
TL-1 MICROWAVE RADIO
RECEIVER TESTS
SQUELCH CIRCUIT ALIGNMENT

This section contains the test and alignment procedures for the squelch circuits that are part of the automatic gain control (AGC) and the automatic frequency control (AFC) circuits.

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

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

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

This reissue does not affect the Equipment Test List.

The AGC squelch circuit prevents the transmission of noise through the receiver baseband amplifier when the signal level falls below a predetermined value. The AFC squelch circuit disables AFC operation in a similar manner. These tests require that an unmodulated IF signal be applied to the receiver IF and baseband unit except for systems equipped with the J99296AA, List 3 modulator-preamplifier units, where the IF signal can be applied at the monitor jack. The monitor jack provides a bridged 75-ohm test point at the interface of the modulator and first IF amplifier.

The procedures of this section require that service be removed from the channel involved on nondiversity systems. Refer to Section 409-306-500 for the procedures for removing and restoring service on nondiversity systems.

The test and alignment procedures in this section are arranged on an equipment basis. Perform the procedures in **only one** chart.

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APPARATUS:

- 1—J99262AA TL Test Set
 - 1—KS-14510 Volt-Ohm-Milliammeter (VOM)
 - 1—190A Adapter
 - 2—372A Plugs
 - 3—P2BJ Cords or as required
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CHART 1

**SYSTEMS EQUIPPED WITH
J99262G RECEIVER IF AND
BASEBAND UNIT**

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

STEP

PROCEDURE

AGC Squelch

- 1 Remove the patch cord between the PREAMPL IN jack of the IF and baseband unit and jack J3 of the 1A receiver modulator.
- 2 With the TL test set, send -95 dBm at 70 MHz into the PREAMPL IN jack.
- 3 Patch the RCVR OUT jack of the IF and baseband unit to the test set VM IN jack with the INPUT switch in the RCVR GAIN position. Measure the receiver output noise.

Requirement: Receiver output noise shall be less than -40 dBm (larger number) indicating that the squelch circuit has operated, disabling the receiving baseband amplifier.

- 4 Increase the 70-MHz level in 1-db steps until the receiver noise power suddenly increases to more than -20 dBm indicating release of the squelch circuit.

Requirement: Input power at the release point shall be -88 dBm or lower (a larger number).

Note 1: If this requirement cannot be met, readjust the SQUELCH potentiometer on the IF amplifier and baseband unit until the squelch circuit releases at -90 dBm. Inability to make this adjustment indicates that the IF and baseband unit should be replaced.

CHART 1 (Cont)

STEP	PROCEDURE
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Note 2: Whenever the SQUELCH control is readjusted, the AGC potentiometer should also be readjusted for an AGC meter indication of 4.2 volts with a 70-MHz IF input of -43 dBm. Furthermore, when the receiver is part of a diversity system, there is some interaction between the controls. In this case, both controls must be adjusted so that the requirements of squelch sensitivity and AGC meter indications are met simultaneously.

AFC Squelch

The AFC squelch relay K1 inserts a large loss in the AFC loop at unusably low-signal levels. This operation is controlled by the same circuit used with the AGC squelch. To test the operation of relay K1 located on the meter and control panel, an unmodulated 66-MHz signal is applied to the input of the IF amplifier and baseband unit on the out-of-service basis. For very low inputs (receiver squelch), the lower meter with the selector switch at AFC indicates approximately 16 volts. For an input equal to or greater than that of Step 4 (receiver squelched), the meter will indicate appreciably lower or higher, depending upon whether the beat-oscillator frequency is below or above the incoming carrier.

- 5 On the meter and control panel, operate the AFC switch to the OFF position and the selector switch to the RCVR AFC position.
- 6 Observe the 30-volt scale on the lower meter on the meter and control panel.

Requirement: The meter indicates 16 ± 0.5 volts.

Note: If the requirement is not met, adjust potentiometer R27 for an indication of 16.0 volts.

