amplitude response flat to within 0.01 dB over the 60- to 80-MHz band.

APPARATUS:

1—Kruse 52011 IF/RF Test Set

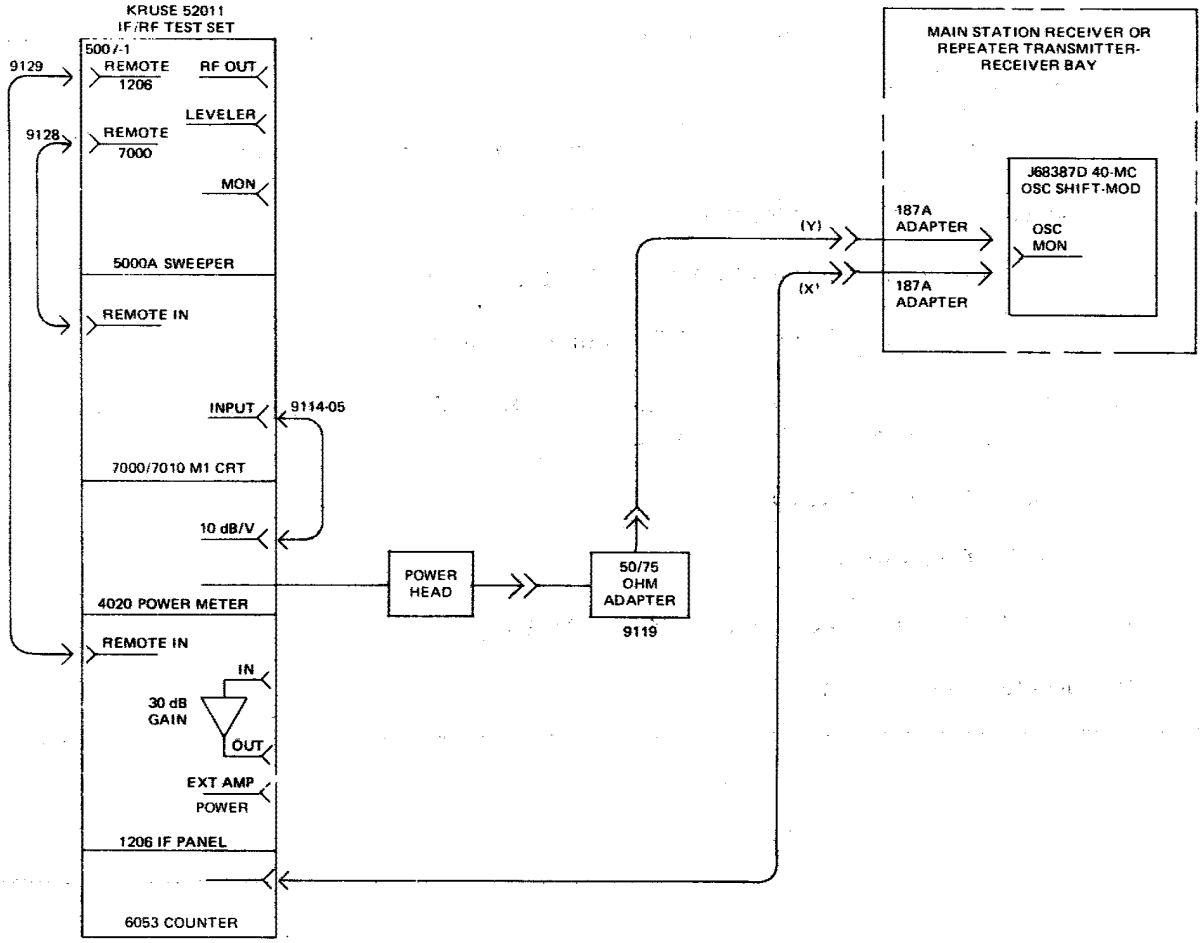
STEP	PROCEDURE
1	Prepare test set in accordance with Exhibit 2, option (X), and perform Preparation for Test steps.
2	Disconnect cables from the IF IN and IF OUT jacks on the IF main amplifier.
3	Connect Exhibit 2, option (Y).
4	Increase value of the pad at the IF main amplifier input as follows: Bays equipped with the J68387P modulator, 18 dB total. Bays equipped with the J68387C modulator, 25 dB total.
5	Operate sweeper MODE switch to WIDE F1-F2. On receiver control panel, set AGC switch to MANUAL position and adjust MANUAL GAIN control for coincidence of the test trace and reference line at 70 MHz. The test trace displays the amplitude response of the IF main amplifier. Measure test trace flatness. *Requirement:* Flat to within 0.02 dB over the 60- to 80-MHz band. If the requirement is not met, adjust the SLOPE 1 and SLOPE 2 controls on the IF main amplifier. Maintain coincidence of the test trace and the reference line with the MANUAL GAIN control. If the requirement still is not met, replace the IF main amplifier.
6	Increase pad value at the IF main amplifier as follows: Bays equipped with the J68387P modulator, 35 dB total. Bays equipped with the J68387C modulator, 28 dB total.

