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## TL-1 MICROWAVE RADIO

### POWER SUPPLY

### VOLTAGE CHECKS

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The purpose of this section is to describe the procedures for rapid localization of trouble and routine maintenance tests on the TL power supply. When the test procedures are such that service will be interrupted, the equipment shall be taken out of service in accordance with Section 409-308-500, Fig. 1. When in-service tests are performed, care shall be taken to avoid interruption of service.

This section is reissued to add a requirement to Chart 1 for common office battery applications and to add a dc regulator control gain test for common office battery applications. Because changes in this issue are extensive, arrows ordinarily used to indicate changes have been omitted. This reissue does not affect the Equipment Test List.

***Warning: When using any portable instrument, the leads shall be carefully examined to make sure the insulation is undamaged. The leads shall be properly connected at the instrument before making contact with the circuit to be changed from one instrument range to another; the power shall first be disconnected from the equipment being tested; or, if test probes are being used, they shall be removed from the equipment under test. Voltages inside the power supply are higher than those usually encountered in the telephone plant. Avoid contact with all terminals when the power supply is energized because high voltages may be present between terminals or between the terminals and chassis (as in the case of the klystron heater circuit). Do not allow a test probe to touch two metal parts which may be at different potentials at the same time as destructive and dangerous short circuits may occur.***

When the power supply is to be checked on a routine in-service basis, only the following tests shall be performed:

- (a) Voltage Checks, Steps 1 through 5
- (b) -20 Volt Regulator Alignment, J86499D, Step 7
- (c) Battery Voltage Alarm Test, J86499E, Steps 18 through 22
- (d) DC Regulator Control Gain Test, Steps 23 through 42
- (e) Battery Maintenance.

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#### APPARATUS:

931 Weston DC Voltmeter, 15-volt dc and 30-volt dc scale

KS-14510 Volt-ohm-milliammeter (VOM)

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J99262AA TL Test Set

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**Note:** Control panel meter indications may be used on an in-service basis to check that the condition of the equipment is generally satisfactory or to provide a quick means of isolating a trouble area.

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**STEP**

**PROCEDURE**

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**VOLTAGE CHECKS**

- 1 Check the voltages and currents per Fig. 2 on the lower meter of the J99262K meter and control panel located on the J99262E transmitter-receiver panel.

**Note 1:** For dedicated battery chargers: If the power has been on for a prolonged period, the battery should be at or near full charge. Meter indication should be  $-27.6 \pm 1.0$  volts when the meter selector switch is on BAT.

**Note 2:** For common office battery: The meter indication should be between  $-23.5$  and  $-26.0$  volts when the meter unit selector switch is in the BAT position.

**Note 3:** If the bay or cabinet is operating properly, the sum of CR1 and CR2 currents shall equal  $1.6 \pm 0.1$  mA.

**Note 4:** The automatic gain control (AGC) reading depends on the received RF signal strength as described in Section 409-302-500.

**Note 5:** Transmitting klystron power output is +20 dBm plus the meter reading when the meter selector switch is on XMTR RF PWR.

- 2 Using a KS-14510 VOM measure the voltage across the pin jacks on the meter and control panel. The voltmeter should be set to the 12-volt dc scale and the negative lead connected to pin jack -J1 and the positive lead connected to pin jack +J2.

**Warning:** *J1 and J2 are approximately 400 volts off ground potential. Although the jacks are protected by series resistors, care should be taken to avoid contact with this circuit or to avoid shorting these jacks to ground.*

**Requirement:** 5.9 to 6.5 volts

- 3 Based on the preceding meter indications, Fig. 2 provides a means for identifying the most likely trouble conditions in terms of the out-of-limit indications.

