OVER-THE-HORIZON RADIO SYSTEMS
ITTL 12A-1 OVER-THE-HORIZON RADIO SYSTEM
NUS 3298 RECEIVER
NUS 3354 RF AMPLIFIER
TESTS AND ADJUSTMENTS

This section contains the tests for the NUS 3354 RF amplifier. The tests are arranged in a sequence for minimum duplication of effort and should be performed in the order given.

Unless otherwise noted, the tests and adjustments described in this section require the system receivers to be operated in dual diversity with the receiver under test removed from service as described in Section 403-413-301. Each dual diversity receiver is equipped with two receiver control units. Except for automatic gain control functions, the upper receiver control unit is associated with the left receiver branch and the lower receiver control unit is associated with the right receiver branch.

CHART **PAGE**

APPARATUS:

1—Test Set, 45A

1—General Radio Co. Signal Generator, 1021AU

1—VARI-L Co. Doubly Balanced Mixer, 200 dBm

1—Matching Attenuator, 75 to 50 ohms, 20 dB

1—Hewlett-Packard Noise Source, 349A

1—Hewlett-Packard Noise Figure Meter, 342A

1—Hewlett-Packard Coaxial Termination, 908A

APPARATUS (Cont):

1—General Radio Co. Vacuum Tube Voltmeter, GR 1800-B (VTVM)

1—416B Tube Mount Shim, .006 in.

2—416B Tube Mount Shim, .012 in.

2—416B Tube Mount Shim, .015 in.

1—KS-14408 Tube Extractor

CHART 1

ELECTRON TUBE TESTS

The conclusive test of the RF amplifier tube is the measurement of performance as an amplifier as described in Chart 3 of this section.

The fundamental emission test described in this part is a measure of the suitability of a tube for use in the RF amplifier. This test can be performed with the receiver in service.

STEP	PROCEDURE
1	On the receiver control unit associated with the receiver branch under test, operate the meter switch to the TST B position.
2	Connect the receiver branch filament activity test cord to the TP1B test jack on the RF amplifier and observe the control unit meter. ***Requirement:*** The meter should indicate a positive RF amplifier cathode bias. ***Note:*** If the receiver control unit meter indicates a negative or zero cathode bias voltage, tube V1 in the RF amplifier should be replaced. The tube replacement procedure is described in Chart 4 of this section.

CHART 2

GAIN-FREQUENCY TESTS

The RF amplifier requires periodic test and alignment to compensate for tube characteristic changes. The amplifier must be realigned following tube replacement. To attain proper alignment, the procedures described should be performed in the order presented.

CHART 2 (Cont)

The RF amplifier is tuned to the receiver signal frequency. The swept-frequency test equipment arrangement generates outputs at the signal frequency and at other undesired frequencies. The alignment instructions are designed to prevent improper frequency selection.

The tuning controls should operate without binding, and meter and oscilloscope indications should respond smoothly to the adjustment of controls. Erratic indications observed when adjusting the cavity controls indicate internal trouble in the cavities. Generally, this type of trouble can be corrected by cleaning and adjustment of cavity components or replacement of worn parts. Section 410-402-503 describes procedures for maintenance of similar microwave cavities.

The RF amplifier test arrangement includes the receiver mixer and IF preamplifier. The test results include the performance of these units. It is an ***absolute pre-requisite*** that the IF preamplifier used with the RF amplifier meets the requirements of the Gain-Frequency Characteristic and Gain Test in Section 410-722-500.

STEP	PROCEDURE

1 Determine that the RF amplifier is tuned to the receiver frequency. If the receiver performance has been near normal and there have been no tube or component replacements or tuning control adjustments made on the RF amplifier, it is established that the RF amplifier circuits are tuned to the proper received signal frequency.

Requirement: The RF amplifier tuned circuits should be aligned to the receiver frequency as determined in Step 1.

Note: If the requirement is met, proceed with Step 8. The intervening steps may be omitted. If this requirement is not met, proceed with Step 2.

2 In the receiver branch ***not*** under test, remove the cable normally used at the IF amplifier INPUT jack.

3 On the 1021AU signal generator, make the following control adjustments:

CONTROL	POSITION
POWER	POWER
MODULATION	OFF
METER READS	CARRIER
ATTENUATOR	Fully clockwise
250-920 MEGACYCLES	Receiver frequency

CHART 2 (Cont)

STEP	PROCEDURE

4 Determine which of the two receiver control units is in use for receiver gain control by noting the position of the AGC amplifier selector switch on the diversity switching panel. Make the following control adjustments on the receiver control unit in use:

CONTROL	POSITION
CONT	MAN
MAN	Fully counterclockwise
Meter switch	RCVR OUTPUT

5 Using coaxial cable, connect from the signal generator OUTPUT jack to the INPUT jack J1 on the RF amplifier.

6 While observing the receiver control panel meter, slowly adjust the signal generator ATTENUATOR control clockwise until a meter deflection is obtained. If no deflection is seen, set the ATTENUATOR control fully counterclockwise and adjust controls C3 and C5 on the RF amplifier until a small meter defection is obtained.

