TRANSMITTER-RECEIVER BAY
OVERALL TRANSMITTER TESTS USING J68392A TEST SET
TD-3D MICROWAVE RADIO

This section covers the methods for measuring and adjusting the gain and amplitude response of the TD-3D microwave radio transmitter in the J68386L and J68386M transmitter-receiver bays which are used in main stations and repeater stations with earlier TD-3 equipment. These tests are designed for use with the J68392A transmitter-receiver test set only. ▶Charts 5 and 7 of this section are tests for 45-megabit per second (45-Mb/s) digital operation.◀

This section is reissued to add Charts 5 and 7, including test procedures for 45-Mb/s digital operation.

Revision arrows are used to denote significant changes.

This reissue does not affect the Equipment Test List.

Caution: If this equipment is being operated in a hot standby/space diversity (HS/SD) mode, precautions should be taken not to interrupt service since HS/SD switching has no frequency allocated for protection. The system should be force-switched to the transmitter that is not to be maintained as directed in Section 415-600-500.

CHART PAGE

CHART 1

IN-SERVICE CHECKS

STEP	PROCEDURE
1	On the meter panel (see Fig. 1 and 2), rotate the selector switch so that the meter indicates, one at a time, the circuits designated for the TRMTR. Compare each meter indication with the requirement for the applicable function shown in Table A. ***Note 1:*** Preparatory to making the in-service readings, the plate currents should be readjusted to within ±1.0 mA of that labeled during the last bay maintenance. Where this cannot be accomplished, further maintenance will be required as indicated in Table A. ***Note 2:*** The value recorded on the panel should not be changed when in-service checks are performed.

TABLE A

TRANSMITTER IN-SERVICE METER READINGS

SWITCH	NOMINAL	TOLERANCE	IF REQUIREMENT IS NOT MET, REFER AS DIRECTED
−19V (92B)	70	±2	Adjust VOLTS ADJ on the transmitter regulator, or replace the 88A unit.
−19V (88A)	72	±3	
−11V*	70	±4	Replace unit
+250V*	70	±4	Replace unit
MWV GEN 1	—	—	Used for alignment only
MWV GEN 2	—	—	
MWV GEN 3	—	—	
MWV CUR MON	—	—	
MWV GEN OUT	70	±5	Chart 3
AMP 1 I_P*	Recorded value	±10%	Align transmitter
AMP 2 I_P*	Recorded value	±10%	
AMP 3 I_P*	Recorded value	±10%	
TRMTR OUT	70	±20	

*For transmitters equipped with a 660 ( ) integrated circuit (IC) transmitter amplifier, these switches either have no functions or are not present on the meter panel.