If the preceding checks indicate trouble in the J86499D 20-volt 0.75-ampere regulator, or in the J86499C 5-ampere regulator and inverter, the output voltages from these units may be checked as follows:

- 4 **IF Regulator Voltage:** Measure the voltage across jacks -J3 and +J4 (see Fig. 1) using a KS-14510 VOM on 60-volt dc scale. (On early models of the power supply, it will be necessary to remove the front dust cover to provide access to these jacks.)
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## STEP

## PROCEDURE

**Requirement:** The voltage on the meter shall indicate between 19.5 and 20.5 volts.

- 5 **Klystron Regulator Voltage:** Measure the voltage across jacks -J1 and +J2 (see Fig. 1) using a KS-14510 VOM. (On early models of the power supply, it will be necessary to remove the front dust cover to provide access to these jacks.)

**Requirement:** The voltage on the meter shall indicate between 18.3 and 19.7 volts.

- 6 If it is suspected that the metering circuit in the meter and control panel is faulty, the supply voltages may be checked at the J86499A power supply terminal strips (see Fig. 1) in accordance with the following table using the KS-14510 VOM.

VOLTAGE MEASUREMENTS TAKEN			VOLTAGES	
ON	FROM TERM.	TO TERM.*	METER INDICATIONS IN VOLTS	USING METER VOLTAGE RANGE
TB1	1	2	105 to 129	0 to 300 ac
TB1	5	4	22.0 to 29	0 to 60 dc
TB3	2	1	186† to 214	0 to 300 dc
TB3	3	2	372 to 428	0 to 600 dc
TB3	5	4	10.1† to 10.9	0 to 12 dc
TB4	1	2	38.7 to 47.2	0 to 60 ac
TB4	2	3	38.7 to 47.2	0 to 60 ac
TB4	4	5	38.7 to 47.2	0 to 60 ac
TB4	5	6	38.7 to 47.2	0 to 60 ac
TB5	8	7	19.5 to 20.5	0 to 60 dc

\* This terminal shall be connected to negative jack of meter for dc measurements.

† Floated on -400 volt potential.

#### -20 VOLT REGULATOR ALIGNMENT, J86499D

The following test describes how to check and, when necessary, adjust the J86499D -20 volt regulator which supplies the IF and baseband equipment. This test will be done on a routine basis or when the J86499D regulator unit has been replaced.

- 7 Using a 931 Weston dc voltmeter on the 30-volt scale, measure the voltage across jacks -J3 and +J4 (see Fig. 1). (On early models of the power supply, it will be necessary to remove the front dust cover to provide access to these jacks.)

**Requirement:** The voltmeter shall indicate between 19.5 and 20.2 volts.

If the requirement is not met, adjust the IF AMPL VOLTS ADJ potentiometer (see Fig. 1) to bring the voltage to 20.0 volts.

## STEP

## PROCEDURE

**Note:** If this test is being done on a routine basis, it should precede routine testing of the battery voltage alarm circuit and the IF and baseband equipment.

**KLYSTRON SUPPLY REGULATOR AND INVERTER UNIT ALIGNMENT, J86499C**

The following test describes how to check and, when necessary, adjust the J86499C regulator and inverter unit. Since this unit feeds the -400 volt, -200 volt, and -10.5 volt rectifiers, each of these supplies will be affected by adjustments on the regulator. This test shall be done when the following replacements have been made:

- (a) J86499C regulator and inverter unit
- (b) -10.5 volt rectifier or filter components
- (c) -400 volt rectifier or filter components.

8 Remove the equipment from service in accordance with Section 409-308-500, Fig. 1.

Remove the four fuses (IF AMPL BB, ALM & OW, BAT V ALM, and KLYSTRON) located on the front panel of the J86499A power supply, and open the 117-volt ac input line to the radio equipment. In the case of the J99262A cabinet equipment, this should be done by removing the 8-ampere fuse F2 in the ac distribution box located in the upper right-hand portion of the cabinet. In the case of the bay equipment in equipment shelters or buildings, use disconnects provided in ac power line.

9 Remove the power supply cover after the dc voltages, as indicated on the lower meter of the meter and control panel, have dropped to zero.