7 While limiting the meter indication to half-scale value by means of the signal generator ATTENUATOR control, adjust capacitors C3 and C5 on the RF amplifier until the greatest value meter indication is obtained with the least signal generator output level. This is a preliminary adjustment and need not be refined.

8 Arrange the test equipment as shown in Fig. 1. Use option (W).

9 On the 45B IF sweep oscillator, set the controls to the indicated positions:

CONTROL	POSITION
POWER	ON
SWEEP	Fully clockwise
AT 11	15 DB
AT 12	15 DB
FREQ M1	60
FREQ M2	80

10 On the 45C RF sweep oscillator, set the POWER switch to OFF and the MTR switch to IF DBM.

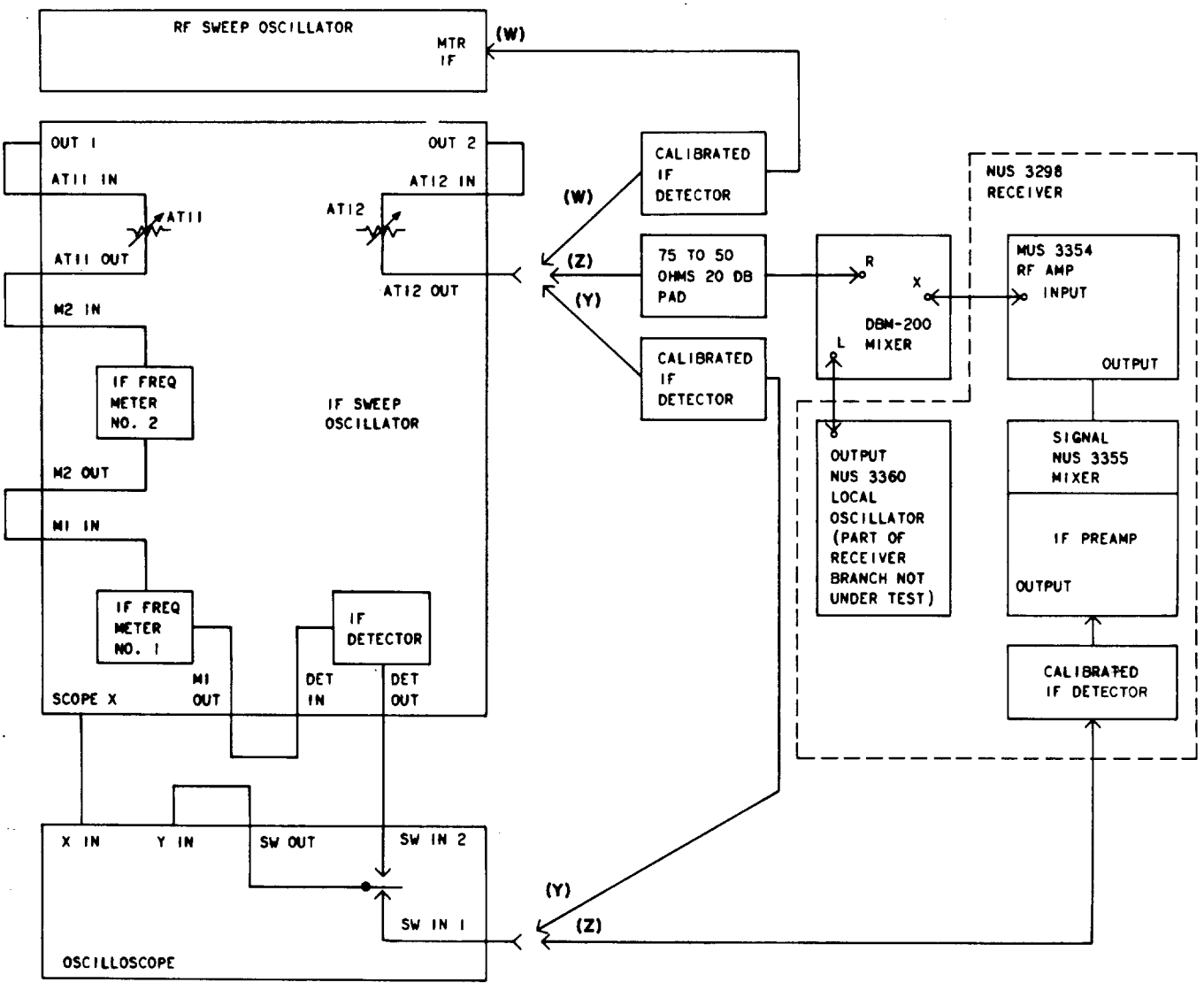


Fig. 1—Gain-Frequency Characteristic Tests—Test Setup Diagram

CHART 2 (Cont)

STEP	PROCEDURE
11	Adjust AT12 to produce an indication of +3.0 dBm on the RF sweep oscillator power meter.
12	Rearrange the calibrated IF detector test circuit to that shown as option (Y).
13	Adjust the oscilloscope Y POSITON, X POSITION, and X AMPLITUDE to produce an oscilloscope display of a reference trace with the two frequency markers two major divisions apart with each marker one major division from the horizontal center of the graticule.

CHART 2 (Cont)

STEP	PROCEDURE
14	Calibrate the vertical gain of the oscilloscope of 1 dB per inch as follows: (a) On the oscilloscope, operate the ADJUST INPUT 1 control to make the test and reference traces coincide at the horizontal center. (b) Increase the value of the AT12 by 1 dB. (c) Adjust the Y AMPLITUDE control to separate the test and reference oscilloscope traces by approximately one inch. (d) Decrease the value of AT12 by 1 dB.
