J68331A TRANSMITTER-RECEIVER BAY

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1. GENERAL

1.01 This section discusses tests for localizing troubles and methods for restoring the bay or the individual units to normal operation. The test equipments are included in general in the listings of the J68340A Test Bay and J68333A Test Bench. The test bay includes such units as:

J68340C IF Sweep Oscillator or J68340M 30 Cycle Switch
J68340D IF Detector Panel
J68340E Power Meter
J68340F Power Measuring Head
J68340H RF Sweep Oscillator
Dumont Mod. 2551 Oscilloscope
Power Control Panel
Various Plate and Bias Supplies for above
Miscellaneous Waveguide Attenuators, Bends and Terminations
Directional Coupler and Monitor Assembly
Weston Model 779 Analyzer

The test bench itself includes:

J68330B Receiver Control Unit
J68330H 40 MC Shifter (less the 40 MC Generator)
J68330M Transmitter Control Unit
J68330G Microwave Generator

Included in the listing of associated equipment are such items as:

Miscellaneous Waveguide, Bends, Spacers, Terminations, Junctions and Attenuators
IF Directional Coupler
KS-5727 Tube Tester
J64001AK Tube Test Set
Miscellaneous Coaxial Cords
Miscellaneous Tools

The various test arrangements are somewhat biased in favor of "bench" tests which, furthermore, assume that usually a number of different alignemnt tests will be made

in succession. It may be found, therefore, that for some tests the setup may appear more elaborate than necessary. For tests of units mounted on the bay, the departures from the indicated procedures will usually be apparent, such as the use of terminations, etc.

2. TRANSMITTER-RECEIVER BAY SYSTEM TESTS

(A) General

2.01 The tests outlined in this part include those which will be made on the bay. Other tests involving only one unit, which may be made either on the bay or on a test bench, are outlined under the individual panels.

(B) Summary of Voltage and Current Measurements

2.02 Receiver Control Unit:

Switch Position	Meter Reading	Full Scale
CR1	1.5 ma	2.5 ma
CR2	1.5 ma	2.5 ma
MAN BIAS	*	5 V
AUTO BIAS	*	5 V
+BIAS	9V	10 V
RCVR OUTPUT	*	2.5 V
130V	130V ± 2	250V
TST A	-	
TST B		
V2 CATH (For AUTO BIAS = 0)	55-70 V	100V
V1 PLATE	Within -2, to 0 of V2 CATH value	100V

*These readings depend upon IF gain, path loss, etc.

2.03 Transmitter Control Unit:

Switch Position	Meter Reading
PLT CUR-MOD	15 ma
PLT CUR-AMP 1	25 ma
PLT CUR-AMP 2	25 ma
PLT CUR-AMP 3	30 ma
BIAS-MOD	-1.0 ±0.2 volt
BIAS-AMP 1	Function of Tubes
BIAS-AMP 2	Function of Tubes
BIAS-AMP 3	Function of Tubes

	Meter Reading
Power Out Meter	0 ± 1 db

Jack Designation	
MOD FIL	6.3 ± 0.2 volts
AMP 1 FIL	6.3 ± 0.2 volts
AMP 2 FIL	6.3 ± 0.2 volts
AMP 3 FIL	6.3 ± 0.2 volts
-11V	-11 volts
+250V	250 ± 5 volts

2.04 40 MC Shifter:

Switch Position	Meter Reading
V1-E_P	150 ± 3 V
V1-I_{P1}	13 ± 3 ma
V1-I_{G2}	0.3 ± 0.15ma
V1-I_{P2}	8 ± 3 ma
V2-I_{P+S}	30 ma max
CR1	50 ± 12 ma
CR2	50 ± 12 ma
*Average	50 ± 2 ma

Jack Designation	
+250V	250 ± 5 volts
+150V	150 ± 3 volts
-11V	10.8 ± 0.2 volts

2.05 Microwave Generator:

Switch Position	Meter Reading Receiver	Meter Reading Transmitter
V1-I_{P1}	10 ± 2 ma	10 ± 2 ma
V1-I_{G1}	0.3 ma min	0.3 ma min
V1-I_{P2}	5 ± 2 ma	5 ± 2 ma
V2-I_P	3.5± 1 ma	3.5± 1 ma
V3-I_G	0.8± 0.25ma	0.8± 0.25ma
V3-I_P	6.5± 2 ma	6.5± 2 ma
V4-I_G	3.0± 2 ma	3.0± 2 ma
V4-I_P	17 ± 2 ma	17 ± 2 ma
V5-I_P	13 ± 3 ma	13 ± 3 ma
V6-I_P	0	19 ± 2 ma
V7-I_P	12 ma max	20 ma max

Jack Designation	Meter Reading
V6 FIL V	* -6.3 ± 0.2 V
V7 FIL V	-6.3 ± 0.2 V
+250V	+250V ± 5V
+150V	150V ± 3V
-11V	-11V

* -11 volts for a receiver microwave generator.

2.06 IF Main Amplifier:

Jack Designation	Meter Reading
FIL A	11V
FIL B	11V
C+	9 ± 0.5 V

2.07 IF Preamplifier:

Jack Designation	Meter Reading
FIL	11 volts
+C	9 ± 0.5 volts

2.08 Power Levels:

Unit	Input	Output
Receiver Converter	* - 35 dbm ** - 58	- 41 dbm - 64
IF Preamplifier	- 41 - 64	- 29 - 52
IF Equalizer	- 29 - 52	- 30 - 53
IF Main Amplifier	- 30 - 52	*** +6 to +10 +6 to +10
IF Buffer Amplifier	+ 3	*** +1 to +5
Transmitter Modulator	+1 to +5	+ 9
Transmitter Amplifier	+ 9	+ 27
Output Monitor Directional Coupler - Measuring Arm		**** +2 to +3

*Input with radio signal over a 30-mile path with no fading - path loss assumed to be 138 db.

**Minimum input which can be fully compensated with IF amplifier output of +10 dbm. This is equivalent to a 23 db fade.

***The amplifier outputs will be adjusted to meet the input requirements of the transmitter modulator or the FM terminal receiver.

****The loss to the output of the measuring branch of the output monitor directional coupler is stenciled on the unit. The value will vary with different units but will generally be between 24 and 25 db.

(C) Gain-frequency Characteristic - Converter Input to Transmitter Amplifier Output

2.09 Procedure:

(1) Set up the equipment associated with the J68340A Test Bay as in Fig. 1. This will require disconnecting the receiver converter from the channel separation filter. The exposed output of the channel separation filter should be terminated with the waveguide termination which is removed from the output directional coupler in order to make the connection for the output power measurement.

(2) Set AT2 to 20 db.

(3) Connect the RF power meter to the output of AT2.

(4) With the SWEEP switch on the RF sweep oscillator operated to OFF, set the frequency to the center of the receiver band, and adjust AT1 to make the power meter read +3 dbm.

(5) Set AT3 to 0, AT4 to 12 db and AT5 to 10 db.

Note: If no RF patch cord is used, the setting of AT5 should be 20 db.

(6) Disconnect the power meter from AT2 and connect it to the arm of the directional coupler in the output monitor from which the termination was removed.

(7) Set the CONT switch on the receiver control unit to MAN.

(8) Adjust the MAN potentiometer to make the power reading plus the output coupler loss equal to 27 dbm.

(9) Increase the setting of AT3 until the power meter reading decreases 1.0 db. Note the setting of AT3. Return AT3 to 0 db.

Requirement: The increase in setting of AT3 shall not exceed 4 db.

(10) Connect RF detector No. 2 to the output of the bay coupler, and adjust ADJ XTAL 1 to bring the two traces on the scope together. (If necessary, connection to XTAL 1 and XTAL 2 may be reversed.)

(11) Increase AT3 to the value noted in (9) and set the vertical scope gain to make the separation of the traces equal to one inch. Return AT3 to 0 db. The traces should coincide within 0.05 inch. If not, repeat (10) and (11).

(12) Turn on the sweep and adjust the horizontal gain to give a convenient display such as 10 mc per inch.

(13) The scope picture should be similar to Fig. 2.

Requirement: The band shall be flat within ± 0.1 db over the center 20 mc of the band, with the additional requirement that ripples shall be less than ± 0.05 db peak-to-peak.

Requirement: The interfering signal which may appear at one edge of the band shall be less than 0.2 db peak-to-peak.

(14) If the first requirement is not met, and the receiver is known to meet its requirements, the over-all bay characteristic may be flattened by adjusting one or both of the adjacent tuners near the input of the transmitter amplifier.

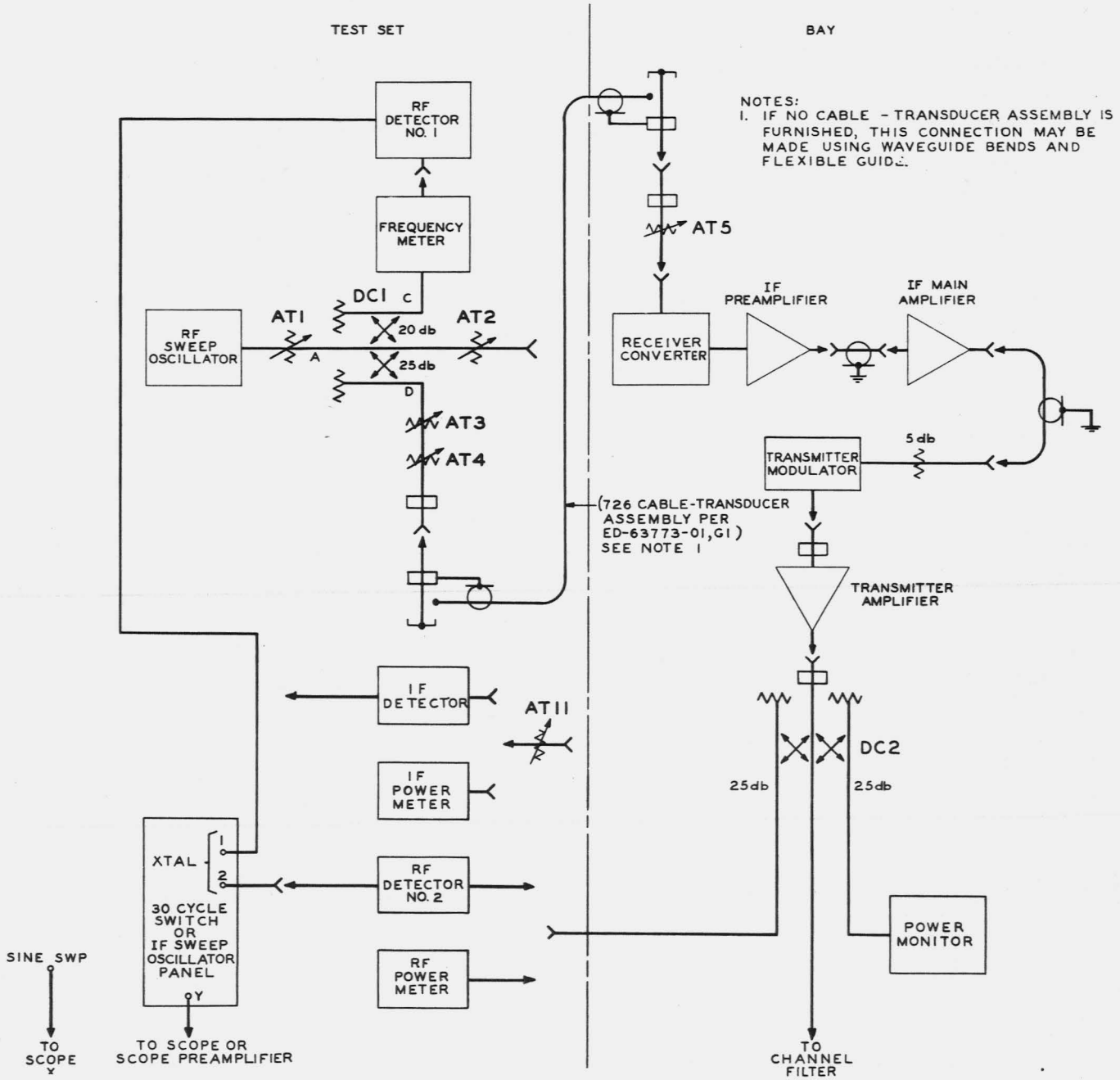

Fig. 1 - Arrangement for Gain-frequency Test of Over-all Radio Transmitter-Reciver Bay

(15) If the second requirement is not met, check the receiver as in 2.13, (9) through (11).

(D) Gain-frequency Characteristic - Transmitter Modulator Input to Transmitter Amplifier Output (Main Stations Only)

2.10 Procedure:

(1) Set up the equipment associated with the J68340A List 1 Test Bay as in Fig. 3. Remove the waveguide termination from the output directional coupler by means of the quick-clamp.

(2) Connect the RF power meter to the coupler output.

(3) With the sweep off, the frequency set to 70 mc, adjust AT11 to make the power meter reading plus the output coupler loss equal to +27 dbm ±0.5 db.

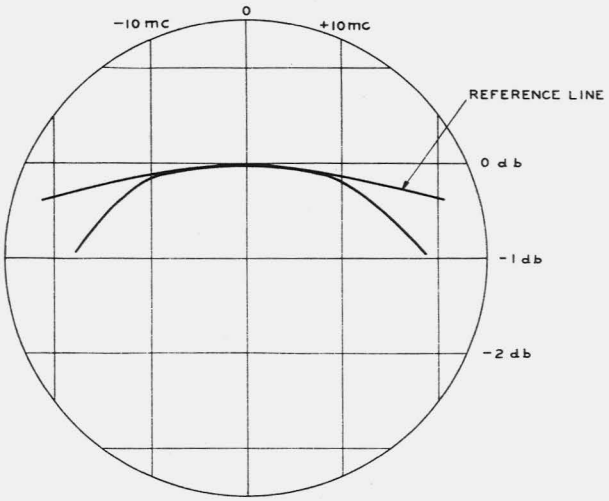

Fig. 2 - Typical Scope Presentation of Transmission Characteristic

(4) Increase AT11 by 2 db, and note the decrease in the reading of the power meter.

Requirement: The decrease shall be at least 0.5 db.

(5) Return AT11 to its original setting.

(6) Connect the RF detector to the coupler, and adjust AT12 and ADJ XTAL 1 to make the two traces coincide.

(7) Increase AT11 by 2 db and adjust the scope vertical gain to make the separation of the two traces equal in inches to the db change in output power measured in (4) above. (This makes the vertical sensitivity equal one db per inch.)

(8) Return AT11 to its pervious setting; the two traces should coincide within .05 inch. If not, repeat (6), (7) and (8).

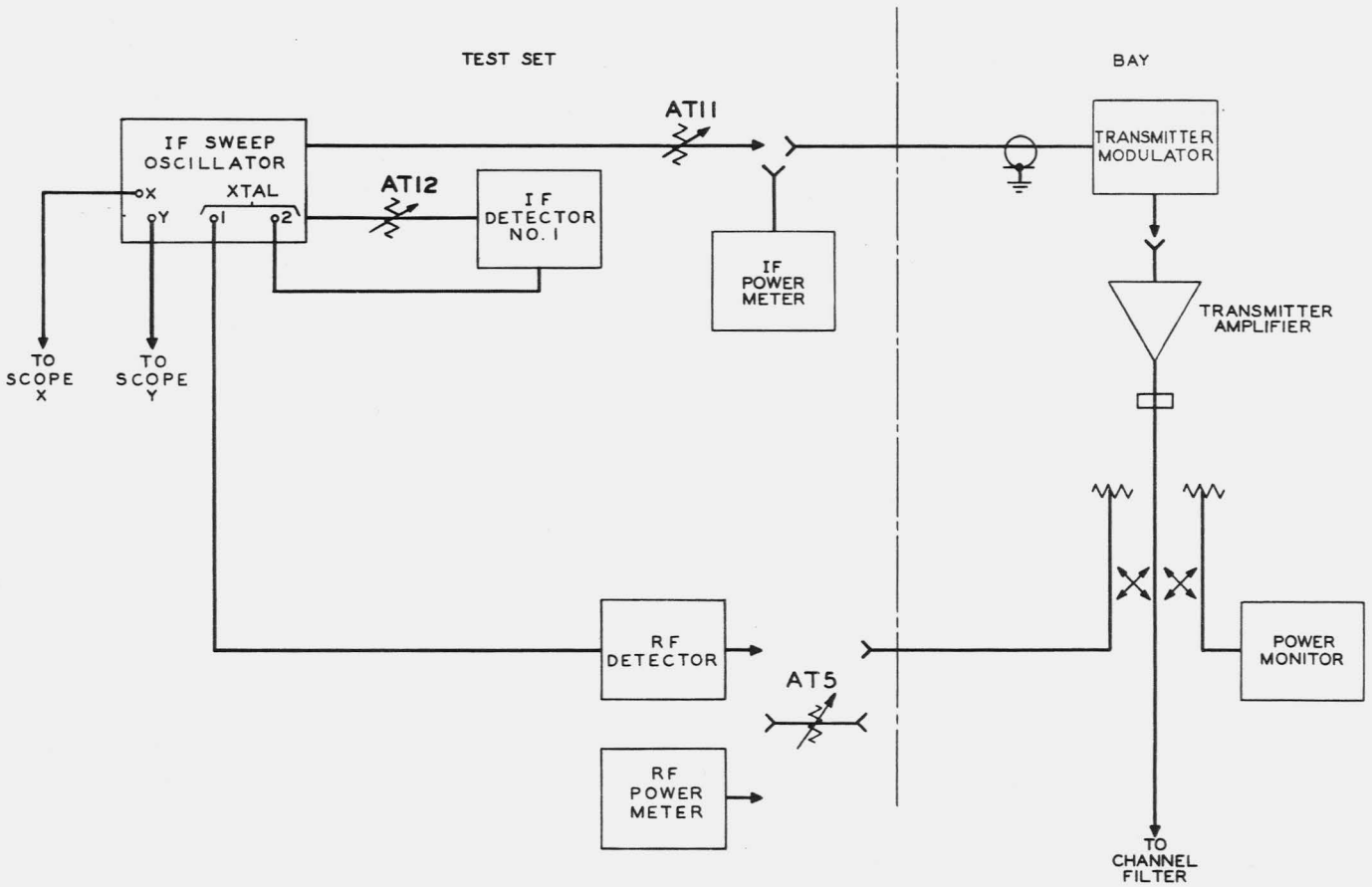

Fig. 3 - Arrangement for Gain-frequency Test form Transmitter Modulator Input to Transmitter Amplifier Output

(9) Turn on the sweep and adjust the horizontal gain to give a convenient display such as 10 mc per inch, using the wavemeter dip on the reference trace.

(10) The scope picture should be similar to Fig. 2.

Requirement: The band shall be flat within ±0.1 db over the center 20 mc of the band.

(11) If the requirement is not met, the characteristic may be flattened by adjusting one or both of the adjacent tuners near the input of the transmitter amplifier.

(E) Gain-frequency Characteristic - Transmitter Modulator Input to Transmitter Modulator Output (Main Stations Only)

2.11 Procedure:

(1) Set up the equipment as shown in Fig. 3, with the modulator disconnected from the transmitter amplifier.

(2) Connect the output of the modulator to AT5 and connect AT5 to the RF power meter.

(3) Set AT5 to 8 db, set the IF sweep oscillator to 70 mc with the sweep OFF, and adjust AT11 to make the RF power meter read +2 ±0.5 dbm.

(4) Remove the power meter and connect the RF detector in its place.

(5) Adjust AT12 and ADJ XTAL 1 to make the two traces on the scope coincide.

(6) Increase AT5 by 1 db and adjust the vertical scope gain to make the trace separation equal 1 inch.

(7) Return AT5 to its original setting; the two traces should coincide within 0.05 inch. If not, repeat (5), (6) and (7).

(8) Operate the sweep to ON and adjust the horizontal scope gain to give a display of 10 mc per inch.

(9) The scope picture should be similar to Fig. 2.

(10) Adjust the output tuner for optimum flatness.

Note: When the modulator is reconnected to the amplifier, this tuner may be readjusted to flatten the over-all transmission band.

Requirement: The band shall be flat within ±0.1 db over the center 20 mc.

(F) Gain-frequency Characteristic - Receiver Converter Input to Transmitter Modulator Output

2.12 Procedure:

(1) Set up the equipment as shown in Fig. 1 with the modulator disconnected from the transmitter amplifier.

(2) Make connection from the test bay to the converter input with AT5 removed.

(3) Connect AT5 to the output of the modulator, and set it to 7 db.

(4) Set AT2 to 20 db.

(5) Connect the RF power meter to the output of AT2.

(6) With the SWEEP switch on the RF sweep oscillator operated to OFF, set the oscillator frequency to the center of the receiver band, and adjust AT1 to make the power meter read +3 dbm.

(7) Set AT3 to 12 db and AT4 to 10 db.

Note: If no RF patch cord is used, the setting of AT4 should be 20 db.

(8) Connect the RF power meter to the output of AT5.

(9) Operate the CONT key on the receiver control unit to MAN and adjust the MAN gain control to make the power meter reading +2 dbm.

(10) Remove the power meter and connect RF detector No. 2 in its place.

(11) Adjust ADJ XTAL 1 to make the two traces on the scope coincide.

(12) Increase the setting of AT5 by 1 db and adjust the vertical scope gain to make the trace separation equal 1 inch.

(13) Return AT5 to its original setting; the two traces should coincide within 0.05 inch. If not, repeat (11), (12), and (13).

(14) Operate the sweep to ON and adjust the horizontal scope gain to give a display of 10 mc per inch.

(15) The scope picture should be similar to Fig. 2.

(16) Adjust the output tuner for optimum flatness.

Requirement: The band shall be flat within ±0.1 db over the center 20 mc.

Note: When the modulator is connected to the transmitter amplifier this tuner may be readjusted to flatten the over-all transmission band.

(G) Gain-frequency Characteristic - Receiver Converter Input to IF Main Amplifier Output

2.13 Procedure:

(1) Proceed as in 2.09, (1) through (5), including note.

(2) Set the CONT switch on the receiver control unit to MAN.

(3) Connect the IF main amplifier output to the IF detector input using the shortest patch cord (approximately 1 foot).

(4) Adjust MAN gain and ADJ XTAL 1 to make the two traces coincide on the scope.

(5) Increase AT3 one db and adjust the scope vertical gain to make the trace separation equal one inch. Return AT3 to its original setting. The two traces should coincide within 0.05 inch. If not, repeat (4) and (5).

(6) Turn on the sweep and adjust the horizontal gain to give a convenient display such as 10 mc per inch, using the frequency meter dip.

(7) The scope picture should be similar to Fig. 2.

Requirement: The transmission shall be flat within ±0.1 db over the center 20 mc of the band.

(8) If this requirement is not met, adjust L53, L54, L55, L56 and C59 in the IF main amplifier.

(9) Set AT3 to 20 db, and adjust MAN gain to make the two traces coincide approximately.

(10) Look for the interfering signal at one edge of the band.

Requirement: The interfering signal shall be less than 0.2 db peak-to-peak.

(11) If this requirement is not met, adjust the tuner at the top end of the filter assembly. The CR1 and CR2 readings on the receiver control unit should be maintained at 1.5 ma during this procedure by adjusting the REC CONV control on the 40 mc shifter unit (receiving microwave generator at main stations).

(H) Gain-frequency Characteristic - Receiver Converter Input to IF Preamplifier Output

2.14 Procedure:

(a) If RF patch cord is used:

(1) Proceed as in 2.09, (1) through (4).

(2) Set AT5 to 10 db.

(3) Disconnect RF power meter and connect RF patch cord between AT2 and AT5.

(4) Connect the scope preamplifier ahead of the scope.

(5) Connect the output of the IF preamplifier to the IF detector input using the shortest patch cord (about 1 foot).

(6) Make the two traces on the scope coincide by increasing AT1 and decreasing AT2 the same amount. ADJ XTAL 1 may be adjusted as well.

(7) Set AT3 to 1 db and adjust the vertical scope gain to make the separation of the two traces equal 1 inch.

(8) Set AT3 to 0 db; the two traces should coincide within 0.05 inch. If not, repeat (6), (7) and (8).

(9) Operate SWEEP to ON and adjust the horizontal scope gain to give a display of 10 mc per inch.

(10) The scope picture should be similar to Fig. 2.

Requirement: The transmission shall be flat within ±0.05 db over the center 20 mc.

(11) If this requirement is not met, a small slope correction may be obtained by adjusting C31 in the IF preamplifier.

(b) If RF patch cord is not available:

(1) Proceed as in 2.09, (1) through (4), with AT5 removed from converter input.

(2) Set AT3 to 0 and AT4 to 5 db.

(3) Insert AT5 between the frequency meter and RF detector No. 1.

(4) Connect the scope preamplifier ahead of the scope.

(5) Connect the output of the IF preamplifier to the IF detector using the shortest patch cord (about 1 foot).

(6) Adjust AT5 and ADJ XTAL 1 to make the two traces on the scope coincide.

(7) Proceed as in 2.14 (a), (7) through (11).

(I) Gain - Receiver Converter Input to Transmitter Amplifier Output

2.15 Procedure:

(1) Proceed as in 2.09, (1) through (9).

(2) With the power output equal to +27 dbm, note reading of PWR OUT meter on the transmitter control unit.

Requirement: Meter should read 0 db; if not, readjust PWR ADJ control.

Caution: The power meter calibration should be checked often enough to be sure that it reads power correctly.

(3) Operate the CONT switch on the receiver control unit to AUTO.

(4) Adjust the AUTO gain control to make the power output (power meter reading plus coupler loss) equal +27 dbm.

(5) Set AT3 to 20 db, AT4 to 15 db, and again read the power meter.

Requirement: Output shall not drop more than 1 db.

Note: This indicates that the repeater bay is capable of putting out essentially full power with a fade of 23 db below the normal signal input.

(J) Gain - Transmitter Modulator Input to Transmitter Amplifier Output (Main Stations Only)

2.16 Procedure:

(1) Proceed as in 2.10, (1) through (5).

(2) Connect the IF power meter to the output of AT11 and measure the IF power.

Requirement: The IF power shall be between +1 and +5 dbm.

Note: This represents an over-all gain of 22 to 26 db of which 18 db should be in the amplifier and 4 to 8 db in the transmitter modulator.