10 Set the 931 Weston dc voltmeter to the 15-volt range.

11 Connect the 931 Weston dc voltmeter across terminals 4 and 5 of terminal strip TB3 (see Fig. 1). Terminal 4 should be connected to the negative post of the meter.

12 Replace the four fuses (IF AMPL BB, ALM & OW, BAT V ALM, and KLYSTRON) located on the front panel and restore ac power to the radio equipment.

13 Allow the klystron currents as read on the J99262K meter and control panel to reach nominal values (see Step 1).

14 Observe the voltage indicated on the Weston voltmeter.

**Requirement:** The voltmeter shall indicate between -10.3 and -10.7 volts.

If the requirement is not met, adjust the KLYSTRON VOLTS ADJ potentiometer (see Fig. 1) to bring the voltage to -10.5 volts.

15 Remove fuses and ac power in accordance with Step 8, observe voltages as in Step 9, remove Weston voltmeter leads from TB3, replace power supply cover, and restore power and fuses as in Step 12.

## STEP

## PROCEDURE

- 16 Check that the -200 volt and -400 volt outputs are within the limits specified in Step 1.

**Note:** If the 10.5 volt output has been properly adjusted, it is highly unlikely that the -200 and -400 volt supplies will be out of limits. In case they are, remove the fuses and ac power from the supply in accordance with Step 8, remove cover in accordance with Step 9, change transformer taps as described below, replace the cover, and repeat Steps 12 through 16.

(a) **-200 Volt Supply:** Move lead AT-6 which may be connected to terminal 12, 13, or 14 of transformer T2 to an adjacent tap of transformer T2 as required. Taps 14 and 12 provide voltages 3 percent above and below tap 13, respectively.

(b) **-400 Volt Supply:** Move lead AT-7 which may be connected to terminal 8, 9, or 10 of transformer T2 to an adjacent tap on transformer T2 as required. Taps 10 and 8 provide voltages 3 percent above and below tap 9, respectively.

- 17 Restore equipment to service in accordance with Section 409-308-500, Fig. 1.

**BATTERY VOLTAGE ALARM TEST, J86499E**

The following test describes how to check the J86499E battery voltage alarm unit. This test will be done on a routine basis or when the battery voltage alarm unit has to be replaced. It shall be ascertained before making this test that the battery is fully charged as indicated by a reading of  $27.6 \pm 1$  volts on the meter and control panel when the meter selector switch is on BAT. This J86499E subassembly is mounted on the J86499D -20 volt regulator as shown in Fig. 1.

- 18 Check with the control center that no ac failure alarm condition exists at the station under test.
- 19 Note the battery voltage as read on the lower meter of the meter and control panel with the meter selector switch set at the BAT position.
- 20 Open the 117-volt ac input line to the radio equipment as discussed in the last part of Step 8.
- 21 Request the control center to provide notification when the ac alarm comes in at the station under test.

**Requirement:** The ac failure alarm shall come in before the battery voltage has dropped below 25 volts.

**Note:** When the ac input to the radio equipment is removed, the time interval required for the battery voltage to drop below 25 volts may vary from a few minutes to a few hours, depending upon the temperature and the condition of the batteries.

- 22 Reapply ac input to the radio equipment.

## STEP

## PROCEDURE

**Requirement:** The ac failure alarm shall disappear before the battery voltage rises to within 2 volts of the value read in Step 19.

If the requirement is not met, replace battery voltage alarm panel and repeat Steps 18 through 22.

**DC REGULATOR CONTROL GAIN TEST—DEDICATED BATTERY CHARGERS**

The following test describes how to check the control gain of the transistorized dc regulator circuits. This test shall be done on a routine basis or when the J86499D -20 volt 0.75-ampere regulator or J86499C 5-ampere regulator and inverter are replaced.

