
TL-1 MICROWAVE RADIO
RECEIVER TESTS
MISCELLANEOUS OUT-OF-SERVICE CHECKS

Sections 409-302-501 and 409-306-501 through 409-306-504 contain the field tests used in locating trouble. This section includes all of the remaining checks of the receiver which can be made in the field.

This section is reissued to add test information for TL-1 receivers that may now be equipped with either of the following:

- (a) The J99296AA-1, List 3 modulator-preamplifier unit with the J99296G-2 receiver IF and baseband unit
- (b) The J99296AA-1, List 3 modulator-preamplifier unit with the J99351E-1 IF amplifier unit and the J99351J-1 FM receiver unit.

Since this is a general revision, change arrows ordinarily used have been omitted.

This reissue does not affect the Equipment Test List.

The tests in this section require that the receiver under test be removed from service. Refer to Section 409-306-500 for the procedures required for removing and restoring service. These tests are also useful to check the condition of spare receiver IF and baseband units which are used as substitutes while troubleshooting. The tests are equipment oriented; therefore, perform the procedures in one and *only one* chart.

Warning: Voltages applied to the klystron are higher than those normally encountered in the telephone plant. Only that work which is absolutely necessary should be performed with the protective devices disabled or removed.

General instructions on the maintenance and handling of electronic equipment involving hazardous voltages as contained in Section 010-110-001 should be strictly observed.

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APPARATUS:

- 1—KS-14510 Volt-Ohm-Milliammeter (VOM)
 - 1—J99262AA TL Test Set
 - P2BJ Cable (as required)
 - 190A Adapters (as required)
 - 372A plugs (as required)
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CHART 1

UNMODIFIED SYSTEMS

This is an out-of-service test. Be certain that the radio channel is removed from service as specified in Section 409-306-500.

STEP

PROCEDURE

Limiter Input Level

The automatic gain control (AGC) circuit of the IF amplifier operates to hold the input to the limiter nearly constant with changes of received signal caused by fading. The LIM IN potentiometer on the front of the IF and baseband unit controls the limiter input level. Fig. 1 shows the relationship between the volts indicated at the LIM IN jacks by the VOM and the power into the limiter in dBm.

- 1 Remove the patch cord between the PRE AMPL IN jack of the IF and baseband unit and OUT jack J3 of the 1A receiver modulator.
- 2 Send a 70-MHz signal at -43 dBm from the TL test set to the PRE AMPL IN jack.
- 3 Connect the VOM to the LIM IN jacks of the IF and baseband unit using the 3-Vdc scale and observing the proper polarity.

Requirement: The VOM indicates (± 0.03 volt) the voltage stamped on the panel by the LIM IN jacks.

Note: If the requirement is not met, adjust the LIM IN potentiometer for the specified indication.

- 4 Remove the test equipment and restore the patch between the 1A modulator and the preamplifier input jack.

CHART 1 (Cont)