(3) Check the indication on the PWR OUT meter on the transmitter control unit.

Requirement: Should read 0 db; if not readjust PWR ADJ.

Caution: The power meter calibration should be checked immediately before an important power measurement is made.

(K) Gain - Transmitter Modulator Input to Transmitter Modulator Output (Main Stations Only)

2.17 Procedure:

(1) Set up the equipment as shown in Fig. 3, with the modulator disconnected from the amplifier.

(2) Using the IF power meter, set up a level of 3 ±0.5 dbm at output of AT11.

(3) Connect the output of AT11 to input of modulator.

(4) Set AT5 to 7 db and connect it to the modulator output.

(5) Measure the RF power at the output of AT5.

Requirement: The RF power shall be -1 dbm or greater.

(L) Gain - Receiver Converter Input to Transmitter Modulator Output

2.18 Procedure:

(1) Proceed as in 2.12, (1) through (9).

(2) Connect the output of the IF main amplifier to AT11 and the output of the AT11 to the IF power meter.

(3) Set AT11 to 10 db and measure the IF power.

Requirement: The IF power meter shall read less than +1 dbm.

(M) Gain - Receiver Converter Input to IF Main Amplifier Output

2.19 Procedure:

(1) Proceed as in 2.09, (1) through (5).

(2) Set the CONT switch on the receiver control to AUTO.

(3) Connect the IF main amplifier output to AT11 and the output of AT11 to the IF power meter.

(4) Set AT11 to 8 db.

(5) Adjust the AUTO gain control to make the IF power meter reading 0 dbm.

(6) Set AT3 to 20 db and AT4 to 15 db and again read the IF power meter.

Requirement: The power meter shall read -2 dbm or greater.

Note: This indicates that the receiver is capable of putting out essentially full power with a fade of 23 db below normal signal.

(N) Gain - Receiver Converter Input to IF Preamplifier Output

2.20 Procedure:

(1) Proceed as in 2.14 (a), (1) through (3) or as in 2.14 (b), (1) through (2).

(2) Connect the IF power meter to the IF preamplifier output and measure the power.

Requirement: The power output shall be -4 dbm or greater.

(O) Receiver Noise Figure

2.21 Procedure:

(1) Connect a waveguide termination to the receiver converter input.

(2) Connect the IF main amplifier output through AT11 to the 5 db pad ahead of the transmitter modulator.

(3) Disconnect the transmitter output from the directional coupler, and connect the RF power meter to the transmitter amplifier output.

(4) Set AT11 to 0.

(5) Operate the CONT switch on the receiver control unit to MAN.

(6) Adjust the MAN gain control to give a power meter reading of 0 dbm.

(7) Set AT11 to 25 db, AT2 to 20 db, AT3 to 20 db, AT4 to 20 db, and AT5 to 20 db, and connect the power meter to output of AT2.

(8) With the SWEEP switch on the RF sweep oscillator operated to OFF, set the frequency to the center of the receiver band, and adjust AT1 to make the power meter read + (A-D coupler loss minus 25) dbm. This is approximately 0 dbm and makes the output of the D branch of the coupler equal to -5 dbm.

(9) Connect power meter to output of transmitter amplifier and reduce setting of AT4 until power meter reads 0 dbm.

(10) Compute the noise figure as follows:

(a) Noise figure = (99-5-AT3-AT4-AT5-AT11-RF patch cord) db

= 29-AT4-RF patch cord if other attenuators were as specified.

Note 1: 99 is the negative of the thermal noise in dbm for a 30 mc band.

Note 2: If no RF patch cord is available, substitute zero in the above equations where RF patch cord appears.

Requirement: The noise figure shall be less than 14 db.

(P) Trouble Location Tests

2.22 General:

(a) These tests are intended to assist in localizing the trouble in a particular unit after it has been definitely established that the radio transmitter-receiver bay is in trouble. After it has been determined which unit is in trouble, reference should be made to the maintenance methods pertaining to that particular unit.

(b) The first step in tracing a trouble condition is a check of all meter readings which, in some cases, will point immediately to the faulty component. In other cases, the meter readings may indicate the order of subsequent tests.

2.23 No Power Indication on POWER OUTPUT Meter:

(1) Operate the RESET key on the transmitter control unit momentarily to make sure that the meter has been released.

(2) Check whether the trouble is in the receiver or the transmitter:

(a) Operate the meter switch on the receiver control unit to RCVR OUTPUT.

(b) If no output, the trouble is in the receiver; proceed with (8).

(c) If the output appears reasonable, the trouble lies between the IF main amplifier OUTPUT jack and the transmitter output; proceed as in (3).

(3) Check if transmitter meter readings indicate which unit might be in trouble:

(a) Operate meter and PLT CUR-BIAS switches on the transmitter control unit to check plate current and bias readings of the modulator and amplifier. If these appear normal, proceed as in (4). If these are not normal,

(b) Check filament voltages in FIL V jacks and adjust if necessary.

(c) Adjust plate currents to normal by means of the BIAS ADJ potentiomenters. Inability to meet requirements indicates that the tube is likely to be in trouble.

Note: Biases should be readjusted after power is again normal.

(d) In a station using separate receiver and transmitter microwave generators, if the modulator bias is outside the limits -0.8 to -1.2 in the positive direction, the microwave generator may be in trouble. (Maintenance methods are given in part 12.)

(4) Check that there is actually an input signal to the transmitter:

(a) Remove the coaxial cable connection to the input of the transmitter modulator and connect the cable to the IF power meter.

(b) If no power output, check the cable connection to the IF main amplifier OUT jack and if still no output, measure directly out of the OUT jack as there might be internal trouble in the jack.

(c) If the output in (a) is normal, restore the cable to the transmitter modulator and proceed as in (5).

(5) Check whether the trouble might be in the output monitor circuit:

(a) Remove the termination from the measuring arm of the output monitor directional coupler and connect the RF power meter.

(b) If the output is normal, the trouble is in the output indication circuit; proceed as in (7).

(c) If there is no output, the trouble is in the transmitter or modulator; proceed as in (6).

(6) Measure power at output of modulator using AT5 and RF power meter as in 2.12 (or 2.11 at Main Stations):

(a) If output is normal, replace the transmitter amplifier and check over-all gain and gain-frequency.

(b) If output is down, replace the modulator and check over-all gain and gain-frequency.

(7) If the power output in (5) is normal, check the power monitor circuit:

(a) Hold the RESET key operated and with a screwdriver rotate the PWR ADJ potentiometer clockwise. If still no indication, restore the potentiometer setting and,

(b) replace the varistor in the output monitor and again press the RESET key. (The PWR OUTPUT circuit will then need to be recalibrated.) If still no indication,

(c) Check the continuity of the power monitor circuit from the power monitor to and within the transmitter control unit.

(8) If the trouble was found in (2) to be in the receiver, check the meter readings on the receiver control unit for the receiver converter and the IF main amplifier to see whether there is any indication of what unit might be in trouble:

(a) If the CONVR CR1 and CR2 varistor currents are low, the converter, the 40 mc shifter or the microwave generator may be in trouble. (In stations employing separate transmitter and receiver microwave generators, it would be the receiver microwave generator that would be in trouble.) Proceed as in (9).

(b) If all measurements are normal, the trouble might be in the connection between the converter and the preamplifier or in either the IF preamplifier or the IF main amplifier. Proceed as in (10).

(9) Check whether the trouble is in the beating oscillator supply:

(a) To check whether the trouble is in the microwave generator (at auxiliary stations), check the transmitter modulator on the transmitter control unit. If this is outside the

limits -0.8 to -1.2 in the positive direction, it is likely that the microwave generator is in trouble. Observe meter readings on that unit and, if necessary, service in accordance with part 12.

(b) To check whether the trouble is in the 40 mc shifter, observe meter readings on the unit and, if necessary, service in accordance with part 13.

(c) If the above appear normal, the trouble may be in the varistors in the receiver converter, in which case the unit will need to be removed from the bay and serviced in accordance part 3.

(10) Check receiver converter input to IF preamplifier output as in 2.20:

(a) If normal, replace IF main amplifier.

(b) If not normal, replace receiver converter and preamplifier.

Note: At main stations where an IF sweep oscillator is available it will be found more convenient to test units at IF wherever possible.

2.24 Gain-frequency Characteristic Does not Meet Requirements.

(1) Determine whether trouble is in the transmitter:

(a) Check gain-frequency of converter input to IF main amplifier as in 2.13.

(b) If the requirements are met, the trouble is in the transmitter; proceed as in (2).

(c) If the requirements are not met, proceed as in (3).

(2) Determine whether trouble is in transmitter amplifier or modulator:

(a) Check gain-frequency of converter input to transmitter modulator output.

(b) If the requirements are met, replace the transmitter amplifier; check over-all.

(c) If the requirements are not met, replace the transmitter modulator; check over-all.

(3) Determine whether trouble is in IF main amplifier or in converter-IF preamplifier:

(a) Check gain-frequency of converter input to IF preamplifier output.

(b) If requirements are met, trouble is in IF main amplifier; replace and check over-all.

(c) If requirements are not met, trouble is in converter or preamplifier; replace and check over-all.

Note: At main stations, it will be more convenient to make tests using IF sweep oscillator wherever possible.

(Q) Tube Replacement in the Bay

2.25 General: Certain tubes may be replaced in the bay and adjustments made to restore the unit to normal.

Caution: Some tubes may not be replaced without a test bench realignment.

2.26 Microwave Generator:

(1) Any tube may be replaced and the unit may be realigned in accordance with part 12.

2.27 40 mc Shifter:

(1) Any tube may be replaced and the 40 mc generator may be realigned as in part 13.

2.28 IF preamplifier:

(1) Either tube may be replaced.

(2) After replacing a tube, measure converter-IF preamplifier as in 2.14 and 2.20.

(3) Check receiver as in 2.13.

2.29 IF Main Amplifier:

(1) At auxiliary stations, any tube may be replaced.

(2) At main stations V8, THE OUTPUT TUBE, MAY NOT BE REPLACED without realignment of IF amplifier on the test bench according to part 5.

(3) When a tube is replaced, measure converter input to IF main amplifier output as in 2.13 and 2.19.

2.30 Transmitter Modulator:

(1) The transmitter modulator tube may be replaced.

(2) When a tube is replaced measure converter input to modulator output as in 2.12 and 2.18. All adjust-

ments on the modulator may be varied to meet the requirements; however, if the requirements can not be met the modulator should be replaced and the faulty one serviced in the usual manner.

(3) Check over-all bay gain-frequency as in 2.09.

2.31 Transmitter Amplifier

(1) V1 of the transmitter amplifier may be changed, and the over-all bay realigned by making adjustments on the first stage as required.

Caution: V2 and V3 must not be changed, and no controls associated with V2 and V3 may be adjusted except on the test bench.

3. RECEIVER CONVERTER

(A) General

3.01 All converter tests require the associated preamplifier and 400-type tuner.

3.02 A standard 1301-type filter for the desired signal frequency is required as follows:

Receiving Frequency	1301-Type Filters
3730	1301-A
3770	1301-B
3810	1301-C
3850	1301-D
3890	1301-E
3930	1301-F
3970	1301-G
4010	1301-H
4050	1301-J
4090	1301-K
4130	1301-L
4170	1301-M

3.03 All apparatus required for the receiver converter tests is included in the

J68340A Test Bay
J68333A Test Bench

The arrangement of the apparatus is indicated in Fig. 4.

3.04 All receiver converter measurements require a beating oscillator input power of approximately +3 dbm and a signal input of -7 dbm.

3.05 Test Setup and Calibration Procedure:

(1) Place the proper crystal to give the desired beating oscillator frequency in the microwave generator and adjust in accordance with part 12.

The beating oscillator frequencies are as follows:

Signal Frequency	Beating Oscillator Frequency
3730	3800
3770	3840
3810	3880
3850	3920
3890	3820
3930	3860
3970	3900
4010	3940
4050	3980
4090	4020
4130	4060
4170	4100

(2) Connect the test equipment and receiver converter-preamplifier assembly as shown in Fig. 4.

(3) Set the attenuators as follows:

AT1 - 10 db AT4 - maximum
AT2 - 20 db AT5 - 3 db
AT3 - 12 db AT6 - maximum

(4) Connect power from the receiver Control panel to the preamplifier and adjust voltages.

(a) Filament -10.8V ±0.1
(b) Bias +9.0V ±0.2
(c) Plate 135V ±1.5

(5) Adjust AT6 for a beating oscillator input power to the converter such that the average of the two varistor currents is 1.5 ma.

(6) Tune the RF sweep oscillator for measurements at the desired signal frequency and adjust the oscilloscope horizontal gain to give approximately 10 mc per inch on the oscilloscope horizontal trace with a total oscillator sweep of 30 mc ±2 mc.

(7) Stop the signal oscillator from sweeping and adjust the frequency to the center of the band. Adjust AT1 to make the input power to the converter -7 dbm. (With AT2 set at 20 db and AT3 set at 12 db the converter input power will be -7 dbm when the RF power meter reading in dbm plus the directional coupler loss equals 25 db.)

(B) Varistor Balance Measurement

3.06 Procedure:

(1) Set up the test equipment as in Fig. 4 and calibrate in accordance with paragraph 3.05.

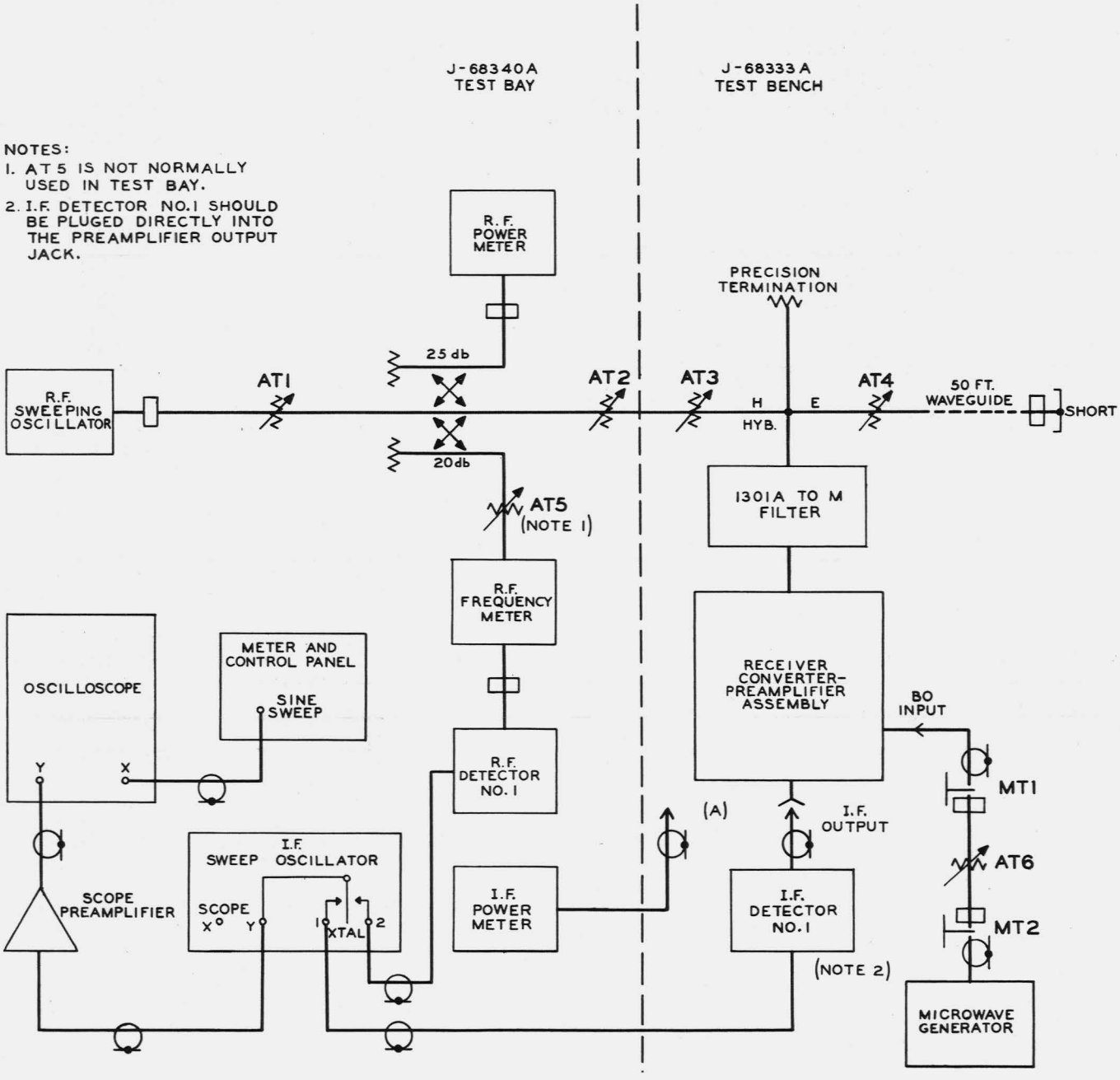

Fig. 4 - General Test Arrangement for Receiver Converter

(2) With the beating oscillator set to give an average crystal current of 1.5 ma observe the two crystal current readings.

Requirement: The difference between the two varistor current readings shall not exceed 0.3 ma.

3.07 If this requirement is not met, one or both of the varistors should be changed to obtain a pair of varistors that will meet the requirement, and the converter assembly should be retuned. (Paragraphs 3.10, 3.13 and 3.14)

(C) Input Impedance Measurements

3.08 Procedure:

(1) With the test apparatus set up as in Fig. 4 and calibrated in accordance with paragraph 3.05, turn on the oscillator sweep and adjust AT5 for coincidence of the test and reference traces at the center frequency.

(2) Increase the setting of AT5 by 1 db and adjust the oscilloscope vertical gain to make the separation of the two traces equal one inch at the center frequency. Reduce the setting of AT5 by 1 db. The two traces should again be in coincidence at the center frequency.

(3) Set AT4 to a value such that the loss of the 50 feet of waveguide plus the setting of AT4 equals 4.5 db.

(4) Note the ripples which appear on the transmission curve. A typical oscilloscope picture is shown in Fig.5.

Requirement: The ripple shall not exceed 0.1 db peak-to-peak from 60 to 80 mc.

(5) If this requirement is not met retune as outlined in paragraph 3.10.

(D) Input Impedance Adjustments

3.09 The input impedance adjustments are made by means of the tuning screws in the 400-type tuner.

3.10 Procedure:

(1) With the apparatus set up as in Fig. 4 and calibrated in accordance with paragraph 3.08, Steps (1) to (3) inclusive, start with the tuning screws all the way out (just entering the waveguide) and adjust the tuning screws for minimum ripples over the center 20 mc of the band. Adjust AT5 as required to keep the separation of the two traces not more than 0.1 db at the center of the band.

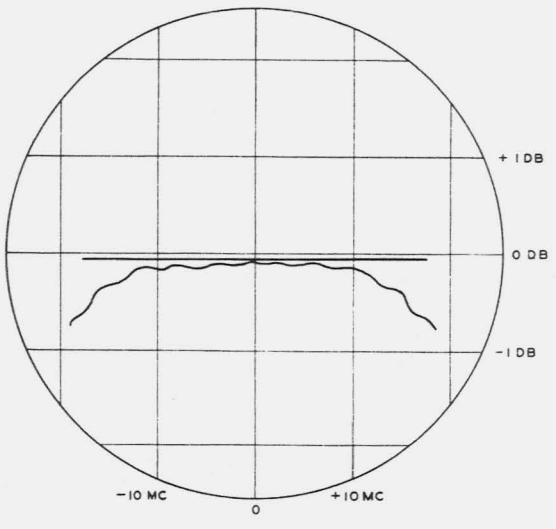

Fig. 5 - Typical Input Impedance Characteristic of the Receiver Converter

(2) Leaving AT5 fixed, keep turning the tuning screws, in a clockwise direction, until another adjustment is found where the ripples are minimum and note whether the level of the test trace has increased or decreased from the previous adjustment. Choose the adjustment which gives the higher level and adjust the screws for minimum ripple.

(3) Check the oscilloscope vertical sensitivity, paragraph 3.08, Steps (1) and (2). (AT4 should be set at maximum.)

(4) Reset AT4 (paragraph 3.08, Step (3)) and observe the ripples. The ripples should not exceed the 0.1 db peak-to-peak requirement.

(E) Gain-frequency Characteristic

3.11 Procedure:

(1) With the apparatus set up as in Fig. 4 and calibrated in accordance with paragraph 3.08, Steps (1) and (2), set AT4 at maximum and observe the difference between the test and reference traces over the center 20 mc portion of the band.

Requirement: The transmission characteristic shall be flat to 0.15 db over the center 20 mc band.

(2) If this requirement is not met, retune as outlined in paragraph 3.13.

(F) Over-all Transmission Adjustments

3.12 Adjustments of the over-all transmission characteristics are made by means of the waveguide spacers between the 400-type tuner and signal input to the converter and tuning adjustments of C31 on the preamplifier.

3.13 Procedure:

(1) With the apparatus set up as in Fig. 4 and calibrated in accordance with paragraph 3.08, Steps (1) and (2), set AT4 to maximum attenuation.

(2) Rotate C31 on the preamplifier in both a clockwise and counterclockwise direction. The 80 mc edge of the band should rock an equal amount above and below the 60 mc edge of the band. As C31 is tuned there should be an adjustment where the band is flat.

(3) If the requirements cannot be met by adjustments of C31 it will be necessary to change the waveguide spacers between the tuner and the converter. The spacing should be changed in 1/16 inch steps.

(4) Each time a spacer is added or taken out repeat Step (2) of this paragraph and Steps (3) and (4) of paragraph 3.08.

(5) If necessary, adjust the tuning screws of the 400-type tuner to keep the ripple within the 0.1 db requirement.

(6) It may be necessary to add or take out several waveguide spacers before the 0.15 db flatness requirement is obtained.

(G) Conversion Gain Measurements

3.14 Procedure:

(1) With the apparatus set up as in Fig. 4 and calibrated in accordance with paragraph 3.05, disconnect the IF detector from the output jack of the preamplifier at A.

(2) Connect the IF power meter in the output jack of the preamplifier.

(3) Turn the oscillator sweep off and adjust the oscillator to the mid-band frequency.

(4) The input power to the converter should be -7 dbm (paragraph 3.05, Step (7)).

(5) Observe the IF power meter reading in dbm. From this reading subtract 7 db, the RF input power. The resultant is the over-all converter-preamplifier gain.

(6) The converter conversion loss is the measured preamplifier gain plus 0.9 db minus the over-all preamplifier gain.

Example

IF output power	-1 dbm
RF input power	-7 dbm
Over-all Conv. - Preamp. Gain	6 db
Measured preamp. gain	11.0 db
plus 0.9 db correction	0.9 db
	11.9 db

Conversion loss = 11.9-6 = 5.9 db

Requirement: The conversion loss shall not be greater than 6.5 db.

(7) If the conversion loss is greater than 6.5 db a new pair of varistors should be selected and the converter retuned (paragraphs 3.06, 3.13, and 3.14).

(H) Trouble Location Tests

3.15 No Varistor Current:

(1) Check coaxial cable fittings for loose contacts.

(2) Check for DC continuity of wiring.

(3) Replace varistors and retune per paragraphs 3.06, 3.10, 3.13, and 3.14.

3.16 Low Varistor Current:

(1) Check output of 40 mc shifter or microwave generator.

(2) Replace varistors and retune in accordance with paragraphs 3.06, 3.10, 3.13, and 3.14.

3.17 Widely Different Varistor Currents:

(1) Replace varistors and retune in accordance with paragraphs 3.06, 3.10, 3.13, and 3.14.

3.18 Low Gain:

(1) Measure preamplifier gain; see part 4.

(2) Replace varistors and retune per paragraphs 3.06, 3.10, 3.13, and 3.14.

3.19 Slope Across the Band:

(1) Check tuning of C31 on the preamplifier, paragraph 3.13, Steps (1) and (2).

(2) Check Transmission characteristics of the preamplifier (see part 4).

3.20 Noisy or Intermittent Output:

(1) Check connections to preamplifier and varistor holders for loose contacts.

(2) Check the preamplifier stability (see part 4).

(3) Replace varistors and retune per paragraphs 3.06, 3.10, 3.13, and 3.14.

4. IF PREAMPLIFIER

(A) General

4.01 The filament activity test prescribed below may be performed either at the transmitter-receiver bay or at the test bench. The gain-frequency test may be performed at the transmitter-receiver bay if a test bay equipped with an IF sweeper is available. Otherwise this test must be

performed at the test bench. The impedance test may be made only at the test bench. The test bench is provided with a receiver control unit so as to simulate bay operation. Power requirements for the receiver control unit are:

Filament Supply	10.9 ±0.1 volts 1.25 amperes (positive grounded)
Plate Supply	134-137 volts 0.1 ampere (negative grounded)

(B) Filament Activity Test

4.02 This test is intended to determine that the tubes in the amplifier are in satisfactory operating condition. It may be made either at the transmitter-receiver bay or at the test bench. At the bay, all of the units comprising the receiver must be connected and must have their filaments turned on. At the test bench, the filament voltage must be adjusted by means of the rheostat and meter provided at the bench.

4.03 Apparatus:

Weston 779 Analyzer
J68333A Test Bench (for bench testing only)

4.04 Procedure:

(1) With power connected to the unit and with the tubes in place, operate the FIL circuit breaker to ON if not already so operated. Insert the ±130V fuse if not already in place.

(2) Operate FIL ACT test switches on the receiver control unit to NORM. After power has been applied, with these switches at NORM, for at least five minutes, proceed with the test.

(3) Turn meter switch on the receiver control unit to TST A position.

(4) Insert the filament activity test cord (provided on the test bay or on the test bench) into jack TP1A on the amplifier. In the bay, this cord is provided permanently attached to the bay terminal strip. At the bench, connect a meter lead to the pin jack designated FIL ACT TST.

(5) Note the meter reading.

(6) Insert the test cord in test point TP2A and note the meter reading.

(7) At the transmitter-receiver bay proceed as follows:

(a) Operate the FIL ACT A test switch on the receiver control unit to TST.

(b) Connect the positive terminal of the analyzer set for 2.5 volts full scale, to the pin jack FIL A. Connect the negative terminal to the pin jack FIL B of the main IF amplifier.