- 23 **J86499C Regulator and Inverter:** Connect a ground lead, which is supplied as part of the TL test set, between the ground pin jack of the J99262AA TL test set and the chassis of the J86499A power supply.
- 24 Using a KS-14510 VOM on the 300-volt scale, connect the negative lead of the voltmeter to the -22 volt pin jack on the test set and the positive lead on the voltmeter to the -J1 jack on the J86499C regulator and inverter assembly of the J86499A power supply as shown in Fig. 3, option A. (On early models of the power supply, it will be necessary to remove the front dust cover to provide access to the test jack.)
- 25 Decrease the voltage range on the voltmeter to the 3-volt range.
- 26 Open the 117-volt ac input to the radio equipment as per second part of Step 8 and after 20 minutes observe the indication on the KS-14510 VOM.
- 27 Restore the 117-volt ac input to the radio equipment and after a period of 5 minutes observe the KS-14510 VOM. The voltage change should be not more than 0.1 volt. If the change is greater than 0.1 volt, the J86499C regulator and inverter shall be replaced.
- 28 **J86499D -20 Volt Regulator:** Connect a ground lead between the ground pin jack of the J99262AA TL portable test set and the chassis of the J86499A power supply.
- 29 Using a KS-14510 VOM on the 300-volt scale, connect the negative lead of the voltmeter to the -22 volt pin jack on the test set and the positive lead on the voltmeter to the -J3 jack on the J86499D -20 volt regulator assembly of the J86499A power supply as shown in Fig. 3, option B. (On early models of the power supply, it will be necessary to remove the front dust cover to provide access to the test jack.)
- 30 Decrease the voltage range on the voltmeter to the 3-volt range.
- 31 Open the 117-volt ac input to the radio equipment as per second part of Step 8 and after 20 minutes observe the reading on the KS-14510 VOM.
- 32 Restore the 117-volt ac input to the radio equipment and after a period of 5 minutes observe the voltmeter. The voltage change should be not more than 0.1 volt. If the change is greater than 0.1 volt, the J86499D -20 volt regulator shall be replaced.

## STEP

## PROCEDURE

**DC REGULATOR CONTROL GAIN TEST—COMMON OFFICE BATTERY SOURCE**

**Note 1:** The following test describes how to check the control gain of the transistorized dc regulator circuits. This test shall be performed on a routine basis or when the J86499D -20 volt 0.75-ampere regulator or J86499C 5-ampere regulator and inverter are replaced.

**Note 2:** The performance of this test requires the presence of the ED-92173-7 filter assembly equipped with ED-3C325-30, Group 4 applique or the ED-3C325-30 filter assembly equipped with ED-3C325-30 Group 3 applique.

**J86499C REGULATOR AND INVERTER**

- 33 Connect a ground lead, which is supplied as part of the J99262AA TL test set, between the ground pin of the TL test set and the chassis of the J86499C regulator and inverter.
- 34 Using the VOM on the 300-volt scale, connect the negative lead of the VOM to the -22V pin jack on the TL test set and the positive lead on the VOM to test jack J1(—) on the J86499C regulator and inverter as shown in Fig. 3, option A. (On early models of the power supply, it will be necessary to remove the front dust cover to provide access to the test jack.)
- 35 Decrease the voltage range on the VOM to the 3-volt scale.
- 36 Depress the LOAD switch. The meter indication should change immediately. Note the VOM indication.
- 37 Release the LOAD switch. Again, the meter should respond immediately. Note the VOM indication.

**Requirement:** The voltage change must not be more than 0.1 volt.

If this requirement is not met, the J86499C regulator and inverter must be replaced.

**J86499D -20 VOLT REGULATOR**

- 38 Connect a ground lead between the ground pin jack of the TL test set and the chassis of the J86499D regulator.
- 39 Using the VOM on the 300-volt scale, connect the negative lead of the VOM to the -22V pin jack on the TL test set and the positive lead on the voltmeter to jack J3(—) on the J86499D regulator unit as shown in Fig. 3, option B.
- 40 Decrease the voltage range on the VOM to the 3-volt scale.
- 41 Depress the LOAD switch. The meter indication should change immediately. Note the VOM indication.
- 42 Release the LOAD switch. Again, the meter should respond immediately. Note the VOM indication.