STEP	PROCEDURE
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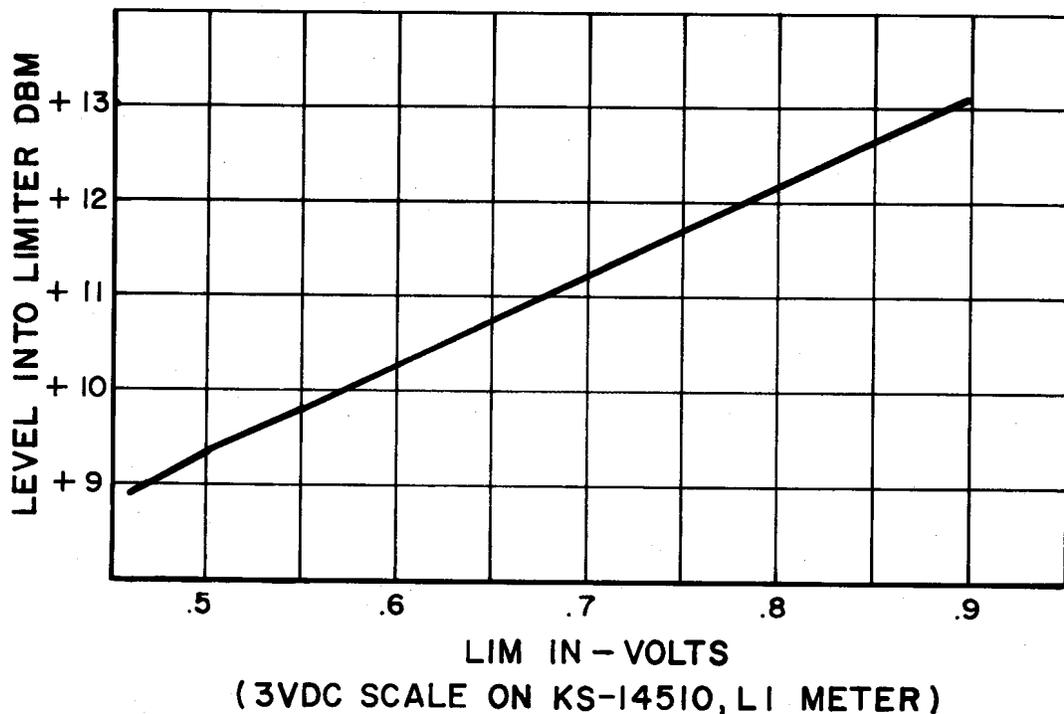


Fig. 1—Limiter Input Calibration Chart

AGC Performance

Known levels of 70-MHz signal are applied to the input of the IF and baseband unit on an out-of-service basis, thus disabling the receiver. The limiter input level can be obtained at the LIM IN jacks with a VOM. The AGC circuit holds the limiter input level fairly constant regardless of changes in the received signal level caused by fading.

- 5 Remove the patch cord between the PRE AMPL IN jack at the IF and baseband unit and OUT jack J3 of the receiver modulator.
- 6 Send a 70-MHz signal at -43 dBm from the TL test set to the PRE AMPL IN jack of the IF and baseband unit.
- 7 Connect the VOM to the LIM IN jacks and observe the indication on the 3-Vdc scale.

CHART 1 (Cont)

STEP	PROCEDURE
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Requirement: The VOM indicates (± 0.03 volt) the voltage stamped on the panel by the LIM IN jacks.

Note: If the requirement is not met, adjust the LIM IN potentiometer for the specified indication.

- 8 Change the level of the input signal to -33 dBm, -78 dBm, and -83 dBm in turn, and observe the indications on the VOM.

Requirement: The changes in the VOM indications from the indication at -43 dBm shall be as specified in Table A.

Note 1: Reading the VOM so closely requires some estimation.

Note 2: If the requirement is not met, the IF and baseband unit is defective and should be replaced.

- 9 Restore the circuit to normal by replacing the receiver input patch cord and observe on the AGC, IF frequency, and automatic frequency control (AFC) meters that the receiver beat-oscillator (BO) klystron is locked on the incoming signal.

IF Amplifier Bandwidth

This test requires that an unmodulated signal be applied to the input of the IF and baseband unit on an out-of-service basis.

- 10 Remove the patch cord between the PRE AMPL IN jack of the IF and baseband unit and OUT jack J3 of the 1A receiver modulator.
- 11 Send a 70-MHz signal at -43 dBm from the TL test set to the PRE AMPL IN jack of the IF and baseband unit.
- 12 Set the selector switch on the meter and control panel to the RCVR AGC position and observe the lower meter.

TABLE A

INPUT LEVEL	VOLTAGE CHANGE	DIRECTION OF CHANGE
dBm		
-33	0.05 volt or less	Rise
-78	0.05 volt or less	Drop
-83	0.10 volt or less	Drop

CHART 1 (Cont)

STEP**PROCEDURE**

Requirement: The lower meter indicates 4.2 volts on the 6-volt scale.

Note 1: If the requirement is not met, adjust the AGC potentiometer for the specified indication.

Note 2: The AGC potentiometer and the SQUELCH control interact to an appreciable extent. If it is necessary to adjust the 4.2 volts with the AGC control, the squelch operate level should be checked in accordance with procedures in Section 409-306-504.