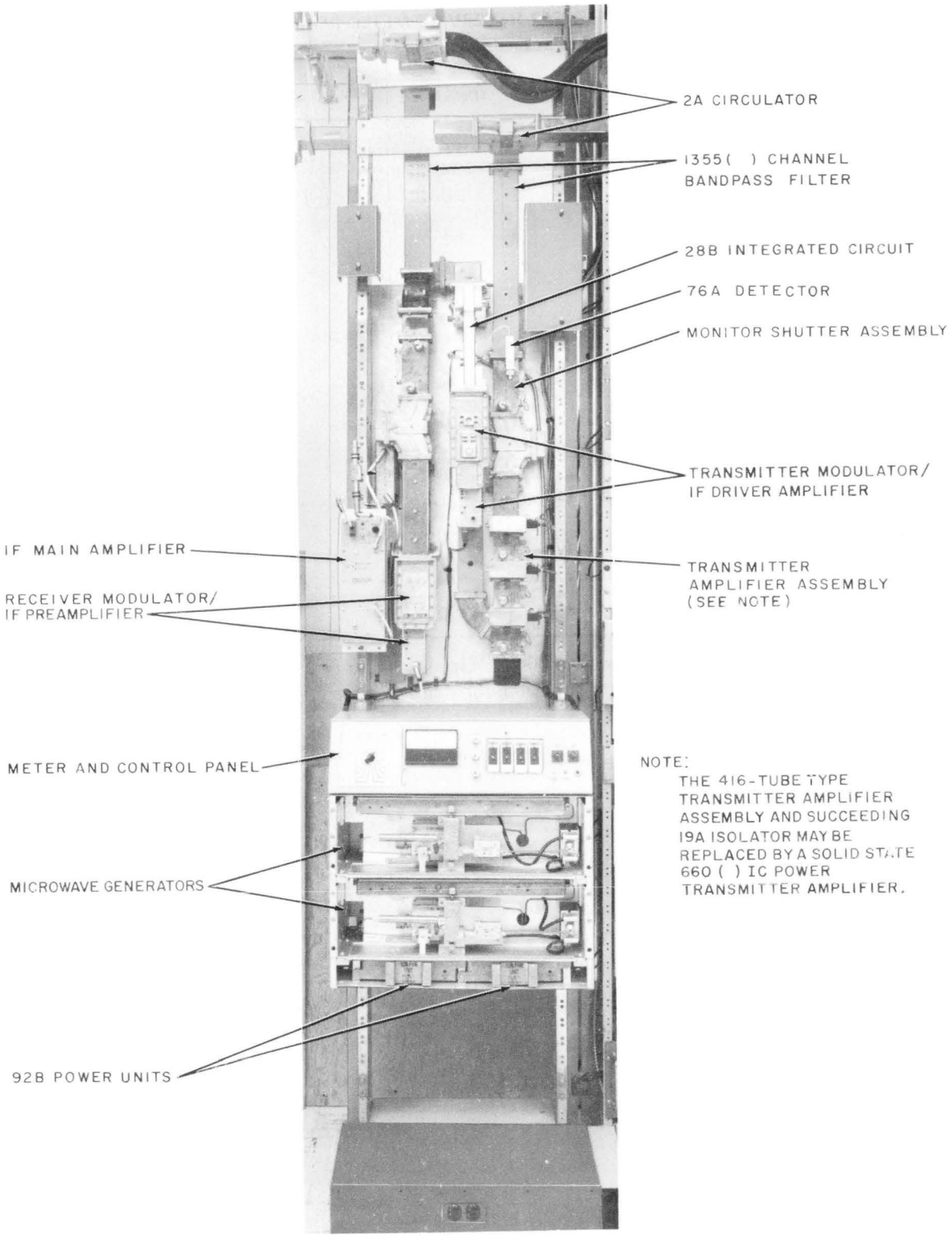


Fig. 1—J68386M Main Station Bay

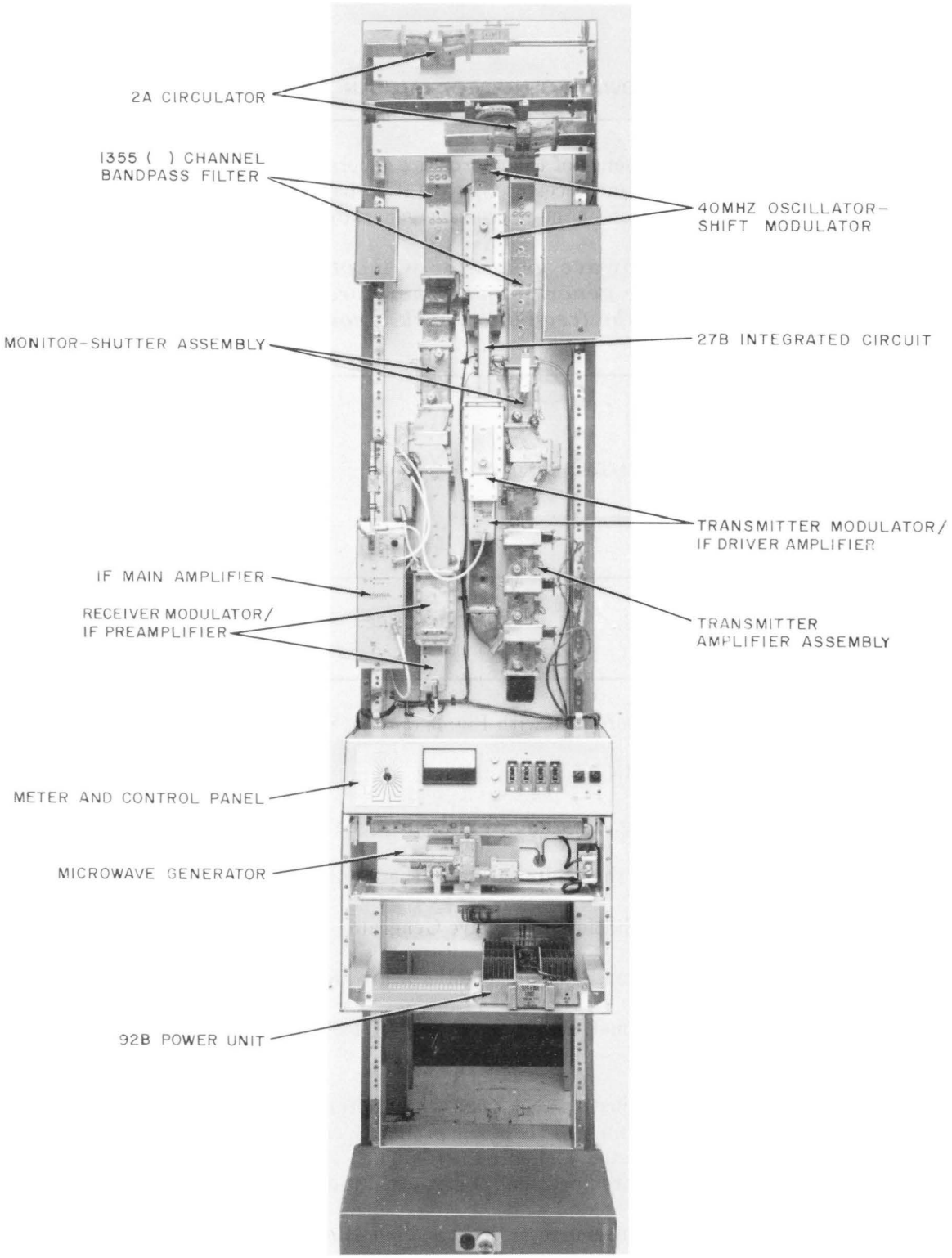


Fig. 2—J68386L Repeater Station Bay

CHART 2

MICROWAVE GENERATOR FREQUENCY CHECK

The following is a check of the frequency of the microwave generator. Repeater station bays use a single generator for both the transmitter and receiver. Main station bays provide separate generators for the transmitter and receiver. For location of the microwave generators, see Fig. 1.

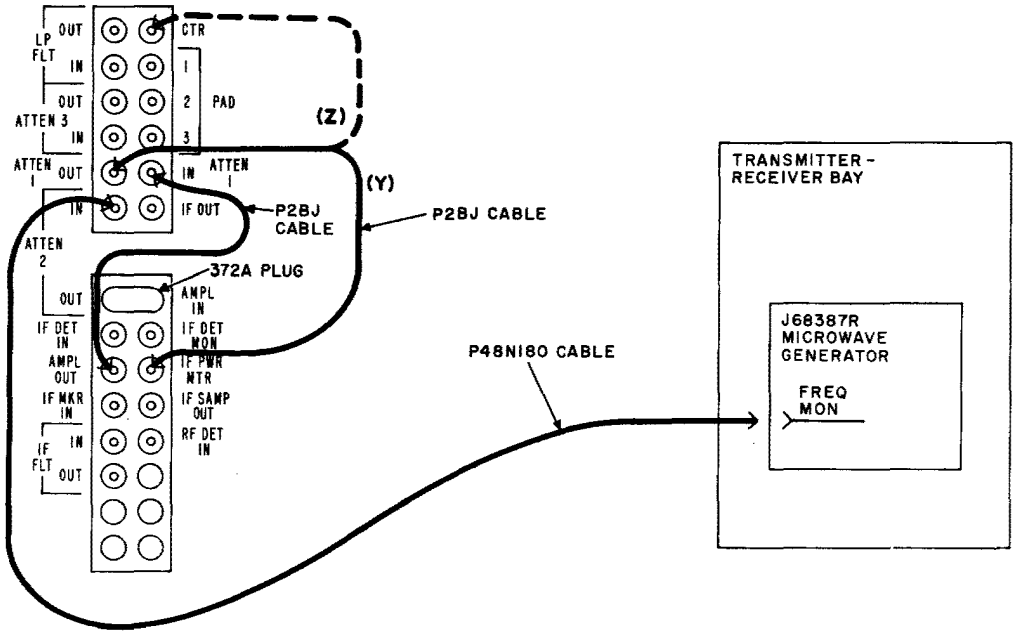
Caution: Operating the microwave generator without the front cover of the bay may change the temperature of the generator and therefore its output frequency. The cover should be replaced as soon as the frequency check is completed.

APPARATUS:

1 —J68392A Transmitter-Receiver Test Set

1 —P-48Q352 Adjusting Tool

STEP	PROCEDURE
1	Prepare for testing in accordance with Fig. 3, option (Y).
2	Adjust the IF AMPL GAIN control on the test set until the power meter indicates 0 dBm.
3	Change connections to Fig. 3, option (Z) and measure the frequency on the counter. ***Requirement:*** Within the limits shown in the following: Table B—Repeater Station Microwave Generator Frequencies Table C—Main Station Transmitter Microwave Generator Frequencies If the requirement is not met, adjust the FREQ ADJ control to bring the frequency to within 10 Hz of nominal. ***Note:*** The P-48Q352 adjusting tool has a slight detuning effect on the oscillator frequency. Adjust the control to within ±10 Hz of the oscillator output frequency with the tool inserted in the control. Remove the tool and note the frequency shift. Readjust, taking the shift into account, so that the ±10 Hz requirement is met when the tool is removed.
4	If unable to meet the requirement, refer to Section 415-410-500.
5	Disconnect the cable at the FREQ MON jack.



PREPARATION FOR TEST (FIG. 3)

1. Connect power to the test set.
2. Observe the pilot lamp at the top right front of the test set. If the lamp is not lighted, operate the toggle switch to the opposite position and the lamp should be lighted.
3. Observe that no fuse alarm lamps are lighted.
4. Energize the counter and power meter.
5. Allow the equipment to warm up for at least 15 minutes.
6. On the power meter, set the INPUT CHANNEL switch to IF, determine that no input is connected, then zero the power meter by placing the POWER RANGE DBM switch to –25 and adjusting the METER ZERO control for an indication of zero on the meter.

   Caution: Never apply more than +10 dBm to the power meter.

7. Set the POWER RANGE DBM switch to 0.
8. Set the FUNCTION switch on the counter to TEST, press the RESET button, and determine that the counter indicates 1 MHz ±1 count. Then set the FUNCTION switch to FREQUENCY.
9. Set the CTR switch to EXT. The test set is now ready for operation.
10. Set the AMPL GAIN control to the maximum counterclockwise position.
11. Set attenuators ATTEN 2 to 20 dB and ATTEN 1 to 5 dB.

Fig. 3—Microwave Generator Frequency Check

TABLE B

REPEATER STATION
MICROWAVE GENERATOR FREQUENCIES

RECEIVER		MICROWAVE GENERATOR LOW-FREQUENCY OSCILLATOR	
FREQUENCY (MHz)	CHANNEL	NOMINAL FREQUENCY (MHz)	LIMITS (MHz)
3730	1A	120.0000	119.999400 — 120.000600
3770	1B	118.7500	118.749400 — 118.750600
3810	2A	122.5000	122.499400 — 122.500600
3850	2B	121.2500	121.249400 — 121.250600
3890	3A	120.6250	120.624400 — 120.625600
3930	3B	119.3750	119.374400 — 119.375600
3970	4A	123.1250	123.124400 — 123.125600
4010	4B	121.8750	121.874400 — 121.875600
4050	5A	125.6250	125.624400 — 125.625600
4090	5B	124.3750	124.374400 — 124.375600
4130	6A	128.1250	128.124400 — 128.125600
4170	6B	126.8750	126.874400 — 126.875600
3710	7A	119.3750	119.374400 — 119.375600
3750	7B	118.1250	118.124400 — 118.125600
3790	8A	121.8750	121.874400 — 121.875600
3830	8B	120.6250	120.624400 — 120.625600
3870	9A	120.0000	119.999400 — 120.000600
3910	9B	118.7500	118.749400 — 118.750600
3950	10A	122.5000	122.499400 — 122.500600
3990	10B	121.2500	121.249400 — 121.250600
4039	11A	125.0000	124.999400 — 125.000600
4070	11B	123.7500	123.749400 — 123.750600
4110	12A	127.5000	127.499400 — 127.500600
4150	12B	126.2500	126.249400 — 126.250600