CHART E (Contd)

STEP	PROCEDURE
7	Turn the MANUAL GAIN control to its maximum counterclockwise (maximum gain) position.
8	Adjust AGC RANGE control on the AGC amplifier for coincidence of the test trace and the reference line at 70-MHz. Measure flatness of the test trace. *Requirement:* Flat to within 0.5 dB over the 60- to 80-MHz band.
9	Turn MANUAL GAIN control to its maximum clockwise (minimum gain) position.
10	Change pad value at the IF main amplifier as follows: Bays equipped with the J68387P modulator, 35 dB total. Bays equipped with the J68387C modulator, 28 dB total.
11	Adjust MANUAL GAIN control counterclockwise to obtain coincidence of the test trace and the reference line.
12	Press AGC REF pushbutton and record the panel meter indication.
	AGC Amplifier
13	Change the vertical sensitivity of the oscilloscope to 0.2 dB per division (20 MV/DIV).
14	Press the AGC pushbutton to extinguish the MANUAL lamp. Adjust the IF LEVEL control on the AGC amplifier for coincidence of the test trace and the reference line at 70 MHz. The test trace displays the loss characteristic of the AGC filter circuit. *Requirement:* The filter characteristic shall be centered about 70 MHz with the 64- and 76-MHz markers at equal levels and displaced 1.5 dB or less up from the 70-MHz marker. See Fig. 6 for a typical filter characteristic. If the requirement is not met, adjust the C6 and C7 controls on the AGC amplifier using a nonmetallic screwdriver (KS-20114). If the requirement still is not met, replace the AGC amplifier.
15	On the IF/RF sweep generator, position the MODE control to CW.
16	Adjust frequency of sweeper to obtain a 70 ±0.2 MHz indication on the frequency counter.
17	Note power meter indication.
18	Insert a pad between the directional detector and the IF main amplifier input as follows: Bays equipped with the J68387P modulator, 35 dB. Bays equipped with the J68387C modulator, 28 dB.

CHART E (Contd)

STEP	PROCEDURE
19	Note meter indication. *Requirement:* The power shall not decrease by more than 0.5 dB from that noted in Step 17.
20	Change pad at IF main amplifier input as follows: Bays equipped with the J68387P modulator, 18 dB. Bays equipped with the J68387C modulator, 25 dB.
21	On the receiver control panel, press the RCVD SIG LEV pushbutton and adjust the RCVD SIG LEV ADJ control for the following: J68387P modulator, 70 J68387C modulator, 56
22	Press the AGC switch to turn on the MANUAL lamp.
23	Perform the test in Chart C.



