
TL-1 MICROWAVE RADIO
RECEIVER TESTS
RECEIVED SIGNAL LEVEL

This section contains the procedures for the measurement of the level of a received signal at the receiver of the TL-1 microwave radio system.

This section is reissued to add test 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-1, 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 two principle methods of measuring the received signal level are the approximate method and the calibrated method. The calibrated method is preferred. This method is based upon the long-term stability of the gain of the modulator-preamplifier. It is an out-of-service test. A less accurate method is the substitution method which is not only dependent upon the modulator-preamplifier gain, but also the AGC calibration of the IF and baseband unit. This is an in-service test of short duration.

Both methods of measuring the received signal level are given in *each* of the charts in this section; however, only one method is normally used. Perform the procedures in *only one chart*. Chart 1 is applicable to TL-1 systems that have not been modified. Charts 2 through 5 are applicable to TL-1 systems that have been modified as indicated by the second paragraph in this section.

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Unit and a J99351E IF Amplifier Unit with a J99351J FM Receiver Unit 14

APPARATUS:

- 1—KS-14510 Volt-Ohm-Milliammeter (VOM)
 - 1—J99262AA TL Test Set
 - 1—KS-16647 Hewlett-Packard RF Test Set
 - 1—1A Transducer
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CHART 1**PROCEDURES FOR UNMODIFIED SYSTEMS**

The procedures in this chart are applicable to TL-1 systems that are still equipped with the J99262F modulator-preamplifier unit and the J99262G receiver unit.

Some of the procedures are performed on an out-of-service basis. Be certain that the radio channel is removed from service as specified in Section 409-306-500.

STEP**PROCEDURE****Approximate Method**

- 1 Set the selector switch of the meter and control panel to the RCVR AGC position and observe the 6-volt scale of the lower meter.
- 2 Refer to the curve of Fig. 1 to obtain the approximate input level to the receiver modulator.

Calibrated Method

This procedure substitutes an unmodulated 70-MHz signal from the TL test set for the normal signal from the modulator. The attenuators of the TL test set are adjusted to give the same AGC meter indication as the normal signal. This is an out-of-service procedure. Refer to Section 409-306-500.

- 3 Set the selector switch of the meter and control panel to the AGC position and note carefully the indication of the lower meter. Tap the meter lightly to remove any bearing-friction error.
- 4 Remove the patch cord between the PRE AMPL IN jack of the IF and baseband unit and jack J3 of the 1A receiver modulator.

CHART 1 (Cont)

STEP	PROCEDURE
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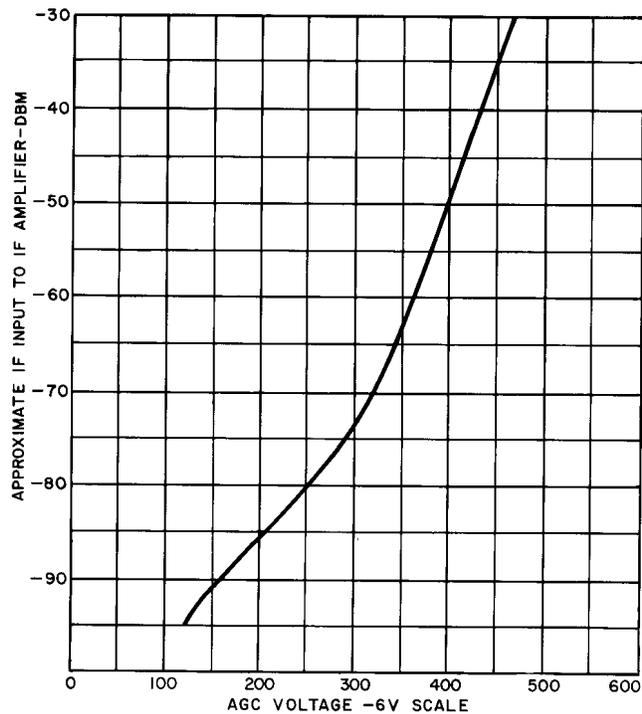


Fig. 1—TL-1 Receiver—Typical AGC Characteristics—Graph

- 5 Arrange the TL test set to send a 70-MHz signal into the PRE AMPL IN jack and adjust the level to obtain the same AGC indication as observed in Step 3. Again tap the meter lightly to remove any bearing-friction error.
- 6 From the attenuators of the test set, read the signal level at the input of the IF amplifier. Add to this number the number that is stamped on the 1A modulator. The result is the RF input to the 1307 bandpass filter preceding the modulator.