TABLE C

MAIN STATION
TRANSMITTER MICROWAVE GENERATOR FREQUENCIES

TRANSMITTER		GENERATOR OUTPUT (MHz)	MICROWAVE GENERATOR LOW FREQUENCY OSCILLATOR	
FREQUENCY (MHz)	CHANNEL		FREQUENCY (MHz)	LIMITS (MHz)
3710	7A	3780	118.1250	118.124400 — 118.125600
3730	1A	3800	118.7500	118.749400 — 118.750600
3750	7B	3820	119.3750	119.374400 — 119.375600
3770	1B	3840	120.0000	119.999400 — 120.000600
3790	8A	3860	120.6250	120.624400 — 120.625600
3810	2A	3880	121.2500	121.249400 — 121.250600
3830	8B	3900	121.8750	121.874400 — 121.875600
3850	2B	3920	122.5000	122.499400 — 122.500600
3870	9A	3800	118.7500	118.749400 — 118.750600
3890	3A	3820	119.3750	119.374400 — 119.375600
3910	9B	3840	120.0000	119.999400 — 120.000600
3930	3B	3860	120.6250	120.624400 — 120.625600
3950	10A	3880	121.2500	121.249400 — 121.250600
3970	4A	3900	121.8750	121.874400 — 121.875600
3990	10B	3920	122.5000	122.499400 — 122.500600
4010	4B	3940	123.1250	123.124400 — 123.125600
4030	11A	3960	123.7500	123.749400 — 123.750600
4050	5A	3980	124.3750	124.374400 — 124.375600
4070	11B	4000	125.0000	124.999400 — 125.000600
4090	5B	4020	125.6250	125.624400 — 125.625600
4110	12A	4040	126.2500	126.249400 — 126.250600
4130	6A	4050	126.8750	126.874400 — 126.875600
4150	12B	4080	127.5000	127.499400 — 127.500600
4170	6B	4100	128.1250	128.124400 — 128.125600

CHART 3

MICROWAVE GENERATOR OUTPUT POWER CHECK

APPARATUS:

1 —P-48Q352 Adjusting Tool

1 —388A Tool (wrench to loosen locknuts on ×4 multiplier)

STEP	PROCEDURE
1	If checking a main station bay, proceed to Step 6.
	A. Repeater Station Bay Microwave Generator
2	On the meter panel, set the selector switch to MWV GEN OUT.
	Requirement: The meter indicates 70 ±10.
	If the requirement is not met, refer to Section 415-410-500 and realign the generator; then proceed with Step 3.
3	Adjust the LEV ADJ control on the microwave generator for an indication of 70 on the meter.
4	Loosen the locknuts on the ×4 multiplier and adjust for peak indication; then readjust the LEV ADJ control for an indication of 70 on the meter.
5	After all adjustments have been made, record the meter indications in the spaces provided on the meter panel and relock the nuts on the ×4 multiplier.
	B. Main Station Transmitter Microwave Generator
6	Select MWV GEN OUT control on the meter panel.
	Requirement: 70 ±10
	If the requirement is not met, refer to Section 415-410-500 and realign the generator. After realignment, proceed with Step 7.
7	Adjust attenuator ATT1 on the 28B integrated circuit until the meter indicates 70.
	Note: The nut associated with the ATT1 control should exert some drag when the control is being adjusted. When the nut is properly adjusted, it should be possible to adjust the control with the fingers of one hand while the nut remains stationary. It is not necessary to lock the nut after making the adjustment.
	Caution: To maintain the correct power level and to prevent RF leakage, the ATT1 control should not be left in a loose condition.

▶CHART 4

OVERALL TRANSMITTER TRANSMISSION TEST
ANALOG FM OPERATION

STEP	PROCEDURE

1 When performing the main station (or HS/SD 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. Hot standby or hot standby/spare diversity bays ***must*** be switched ***off*** of the channel 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 transmitting IF switch bay or in the radio transmitter carrying service for HS/SD arrangements.

2 Verify that the input to the IF IN jack on the driver amplifier-transmitter modulator is removed.

3 Remove the cover from the access slot on the ED-52277-30 monitor-shutter assembly.

4 Insert an ED-51568 shorting plate into each of the three access slots (only one access slot on HS/SD transmitters).

5 Remove the cap from coaxial port A on the monitor-shutter assembly and insert the ED-51567 probe assembly.

Caution: The IF input drive power to the driver amplifier should be removed when making or changing the test connections to the monitor-shutter assembly, the monitor-transducer assembly, or the tuner-transducer assemblies.

A. Response Test

6 Refer to Fig. 7 and make connections shown in option (D) and do the Preparation for Test.

7 For solid-state transmitters only, adjust the PWR ADJ control on the 660( ) amplifier to its fully clockwise position (i.e., for maximum gain) and adjust the GAIN control on the transmitter modulator to its fully counterclockwise position (i.e., for maximum gain).

8 Measure the response.

Requirement 1 (Tube-Type Transmitter Amplifier): The test trace shall coincide with the reference trace over ±7.5 MHz within 0.05 dB and shall be below the reference trace not more than 0.1 dB at ±10 MHz.

If the requirement is not met, perform Charts 6 and 8 then repeat this chart.

Requirement 2 [660( ) IC Transmitter Amplifier]: The amplitude response shall have a smooth characteristic over the 20-MHz band; any step-type discontinuity, if present, shall not exceed 0.1 dB. The overall variation across the 20-MHz band shall not exceed 0.3 dB peak to peak in the absence of any step-type discontinuity, or shall not exceed 0.4 dB peak to peak if a step-type discontinuity is present.

CHART 4 (Contd)

STEP	PROCEDURE

If the requirement is not met, adjust the SLOPE control on the transmitter modulator. If the requirement still is not met, complete Chart 6 and then repeat this chart.

If the requirement cannot be met, it indicates a defective 660( ) IC amplifier which should be replaced as directed in Chart 10.

B. Power Measurement

9 Perform the Preparation for Test for Fig. 6.

10 For solid-state transmitters only, adjust the BIAS control on the transmitter modulator for maximum power output. Adjust the GAIN control on the transmitter modulator to obtain the desired output power.

Note 1: If the power cannot be reduced to the desired power with the GAIN control fully counterclockwise, the PWR ADJ control on the solid-state transmitter can be adjusted in the counterclockwise direction (increasing attenuation) to reduce the output power.

Note 2: For the +30 dBm (1 watt) case, the PWR ADJ control will always have to be used.

11 Apply the input to the driver amplifier, option (W) of Fig. 6, and connect the output of the transmitter to the power meter, option (D).

12 Calculate the output power.

Output power = loss of pads + loss of the KS-19986 cable + power meter indication.

Requirement 1 (Tube-Type Equipment): 5-watt +37 dBm ±0.5 dB
2-watt +33 dBm ±0.5 dB
1-watt +30 dBm ±0.5 dB

Requirement 2 (Solid-State Equipment): 5-watt +37 dBm ±0.1 dB
2-watt +33 dBm ±0.1 dB
1-watt +30 dBm ±0.1 dB

If the requirement is not met for the tube-type transmitter amplifier, complete Charts 6 and 8 and then repeat this chart.

▶CHART 4 (Contd)

STEP	PROCEDURE

If the requirement is not met for the solid-state transmitter amplifier, adjust the GAIN control located on the transmitter modulator to meet the requirement. If the requirement still cannot be met, complete Chart 6 and then repeat Chart 4. If the requirement still cannot be met, replace the 660( ) IC as directed in Chart 10 and then repeat this chart.

Note: The 660A and B IC amplifiers are 3-stage units for use in 1- and/or 2-watt systems. The 660C and D IC amplifiers are 4-stage units for use in 5-watt systems only. The A and C units cover the 3700- to 3940-MHz range. The B and D units cover the 3940- to 4200-MHz range.

13 Repeat Steps 6 through 8 to make an amplitude response test.

If the requirements are not met in Step 8 and the SLOPE control is adjusted, the GAIN control should be adjusted to maintain the final output power noted in Step 12.

14 When the requirement is met, maintain the test arrangement and proceed to Chart 9, Alarm Adjustment.◀

▶CHART 5

OVERALL TRANSMITTER TRANSMISSION TEST
45-MB/S DIGITAL OPERATION

STEP	PROCEDURE

1 When performing the main station transmitter test, disconnect the cable at the IF IN jack of the 48A attenuator and terminate the end of the cable with a 20-dB 63A pad.