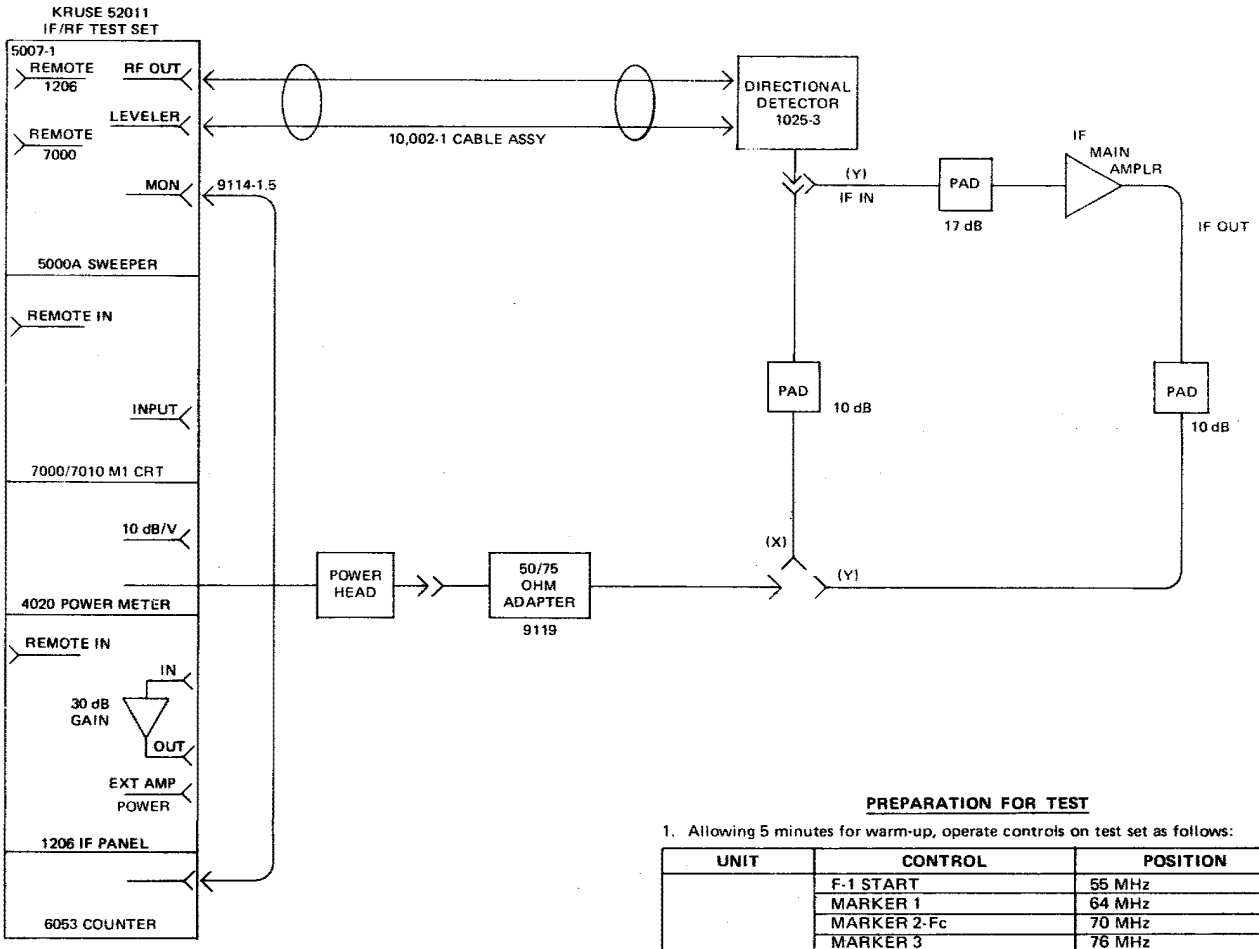
PREPARATION FOR TEST

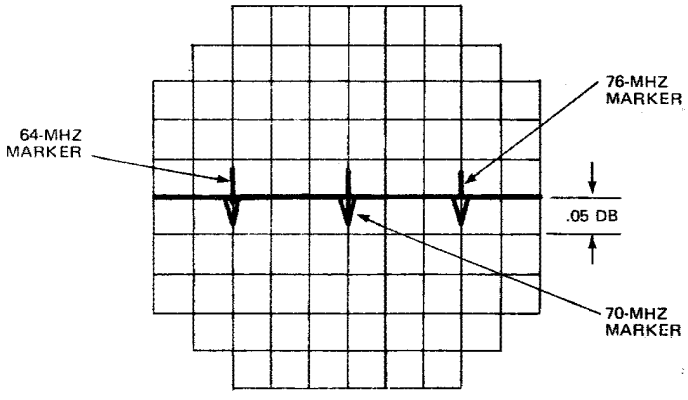
1. Allowing 5 minutes for warm-up, operate test set controls as follows:

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.