Note: With the voltmeter connected as above, the voltage drop across the resistor introduced by operating the FIL ACT test switch can be measured directly.

(c) With a screwdriver, adjust the potentiometer FIL ADJ TST A on the receiver control unit until the voltmeter reads 0.85 volt ±0.1 volt. Wait at least one minute.

(8) At the test bench, with no main amplifier available, instead of operating the FIL ACT TST A switch, lower the filament voltage as indicated on the test bench meter by 0.85 volt, using the rheostat on the bench.

(9) Note new readings when the test cord is inserted in TP1A and TP2A and compare with readings obtained in (5) and (6) above.

Requirements: (To be determined)

(10) If the requirements are not met, the tube, or tubes, should be replaced and the test repeated.

(11) If the new tube does not meet the requirements, check the amplifier in accordance with the trouble location tests (F).

(12) Restore the FIL ACT A switch to NORM.

(C) Output Impedance Measurement

4.05 If the output impedance does not properly match the 75 ohm line to which it is normally connected, reflections will occur which will distort the pass band and the phase characteristic of the repeater. This test measures the output impedance of the amplifier by measuring the reflection which occurs when the amplifier output is compared to a precise 75 ohm termination.

4.06 Apparatus:

J68340A Test Bay
J68333A Test Bench

4.07 Procedure:

(1) Connect the test circuit as in Fig. 6 and set the power levels as follows:

(a) Set AT11 to 17 db.

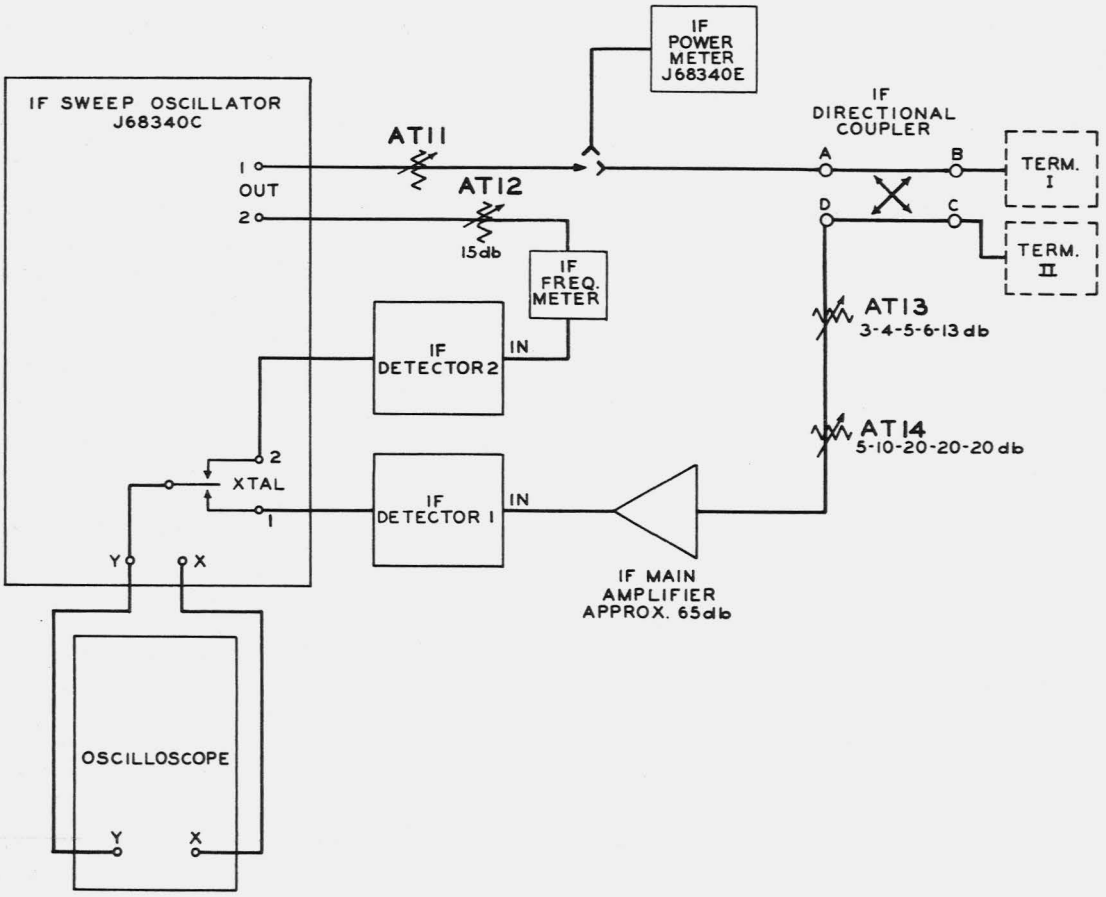

Fig. 6 - Test Arrangement for Measurement of Impedance of IF Amplifiers

(b) Connect from AT11 to power meter.

(c) Readjust AT11 if required to get a reading of +3 ±0.5 dbm on the power meter.

Caution: Maintain at least 10 db in AT11 when connected to the power meter.

(d) Disconnect the power meter and connect from AT11 to the A connection of the coupler.

(e) Connect 486A Jack to the B connection of the coupler in position marked TERM I. Omit TERM II.

(2) Calibrate the test setup as follows:

(a) Adjust attenuators AT13 and AT14 until the test and reference traces match at the center of the oscilloscope. If the slope circuit is turned off, the traces will appear as in Fig. 7A. The vertical gain of the oscilloscope should be set so that 1 db is 1/4 to 1/2 inch.

(b) Turn slope circuit on, and adjust slope of reference trace until it matches test trace as shown in Fig.7B.

Note: It may be necessary to readjust the attenuators and the ADJ XTAL 1 control on the sweep oscillator to match the traces as shown.

(c) Note the total attenuation in AT13 and AT14 at this point. This corresponds to complete reflection at TERM II, since there is no termination at this point.

(3) Check the performance of the directional coupler as follows:

(a) Connect a second 486A Jack to the C plug of the directional coupler in the position designated TERM II. Since the coupler is now completely terminated, the test trace should show practically no reflection.

Requirement: With the total attenuation of AT13 and AT14 40 db less than the value in (2), the test trace shall remain below the reference trace.

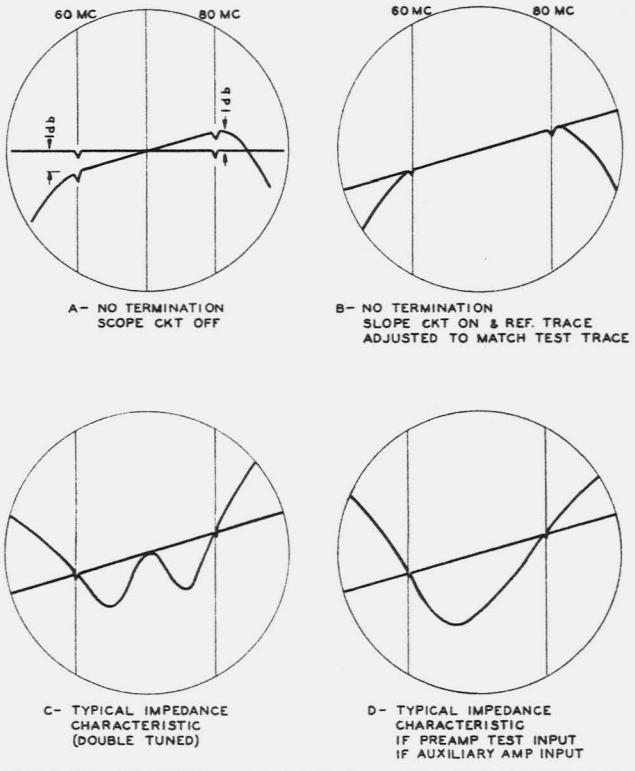

Fig. 7 - Typical Impedance Characteristics of IF Amplifiers

Note: Failure to meet this requirement indicates that either the directional coupler or the 486A Jacks are defective and should be repaired or replaced.

(4) Check the output impedance as follows:

(a) Remove the 486A Jack from the C plug of the coupler (TERM II position), and in its place connect the output jack of the amplifier. This connection must be made directly, without use of a patch cord. The test trace will now show the signal reflected from the amplifier output circuit.

(b) Adjust the attenuation of AT13 and AT14 until the test trace is as close to the reference trace as possible, but still below it from 60 to 80 mc. Fig. 7C shows a typical characteristic.

Requirement: With AT13 and AT14 adjusted as above, the total attenuation shall be at least 25 db less than the value noted in (2). With the correct adjustment, the test trace will be just below the reference trace at 60, 70 and 80 mc.

Note: The reflected signal in this case will then be at least 25 db less than it would be with complete reflection. L10, L11, and C14 may be adjusted as necessary to meet this requirement.

(D) Gain-frequency Characteristic

4.08 Transmission tests cannot be made on the IF preamplifier unless it is disconnected from the receiver converter. Unless components other than tubes have been changed, it will normally be satisfactory to make only the transmission test specified for the combined receiver converter and IF preamplifier described in part 2. Transmission test for the amplifier alone is described below.

4.09 Apparatus:

J68340A Test Bay
J68333A Test Bench

4.10 Procedure:

(1) Set up the apparatus in accordance with Fig. 8 setting attenuators as follows:

AT11	20 db
AT13	0 db
AT14	0 db

(2) Set the power level by connecting from AT14 to the power meter and readjusting AT11 until the power meter reads ±5 ±0.5 dbm.

(3) Set the reference trace as follows:

(a) Disconnect the power meter and connect from AT14 to detector 1.

(b) Adjust AT12 and the ADJ XTAL 1 control on the sweeper until the traces match as nearly as possible.

(c) Reduce the setting of AT12 by 1 db and adjust the vertical gain and centering controls on the oscilloscope until the traces are one inch apart.

(d) Increase the setting of AT12 and observe whether the traces match again. If not, set ADJ XTAL 1 control to match them, and repeat (c) and (d).

Requirement: With ADJ XTAL 1 control set so that the highest point on the test trace (detector 1), between 60 and 80 mc, coincides with the reference trace (detector 2), then no portion of the test trace shall differ from the reference trace by more than 0.05 db between 60 and 80 mc.

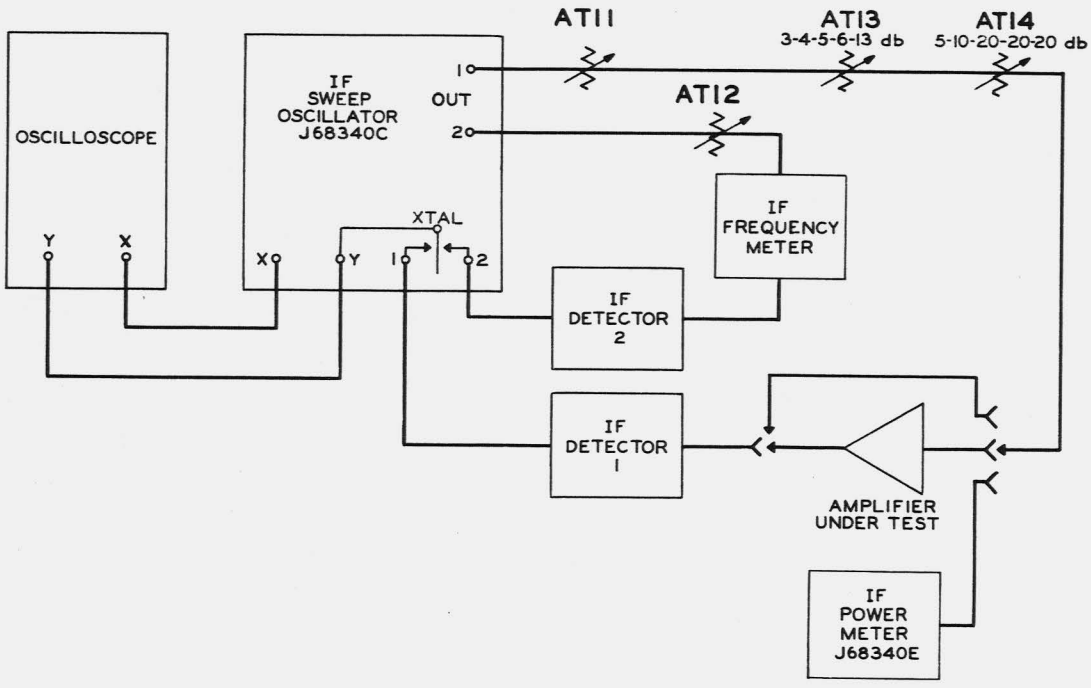

Fig. 8 - Test Arrangements for Measurement of Gain-frequency Characteristics of IF Amplifiers

(4) Check the gain-frequency characteristic as follows:

(a) Remove patch cord from AT14 to detector 1, and connect from AT14 to TST IN jack on the amplifier. Connect from the output jack on the amplifier to detector 1. This detector must be the loose one, and must be connected to the amplifier with the shortest available cable.

(b) Increase the attenuation of AT13 until traces again match. When the traces match, the gain of the amplifier is equal to the setting of this attenuator. The top of the test trace may be made to coincide with the reference trace by use of the ADJ XTAL 1 control. For gain measurements, however, this control should remain as set in (3).

Requirement: When the highest point on the test trace coincides with the reference trace, the test trace shall be within 0.1 db of the reference trace between 60 and 80 mc. In addition the test trace shall remain within 0.1 db of the reference trace, when aligned as above, for a band at least 22 mc wide. The gain shall be at least 8 db. If both tubes are new, the gain shall be at least 10 db.

Note: L7, L8, L9, C12 and C17 may be adjusted as necessary to meet the above requirement.

(c) If the requirement cannot be met, check the above coils for continuity and even spacing of turns, and check C18, C19, and R5 for value of capacitance or resistance. An open or short circuit in any of the 1000 mf by-pass condensers in the amplifier will also result in failure to meet these requirements.

(d) If the band shape requirement is met, but the gain is low, it may be necessary to replace one or both of the tubes.

(E) Continuity Tests

4.11 Continuity tests will normally be made with the panel removed from the bay.

4.12 Apparatus:

Weston 779 Analyzer

4.13 Procedure:

(1) With power off, measure resistance values between points indicated:

Requirements:

From:	To:	Resistance:
PWR plug, term 2	V2, term 9	15 to 17 ohms
PWR plug, term 2	V1, term 9	15 to 17 ohms
PWR plug, term 2	Grd	more than 10 megohms
PWR plug, term 3	V2, term 1	less than 10 ohms
PWR plug, term 3	V1, term 1	less than 10 ohms
PWR plug, term 3	Grd	more than 10 megohms
PWR plug, term 6	V2, terms 4,5,7,& 8	2000 ±200 ohms
PWR plug, term 6	V1, terms 4,5,7,& 8	3000 ±300 ohms
PWR plug, term 6	Grd	more than 10 megohms
PWR plug, terms 1 & 7	Grd	less than 1 ohm
PWR plug, term 9	Converter term 1	less than 10 ohms
PWR plug, term 9	Grd	more than 10 megohms
PWR plug, term 10	Converter term 2	less than 10 ohms
PWR plug, term 10	Grd	more than 10 megohms
TP1A	V1, term 6	less than 5 ohms
TP1A	Grd	325 - 395 ohms
TP2A	V2, term 6	less than 5 ohms
TP2A	Grd	325 - 395 ohms
TST IN jack	Junction of C1,C2 & C30	27-33 ohms

(F) Trouble Location Tests

4.14 The following tests and adjustments need only be made in cases where the amplifier fails to meet the requirements already specified. Before proceeding with these tests, be sure that the amplifier is being provided with the proper voltages:

Requirement	Minimum	Maximum
FIL A to GRD	10.7 volts	11.0 volts
C+ to GRD	8.7 volts	9.3 volts
Term 3 of PWR plug to GRD	131 volts	140 volts

4.15 No output signal:

(1) Check coaxial input and output connections.

(2) See whether tubes are lighted.

(3) Operate meter switch on the receiver control unit to +BIAS and note reading.

Requirement: 9 ±0.25 volts.

(4) Make continuity measurements as in (E).

4.16 Fails to meet transmission requirements when tested with receiver converter:

(1) Disconnect the two leads located inside the preamplifier between the output terminals of the converter and the input terminals of the preamplifier.

(2) Put a 368A Plug in the input jack of the amplifier.

(3) Check the output impedance of the amplifier as in (C).

(4) Set C31 for maximum capacitance.

(5) Check the input impedance of the amplifier using a procedure similar to (C). Put a 368A Plug in the output jack of the amplifier during this test. Adjust L6 as necessary to meet requirements.

Requirement: The total attenuation of AT13 and AT14 shall be at least 25 db less than the value noted in Step (2) of 4(C). A typical characteristic is shown in Fig. 7D. With the best adjustment, the test and reference traces will intersect at 60 and 80 mc.

(6) Check the gain-frequency characteristic of the amplifier as in 4(D).

(7) If more than a slight change in tuning is necessary in (6), repeat (2) to (6), inclusive.

5. IF MAIN AMPLIFIER

(A) General

5.01 The filament activity test prescribed below can be performed either at the transmitter-receiver bay or at the test bench. Gain-frequency test of the over-all amplifier may be performed at the transmitter receiver bay if a test bay equipped with an IF sweeper is available. The impedance tests and the gain-frequency test of the amplifier stages must be made at the test bench. The test bench is provided with a receiver control unit so as to simulate bay

operation. The power requirements for the receiver control unit are:

Filament Supply	10.9 ±0.1 volts 4 amperes (positive grounded)
Plate Supply	134-137 volts 0.325 ampere (negative grounded)

(B) Filament Activity Test

5.02 This test is intended to determine that the tubes in the amplifier are in satisfactory operating condition. The test may be made at the transmitter receiver bay without taking the unit out of service. At the bay, all of the units comprising the receiver must be connected and their filaments turned on. At the bench, the filament voltage must be adjusted using the rheostat and meter on the bench.

5.03 Apparatus:

Weston 779 Analyzer
J68333A Test Bench (bench test only)

5.04 Procedure:

(1) With power connected to the unit and with the tubes in place, operate the FIL circuit breaker to ON if not already so operated. Insert the +130V fuse if not already in place.

(2) Operate FIL ACT switches on the receiver control unit to NORM. After power has been applied, with these switches at NORM, for at least five minutes, proceed with the test.

(3) Turn meter switch on the receiver control unit to MAN GC BIAS position.

(4) If the amplifier is not in service, adjust the MAN CONT potentiometer until the meter reads 5 on 0-10 scale (2.25 volts), and operate CONT key to MAN position.

(5) If amplifier is in service, use the following procedure to switch from automatic to manual control.

(a) Set meter switch in AUTO GC BIAS position and read meter. If meter reading varies widely, fading is occurring and changing to manual control is not recommended.

(b) If AUTO GC BIAS is steady, note reading.

(c) Rotate meter switch to MAN GC BIAS position, and adjust MAN CONT knob until same reading is obtained as on AUTO.

(d) Switch meter between AUTO and MAN to be sure the reading is the same for both positions. Then operate CONT key to MAN position.

(6) Turn meter switch on the receiver control unit to TST A.

(7) Insert the filament activity test cord (provided on the bay or on the test bench) into jack TP1A on the IF main amplifier and note the meter reading. The amplifier shall have been in operation long enough for this reading to be steady.

(8) Repeat for TP7A and TP8A.

(9) Turn the meter switch to the TST B position.

(10) Using the test cord as before, note readings for TP2B to TP6B, inclusive, of the IF main amplifier.

(11) Return meter switch to the TST A position.

(12) At the transmitter receiver bay proceed as follows:

(a) Insert positive lead of analyzer (set to read 0 -2.5 volts) into FIL A jack on IF main amplifier, and negative lead into FIL B jack.

(b) Operate FIL ACT switch A to TST position.

(c) With a screwdriver, adjust FIL ADJ TST A resistor so that analyzer reads 0.85 ±0.1 volt. Then wait at least one minute.

(13) At the test bench, instead of operating the FIL ACT TST A switch, lower the filament voltage as indicated on the test bench meter by 0.85 volts, using the rheostat on the test bench. Wait at least one minute.

(14) Turn meter switch to TST A position and insert the test cord into test jacks TP1A, TP7A and TP8A, and after allowing reading to become steady note new readings.

(15) If the voltage has been reduced by the rheostat at the test bench, proceed as in (16). Otherwise proceed as follows:

(a) Restore FIL ACT A switch to NORM.

(b) Interchange analyzer leads, connecting the positive lead to FIL B and the negative lead to FIL A. Operate FIL ACT B switch to TST.

(c) Adjust the FIL ADJ B resistor so that the analyzer reads 0.85 volt. Wait at least one minute.

(16) Turn meter switch to TST B position and insert test cord in TP2B to TP6B, inclusive, and after allowing the reading to become steady note new values.

Requirement: (to be determined)

(17) Restore FIL ACT B switch to NORM on completion of this test.

(18) If these requirements are not met, the tube corresponding to the particular test point should be replaced with a new tube and the test repeated. If the new tube meets the requirement the old tube should be discarded. If the new tube does not meet the new requirement, check the amplifier in accordance with the trouble location tests (H).

(C) Input and Output Impedance Measurements

5.05 If the input or output impedance does not properly match the 75 ohm line to which it is normally connected, reflections will occur which will distort the pass band and the phase characteristic of the repeater. This test measures the input and output impedance of the amplifier by measuring the reflection which occurs when the amplifier input or output is compared to a precise 75 ohm termination.

5.06 Apparatus:

J68340A Test Bay
J68333A Test Bench

5.07 Procedure:

(1) Connect the test circuit as in Fig. 6 and set power level as follows:

(a) Set AT11 for 17 db.

(b) Connect from AT11 to power meter.

(c) Readjust AT11 if required to get a reading of +3 ±0.5 dbm on power meter.

Caution: Maintain at least 10 db in AT11 when connected to power meter.

(d) Disconnect power meter and connect from AT11 to A connection of coupler.

(e) Connect 486A Jack to B connection of coupler in position marked TERM I. Omit TERM II.

(2) Calibrate the test setup as follows:

(a) Adjust attenuators AT13 and AT14 until the test and reference traces match at the center of the oscilloscope. If the slope circuit is turned off, the traces will appear as in Fig. 7A. The vertical gain of the oscilloscope should be set so that 1 db is 1/4 to 1/2 inch.

(b) Turn slope circuit on, and adjust slope of reference trace until it matches test trace as shown in Fig. 7B.

Note: It may be necessary to readjust the attenuators and the ADJ XTAL 1 control on the sweep oscillator to match the traces as shown.

(c) Note the total attenuation in AT13 and AT14 at this point. This corresponds to complete reflection at the C plug of the coupler, since there is no termination at this point.

(3) Check the performance of the directional coupler as follows:

(a) Connect a second 486A Jack to the C plug of the directional coupler in the position marked TERM II. Since the coupler is now completely terminated, the test trace should show practically no reflection.

Requirement: With the total attenuation of AT13 and AT14 40 db less than the value in (2c) above, the test trace shall remain below the reference trace.

Note: Failure to meet this requirement indicates that either the directional coupler or the 486A Jacks are defective and should be repaired or replaced.

(4) Check the input impedance as follows:

(a) Remove the 486A Jack from the C plug of the coupler, and in its place connect the input jack of the amplifier.

Note: This connection must be made directly, without use of a patch cord.

(b) On the receiver control unit, operate the CONT key to MAN, and the CONT MAN potentiometer to the extreme clockwise end of its rotation.

(c) Operate the meter switch to MAN and note meter reading.

Requirement: Should read at least 3 volts.

(d) The test trace will now show the signal reflected from the amplifier input circuit.

(e) Adjust the attenuation of AT13 and AT14 as required until the test trace is as close to the reference trace as possible, but still below it from 60 to 80 mc.

Requirement: Fig. 7C shows a typical characteristic. The total attenuation of AT13 and AT14 shall be at least 25 db less than the value noted in (2). With the correct adjustment, the test trace will be just below the reference trace at 60, 70 and 80 mc.

Note: The reflected signal in this case will then be at least 25 db less than it would be with complete reflection.

(f) Adjust L1, L2, C6, and C8 as necessary to meet this requirement.

(5) Check the output impedance as follows:

(a) Disconnect the input jack of the amplifier from the C plug of the coupler, and replace the 486A Jack TERM II.

(b) Remove the other 486A Jack TERM I, and connect the B plug of the directional coupler directly to the OUT jack of the amplifier.

(c) Repeat (4e) to check the output impedance.

(d) Adjust L62, L63, and C70 as necessary to meet this requirement.

(D) Gain-frequency Characteristic of Over-all Amplifier

5.08 This test is intended to check the gain and over-all gain-frequency characteristic of the amplifier. The interstage transformers between tubes V1 to V7, inclusive, have been factory aligned and should not require adjustment. The interstage between V7 and V8 has been designed with sufficient adjusting range for normal adjustment to meet the requirements of this test as outlined below.

5.09 Apparatus:

J68340A Test Bay
J68333A Test Bench

5.10 Procedure:

(1) Set up apparatus per Fig. 8, setting attenuators as follows:

AT11	-	20 db
AT13	-	0 db
AT14	-	0 db

(2) Set power level as follows: Connect from AT14 to power meter and readjust AT11 until power meter reads +5 ±0.5 dbm.

(3) Set reference trace as follows:

(a) Disconnect power meter and connect from AT14 to detector 1.

(b) Adjust AT12 and ADJ XTAL 1 control on sweeper until traces match as nearly as possible.

(c) Reduce setting of AT12 by 1 db and adjust vertical gain and centering controls on scope until traces are 1 inch apart.

(d) Increase setting of AT12 and observe whether traces match again. If not, set ADJ XTAL 1 control to match them, and repeat (c) and (d).

Requirement: With ADJ XTAL 1 control set so that the highest point on the test trace (detector 1) between 60 and 80 mc, coincides with the reference trace (detector 2), then no portion of the test trace shall differ from the reference trace by more than 0.05 db between 60 and 80 mc.

(4) Check gain-frequency characteristic as follows:

(a) Remove patch cord from AT14 to detector 1, and connect AT14 to INPUT jack on the amplifier.

(b) Connect the output jack of the amplifier to detector 1. This detector must be the loose one, and must be connected to the amplifier with the shortest available cable.

(c) Insert 4 and 6 db sections of AT13 and 10 and 20 db sections of AT14 (total 40 db).