Note 1: 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.

Note 2: At main stations, the test signal is applied to the IF IN jack of the 48A attenuator at a power of −7 dBm. At repeater stations, the attenuator is part of the ADP( ) equalizer and is included in the test bay applying the test signal to the J2B jack on the ADP( ) unit at a power of 0 dBm. In either case, the test signal power duplicates the normal power at the specified test points.

CHART 5 (Contd)

STEP	PROCEDURE
2	Verify that the input to the IF IN jack on the driver amplifier-transmitter modulator is removed.
3	Remove the cover from the access slot on the ED-52277-30 monitor-shutter assembly.
4	Insert an ED-51568 shorting plate into each of the three access slots.
5	Remove the cap from coaxial port A on the monitor-shutter assembly and insert the ED-51567 probe assembly. ***Caution: The IF input drive power to the driver amplifier should be removed when making or changing the test connections to the monitor-shutter assembly, the monitor-transducer assembly, or the tuner-transducer assemblies.***
6	Adjust the PWR ADJ control on the 660 amplifier to its fully clockwise position (i.e., for maximum gain) and adjust the GAIN control on the transmitter modulator to its fully counterclockwise position (i.e., for minimum gain).
	A. Response Test
7	Refer to Fig. 9 and make connections shown in option (D) and do the Preparation for Test.
8	Measure the response. ***Requirement:*** The amplitude response shall have a smooth characteristic over the 20-MHz band; any step-type discontinuity, if present, shall not exceed 0.1 dB. The overall variation across the 20-MHz band shall not exceed 0.3 dB peak to peak in the absence of any step-type discontinuity, or shall not exceed 0.4 dB peak to peak if a step-type discontinuity is present. If the requirement is not met, adjust the SLOPE control on the transmitter modulator. If the requirement still is not met, it indicates a defective 660( ) IC amplifier which should be replaced as directed in Chart 10.
	B. Power Measurement
9	Perform the Preparation for Test for Fig. 8.
10	Adjust the BIAS control on the transmitter modulator for maximum power output.
11	With the input applied to the attenuator, option (W) of Fig. 8, and the output of the transmitter connected to the power meter, option (D), calculate the output power.

CHART 5 (Contd)

STEP	PROCEDURE
	Output power = loss of pads + loss of the KS-19986 cable + power meter indication. ***Requirement:*** +25 dBm ±0.3 dB If the requirement is not met, adjust either the ADJ control on the 48A attenuator (main station) or the IF OUT B ADJ control on the ADP( ) equalizer to meet the requirement. If the requirement cannot be met, complete Chart 7 and then repeat Chart 5. If the requirement still cannot be met, replace the 660( ) IC as directed in Chart 10 and then repeat this chart.
12	Repeat Steps 7 through 8 to make an amplitude response test. If the requirements are not met in Step 8 and the SLOPE control is adjusted, the GAIN control should be adjusted to maintain the final output power noted in Step 11.
13	When the requirement is met, maintain the test arrangement and proceed to Chart 9.

CHART 6

DRIVER AMPLIFIER—TRANSMITTER MODULATOR ADJUSTMENT ANALOG FM OPERATION

APPARATUS:

1 —J68392A Transmitter-Receiver

1 —1/4-inch Open-End Wrench

STEP	PROCEDURE
	Note: If the procedures in this chart are not met, refer to Section 415-410-504 for trouble-shooting procedures. ***Caution: The IF input drive power to the driver amplifier must be removed when making or changing the test connections to the monitor-shutter assembly, the monitor-transducer assembly, or the tuner-transducer assemblies.***
1	Make the test connections as shown in Fig. 6. Complete the Preparation for Test.

CHART 6 (Contd)

STEP	PROCEDURE

Note: For bays equipped with a 660( ) IC transmitter amplifier, omit Steps 6 and 7. For bays equipped with a tube-type transmitter amplifier, omit Steps 3, 4, and 5.

2 Verify that the input to the IF IN jack on the driver amplifier is removed.

3 Remove the waveguide section between the support bracket and the input to the 660( ) IC housing.

4 Connect a 24A transducer to the section of flexible waveguide at the support bracket. Terminate the input of the 660( ) IC amplifier with a shorting plate.

5 Connect the 10-dB pad to the 24A transducer and options (W), (A), and (U) or (V). Proceed to Step 8.

6 Remove the cover from the access slot and insert a shorting plate at tuner-transducer V1. Remove the plug from port A and insert the probe assembly.

7 Connect options (W), (A), and (U) or (V).

8 Adjust the BIAS control on the driver amplifier for maximum power indication.

9 Measure the power.

Requirement: +12 dBm ±0.25 dB

If the requirement is not met, adjust the GAIN control on the 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 driver amplifier-transmitter modulator.

10 Change the test arrangement to Fig. 7, use the 24A transducer, or option (A) and perform the Preparation for Test.

11 Measure the swept frequency response of the driver amplifier-transmitter modulator.

Requirement: The test trace shall coincide with the reference trace within 0.15 dB from 10 MHz below to 10 MHz above the transmitter channel frequency.

If the requirement is not met, adjust the SLOPE and GAIN controls to meet the requirement.

Caution: The BIAS control must not be changed for transmission adjustments. (It has an adverse effect on the amplitude modulation/pulse modulation [AM/PM] conversion of the transmitting modulator.)

CHART 6 (Contd)

STEP	PROCEDURE
12	Measure the power output, use the 24A transducer, or option (A) and option (U) or (V) in Fig. 6. ***Requirement:*** +12 dBm ±0.25 dB If the requirement cannot be met, adjust the GAIN control. If still not met, replace the driver amplifier-transmitter modulator and repeat the procedures in this chart.
13	With tests completed, remove the 24A transducer and return the waveguide section or remove the probe and shorting plate.

▶CHART 7

DRIVER AMPLIFIER—TRANSMITTER MODULATOR ADJUSTMENT
45-MB/S DIGITAL OPERATION

APPARATUS:

1 —J68392A Transmitter-Receiver

1 —1/4-inch Open-End Wrench

STEP	PROCEDURE
	Note: If the procedures in this chart are not met, refer to Section 415-410-504 for trouble-shooting procedures. ***Caution: The IF input drive power to the driver amplifier must be removed when making or changing the test connections to the monitor-shutter assembly, the monitor-transducer assembly, or the tuner-transducer assemblies.***
1	Make the test connections as shown in Fig. 6. Complete the Preparation for Test.
2	Verify that the input to the IF IN jack on the driver amplifier is removed.
3	Remove the waveguide section between the support bracket and the input to the 660( ) IC housing.

▶CHART 7 (Contd)

STEP	PROCEDURE
4	Connect a 24A transducer to the section of flexible waveguide at the support bracket. Terminate the input of the 660( ) IC amplifier with a shorting plate.
5	Connect the 10-dB pad to the 24A transducer and options (W), (A), and (U) or (V). Proceed with Step 6.
6	Adjust the BIAS control on the driver amplifier for maximum power indication.
7	Measure the power. ***Requirement:*** +12 dBm ±0.25 dB If the requirement is not met, adjust the GAIN control on the 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 driver amplifier-transmitter modulator.
8	Change the test arrangement to Fig. 7, use the 24A transducer and perform the Preparation for Test.
9	Measure the swept frequency response of the driver amplifier-transmitter modulator. ***Requirement:*** The test trace shall coincide with the reference trace within 0.15 dB from 10 MHz below to 10 MHz above the transmitter channel frequency. If the requirement is not met, adjust the SLOPE and GAIN controls to meet the requirement. ***Caution: The BIAS control must not be changed for transmission adjustments. (It has an adverse effect on the AM/PM conversion of the transmitting modulator.)***
10	Measure the power output, use the 24A transducer, or option (A) and option (U) or (V) in Fig. 6. ***Requirement:*** +12 dBm ±0.25 dB If the requirement cannot be met, adjust the GAIN control. If still not met, replace the driver amplifier-transmitter modulator and repeat the procedures in this chart.
11	With tests completed, remove the 24A transducer and return the waveguide section or remove the probe and shorting plate.◀

CHART 8

416 TUBE-TYPE TRANSMITTER AMPLIFIER ADJUSTMENT

APPARATUS:

1 —J68392A Transmitter-Receiver Test Set

1 —1/4-inch Open-End Wrench

1 —1/8-inch Allen Wrench

1 —KS-14409 or P-43J473 Tool

1 —3-inch Cabinet Screwdriver

STEP	PROCEDURE

Caution 1: The IF input drive power to the driver amplifier must be removed when making or changing the test connections to the monitor-shutter assembly, the monitor-transducer assembly, or the tuner-transducer assemblies.

