

J68338A IF SWITCHING AMPLIFIER  
J68338B IF DISTRIBUTING AMPLIFIER

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1. GENERAL

1.01 This section describes the method of making maintenance and trouble

location tests and the alignment procedures to be followed in restoring the amplifier to normal operation.

1.02 The routine maintenance tests specified in Section R60.063 are made with the amplifier mounted in the patching bay. The equipment required consists of the J64001 IAK Tube Test Set, the 515A Filter, and the J68340A, List 1, Transmitter-Receiver Test Bay.

1.03 Alignment procedures and tests other than those for routine maintenance are made at the test bench with the amplifier removed from the bay. The equipment required consists of the J68333A Test Bench, and the J68340A, List 1, Transmitter-Receiver Test Bay.

Note: When any vacuum tube is changed, the gain limits of the amplifier must be checked. The input and output impedance and the gain-frequency characteristic must also be checked and adjusted to meet requirements. These tests and adjustments must be made at the test bench.

1.04 Any final adjustments of impedance or transmission must be made only after power has been applied to the amplifier for a period of at least 15 minutes time.

2. PREPARATION OF TEST EQUIPMENT

(A) General

2.01 It is assumed that the test equipment has been maintained and will be operated in accordance with the following Bell Systems Practices.

J68340A Test Bay	Section R70.200
J68333A Test Bench	Section R70.210
J64001 IAK Tube Test Set	Section R70.270

Note: Some early models of the IAK Tube Test Set may be found in the field with a loose dummy plug. It is suggested that on such models, the dummy plug be securely fastened to the cable end of the 15-pin connector by means of a cord about 9" long.

(B) To Check Transmission

2.02 Apparatus Required:

J68340A, List 1, Test Bay  
515A Filter

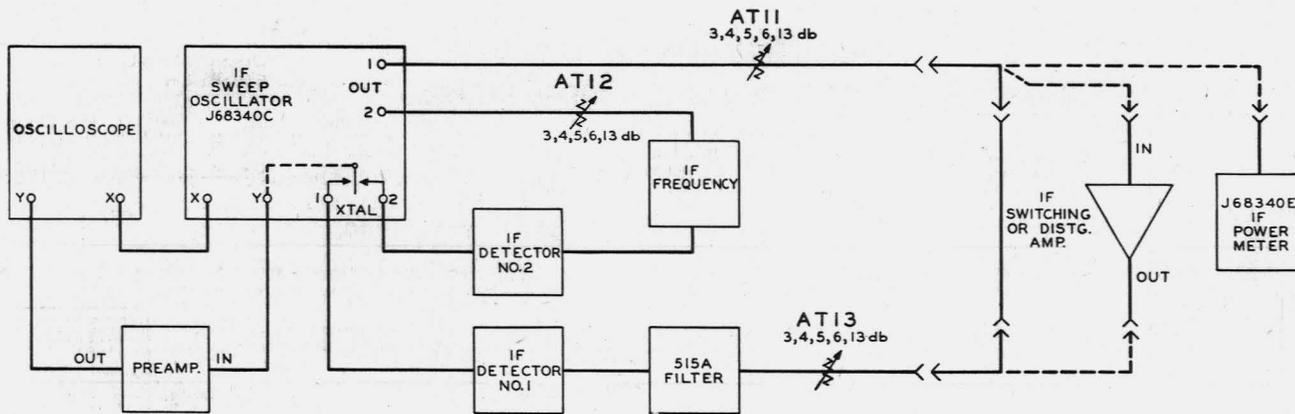


Fig. 1 - Transmission Test Setup for IF Switching and Distributing Amplifiers

2.03 The test setup used to measure gain and check the gain-frequency characteristic is shown in Fig. 1. The branch circuit containing AT12, the IF frequency meter, and IF detector No. 2 is the reference circuit and the trace appearing on the oscilloscope corresponding to transmission through this circuit is the reference trace. The branch circuit containing AT11, AT13, the 515A Filter, and IF detector No. 1, is the test circuit and the trace appearing on the oscilloscope corresponding to transmission through this circuit is the test trace whether the circuit contains the amplifier under test or simply a patch connection between AT11 and AT13.

2.04 The procedure by which the test setup is prepared for use is as follows:

- (1) Set the frequency meter in the J68340D IF Detector Panel at 80 mc and the frequency meter in the IF sweep oscillator at 60 mc. The 80-mc marker will now appear in the reference trace only while the 60-mc marker will appear in each trace.
- (2) Operate the slope switch on the IF sweep oscillator panel to ON.
- (3) Set AT11 at 15 db total attenuation.
- (4) Set AT12 at 20 db total attenuation.
- (5) Set AT13 at 5 db.
- (6) Connect the IF power meter to AT11 using a patch cord which is long