(d) Adjust MAN CONT potentiometer until the traces match.

Requirement: When the highest point of the test trace just touches the reference trace, no part of the test trace should be below the reference trace by more than 0.1 db from 60 to 80 mc.

(e) Check the intersections of the test trace and the reference trace at the 0.1 db down points by readjusting the MAN CONT potentiometer so that the highest point on the test trace is 0.1 db above the reference trace.

Requirement: The lower 0.1 db down point shall be at or below 59 mc. The upper 0.1 db down point shall be at or above 81 mc.

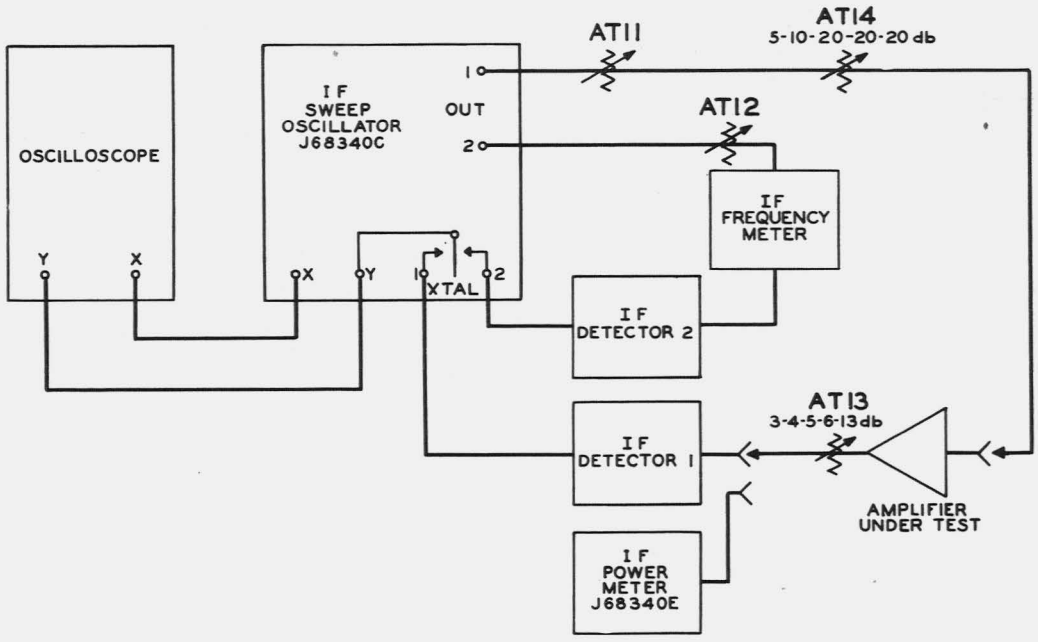

Fig. 9 - Test Arrangement for Checking the Rectified Output of the IF Main Amplifier

(f) Check the intersection of the test trace with the reference trace at the 3 db down points by readjusting the MAN CONT potentiometer until the traces match as in (3) and removing the 6 db section of AT13 and inserting a 3 db section.

Requirement: The lower 3 db down point shall be at or below 54 mc. The upper 3 db down point shall be at or above 86 mc.

(g) Check the characteristic at 25 db gain by removing all attenuation sections of AT13 and AT14 except 5 db in AT13 and 20 db in AT14. Readjust MAN CONT potentiometer until the highest point of the test trace matches the reference trace.

Requirement: Test trace shall not be below reference trace by more than 0.3 db from 60 to 80 mc.

(h) Check the characteristic at maximum gain, by inserting an additional 20 db and a 10 db section (total 50) in AT14. Reduce MAN bias to 0 by rotating MAN CONT potentiometer counterclockwise as far as it will go. Adjust AT13 until highest point on test trace is at, or within 1 db above, the reference trace. The sum of the readings of AT13 and AT14 will then give the maximum gain of the amplifier.

Requirement: The maximum gain of the amplifier shall be at least 58 db. If the amplifier is equipped with all new tubes, the maximum gain should be at least 65 db.

(i) Check the characteristic at 58 db gain. With 50 db in AT14, insert the 3 and 5 db sections only in AT13. Adjust MAN CONT potentiometer until highest point of the test trace just meets the reference trace.

Requirement: Test trace shall not be below reference trace by more than 0.75 db from 60 to 80 mc.

(5) Check the rectified output as follows:

(a) Rearrange setup per Fig. 9, placing AT13 in the output instead of the input, adjusting AT14 for 35 db, and AT12 for 20 db.

(b) Insert 3 and 4 db sections only of attenuator AT13.

(c) Operate CONT key on control unit to AUTO.

(d) Set AUTO CONT potentiometer so that traces match approximately at 70 mc.

(e) Stop sweep motor and set oscillator for 70 mc.

(f) Disconnect AT13 from its crystal detector, and connect to IF power meter.

(g) Readjust AUTO CONT potentiometer if necessary to make power meter read 0 dbm. Output of the amplifier under this condition will then be +7 dbm.

(h) Set meter switch on the receiver control unit to RCVR OUTPUT position, and read meter.

Requirement: With amplifier delivering an output of +7 dbm, RCVR OUTPUT reading shall be at least 0.6 volt.

(E) Gain-frequency Characteristics of Amplifier Stages

5.11 The results of these measurements are only approximate and are intended as a guide in locating a stage which is in trouble. The measurements will need to be made on a test bench.

5.12 Apparatus:

J68340A Test Bay
J68333A Test Bench

5.13 Procedure:

(1) Set up the apparatus as in Fig. 8.

(a) Connect the OUT jack of the amplifier to detector 1.

(b) Remove connections from both ends of attenuator AT14.

(c) Turn amplifier on its side so that access may be had to both the tube side and the wiring side.

(d) Remove cover. Operate FIL circuit breaker on the receiver control unit to ON. Insert +130V fuse.

(e) Operate CONT key on receiver control unit to MAN position.

(f) Set MAN CONT potentiometer in approximately the center of its range.

(g) Plug the IF signal inserter into attenuator AT13.

(2) Check the gain-frequency characteristic from the grid of V7 to the output as follows:

(a) Connect the probe end of the signal inserter to terminal 1 of V7, and the ground clip to the shield across the socket of V7.

(b) Adjust AT13 until the highest point on the reference trace is at, or within one db above, the reference trace.

Requirement: Under the conditions described above, the setting of AT13 shall be at least 5 db.

(c) Adjust ADJ XTAL 1 control on the IF sweeper until the test trace matches the reference trace at 80 mc. Observe how far, in db, the test trace is below the reference trace at 60 mc.

Requirement: Under the conditions described above, the test trace shall be approximately 1/2 to 3/4 db down from the reference trace at 60 mc.

(d) Observe the 1 db down points by reducing the setting of AT13 by one db and noting the frequencies at which the test and reference traces intersect.

Requirement: The 1 db down points shall be separated by at least 30 mc.

(3) If the above requirement is not met, it will be necessary to retune the interstage between V7 and V8 to give flat transmission, so that it may be carefully checked. To accomplish this, adjust L53, L54, L55, L56, and C59.

Requirement: With the interstage between V7 and V8 adjusted as above, and with the highest point on the test trace adjusted to match the reference trace, the test trace should be within 0.1 db of the reference trace from 59 to 81 mc.

(4) If this requirement cannot be met,

(a) Check the above coils for continuity and even spacing of turns.

(b) Check the associated condensers for shorts, grounds, or loose connections.

(c) Disconnect R45 and check that its resistance is between 510 and 610 ohms.

(d) Replace components as required, and recheck and adjust output impedance.

(5) Having established satisfactory transmission from the grid of V7 to the output, use the signal inserter to look at transmission from each grid, in turn, to the output, beginning with V6 and proceeding to V2, as follows:

(a) Connect an input signal to terminal 1 of V7, using the signal inserter.

(b) Adjust AT1 and ADJ XTAL 1 control until the highest point on the test trace matches the reference trace.

(c) Move the signal inserter to terminal 1 of V6. Adjust MAN CONT potentiometer on receiver control unit until the test trace again matches the reference trace as above.

(d) Observe the characteristic.

(e) Move the signal inserter to terminal 1 of V5 and note how much the gain has changed.

(f) Readjust MAN CONT potentiometer until traces match and observe the characteristic. Continue this procedure for each tube in turn except V1.

Requirement: Typical scope pictures for the above conditions are given in Fig. 10.

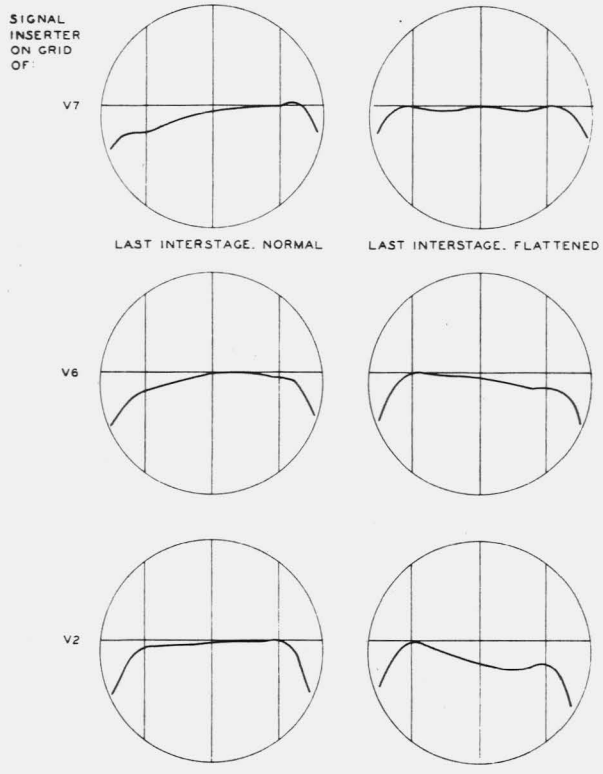

Fig. 10 - Typical Gain-frequency Characteristics of Portions of the IF Main Amplifier

Notes: With a V7-V8 interstage having normal slope as in (2), the slope shall decrease and the trace become straighter each time the signal inserter is moved back another stage. When looking into the grid of V2, the characteristic will not ordinarily deviate from the test trace by more than 0.2 db.

With a V7-V8 interstage adjusted to be flat as in (3) the trace will fall off at the high frequency end as more tubes are included, and eventually will show a curvature which is concave upward. When looking into the grid of V2, the response at 80 mc will typically be down 1/2 to 3/4 db.

Under either of the above conditions, moving the signal inserter from V6 to V5, V5 to V4, V4 to V3, or V3 to V2 should not usually change the gain by more than 3 db, before readjustment of the MAN CONT potentiometer.

(F) To Retune an Interstage

5.14 This procedure is applicable to all interstages between V1 and V7. It must be applied to each interstage separately, and involves the two tubes on either side of the interstage, the resistors connected to the plate of the tube ahead of the interstage and to the grid of the tube following the interstage, and the three coils comprising the interstage network. For the interstage between V1 and V2 these components would be R3, R5, L5, L6, and L7. The coil connected to the grid is factory adjusted and needs no further attention unless damaged, in which case it should be replaced by a new coil.

Caution: Interstages between V1 to V7, inclusive, have been factory aligned with nominal capacitance tubes. Realignment of these interstages should not be attempted except as a last resort. Be sure that the apparatus needed for this adjustment is available before disturbing factory adjustment.

5.15 Apparatus:

Meas. Corp. Model 59 Megacycle Meter
Star Expansion Products Co. Type JE-9 Wiring Plug

5.16 Procedure:

(1) Remove all power connections from the amplifier.

(2) Disconnect the grid and plate resistors.

(3) Remove the tube whose grid is connected to the interstage being tuned, and insert the JE-9 wiring plug in its place.

Note: This will short-circuit the grid side of the interstage.

(4) Using the megacycle meter, check the resonant frequency of the coil which is directly connected to the plate of the preceding tube, as follows:

(a) Insert the coil for the appropriate frequency in the megacycle meter.

(b) Set the switch on top of the megacycle meter at the CW position, and the sensitivity control so that the grid current meter reads approximately mid-scale.

(c) Position the megacycle meter so that its coil is in line with the coil being checked, and approximately 1/2 inch away.

(d) Rotate the frequency dial on the megacycle meter until the grid current meter dips sharply.

(e) Determine the exact frequency of the dip by adjusting the frequency dial for minimum reading of the meter. (Increase sensitivity as required to determine this minimum accurately.)

(f) Read frequency on dial.

(g) Adjust coil and check until coil is resonant at frequency indicated in table below.

(5) Replace tube whose grid is connected to the interstage, and remove the tube whose plate is connected to the interstage, substituting for it a JE-9 wiring plug.

Note: This will short-circuit the plate side of the interstage.

(6) Adjust resonant frequency of the other adjustable coil in the interstage to the resonant frequency indicated below.

(7) Repeat until both coils resonate at their correct frequencies without further adjustment.

Requirements:

Coil to be Adjusted	Tube in Socket	Wiring Plug in Socket of	Resonant Frequency
L5	V1	V2	80
L6	V2	V1	85
L13	V2	V3	79 mc
L14	V3	V2	86
L21	V3	V4	79
L22	V4	V3	86
L29	V4	V5	79
L30	V5	V4	86
L37	V5	V6	79
L38	V6	V5	86
L45	V6	V7	80
L46	V7	V6	93

(8) After completion of the above adjustments, replace the resistors removed in (2).

(9) Recheck amplifier for transmission in accordance with (D).

(G) Continuity

5.17 Continuity tests will normally be made with the panel removed from the bay.

5.18 Apparatus:

Weston 779 Analyzer

5.19 Procedure:

(1) With the power off, measure resistance values between points indicated:

Requirements:

From:	To:	Resistance:
PWR plug, term 1	Chassis	less than 1 ohm
PWR plug, term 2	V2-V6, term 9	15-17 ohms
PWR plug, term 4	V8, term 6	7.5 - 8.5 ohms
PWR plug, term 3	V1, term 1 V2-V7, term 6 V8, term 2	less than 15 ohms
PWR plug, term 4	V1, term 3 V7, term 9	15 - 17 ohms
PWR plug, term 6	V1, terms 4, 5, 7 & 8	less than 10 ohms
PWR plug, term 6	V7, term 1	360-420 ohms
PWR plug, term 6	V8, term 8	less than 10 ohms
PWR plug, term 7	Chassis	less than 1 ohm

From:	To:	Resistance:
PWR plug, term 8	V2-V6, term 1	310-350 ohms
PWR plug, terms 2, 3,4,5,6 & 9	Chassis	greater than 10 megohms
OUT jack (center)	MON jack (center)	700-800 ohms
MON jack (center)	Chassis	74-90 ohms
TP1A	Chassis	325-395 ohms
TP1A	V1, term 6	less than 5 ohms
TP2A to TP6A,incl.	Chassis	33-40 ohms
TP2A to TP6A,incl.	V1-V6, term 4	14-20 ohms
TP7A	Chassis	390-475 ohms
TP7A	V7, term 4	less than 5 ohms
TP8A	Chassis	135-165 ohms
TP8A	V8, term 8	less than 5 ohms
INPUT jack (center)	Chassis	more than 10 megohms
V1, term 1	V2, term 1	more than 10 megohms
V2, term 6	V3, term 1	more than 10 megohms
V3, term 6	V4, term 1	more than 10 megohms
V4, term 6	V5, term 1	more than 10 megohms
V5, term 6	V6, term 1	more than 10 megohms
V6, term 6	V7, term 1	more than 10 megohms
V7, term 6	V8, term 8	more than 10 megohms

(H) Trouble Location Tests

5.20 No Output Signal

(1) See whether tubes are lighted.

(2) Operate meter switch on the receiver control unit to +BIAS and note reading.

Requirement: 9 ±0.25 volts.

(3) Operate the CONT key on the receiver control panel to MAN, turn the MAN bias control counterclockwise as far as it will go (0 bias), and with a voltmeter check the cathode bias voltages on the amplifier.

Requirement:

Tube	Test Points	Approximate Voltage
V1	TP1A to C+	0.2 to 1.2
V2	TP2A to GRD	0.4 to 1.4
V3	TP3A to GRD	0.4 to 1.4
V4	TP4A to GRD	0.4 to 1.4
V5	TP5A to GRD	0.4 to 1.4
V6	TP6A to GRD	0.4 to 1.4
V7	TP7A to C+	0.15 to 1.5
V8	TP8A to C+	0.5 to 2.0

(4) Remove the amplifier from the bay and without power connection and with tubes removed, check for continuity in accordance with (G).

5.21 Fails to meet impedance requirements:

(1) Be sure that filament and plate voltages are normal.

(2) For input impedance try replacing V1, as low transconductance in this tube will materially affect the input impedance.

(3) Check L1 and L2 for continuity and even spacing of turns.

(4) Check C6, C12, C8, and C16 for loose connections or shorts.

(5) Make continuity tests as in (G) particularly for those points involving the input or output tube concerned.

(6) For output impedance test, try replacing V8.

(7) Check L62 and L63 for continuity and even spacing of turns.

(8) Check C70 and C71 for loose connections, shorts or grounds.

(9) Disconnect R52 and check resistance.

5.22 Fails to meet transmission requirements:

(1) Make continuity tests as in (G).

(2) Check transmission stage by stage as in (F).

5.23 Transmission of a particular interstage found to be unsatisfactory:

(1) Before attempting to work on a particular interstage, check the tubes involved on a tube checker.

(2) Check all by-pass condensers for loose connections, opens or shorts.

Note: An open by-pass condenser can be checked by paralleling it with a good condenser and observing whether transmission is improved. Lead lengths on such a paralleling condenser should be kept extremely short.

(3) Grid and plate resistors should be disconnected and checked for resistance.

(4) If any component other than a tube is replaced, or if transmission is still unsatisfactory after the above checks, the interstage should be retuned as in (F).

Caution: Interstages between tubes V1 to V7, inclusive, have been factory aligned with nominal capacitance tubes. Realignment of these interstages should not be attempted except as a last resort. Be sure that the apparatus needed for this adjustment is available before disturbing factory adjustment.

5.24 Gain of amplifier is high and cannot be reduced by MAN CONT potentiometer:

(1) Check resistance of CR2, using Weston 779 Analyzer.

Requirement: With the positive lead of the analyzer on terminal 2 of the varistor, the resistance shall be less than 1,000 ohms. With the positive lead of the analyzer on terminal 1 of the varistor, the resistance shall be more than 0.2 megohm.

Note: The positive lead of the analyzer is the one designated +, and actually applies a negative potential to the varistor.

6. RECEIVER CONTROL UNIT

(A) General

6.01 Tests on the receiver control unit are intended to check that it provides the correct power and bias voltages to the IF amplifiers, and that it regulates the output power of the IF main amplifier. To make the regulation tests, an IF main amplifier which meets the requirements of part 5 must be used with the control unit. Power must be supplied to the control unit as follows:

Filament battery : 10.9 ±0.1 volts, positive grounded, 4 amperes

Plate battery: 134-137 volts, negative grounded, 0.325 ampere

(B) DC Tests and Adjustments

6.02 These tests check the voltages supplied to the IF amplifiers. The unit must have the IF preamplifier and IF main amplifier connected in the normal manner for these tests.

6.03 Apparatus:

Analyzer, Weston 779, or equivalent

6.04 Procedure:

(1) Connect power to the receiver control unit; connect power and control cable from receiver control unit to IF main amplifier; install 70A fuse, 1-1/3 amp., in position designated +130; operate FIL circuit breaker to ON position.

(2) Check 130V supply: Operate meter switch to 130V position, and read meter (full scale = 250V).

Requirement: Min. 131 volts, max. 140 volts.

(3) Check +BIAS: Operate meter switch to +BIAS position and read meter (full scale = 10V).

Requirement: 9 ±0.2 volts.

Note: Potentiometer +BIAS may be adjusted to meet this requirement.

(4) Check MAN GC BIAS: Operate meter switch to MAN position. Rotate MAN CONT potentiometer to extreme clockwise end. Read meter (full scale = 5V).

Requirement: Min. 3 volts.

(5) Check V2 CATH voltage: Operate meter switch to AUTO position. Adjust AUTO CONT potentiometer so that meter reads 0 volts. Then operate meter switch to V2 CATH position. Read meter (full scale = 100V).

Requirement: Min. 55 volts, max. 70 volts.

(6) Check V1 PLT voltage: Operate meter switch to V1 PLT position and read meter (full scale = 100V).

Requirement: Meter shall read less than in (5), above, by not more than 3 volts.

(7) Check FIL ADJ TST A adjustment: Set analyzer to read 0-2.5 volts. Insert positive lead in FIL A test jack and negative lead in FIL B test jack on the IF main amplifier. Operate FIL ACT A switch to TST position (with FIL ACT B switch in NORM position), and read voltage indicated on the analyzer.

Requirement: 0.85 ±0.1 volt.

Note: FIL ADJ TST A resistor may be adjusted to meet this requirement.

(8) Check FIL ADJ TST B adjustment: Restore FIL ACT A switch to NORM, and interchange analyzer leads. Operate FIL ACT B switch to TST position and read voltage indicated on analyzer.

Requirement: 0.85 ±0.1 volt.

Note: FIL ADJ TST B resistor may be adjusted to meet this requirement.

(C) IF Output Regulation Tests

6.05 These tests are intended to determine that the IF output, as regulated by the control unit, can be adjusted over the required range, and will hold at the adjusted level within the required limits as the IF input is varied. An IF main amplifier which meets the requirements of part 5 must be connected for these tests.

6.06 Apparatus:

J68340A Test Bay
J68340E Power Meter

6.07 Procedure:

(1) Connect test equipment to receiver control unit under test as shown in Fig. 11. Turn sweep off, and set sweep oscillator at 70 mc, using index mark on sweep motor shaft. Set attenuator AT13 for 13 db attenuation before connecting power meter. Set controls on control unit as follows:

Control	Position
CONT key	AUTO
AUTO CONT potentiometer	Extreme counter-clockwise
FIL ACT A switch	NORM
FIL ACT B switch	NORM

Set AT14 at 35 db.

(2) Check maximum output: Rotate AUTO CONT potentiometer slowly clockwise, observing reading of power meter.

Requirement: Power meter reading shall read 0 dbm minimum before end of adjusting range is reached.

(3) Check minimum output: Return AUTO CONT potentiometer to extreme counterclockwise position. Disconnect power meter, reset AT13 at 4 db, and reconnect power meter.

Requirement: Power meter shall read 0 dbm maximum.

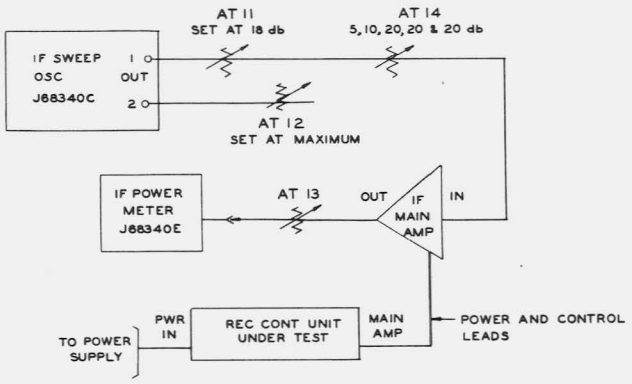

Fig. 11 - Arrangement for Testing the Regulation of the IF Output by the Receiver Control Unit

(4) Check regulation: Set AUTO CONT potentiometer so that power meter reads 0 dbm. Increase attenuation of AT14 by 20 db (total 55 db). Read power meter.

Requirement: Power meter reading shall not decrease more than 1 db.

(D) Check of -12V Bias Filter

6.08 This test is intended to check the filter circuit which reduces the ripple on the -12 volt bias lead.

6.09 Apparatus:

Dumont Type 2551 Oscilloscope, part of J68340A Test Bay
3 Test Leads (such as Meter Leads)
Weston 779 Analyzer

6.10 Procedure:

(1) Turn on the oscilloscope and set the controls as follows:

Coarse Frequency - 2K
Fine Frequency - Max
X-Axis Amp Gain - for convenient pattern width
Y-Axis Amp Switch - "input under 250V RMS"

(2) Connect a test lead from one of the ground terminals of the oscilloscope to the chassis of the receiver control unit.

(3) Set CONT key at AUTO.

(4) Connect a second test lead from the TEST SIGNAL terminal on the oscilloscope to terminal 1 of VS3.

(5) Connect a third test lead from the Y-AXIS SIGNAL INPUT terminal of the oscilloscope to terminal 1 of VS3. Set vertical gain so scope pattern is 2 inches high.

(6) Move third lead from VS3 to ungrounded side of C9. Observe height of pattern.

Requirement: The pattern height shall be less than 0.4 inch.

(7) Disconnect test leads. Measure the DC resistance of L3, using the Weston analyzer.

Requirement: The resistance of L3 shall be 45 ±10 ohms.

(E) Test of Output Filter

6.11 This test is intended to check the filter in the AVC lead which controls the speed of response of the AVC circuit.

6.12 Apparatus:

Dumont Type 2551 Oscilloscope, part of J68340A Test Bay
3 Test Leads (such as Meter Leads)
Weston 779 Analyzer

6.13 Procedure:

(1) Turn on the oscilloscope and set controls as in 6.10 (1).

(2) Connect a test lead from one of the ground terminals of the oscilloscope to the chassis of the receiver control unit.

(3) Set CONT key at AUTO.

(4) Remove V2 and V3 from their sockets.

(5) Connect a second test lead from the TEST SIGNAL terminal to the insulated terminal supporting one end of R10.

(6) Connect the third test lead from the Y-AXIS SIGNAL INPUT to the same insulated terminal. Set vertical gain for 2-inch height of pattern on oscilloscope.

(7) Move third lead to other end of R10 and observe pattern height.

Requirement: The pattern height shall be less than 0.2 inch.

(F) V1 and V2 Tube Test

6.14 No provision is made for checking V1 and V2 in a working circuit. However, they may be removed for checking in a tube tester by first switching the gain control of the IF amplifier to manual, as follows:

6.15 Procedure:

(1) Switch the gain control of the IF amplifier in the working circuit to manual by method outlined below:

(a) Set meter switch in AUTO GC BIAS position and read meter. If meter reading varies widely, fading is occurring and changing to manual control is not recommended.

(b) If AUTO GC BIAS is fairly steady, note reading.