Example: Suppose the IF input from the test set required to match the normal AGC indication is -46 dBm, and the number stamped on the 1A modulator is 7.0 dB; the RF input to the 1307 filter is $-46 + 7 = -39$ dBm.

Note: The number stamped on the 1A modulator is the factory-measured loss of the J99262F receiver modulator unit. This number is intended to be used during initial system lineup for the purpose of checking the antenna orientation. The loss will change from the stamped number as the CR1 and CR2 diodes age or if they are changed.

CHART 1 (Cont)

STEP	PROCEDURE
7	<p>Restore the circuit to normal and observe on the AGC, IF frequency, and automatic frequency control (AFC) meter that the receiver beat-oscillator klystron is locked on the incoming signal.</p> <p>It is suggested that an accurate plot be made for each IF and baseband unit similar to the typical curve of Fig. 1. This would be done following the procedure above for test set outputs from -90 dBm to -35 dBm.</p>
RF Substitution Method	
<p>This procedure is not performed on a routine basis but is primarily intended for installation and trouble conditions. Refer to Section 409-306-500 for out-of-service instructions. The out-of-service condition will exist for all RF panels in the radio bay where these procedures are being performed.</p>	
8	<p>Set the waveguide switch included with the coupling unit to the OFF position. The individual transmitter waveguide switches should also be in the OFF position.</p>
9	<p>Set the selector switch to the RCVR AGC position.</p>
10	<p>Observe and record carefully the AGC voltage indication on the lower meter. Tap the meter lightly to remove any bearing-friction error.</p>
11	<p>Remove the radio bay from service. Refer to Section 409-306-500.</p>
12	<p>Calibrate the frequency for the receiver to be tested and the power output of the RF generator on the RF test set and connect the RF generator to the RF measurement coupling unit.</p>
13	<p>Adjust the power output level of the RF generator to give the same AGC indication as in Step 10. Tap the meter lightly to prevent bearing-friction error.</p>
14	<p>Add the appropriate losses in Table A to the value of the RF generator level. This is the received signal level.</p> <p><i>Note:</i> The RF measurement coupling unit may have the midband and sideband losses stamped on it. The values in Table A are a mean value and not the actual test value of the coupler. The loss stamped on the unit should be used to determine the most precise value for the received signal level.</p>
15	<p>Restore the system to normal operation as specified in Section 409-306-500.</p>

TABLE A
RECEIVER LOSSES

CHANNEL NUMBER	NUMBER OF RECEIVERS IN BAY		
	1 OPTION A	2 OPTION B	3 OPTION C
1	21.7	22.0	22.3
2	—	21.8	22.2
3	—	—	22.0

CHART 2

PROCEDURES FOR SYSTEMS EQUIPPED
WITH A LATER J99296AA, L3 MODULATOR-PREAMPLIFIER
UNIT AND A J99296G RECEIVER
IF AND BASEBAND UNIT

The procedures in this chart are applicable to TL-1 systems that have been modified with a J99296AA, List 3 modulator-preamplifier that is stamped with 20 DB CONV GAIN. If the List 3 modulator-preamplifier is stamped with XXX DB CNV FCTR, then refer to either Chart 4 or 5. If it is considered necessary to calibrate the lower meter on the meter and control panel for AGC indications, refer to Steps 1 through 4.