- 7 Operate the AFC switch to the ON position.
- 8 With the TL test set, apply a 66-MHz signal at -95 dBm to the PREAMPL IN jack.

Requirement: Relay K1 of the meter and control panel releases.

Note: If relay K1 is released, the lower meter will indicate 16 ± 2.5 volts.

- 9 Increase the input level of the 66-MHz signal in 1-dB steps, waiting 10 seconds between steps until the lower meter slowly drops to less than 10 volts or rises to more than 22 volts to indicate the operation of relay K1.

Requirement: Input power at the relay operating point shall be -88 dBm or lower (a larger number as in Step 4).

Note: Inability to meet this requirement indicates a defective K1 relay or a defective IF baseband unit.

CHART 1 (Cont)

STEP	PROCEDURE
10	Restore the circuit to normal by replacing the IF input and output patch cords and observe on the AGC, IF frequency, and AFC meters that the receiver beat-oscillator klystron is locked on the incoming signal.

CHART 2
**SYSTEMS EQUIPPED WITH A
J99296G RECEIVER IF AND
BASEBAND UNIT**

The procedures of this chart can be performed without the loss of service on frequency diversity systems by either of two methods. The critical procedure of klystron detuning and retuning is supplemented by a simplified transmitter-blocking procedure. The blocking procedure can be used instead of the klystron tuning procedure. Although the blocking procedure requires additional personnel at the adjacent transmitting station, the procedure requires no misadjustment of the equipment, thus minimizing the effects of the tests on alignment and performance. Both methods require that service be switched to the other channel of the diversity pair.

Preliminary tests are made to ensure that the receiver squelches with no received RF signal and that the receiver IF and baseband unit squelches with no signal input. Then the squelch sensitivity of the receiver IF and baseband unit is measured.

STEP	PROCEDURE
Preliminary Squelch Checks	
1	Remove the required units from service.
2	Remove the coaxial patch cord from the IF IN jack on the receiver IF and baseband unit.
3	Make connections in accordance with Fig. 1, option A, with the VOM on the 12-Vdc scale and connected to the AGC jack. Adjust the TL test set for a 70-MHz output at a level of -70 dBm.
4	Observe the meter indication.

Requirement: Less than 2 volts

Note: If this requirement is not met, replace the IF and baseband unit and repeat the entire test.

CHART 2 (Cont)