## STEP

## PROCEDURE

**Requirement:** The voltage change must not be more than 0.1 volt.

If this requirement is not met, the J86499D regulator must be replaced.

## BATTERY MAINTENANCE

- 43 For battery maintenance, see Sections 157-601-701 and 157-601-301.

## RIPPLE TEST

Noise or ripple on the -400 volt and -600 volt supplies is suppressed by passive filter circuits. For this reason it is expected that high noise conditions will be an infrequent occurrence. Should the problem arise, however, the following test provides a means for determining if the noise or ripple on the -400 and -600 volt supplies is within limits. Because of the expected infrequency of this test and the fact that the test equipment required is commonly used throughout the telephone plant, the apparatus specified herein is not included in the list of standard TL test equipment. The additional items required are:

- (a) J94003 3A noise measuring set
- (b) 2B noise set
- (c) 0.5-uf capacitor, 1000 volts dc.

**Note:** This test will be done on an as required basis and only where batteries are fully charged.

- 44 Remove the equipment from service in accordance with Section 409-308-500, Fig. 1.
- 45 Remove the four fuses (IF AMPL BB, ALM & OW, BAT V ALM, and KLYSTRON) from the front panel of the J86499A power supply and open the 117-volt ac input line to the radio equipment as per second part of Step 8.
- 46 Remove the power supply cover after the dc voltages as indicated on the lower meter of the meter and control panel have dropped to zero.
- 47 **3A Noise Measuring Set:** To test the ripple or noise in the -400 or -600 volt supply, connect the equipment as shown in Fig. 4, option A.
- 48 Set weighting plug on 3A noise measuring set to C weighting.
- 49 Calibrate 3A noise measuring set.
- 50 Set function switch to 600.
- 51 Reinsert fuses on front of J86499A power supply and restore 117-volt ac input to the radio equipment. Wait for cathode currents XMTR CATH and RCVR CATH, observed on the



STEP	PROCEDURE
	lower meter of the J99262K meter and control panel, to reach normal level as shown in Fig. 2.
52	<p>Measure ripple or noise on 3A noise measuring set.</p> <p><b>Requirements:</b> The -600 volts shall indicate +31 dBrn or +26 dba maximum. The -400 volts shall indicate +20 dBrn or +15 dba maximum.</p> <p><b>Note:</b> If the requirements are not met, check for defective rectifiers or filters in the power supply.</p>
53	<b>2B Noise Set:</b> Remove all J86499A power supply fuses and open the 117-volt ac input line to the radio equipment as per second part of Step 8.
54	To test ripple or noise on the -400 or -600 volt supply connect the equipment as shown in Fig. 4, option B, after the dc voltages as indicated on the lower meter of the meter and control panel have dropped to zero.
55	Calibrate 2B noise set.
56	Set weighting key to F1A.
57	Insert input plug to line jacks.
58	Set K1 and K3 keys to normal position.
59	Reinsert fuses on the front of the J86499A power supply and restore 117-volt ac input to the radio equipment. Wait for cathode currents XMTR CATH and RCVR CATH, observed on the lower meter of the meter and control panel, to reach normal level as shown in Fig. 2.
60	<p>Measure ripple or noise on 2B noise set.</p> <p><b>Requirements:</b> The -600 volts shall indicate 19 dB or 26 dba maximum. The -400 volts shall indicate 8 dB or 15 dba maximum.</p> <p><b>Note 1:</b> Due to the low sensitivity on the 2B noise set, the -400 volt ripple or noise indication may not be visible if the -400 volt ripple or noise is within limits because lowest dba indication on 2B noise set is 15 dba.</p> <p><b>Note 2:</b> If the requirements are not met, check for defective rectifiers or filters in the J86499A power supply.</p>
61	Remove fuses and disconnect ac power as in Step 53; after dc voltages have reached zero as in Step 54, remove test equipment, install power supply cover, and restore ac power and fuses as in Step 59.
62	Restore equipment to service in accordance with Section 409-308-500, Fig. 1.

