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**TL-1 MICROWAVE RADIO**  
**GENERAL INFORMATION**  
**TRANSMITTER-RECEIVER BAY—CHECKS AND TROUBLE LOCATION**

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This section contains the checks which should be made during each visit to a radio station, as well as the methods for locating troubles in the transmitting or receiving units of the TL-1 radio bay.

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

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

Since the changes in this reissue are extensive, the change arrows have been omitted.

This reissue does not affect the Equipment Test List.

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**APPARATUS:**

- 1—J99262AA TL Test Set
- 1—KS-14510, List 1 Volt-Ohm-Milliammeter
- 1—KS-19178, List 1 Voltmeter

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**CHART 1**  
**ROUTINE CHECK PROCEDURE**

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Regardless of the reason for station visits, the maintenance personnel should always make the following checks before and after performing any work on the equipment.

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**CHART 1 (Cont)**


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STEP	PROCEDURE
<b>Meter Indications</b>	
1	Operate the selector switch on the TL-1 meter and control panel to each of its 12 positions and observe and record the corresponding indications on the lower meter. The indications should be within the limits prescribed in Table A.
<b>Diversity Switch</b>	
2	Check that the MAN switch is in the AUTO position.
<b>Battery</b>	
3	Check that the battery fluid level is between the two black lines on the side of the case.
4	Operate the selector switch to the RCVR CATH position.
5	Observe the current indication on the lower meter (60 mA full scale).

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**CHART 2****TROUBLE LOCATION PROCEDURE**

When trouble is known to exist at a particular radio station but its exact nature has not been previously determined, the following series of tests, both in-service and out-of-service, may be made to locate the faulty apparatus quickly so that service interruption or degradation may be minimized. Out-of-service tests should be performed only when other methods have failed. All of the following tests assume that radio equipment at adjacent radio stations is performing satisfactory.

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STEP	PROCEDURE
<b>In-Service Tests</b>	
1	Using the trouble location chart in Fig. 4 as a guide, check supply voltages, currents, signal levels, etc. This chart helps locate specific apparatus as possible causes of out-of-limits voltage indications.
2	In case of failure to meet the RCVR CATH requirement, the klystron heater voltage should be check as follows. Connect the KS-14510 volt-ohm-milliammeter, set on the 15-Vdc scale, to jacks J1- and J2+ on the meter and control panel, observing the correct polarity.

**Caution:** These jacks are at a potential of approximately -400 volts with respect to ground. Be sure that the voltmeter is not inadvertently connected between either of the jacks and ground. Failure to observe this precaution will damage the voltmeter.

**Requirement:** Voltage shall be 5.9 to 6.5 volts.

**Note:** If this requirement is not met, investigate the power supply using Section 409-308-501.

TABLE A

SWITCH POSITION		LOWER METER INDICATION	FULL-SCALE DEFLECTION	SEE NOTE.
OFF -400 -200		0 365 to 435 Vdc 180 to 220 Vdc	600 Vdc 600 Vdc	
BAT -20		21.1 to 29.2 Vdc 19 to 21 Vdc	30 Vdc 30 Vdc	1
RCVR	AFC	15 to 17 Vdc	30 Vdc	2 and 8
	CR1	0.4 to 1.2 mA	6 mA	3 and 4
	CR2	0.4 to 1.2 mA	6 mA	3 and 4
	AGC	See Fig. 1, 2, or 3.	6 Vdc	5
	CATH	33 to 50 mA	60 mA	
XMTR	PF PWR	-1.0 to +6.0 dBm	+6 dBm	6 and 7
	CATH	33 to 50 mA	60 mA	
FREQ IF		$0 \pm 2 \mu\text{A}$	$\pm 50 \mu\text{A}$	2

**Notes:**

1. If the power has been on for a prolonged period, the battery should be near or at full charge. Meter indication should be  $-27.6 \pm 1.0$  volts.
2. If outside these limits, consult Section 409-306-502.
3. These indications will be zero if the beat-oscillator (BO) klystron is not operating. This could be due to improper adjustment of the receiver automatic frequency control (AFC).
4. If the bay or cabinet is operating properly, the sum of CR1 and CR2 shall equal  $1.6 \pm 0.1$  mA. If not, adjust the 25A attenuator behind the klystron oven until this requirement is met.
5. Figure 1, 2, or 3 may be used to approximate the receiver input levels from the automatic gain control (AGC) meter indications, depending on which of the units is provided. The three available units are as follows:
  - (a) The J99262G receiver IF and baseband unit. See Fig. 1.
  - (b) The J99296G receiver IF and baseband unit. See Fig. 2.
  - (c) The J99351E-1 IF amplifier unit with the J99351J-1FM receiver unit. See Fig. 3.