(c) Rotate meter switch to MAN GC BIAS position, and adjust MAN CONT knob until same reading is obtained as on AUTO.

(d) Switch meter between AUTO and MAN to be sure the reading is the same for both positions. Then operate CONT key to MAN position.

(2) Remove V1 and V2 as required and test in a tube tester in accordance with standard methods.

Caution: Do not remove V4 from circuit when 130V power is on. Removing V4 will greatly increase the +BIAS and cause excessive current in the IF amplifier tubes.

(G) V3 Tube Test

6.16 The procedure for testing a V3 vacuum tube in a working circuit is as follows:

(1) Operate meter switch in AUTO GC BIAS position and note meter reading. (Full scale in this position is 5 volts.)

(2) Operate meter switch to V2 CATH position and note meter reading. (Full scale in this position is 100 volts.)

(3) Add the two voltages noted in (1) and (2).

Requirement: The sum of the AUTO GC BIAS and V2 CATH voltages shall be 55 volts minimum, 70 volts maximum.

6.17 The procedure for checking V3 at the test bench is to check the V2 CATH voltage as in paragraph 6.04(5). Failure to meet the requirement of this paragraph indicates a defective V3.

(H) V4 Tube Test

6.18 Apparatus:

Weston 779 Analyzer or equivalent

6.19 Procedure:

(1) Apply +130 volt power to the unit, if it is not already working.

(2) Measure the voltage from terminal 4 of VS4 to ground.

Requirement: Voltage from terminal 4 of V4 to ground shall be minimum 55 volts, maximum 70 volts.

(I) Continuity Tests

6.20 The following tests are given as an assistance in locating defective wiring or components.

6.21 Apparatus:

Weston 779 Analyzer or equivalent

6.22 Procedure:

(1) Disconnect all external connections and remove all tubes.

(2) Set meter switch at CR1 position.

(3) Operate FIL circuit breaker to ON position, and insert +130 volt fuse.

(4) Operate FIL ACT switches to NORM position.

(5) Using the analyzer, check resistance between the following points:

Measure Resistance

From:	To:	Requirement:
V1-terms 1 & 5	Grd.	less than 1 ohm
terms 2 & 8	Grd.	300-360 ohms
term 3	MAIN AMP jack term 5	less than 1 ohm
term 3	Grd.	more than 30,000 ohms
term 4	PWR IN plug term 3	74,000-90,000 ohms
term 6	PWR IN plug term 3	less than 10 ohms
term 7	Grd.	300-360 ohms
term 9	PWR IN plug term 2	15-17 ohms
V2-terms 1,5,& 8	Grd.	less than 1 ohm
term 2	V3-term 4	less than 1 ohm
term 2	Grd.	more than 10 megohms
term 3	Grd.	more than .17 megohm
term 3	V1-term 4	.05-.15 megohm
term 4	PWR IN plug term 3	less than 10 ohms
terms 6&7	V3-term 1	less than 1 ohm
From:	To:	Requirement:
(with CONT key in AUTO position:)		
V3-term 1	MAIN AMP jack term 8	9,000-11,000 ohms
V3-term 1	PWR IN plug term 9	2000-2500 ohms
(with CONT key in MAN position:)		
MAN CONT pot., term 3	MAIN AMP jack term 8	9,000-11,000 ohms
V4-term 1	Grd.	less than 1 ohm
V4-term 4	PWR plug term 3	6000-7500 ohms
V4-term 4	Grd.	20,000-26,000 ohms
+BIAS pot. term 3	MAIN AMP jack term 6	less than 10 ohms
	PRE AMP jack term 6	less than 10 ohms
PWR IN plug:		
term 1	Grd. (Panel)	less than 1 ohm
term 2	PWR IN plug term 10	less than 10 ohms
	FIL ckt.breaker term 4	270-330 ohms
term 3	MAIN AMP jack term 3	less than 10 ohms
	PRE AMP jack term 3	less than 10 ohms
term 5	FIL ckt. breaker term 3	less than 10 ohms
	PWR IN plug term 2	more than 1 megohm
term 6	+130V fuse block- term A	2600-3800 ohms
	PWR IN plug term 3	more than 1 megohm
PWR IN plug term 2	MAIN AMP jack terms 2 & 4	less than 1 ohm
	PRE AMP jack term 2	less than 1 ohm
MAIN AMP jack		
term 7	Grd.	more than 1 megohm
term 9	AUTO CONT pot term 3	less than 10 ohms
term 10	Grd.	more than 1 megohm

(6) The metering circuit may be checked for continuity as follows: (It should be noted that the analyzer is not accurate enough to check the metering resistors themselves, but only to indicate continuity of circuit.)

Measure Resistance

Meter Switch Position	From	To	Requirement
CR1	Meter +	PRE AMP jack term 9	less than 1 ohm
	Meter -	PRE AMP jack term 7	less than 1 ohm

Meter Switch Position	From	To	Requirement
CR2	Meter +	PRE AMP jack term 7	less than 1 ohm
	Meter -	PRE AMP jack term 10	less than 1 ohm
MAN	Meter +	Grd.	less than 10 ohms
	Meter -	MAN CONT pot term 3	85000-95000 ohms
AUTO	Meter +	Grd.	less than 10 ohms
	Meter -	VS3 term 1	85000-95000 ohms
+BIAS	Meter +	MAIN AMP jack term 6	.18-.21 meg-ohms
	Meter -	Grd.	less than 10 ohms
RCVR	Meter +	VS1 term 3	31,000-34,000 ohms
OUTPUT	Meter -	AUTO CONT pot term 3	less than 10 ohms
+130V	Meter +	PWR IN plug term 3	4.7-5.3 meg-ohms
	Meter -	Grd.	less than 10 ohms
TST A	Meter +	MAIN AMP jack term 10	46,000-51,000 ohms
	Meter -	MAIN AMP jack term 6	less than 10 ohms
TST B	Meter +	MAIN AMP jack term 10	3300-3700 ohms
		MAIN AMP jack term 7	less than 10 ohms
V1 PLT	Meter +	VS1 term 4	less than 10 ohms
	Meter -	Grd.	1.9-2.1 meg-ohms
V2 CATH	Meter +	VS2 term 2	less than 10 ohms
	Meter -	Grd.	1.9-2.1 meg-ohms

(J) Trouble Location Tests

6.23 These tests assume that the trouble has been localized in the receiver control unit.

6.24 No output from the receiver:

(1) Verify by operating the meter switch to RCVR OUT and observing the meter reading.

(2) Check the filament supply by observing whether the tubes are lighted.

(3) Check the +130 volt supply by operating the meter switch to 130V.

(4) Check the +BIAS by operating the meter switch and if abnormal, check V4.

(5) Check whether V1, V2, and V3 are operative by operating the CONT key to MAN and adjust MAN CONT as required. If this restores output,

(6) Check V1, V2, and V3.

6.25 High or uncontrollable output from receiver:

(1) Operate the meter switch to RCVR OUT; high or uncontrollable output of the receiver may result from failure of -12V bias supply.

(2) Check MAN BIAS voltage, while rotating MAN CONT knob.

(3) If no reading or a backward reading is observed, check voltage at insulated terminal at junction of (R8), (R25), and (R35), with respect to ground.

Requirement: Min. 10 volts, max. 11.5 volts.

(4) If this requirement is not met, check L3 for resistance per paragraph 6.10(4).

(5) Check continuity through external strap between terminals 9 and 10 of PWR IN plug. (See SD-59405-01, note 102.)

6.26 Receiver output cannot be adjusted over required range:

(1) Check V2 CATH and V1 PLT voltages.

(2) Check vacuum tube V1.

(3) Check bias voltage provided by AUTO CONT potentiometer by measuring the voltages to ground at terminals 1 and 2 of this potentiometer.

Requirements: Terminal 1 shall be minimum 3.3 volts positive with respect to ground. Terminal 2 shall be minimum 1 volt negative with respect to ground.

7. IF BUFFER AMPLIFIER

(A) General

7.01 Impedance and transmission measurements shall always be made with power applied to the amplifier. Final impedance measurements shall be made after the ampli-

fier has had power applied for at least 15 minutes. Final transmission adjustment shall be made after the amplifier has had power applied for at least 30 minutes.

(B) Alignment

7.02 Procedure:

(1) Adjust input and output impedance in accordance with (C).

(2) Adjust gain-frequency characteristic as per (D).

(3) Check gain limits in accordance with (E)

(C) Output and input impedance measurements

7.03 These tests must be made on the test bench.

7.04 Apparatus:

J68340A Test Bay
J68333A Test Bench

7.05 Procedure:

(1) Set up the test equipment as in Fig. 6 and make the adjustments as indicated in Steps (1) to (3), inclusive, of paragraph 5.07.

(2) To check the output impedance, first remove the 486A Jack from the C plug of the directional coupler and in its place connect the output jack of the amplifier. This connection requires the use of a short cord equipped with 477A Jacks at both ends. Use the shortest available cord.

(3) Insert a 368A Plug in the input jack of the amplifier.

Note: The test trace will now show the signal reflected from the amplifier output circuit.

(4) Adjust the attenuation of AT13 and AT14 as required until the test trace is as close to the reference trace as possible, but still below it from 60 to 80 mc. Fig. 12 shows a typical characteristic.

Requirement: The total attenuation of AT13 and AT14 shall be at least 26 db less than the value noted in Step (2c) of paragraph 5.07. If this requirement is not met, adjust L7, L8, and C14.

(5) To check input impedance, disconnect the coupler from the amplifier output and the 368A Plug from the input. Remove the short jack-ended cord from the circuit.

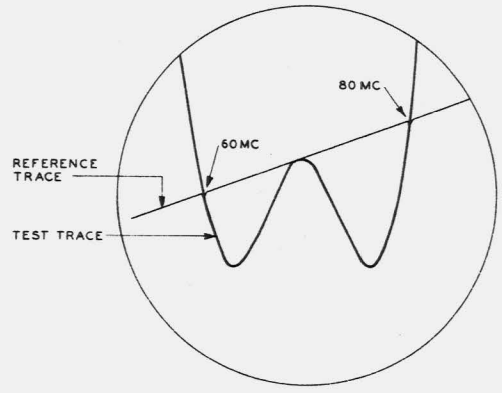

Fig. 12 - Typical Output Impedance Characteristic of IF Buffer Amplifier

(6) Connect a 486A Jack to the output of the amplifier.

(7) Plug the C connection of the directional coupler into the input jack of the amplifier.

(8) Set the GAIN control of the amplifier in the approximate center of its range.

Note: The test trace will now show the signal reflected from the amplifier input circuit.

(9) Adjust the attenuation of AT13 and AT14 as required until the test trace is as close to the reference trace as possible, but still below it from 60 to 80 mc. Fig. 12 shows a typical characteristic.

Requirement: The total attenuation of AT13 and AT14 shall be at least 30 db less than the value noted in (4). If this requirement is not met, adjust L1, L2, L3, C1, and C18.

(D) Gain-frequency Characteristic

7.06 This test is intended to check the gain and over-all gain-frequency characteristic of the IF buffer amplifier. It should preferably be made on a test bench to reduce the length of the coaxial patch cords.

7.07 Apparatus:

J68340A Test Bay
J68333A Test Bench

7.08 Procedure:

(1) Set up apparatus as in Fig. 13.

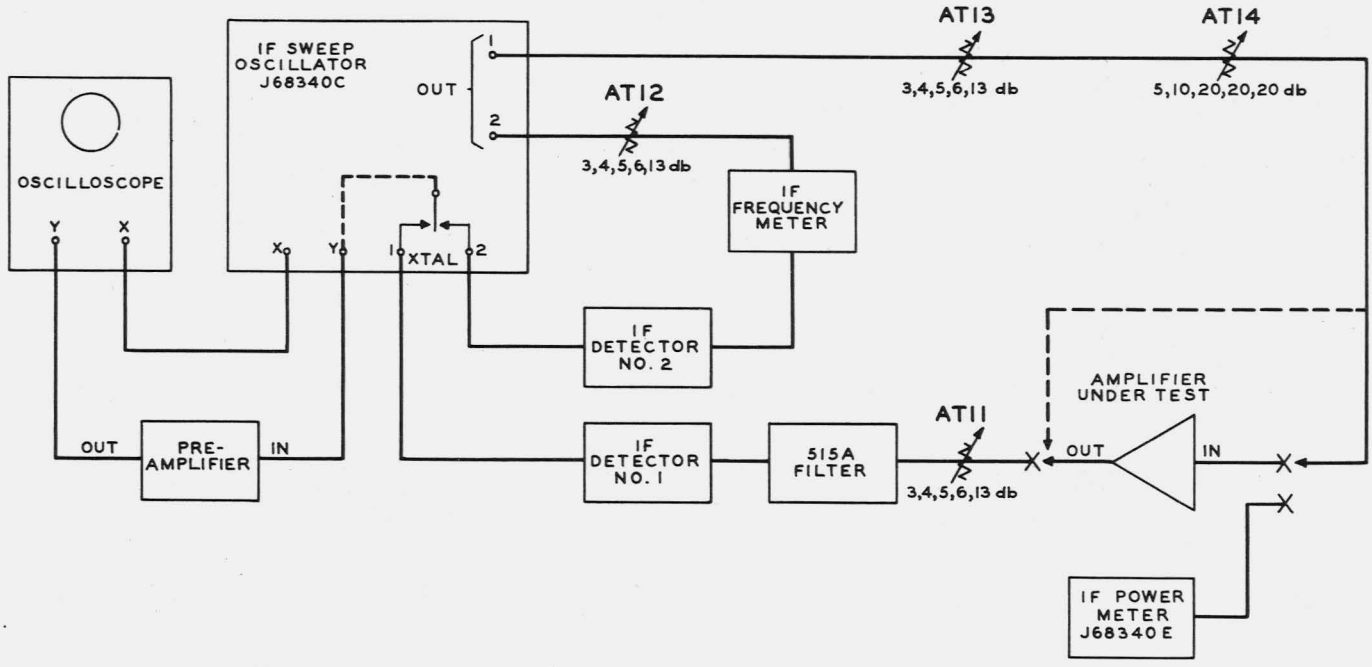

Fig. 13 - Transmission Measurement Test Setup for IF Buffer Amplifier

(2) Turn power on, including the amplifier under test. See paragraph 7.01.

(3) Set AT11 for 6 db, AT14 for 10 db, and AT13 for 5 db.

(4) Set the frequency meter associated with the IF sweep oscillator for 60 mc and the external IF frequency meter for 80 mc.

(5) To set the power level, connect from AT14 to the power meter and adjust AT13 and AT14 until the power meter reads +3 ±0.5 dbm.

(6) Disconnect the power meter and connect from AT14 to AT13.

(7) To line up the test and reference paths adjust AT12 and the ADJ XTAL 1 gain control on the IF sweep oscillator until the two traces match as nearly as possible over the range 60 - 80 mc.

(8) Adjust the sensitivity of the oscilloscope:

(a) Set AT11 at 5 db.

(b) Adjust vertical gain and centering controls on scope until traces are 1 inch apart.

(c) Restore AT11 to former setting of 6 db. Observe whether traces match. If not, repeat (b) and (c).

(9) Disconnect AT14 from AT11 and connect to the input of the buffer amplifier.

(10) Connect the output of the buffer amplifier to AT11 using a P2BJ cord and the shortest available cord equipped with 477A Jacks on both ends.

(11) Set AT11 at 7 db.

Note: An output of +4 dbm will now be required from the buffer amplifier to match the reference trace.

(12) Adjust GAIN control of the buffer amplifier until the test and reference traces coincide at 60 mc.

Requirement: The test trace should be 0.25 db ±0.1 db higher than the reference trace at 80 mc.

(13) If this requirement is not met, adjust L3 to just meet the requirement but to maintain the same general characteristic relative to the mean requirement.

Note: If it has been found necessary to change L3, the input impedance will need to be readjusted as in paragraph 7.05, except that adjustments of the input impedance shall be made using only L1, L2, C1, and C18; i.e., do not now change adjustment of L3.

(14) Recheck the transmission requirement after having readjusted the input impedance in accordance with the note above.

(E) Gain Measurement

7.09 This measurement will indicate the range in the gain adjustment of the amplifier. The actual gain to which the amplifier should be adjusted will depend upon the input requirements of the transmitter modulator with which it is to be associated.

7.10 Apparatus:

J68340A Test Bay
J68333A Test Bench

7.11 Procedure:

(1) Set up apparatus, adjust controls, and connect to buffer amplifier as in 7.08, Steps (1) to (10), inclusive.

(2) Rotate the amplifier GAIN adjustment to its maximum clockwise position.

(3) Increase ATl1 until the traces coincide within 0.5 db. The difference between this setting of ATl1 and 6 db indicates the maximum gain of the amplifier.

Requirement: Shall be at least 3 db for an amplifier with a new tube and 2 db for an amplifier with an old tube.

(4) Rotate the amplifier GAIN adjustment to its maximum counterclockwise position.

(5) Decrease ATl1 until the traces coincide within 0.5 db. The difference between 6 db and this setting of ATl1 indicates the maximum loss through the amplifier.

Requirement: The loss should be at least 3 db.

(F) Filament Activity Test

7.12 This test can be made with the unit on a bench or mounted on the radio transmitter-receiver bay. In the latter case, the unit need not be removed from service.

7.13 Apparatus:

1AK Tube Test Set

7.14 Procedure:

(1) Operate the FIL circuit breaker on the buffer amplifier to ON, if not already so operated.

(2) After the power has been applied for at least 30 minutes, connect the plug P1 on the tube test set to the jack TST on the buffer amplifier.

(3) Set VOLTS-% switch on the 1AK Tube Set to VOLTS, and tube selector switch to V1.

(4) Note the meter reading in volts.

(5) Operate VOLTS-% switch to %.

(6) Adjust the variable resistor V1 so that the meter has a full scale indication zero on the % scale.

(7) Operate the FIL ACT switch on the buffer amplifier to TST and wait at least two minutes. If testing at bench, adjust bench rheostat as required to maintain filament voltage at the bench constant.

(8) From the meter on the tube test set read the decrease in per cent of the grid-cathode voltage.

Requirements: (To be determined)

(G) Continuity

7.15 Continuity test will in general be made with the unit on the test bench and with the cover off.

7.16 Apparatus:

Weston Model 779 Analyzer

7.17 Voltage Measurements

From		To	Voltage
-11		GRD	10.8 ±0.2
B+		GRD	134-137
K+		GRD	9 volts min.
C+		GRD	9.5 ±0.5
Tube Terminal	1	GRD	0
	2	GRD	130-137
	4	GRD	9 volts min.
	5	GRD	130-137
	6	GRD	6.2 ±0.2
	8	GRD	9.5 ±0.5
	9	GRD	9 volts min.

(H) Trouble Location Tests

7.18 These tests assume that the trouble has been localized in the buffer amplifier. The procedure for Distorted Transmission Characteristics assumes that the amplifier gain and output power appear approximately normal. Low output is also likely to result in a distorted transmission characteristic but in this case the trouble will generally be found to be a defective component or soldered connection rather than misalignment.

7.19 No output:

(1) Check operation of FIL circuit breaker and check +130V fuse.

(2) Check whether the tube is lighted.

(3) Check filament voltage -11 to GRD.

(4) Check voltage from K+ to GRD.

Note: Zero voltage indicates no cathode current and hence no plate voltage; check B+ to GRD.

(5) Check grid bias C+ to GRD.

Note: If voltage is out of limits while B+ is normal, remove the unit from the bay and check resistors R7 and R10.

(6) Make continuity tests:

(a) From pin jack B+ to pin 2 of tube socket.

(b) From pin jack B+ to pin 5 of tube socket.

(c) From pin 8 of tube socket to junction of coil L1 and capacitors C1 and C2.

(d) From central conductor of INPUT jack J1 to junction of R3 and the capacitors C1 and C2.

(e) From pin 2 of the tube socket to the junction of coil L9 and capacitors C14 and C15.

(f) From the junction of capacitors C14 and C15 to the central conductor of OUTPUT jack.

7.20 Low output:

(1) Vary the GAIN control on the amplifier to see whether output can be increased to normal. If varying the gain control has no effect upon the output, it will probably be necessary to remove the unit from the bay and make the continuity check (6) below.

(2) Check voltages K+, -11, B+, and C+ to GRD.

(3) Make filament activity test in accordance with (F).

(4) If the voltage C+ to GRD is low, remove the amplifier from the bay for continuity tests:

(a) From C+ to pin 8 of tube socket.

Requirement: Approximately 1000 ohms.

(b) From pin 8 of tube socket to GRD.

Requirement: Approximately 6000 ohms.

Note: Resistance materially less than 6000 ohms indicates a shorted or defective C4 or C11 capacitor. Resistance greater than 6000 ohms indicates a defective R4 or open inductors L3 or L11.

(c) Check resistance between C+ and B+ (R10).

Requirement: Approximately 62,000 ohms.

(5) Check resistance of R2.

(6) Measure resistance from pin 9 of tube socket to GRD.

Requirement: 150 to 1700 ohms depending on the setting of the gain control.

(7) Measure resistance from pin 2 of tube socket to GRD.

Requirement: Approximately 70,000 ohms.

(8) Measure resistance from pin 2 to pin 5 of tube socket.

Requirement: Not more than 5 ohms.

(9) Measure resistance from pin 2 of tube socket to pin jack B+.

Requirement: Not more than 5 ohms.

7.21 Distorted transmission characteristics:

(1) Inspect soldered connections of resistors R11, R18, and R19 and of coils L2 and L8.

(2) Make alignment tests in accordance with (B).

8. TRANSMITTER MODULATOR

(A) General

8.01 The transmitter modulator assembly is tested as a unit and whenever it is necessary to make adjustments in any part of the circuit the over-all alignment should be checked. All transmitter modulator adjustments require a beating oscillator input power of +23 dbm. The beating oscillator frequencies are:

Trans. Freq.	B.O. Freq.
3730 mc	3800 mc
3770 mc	3840 mc
3810 mc	3880 mc
3850 mc	3920 mc
3890 mc	3820 mc
3930 mc	3860 mc
3970 mc	3900 mc

Trans. Freq.	B.O. Freq.
4010 mc	3940 mc
4050 mc	3980 mc
4090 mc	4020 mc
4130 mc	4060 mc
4170 mc	4100 mc

The cavity must be provided with forced air cooling at a pressure of 0.25 pounds per square inch whenever the power is on.

8.02 Apparatus:

J68340A Test Bay
J68333A Test Bench

8.03 Calibration procedure:

(1) To obtain a reference for beating oscillator input and return loss measurements, connect the beating oscillator input test equipment as shown in Fig. 14.

(a) Set the attenuators as follows:

AT1 5 db
AT2 20 db
AT3 20 db
AT4 20 db
AT5 20 db

(b) With the sweep off, set the frequency of the RF sweep oscillator to the beating oscillator frequency.

(c) Set AT3 at 0 and adjust AT2 to give an RF power meter reading of +4 dbm.

(d) Set AT3 at 5 db and with AT4 set at 20 db, remove the termination, at "A" Fig. 14, and connect the shorting plate.

Note: Reference for beating oscillator input return loss measurements is 25 db, setting of AT4 plus AT3.

(e) Adjust the crystal current meter sensitivity to make the crystal current meter read at mid-scale.

(f) Remove the shorting plate and patch cord from the RF detector No. 1 and "XTAL 1" jack on the IF sweeper. Disconnect the sine sweep from the scope "X" amplifier.

(2) Connect the IF test equipment as shown in Fig. 15

(a) Set the attenuators as follows:

AT11 20 db
AT12 20 db
AT13 max.
AT14 max.

(b) The slope network should be out of the circuit.

(c) Turn the oscillator sweep off and adjust the oscillator frequency to 70 mc.

(d) Adjust AT11 to give an IF power meter reading between +5 and +6 dbm.

Note: AT11 should be left at this setting for all tests.

(e) Set AT12 to the same setting as AT11.

(f) Disconnect the IF power meter from AT11 and connect the output of AT11 to the directional coupler "A" arm.

(g) Turn the oscillator sweep on.

(h) Set the oscilloscope "Y" axis gain at 50 and adjust the "X" axis gain to give a frequency spread of 10 mc per inch on the horizontal trace.

(i) Remove the 486A Jack from the "B" arm of the directional coupler.

(3) Connect the modulator and test equipment as shown in Fig. 16 with AT6 set at 20 db.

(4) Connect power from the transmitter control panel to J1 of the modulator.

Caution: The cavity must be provided with forced air cooling whenever the power is on. The plate voltage should not be applied until the heater has been on for at least one minute.

(a) Apply power and adjust the heater voltage to 6.3 volts.

(b) Adjust the bias control to make the plate current 15 ma.

(c) Set the microwave frequency meter at the transmitting frequency.

(B) Removal and Installation of 416A Tubes in Modulator Cavity

8.04 Apparatus:

Tube Wrench
1/8" Allen Wrench

8.05 Procedure:

(1) Remove the protecting cover from the IF transformer housing. Unscrew the knurled locking ring and remove the IF transformer assembly from the housing.