- 13 Send a 66-MHz signal at -43 dBm to the IF and baseband unit and observe the lower meter. Change the frequency of the signal to 74 MHz at the same level (-43 dBm) and observe the lower meter.

Requirement: The indications are within the range of 4.15 to 4.25 volts on the 6-volt scale.

Note: If this requirement is not met, the IF and baseband unit should be replaced.

- 14 Restore the circuit to normal by replacing the receiver input patch cord and observe on the AGC, IF frequency, and AFC meters that the receiver BO klystron is locked on the incoming signal.

Discriminator Linearity

This test provides three separate indications of the AFC amplifier output voltage to give an approximate indication of discriminator linearity. Three unmodulated signals (66, 70, and 74 MHz) are applied to the input of the IF amplifier on an out-of-service basis.

- 15 Remove the patch cord between the PRE AMPL IN jack of the IF and baseband unit and OUT jack J3 of the receiver modulator.
- 16 Arrange the TL test set to send the three signals (70, 66, and 74 MHz) at -40 dBm to the PRE AMPL IN jack of the IF and baseband unit.
- 17 On the meter and control panel, set the FREQ switch to the IF position and the AFC switch to the OFF position.
- 18 Apply the 70-MHz signal and adjust the AFC ZERO potentiometer of the IF and baseband unit for an indication on the meter and control panel.
- 19 Send the 66-MHz signal and observe the upper meter; then send the 74-MHz signal and observe the meter.

Requirement: Each indication is between 15 and 25 dBm and the two differ by 2 dBm or less.

CHART 1 (Cont)

STEP	PROCEDURE
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Note: If this requirement is not met, the IF and baseband unit should be replaced.

- 20 Restore the circuit to normal by replacing the receiver input patch cord and operate the AFC switch to the ON position. Observe the AGC, IF frequency, and AFC meters to determine that the receiver BO klystron is locked on the incoming signal.

Noise for Low Input Signal

This test requires that noise be measured at the receiver output for an input signal of -83 dBm on an out-of-service basis.

- 21 Remove the patch cord between the PRE AMPL IN jack of the IF and baseband unit and OUT jack J3 of the 1A receiver modulator.
- 22 Arrange the TL test set to send a 70-MHz signal at -83 dBm to the PRE AMPL IN jack or the IF and baseband unit.
- 23 Set the voltmeter of the TL test set for RCVR GAIN and connect it to the RCVR OUT jack of the IF amplifier.

Requirement: The receiver output is -19 dBm or lower (a larger number).

Note: If this requirement is not met, the IF and baseband unit should be replaced.

- 24 Restore the circuit to normal by replacing the receiver input patch cord and observe the AGC, IF frequency, and AFC meters to determine that the receiver BO klystron is locked on the incoming signal.

CHART 2

SYSTEMS EQUIPPED WITH THE
J99296G RECEIVER IF AND
BASEBAND UNIT

This is an out-of-service test. Be certain that the radio channel is removed from service as specified in Section 409-306-500.

CHART 2 (Cont)

STEP	PROCEDURE
	<p>Limiter Input Level</p> <p>The AGC circuit of the receiver IF and baseband unit operates to hold the input to the limiter constant during changes in received signal level caused by fading. The LIM IN control on the front of the receiver IF and baseband unit adjusts the limiter input level.</p> <ol style="list-style-type: none"><li>1 Remove the patch from the IF IN jack on the receiver IF and baseband unit.<li>2 Connect a 70-MHz signal at -25 dBm into the IF IN jack.<li>3 Connect the VOM, set on the 3-Vdc scale, to the LIM IN jacks on the receiver IF and baseband units observing the proper polarity. <p>Requirement: The meter should indicate within 0.03 volt of the voltage stamped on the panel adjacent to the LIM IN jacks.</p> <p>Note: If this requirement is not met, adjust the LIM IN control to bring it within limits. If this is not possible, the receiver IF and baseband unit should be replaced.</p> <ol style="list-style-type: none"><li>4 Remove the test equipment and restore the patch cord to the IF IN jack on the receiver IF and baseband unit.
	<p>AGC Performance</p> <p>Known levels of 70-MHz signal are applied to the input of the receiver IF and baseband unit. The limiter input level is indicated at the LIM IN jacks by means of the VOM. The AGC circuit holds the input level to the limiter constant over an input range of approximately 50 dB.</p> <ol style="list-style-type: none"><li>5 Remove the patch cord from the IF IN jack on the receiver IF and baseband unit.<li>6 Connect a 70-MHz signal at -25 dBm from the TL test set into the IF IN jack on the receiver IF and baseband unit.<li>7 Connect the VOM, set on the 3-Vdc scale, to the LIM IN jacks and observe the meter indication. <p>Requirement: The meter should indicate within 0.03 volt of the voltage stamped on the panel adjacent to the LIM IN jacks.</p> <p>Note: If this requirement is not met, the LIM IN control should be readjusted to bring it within limits.</p> <ol style="list-style-type: none"><li>8 Change the level of the input signal to -15 and -60 dBm, in turn, and observe the meter indication.