CHART 2 (Cont)

STEP

PROCEDURE

TABLE A (Cont)

Figure 2 represents the improved temperature compensated IF and baseband unit which may be identified by the markings J99296G, L3, H or L4 on the unit. Figure 3 shows the AGC characteristic for stations equipped with the new IF amplifier and FM receiver arrangement (J99351E and J99351J). For routine checks on working systems, refer to the station records which show the received signal level indications obtained at the time of initial installation and on previous station units. These records should be compared with present receiver input levels to determine the status.

6. Transmitting klystron power output is +20 dBm plus meter indication.
7. When RF PWR is less than -1 dBm, the tube should be replaced.
8. The lower meter indication shall be 13 to 15 Vdc for receivers equipped with either of the following: The J99296AA-2, List 3 modulator-preamplifier unit with the J99296G-2 receiver IF and baseband unit or the J99296AA, List 3 modulator-preamplifier unit with the J99351E-1 amplifier unit and the J99351J-1 FM receiver unit.

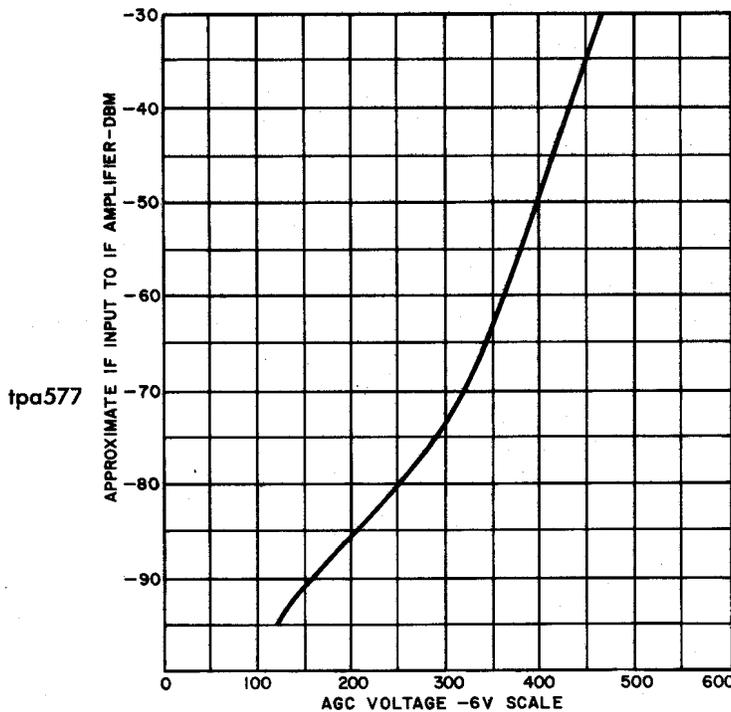


Fig. 1—Typical TL-1 Receiver—AGC Characteristics—Graph

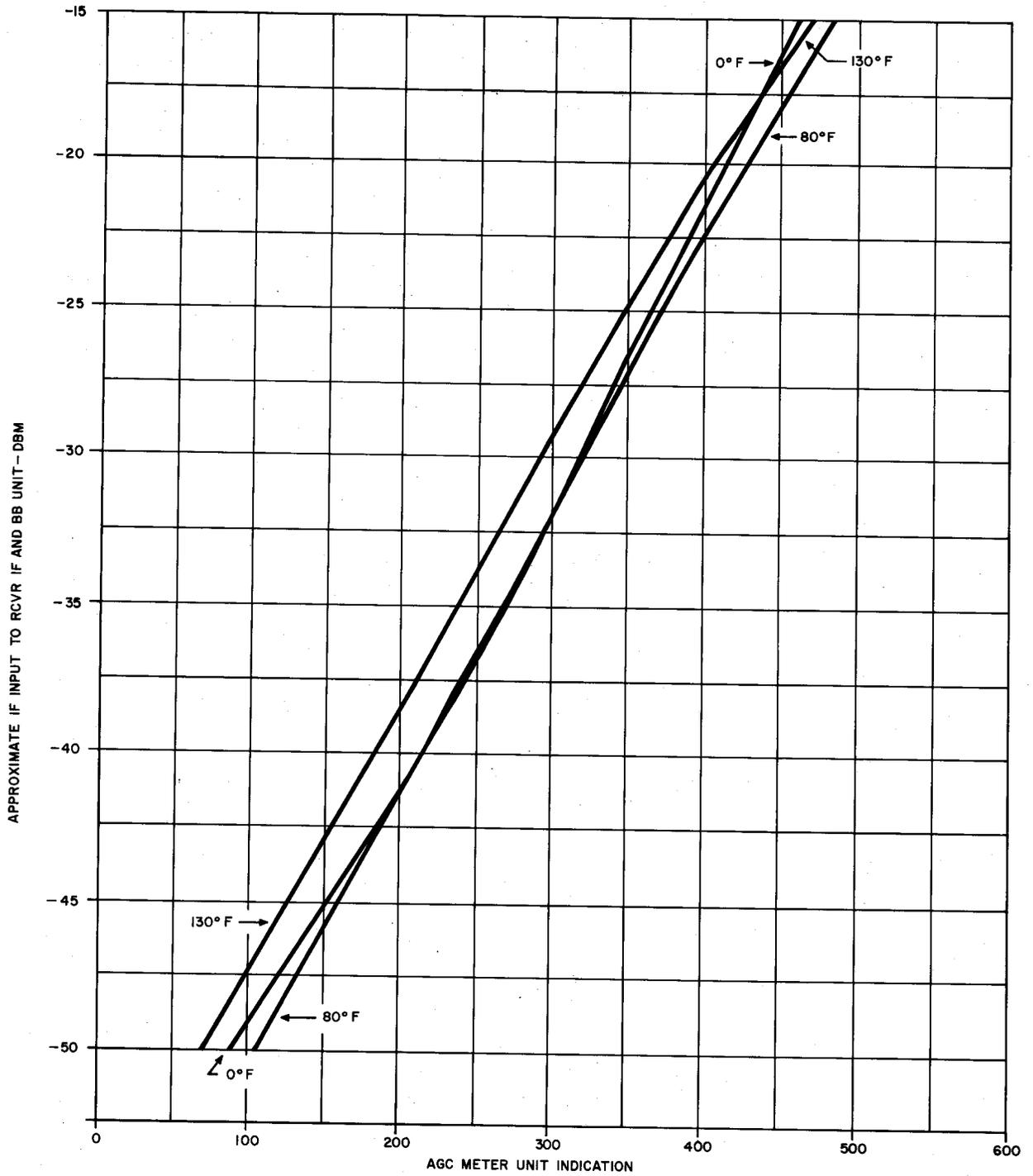


Fig. 2—J99296G-1, List 3 Unit—Receiver AGC Characteristics—Graph

## CHART 2 (Cont)

STEP

PROCEDURE

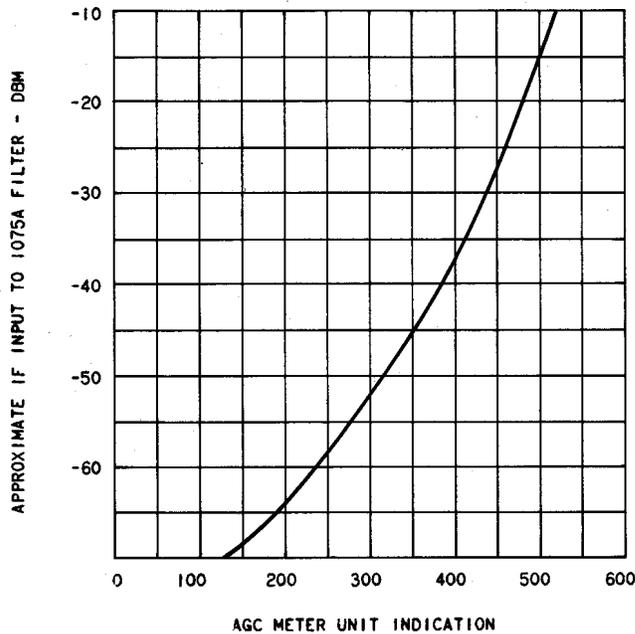


Fig. 3—J99351E Unit—Receiver AGC Characteristics—Graph

- 3 The transmitter baseband amplifier bias may be measured by connecting the KS-14510 volt-ohm-milliammeter, set on the 12-Vdc, across jacks BIAS (–) and GRD (+) on the baseband amplifier chassis.

**Requirement:**  $-7.0 \pm 0.2$  Vdc

**Note:** If this requirement is not met, adjust the BIAS control on the baseband amplifier until the volt-ohm-milliammeter indicates  $-7.0$  Vdc. If this adjustment is not possible, replace the baseband amplifier according to Section 409-304-504.