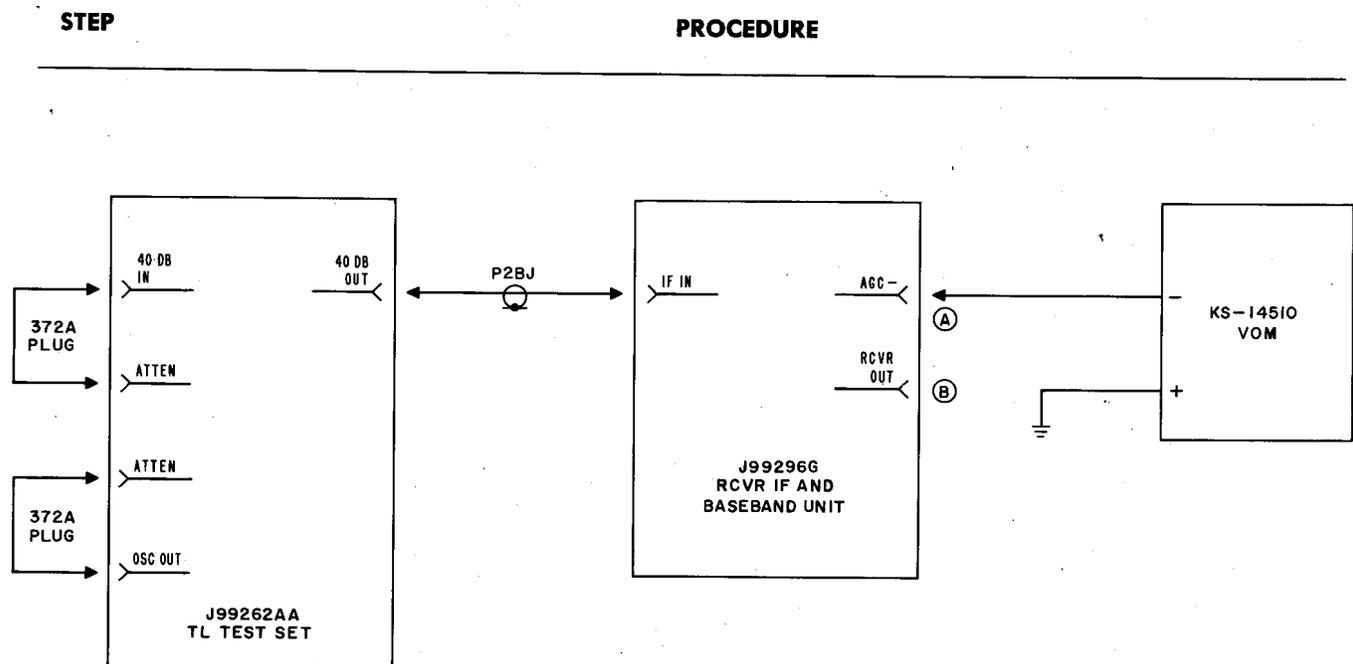


Fig. 1—AGC Operation Check—Test Setup Diagram

- 5 Make connections in accordance with Fig. 1, option B, with the VOM on the $R \times 1$ scale. Adjust the TL test set for a 70-MHz output at a level of -70 dBm.

Requirement: The VOM shall indicate a short circuit showing that the squelch relay K1 has released, disabling the output of the receiver baseband amplifier.

Note: Inability to meet this requirement indicates a defective K1 relay in the receiver control unit or a defective squelch circuit in the receiver IF and baseband unit. One or both units should be replaced and the entire test repeated.

Check of Receiver IF and Baseband Unit Squelch Sensitivity

- 6 Make connections in accordance with Fig. 1, option B, and set the VOM on the $R \times 1$ scale.
- 7 Adjust the 70-MHz output of the TL test set to just operate or release the squelch circuit as shown by the change in VOM indication from open circuit to short circuit or vice versa.

Requirement: The receiver IF and baseband squelch circuit shall operate or release between -59.0 and -64.0 dBm.

Note: If the requirement cannot be met, adjust the IF GAIN control located on the back edge of the IF and baseband unit or replace the IF and baseband units which do not have this control (J99296G L1, L2, and L3 and certain J99296G2 units).

CHART 2 (Cont)

STEP	PROCEDURE
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RF Squelch Sensitivity in the Presence of Noise

- 8 Remove the coaxial patch cord from the RCVR OUT jack on the receiver IF and baseband unit. Connect the VOM, set to the R \times 1 scale, between ground and the center conductor of the RCVR OUT jack.

Note: If the transmitter blocking method is to be used, perform Step 9 and then proceed to Step 13. If the klystron detuning and retuning method is to be used, omit Step 9.

- 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. Check that the VOM indicates a short circuit, showing that the receiver has squelched. Proceed to Step 13.
- 10 Set the AFC switch on the receiver control unit to the OFF position.
- 11 Slowly adjust the BO KLY ADJ control two and one-half turns as follows. Turn the BO KLY ADJ control in a clockwise direction for all channels with the suffix letters A, P, or E or in a counterclockwise direction for all channels with the suffix letters B, J, or D.
- 12 Set the meter unit selector switch to CR1 and CR2 and check that CR1 and CR2 still indicate crystal current, showing that the beating oscillator is still oscillating.
- 13 Leave the BO klystron detuned, or the transmitter waveguide switch in the OFF position for the remainder of the AGC squelch sensitivity tests.