CHART 2 (Cont)

- | STEP | PROCEDURE |
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| | <p>Requirement: The change in VOM indication from a -25 dBm input should be within that shown in Table B.</p> <p>Note: If this requirement is not met, allow the unit to warm up (about 1 hour) and recheck the indication. If the unit fails to meet the requirement after warm-up, the receiver IF and baseband unit should be replaced.</p> |
| 9 | Restore the circuit to normal by placing the receiver input patch cord to the IF IN jack. With the FREQ switch in the IF position and the selector switch set to the AGC and AFC positions, observe the meter indications to see that the receiver BO klystron is locked on the incoming signal. |
| | <p>IF Amplifier Bandwidth</p> <p>This test requires that an unmodulated signal be applied to the MON jack.</p> |
| 10 | Remove the coaxial patch cord from the RCVR OUT jack on the receiver IF and baseband unit. Connect the VOM, set on the R×1 scale, between ground and the center conductor of the RCVR OUT jack. |
| 11 | If personnel are available at the adjacent transmitting station, perform this step; if personnel are not available, proceed to Step 12. Establish voice communications with the personnel at the transmitting station and request that the appropriate transmitter be blocked by inserting the waveguide switch to the OFF position. The VOM should indicate a short circuit. Proceed to Step 16. |
| 12 | Operate the AFC switch on the receiver control unit to the OFF position. |
| 13 | Slowly adjust the BO KLY ADJ control 2-1/2 turns as follows. Turn the BO KLY ADJ control in a clockwise direction for all channels with the suffix letters A, P, or E and in a counterclockwise direction for all channels with the suffix letters B, J, or D. |
| 14 | Set the selector switch to CR1 and CR2 and check that CR1 and CR2 still indicate crystal current, showing that the BO klystron is oscillating. |
| 15 | Observe the VOM meter indication or the TL test set voltmeter. |

TABLE B

INPUT LEVEL	VOLTAGE CHANGE	DIRECTION OF CHANGE
-15 dBm	0.05 volt or less	Rise
-60 dBm	0.05 volt or less	Drop

CHART 2 (Cont)

STEP	PROCEDURE
	<i>Requirement:</i> The VOM should indicate a short circuit.
16	Disconnect the VOM and restore the coaxial patch cord to the RCVR OUT jack.
17	Connect a 70-MHz signal at -15 dBm from the TL test set into the MON jack of the modulator-preamplifier unit.
18	Set the selector switch to the AGC position and note the meter indication.
	<i>Requirement:</i> 320 to 440 units
	<i>Note:</i> If this requirement is not met, proceed to Step 19. If the requirement is met, proceed to Step 22.
19	Remove the patch cord from the IF IN jack on the receiver IF and baseband unit.
20	Connect a 70-MHz signal at -25 dBm from the TL test set into the IF IN jack on the receiver IF and baseband unit.
21	Set the selector switch to the AGC position and note the indication of the lower meter (full scale 600 units). Tap the meter lightly to remove any bearing-friction error.
	<i>Requirement:</i> 320 to 440 units
	<i>Note 1:</i> If this requirement is not met, calibrate the AGC CAL control on the meter and control panel as given in Section 409-306-503.
	<i>Note 2:</i> If the requirement is still not met, the receiver IF and baseband unit should be replaced. If the requirement is met, the modulator-preamplifier unit should be replaced.
22	Connect 66 MHz, then 74 MHz at -15 dBm into the MON jack of the modulator-preamplifier.
	<i>Requirement:</i> Indications are within 10 units of the indication in Step 18.
	<i>Note:</i> If this requirement is not met, proceed with Step 23. If the requirement is met, proceed to Step 27.
23	Remove the patch cord from the IF IN jack on the receiver IF and baseband unit.
24	Connect a 70-MHz signal at -25 dBm from the TL test set into the IF IN jack on the receiver IF and baseband unit.
25	Set the selector switch to the AGC position and note the indication of the lower meter (full scale 600 units). Tap the meter lightly to remove any bearing-friction error.
	<i>Requirement:</i> 320 to 440 units