Caution 2: If the plate voltage is removed from V1, V2, or V3 of the transmitting amplifier, the AMP 1, AMP 2, and AMP 3 BIAS ADJ controls should be turned fully counterclockwise before the plate voltage is reapplied. After the plate voltage has been reapplied, the BIAS ADJ controls should be reset to give the previously recorded plate currents. Failure to follow this procedure could reduce the life of the tubes.

1 Adjust the plate currents of AMP 1, AMP 2, and AMP 3 with the corresponding BIAS ADJ control on the bay control panel to obtain the meter indications listed in Table D.

2 Connect the test set as shown in Fig. 6, options (W), (B), and (U) or (V). Remove the cover from the access slot on the tuner-transducer at (B) and insert the shorting plate. Remove the plug from port A and insert the probe assembly. (It is assumed that the Preparation for Test has been performed in previous charts.)

3 Turn the SWEEP WIDTH control on the test set completely counterclockwise.

4 Adjust V1 plate tuning, input aperture, and input tuner controls for maximum power output.

5 Change the test arrangement to Fig. 7, option (B).

6 On the test set, set the SWEEP WIDTH control to re-establish the sweep as originally set up in the Preparation for Test.

Note: The position of the markers may be used to identify the re-establishment of the trace to its proper position.

CHART 8 (Contd)

STEP	PROCEDURE
7	Adjust variable attenuator AT3 and the oscilloscope SENSITIVITY controls to make the traces on the oscilloscope coincide at the highest point on the trace.
8	Decrease the loss in AT3 by 0.1 dB and adjust the SENSITIVITY, VERNIER, and POSITION controls on the oscilloscope differential amplifier for 2 centimeters deflection between the traces. This calibrates the oscilloscope for 0.05 dB per centimeter.
9	Increase the loss in AT3 by 0.1 dB. The highest point on the traces should coincide within 0.1 centimeter. If not, repeat Steps 7, 8, and 9.
10	Adjust V1 plate tuning, input aperture, input tuner, and output coupling for maximum power. Refer to Fig. 4 for location of transmitter amplifier controls. Readjust the controls only as required to meet the requirement. ***Requirement:*** The amplitude response shall be greatest at center frequency with a smooth roll-off not exceeding −0.2 dB at center frequency ±10 MHz. Refer to Fig. 5.
11	Turn the SWEEP WIDTH control counterclockwise to remove the sweep.
12	Change the test arrangement to Fig. 6, options (W), (B), and (U) or (V).
13	Calculate the power. ***Requirement:*** See Table D. ***Note:*** The gain and current requirements in the table should be used as a guide rather than an exact requirement. However, amplifiers which have difficulty meeting the minimum gain requirements may cause the overall amplifier to have trouble meeting its output requirements. If the requirement is not met, proceed as follows: ***+30 dBm:*** Adjust the plate current of AMP 1 and repeat Steps 3 through 13. ***+33 dBm:*** Adjust the plate current of AMP 1 but do not exceed 45 mA and repeat Steps 4 through 13. ***+37 dBm:*** Adjust the plate current of AMP 1 but do not exceed 55 mA and repeat Steps 4 through 13. If the requirement is not met after increasing the plate current, replace V1 and repeat Steps 3 through 13. Refer to Section 415-410-505 for replacement information.
14	Disconnect the driver amplifier IF input.
15	Remove the cover and plug from the V2 and V3 interstage and transfer the shorting plate and probe assembly from the V1 output to the V2 output. See Fig. 6, option (W), (C), and (U) or (V).

CHART 8 (Contd)

STEP	PROCEDURE
16	Replace the plug and cover removed in Step 2.
17	Reconnect the driver amplifier input.
18	Adjust V2 plate tuning and input aperture for maximum output.
19	Re-establish the sweep with the SWEEP WIDTH control.
20	Make the test arrangement as shown in Fig. 7, option (C).
21	Adjust AT3 and the oscilloscope controls to calibrate the oscilloscope as outlined in Steps 7, 8, and 9.
22	Adjust V2 plate tuning, input aperture, input tuner, and output coupling for maximum power. Then readjust the controls only as necessary to meet the requirement. See Fig. 4 for location of controls. ***Requirement:*** The amplitude response shall be greatest at center frequency with a smooth roll-off not exceeding −0.2 dB at center frequency ±10 MHz. A typical response is shown in Fig. 5.
23	Turn the SWEEP WIDTH control counterclockwise.
24	Change the test arrangement to Fig. 6, options (W), (C), and (U) or (V).
25	Calculate the power output. ***Requirement:*** See Table D. ***Note:*** The gain and current requirements in the table should be used as a guide rather than an exact requirement. However, amplifiers which have difficulty meeting the minimum gain requirements may cause the overall amplifier to have trouble meeting its output requirements. If the requirement is not met, proceed as follows: ***+30 dBm:*** Increase the plate current of AMP 2 but do not exceed 30 mA and repeat Steps 18 through 24. ***+33 dBm:*** Increase the plate current of AMP 2 but do not exceed 45 mA and repeat Steps 18 through 24. ***+37 dBm:*** Increase the plate current of AMP 2 but do not exceed 55 mA and repeat Steps 18 through 24. If the requirement still is not met, replace V2 and repeat Steps 18 through 24.

CHART 8 (Contd)

STEP	PROCEDURE
26	Disconnect the input to the driver amplifier.
27	Remove the probe and shorting plate from the V2 output and replace the plug and cover.
28	Connect the test equipment according to Fig. 6, options (W), (D), and (U) or (V).
29	Reconnect the drive amplifier input.
30	Turn down the sweep (SWEEP WIDTH control).
31	Adjust V3 plate tuning, output filter, and input aperture for maximum output.
32	Set the SWEEP WIDTH control to the previous position.
33	Establish test arrangement shown in Fig. 7, option (D).
34	Adjust the traces to coincide at the highest point of the test trace.
35	Recalibrate the oscilloscope as outlined earlier in Steps 7, 8, and 9.
36	Re-establish the sweep with the SWEEP WIDTH control.
37	Adjust V3 plate tuning, output filter, input aperture, input tuner, and output coupling for maximum power. Then adjust the controls only as necessary to meet the requirement. When the V3 plate tuning and output filter are properly tuned, tuning the output filter slightly will cause the trace to rock or teeter about the center frequency. When this condition has been achieved, the output coupling and input tuning can be used to control the bandwidth and flatness. ***Note:*** If the transmitter is being adjusted for +37 dBm, the teeter condition may be difficult, if not impossible, to arrive at and can be disregarded if not attained in a reasonable length of time. ***Requirement:*** When the highest point of the test trace coincides with the reference, no point on the test trace shall be below the reference trace more than 0.05 dB over a ±7.5 MHz band or more than 0.1 dB over ±10 MHz about the center frequency. Refer to Fig. 5. If this requirement cannot be met, it may be necessary to replace either the 416-type tube or the cavity and repeat Steps 31 through 37.
38	Remove the sweep by turning down the SWEEP WIDTH control.
39	Establish connections in Fig. 6, options (W), (D), and (U) or (V).
40	Measure the V3 output power.

CHART 8 (Contd)

STEP	PROCEDURE

Requirement: +30.0 dBm ±1.0 dB
+33.0 dBm ±0.5 dB
+37.0 dBm ±0.5 dB

If the requirement is not met, proceed as follows:

+30 dBm: If the output is low, increase AMP 3 plate current and repeat Steps 26 through 40. If the output is high, reduce AMP 2 plate current and repeat Steps 18 through 40.

+33 dBm: If the output is low, increase AMP 3 plate current but do not exceed 45 mA and repeat Steps 37 through 40. If the output is high, reduce AMP 3 plate current and repeat Steps 31 through 40.

+37 dBm: If the output is low, increase the AMP 3 plate current but do not exceed 85 mA and repeat Steps 37 through 40. If the output is high, reduce the AMP 3 plate current and repeat Steps 31 through 40.