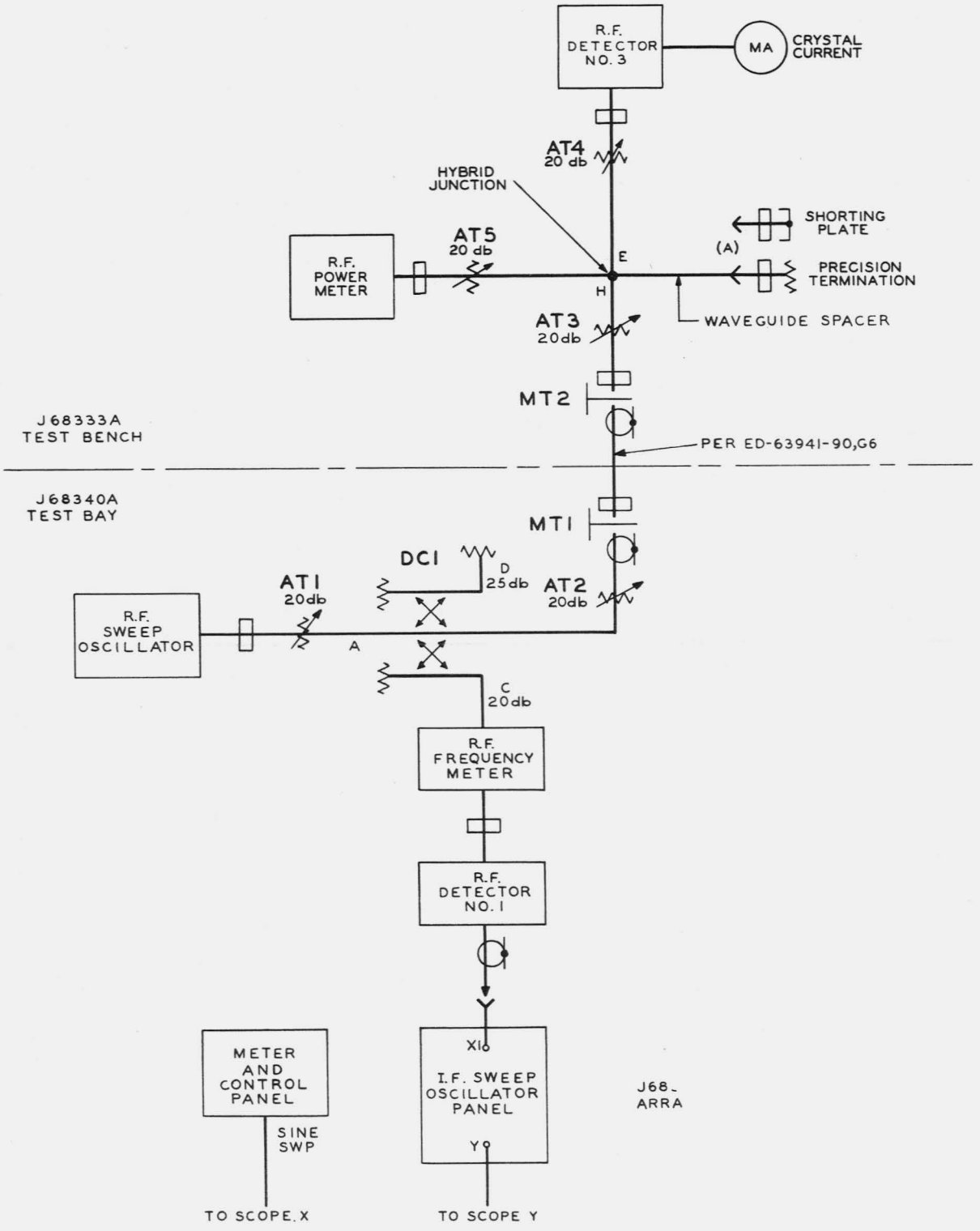

Fig. 14 - Arrangement of Beating Oscillator Input Test Equipment for Calibration

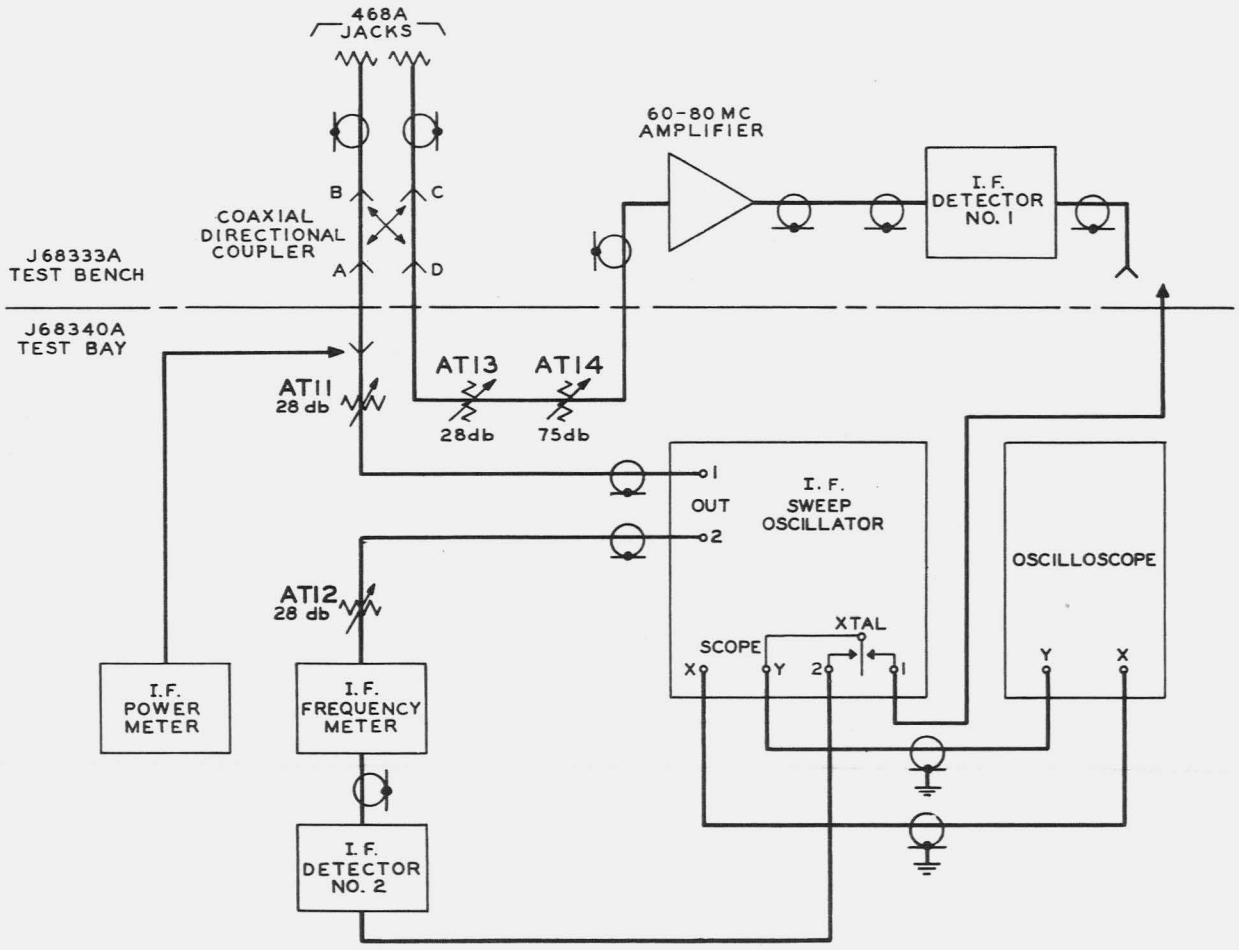

Fig. 15 - Arrangement of IF Test for Calibration

(2) To remove the tube from the cavity using the tube wrench:

(a) Grip the base of the tube with the tube wrench by holding the rear ring and turning the front ring counterclockwise until the front ring has slipped as indicated by a click made by the torque limiting device in the front ring.

(b) Holding the wrench by the rear ring rotate counterclockwise until the tube is unscrewed, and then withdraw it from the cavity.

(3) To install a new tube using the tube wrench:

(a) With the chuck jaws slightly protruding from the end of the barrel insert the tube in the chuck. Rotate the front ring counterclockwise while holding the rear ring until the front ring slips, which is indicated by a click.

Caution: It is possible to damage the tube by improper use of the tube wrench. Instruction Sheet P-379373 should be studied before using the tube wrench.

(b) Insert the tube in the cavity and holding the wrench by the rear ring rotate clockwise until the rear ring slips which is indicated by a click.

(c) To remove the wrench from the tube rotate the front ring in a clockwise direction.

(4) Using a 1/8" Allen wrench loosen the clamp ring at the base of the IF transformer housing and turn the transformer housing clockwise three or four turns.

(5) Place the IF transformer assembly containing the tube socket, on tube. Turn the transformer housing counterclockwise until the base of the

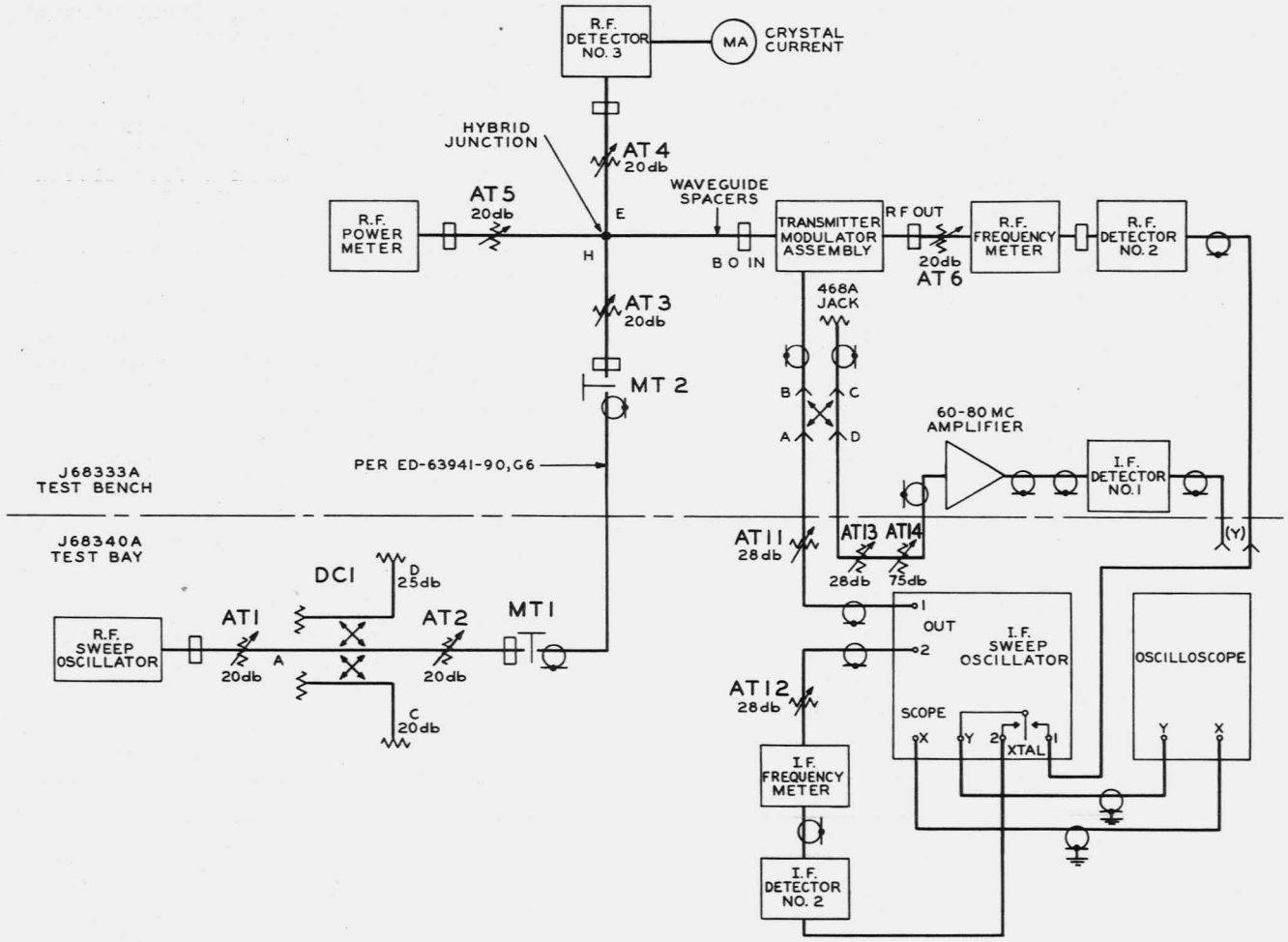

Fig. 16 - Arrangement for Tests

IF transformer assembly seats on the base of the transformer housing; then, continue turning the transformer housing counterclockwise 1/2 turn and tighten the clamp ring.

(6) Replace the knurled locking ring and tighten.

(C) Beating Oscillator Input and Return Loss Measurements

8.06 Procedure:

(1) Set up and calibrate the test equipment in accordance with paragraph 8.03.

(2) Reduce the setting of AT3 to give a bias reading of -1.0 volt. If necessary readjust the bias control to make the plate current 15 ma and readjust AT3 for -1.0 volt bias.

(3) Observe the microwave power meter reading. To the power meter reading in dbm add 20 db (setting of AT5). The resultant is the beating oscillator input power in dbm.

Requirement: The beating oscillator input power shall not exceed +23 dbm.

(4) If this requirement is not met:

(a) Retune the beating oscillator input circuit (paragraph 8.08).

(b) Retune the beating oscillator filter (paragraph 8.17).

(c) Replace the 416A tube and retune (paragraphs 8.08, 8.11, 8.14 and 8.15).

(5) Reduce the setting of AT4 to give a crystal current meter reading at mid-scale. Add the setting of AT4 to the setting of AT3, in db, and subtract this total from 25 db. The resultant is the return loss.

Requirement: The return loss shall be 20 db or greater.

(6) If the requirement is not met retune the beating oscillator input circuits (paragraph 8.08).

(D) Beating Oscillator Input and Return Loss Adjustments

8.07 The modulator input and return loss adjustments are made by means of the input iris tuning (CP1) and adjustments of the 400B tuner. The same apparatus setup is used as in paragraph 8.06.

8.08 Procedure:

(1) Set AT3 at 1 db and adjust the input iris tuning screw to give maximum negative bias; if the bias is greater than -1 volt adjust AT3 to reduce the bias to -1 volt.

(2) Set the IF frequency meter at 70 mc and the RF frequency meter at the signal frequency.

(3) Adjust the plate tuning for approximately maximum transmission, adjusting AT6 for coincidence of the test and reference traces at 70 mc.

Note: In tuning the plate circuit, it may be possible to obtain an indicated output when the plate tuning is adjusted to the undesired sideband. When the plate circuit is tuned to the desired sideband, the test trace will contain a pip from the RF frequency meter. The pips from the RF and IF frequency meter should coincide. If the pips are displaced adjust the beating oscillator frequency to cause coincidence of the two frequency meter pips.

(4) Repeat Step (1).

(5) Adjust AT4 to give a deflection near maximum on the crystal current meter. Adjust the tuning studs of the 400B tuner, in the direction that will cause the crystal current meter deflection to decrease. Continue the adjustment reducing the setting of AT4 until no further improvement is obtained.

(6) If necessary readjust AT3 for -1.0 volt bias and repeat Step (5).

(7) Add the settings of AT4 and AT3, in db, and subtract the total from 25 db. The resultant is the return loss and should be 20 db or greater.

(8) Observe the microwave power meter reading; to this add 20 db (AT5). This is the beating oscillator input power and should not exceed +23 dbm.

(E) Intermediate Frequency Input Circuit - Return Loss Measurements

8.09 Procedure:

(1) With the modulator and test equipment set up and calibrated in accordance with paragraph 8.03 disconnect the RF detector No. 2 and connect the IF detector No. 1 to the "XTAL 1" jack on the IF sweeper (see "Y", Fig.16) and calibrate for return loss measurements.

(a) Disconnect the modulator from the "B" arm of the directional coupler and terminate the "B" arm with a 486A Jack.

(b) Remove the 486A Jack from the "C" arm of the directional coupler.

(c) Set AT13 and AT14 to give a total attenuation of 50 db.

Note: This is a reference for the IF input return loss measurements.

(d) Put the slope network in.

(e) Adjust the test amplifier gain, the slope control and vernier gain control on the IF sweeper for coincidence of the test and reference traces at the 60 and 80 mc points.

(f) Terminate the "C" arm of the directional coupler with a 486A Jack and reduce AT13 and AT14 by a total of 40 db. The test trace should remain below the reference trace between 60 and 80 mc. Failure to meet this requirement means the directional coupler or the 486A Jack is in trouble and should be repaired in accordance with the test section for this equipment.

(g) Reset AT13 and AT14 to the reference setting, 50 db.

(h) Remove the 486A Jack from the IF directional coupler "B" arm and connect the modulator IF input to the "B" arm of the directional coupler.

(2) Adjust AT13 and AT14 to the lowest value at which the test trace remains below the reference trace between 60 and 80 mc. A typical picture is shown in Fig. 17. Deduct the combined settings of AT13 and AT14 from the reference setting, 50 db. The resultant is the return loss.

Requirement: The return loss shall be 17 db or greater.

(3) If the requirement is not met retune the IF input circuit (paragraph 8.11).

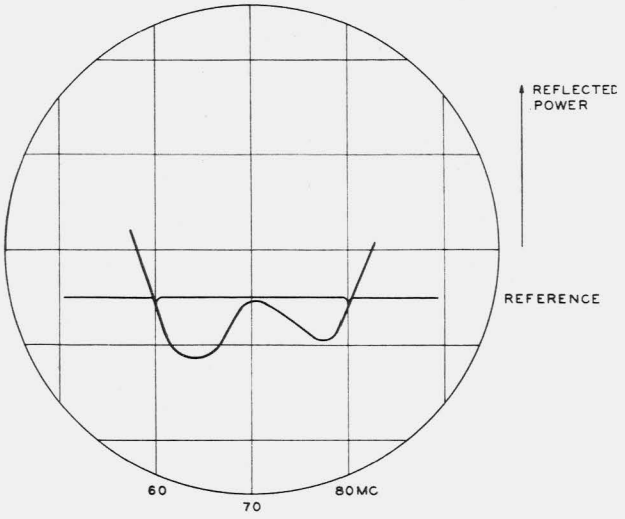

Fig. 17 - Typical Modulator IF Impedance Characteristic

(F) Intermediate Frequency Input Circuit - Return Loss Adjustments

8.10 The modulator intermediate frequency input adjustments are made by adjustments of L1, L2, C2.1, and C3.1.

8.11 Procedure:

(1) With the apparatus set up as in paragraph 8.09, set AT13 and At14 for coincidence of the test and reference traces at some point between 60 and 80 mc.

(2) Adjust L1, L2, C2.1, and C3.1 so that the test trace is as far as possible below the reference trace between 60 and 80 mc. Reduce the settings of AT13 and AT14 and continue the adjustments reducing AT13 and AT14 until no further improvements can be made.

(3) Adjust AT13 and AT14 to the lowest value at which the test trace remains below the reference trace between 60 and 80 mc. Deduct the combined settings of AT13 and AT14 from the reference setting, 50 db. The difference should be 17 db or greater.

(G) Gain-frequency Characteristic

8.12 Procedure:

(1) With the test set up as in paragraph 8.09 disconnect the IF detector No. 1 and connect the RF detector No. 2 to the "XTAL 1" jack on the IF sweeper (see "Y", Fig. 16) and remove the slope network.

(2) Adjust AT6 for coincidence of the test and reference traces at the 60 and 80 mc points.

(3) Change AT12 by one db and adjust the oscilloscope "Y" axis gain to give a separation of one inch between the two traces.

(4) Reset AT12 to the original setting.

(5) Observe the difference between the test and reference traces between 60 and 80 mc. A typical picture is shown in Fig. 18.

Requirement: The over-all transmission shall be flat to 0.1 db from 60 to 80 mc.

(6) If the requirement is not met retune the output circuits (paragraph 8.14).

(H) Output Circuit Adjustments

8.13 The adjustments in the modulator output circuit are made by adjustments of the plate tuning, the coupling screw (CP2), tuning of the output filter section and adjustments of the 400G tuner.

Caution: No adjustments are to be made on the 1303 filter.

8.14 Procedure:

(1) With the apparatus set up as in paragraph 8.12, adjust AT6 for coincidence of the test and reference traces at the mid-band frequency.

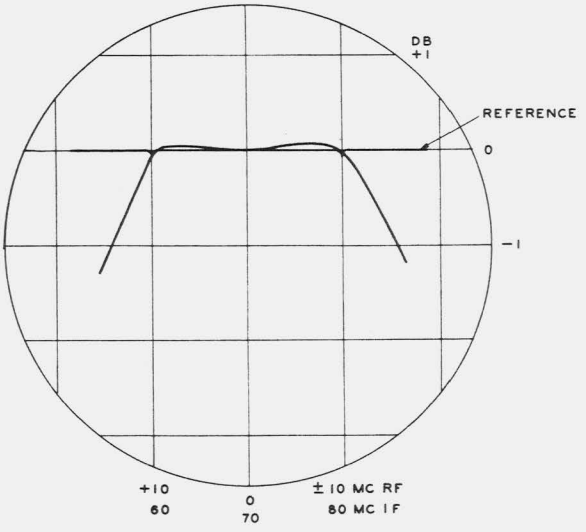

Fig. 18 - Typical Over-all Gain-frequency Characteristic of the Transmitter Modulator

(2) Adjust the plate tuning, the coupling screw and the output filter section tuning screw for maximum flat output characteristics, adjusting AT4 for coincidence of the test and reference traces at the 60 and 80 mc points.

(3) If the required 0.1 db flatness of output is not obtained by the plate circuit and output filter adjustments, the 400G tuner should be adjusted.

(4) Check the beating oscillator input and return loss adjustments and the IF input circuit adjustments (paragraphs 8.08 and 8.11).

(5) Repeat Steps (2) and (3). The adjustments are completed when the 0.1 db flatness is obtained.

(I) Conversion Gain Measurement

8.15 Procedure:

(1) With the test equipment as in paragraph 8.12:

(a) Disconnect the microwave power meter from AT5.

(b) Set AT6 at 20 db.

(c) Disconnect the RF detector No. 2 and connect the microwave power meter.

(d) Turn the IF oscillator sweep off and adjust the oscillator to 70 mc.

(2) Reduce AT6 to give a reading of +3 dbm on the microwave power meter; add +3 db (power meter reading) to the reading of AT4; call this P_o, the microwave output power in dbm.

(3) Disconnect the modulator IF input from AT11 and connect the 70 mc power meter.

(4) Observe the 70 mc power reading; call this P_I (this should be between +5 and +6 dbm).

(5) The conversion gain is $P_o - P_I$ in db.

Requirement: The conversion gain shall be 5 db or greater.

(6) If the requirement is not met, the 416A tube should be replaced.

(J) Beating Oscillator Filter Adjustments

8.16 The filter adjustments are made by means of the tuning screw.

8.17 Procedure:

(1) Connect the test equipment as shown in Fig. 19 and adjust.

(a) Set the attenuators as follows:

AT1 5 db
AT2 0 db
AT3 5 db
AT4 20 db
AT5 20 db
AT6 7 db
AT7 8 db

(b) With the sweep on, adjust the RF sweep oscillator to the beating oscillator frequency, and adjust the sweep width to sweep approximately ±20 mc centered at the beating oscillator frequency.

(c) Adjust the oscilloscope "X" axis gain so that the entire trace is in view on the CRO tube.

(d) Adjust AT7 for coincidence of the test and reference traces.

(e) Change the setting of AT6 by 1 db and adjust the oscilloscope "Y" axis gain to give a trace separation of one inch.

(f) Reset AT6 to 7 db.

(2) Connect the filter between AT7 and AT6 and with the RF frequency meter set at the beating oscillator frequency adjust the filter tuning screw for maximum transmission at the beating oscillator frequency.

(3) Adjust AT6 for coincidence of the test and reference traces at the beating oscillator frequency.

(4) Deduct the new setting of AT6 from 10 db (original setting of AT6). This is the insertion loss.

Requirement: Shall not be more than 0.5 db.

(K) Trouble Location Tests

8.18 The tests assume that trouble has been localized in the transmitter modulator.

8.19 Bias voltage less than -1.0 volt:

(1) Check alignment of the beating oscillator input circuit (paragraph 8.06).

(2) If alignment is satisfactory the emission of the 416A tube may be low; replace the 416A tube and realign.

(3) Check alignment of the beating oscillator input filter (paragraph 8.17).

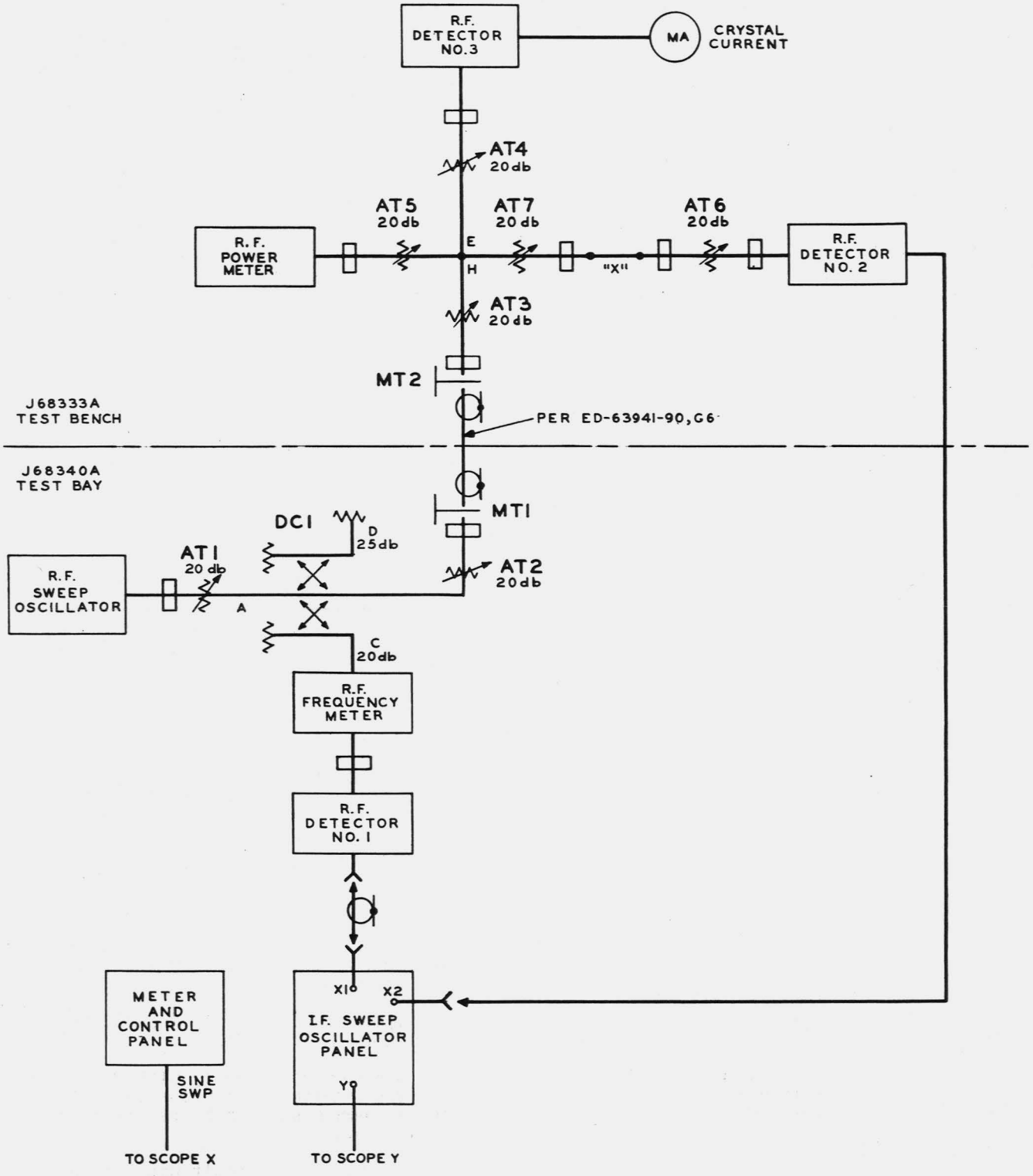

Fig. 19 - Test Arrangement for Oscillator Filter Adjustments

8.20 High plate current:

(1) Vary the BIAS ADJ control on the transmitter control unit. If the plate current does not respond to bias adjustments:

(a) Check plate wiring for shorts.