RF Squelch Sensitivity in the Presence of Noise

- 14 Make connections in accordance with Fig. 2.

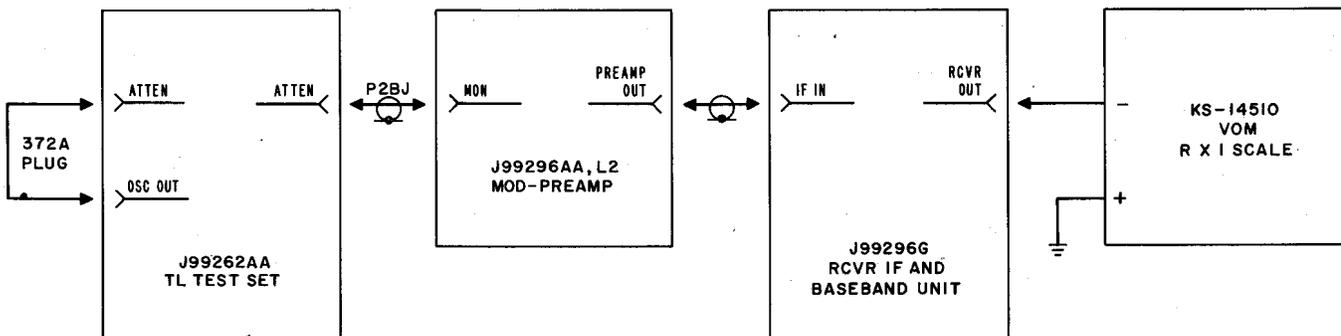


Fig. 2—Squelch Sensitivity Test—Test Setup Diagram

CHART 2 (Cont)

STEP	PROCEDURE
15	<p>Adjust the 70-MHz output of the TL test set to just operate the squelch circuit as shown by the change in VOM indication from open circuit to short circuit or vice versa. The RF squelch sensitivity is the level from the test set plus the conversion factor stamped on the modulator-preamplifier unit.</p> <p><i>Note:</i> Later versions of the List 3 modulator-preamplifier units are stamped 20.0 dB CONV GAIN and X.X DB MON LOSS. To obtain the conversion factor for these units add the GAIN to the MON LOSS value ($20.0 + \text{MON LOSS} = \text{conversion factor}$).</p> <p><i>Example:</i> Suppose that the level from the TL test set is -53 dBm and the conversion factor is 29 dB; then, the RF squelch sensitivity is: $-(53 + 29) = -82$ dBm.</p> <p><i>Requirement:</i> The RF squelch sensitivity found in this manner shall be between -77 and -82 dBm for J99296 G2 units and between -77 and -88 dBm for J99296 G1 units.</p>
16	<p>Restore the coaxial patches to normal and adjust the BO KLY ADJ control to the correct frequency <i>or</i> communicate with the adjacent station and have the appropriate transmitter unblocked by inserting the waveguide switch to the ON position.</p> <p>AFC Squelch Operation</p> <p>The AFC squelch circuit disables the AFC circuit during deep fades to prevent AFC lockout. The AFC squelch relay K1 is released when the received signal falls below a usable level inserting a high resistance in the AFC loop. This is the same relay that provides the AGC squelch. A separate set of contacts is provided for the AFC function. This test requires that an unmodulated signal be applied to the receiver IF and baseband unit on an out-of-service basis.</p>
17	<p>On the meter and control panel, set the AFC switch to the OFF position.</p>
18	<p>On the meter and control panel, set the selector switch to the RCVR AFC position.</p> <p><i>Requirement:</i> The lower meter indicates 14.0 ± 0.5 volts (on the 30-volt scale).</p> <p><i>Note:</i> If the requirement is not met, adjust R27 for an indication of 14.0 volts.</p>
19	<p>Set the AFC switch to the ON position.</p>
20	<p>Remove the coaxial patch cord from the IF IN jack on the receiver IF and baseband unit.</p>
21	<p>Apply a 66-MHz signal at -75 dBm from the TL test set to the IF IN jack.</p> <p><i>Requirement:</i> Relay K1 of the meter and control panel releases.</p> <p><i>Note 1:</i> If relay K1 is released, the lower meter will indicate 13.5 ± 3.0 volts.</p>

CHART 2 (Cont)

STEP	PROCEDURE
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Note 2: If this requirement is not met, a defective K1 relay or the IF and baseband unit is indicated and either or both should be replaced.