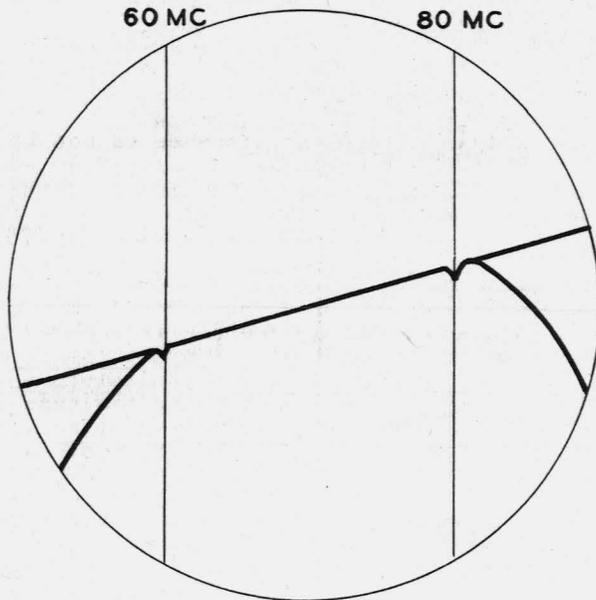
enough to reach from AT11 to the input of the amplifier which will be under test in a subsequent operation.

- (7) Adjust AT11 until the power meter reads  $+3 \pm 0.5$  dbm.

Note: This is the required power level which is to be applied to the input of the amplifier when gain or transmission tests are made.

- (8) Disconnect the patch cord from the IF power meter. Connect to AT13 a patch cord long enough to reach to the output of the amplifier under test. Connect the free ends of these two cords together using the short jack-ended cord furnished with the test bay.
- (9) Adjust AT12 and the vernier gain control on the IF sweeper, ADJ XTAL 1, until the two traces on the oscillator cross in the 60-80 mc range. Rotate the control ADJ SLOPE, on the IF sweeper until the traces are parallel. Continue to adjust AT12, the vernier gain and ADJ SLOPE controls until the two traces coincide in the frequency range 60-80 mc. If the two traces cannot be made to coincide because of a slope across the frequency band, interchange the connections of the IF detectors at XTAL 1 and 2. Readjust AT12 and the controls on the IF sweeper to obtain the required coincidence.
- (10) Increase the attenuation in AT13 to 6 db.
- (11) Adjust the vertical gain control of the oscilloscope until the





**B- NO TERMINATION  
SLOPE CKT ON & REF. TRACE  
ADJUSTED TO MATCH TEST TRACE**

Fig. 3 - IF Impedance Test -  
Scope Presentation  
After Reference Adjustment

typical scope presentation of the desired result.

- (10) Increase the attenuation of AT11 to 16 db.
- (11) Adjust the vertical gain control of the oscilloscope until the two traces are about 1/4" to 1/2" apart.

Note: The vertical sensitivity in inches per db will now be satisfactory for impedance tests.

- (12) Restore AT11 to 15 db.

2.08 At the conclusion of 2.07 (12) above, the test circuit is ready for use subject to the following test which should be made only as frequently as may be necessary to check the performance of the directional coupler and the 486A jacks.

- (1) Connect a second 486A jack to the C plug of the directional coupler.
- (2) Reduce the attenuation in AT14 to 10 db.

Requirement: The test trace shall remain below the reference trace in the frequency range 60-80 mc.

Note: Failure to meet this requirement indicates that either the directional coupler or the

486A jacks are defective and should be repaired or replaced.

### 3. ROUTINE MAINTENANCE TESTS AND REQUIREMENTS

#### (A) General

3.01 Tests of the Gain-Frequency Characteristic of IF switching and distributing amplifiers are to be made at 0-db gain. This is also the usual operating gain setting for the amplifiers. Hence, the initial test will be to set the amplifier gain to this value. However, there may be cases at auxiliary repeater stations where IF switching amplifiers are operated at some other gain setting. At such locations, the gain is readjusted after completion of maintenance tests to meet the requirements of individual circuits when those circuits are restored to service. At main stations and other locations where the patching level is fixed at +3 dbm, the gain control is not changed after adjustment to 0 db.

Note: IF switching amplifiers are to be tested individually for both gain and gain-frequency characteristics whether they are line switching amplifiers, program switching amplifiers, or part of a program switch group.

#### (B) Gain

3.02 After the test setup has been prepared as in part 2(B) above, gain adjustments are made as follows:

- (1) Disconnect the patch cords from the short jack-ended cord and use them to connect AT11 to the input of the amplifier under test and AT13 to the output of the amplifier under test.
- (2) Adjust the gain control for the transmission path being tested until the test and reference traces coincide at 60 mc. When this is done the gain is 0 db at 60 mc.

#### 3.03 IF Distributing Amplifier

- (1) Adjust GAIN A for the transmission path IN to OUT A.
- (2) Adjust GAIN B for the transmission path IN to OUT B.
- (3) Adjust GAIN C for the transmission path IN to OUT C.

#### 3.04 IF Switching Amplifier

- (1) Set up IN A to OUT transmission path by means of the switching control key or control circuit and adjust GAIN A.

(2) Set up IN B to OUT transmission path by means of the switching control key or control circuit and adjust GAIN B.