**For Receivers Equipped With the J99262G Receiver IF and Baseband Unit**

- 4 An indication of the receiver IF and baseband amplifier can be obtained from monitoring the input to the limiter circuit. With the meter and control panel switch on AGC, observe that the lower meter indicates between 3.8 and 4.3 volts on the 6-Vdc scale.

## CHART 2 (Cont)

STEP	PROCEDURE
5	Set the KS-14510 volt-ohm-milliammeter to the 3-Vdc range and connect it across the LIM IN jacks on the front of the receiver IF and baseband panel.  <b>Requirement:</b> As stamped adjacent to the LIM IN jack, $\pm 0.03$ volt  <b>Note:</b> If the requirement cannot be met by adjustment of the LIM IN control, the unit must be replaced following the procedures outlined in Section 409-306-506.  <b>Out-of-Service Tests</b>  If the baseband output from the receiver is out of limits as determined by measurement of the 2600-Hz pilot level (Section 409-303-501) and all the preceding receiver checks are satisfactory, the trouble may be in the preceding transmitter or it may be a more obscure trouble in the receiver IF and baseband unit. The following out-of-service test, using a simulated FM square wave from the TL test set, will distinguish between these possibilities and confirm whether the receiver IF and baseband unit is operating satisfactorily.
6	Measure the level of the 2600-Hz pilot tone as specified in Section 409-303-501, and record this level.  <b>For Receivers Equipped With the J99262G Receiver IF and Baseband Unit</b>
7	After complying with the procedures for removing and restoring service (Section 409-302-500, Fig. 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.
8	Arrange the portable test set to send 66/74 MHz into the PRE AMPL IN jack of the IF and baseband unit.
9	Patch the RCVR OUT jack to the test set VM jack arranged with the INPUT switch on RCVR GAIN.
10	Rotate the RCVR GAIN control to its maximum clockwise position corresponding to maximum gain.  <b>Requirement:</b> At least +12 dBm  <b>Note:</b> If this requirement is not met, a faulty IF and baseband unit requires replacement.
11	Restore the patch cord between PRE AMPL IN and the 1A modulator.
12	Adjust RCVR GAIN to give the same level of 2600-Hz pilot tone as measured in Step 6.

## CHART 2 (Cont)

## STEP

## PROCEDURE

**For Receivers Equipped With J99296G IF and Baseband Unit**

- 13 Arrange the TL test set to send a 70-MHz signal at a level of  $-25$  dBm into the IF IN jack on the IF and baseband unit. Connect the VOM, set to the 3-Vdc scale, to the LIM IN jacks on the IF and baseband unit.

**Requirement:** The VOM should indicate within 0.03 volt of the value stamped adjacent to the LIM IN jacks. If this requirement is not met, adjust the LIM IN control to obtain the stamped value. If this adjustment is not possible, replace the IF and baseband unit.

**For Receivers Equipped With the J99351E-1 IF Amplifier and the J99351J-1 FM Receiver Unit**

- 14 Arrange the TL test set to send a 70-MHz signal at a level of  $-9$  dBm into the 1075A filter. Connect the 70B power meter to the IF MON jack.

**Requirement:** The 70B power meter should indicate  $0 \pm 0.3$  dBm.

**Note:** If this requirement is not met, adjust the AGC control for 0 dBm on the power meter. If this adjustment is not possible, replace the IF amplifier unit.

- 15 If it is known that baseband multiplex information is being applied to the transmitter baseband amplifier and that the trouble is after this point, turn the FREQ switch on the meter and control panel to XMTR and observe the upper meter indication.

**Note:** The XMTR FREQ indication on the upper meter will vary with the amount of transmitter modulation and with various settings of the SENS and BIAS controls.

- 16 Remove the patch from the IN jack of the transmitter baseband amplifier. If the current indication on the upper meter does not increase, the transmitter klystron is not being frequency-modulated. This could indicate a defective baseband amplifier.

- 17 Another test is to send  $-10.5$  dBm at 100 kHz from the portable test set into the IN jack of the transmitter baseband amplifier.

- 18 Patch from the monitor output jack of the transmitter baseband amplifier to the 75-ohm terminated VM IN of the portable test set with the P2DG cord.

- 19 The output of the baseband amplifier should be between  $-8$  dBm and  $-14$  dBm depending on where the baseband amplifier gain control is set.