(b) Replace the 416A tube and retune.

8.21 Low plate current:

(1) Low 416A tube emission; replace the 416A tube and retune.

8.22 No plate current:

(1) Check power wiring connection.

(2) Check filament, plate and bias voltages.

(a) Filament voltage high. Tube heater open, replace the 416A tube and retune.

8.23 No output:

(1) Check plate current and bias voltage.

(2) Check signal input and output connections.

(3) Check beating oscillator input and circuit connections.

(4) Retune the modulator output circuits in accordance with paragraph 8.14.

8.24 Poor transmission characteristics:

(1) Realign the modulator.

9. TRANSMITTER AMPLIFIER

(A) General Test Arrangements

9.01 A bench test of the transmitter amplifier is required whenever a tube other than V1 is replaced and when the over-all transmitter measurement indicates trouble. If an amplifier is to be constructed using untuned cavities or if it is required to change the operating frequency of an assembled amplifier it will be necessary to adjust the cavities individually prior to assembly. However, in most cases, it will only be necessary to test and adjust the complete amplifier.

9.02 Apparatus:

J68340A Test Bay
J68333A Test Bench

9.03 The general test setup is shown in Fig. 20.

(a) The microwave sweeper generates an RF signal which is swept about ±20 mc about the center of the frequency band of interest. The double directional coupler is used to provide a means for measuring the power level and to provide a reference level which is detected by RF detector No. 1, and appears as a reference trace on the scope.

(b) Hybrid junction No. 1 is used to measure the input mismatch of the amplifier under test. This is accomplished by virtue of the fact that when the match is perfect, no signal will appear at RF detector No. 3.

(c) Hybrid junction No. 2 is used to measure the output mismatch of the amplifier under test. The amplifier output power splits at the hybrid, half going to RF detector No. 2 and half being transmitted down the line where it reflects from the short circuit and returns to the hybrid. This signal splits between branches 1 and 2. The half in branch 1 is partially reflected from the amplifier output and splits again between the H and E branches.

(d) The resulting signal at the detector then consists of the main signal plus a small signal which is reduced in level by $(W + 6 + 2\alpha + 2L)$ db where 6 db is twice the hybrid loss, α is the loss of attenuator AT7, and L is the loss in the 50 feet of line. W is the return loss of the amplifier output.

(e) Since the small signal has been transmitted over a path which is about 100 feet longer than that of the main signal, the two signals will phase in and out as the frequency varies and the output of the detector will have ripples of an amplitude which is related to the mismatch of the amplifier output.

(f) If only the transmission characteristic of the amplifier is to be measured, AT7 can be increased to erase the ripples.

9.04 The procedure for turning on the amplifier is as follows:

(1) Provide each cavity with forced air cooling at a pressure of 0.25 pounds per square inch, before power is applied.

(2) Operate FIL circuit breaker on transmitter control panel to ON.

Note: There will be a delay of approximately two minutes before plate voltage is applied to the tubes.

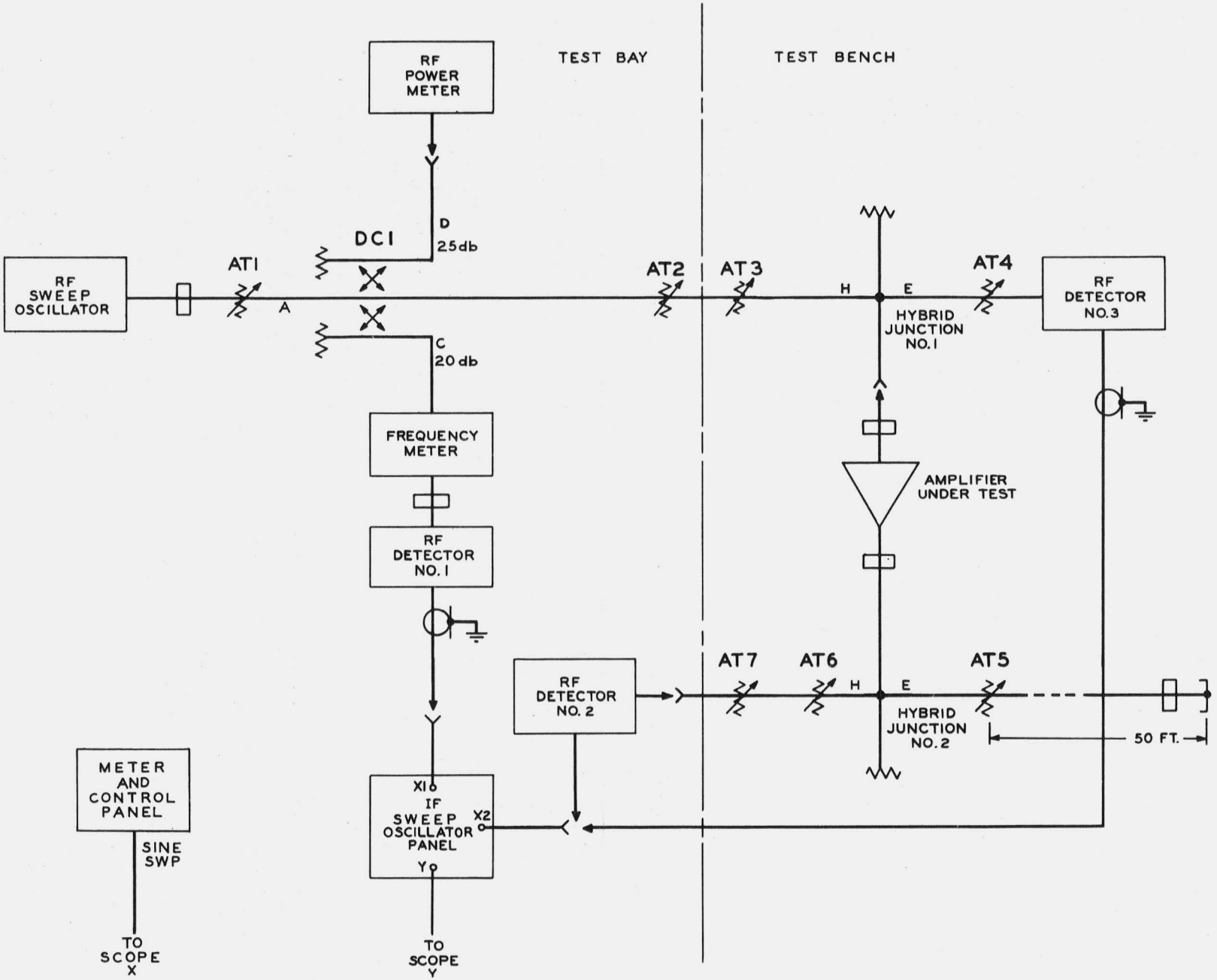

Fig. 20 - General Test Arrangements for Transmitter Amplifier Measurements

(3) Measure each filament voltage using an external meter and set the voltage to 6.3V.

(4) If a previously working amplifier is being tested, set the AMP 3 plate current to 30 ma, AMP 2 to 25 ma, and AMP 1 to 25 ma.

(5) After a warmup period of about 5 minutes, the amplifier may be tested.

(B) Installation of Tubes

9.05 Apparatus:

Tube Wrench

9.06 Procedure:

(1) Unscrew the shield of the tube to be changed and carefully remove the tube socket without exerting side thrust on the tube pins.

(2) Using the tube wrench, grip the base of the tube by holding the small knurled knob and turning the knurled ring counterclockwise just sufficiently to grip the base.

(3) Continue to turn the wrench counterclockwise until the tube is unscrewed, and then withdraw it from the cavity using a steady pull.

(4) Inspect the cavity for dirt or chips.

(5) To place a new tube in the wrench, engage it in the chuck by turning the knurled ring counterclockwise only sufficiently to grip the tube firmly.

Caution: It is possible to damage the tube by using too much force on the knurled ring.

(6) With a steady thrust, insert the new tube in the cavity taking care not to apply sidewise thrust. When tube is seated, screw clockwise about six turns, using only the small knurled knob. Continue to turn until the ratchet clicks twice.

(7) Turn the larger knurled ring clockwise to remove the wrench from the tube.

(8) Carefully place socket on the tube base and replace the shield and outer cover.

(C) Alignment of Individual Stages

9.07 General: Each of the stages will be tested at a moderate power level before assembly.

9.08 Procedure:

(1) For the first two stages, adjust the output impedance match as described in (G).

(2) For the final stage, with the output filter attached, adjust the output impedance match and gain-frequency characteristic as described in (F).

(3) For all stages, adjust the input impedance match as described in (H).

(4) In all cases, the input and output should be adjusted successively until no further improvement in either can be obtained.

(5) After the stage has been aligned, the gain should be measured as in 9.16.

(D) Alignment of Over-all Amplifier

9.09 General: The assembled amplifier should be tested with an output power of +27 dbm.

9.10 Procedure:

(1) Check the output impedance match and gain-frequency characteristic as described in (E).

(2) If necessary, adjust the output coupling screw, the plate tuning, and the output filter section for a suitable impedance match.

(3) If necessary, adjust the input tuning screw of the final stage, the input tuning screw of the second stage, and the plate tuning of the second stage for a flat gain-frequency characteristic.

Note: The output impedance match and the gain-frequency characteristic should be observed several times successively and adjustments made until both requirements are met.

(4) Adjust the tuner and input tuning screw of the first stage for optimum input impedance match as described in (H).

(5) Check input impedance, output impedance and gain-frequency characteristic against requirements.

(6) Measure amplifier gain as described in (I).

(7) If the amplifier gain is too high, as it will be if the amplifier stages have not been associated before, readjust the plate tuning of the first

and second stages and the input tuning of the second and third stages to decrease the gain, maintaining a flat band and good output impedance as described in 9.11.

(E) Gain-frequency Characteristic and Output Impedance Match of Over-all Amplifier

9.11 Procedure:

(1) Connect power and air to the amplifier as described in paragraph 9.04.

(2) Set the various attenuators in Fig. 20 to the following positions, and connect detector No. 3 to X2:

AT1	10 db
AT2	6 db
AT3	4 db
AT4	20 db
AT5	20 db
AT6	10 db
AT7	12 db

(3) With the sweep OFF, set the frequency of the microwave sweeper to the center of the band.

(4) Connect the RF power meter to the D branch of DC1 and adjust AT1 to make the measured power level equal to 22 dbm minus A-D loss of DC1.

Note: This is a reference value which makes the input power to AT2 equal to +22 dbm. As long as this reference power is constant, the amplifier input power equals (22-AT2-AT3-3) dbm.

(5) Connect the RF power meter to AT7 and adjust AT2 to give an amplifier output of +27 dbm (power meter reading of +2 dbm).

Note: In the case of an amplifier which has had a tube replaced, it may be necessary to adjust the cavity tuning in order to get the required power out.

(6) Connect RF detector No. 2 to AT7 and adjust AT7 to make the two traces on the scope coincide.

(7) Increase the setting of AT6 by one db and adjust the scope gain to make the separation of traces equal one inch.

(8) Return AT6 to its original reading. The two traces should coincide within 0.05 inch. If not, repeat (6), (7) and (8).

Note: The vertical sensitivity of the scope is now one db per inch.

(9) Turn sweep to ON and adjust the horizontal scope gain to give a sensitivity of 10 mc per inch. Departures from coincidence of the two traces now represent departures from transmission flatness. A typical scope picture is shown in Fig. 21.

Requirement: The transmission shall be flat within ±0.05 db over the center 20 mc of the band.

(10) Reduce AT5 to such a setting that the loss of AT5 plus the loss of the 50 feet of line is equal to 4.5 db.

(11) Note the ripples which appear on the transmission characteristic. The loss in the circuit is now such that a ripple amplitude (peak-to-peak) of 0.1 db represents a return loss of 30 db or a standing wave of approximately 0.5 db. A typical scope picture is shown in Fig. 22.

Requirement: The return loss shall be greater than 30 db (ripples less than 0.1 db) over the center 10 mc of the band, and greater than 24 db (ripples less than 0.2 db) over the center 20 mc of the band.

(F) Gain-frequency Characteristic and Output Impedance Match of Output Stage Alone

9.12 Procedure:

(1) Follow paragraph 9.11, (1) through (4) and set AT2 to 3 db.

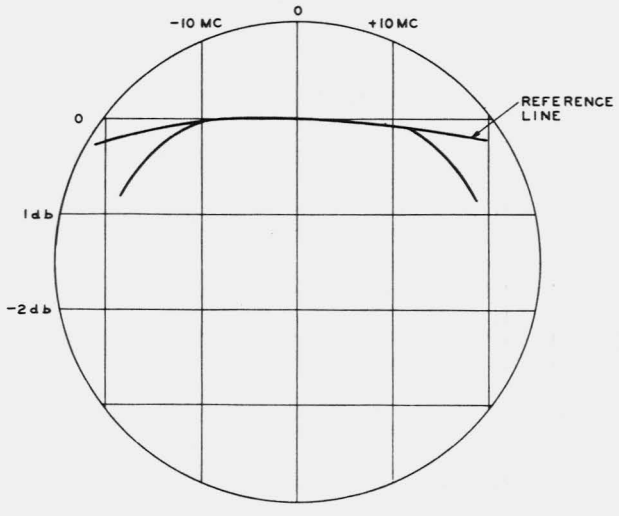

Fig. 21 - Typical Gain-frequency Characteristic of Transmitter Amplifier

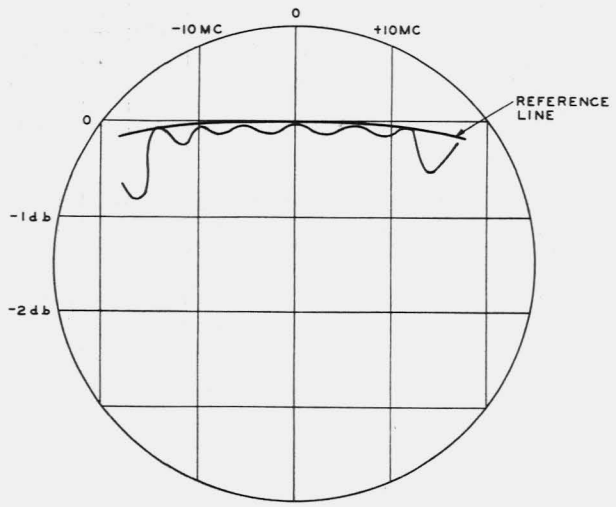

Fig. 22 - Typical Output Impedance Characteristic of Transmitter Amplifier

(2) Connect RF detector No. 2 to AT7, turn on the sweep and reduce AT7 until the trace indicating transmission approaches the reference trace.

Note: If the cavity is badly out of tune, no transmission will be observed even with AT7 reduced to zero.

(3) Adjust the plate tuning, the output filter, and the input tuning screw for maximum transmission, increasing the setting of AT7 as required to keep the traces together.

(4) Adjust AT7 to make the two traces coincide at a convenient point.

(5) Increase AT6 by one db and adjust the vertical gain to make the trace separation equal one inch.

(6) Return AT6 to its original setting.

Requirement: The two traces should coincide within 0.05 inch. If not, repeat (4), (5), and (6).

(7) Adjust the output filter tuning and the plate tuning for a flat-topped characteristic approximately symmetrical about the center frequency.

(8) Adjust the input impedance as described in (H).

(9) Repeat (1) through (7).

(10) Set AT5 to 3.5 db.

(11) Adjust the coupling screw, the plate tuning and the output filter tuning for minimum ripples over the band.

(12) Set AT5 to 20 db and repeat (8).

(13) Set AT4 to 20 db and observe the output characteristic, as in (10) and (11). A typical scope picture is shown on Fig. 22.

Requirement: The ripples shall be less than 0.2 db peak-to-peak over the center 20 mc of the band.

(14) Set AT5 to 20 db.

Requirement: The transmission shall be flat within ±0.1 db over the center 20 mc of the band.

(G) Gain-frequency Characteristic and Output Impedance Match of First and Second Stages

9.13 Procedure:

(1) Follow paragraph 9.11, (1) through (4), and set AT2 to 0 db.

(2) Connect RF detector No. 2 to AT7, turn on the sweep, reduce AT7 until the trace indicating transmission approaches the reference trace.

Note: If the cavity is badly out of tune, no transmission will be observed even with AT7 reduced to zero.

(3) Adjust the plate and input tuning for maximum transmission at the center frequency, increasing the setting of AT7 as required to keep the traces together.

(4) Set AT2 to 6 db and adjust AT6 and AT7 to bring the two traces together at the center frequency.

(5) Increase AT6 by one db and adjust the vertical gain to make the trace separation equal one inch.

(6) Return AT6 to its original setting.

Requirement: The two traces should coincide within 0.05 inch at the center frequency. If hot, repeat (4), (5), and (6).

(7) Reduce AT5 to such a value that the loss of AT5 plus the 50 feet of line is equal to 4.5 db.

(8) Adjust the plate tuning and coupling screw to reduce the ripples to a minimum at the center frequency. A typical picture is shown on Fig. 23.

(9) Adjust input impedance as described in 9.14.

(10) Set AT4 to 20 db and repeat (4) through (8).

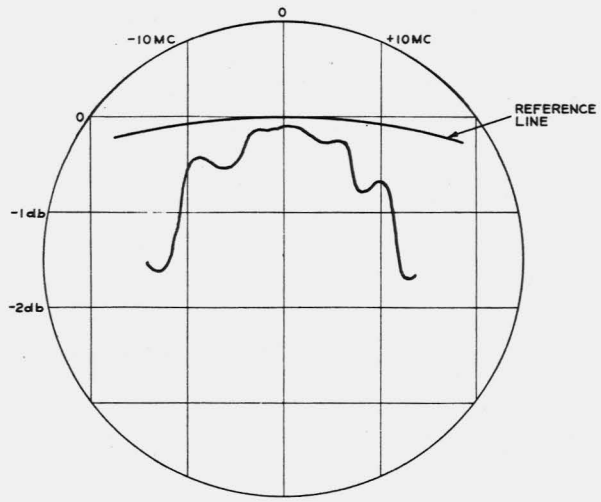

Fig. 23 - Typical Output Impedance Characteristic of First and Second Stages of Transmitter Amplifier

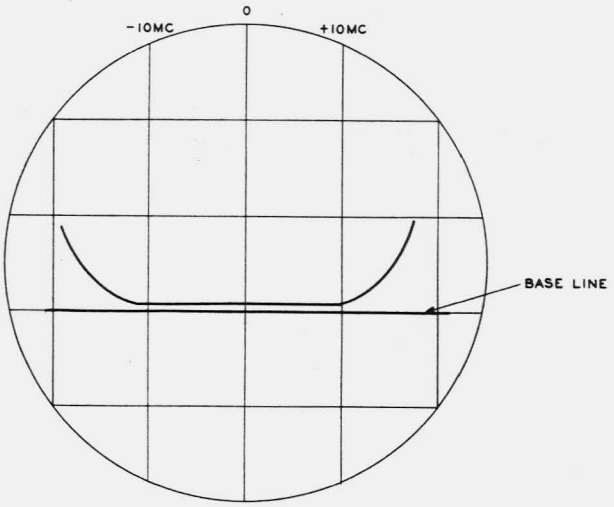

Fig. 24 - Typical Input Impedance Characteristic of Transmitter Amplifier

Requirement: The ripples should be minimum at the center frequency as shown in Fig. 23.

(H) Input Impedance of Over-all Amplifier or Individual Stages

9.14 Procedure:

(1) For an over-all amplifier follow 9.11, (1) through (6).

(2) For an output stage, follow 9.12, (1) through (4).

(3) For the first or second stage, follow 9.13, (1) through (4).

(4) Disconnect output of detector No. 1, connect the output of detector No. 3 to X2, turn the input aperture tuning screw all the way clockwise, and adjust the vertical gain to make the trace separation equal 0.5 inch.

(5) Adjust the input aperture tuning screw for minimum separation of traces and reduce AT4 to zero.

(6) Adjust the input tuner and the input tuning screw to minimize the trace separation over the center 20 mc. A typical scope picture is shown in Fig. 24.

Requirement: The trace separation shall be less than 0.5 inch, representing a return loss of greater than 20 db, over the center 20 mc of the band.

(I) Gain Measurement of Over-all Amplifier

9.15 Procedure:

(1) Follow 9.11, (1) through (5).

(2) The amplifier gain is then equal to (27-22 + AT2 + AT3 + 3) db.

Requirement: The amplifier gain shall be 18 ± 0.5 db.

Note: An amplifier which has not been previously aligned will usually have a gain considerably greater than 18 db. The gain should be reduced as described in 9.10(7).

(J) Gain Measurement of Individual Stages

9.16 Procedure:

(1) After the stage has been completely aligned, connect the RF power meter to the output of AT7.

(2) Adjust AT6 and AT7 to give a power meter reading of 0 dbm.

(3) The gain of the stage is then equal to (AT2 + AT3 + AT6 + AT7 - 16) db.

Requirement: The gain of an individual stage shall be 7 db or more.

(K) Trouble Location Tests

9.17 Low gain:

(1) Check filament voltage, plate current, and bias of each tube.

(2) Check gain-frequency characteristic of over-all amplifier, readjust cavity tuning if necessary.

(3) Replace tubes one at a time, readjusting corresponding cavity for flat transmission.

9.18 High Gain:

(1) Check filament voltage, plate current, and bias of each tube.

(2) Check gain-frequency characteristic of over-all amplifier and reduce gain as described in 9.10(7).

9.19 Distorted Gain-frequency Characteristic:

(1) Check filament voltage, plate current, and bias of each tube.

(2) Realign over-all amplifier as described in 9.10.

9.20 Noise:

(1) Replace amplifier tubes one at a time and realign over-all amplifier as described in 9.10.

10. TRANSMITTER CONTROL UNIT

(A) Check of Time Delay Circuit (Unit on the Bay)

10.01 Apparatus:

DC Voltmeter with at least 250 volts full scale
Watch

10.02 Procedure:

(1) Remove cover from the unit and disconnect plugs from jacks 8 and 9.

(2) Insert 1-1/3 amp fuse F1 in fuse block if not so equipped.

(3) Short-circuit terminals 11 and 12 on jacks J8 and J9.

(4) Connect the positive terminal of the voltmeter to terminal 4 of jack J8 and the negative terminal of the voltmeter to terminal 5 of J8.

Note: The above represents only one of several combinations whereby the observations can be made. Terminal 5 of J8 is the grounded side of the 250V supply and such a connection can be made either to the frame or to terminal 1 of J8 or to terminal 1 or 5 of jack J9. The positive side of the 250V supply may also be picked up on terminal 4 or 8 of jack J9.

(5) Operate FIL circuit breaker to the ON position.

(6) Note the time from the operation of the circuit breaker until there is an indication on the voltmeter. Such a voltage reading indicates that both the K7 and the K5 relays have operated.

Requirement: Should operate in a minimum of 50 seconds and a maximum of 120 seconds.

(B) Check of Time Delay Circuit (Unit on the Bench)

10.03 Apparatus:

J68333A Test Bench
Watch

10.04 Procedure:

(1) Remove the cover from the unit and connect power plug to jack J10.

(2) Short-circuit terminals 11 and 12 on jacks J8 and J9.

(3) Insert 1-1/3 amp fuse F1 in fuse block if not so equipped.

(4) Operate FIL circuit breaker to ON position.

(5) Visually observe relay K5 and note the time required for its operation after the filament circuit breaker has been operated. Operation of relay K5 indicates that relay K7 has also operated.

Requirement: Should operate in a minimum of 50 seconds and a maximum of 120 seconds.

(C) Check of Operation of Plate Relays

10.05 This is preferably a "bay" test as it requires a transmitter amplifier or modulator to be connected to the control unit.

10.06 Apparatus:

Screwdriver

10.07 Procedure:

(1) With the transmitter amplifier and modulator normally connected in the circuit, operate FIL circuit breaker to the ON position.

(2) Operate the meter switch to MOD and the key to PLT CUR, which is the normal position.

(3) With the screwdriver, vary the BIAS ADJ potentiometer and note any change in plate current.

Requirement: A change in the place current with a change in the adjustment of the BIAS ADJ potentiometer indicates that the associated plate relay is operated; no change indicates that the relay is not operated.

(4) Repeat with meter switch set to AMP1; AMP2; AMP3.

(D) Check of Operation of POWER OUT Meter

10.08 This test should be made on the bay as it involves normal microwave power being transmitted through the output monitor.

10.09 Procedure:

(1) Check to see that radio transmitter is in operation and that power should presumably be transmitted.

(2) Observe POWER OUT meter.

Requirement: Meter should read 0 DB.

(3) If no reading, operate the RESET key momentarily to make sure the meter has been released.

(4) With the meter reading 0 DB, remove plug P15 from the jack at the output monitor. Meter should release and operate the visual and audible alarm.

(5) Operate the ACO key which should release the alarm signals.

(6) Restore plug P15 in output monitor jack.