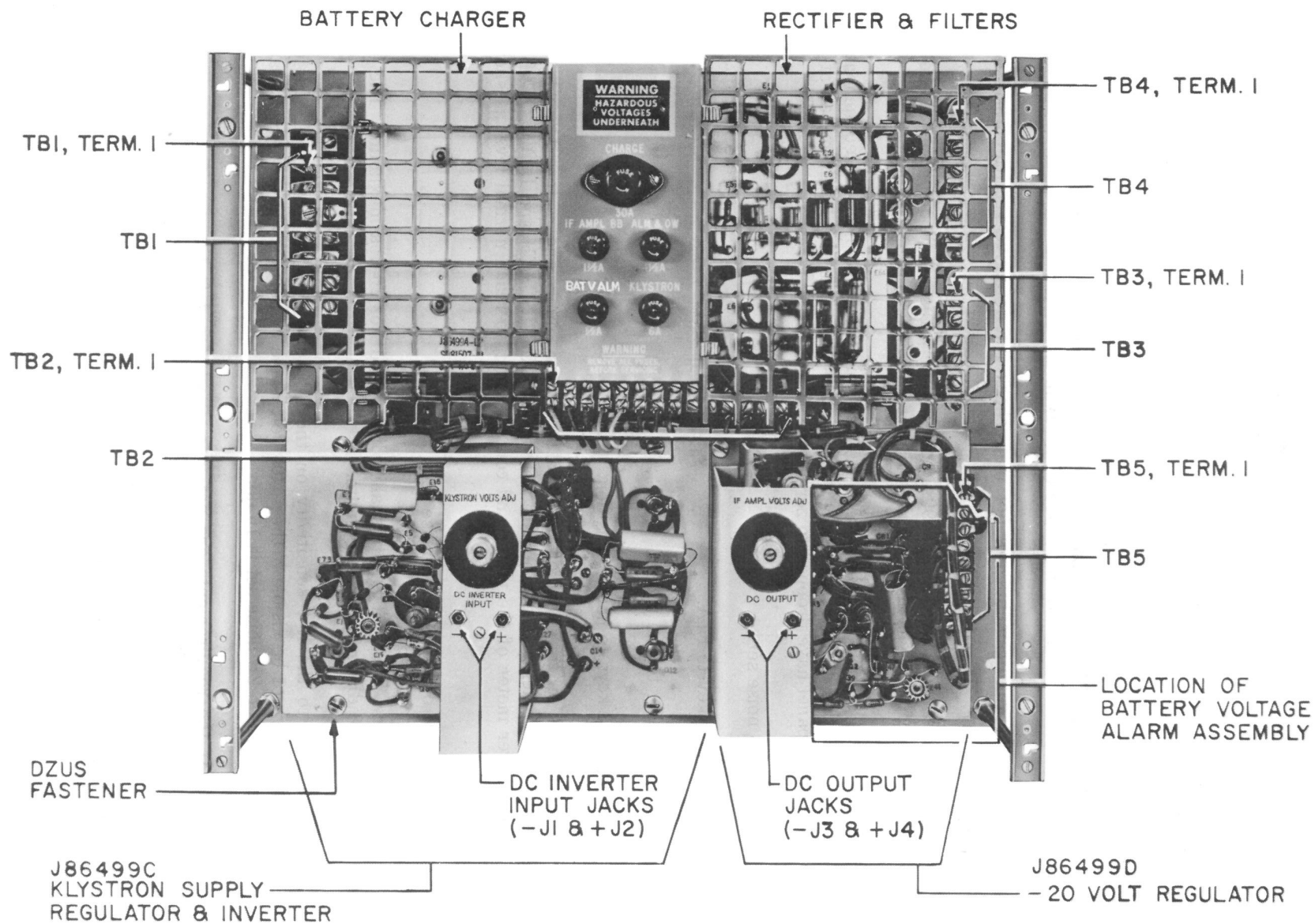


Fig. 1—J86499A Power Supply—Cover Removed

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									IF AMPL & BB	OW & ALM	BAT VOLT ALM	CHGR								
J99262K METER & CONTROL PANEL	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 12-20 VDC	30 VDC	X		X					X	X		X	X	X				X	X	X	X	X	X
			CR 1	E 0.4-1.2 MA	6 MA	(X)					X		(X)	X		X	X	X				X	X	X	X	X	X
			CR 2	E 0.4-1.2 MA	6 MA	(X)						X	(X)	X		X	X	X				X	X	X	X	X	X
			AGC	SEE FIG. 1 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	
		XMTR	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	
		FREQ SWITCH																									