40-MHz Oscillator and Shift Modulator
Frequency and Power Measurements
Exhibit 1





TYPICAL DISPLAY OF TEST SET
IF TO IF RESPONSE

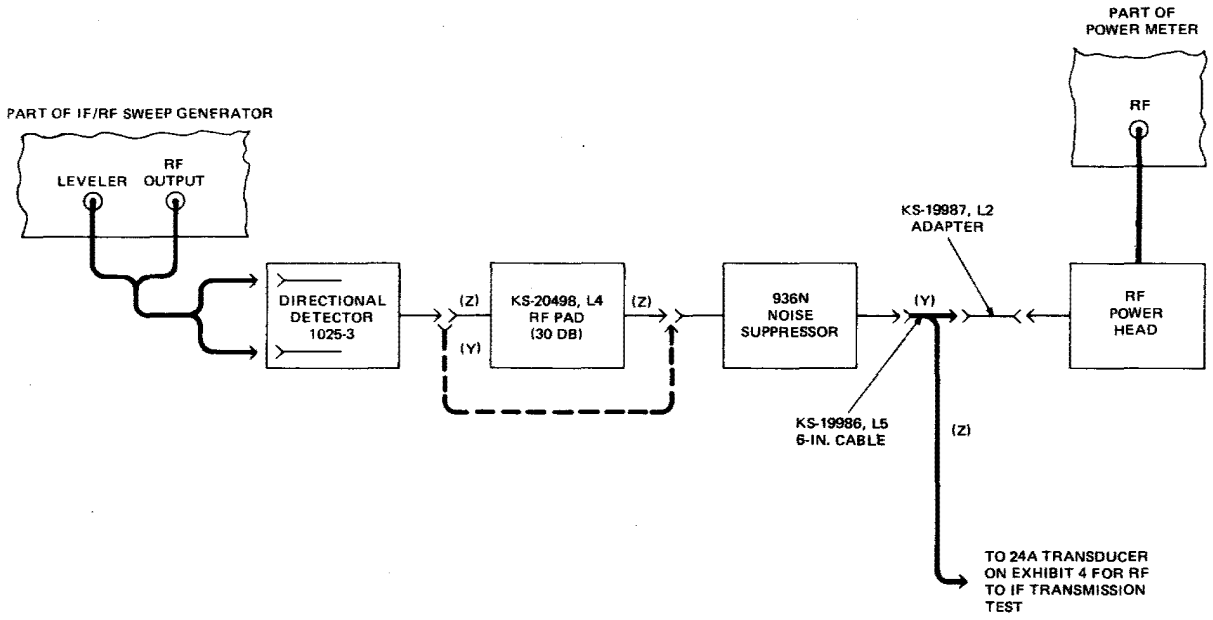
PREPARATION FOR TEST

1. Allowing 5 minutes for warm-up, operate controls on test set as follows:

UNIT	CONTROL	POSITION
5000A SWEEPER WITH 50007-1 IF PLUG-IN	F-1 START	55 MHz
	MARKER 1	64 MHz
	MARKER 2-Fc	70 MHz
	MARKER 3	76 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
7000-M1/ 7010-M1 CRT DISPLAY SCOPE	OFFSET	MIDSCALE (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
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 sweeper MODE switch to WIDE F1-F2 and center trace on scope using power meter OFFSET control and scope HORIZ and GAIN controls. Swept response between 55 and 85 MHz is now displayed with .05 dB/div calibration with markers at 64, 70, and 76 MHz.