CHART 2 (Cont)

STEP

PROCEDURE

Note: If this requirement is not met, the receiver IF and baseband unit should be replaced.

- 26 Connect 66 MHz, then 74 MHz at -25 dBm into the IF IN jack of the receiver IF and baseband unit and note the meter indications with the selector switch set in the AGC position. Tap the meter lightly to remove any bearing-friction error.

Requirement: Indications are within 10 units of indication for Step 25.

Note: If this requirement is not met, the IF and baseband unit should be replaced. If the requirement is met, the modulator-preamplifier unit should be replaced.

- 27 If Step 12 and 13 were performed, restore the circuit to normal by retuning the BO klystron and by operating the AFC switch to the ON position. If Step 11 was performed, insert the waveguide switch to the ON position. With the FREQ switch set to the IF position and the selector switch in the AGC and AFC positions, observe the meter indications to be certain that the receiver BO klystron is locked on the incoming signal.

Discriminator Linearity

Note: This test uses three separate output voltages of the discriminator as an approximate indication of discriminator linearity. Three unmodulated signals (66, 70, and 74 MHz) are applied to the input of the receiver IF and baseband unit on an out-of-service basis.

- 28 Remove the patch cord from the IF IN jack on the receiver IF and baseband unit.
- 29 Arrange the TL test set to send 70, 66, and 74 MHz at -25 dBm into the IF IN jack on the receiver IF and baseband unit.
- 30 On the meter and control panel, operate the AFC switch to the OFF position and the FREQ switch to IF position.
- 31 With a 70-MHz input, adjust the AFC ZERO control on the receiver IF and baseband unit for an indication of zero on the upper meter.
- 32 Note the indications on the same meter for inputs of 66 and 74 MHz.

Requirement: Each indication should be between 12 and 18 μ A and the two shall differ by 2 μ A or less.

Note: If this requirement is not met, the receiver IF and baseband unit should be replaced.

- 33 Restore the circuit to normal by patch cord to the IF IN jack and operating the AFC switch to the ON position. With the FREQ switch in the IF position and the selector

CHART 2 (Cont)

STEP**PROCEDURE**

switch in the AGC and AFC positions, observe the meter indications to be certain that the receiver BO klystron is locked on the incoming signal.

CHART 3

**SYSTEMS EQUIPPED WITH THE
J99351E IF AMPLIFIER UNIT
AND THE J99351J FM RECEIVER UNIT**

This is an out-of-service test. Be certain that the radio channel is removed from service as specified in Section 409-306-500.

STEP**PROCEDURE****AGC Performance**

The AGC circuit of the IF amplifier operates to hold the output of the IF amplifier (the input to the limiter circuit) constant during fading conditions. The AGC control adjusts the output level of the IF amplifier.

- 1 Remove the 469A terminating plug from the IF MON jack on the IF amplifier.
- 2 Remove the patch cord from the input jack on the 1075A filter that is normally connected to the receiver modulator-preamplifier.
- 3 Connect the equipment as shown in Fig. 2 with a 70-MHz IF output at a level of -9 dBm from the TL test set.

Requirement: 0 dBm into the power meter

Note: If the requirement is not met, adjust the AGC control to obtain 0 dBm.