STEP

PROCEDURE

Calibration of Lower Meter for AGC Indications

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

- 1 Arrange the TL test set to send a 70-MHz signal at -30 dBm to the IF IN jack of the J99296G receiver IF and baseband unit.
- 2 Set the selector switch on the meter and control panel to the RCVR AGC position.
- 3 Observe the indication on the 600 scale of the lower meter. Tap the meter lightly to remove any bearing-friction error.

Requirement: The lower meter indication is the same as specified in Fig. 2 or Fig. 3 (± 10 units).

Note: If the requirement is not met, adjust the AGC CAL control on the meter and control panel until the requirement is met.

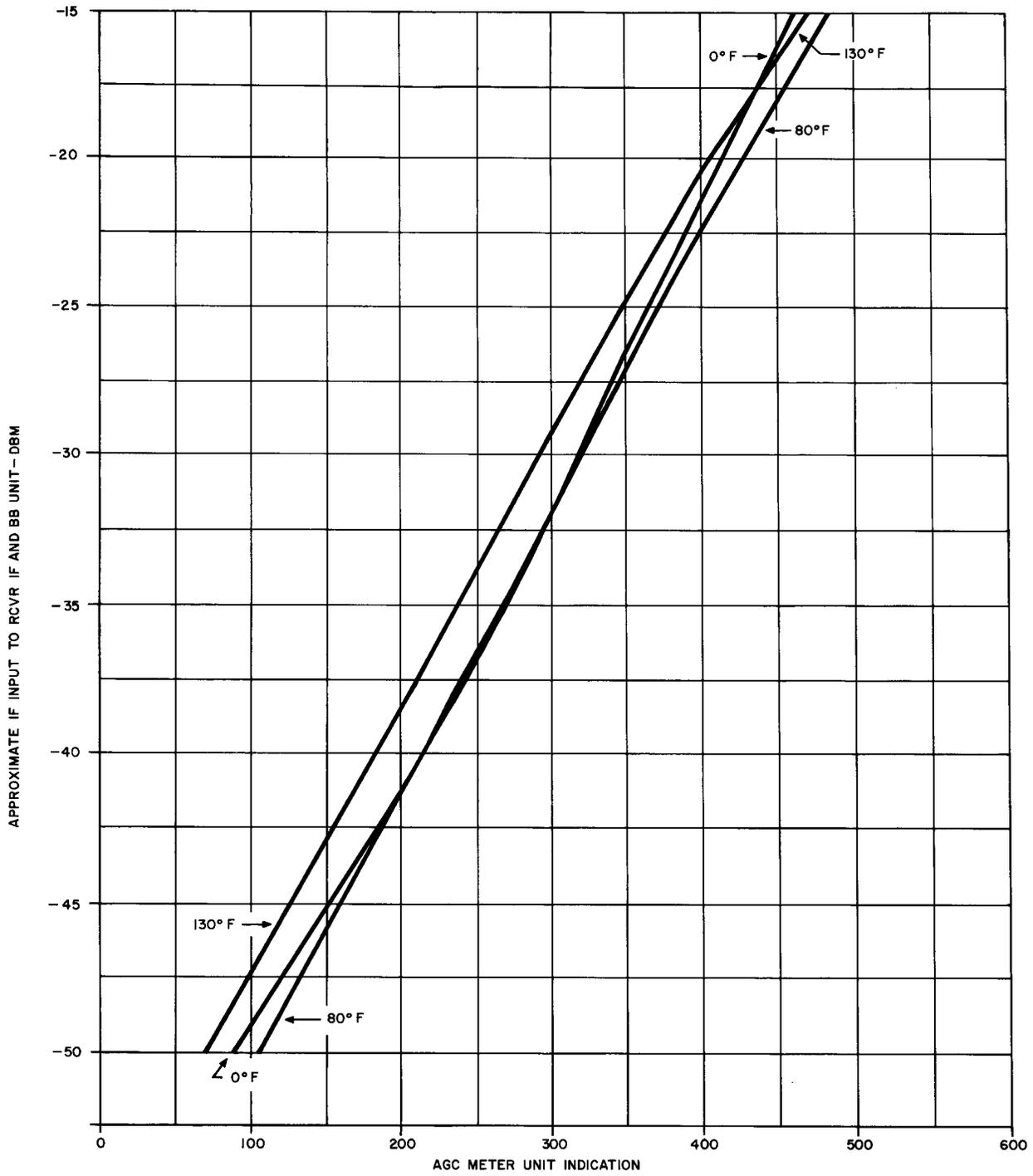


Fig. 2—J99296G,L3—Typical AGC Characteristics—Graph

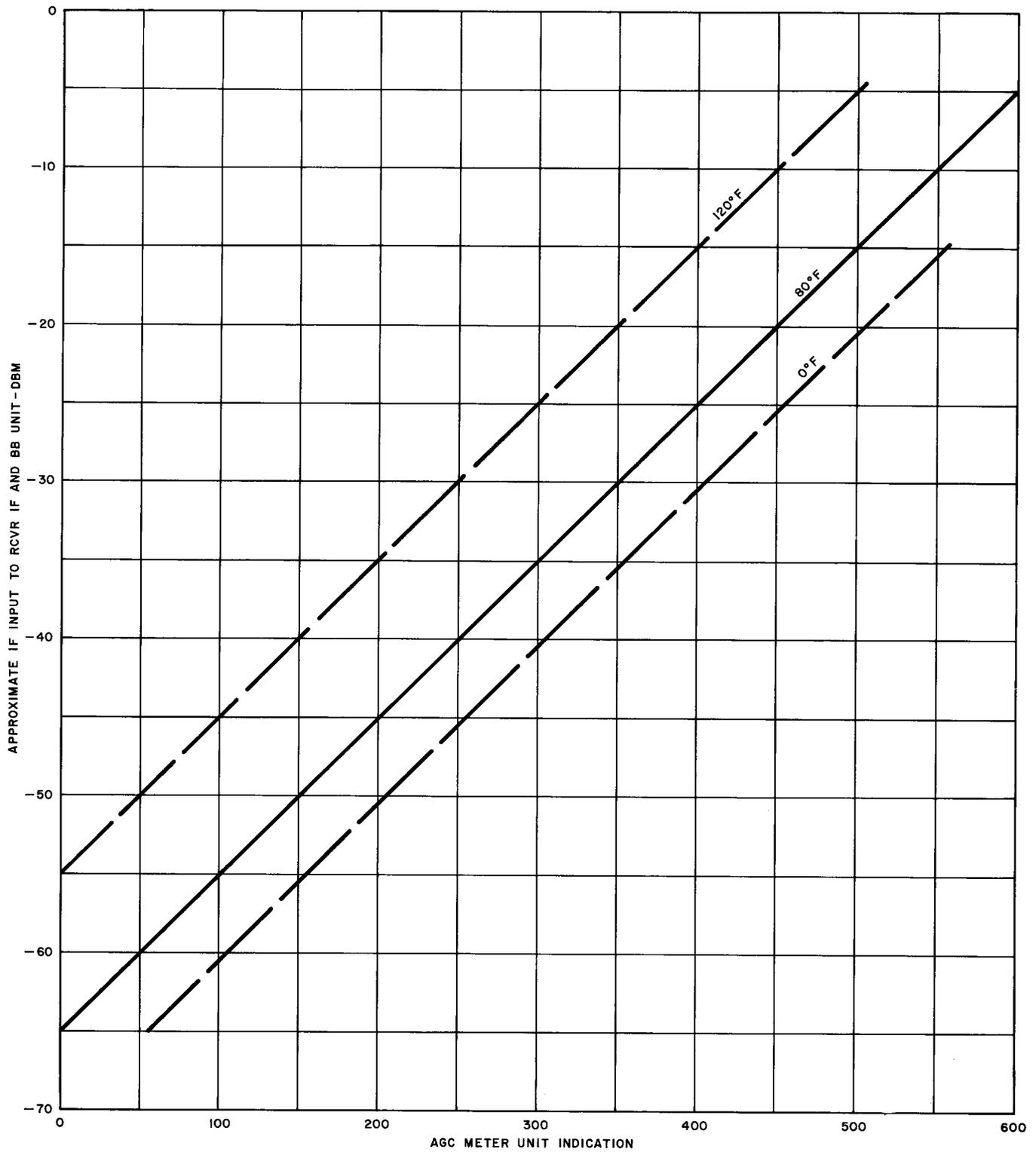


Fig. 3—J99296G-2, L2—Typical AGC Characteristics—Graph

CHART 2 (Cont)