Note 3: If a unit is replaced, repeat the entire test.

- 22 Increase the level of the 66-MHz signal in 1-dB steps, waiting 10 seconds between steps (to allow the magnetic amplifier to come out of saturation) until the lower meter drops to less than 10 volts or rises to more than 22 volts, indicating operation of relay K1.

Requirement: IF input power at the relay operating point should be between -59 and -64 dBm.

Note 1: If this requirement is not met, a defective K1 relay or IF and baseband unit is indicated and either or both should be replaced.

Note 2: If a unit is replaced, repeat the entire test.

- 23 Restore the circuit to normal by replacing the IF input and the receiver output patch cord. With the FREQ switch set to IF and the selector switch in the AGC and AFC positions, observe the meter indications to see that the receiver BO klystron is locked on the incoming signal.

CHART 3

**SYSTEMS EQUIPPED WITH A
J99351E IF AMPLIFIER AND A
J99351J FM RECEIVER**

The procedures of this chart can be performed without the loss of service on frequency diversity system by either of two methods. The critical procedure of klystron detuning and retuning is supplemented by a simplified transmitter-blocking procedure. The blocking procedure can be used instead of the klystron tuning procedure. Although the blocking procedure requires additional personnel at the adjacent transmitting station, the procedure requires no misadjustment of the equipment, thus minimizing the effects of the tests on alignment and performance. Both methods require that service be switched to the other channel of the diversity pair.

The squelch sensitivity of the IF amplifier and FM receiver units is measured. Then, the squelch sensitivity is again measured with the IF amplifier receiver unit connected to the modulator-preamplifier with a 70-MHz signal plus the noise contributed by the modulator-preamplifier. The RF squelch sensitivity can be calculated from these results.

CHART 3 (Cont)

STEP	PROCEDURE
IF Amplifier and FM Receiver Squelch Sensitivity Check	
1	Remove the required unit from service.
2	Remove the patch cord connection at the PREAMP out jack on the modulator-preamplifier.
3	Arrange the TL test set to send the frequency-modulated signal into the 1075A filter by patching from the 66/74 MC OUT jack into the ATTEN jack, setting 12 dB in the ATTENUATOR, depressing the 66/74 MC button, and patching from the remaining ATTEN jack to the cord disconnected in Step 2 with a P2DE test cord. (Fig. 3).
4	Patch the RCVR OUT jack to the TL test set VM IN jack with the INPUT switch set on RCVR GAIN. Set the RANGE DBM switch to the +10 position.
Requirement: +10.0 \pm 0.2 dBm	
Note 1: If the requirement is not met, readjust the BB GAIN control to give an output of +10.0 dBm. Inability to make this adjustment indicates that the IF amplifier, FM receiver, and/or 1075A filter must be replaced.	
Note 2: The output level should increase with a clockwise rotation of the BB GAIN control. If the output level decreases with a clockwise rotation of the BB GAIN control, adjust the BB GAIN control fully counterclockwise, then adjust it clockwise to obtain 10.0 dBm.	
5	Arrange the TL test set to send a 70-MHz signal at a level of -10 dBm into the 1075A filter by moving the 327A plug from the 66/74 MC OUT jack to the OSC OUT jack, depressing the 70-MHz button, and setting -10 dB in the attenuator.
6	Adjust the range control on the TL test set until the VOLTMETER indicates the presence of noise at the RCVR OUT jack.