**Requirement:** The gain of each transmission path in IF Switching and Distributing Amplifiers shall be set for 0 db at 60 MC.

**Note:** If this requirement cannot be met, the amplifier shall be tested and adjusted as in parts 4 and 5.

### (C) Gain-Frequency Characteristic

3.05 This test should be performed for each transmission path immediately after part 3(B) above using the same test setup and gain adjustment.

3.06 Inspect the gain-frequency characteristic by comparison of the test and reference traces between the 60 and 80 mc frequency markers with reference to the requirements listed below. If the test trace lies above the reference trace at 80 mc, the gain is positive at 80 mc relative to 60 mc. If the test trace lies below the reference trace at 80 mc, the gain is negative at that frequency with respect to 60 mc. The test trace should not show appreciable deviation from a straight line between the 60 and 80 mc markers unless the same deviation from straightness is present in the reference trace. Fig. 4 shows the gain-frequency characteristic as presented by the test and reference traces on the oscilloscope. The upper test trace represents the upper limit and the lower test trace represents the lower limit.

**Requirement:** The gain-frequency characteristic of each transmission path in an IF Switching or Distributing Amplifier shall be approximately linear between 60 and 80 mc,

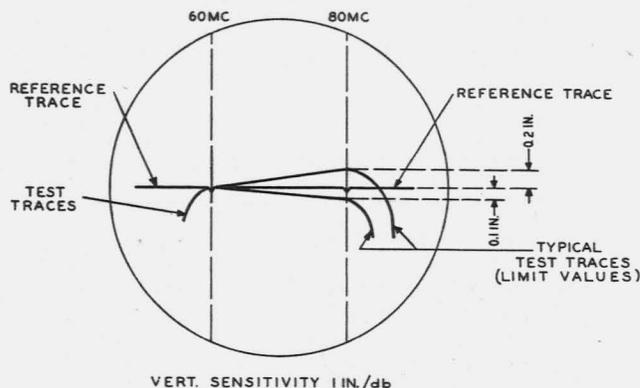


Fig. 4 - Gain-Frequency Characteristic for IF Switching and Distributing Amplifier

and the gain at 80 mc relative to 60 mc shall be within the limits -0.1 db and +0.2 db.

**Note:** If the requirements cannot be met, the amplifier shall be tested and adjusted as described in parts 4 and 5.

### (D) Filament Activity Test

3.07 Filament activity tests on IF Switching and Distributing Amplifiers may be made while the amplifiers are in service. In the case of the switching amplifier, however, a hazard exists because the tube which is cut off must be returned to normal operation before the test can be made. A test on this tube while the other tube is in service requires that the patch connection to the input corresponding to the cut-off tube be removed and the FIL ACT switch on the rear of the amplifier chassis be operated. This procedure will activate the tube previously cutoff but, since its input circuit is open, no interference in the desired service will result. If this procedure is followed, a required preliminary step is to make sure that there is no requirement for switching the amplifier during the time the activity test is being made. Finally, the patch connection must be restored. In view of these complications it is recommended that, whenever possible, the filament activity tests on IF Switching Amplifiers, particularly program switching amplifiers, be made when they are out of service for other maintenance tests. If the test is made while the switching amplifier is out of service, make it on one tube then operate the switching control key or control circuit to establish operation of the other tube. Allow about 5 minutes time for the tube to stabilize and proceed with the activity test of this second tube.

3.08 Filament activity tests are made with the J64001 1AK Tube Test Set. The method of making the test is given in Section R70.270.

3.09 Perform a filament activity test on each of the two 404A tubes of the IF Switching Amplifier and on each of the four 404A tubes of the IF Distributing Amplifier. If the meter on the test set cannot be set to 0% on a particular tube, the test need not be completed. The initial bias reading as well as the final % reading should be recorded since the requirement is related to the bias.

**Requirement:** The % change in bias shown by a vacuum tube in an IF Switching Amplifier or Distributing Amplifier as a result of a filament activity test is related to the initial bias and shall not be greater than shown in the table below:

Table of Requirements

Initial Bias Volts	Maximum Bias Change %
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(values to be determined)

If the requirement cannot be met, the 404A tube must be changed and the amplifier performance checked as described in part 4.

(E) Panel Lights

3.10 NE51 lamps are used on the front panel of the IF Switching Amplifier to indicate the active transmission path. The bulbs of these lamps become discolored with use. Inspection of the lamps, either by noting their brightness or by unscrewing the plastic caps and checking the blackening of the bulb glass, will readily indicate when the lamps should be replaced.

Caution: A switching amplifier in service will have only one lamp lighted. The other lamp should be inspected by direct examination of the bulb. If the switching amplifier is out of service for other maintenance tests, the brightness of both lamps can be inspected by operating the switching control key or control circuit.

A panel light may be changed while the amplifier is in service.