STEP	PROCEDURE
4	Restore equipment to original condition.
	Approximate Method
5	Set the selector switch on the meter and control panel to the RCVR AGC position and observe the 600 scale on the lower meter.
6	Refer to Fig. 2 or Fig. 3 to obtain the approximate signal input level to the receiver IF and baseband unit.
	Note: The temperature should be measured approximately 2 inches from the side of the receiver IF and baseband unit.
7	Add the number stamped on the modulator-preamplifier (CONV GAIN) to the level obtained in Step 6.
	Example: The approximate input level to the receiver IF and baseband unit is -25 dBm; the conversion gain is 20 dB; therefore, the approximate RF input level to the modulator-preamplifier is $-(25 + 20) = -45$ dBm.
	Calibrated Method
	This is an out-of-service test for the receiver being tested.
8	Set the selector switch on the meter and control panel to the RCVR AGC position and record the indication on the 600 scale of the lower meter. Tap the meter lightly to remove any bearing-friction error.
9	Remove the patch cord from the IF IN jack of the J99296G receiver IF and baseband unit.
10	Apply a 70-MHz signal from the TL test set to the IF IN jack and adjust the level to obtain the same AGC indication as recorded in Step 8.
11	From the attenuators of the TL test set, observe the signal level at the input of the receiver IF and baseband unit.
12	Add the stamped gain of the modulator-preamplifier to the value obtained in Step 11. The result is the RF input to the modulator-preamplifier.
13	Restore the receiver to service and with the FREQ switch set to the IF position and selector switch set to the AGC and AFC positions, observe the meters to see that the receiver beat-oscillator klystron is locked on the incoming signal.

CHART 3

**PROCEDURES FOR SYSTEMS EQUIPPED
WITH A LATER J99296AA, L3 MODULATOR-PREAMPLIFIER
UNIT AND A J99351E IF AMPLIFIER
UNIT WITH A J99351J FM
RECEIVER UNIT**

The procedures in this chart are applicable to TL-1 systems that have been modified with a J99296AA, List 3 modulator-preamplifier that is stamped with 20 DB CONV GAIN. If the List 3 modulator-preamplifier is stamped with XXX DB CNV FCTR, refer to either Chart 4 or 5.

If it is considered necessary to calibrate the lower meter on the meter and control panel for AGC indications, refer to Steps 1 through 4.

STEP	PROCEDURE
Calibration of Lower Meter for AGC Indications	
This is an out-of-service procedure. Be certain that the radio channel is removed from service as specified in Section 409-306-500.	
1	Arrange the TL test set to send a 70-MHz signal at -30 dBm to the input of the 1075A filter of the J99351E IF amplifier unit.
2	Set the selector switch on the meter and control panel to the RCVR AGC position.
3	Observe the indication on the 600 scale of the lower meter. Tap the meter lightly to remove any bearing-friction error.
Requirement: The lower meter indication is the same as specified in Fig. 4 (± 10 units).	
Note: If the requirement is not met, adjust the AGC CAL control on the meter and control panel until the requirement is met.	
4	Restore equipment to original condition.
Approximate Method	
5	Set the selector switch on the meter and control panel to the RCVR AGC position and observe the 600 scale on the lower meter.
6	Refer to Fig. 4 to obtain the approximate signal input level to the 1075A filter of the J99351E IF amplifier unit.
7	Add the number stamped on the modulator-preamplifier (CONV GAIN) to the level obtained in Step 6.