15	Change the test equipment arragement to that shown as option (Y).
16	Adjust AT12 and the ADJUST INPUT 1 controls to make the highest part of test trace coincide with the reference trace. ***Requirement:*** The overall response of the RF amplifier and the mixer-preamplier assembly indicated on the oscilloscope should be symmetrically centered around 70 MHz with no point between 63 and 77 MHz lower than 0.4 dB below the reference trace. The display should resemble that shown in Figure 2. ***Note:*** If the requirement is met, proceed to Step 20. If the requirement is not met, proceed to Step 17.
17	Adjust controls C1 and C2 to obtain maximum vertical deflection of the response trace.
18	Adjust controls C3 and C5 to obtain a maximum amplitude symmetrical trace.
19	Adjust C4 to control the flatness of the response.
20	Dismantle the test arrangement. Reconnect all cables in the receiver to normal positions.
21	Perform the RF amplifier gain and noise figure tests described in Chart 3 of this section.

CHART 3

RF AMPLIFIER PERFORMANCE TESTS

These tests include measurements of the receiver noise figure. The noise figure of a receiver is a measure of the noise added to an incoming signal by the receiver. This test provides for the measurement of the noise figure of the individual branches of the diversity receiver. Significant noise is added only at stages operating at low signal levels, mainly in the RF amplifier.

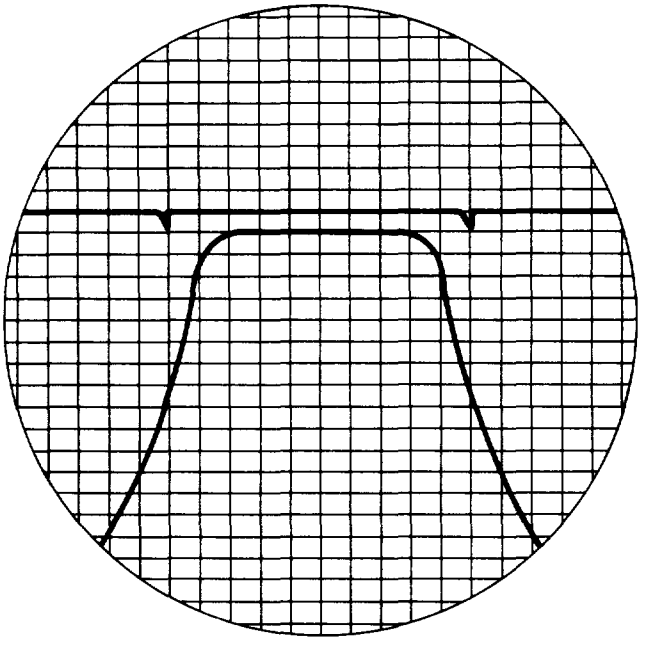


Fig. 2—Typical Response of RF Amplifier and Mixer IF Preamplifier Stages

CHART 3 (Cont)