- 4 Increase the input level from the TL test set by 5 dB to -4 dBm.

Requirement: The output at the IF MON jack should increase by no more than 0.5 dB from 0 dBm.

Note: If this requirement is not met, the IF amplifier (J99351E) should be replaced.

- 5 Decrease the input level from the TL test set by 44 dB to -48 dBm.

CHART 3 (Cont)

STEP	PROCEDURE
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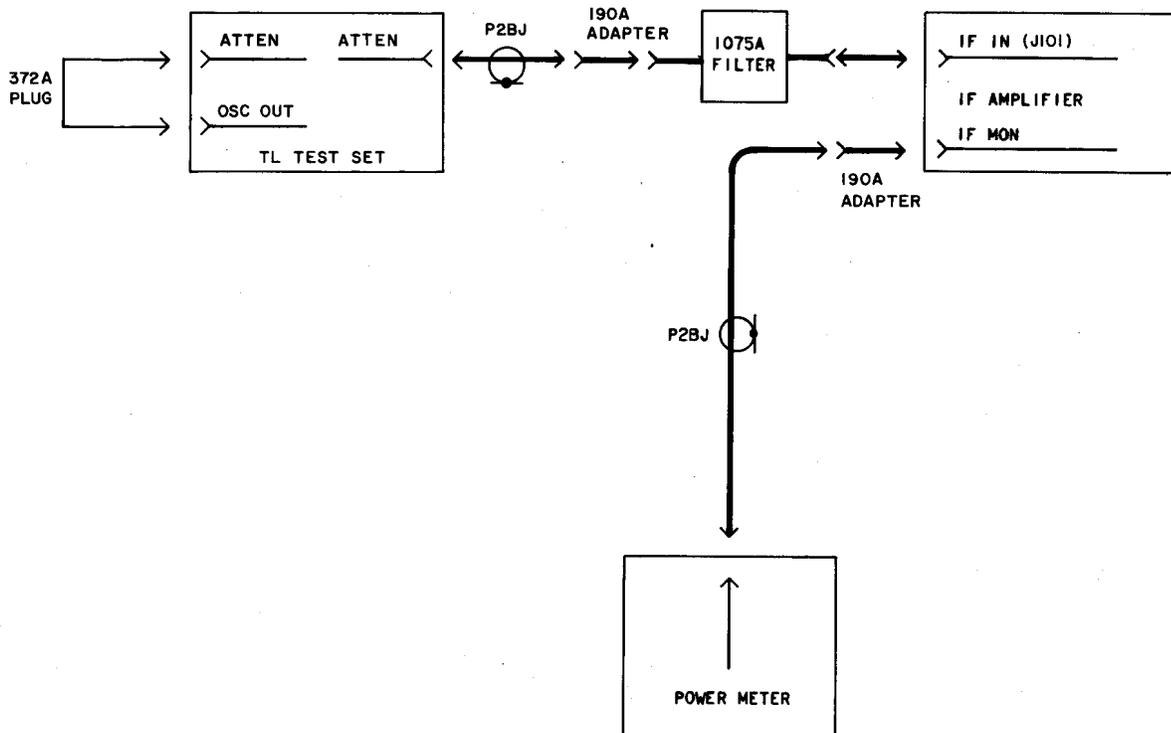


Fig. 2—J99351E IF Amplifier Unit—AGC Performance Test—Test Setup Diagram

Note: This will require use of the 40 dB ATTEN jacks on the TL test set.

Requirement: The output at the IF MON jack should decrease by no more than +3.0 dB from 0 dBm.

Note: If this requirement is not met, the IF amplifier (J99351E) should be replaced.

- Restore the circuit to normal by replacing the patch cord to the 1075A filter jack and replacing the 469A terminating plug to the IF MON jack. With the FREQ switch in the IF position and selector switch set to the AGC and AFC positions, observe the meter indications to see that the receiver BO klystron is locked on the incoming signal.

IF Amplifier Bandwidth

This test requires that an unmodulated signal be applied to the monitor jack.