4. BENCH TESTS, REQUIREMENTS AND ADJUSTMENTS(A) General

4.01 The close spacing of the IF Switching and Distributing Amplifiers in the mounting frame on the patching bay does not permit changing tubes or adjusting coils and condensers of the transformer circuits while the amplifier is in place. The input and output capacities of vacuum tubes vary somewhat from tube to tube and since these capacities are part of the constants of the transformer network the other elements of the network will usually require slight re-adjustment when a vacuum tube is changed. These adjustments must be made at the test bench.

4.02 Apparatus required for making bench tests and adjustments:

J68333A Test Bench  
J68340A, List 1, Test Bay

4.03 Bench tests and adjustments are made after an IF Switching or Distributing Amplifier has failed to meet its requirements during maintenance tests or whenever trouble location tests have been applied because of service failure.

4.04 All bench tests are to be made after the amplifier cover has been securely fastened to the chassis, the amplifier has been connected to the proper power supply outlet at the test bench, the rheostat on the control panel has been adjusted to give -11 volts, and the amplifier has been permitted to warm-up. Final adjustments of impedance shall be made after the amplifier 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.

4.05 The order in which bench tests are to be made is important, particularly if adjustments are required. The tests are made in the following order.

- (1) Output impedance
- (2) Input impedance
- (3) Gain
- (4) Gain-frequency characteristic
- (5) Crosstalk

An exception is noted in 4.07(2)(a) in the case of the switching amplifier.

(B) Impedance

4.06 To check impedance and to make any necessary impedance adjustments use the test setup of Fig. 2 prepared for use as in part 2(C). Proceed as follows:

- (1) Plug C of the IF directional coupler directly into the jack where the impedance is to be checked.
- (2) Reduce and adjust the total attenuation of AT13 and AT14 until the test trace approaches as near the reference trace as possible in the 60-80 mc range but does not lie above the reference trace in any part of this frequency interval.
- (3) Note the total attenuation in AT13 and AT14 for the above condition. Call this attenuation A1. The return loss for the impedance under test is

$$\text{Return loss in db} = 50 - A1.$$

- (4) If the return loss for the impedance under test fails to meet the requirement, adjustment of the input or output transformer network constants will have to be made. The various requirements and adjustments are given below. Fig. 5 shows a typical scope presentation of an input or output return loss characteristic after final adjustments have been made. The return loss requirement is based on the smallest value of return loss in the 60-80 mc

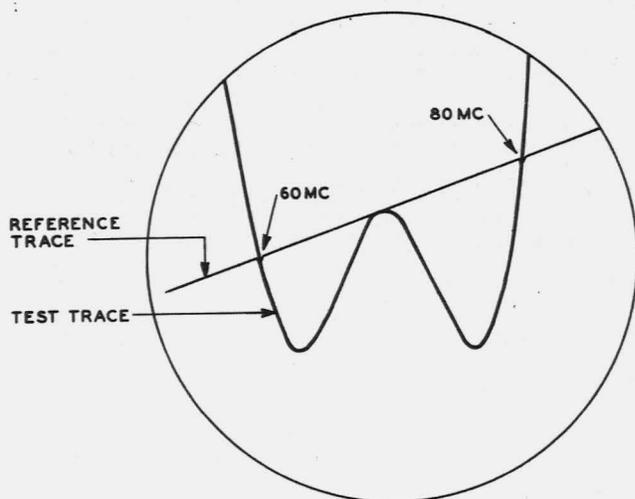


Fig. 5 - IF Impedance Test -  
Scope Presentation  
After Impedance Adjustment

frequency band. Where the test trace lies below the reference trace the return loss is more than (50 - A1) db. The shape of the return loss characteristic shown in Fig. 5 is not typical of that obtained when testing at the monitor jacks of the switching amplifier.

#### 4.07 IF Switching Amplifier

##### (1) Output impedance

- (a) Check the output return loss when the switching control key is set at A.
- (b) Check the output return loss when the switching control key is set at B.

Requirement: The output return loss shall be at least 25 db for each position of the switching control key.

- (c) If the requirement is not met, adjust components L11, L12 and C20.
- (d) If the requirements cannot be met by adjusting L11, L12 and C20, check V1 and V2 and all components of the output circuit including filter elements in the +130V supply lead. Replace any defective components.

##### (2) Input impedance

- (a) Input impedance tests are made preferably after the gain

controls GAIN A and GAIN B have been adjusted to give 0 db gain from IN A to OUT and from IN B to OUT. Instructions for setting the gain to 0 db are given in paragraph 4.09 below. If the impedance is badly out of adjustment, as may be the case after a defective component in the input circuit has been replaced, the gain cannot properly be set to 0 db until the input impedance is at least partially adjusted. In this case, rotate the gain control approximately 1/4 turn counter-clockwise starting from its maximum clockwise position. These settings are made so that the input capacity of the tubes will be as nearly as possible equal to its value under service conditions.

- (b) Check the input return loss at IN A when the switching control key is thrown to A so that IN A is a part of the active transmission path in the amplifier.

- (c) Check the input return loss at IN B when the switching control key is thrown to B so that IN B is a part of the active transmission path in the amplifier.