Exhibit 2



PREPARATION FOR TEST

1. Set controls on the IF/RF sweep oscillator as follows:
   RF CENTER FREQ control to the desired frequency
   MODE to CW
   RF LEVEL to midrange
2. On the power meter, operate the 50Ω pushbutton.
3. Calibrate the power meter per Fig. 2 Preparation for Test step.
4. Make the test connections shown using option (Y).
5. Obtain the value of the calculated or measured received carrier power at the drop arm of the 1355 ( ) receiver channel bandpass filter for the bay under test.
6. Obtain the calibrated value from the KS-20498, L4 30-dB RF pad and add it to the received carrier power value determined in Step 5.

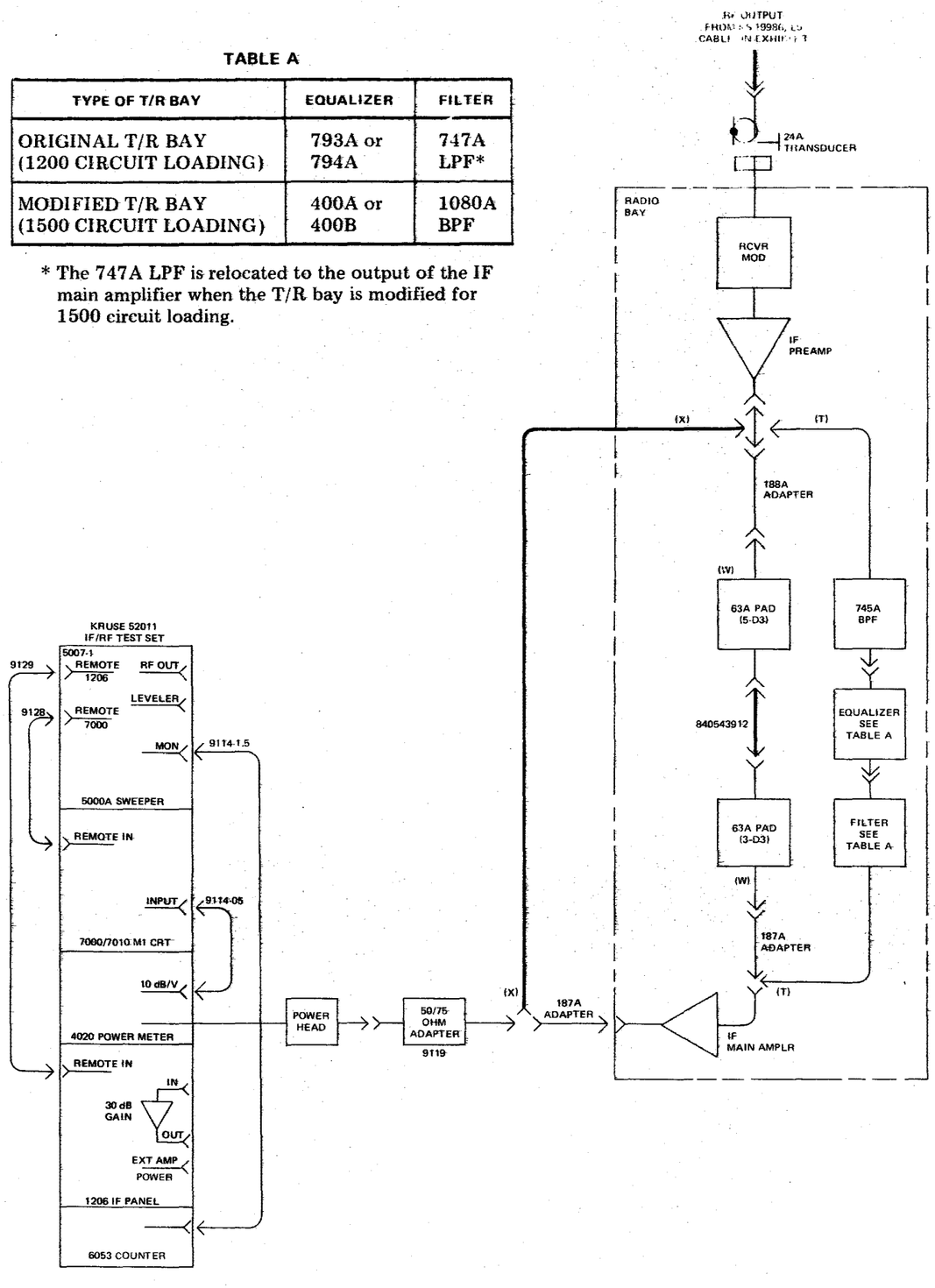
   Example: Received carrier power = −28.0 dBm
   Calibrated RF pad = 30.2 dB
   + 2.2 dBm
7. Adjust the RF POWER LEVEL control on the sweep oscillator to produce a meter indication of the value determined in Step 6.
8. Make the test connections using option (Z).