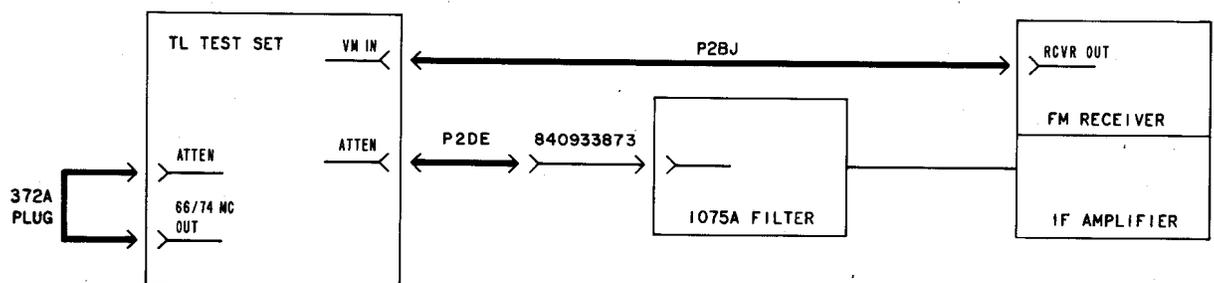


Fig. 3—Squelch Sensitivity Check—Receiver Equipped with IF Amplifier and FM Receiver Units—Test Setup Diagram

CHART 3 (Cont)

STEP	PROCEDURE
7	<p>Decrease the level from the TL test set until the squelch circuit operates (the output is reduced by approximately 50 dB).</p> <p><i>Note:</i> The noise level will increase as the level from the TL test set is decreased until the squelch circuit operates. When the squelch circuit opens, the level at the RCVR OUT jack will decrease by approximately 50 dB.</p> <p><i>Requirement:</i> The squelch circuit should operate between -58 and -60 dBm.</p> <p><i>Note:</i> If this requirement is not met, adjust the SQCH control on the IF amplifier and repeat Steps 5, 6, and 7 until the requirement is met.</p> <p>RF Squelch Sensitivity in the Presence of Noise</p> <p><i>Note:</i> If the transmitter blocking method is to be used, perform Step 8 and then proceed to Step 12. If the klystron detuning and retuning method is to be used, omit Step 8.</p>
8	<p>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. Proceed to Step 12.</p>
9	<p>Set the AFC switch on the meter and control panel to the OFF position.</p>
10	<p>Slowly adjust the BO KLY ADJ control two and one-half 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.</p>
11	<p>At the meter and control panel, set the selector switch to CR1 and CR2 and check that CR1 and CR2 still indicate crystal current, showing that the beat oscillator is still oscillating.</p>
12	<p>Leave the BO klystron detuned, or the transmitter waveguide switch in the OFF position for the remainder of the AGC squelch sensitivity tests.</p>
13	<p>RF Squelch Sensitivity in the Presence of Noise</p> <p>Connect the equipment as shown in Fig. 4 with a 70-MHz signal at a level of -20 dBm from the TL test set. Adjust the RANGE control on the TL test set until the VOLTMETER indicates the presence of noise at the RCVR OUT jack.</p>
14	<p>Decrease the level from the TL test set until the squelch circuit operates (the output is decreased by approximately 50 dB).</p> <p><i>Note 1:</i> The noise level will increase as the level from the TL test set decreases until the squelch circuit operates. When the squelch circuit operates, the level at the RCVR OUT jack will decrease by approximately 50 dB.</p>

CHART 3 (Cont)