CHART 3 (Cont)

STEP

PROCEDURE

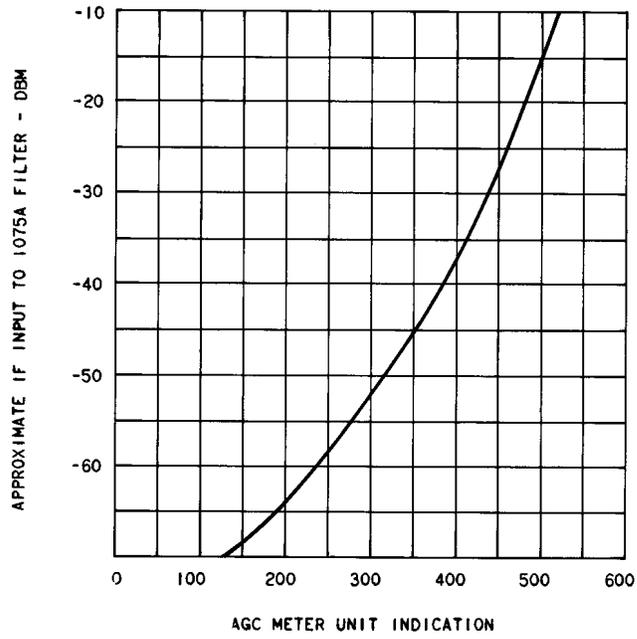


Fig. 4—J99351E—Typical AGC Characteristics—Graph

CHART 3 (Cont)

STEP	PROCEDURE
	<i>Example:</i> The approximate input level to the 1075A filter is -25 dBm. The conversion gain is 20 dB; therefore, the approximate RF input level is $-(25 + 20) = -45$ dBm.
	Calibrated Method
	This is an out-of-service test for the receiver being tested.
8	Set the selector switch on the meter and control panel to the RCVR AGC position and record the indication on the 600 scale of the lower meter. Tap the meter lightly to remove any bearing-friction error.
9	Remove the patch cord from the input jack of the 1075A filter.
10	Apply a 70-MHz signal from the TL test set to the input jack of the 1075A filter and adjust the level to obtain the same AGC indication as recorded in Step 8.
11	From the attenuators of the TL test set, observe the signal level at the input of the 1075A filter.
12	Add the stamped gain of the modulator-preamplifier to the value obtained in Step 11. The result is the RF input to the modulator-preamplifier.
13	Restore the receiver to service and with the FREQ switch set to the IF position and selector switch set to the AGC and AFC positions, observe the meters to see that the receiver beat-oscillator klystron is locked on the incoming signal.

CHART 4

**PROCEDURES FOR SYSTEMS EQUIPPED
WITH AN EARLY J99296AA, L3 MODULATOR-PREAMPLIFIER
UNIT AND A J99296G
RECEIVER IF AND BASEBAND
UNIT**

The procedures in this chart are applicable to TL-1 systems that have been modified with a List 3 modulator-preamplifier that is stamped with XXX DB CNV FCTR. If the List 3 modulator-preamplifier is stamped with 20 DB CONV GAIN, refer to either Chart 2 or 3.

If it is considered necessary to calibrate the lower meter on the meter and control panel for AGC indications, refer to Steps 1 through 4.

CHART 4 (Cont)

STEP	PROCEDURE
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Calibration of Lower Meter for AGC Indications

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

- 1 Arrange the TL test set to send a 70-MHz signal at -30 dBm to the IF IN jack of the J99296G receiver IF and baseband unit.
- 2 Set the selector switch on the meter and control panel to the RCVR AGC position.
- 3 Observe the indication on the 600 scale of the lower meter. Tap the meter lightly to remove any bearing-friction error.

Requirement: The lower meter indication is the same as specified in Fig. 2 (± 10 units).

Note: If the requirement is not met, adjust the AGC CAL control on the meter and control panel until the requirement is met.

- 4 Restore equipment to original condition.