Note: If the output is still too high with the AMP 3 plate current at minimum, adjust AMP 1 plate current and, if necessary, AMP 2 plate current until the requirement is met. Do not allow the plate current of AMP 1 to exceed that of AMP 2. If the output requirement still cannot be met, replace V3 and repeat Steps 31 through 40. If it has been necessary to adjust AMP 1 or AMP 2 plate current, repeat Steps 1 through 40.

41 Maintain the test arrangement and return to Chart 4, Overall Transmitter Transmission Test Analog FM Operation.

TABLE D

TRANSMITTER CURRENT AND GAIN REQUIREMENTS

+37 dBm (5 Watt)					
FREQUENCY	AMP1 I_P	P_O dBm	AMP2 I_P	P_O dBm	AMP3 I_P
3710-3850	25	+24 to +26	35	+31 to +33	60
3870-4010	30	+24 to +26	40	+31 to +33	60
4030-4170	40	+24 to +26	45	+31 to +33	70
+33 dBm (2 Watt)					
FREQUENCY	AMP1 I_P	P_O dBm	AMP2 I_P	P_O dBm	AMP3 I_P
3710-3850	20	+18 to +20	25	+25 to +27	35
3870-4010	20	+19 to +21	30	+26 to +28.5	40
4030-4170	30	+21 to +23	35	+28 to +29.5	45
+30 dBm (1 Watt)					
STAGE		INITIAL PLATE CURRENT		P_O dBm	
AMP 1		25		+21	
AMP 2		25		+26 to +26.5	
AMP 3		35		+29.5 to +30.5	

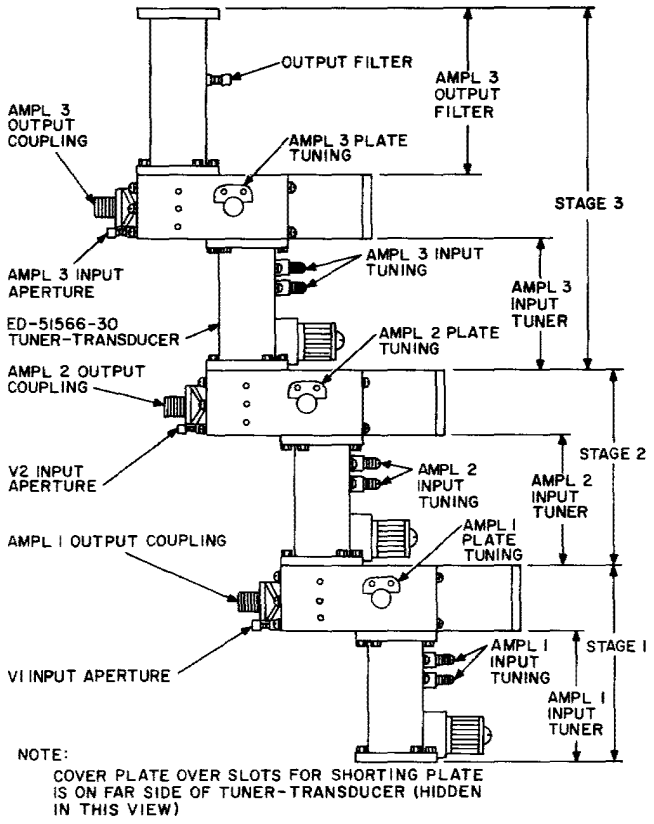


Fig. 4—Transmitter Amplifier Controls

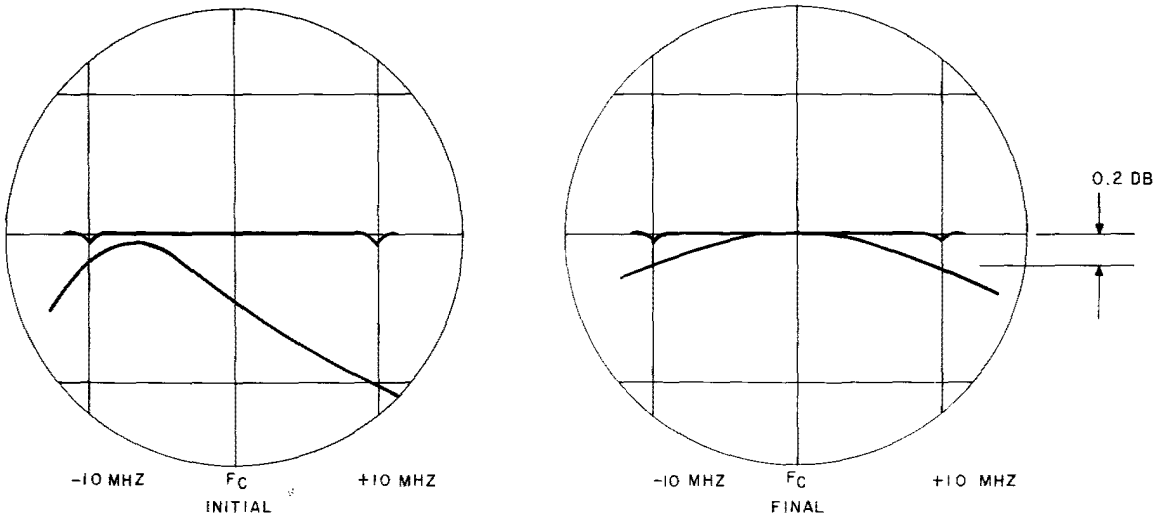


Fig. 5—Typical Gain-Frequency Response

CHART 9

ALARM ADJUSTMENT

STEP	PROCEDURE
	Caution: The IF input drive power to the IF driver amplifier must be removed when making or changing the test connections to the monitor-shutter assembly, the monitor-transducer assembly, or the tuner-transducer assemblies.
1	Make the test connections as outlined in Fig. 6 (analog FM) or Fig. 8 (45-Mb/s digital), options (W), (D), and (U) or (V).
2	Check that the sweep is off. Turn the SWEEP WIDTH control completely counterclockwise.
3	Observe the output power and the setting of ATTEN 2. Record the setting of ATTEN 2.
4	Increase the attenuation in ATTEN 2 until the output power drops by 3 dB.
5	Remove the input to the driver amplifier.
6	Remove the probe assembly and shorting plate from the shutter assembly and restore the covers to the access and port.
7	Restore the drive to the driver amplifier.
8	Adjust the TRMTR ALARM ADJ control on the meter panel in a counterclockwise direction until the TRMTR ALARM lamp just extinguishes.
9	Very slowly rotate the TRMTR ALARM ADJ control clockwise so that the lamp lights.
10	Restore ATTEN 2 to its original setting recorded in Step 3.
11	Set the selector switch on the meter panel to TRMTR OUT.
12	Adjust the TRMTR OUT control on the meter panel so that the panel meter indicates 70.
13	Remove the test equipment and restore the bay to normal.

CHART 10

660( ) IC TRANSMITTER AMPLIFIER REPLACEMENT

APPARATUS:

1 —1/4-inch Open-End Waveguide Wrench

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

PREPARATION FOR TEST (FIG. 6)

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

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

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.
6. Connect option (T).
7. Adjust ATTEN 2 to obtain –7 dBm on the power meter.
8. Connect option (U) or (V).

   Note: Option (U) is used when an internal power head is used in the test set; option (V), when external power head is used.
9. Set the INPUT CHANNEL switch on the power meter to RF and zero the power meter.