STEP	PROCEDURE
	GAIN TEST
1	Arrange the test equipment as shown in Figure 3. Use option (W).
	Note: The noise source should be located close to the RF amplifier using the shortest possible connecting cable from the noise source output terminal.
2	On the 342A noise figure meter, set the controls to the indicated positions:

CONTROL	POSITION
INPUT (MC)	70
POWER	ON
METER FUNCTION	2 MA
NOISE SOURCE	GAS TUBE
NOISE FIGURE (rear)	AUTO

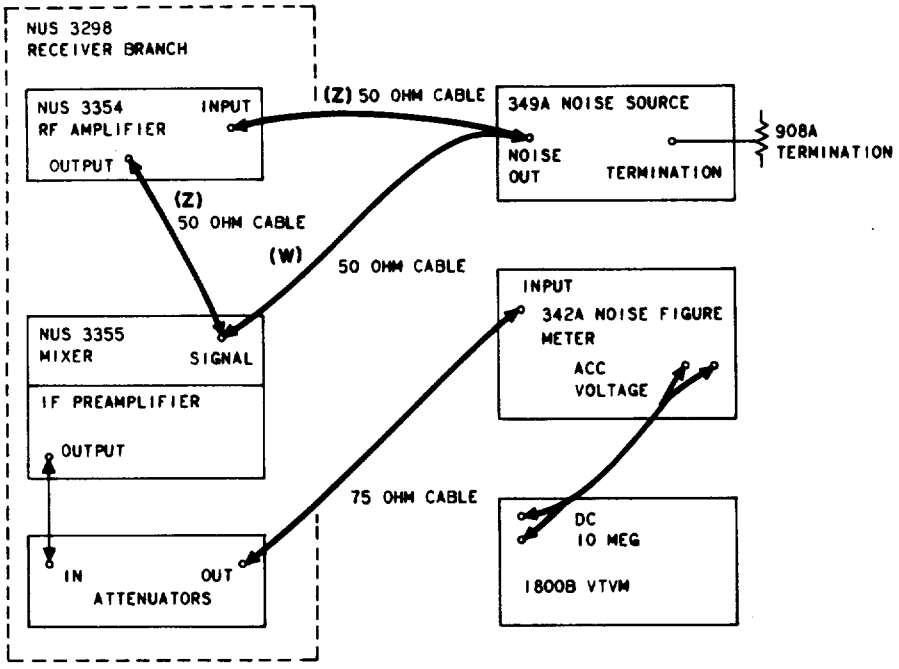


Fig. 3—RF Amplifier Gain and Receiver Noise Figure Measurements—Equipment Setup Diagram

CHART 3 (Cont)

STEP	PROCEDURE
3	On the 1800B VTVM, set the AC-DC switch to −DC and the VOLTAGE RANGE switch to 1.5.
4	Note the total value of the settings of the EQUAL ATTEN controls on the receiver chassis.
5	On the noise figure meter, adjust the CURRENT control to obtain a meter indication of 1.5 mA on the full-scale 2 mA range.
6	On the noise figure meter, operate the METER FUNCTION switch to CALIBRATION-ZERO and adjust the ZERO control to obtain a zero meter indication.
7	Operate the METER FUNCTION switch to CALIBRATION-INF and adjust the INF control to place the meter indicator at INF.
8	Operate the METER FUNCTION switch to NOISE FIGURE.
9	Temporarily short the input terminals of the vacuum tube voltmeter and adjust the zero control to zero the meter. Remove the short and note the VTVM meter indication.
10	Insert the RF amplifier in the test circuit as shown in Figure 3, option (Z).

CHART 3 (Cont)