Requirement: The input return loss shall be at least 27 db at IN A and IN B.

- (d) If the requirement is not met at IN A, adjust components L6, L7, L8, and C10. If the requirement still cannot be met, V2 and all components associated with IN A shall be checked and replaced if necessary.
- (e) If the requirement is not met at IN B, adjust components L1, L2, L3, and C1. If the requirement still cannot be met, check V1 and all components associated with IN B and replace if necessary.
- (f) If either V1 or V2 is changed repeat 4.07(1) in addition to repeating the input impedance test.

##### (3) Impedance at Monitor Jacks

- (a) Check the return loss at MON A jack.
- (b) Check the return loss at MON B jack.

Requirement: The return loss at MON A and MON B jacks shall be at least 25 db.

- (c) If the requirement cannot be met at MON A, replace R15 and/or R17. Repeat the impedance test at IN A as well as at MON A.

- (d) If the requirement cannot be met at MON B, replace R2 and/or R3. Repeat the impedance test at IN B as well as at MON B.

#### 4.08 IF Distributing Amplifier

##### (1) Output Impedance

- (a) Check the return loss at OUT A.  
 (b) Check the return loss at OUT B.  
 (c) Check the return loss at OUT C.

Requirement: The output return loss shall be at least 25 db measured at each output jack.

- (d) If the requirement cannot be met at OUT A, adjust L27, L28, and C39. If the requirement cannot be met by adjusting these components, check V4 and all components associated with OUT A. Replace if necessary.

- (e) If the requirement cannot be met at OUT B, adjust L15, L16, and C23. If the requirement cannot be met by adjusting these components, check V2 and all components associated with OUT B. Replace if necessary.

- (f) If the requirement cannot be met at OUT C, adjust the components L21, L22, and C31. If the requirement cannot be met by adjusting these components, check V3 and all components associated with OUT C. Replace if necessary.

##### (2) Input impedance

- (a) Check the return loss at the IN jack.

Requirement: The input return loss shall be at least 30 db.

- (b) If this requirement cannot be met, adjust components L2, L3, C1 and C47. If the requirement cannot be met by adjusting these components, check V1 and all components of the input circuit. Replace any defective components.

#### (C) Gain

4.09 The test setup and its preparation for use have been described in part 2(B). To make a gain test and adjustment proceed as follows:

- (1) Disconnect the patch cords from the short jack-ended cord and use them to connect AT11 to the input of the

amplifier under test and AT13 to the output of the amplifier under test.

- (2) Set AT13 to 6 db.

- (3) Rotate the gain control clockwise until the test trace coincides with or lies above the reference trace at 60 mc. If the test trace just meets the reference trace, a gain margin of 1 db is indicated. If the test trace lies above the reference trace, the gain margin is more than 1 db.

Requirement: The gain margin of each transmission path through an IF switching amplifier or an IF distributing amplifier shall be 1 db or greater.

- (4) Set AT13 to 5 db.

- (5) Adjust the gain control until the test and reference traces coincide at 60 mc. This corresponds to 0 db gain at 60 mc. It is the gain adjustment required for gain-frequency characteristic tests and is the final gain adjustment.

Requirement: Each transmission path through an IF switching amplifier or an IF distributing amplifier shall be adjusted to 0 db gain.

#### 4.10 IF Switching Amplifier

- (1) To make gain tests and adjustments from IN A to OUT the switching control key must be set to A. Similarly, to test IN B to OUT, the switching control key must be set to B. Failure to meet the requirement of 4.09(3) usually indicates a poor tube - V2 in the case of IN A and V1 in the case of IN B. Other cases of gain failure will be treated under Trouble Location Tests.

#### 4.11 IF Distributing Amplifier

- (1) Failure to meet gain margin requirements of 4.09(3) usually indicates a poor tube or tubes. The association of tubes with transmission paths is as follows:

IN - OUT A, V1 and V4

IN - OUT B, V1 and V2

IN - OUT C, V1 and V3

Note that V1 is common and if all transmission paths have small margins, it should be checked first. If the failure to meet the margin requirement is associated with a specific output the other tube in that transmission

path should be checked. Other cases of gain failure will be treated under Trouble Location Tests.

#### (D) Gain-Frequency Characteristic

4.12 The test setup required and its initial adjustment have been described in part 2(B). The method of connecting the amplifier into the setup is given in 4.09(1). The procedure for checking the gain-frequency characteristic and the requirements which apply are given in 3.05 and 3.06.

#### 4.13 IF Switching Amplifier

- (1) Set the switching control key to A. Test the gain-frequency characteristic of the transmission path IN A - OUT with the path gain adjusted to 0 db.
- (2) Set the switching control key to B. Test the gain-frequency characteristic of the transmission path IN B - OUT with the path gain adjusted to 0 db.
- (3) If requirements for the gain-frequency characteristic cannot be met, the trouble may be a poor tube but is more likely to be a faulty circuit component. Proceed as indicated in Trouble Location Tests.