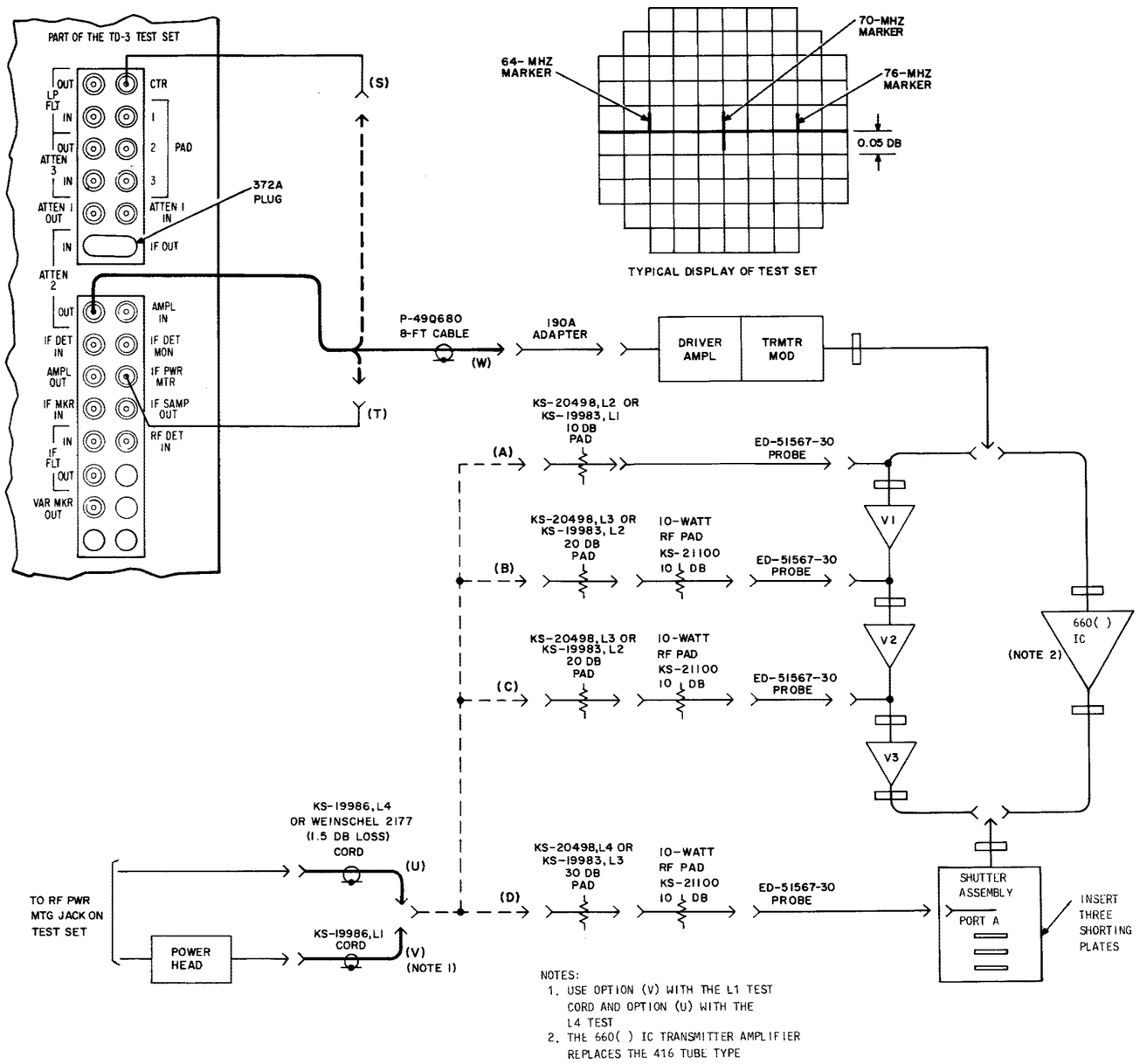


Fig. 6—Overall Transmitter Gain Test

PREPARATION FOR TEST (FIG. 7)

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

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 ×10 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

2. Set ATTEN 2 to 17 dB and 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 horizontal deflection on the oscilloscope screen.
5. Adjust the IF MKR FREQ control on the test set control panel for a 70 ±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. 7.

   Note: An extraneous marker appears at 89 MHz.
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 deflection between the traces. Return the variable pad to its previous setting. This calibrates the oscilloscope for 0.05 dB per centimeter.

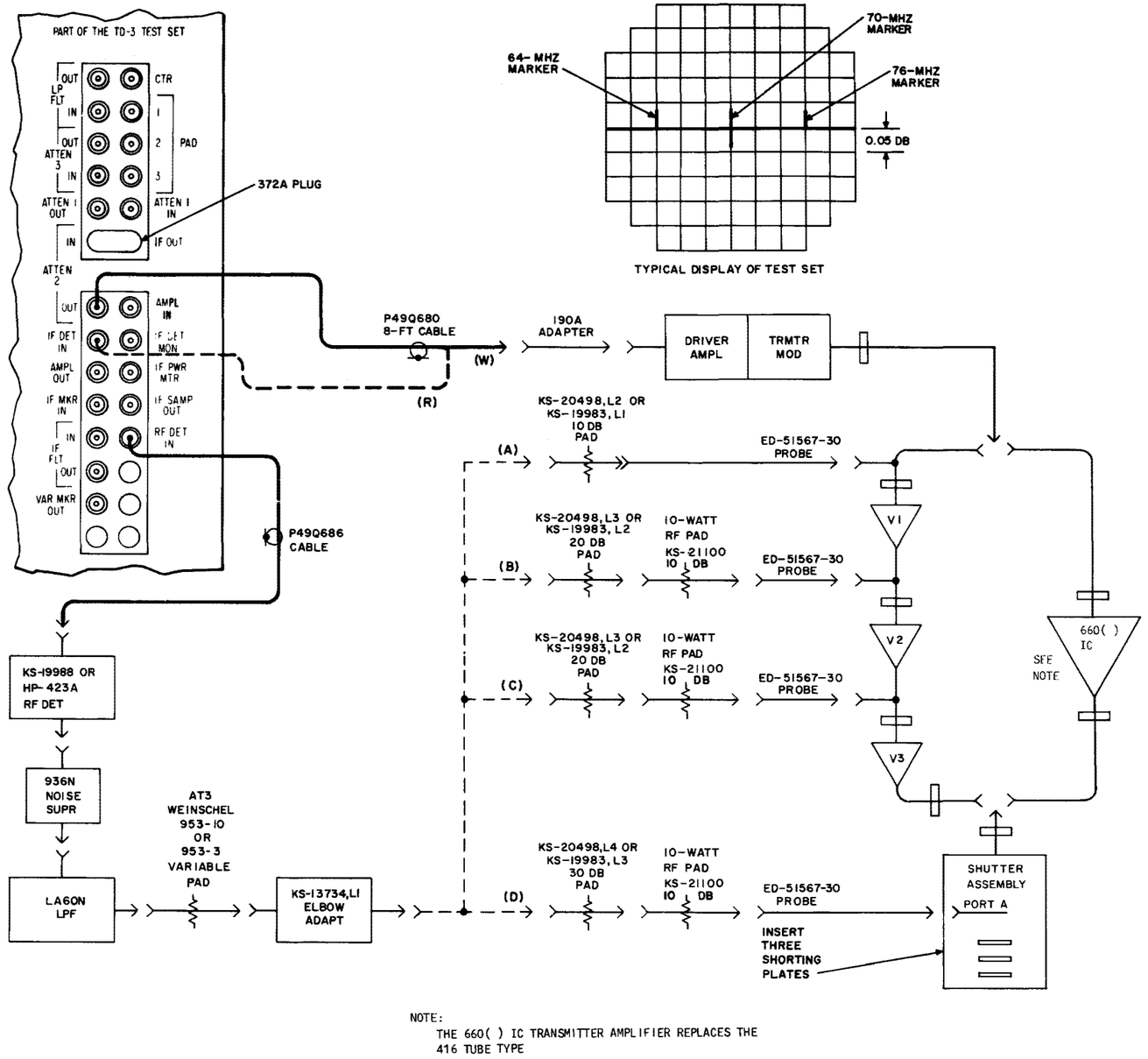


Fig. 7—Overall Transmitter Response Test

PREPARATION FOR TEST (FIG. 8)

Operate the test set controls to the following positions:

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

With the power meter input disconnected, adjust the METER ZERO control for an indication of ZERO.

Set the POWER RANGE DBM control to the −5 position.

Set ATTEN 2 to 17 dB.

Connect option (S) and adjust the IF CENTER FREQ control until the counter indicates 70 ±0.2 Hz.

Connect option (T).

Adjust ATTEN 2 to obtain either −7 dBm (main station) or 0 dBm (repeater station) on the power meter.

Connect option (U) or (V).

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

Set the INPUT CHANNEL switch on the power meter to RF and zero the power meter.