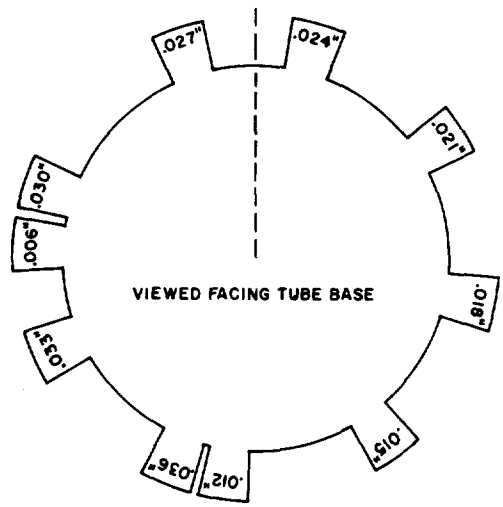
STEP	PROCEDURE
11	Adjust the receiver EQUAL ATTEN controls to obtain a VTVM indication closest possible to that noted in Step 9. ***Requirement:*** The gain of the RF amplifier, which is equal to the sum of the attenuator control settings, should be 12 dB or more. ***Note 1:*** If the requirement is not met, the RF amplifier tube V1 should be replaced as described in Chart 4 of this section. ***Note 2:*** If the requirement is met, retain the test arrangement and continue this test to determine the receiver noise figure.
12	Restore the settings of the EQUAL ATTEN controls to the value noted in Step 4.
	RECEIVER NOISE FIGURE TEST
13	Verify that the test equipment is arranged as shown in Figure 3, option (Z) and that the test equipment controls are adjusted to the positions used at the conclusion of the RF amplifier gain test.
14	Note the noise figure meter indication on the GAS TUBE meter scale. Compute the overall noise figure of the RF amplifier, receiving mixer, and IF preamplifier by adding the constant 0.4 dB to the indicated noise figure value. ***Requirement:*** The receiver noise figure should be a value less than 9.5 dB. ***Note:*** If the requirement is not met, proceed to Step 15; if the requirement is met, proceed to Step 16.
15	Failure to meet the requirement in Step 14 can be due to any of a number of reasons; a defective RF amplifier tube being the most likely cause. Other possible causes of failure to meet the noise figure requirement are listed below: (a) Incorrect mixer crystal current adjustment. (b) Defective mixer crystals. (c) Improper RF amplifier alignment. (d) Defective RF amplifier components or connectors. (e) Environmental noise or interference. (Environmental noise or interference can affect the indicated noise figure but not the true receiver noise figure.)
16	Dismantle the test arrangement and restore the receiver to operating condition.

CHART 4

ELECTRON TUBE REPLACEMENT

This chart contains the procedure for replacing the Western Electric Company 416B tube in the RF amplifier.

STEP	PROCEDURE
1	On the receiver alarm and power distribution panel, operate the 250 Vdc fuse associated with the receiver under test to the OFF position.
2	Disconnect all cables and the air hose from the RF amplifier. Remove the amplifier assembly from the receiver.
3	Remove the amplifier assembly bottom cover to expose the tube socket. Note the position of the tube base locating pin (the pin with the largest diameter).
4	Carefully lift the tube socket from the tube base. Position the socket in a manner which permits use of the tube extractor at the tube base.
5	Grasp the tube base with the tube extractor. Turn the tube in a counterclockwise direction while holding the cathode ring until the tube is disengaged from the threaded mounting hole. Remove any shims which are found under the tube flange.
6	Insert the replacement tube through the cathode ring. While holding the cathode ring stationary, screw the tube into the threaded mounting hole until firmly seated.
7	Note the position of the replacement tube locating pin in relation to the position noted for the locating pin on the tube which was removed. If necessary, remove and re-install the new tube shims under the mounting flange to correct for misalignment of the locating pin. Figure 4 indicates the angular corrections which are obtainable using combinations of .006 inch, .012 inch, and .015 inch tube shims. ***Note 1:*** The angular position of the tube when it is firmly seated should be such as to permit connecting the tube socket to the tube base without placing unreasonable strain on components. ***Note 2:*** The shims provided cannot correct for all misalignment possibilities. Some tubes will be unsuited for use in the amplifier.
8	Connect the socket to the tube base.
9	Replace the bottom cover on the amplifier assembly and mount the amplifier in the receiver.
10	Connect the air hose and cables.
11	On the alarm and power distribution panel, operate the 250 Vdc circuit breaker associated with the receiver branch under test to the ON position.



METHOD OF OBTAINING ANGULAR ALIGNMENT OF AMPLIFIER TUBE IN SOCKET

1. SEAT TUBE IN THREADED HOLE USING NO SHIMS.
2. NOTE ANGLE OF MISALIGNMENT BETWEEN TUBE LOCATING PIN AND TUBE SOCKET LOCATING PIN HOLE. FROM CHART, DETERMINE SHIMS NEEDED TO CORRECT MISALIGNMENT. THE SHIMS PROVIDED CANNOT CORRECT ALL POSSIBLE ERRORS; SOME TUBES ARE UNSUITED FOR USE IN THE AMPLIFIER.
3. REMOVE TUBE FROM MOUNTING HOLE. RE-INSTALL TUBE USING THE REQUIRED SHIMS UNDER THE MOUNTING FLANGE.

Fig. 4—Tube Mounting Angular Alignment Correction Possibilities Using Flange Shims

CHART 4 (Cont)

STEP	PROCEDURE
12	Align the RF amplifier as described in Chart 2.