#### 4.14 IF Distributing Amplifier

- (1) Check the gain-frequency characteristic of each transmission path through the IF distributing amplifier. The transmission to each output should meet the requirements given in 3.06. In general, it will not be possible to adjust the transmission so that the gain-frequency characteristics to the three outputs are identical.
- (2) If the gain-frequency characteristic of transmission to one or more of the outputs is only slightly out of limits, a slight readjustment of one or more of the coils in the interstage, L7, L8, L10 or L11, will normally be sufficient to bring all 3 transmissions into the range of requirements. For example, if the transmission at 80 relative to 60 mc is 0 db at OUT A, -0.1 db at OUT B and -.15 db at OUT C, connect to OUT C and readjust L7 to bring OUT C up to about -.05 db. Check the transmission to OUT A and OUT B. These will now be found to be about +0.1 db and 0 db respectively.
- (3) If the gain-frequency characteristics of the transmissions to the various outputs differ widely or fail to meet requirements by large amounts the procedures for readjustment of the interstage may vary somewhat. It is

understood, of course, that all impedances must meet their requirements before the interstage is adjusted.

(4) If an interstage component has been replaced, set up to check the gain-frequency characteristic of any transmission path and adjust that component until requirements are met. Check the transmission to the other outputs. If necessary trim the adjustment of the other components. The adjustable interstage components are L7, L8, L10, L11 and C13.

(5) If a complete realignment of the interstage is required, the following steps comprise the recommended procedure.

(a) Connect the amplifier into the circuit to test transmission to OUT A. During the preliminary lineup of the interstage set GAIN A control at the approximate center of its range.

(b) Note the attenuation in AT12 as A2.

(c) Adjust the AT12 as may be required for comparison of the test and reference traces on the oscilloscope.

(d) Adjust components L7, L8, L10, L11 and C13 until the test trace approximates the reference trace in the 60-80 mc frequency range.

(e) Set AT12 at A2 db and adjust GAIN A until the two traces nearly coincide.

(f) Continue adjustment of components and GAIN A until the test and reference traces coincide to  $\pm 0.1$  db in the transmission band 60-80 mc.

Note: This is a preliminary requirement. If it cannot be met check all interstage components and all tubes. Replacing any tube will require rechecking the impedance of the corresponding output or input circuit.

(g) Check the gain margin at OUT A. See 4.09(1)-(4).

(h) If the gain margin is not met, use C13 to increase the gain. Readjust L7, L8, L10, and L11 but change C13 as little as possible. Continue these adjustments and repeat the general procedure of (d)-(g) above until the gain margin requirement and the preliminary requirement of (f) are both met.

(i) Set AT12 at A2 db, AT13 at 5 db, and adjust GAIN A until the test trace and the reference trace coincide at 60 mc.

(j) Disconnect OUT A from AT13 and connect OUT B to AT13.

(k) Adjust GAIN B until the test and reference traces coincide at 60 mc. Note the gain-frequency characteristic at OUT B and proceed without reference to its requirement.

(l) Check the gain margin at OUT B. If the gain requirement is not met, proceed as outlined above in (h) for OUT A.

(m) Apply the general procedure outlined in (i) through (l) above to OUT C.

(n) Step n completes the preliminary lineup of the interstage. Check the gain margin and gain-frequency characteristic at each output without making further adjustments of interstage components. Apply the requirements of 3.06 and 4.09(3). If these requirements are met, the interstage adjustments are completed, the requirements of 4.09(5) should be complied with, and the amplifier is ready for service. If the requirements are not met for each transmission path, it will be necessary to make further adjustments of the interstage components. Proceed as below.

(o) Set up to check the transmission to that output which shows the poorest characteristic. Improve this characteristic by adjusting any or all of the components L7, L8, L10, L11 and C13, as may be necessary. Experience will show that these trimming adjustments can usually be made by a slight change in only 1 or 2 of the components. When this transmission meets its requirements, repeat (n). If necessary, repeat this general procedure until all requirements are met. Ultimate failure to meet requirements requires locating and replacing faulty interstage components and repeating the transmission tests.

(6) Discussion of distorted gain-frequency characteristics will be found under trouble location tests.

#### (E) Crosstalk

4.15 The setup of Fig. 2 is adapted and used to measure crosstalk as follows:

(1) Remove the IF directional coupler from the circuit and set the power level out of AT11 at  $+3 \pm .5$  dbm using the IF power meter as in 2.04(6) and (7).

(2) The slope switch in the IF sweep oscillator panel shall be ON.

(3) Set AT12 at 15 db.

(4) Set AT13 and AT14 to a total attenuation of 60 db.

(5) Connect AT11 to AT13.

(6) Adjust IF GAIN at the control panel for the IF main amplifier until the test and reference traces cross in the 60-80 mc range. Rotate the control ADJ SLOPE on the IF Sweeper until the two traces are approximately parallel. If this cannot be done because of a slope across the frequency band, interchange the connections of the IF detectors at XTAL 1 and 2. Adjust IF GAIN and ADJ SLOPE until the two traces intersect at the 60 and 80 mc markers and are as near coincidence as possible over the intervening frequency band.