11. OUTPUT MONITOR

11.01 The only maintenance required on the output monitor is the replacement of the crystal.

12. MICROWAVE GENERATOR

(A) General

12.01 The necessary power supplies provided by the facilities on the bay or on the J68333A Test Bench are as follows:

Filament Supply	11 ± 0.25 V	6 amperes
Plate Supply	250 ± 5 V	0.150 ampere

The V4, V6, and V7 stages must be provided with forced air cooling at a pressure of 0.25 pounds per square inch whenever power is on.

12.02 The microwave generator output and crystal frequencies are:

Microwave Generator Output Freq.	Crystal Freq.
3800 Mc	17.59259 Mc
3820 Mc	17.68518 Mc
3840 Mc	17.77778 Mc
3860 Mc	17.87037 Mc
3880 Mc	17.96296 Mc
3900 Mc	18.05556 Mc
3920 Mc	18.14815 Mc
3940 Mc	18.24074 Mc
3980 Mc	18.42592 Mc
4020 Mc	18.61111 Mc
4060 Mc	18.79630 Mc
4100 Mc	18.98148 Mc

(B) Crystal and Tube Replacements

12.03 Procedure for replacing crystals:

(1) Release the crystal oven cover by the simple catches on the two sides.

(2) Unplug the oven proper from its base and pull off the two small heat shields.

(3) Unplug the crystal and replace. Orientation of the crystal unit in its socket is unnecessary. The oven is keyed for proper orientation in its socket.

12.04 Procedure for replacing vacuum tube V4:

(1) Disconnect the lead plug from socket JV4.

(2) Unscrew the top portion of the mounting which brings the vacuum tube with it.

(3) Remove the finned radiator and replace it on the new tube.

(4) Replace the tube in the reverse order.

12.05 Procedure for replacing vacuum tube V5:

(1) Vacuum tube V5 is removed from the rear of the chassis.

(2) Remove the bakelite socket from the tube base.

(3) Slightly back off the screws that hold the two small retaining springs.

(4) Note the orientation of the tube base with the key of the base pointing between the two posts.

(5) Pull the tube out and replace.

Note: In replacing the tube, the key of the tube base must be positioned so that the socket will engage the two small post contacts projecting from the mounting.

12.06 Procedure for replacing Vacuum Tube V6:

(1) Disconnect the lead from socket JV6.

(2) Disconnect the RF output lead of V5 which enters the side of the V6 assembly.

(3) Remove four screws in the flange.

(4) Draw the whole assembly out far enough from the chassis to allow backing off the ring nut which holds the socket XV6 to the assembly.

(5) Remove the tube by means of the tube wrench.

Caution: Use the tube wrench with care so as not to damage the 416A tube. When gripping a tube in the wrench, the chuck of the wrench first should be engaged on the tube end just sufficiently to hold it; then grasping the larger knurled ring in one hand, with the other hand turn the smaller knurled knob clockwise until two or three clicks are heard. Insert tube and wrench in the mounting and carefully start threading the tube in place; and when it is felt to be nearly seated turn the wrench by its smaller knurled knob until two clicks are heard. Then turn the larger knurled ring CLOCKWISE to release the wrench chuck. Avoid excessive wobbling of the wrench when threading a tube in or out of its mounting.

Note: In event the V6 assembly is not to be replaced in case the unit is to be used as a receiver microwave generator, a small cover assembly attached to nearby supports should be assembled to the chassis with the screws that held the V6 assembly, first fastening the socket to the cover by means of the ring nut.

(6) Screw down the flanged nut at the base of the assembly to insure that the flange of the tube will not be restricted.

(7) Screw the vacuum tube firmly into place.

(8) Attach the socket on the vacuum tube.

(9) Back off the flanged nut at the assembly base until it lightly contacts the socket XV6.

(10) Engage the large knurled ring nut on the socket to the threaded ring on the base of the assembly.

(11) Tighten this nut; this nut holds the socket without applying strain to the tube and also clamps the flange of the cathode spring which is otherwise free to move to a limited extent.

12.07 Procedure for replacing vacuum tube V7:

(1) Remove the socket which is a cylindrical plug-like assembly held in the end of the V7 mounting assembly by a knurled-flange nut.

(2) Pull out the socket assembly.

Note: The retaining nut bears on a ring which in turn bears on a spring surrounding the body of the socket assembly. This arrangement holds the socket on the tube with a moderate pressure that prevents strain on the tube.

(3) Remove the tube by means of the tube wrench.

Caution: Use the tube wrench with care so as not to damage the 416A tube.

(4) Insert the new tube taking the above steps in the reverse order.

(C) Alignment

12.08 Adjust the filament voltage of V6 and V7 to 6.3 volts.

Note: It is necessary to readjust the filament voltage of V6 and V7 whenever these tubes are replaced.

12.09 Apparatus:

J68340A Test Bay

12.10 Procedure:

(1) Connect the test equipment as shown in Fig. 25 with AT5 set at 20 db.

Caution: V4, V6, and V7 must be provided with forced air cooling whenever the power is on.

(2) Install a crystal of the proper frequency in the oven and allow at least five minutes for the crystal to warm up if the oven is already at operating temperature and at least 30 minutes if the oven is cold.

(3) Set C3 so that the condenser plates are in half way

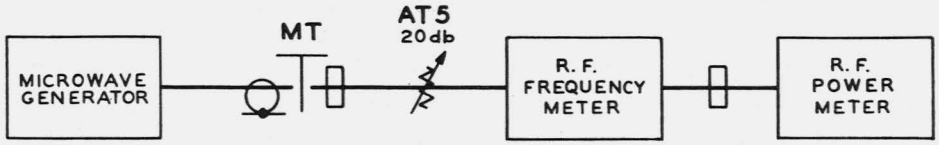

Fig. 25 - Microwave Generator Test Arrangement

(4) With meter switch on V1-I_{G1} adjust L1 tuning slug for maximum meter reading.

Requirement: 0.3 ma minimum

(5) With meter switch on V3-I_G, tune C4 and C5 for maximum reading.

Requirement: 0.8 ma ± 0.25 ma.

(6) Readjust L1 for maximum reading while still on V3-I_G meter position.

(7) With meter switch on V4-I_G, tune C6 and C7 for maximum reading.

Requirement: 3.0 ma ± 2.0 ma.

(8) With meter switch on V4-I_G readjust C4 and C5 for maximum reading.

Note: It is possible by improper adjustments of C6 and C7 to cause V4 to sing. This condition is indicated where no change in the V4-I_G reading is observed when readjusting C4 and C5.

(9) With meter switch on V5-I_P readjust C8 and C9 for maximum reading.

Requirement: 13 ma ± 3 ma.

(10) If the panel has V6 stage which is connected in the circuit, set the meter switch to V6-I_P.

(11) Adjust the V5 plate plunger by rotating the small knurled knob at end of the V5 mounting, the V6 cathode plunger by rotating the larger knurled cylinder at end of the V6 mounting and the V5 output coupling loop rotation for maximum reading but not greater than 20 ma.

Note: Adjust loop rotation to reduce reading to 20 ma if necessary. The loop assembly is locked by means of a hex nut. Whenever the coupling loop is adjusted the V5 plate plunger should be readjusted for maximum V6-I_P.

(12) Set meter to V7-I_P.

(13) Adjust the V6 plate plunger by rotating the smaller knurled cylinder at end of the V6 mounting, the V7 cathode plunger by rotation of the knurled knob at the outer end of the V7 mounting, the V6 output coupling loop rotation and OUTPUT potentiometer for maximum reading but not greater than 20 ma. Use OUTPUT potentiometer to reduce reading, keeping other adjustments tuned for maximum.

Note: The loop assembly is locked by means of a small forked detail controlled by a fillister head screw located centrally inside the smaller tuning cylinder at end of the V6 mounting. Adjustments of the V6 plate plunger will cause a change in V6-I_P. Repeat Steps (9), (10), and (12).

(14) With AT5 set at 20 db, adjust V7 plate plunger, by rotating the large knurled cylinder near the output end of the cavity, for maximum power output; if necessary adjust the OUTPUT potentiometer to reduce V7-Ip to the 20 ma maximum.

Requirement: The output power shall be 25 dbm ± 2 db.

(15) Check the output frequency with the frequency meter.

Requirement: The output frequency shall be within 1 mc of the specified frequency.

(16) If the panel does not use a V6 stage see that the output cable from V5 is plugged into V7. Set the meter switch to V7-I_P.

(17) Adjust V5 plate plunger, the V7 cathode plunger, the V5 output coupling loop rotation and OUTPUT potentiometer for maximum reading but not greater than 10 ma. Use the OUTPUT potentiometer to reduce reading, keeping other adjustments tuned for maximum.

(18) Set AT5 at 6 db and adjust V7 plate plunger for maximum power output.

Requirement: The output power shall be 6 dbm min.

(19) Check the output frequency with the frequency meter.

Requirement: The output frequency shall be within 1 mc of the specified frequency.

(20) The meter readings for the various tubes should be as shown in the table below:

Switch Position	Reading
V1-I_{P1}	10 ma ± 2 ma
V1-I_{G1}	0.3 ma min
V1-I_{P2}	5 ma ± 2 ma
V2-I_P	3.5 ma ± 1 ma
V3-I_G	0.8 ma ± 0.25 ma
V3-I_P	6.5 ma ± 2 ma
V4-I_G	3.0 ma ± 2.0 ma
V4-I_P	17 ma ± 2 ma
V5-I_P	13 ma ± 3 ma
V6-I_P	No V6 stage 0 with V6 19 ma ± 2 ma
V7-I_P	No V6 stage 12 ma max with V6 20 ma max

(D) Filament Activity Tests

12.11 This test is intended to determine that the tubes are in satisfactory operating condition. The test may be made without taking the unit out of service. In this case, no test apparatus is required other than that provided on the transmitter-receiver bay. If not made on the bay, a J68333A Test Bench will be necessary to provide the necessary power supplies. Only one tube should be tested at a time since the plate current is affected by the drive from the previous stage.

12.12 Procedure:

(1) Operate FIL ACT switches to NOR if not already so operated.

(2) Operate meter switch to V5-I_P and V6-I_P and note readings.

(3) Operate FIL ACT V5 switch to TST.

(4) Wait one minute, again note V5-I_P and V6-I_P readings and compare with those previously obtained.

Requirement: Readings should not drop more than 15%.

(5) Restore FIL ACT V5 switch to NOR.

(6) Similarly with FIL ACT V4 switch, compare readings of V4-I_P and V5-I_P on NOR and TST positions.

Requirements: Readings on TST position should not drop more than 15%.

(7) Similarly with FIL ACT V3 switch, compare readings of V3-I_P and V4-I_G on NOR and TST positions.

Requirements: Readings on TST position should not drop more than 15%.

(8) Similarly with FIL ACT V2 switch, compare readings of V2-I_P and V3-I_G on NOR and TST positions.

Requirements: Readings on TST position should not drop more than 15%.

(9) Similarly with FIL ACT V1 switch, compare readings of V1-I_{P1}, V1-I_{G1}, V1-I_{P2}, and V2-I_P.

Requirements: Readings on TST position should not drop more than 15%.

(E) Operation of Crystal Oven Thermostat

12.13 Apparatus:

Weston Dial Thermometer, 0 - 140°C.

12.14 Procedure:

(1) Insert stem of thermometer through the hole in the crystal over can cover.

(2) Operate FIL switch to ON.

(3) Allow 10 minutes for the oven to reach operating temperature.

(4) Observe temperature cycle as indicated by the thermometer.

Requirements: The cycle should normally be about 15 seconds with heating current on and about 45 seconds off. The crystal temperatures will normally vary about 1/2°C about some temperature in the vicinity of 70°C - the exact temperature being somewhat dependent upon ambient temperatures. However, as measured the range will be of the order of ± 3°C.

(F) DC Voltage Checks

12.15 Voltage Measurements:

Pin jack + 150V to GRD	150 ± 5 volts
Pin jack + 250V to GRD	250 ± 5 volts
Pin jack - 11V to GRD	11 ± 0.25 volts
FILV V6	6.3 ± 0.1 volts
FILV V7	6.3 ± 0.1 volts

Tube	Terminal	Voltage
V1	4	105V ± 10V
V1	6	90V ± 5V
V2	5	240V ± 10V
V2	6	145V ± 5V
V3	5	240V ± 10V
V3	6	145V ± 5V
V4	Plate	240V ± 10V
V5	JV5	240V ± 10V
V6	JV6	240V ± 10V
V7	JV7	240V ± 10V
V8	3, 5, 7	150V ± 5V

(G) Trouble Location Tests

12.16 Low output:

(1) Observe meter readings and check if any are below normal.

(2) Check interstage and output cable connections.

(3) Measure output power.

(4) Measure output frequency.

(5) Realign circuits in accordance with (C). If any of the circuits do not tune or tune very broadly, check the by-pass condenser at the end of the coil for possible open.

(6) Replace any weak tubes.

(7) Check any tuned circuits suspected of not tuning to correct frequency with the megacycle meter. The frequencies of the various circuits are as follows:

Circuit	Frequency
L1	Crystal Frequency F
L3C4, L3C5	3F
L4C6, L5C7	6F
L6C8, L7C9	12F

12.17 Intermittent output:

(1) Observe meter readings for fluctuating or low currents.

(2) Replace suspected tubes.

(3) Check plate circuit by-pass condensers for possible short circuits.

12.18 Oven temperature alarm:

(1) Replace heater-thermostat unit in crystal oven.

(2) After a period of five minutes if oven alarm is still on, check temperature of oven with thermometer inserted in top of oven.

(3) If oven temperature is normal check operation of CONT and OVEN ALM relays.

13. 40 MC SHIFTER

(A) General

13.01 The 40 mc shifter converter and the 40 mc generator are tested only as a complete unit.

13.02 The power supply requirements for the 40 mc shifter are:

11 volts ± 0.25 volts DC at 0.75 ampere
250 volts ± 5 volts DC at 50 ma

(B) Filament Activity Tests

13.03 This test is intended to determine that the tubes are in satisfactory operating condition. The test may be made on the bay without taking the unit out of service. In this case no test apparatus is required other than that provided on the transmitter-receiver bay. If not made on the bay a J68333A Test Bench will be necessary to provide the necessary power supplies.

13.04 Procedure:

(1) With power connection to the unit and with tubes in place, operate the FIL circuit breaker to ON if not already so operated.

(2) Operate FIL ACT switches to NOR.

(3) Operate meter switch to V2-I_{P+S}, CR1 and CR2 and note readings for each setting.

(4) Operate FIL ACT V2 switch to TST.

(5) Repeat (3) and compare readings with those previously obtained.

Requirement: Decrease should not be more than 15%.

(6) Operate FIL ACT V2 switch to NOR.

(7) Operate meter switch to V1-I_{P1}, V1-I_{G2}, V1-I_{P2}, and V2-I_{P+S} and note readings for each setting.

(8) Operate FIL ACT V1 to TST.

(9) Repeat (7) and compare readings with those previously obtained.

Requirement: Decrease should not be more than 15%.

(10) Restore FIL ACT V1 switch to NOR.

(C) Alignment of 40 MC Generator

13.05 Alignment of the 40 mc generator may be made either with the unit on a J68333A Test Bench or when mounted on the radio transmitter-receiver bay.

13.06 Procedure:

(1) Remove the panel cover.

(2) Set meter switch on position V1-I_{G2}.

(3) With a screwdriver adjust C8 for maximum meter reading.

Requirement: Should be 0.4 ma ± 0.1 ma.

(4) Set meter switch on position V2-I_{P+S}.

(5) Adjust OUTPUT potentiometer for a reading of 25 ma.

(6) Adjust C14 for maximum reading.

(7) Readjust C8 again for maximum reading.

(8) Set meter switch on CR1.

(9) Adjust C21 and C32 for maximum reading.

(10) Readjust OUTPUT potentiometer for a reading of 60 ma.

(11) Readjust C21 and C32 for maximum reading.

(12) Observe the meter reading on CR1 and CR2 and readjust the OUTPUT potentiometer if necessary until the average of the two readings is 50 ma ± 2 ma.

(13) Check meter readings with the various switch positions.

Requirements:

Switch Position	Meter Reading
V1-E_P	150V ± 3V
V1-I_{P1}	13 ma ± 3 ma
V1-I_{G2}	0.3 ma ± 0.15 ma
V1-I_{P2}	8 ma ± 3 ma
V2-I_{P+S}	30 ma max
CR1	50 ma ± 12 ma
CR2	50 ma ± 12 ma

(D) Output Impedance Adjustment

13.07 Apparatus:

J68340A Test Bay
J68333A Test Bench

13.08 Procedure:

(1) Set up the test equipment as in Fig. 26.

(2) Set up the RF sweep oscillator for measurements at a frequency of 3950 mc ± 50 mc and adjust the oscilloscope to give approximately 10 mc per inch on the horizontal trace with a total sweep of 25 mc ± 5 mc.

(3) Adjust AT1 to obtain a power meter reading of 0 dbm.

(4) Set AT2 to 6 db, AT3 to 0, AT4 to 10db, and AT7 to 5.5 db.

(5) With a shorting plate on the output of AT7 and RF detector No. 1 disconnected, adjust the oscilloscope gain to make the separation of the trace and the baseline equal one inch.

(6) Connect the shifter to the output of AT7 in place of the shorting plate and set AT7 to 0 db.

(7) Adjust the movable transformers in the varistor cavities for minimum separation of the trace and the baseline.

Requirement: The separation of the trace and the baseline shall be less than one inch.

(E) Balance Adjustment

13.09 Apparatus:

J68340A Test Bay
J68333A Test Bench

13.10 Procedure:

(1) Set up the equipment as shown in Fig. 27.

(2) With the sweeping oscillator not sweeping, adjust the frequency to 3920 mc.

(3) Connect the RF power meter to D branch of DC1 and set AT4 to 20 db.

(4) Adjust AT1 for a power meter reading of 0 dbm.

(5) Set AT2 to such a value that the setting of AT2 plus 19 db = D branch loss of DC1.

(6) Connect the RF power meter to the output of the 1302D filter and measure the power.

(7) Adjust the movable transformers in the varistor cavities for minimum power.

Note: The balance point should be quite close to the best impedance point.

Requirement: The output power shall be less than -4 dbm.

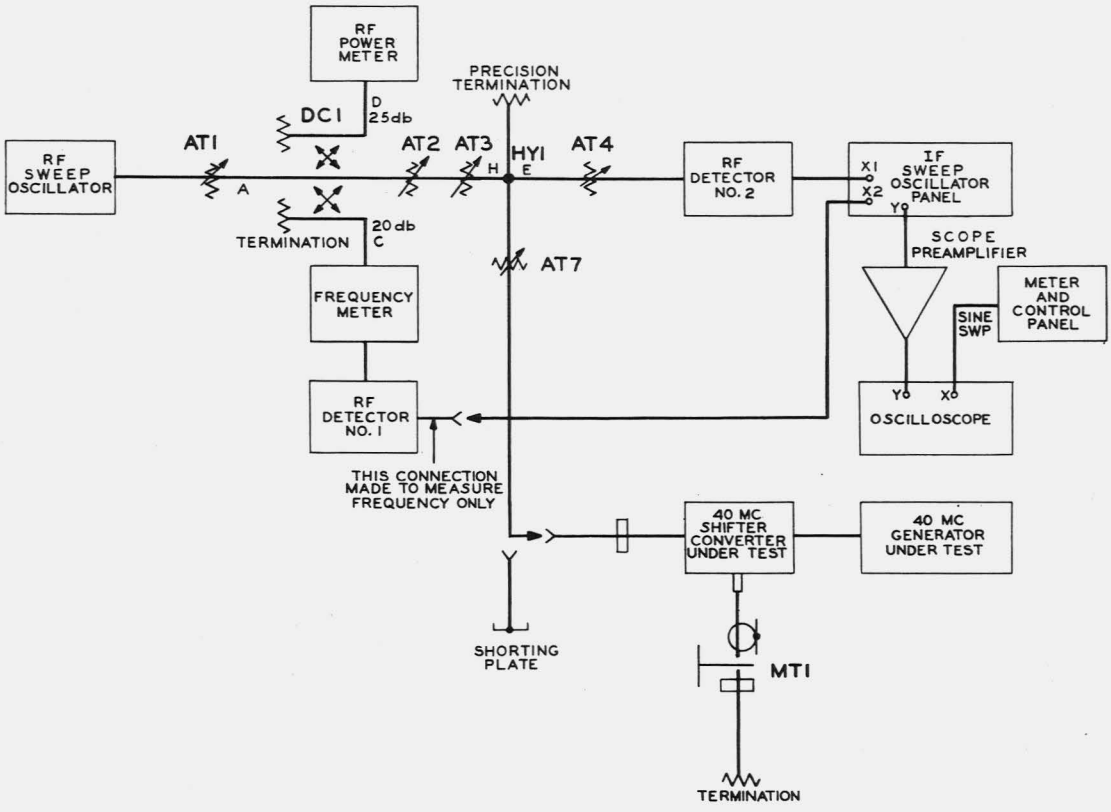

Fig. 26 - Test Arrangement for Output Impedance Adjustment of 40 MC Shifter

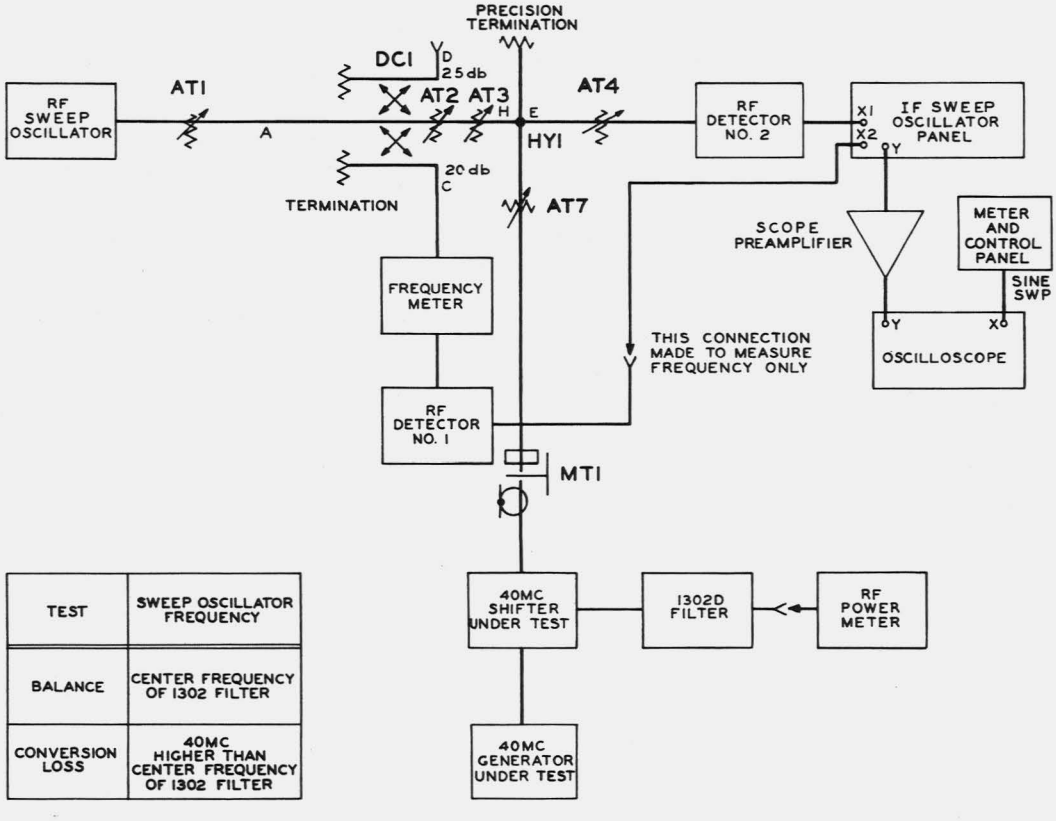

Fig. 27 - Test Arrangement for Balance Adjustment and Conversion Loss of 40 MC Shifter

(F) Conversion Loss

13.11 Apparatus:

J68340A Test Bay
J68333A Test Bench

13.12 Procedure:

(1) Set up the equipment for test as shown in Fig. 27, with AT9 set to 20 db and the RF power meter connected to D branch of DC1.

(2) With the RF sweep oscillator not sweeping, adjust the frequency to 3960 mc.

(3) Set AT2 to such a value that the setting of AT2 plus 19 db = D branch loss of DC1.

(4) Measure the output power from the shifter, by connecting the power meter to the 1302D filter.

Requirement: The output power shall not be less than +5 dbm.

(G) Continuity and DC Tests

13.13 Apparatus:

1 - DC voltmeter capable of measuring 11 volts with an accuracy of 0.2 volt.
1 - DC voltmeter capable of measuring 150 volts with an accuracy of 3 volts and 250 volts with an accuracy of 5 volts with a resistance of at least 20,000 ohms per volt.

13.14 Procedure:

(1) Check the filament voltage on the panel at the -11 volt test jack and the plate voltage at the +250 volt test jack.

Note: During all tests on the panel make sure the filament activity switches are thrown to the normal position.

(2) Set the meter switch to position V1-E_P and adjust the 150 volt potentiometer until the meter reads 150 volts ± 3 volts.

(3) With the voltmeter measure the voltages at the tube sockets of the 40 mc generator which should be as follows:

Tube	Terminal	Voltage
V1	4	145 ± 5 volts
V1	6	145 ± 5 volts
V2	5	240 ± 10 volts
V2	6	240 ± 10 volts

(H) Trouble Location Tests

13.15 Low varistor currents:

(1) Check the vacuum tube currents in the 40 mc generator.

(2) Realign the 40 mc generator circuits in accordance with (C)

(3) Check the plate voltages on the panel.

(4) Make sure the caps on the varistor cavities are secure.

(5) Replace varistors with a new pair and readjust in accordance with (D), (E), and (F).

13.16 Low output from shifter:

(1) Adjust REC CONV attenuator to increase power fed to the receiver converter.

Note: This applies when shifter is operating in the transmitter-receiver bay.

(2) If this does not result in enough power, check the output power supplied from the microwave generator.

(3) Check conversion loss in accordance with (F) and if this is low, replace varistors and readjust.

13.17 Noisy or intermittent output:

(1) Check tube and varistor currents in the shifter.

(2) Make sure the caps on the ends of the varistor cavities are secure.

(3) Check coaxial cable connections.

(4) Observe output from microwave generator for similar noisy or intermittent output.

(5) Make general bench tests.