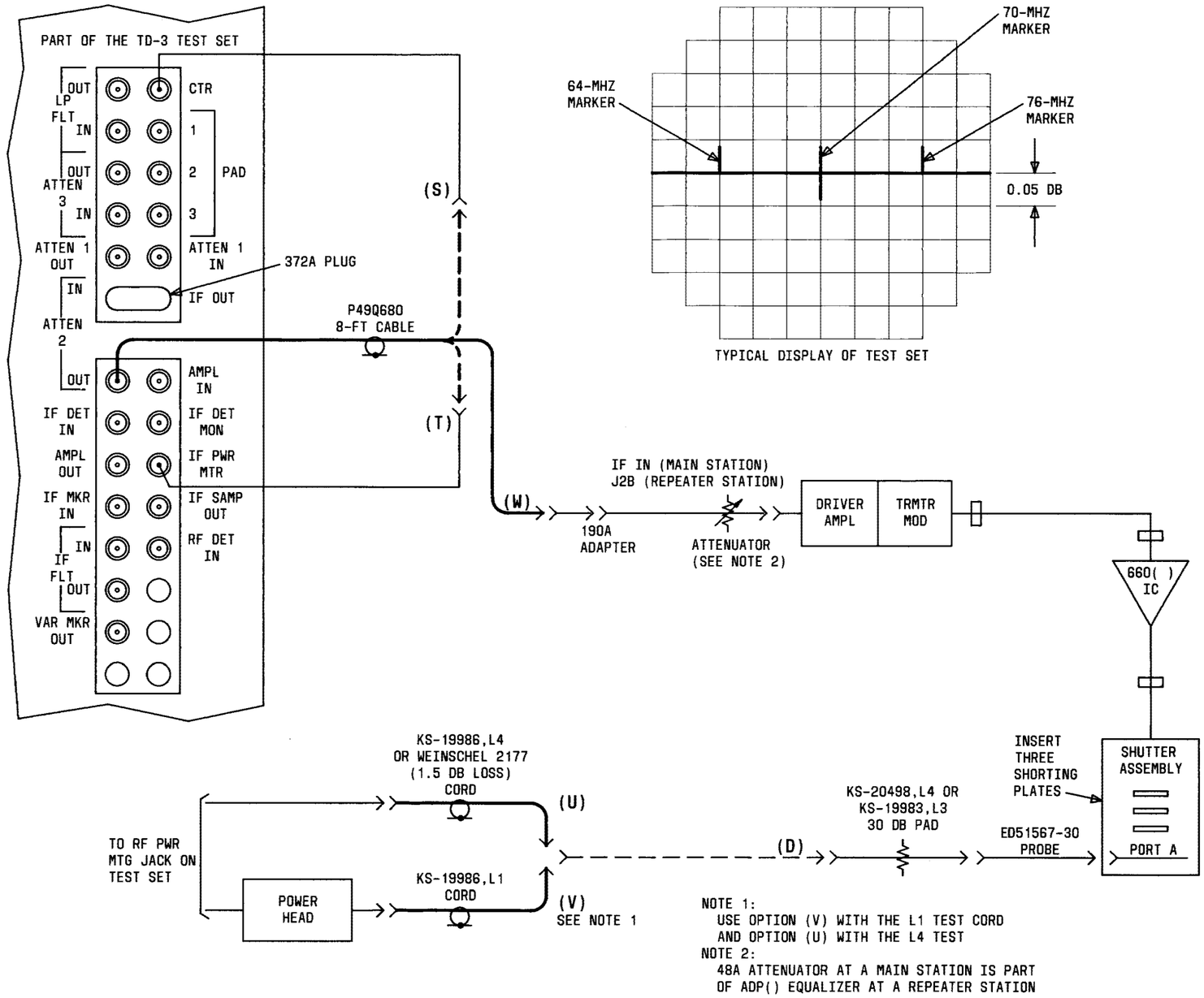


Fig. 8—Overall Transmitter Gain Test for 45-Mb/s Digital Operation

PREPARATION FOR TEST (FIG. 9)

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

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 ×10 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

2. Set ATTEN 2 to 17 dB and 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 horizontal deflection on the oscilloscope screen.
5. Adjust the IF MKR FREQ control on the test set control panel for a 70 ±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. 9.

   Note: An extraneous marker appears at 89 MHz.
7. Disconnect option (R) and establish option (W) at the driver amplifier input.
8. Set ATTEN to either 17 dB (main station) or 10 dB (repeater station).
9. Set the FUNCTION switch on the control panel to IF-RF.
10. Adjust the TEST TRACE and REF TRACE controls on the control panel so that the traces are coincident at 70 MHz.
11. Increase the attenuation of the variable pad by 0.5 dB and adjust the SENSITIVITY, VERNIER, and POSITION controls on the oscilloscope differential amplifier for 10 centimeters deflection between the traces. Return the variable pad to its previous setting. This calibrates the oscilloscope for 0.05 dB per centimeter.

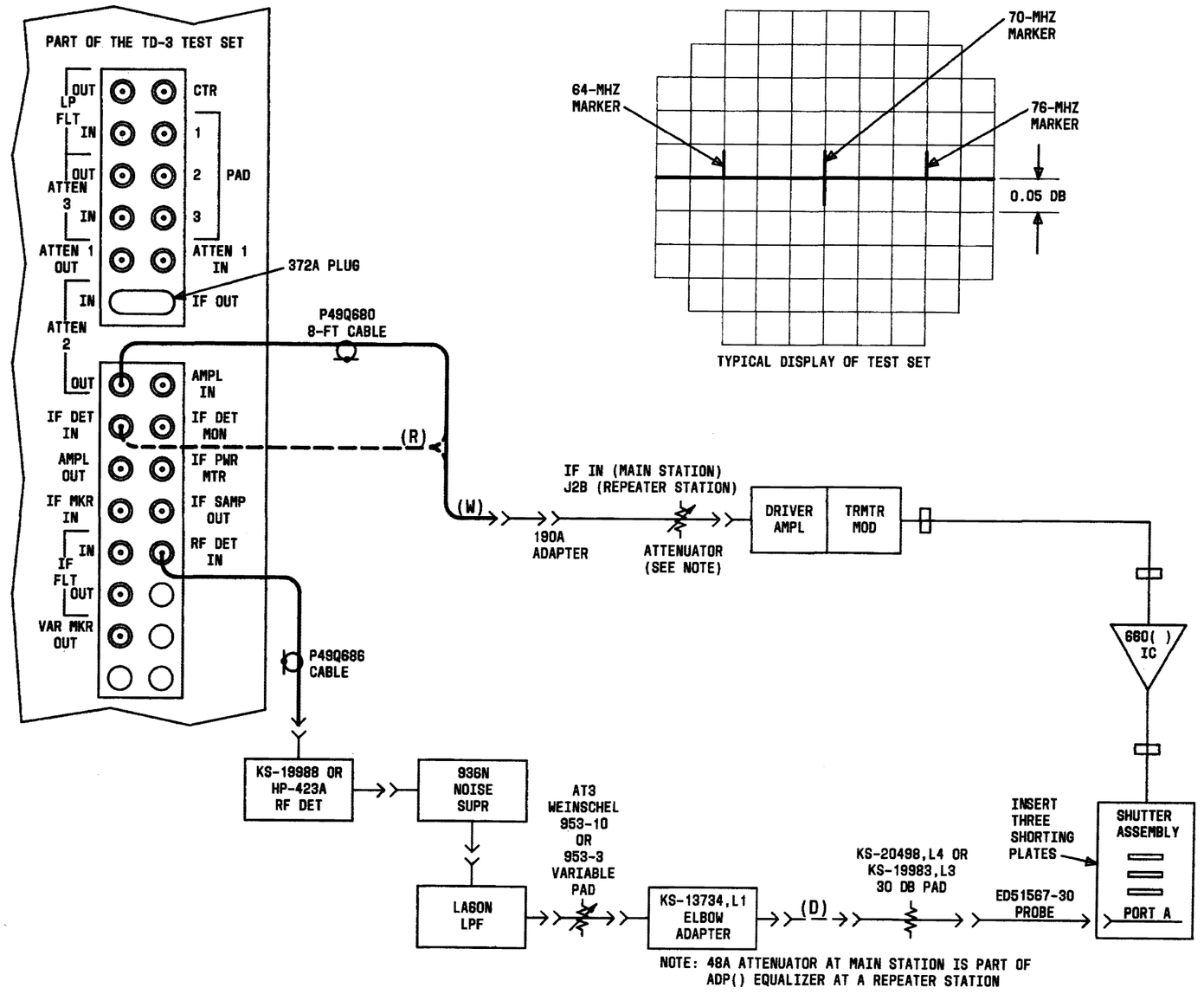


Fig. 9—Overall Transmitter Response Test for 45-Mb/s Operation