(7) Increase the attenuation of AT12 to 16 db.

(8) Adjust the vertical gain control of the oscilloscope until the two traces are about  $1/4"$  to  $1/2"$  apart.

(9) Restore AT12 to 15 db.

(10) Disconnect AT11 from AT13.

(11) Connect AT11 to an input and connect AT13 to the output of an IF switching amplifier. Establish normal transmission from this input to the output. (The gain of the amplifier must have been previously set at 0 db).

(12) Throw the switching control key to cut off the transmission path.

(13) Reduce and adjust the total attenuation in AT13 and AT14 until the highest part of the test trace is within  $\pm 1/2$  db of the reference trace.

(14) Note the total attenuation of AT13 and AT14 as  $A_3$ . The crosstalk reading is obtained from the equation

$$\text{Crosstalk in db} = A_3 - 60.$$

4.16 Measure the crosstalk from IN A to OUT and from IN B to OUT of the IF switching amplifier.

Requirement: -55 db for each transmission path.

4.17 If IN A fails to meet the requirement, change V2. If IN B fails to meet the requirement, change V1.

4.18 If either V1 or V2 is changed the amplifier impedance and transmission characteristics must be rechecked.

## 5. TROUBLE LOCATION TESTS

### (A) General

5.01 These tests assume that the trouble has been localized in a particular amplifier and cannot be remedied by the impedance or transmission adjustments described in part 4.

5.02 Apparatus Required.

J68333A Test Bench

J68340, List 1, Test Bay

5.03 Trouble location tests are usually made at the test bench with the back cover of the amplifier removed. Tests which do not involve voltage measurements should be made with no power connected to the amplifier. Measurements of bias on the vacuum tubes can be made using the LAK Tube Test Set when the amplifier is mounted on the bay.

5.04 Faults in wiring such as poorly soldered connections or broken leads, can often be located by visual inspection only.

### (B) Voltage Measurements

5.06 Voltage measurements at the vacuum tube sockets made with the Weston Model 779 Analyzer can be used to isolate a faulty d-c supply circuit. It is assumed that the +130 V supply at the test bench is actually +135 V.

5.07 Operating bias of the tubes may be measured using the LAK Tube Test Set operated as a voltmeter. The bias will depend upon the setting of the gain control. When the gain control is set at its maximum clockwise position the bias reading should show from 0.5 to 1 volt. If the bias control is set at its maximum counter-clockwise position, the bias will be much greater, usually in excess of 2 volts.

5.08 IF Switching Amplifier

(1) The following table lists the voltages which are required for normal operation of the IF switching amplifier.

Table of Normal Voltages

SW CONT KEY Setting	Positive Connection	Negative Connection	Volts
A	V2 Pin 1	Chassis Grd.	8.0-11
B	V1 Pin 1	Chassis Grd.	8.0-11
A or B	V2 Pin 6	Chassis Grd.	133-135
A or B	V2 Pin 8	Chassis Grd.	133-135
A or B	V1 Pin 6	Chassis Grd.	133-135
A or B	V1 Pin 8	Chassis Grd.	133-135
A	Pin 6 of PWR	Chassis Grd.	110-120
B	Pin 4 of PWR	Chassis Grd.	110-120
A and B	Pin 2 of PWR	Chassis Grd.	110-120
A or B	Chassis Grd.	V1 Pin 9	6.0-6.3
A or B	Chassis Grd.	V2 Pin 3	6.0-6.3

(2) To measure the bias of a tube which has been cut off for some time, establish the transmission path through the tube, wait several minutes to permit the bias to come to a stable value, and then measure the bias.

5.09 IF Distributing Amplifier

(1) The following table lists the voltages which are required for normal operation of the IF distributing amplifier.

Table of Normal Voltages

Positive Connection	Negative Connection	Volts
Pin 8 of TST Jack	Chassis Grd.	8-11
Pin 6 of each VT socket	Chassis Grd.	133-135
Pin 8 of each VT socket	Chassis Grd.	133-135
Chassis Grd.	Pin 9 of V3	6.0-6.3
Chassis Grd.	Pin 3 of V1, V2 and V4	6.0-6.3

### (C) Continuity

5.10 Continuity tests will be made at the test bench with the back cover of the amplifier removed and no power applied. Voltage measurements as in part 5(B) above will serve a purpose similar to continuity tests in some instances.

5.11 Apparatus

Weston Model 779 Analyzer

### (D) No Transmission

5.12 If the amplifier is mounted in the bay, check the filament

and plate supply voltages at the fuse block.

### 5.13 IF Switching Amplifier

(1) When there is no transmission through either side of the amplifier.

- (a) Check that both tubes are lighted.
- (b) Check the plate voltage at pin 6 of each tube.
- (c) Check continuity from pin 6 of either tube to the junction of L13 and C20.
- (d) Check the control circuit. This circuit should take the voltage at pin 2 of the PWR jack and deliver the same voltage to either pin 4 or pin 6 of the same jack.