- 20 Whenever it becomes necessary to replace any components in the transmitter assembly, refer to Sections 409-304-504 and 409-305-500 for detailed instructions.

- 21 The receiver pilot measurements given in Section 409-303-501 will provide additional clues as to the corrective action necessary.

TL RADIO SYSTEM  
TROUBLE LOCATION CHART\*

OUT-OF-LIMITS INDICATIONS				POSSIBLE REASONS FOR OUT OF LIMITS METER INDICATIONS ARE																								
	LIMITS	FULL SCALE DEF	TR KLY	REC KLY	PRECEDING STATION		53A DET 1	53A DET 2	1A MOD CR1	1A MOD CR2	CR1 & CR2	REC IF & BB AMPL	XMTR BB AMPL	13A MAG AMPL #	FUSES					10.5V RECT BRDG &/OR FLT	-200V RECT BRDG &/OR FLT	-400V RECT BRDG &/OR FLT	REG & INV	EXHAUST BAT	-20V REG			
					TR BB AMPL	TR KLY									KLY	IF AMPL & BB	OW & ALM	BAT VOLT ALM	CHGR									
SELECTOR SWITCH																												
	-400	365-435 VDC	600 VDC															X								X	X	X
	-200	180-220 VDC	600 VDC															X					X	X	X	X		
	BAT	21.1-29.2 VDC	30 VDC																	X		B	X				X	
	-20	19-21 VDC	30 VDC															X								X	X	
RCVR	AFC	D 15-17 VDC	30 VDC		X		X					X	X		X	X	X						X	X	X	X	X	X
	CR1	E 0.4-1.2 MA	6 MA		(X)				X		(X)	X		X	X	X						X	X	X	X	X	X	X
	CR2	E 0.4-1.2 MA	6 MA		(X)					X	(X)	X		X	X	X						X	X	X	X	X	X	X
	AGC	SEE FIGS. 1, 2 & 3 SEC 409-302-501	6 VDC		X		X			X	X	X	X		X	X	X						X	X	X	X	X	X
	CATH	33-50 MA	60 MA		X														X				X	X	X	X	X	
	RF PWR	-1.0 - +6.0 DBM	+6.0 DBM	X				X											X				X	X	X	X	X	
	CATH	33-50 MA	60 MA	X															X				X	X	X	X	X	
FREQ SWITCH																												
	IF	C 0 ±2 UA	±50 UA		X		X					X		X				A	X	X				X	X	X	X	X
	XMTR	25-40 UA (NO MOD)	±50 UA	X				X										X	X				X	X	X	X	X	
TEST JACKS																												
	FIL J1 & J2	5.7-6.3 VDC																X					X			X	X	
TEST POINTS																												
RCVR IF & BB AMPL	LIM IN	VOLTAGE STAMPED ON CHASSIS ±.03 VDC										X		X	X	X							X	X	X	X	X	X
XMTR BB AMPL	BIAS	7.0 ±0.2 VDC										X														X	X	
J86499A POWER SUPPLY	-10.5	10.3 - 10.7 VDC																X				X		X	X	X		
	-J1 & +J2	18.3-19.7 VDC																X						X	X	X		
	-J3 & +J4	19.5 - 20.5 VDC																	X					X	X	X		
ORDER WIRE	2600 CPS LEVEL																											
	OW-IN **	-20-(-24)DBM		X	X	X					X	X		X	X	X						X	X	X	X	X	X	

X SIGNIFIES OUT-OF-LIMITS INDICATIONS ( ) SIGNIFIES BOTH INDICATIONS OUT-OF-LIMITS SIMULTANEOUSLY

NOTES:

- A. METER NEEDLE UNSTEADY.
- B. GRADUALLY DROPS TO -24 VOLTS.
- C. WITH AFC ON, IF OUTSIDE 0±2 UA, CONSULT SECTION 409-306-502.
- D. OR 13-15 VDC ON SOME SYSTEMS CONSULT SECTION 409-306-502.
- E. IF THE SUM OF CR1 & CR2 IS NOT 1.6 ±0.1 MA, CONSULT SECTION 409-302-501.

\* THIS CHART IS A GUIDE ONLY. SPECIFIC TROUBLES COULD GIVE OUT-OF-LIMITS INDICATIONS WHICH DO NOT CONFORM EXACTLY WITH THE ABOVE PATTERN.

\*\* MEASURED ON OW-IN JACKS ASSOCIATED WITH RECEIVER UNDER TEST. # REPLACE J99262K METER AND CONTROL UNIT.

Fig. 4—Trouble Location Chart