Approximate Method

- 5 Set the selector switch on the meter and control panel to the RCVR AGC position and observe the 600 scale on the lower meter.
- 6 Refer to Fig. 2 or Fig. 3 to obtain the approximate signal input level to the receiver IF and baseband unit.

Note: The temperature should be measured approximately 2 inches from the side of the receiver IF and baseband unit.

- 7 To calculate the RF signal input level to the modulator-preamplifier, determine the approximate gain of the modulator-preamplifier by subtracting 9.0 dB (nominal loss from the monitor jack to the PREAMP OUT jack) from the conversion factor. (This value is stamped on the modulator-preamplifier.) To the resulting number, which represents the approximate gain of the modulator-preamplifier, add the approximate input level to the receiver IF and baseband unit that was obtained in Step 6.

Example: If the conversion factor is 29.0, the monitor jack loss is 9.0 dBm, the approximate input level to the receiver IF and baseband is -25 dBm; then, the approximate RF signal input level to the modulator-preamplifier is $-[(29.0 - 9.0) + 25] = -45$ dBm.

Note: The conversion factor is a value that relates the input level to the level necessary at the monitor jack to produce the same output level.

CHART 4 (Cont)

STEP	PROCEDURE
	Calibrated Method
	This is an out-of-service test for the receiver being tested.
8	Set the selector switch on the meter and control panel to the RCVR AGC position and record the indication on the 600 scale or the lower meter. Tap the meter lightly to remove any bearing-friction error.
9	Remove the coaxial patch cord from the RCVR OUT jack on the receiver IF and baseband unit. Connect the VOM between the center conductor and ground of the RCVR OUT jack and set it to the R X 1 scale.
10	Set the AFC switch on the meter and control panel to the OFF position.
11	If personnel are present at the preceding transmitting station, perform this step and omit Step 12. If personnel are not available, proceed with Step 12. Establish voice communications with the personnel at the transmitting station and request that the applicable transmitter be blocked by placing the 228B waveguide switch in the OFF position. Check that the VOM indicates a short circuit.
12	Detune the beat-oscillator klystron by slowly turning the BO KLY ADJ control until the VOM indicates a short circuit. <i>Note:</i> Turn the BO KLY ADJ control clockwise for channels with the suffix letters A, P, or E and counterclockwise for channels with the suffix letters B, J, or D.
13	Reconnect the normal patch cord to the RCVR OUT jack on the receiver IF and baseband unit.
14	Apply a 70-MHz signal from the TL test set to the MON jack of the modulator-preamplifier unit and adjust the level to obtain the same indication as observed in Step 8.
15	From the attenuators on the test set, observe the signal level at the MON jack of the modulator-preamplifier and add to this number the conversion factor stamped on the modulator-preamplifier. The result is the RF input to the modulator-preamplifier.
16	If the beat-oscillator klystron was detuned in Step 12, retune the beat-oscillator klystron by turning the BO KLY ADJ control. If Step 11 was performed, establish voice communications with the personnel at the transmitting station and request that the transmitter be returned to normal by placing the 228B waveguide switch to the ON position.
17	Restore the circuit to normal and with the FREQ switch set to the IF position and the selector switch set to the AGC and AFC positions, observe the meters to see that the receiver beat-oscillator klystron is locked on the incoming signal.

CHART 5

**PROCEDURES FOR SYSTEMS EQUIPPED
WITH AN EARLY J99296AA, L3 MODULATOR-PREAMPLIFIER
UNIT AND A J99351E IF AMPLIFIER
UNIT WITH A J99351J FM
RECEIVER UNIT**

The procedures in this chart are applicable to TL-1 systems that have been modified with a List 3 modulator-preamplifier that is stamped with XXX DB CNV FCTR. If the List 3 modulator-preamplifier is stamped with 20 DB CONV GAIN, refer to either Chart 2 or 3.

If it is considered necessary to calibrate the lower meter on the meter and control panel for AGC indications, refer to Steps 1 through 4.