(2) No Transmission from IN A to OUT.

- (a) Check that V2 is lighted.
- (b) Check the plate voltage at pin 6 of V2.
- (c) Check the screen voltage at pin 8 of V2.
- (d) Check the voltage at pin 1 of V2. Make this check with due regard to the sign of the voltage. If -11 volts is obtained, the connection from R26 to pin 6 of PWR plug is open or the switching control circuit is not delivering sufficient voltage to pin 6.
- (e) Check continuity from pin 4 of V2 to chassis. Resistance should be between 400 and 2,000 ohms.

(3) No Transmission from IN B to OUT.

- (a) Check that V1 is lighted.
- (b) Check the plate voltage at pin 6 of V1.
- (c) Check the screen voltage at pin 8 of V1.
- (d) Check the voltage at pin 1 of V1. Make this check with due regard to the sign of the voltage. If -11 volts is obtained the connection from R27 to pin 6 of PWR plug is open or the switching control circuit is not delivering sufficient voltage to pin 6.
- (e) Check continuity from pin 4 of V1 to chassis. Resistance should be between 400 and 2000 ohms.

### 5.13 IF Distributing Amplifier

(1) When there is no transmission to any output of the amplifier.

- (a) Check that all tubes are lighted.
- (b) Check the voltage at pin 6 of each tube.
- (c) Check the voltage at pin 8 of each tube.
- (d) Check continuity from pin 1 of V1 to the junction of L1 and C1.
- (e) Check continuity from the input jack J1 to the junction of R2 and C1. Resistance should be approximately 50 ohms.
- (f) Check continuity from the input jack J1 to chassis. Resistance should be approximately 125 ohms.
- (g) Check the continuity from pin 4 of V1 to chassis. Resistance should be approximately 525 ohms.
- (h) Check continuity from V1 pin 6 to the junction of L30 and C14. Resistance should be less than 5 ohms.
- (i) Check continuity from V2 pin 1 to the junction of L10 and C14. Resistance should be approximately 30 ohms.

(2) When there is no transmission to OUT A.

- (a) Check that V4 is lighted.
- (b) Check the voltages at pins 1, 6, and 8 of V4.
- (c) Check continuity from V4 pin 6 to the junction of L27 and C29.
- (d) Check continuity of V4 pin 4 to chassis. Resistance should be between 500 and 1500 ohms.

(3) When there is no transmission to OUT B.

- (a) Check that V2 is lighted.
- (b) Check the voltages at pins 1, 6, and 8 of V2.
- (c) Check continuity from V2 pin 6 to the junction of L15 and C23.
- (d) Check continuity from V2 pin 4 to chassis. Resistance should be between 500 and 1500 ohms.

- (4) When there is no transmission to OUT C.
- (a) Check that V3 is lighted.
  - (b) Check the voltages at pins 1, 6, and 8 of V3.
  - (c) Check continuity from V3 to the junction L21 and C31.
  - (d) Check continuity from V3 pin 4 to chassis. Resistance should be between 500 and 1500 ohms.

(E) Low Transmission

5.15 The difference in cause between low transmission and no transmission may be one of degree and the test checks of part 5(D) are applicable. The most probable causes of low transmission are poor tubes, low filament voltage, or low positive bias voltage at the grids.

- (1) Check the filament voltage at pin 3 or pin 9 of all tubes.
- (2) Check the voltage at pin 1 of all tubes.
- (3) If the positive voltage at pin 1 is below 8 volts in a switching amplifier make the following tests.
  - (a) Check voltage at pin 2, 4, and 6 of PWR plug. See 5.08. In some cases this voltage can be increased by changing the switch indicating lamp IA, or IB, in the circuit.
  - (b) Check resistance values of R26, R27, R28, and R30.
- (4) If the positive voltages at pin 1 are below 8 volts in a distributing amplifier, check the resistance value of R8 and R9.

- (5) Make continuity checks from pin 4 to chassis at all tubes. Normal resistance values depend on the setting of the gain control. For the switching amplifier the values will range from 400 to 2000 ohms, being 400 ohms at maximum gain and 2000 ohms at minimum gain. For the variable gain tubes in the distributing amplifier the corresponding values are 525 and 1500 ohms. For V1 in the distributing amplifier, the resistance value is 525 ohms.

(F) Distorted Gain-Frequency Characteristic

5.16 When trying to correct a distorted gain-frequency characteristic, always check input and output impedances since proper adjustment of these impedances is a prerequisite for good transmission. If the impedances are good the trouble will be found in defective by-pass condensers in the DC supply circuit for plate, screen and grid. In the case of the IF distributing amplifier also examine the interstage network for defective components or defective wiring.

5.17 Distorted gain-frequency characteristic is often associated with low gain. Correct the gain trouble first.

(G) Failure to Meet Impedance Requirements

5.18 If impedance requirements are not met examine the input or output network for faulty components or wiring. The by-pass condensers particularly, and filter elements generally, associated with the networks and attached DC supply circuits should also be checked.

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