STEP

PROCEDURE

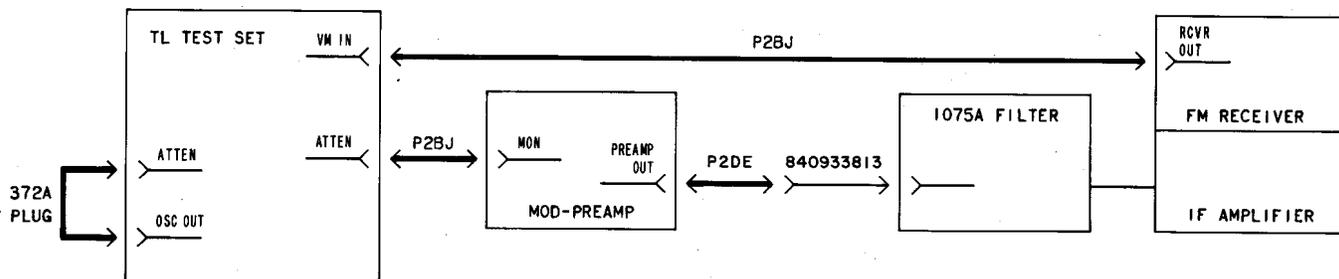


Fig. 4—RF Squelch Sensitivity Test—Test Setup Diagram

Note 2: The RF squelch sensitivity is the level from the TL test set plus the conversion factor stamped on the modulator-preamplifier.

Note 3: Later versions of the List 3 modulator-preamplifier are stamped 20.0 DB CONV GAIN and X.X DB MON LOSS. To obtain the conversion factor, add the conversion gain to the MON LOSS ($20.0 + \text{MON LOSS} = \text{conversion factor}$).

Example: If the level from the TL test set is -48 dBm and the conversion factor is 29 dB; then the RF squelch sensitivity is $-(48 + 29) = -77$ dBm.

Requirement: The RF squelch sensitivity shall be between -77 and -82 dBm.

- 15 Restore the coaxial patches to normal and adjust the BO KLY ADJ control to the correct frequency or communicate with the adjacent station and have the appropriate transmitter unblocked by inserting the waveguide switch to the ON position.

AFC Squelch Operation

This test requires that an unmodulated signal be applied to the receiver IF amplifier and FM receiver units on an out-of-service basis.

Note: The AFC squelch circuit disables the AFC circuit during deep fades to prevent AFC lockout. The AFC squelch relay K1 is released when the received signal falls below a usable level inserting a high resistance in the AFC loop.

- 16 On the meter and control panel, set the AFC switch to the OFF position and the selector switch to the RCVR AFC position.
- 17 Observe the lower meter on the meter and control panel.

CHART 3 (Cont)

STEP

PROCEDURE

Requirement: The meter indicates 14.0 ± 0.5 volts (on the 30-volt scale).

Note: If the requirement is not met, adjust R27 for an indication of 14.0 volts.

18 Set the AFC switch to the ON position.

19 Remove the required unit from service.

20 Remove the coaxial patch cord from the input to the 1075A filter.

21 Apply a 66-MHz signal at -75 dBm from the TL test set to the jack.

Requirement: Relay K1 of the meter and control panel releases.

Note 1: If relay K1 is released (squench operated), the lower meter will indicate 13.5 ± 3.0 volts.

Note 2: If this requirement is not met, a defective K1 relay, IF amplifier, or FM receiver unit is indicated and any or all should be replaced.

Note 3: If a unit is replaced, repeat the entire test.

22 Increase the level of the 66-MHz signal in 1-dB steps, waiting 10 seconds between steps (to allow the magnetic amplifier to come out of saturation) until the lower meter drops to less than 10 volts or rises to more than 22 volts indicating operation of relay K1.

Requirement: IF input at the relay operating point shall be between -58 and -60 dBm.

Note 1: If this requirement is not met, a defective K1 relay, IF amplifier, or FM receiver unit is indicated and any or all should be replaced.

Note 2: If a unit is replaced, repeat the entire test.

23 Restore the circuit to normal by replacing the filter input and the receiver output patch cord. With the FREQ switch set to IF and the selector switch to the AGC and AFC positions, observe the meter indications to see that the receiver BO klystron is locked on the incoming signal.