STEP	PROCEDURE
Calibration of Lower Meter for AGC Indications	
	This is an out-of-service procedure. Be certain that the radio channel is removed from service as specified in Section 409-306-500.
1	Arrange the TL test set to send a 70-MHz signal at -30 dBm to the input of the 1075A filter of the J99351E IF amplifier unit.
2	Set the selector switch on the meter and control panel to the RCVR AGC position.
3	Observe the indication on the 600 scale of the lower meter. Tap the meter lightly to remove any bearing-friction error.
	Requirement: The lower meter indication is the same as specified in Fig. 4 (± 10 units).
	Note: If the requirement is not met, adjust the AGC CAL control on the meter and control panel until the requirement is met.
4	Restore equipment to its original condition.
Approximate Method	
5	Set the selector switch on the meter and control panel to the RCVR AGC position and observe the 600 scale on the lower meter.
6	Refer to Fig. 4 to obtain the approximate signal input level to the 1075A filter of the J99351E IF amplifier unit.
7	To calculate the RF signal input level to the modulator-preamplifier, determine the approximate gain of the modulator-preamplifier by subtracting 9.0 dB (nominal loss from the monitor jack to the PREAMP OUT jack) from the conversion factor. (This value is stamped on

CHART 5 (Cont)

STEP**PROCEDURE**

the modulator-preamplifier.) To the resulting number, which represents the approximate gain of the modulator-preamplifier, add the approximate input level to the 1075A filter of the J99351E IF amplifier unit that was obtained in Step 6.

Example: If the conversion factor is 29.0, the monitor jack loss is 9.0 dBm, the approximate input level to the 1075A filter of the J99351E IF amplifier unit is -25 dBm; then, the approximate RF signal input level to the modulator-preamplifier is $-[(29.0 - 9.0) + 25] = -45$ dBm.

Note: The conversion factor is a value that relates the input level to the level necessary at the monitor jack to produce the same output level.

Calibrated Method

This is an out-of-service test for the receiver being tested.

- 8 Set the selector switch on the meter and control panel to the RCVR AGC position and record the indication on the 600 scale of the lower meter. Tap the meter lightly to remove any bearing-friction error.
 - 9 Patch from the RCVR OUT jack to the VM IN jack on the TL test set. Set the INPUT switch to RCVR GAIN and the range switch to obtain a midscale indication.
 - 10 Set the AFC switch on the receiver control unit to the OFF position.
 - 11 If personnel are present at the preceding transmitting station, perform this step and omit Step 12. If personnel are not available, proceed with Step 12. Establish voice communications with the personnel at the transmitting station and request that the applicable transmitter be blocked by placing the 228B waveguide switch in the OFF position. Check that the TL test set indication is severely reduced by more than 50 dB.
 - 12 Detune the beat-oscillator klystron by slowly turning the BO KLY ADJ control until the TL test set indication is severely reduced by more than 50 dB.
- Note:** Turn the BO KLY ADJ control clockwise for channels with the suffix letters A, P, or E and counterclockwise for channels with the suffix letters B, J, or D.
- 13 Reconnect the normal patch cord to the RCVR OUT jack.
 - 14 Apply a 70-MHz signal from the TL test set to the MON jack of the modulator-preamplifier unit and adjust the level to obtain the same indication as observed in Step 8.
 - 15 From the attenuators on the test set, observe the signal level at the MON jack of the modulator-preamplifier and add this number to the conversion factor stamped on the modulator-preamplifier. The result is the RF input to the modulator-preamplifier.

CHART 5 (Cont)

STEP	PROCEDURE
16	If the beat-oscillator klystron was detuned in Step 12, retune the beat-oscillator klystron by turning the BO KLY ADJ control. If Step 11 was performed, establish voice communication with the personnel at the transmitting station and request that the transmitter be returned to normal by placing the 228B waveguide switch to the ON position.
17	Restore the circuit to normal and with the FREQ switch set to the IF position and the selector switch set to the AGC and AFC positions, observe the meters to see that the receiver beat-oscillator klystron is locked on the incoming signal.