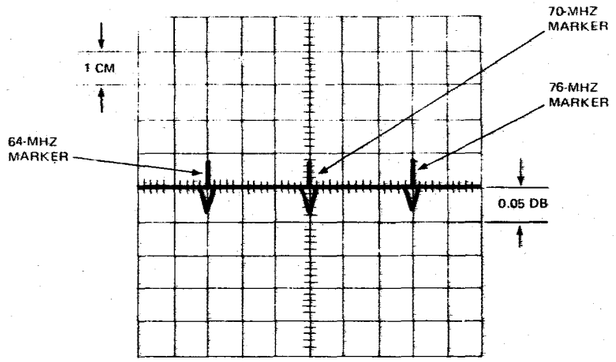
RF Oscillator Setup
Exhibit 3

TABLE A

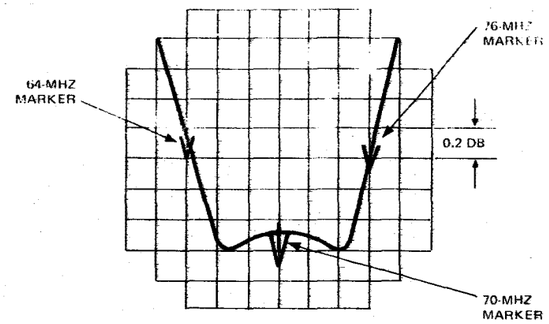
TYPE OF T/R BAY	EQUALIZER	FILTER
ORIGINAL T/R BAY (1200 CIRCUIT LOADING)	793A or 794A	747A LPF*
MODIFIED T/R BAY (1500 CIRCUIT LOADING)	400A or 400B	1080A BPF

* The 747A LPF is relocated to the output of the IF main amplifier when the T/R bay is modified for 1500 circuit loading.





TYPICAL DISPLAY OF MARKERS



TYPICAL AGC FILTER CHARACTERISTIC

PREPARATION FOR TEST

1. Set the controls on the units as follows:

UNIT	CONTROL	POSITION
5000A SWEEPER WITH 5014-( ) PLUG-IN	F-1 START	FC - 10 MHZ
	MARKER 1	FC - 6 MHZ
	MARKER 2-Fc	FC
	MARKER 3	FC + 6 MHZ
	F-2 STOP	FC + 10 MHZ
	VERNIER	MAX CCW
	RF LEVEL	+7 dBm
	1 KHz	OFF
	LEVELER	EXT
	RETRACE	ON
	MARKERS	OFF
	RECUR-TRIG-LINE	RECUR
	MODE	CW
	F2 - F1 VERNIER	MAX CW
	SWEEP SECONDS	.01
	SWEEP SECONDS VERNIER	MAX CW
	EXT/INT'L SWEEP (REAR)	INT'L
7000-M1/ 7010-M1 CRT DISPLAY SCOPE	OFFSET	MIDSCALE (DO NOT READJUST)
	GAIN	XT
	POLARITY	+UP
	BW	30 KHZ
	INPUT	DC
	DB/DIV AT 10 DB/V	.05 DB/DIV - 5 MV/DIV
	VARIABLE (RED)	MAX CW DETENT
4020 POWER METER	LEVEL	10 DB/V
	GROUNDING	INT
	OFFSET	MID-SCALE

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. Establish the connections shown.

RF to IF Transmission
Exhibit 4