CHART 3 (Cont)

STEP	PROCEDURE
7	Remove the coaxial patch cord from the RCVR OUT jack on the FM receiver unit. Patch from the RCVR OUT to the VM IN jack on the TL test set with the input switch to 75 OHM TERM. Set the range switch for an on-scale indication.
8	If personnel are available at the adjacent transmitting station, perform this step; if personnel are not available, proceed to Step 9. Establish voice communications with the personnel at the transmitting station and request that the appropriate transmitter be blocked by inserting the waveguide switch to the OFF position. The TL test set voltmeter should indicate no receiver output by a substantial drop in level. Proceed to Step 13. <i>Note:</i> If the appropriate transmitter does not have a waveguide switch, proceed to Step 9.
9	Operate the AFC switch to the OFF position.
10	Slowly adjust the BO KLY ADJ control 2-1/2 turns as follows. Turn the BO KLY ADJ control in a clockwise direction for all channels with the suffix letters A, P, or E and in a counterclockwise direction for all channels with the suffix letters B, J, or D.
11	Set the selector switch to CR1 and CR2 and check that CR1 and CR2 still indicate crystal current, showing that the BO klystron is oscillating.
12	Observe the TL test set voltmeter. <i>Requirement:</i> The voltmeter should indicate a reduced level.
13	Disconnect the TL test set voltmeter and restore the coaxial patch cord to the RCVR OUT jack.
14	Connect a 70-MHz signal at 0 dBm from the TL test set into the MON jack of the modulator-preamplifier unit.
15	Set the selector switch to the AGC position and note the meter indication. <i>Requirement:</i> 400 to 520 units <i>Note:</i> If this requirement is not met, proceed to Step 16. If the requirement is met, proceed to Step 19.
16	Remove the patch cord from the input jack on the 1075A filter that is normally connected to the receiver modulator-preamplifier.
17	Connect a 70-MHz signal at -25 dBm from the TL test set into the input jack on the 1075A filter.

CHART 3 (Cont)

STEP	PROCEDURE
18	<p>Set the selector switch on the meter unit to the AGC position and note the indication of the lower meter (full scale 600 units). Tap the meter lightly to remove any bearing-friction error.</p> <p>Requirement: 400 to 520 units</p> <p>Note 1: If the requirement is not met, calibrate the AGC CAL control on the meter and control panel as given in Section 409-306-503.</p> <p>Note 2: If this requirement is still not met, replace the IF amplifier unit. If the requirement is met, replace the modulator-preamplifier unit.</p>
19	<p>Connect 66 MHz, then 74 MHz, at 0 dBm into the MON jack of the modulator-preamplifier.</p> <p>Requirement: Indications should be within 10 units of the indication in Step 15.</p> <p>Note: If this requirement is not met, proceed to Step 20. If the requirement is met, proceed to Step 24.</p>
20	<p>Remove the patch cord from the input jack on the 1075A filter that is normally connected to the receiver modulator-preamplifier.</p>
21	<p>Connect a 70-MHz signal at -10 dBm from the TL test set into the input jack on the 1075A filter.</p>
22	<p>Set the selector switch to the AGC position and note the indication of the lower meter (full scale 600 units). Tap the meter lightly to remove any bearing-friction error.</p> <p>Requirement: 400 to 520 units</p> <p>Note: If this requirement is not met, replace the IF amplifier unit.</p>
23	<p>Connect 66 MHz, then 74 MHz at -10 dBm into the input jack on the 1075A filter and note the meter indications with the selector switch set in the AGC position. Tap the meter lightly to remove any bearing-friction error.</p> <p>Requirement: Indications should be within 10 units of the indication in Step 22.</p> <p>Note: If this requirement is not met, the IF amplifier unit should be replaced. If the requirement is met, the modulator-preamplifier unit should be replaced.</p>
24	<p>If Steps 9 and 10 were performed, restore the circuit to normal by retuning the BO klystron and operate the AFC switch to the ON position. If Step 8 was performed, insert the waveguide switch to the ON position. With the FREQ switch set to the IF position</p>

CHART 3 (Cont)

STEP

PROCEDURE

and the selector switch in the AGC and AFC positions, observe the meter indications to be certain that the receiver BO klystron is locked on the incoming signal.