			IF	C 0 ±7 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	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	X	
XMTR BB AMPL	BIAS	7.0 ±0.2 VDC	X										X				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	X			
	-J3 & +J4	19.5 - 20.5 VDC	X														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 ±7 UA, CONSULT SECTION 409-306-502.
- D. IF OUTSIDE 12-20 VDC, 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.

Fig. 2—Trouble Location Chart

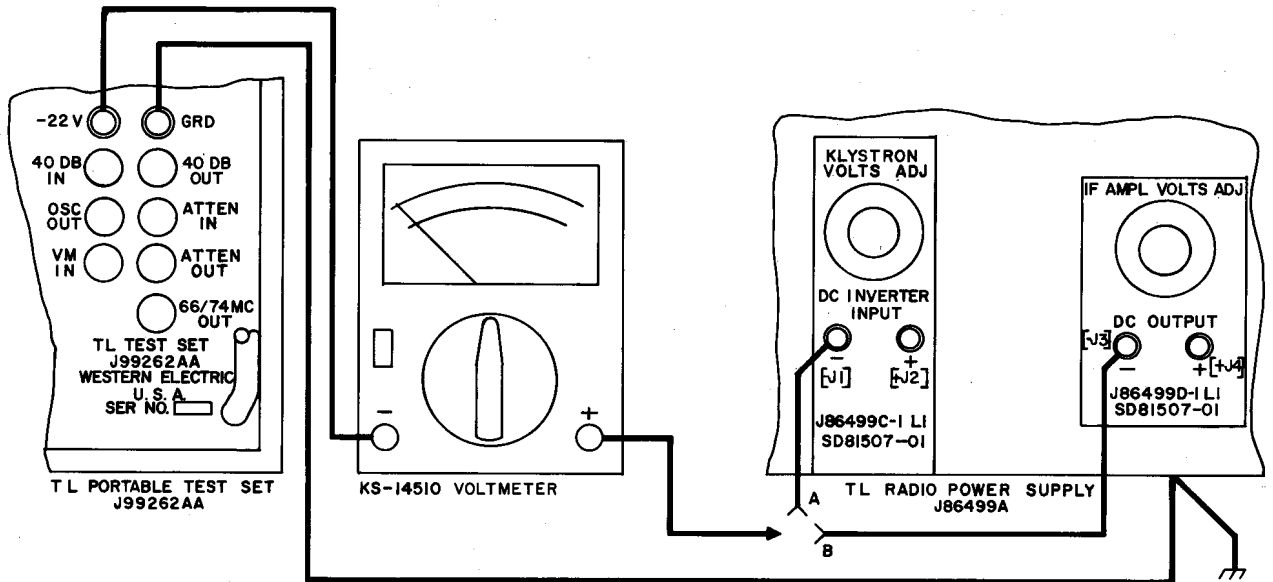


Fig. 3—DC Regulator Control Gain Test Connections at the Klystron Supply Regulator and Inverter and at -20 Volt Regulator

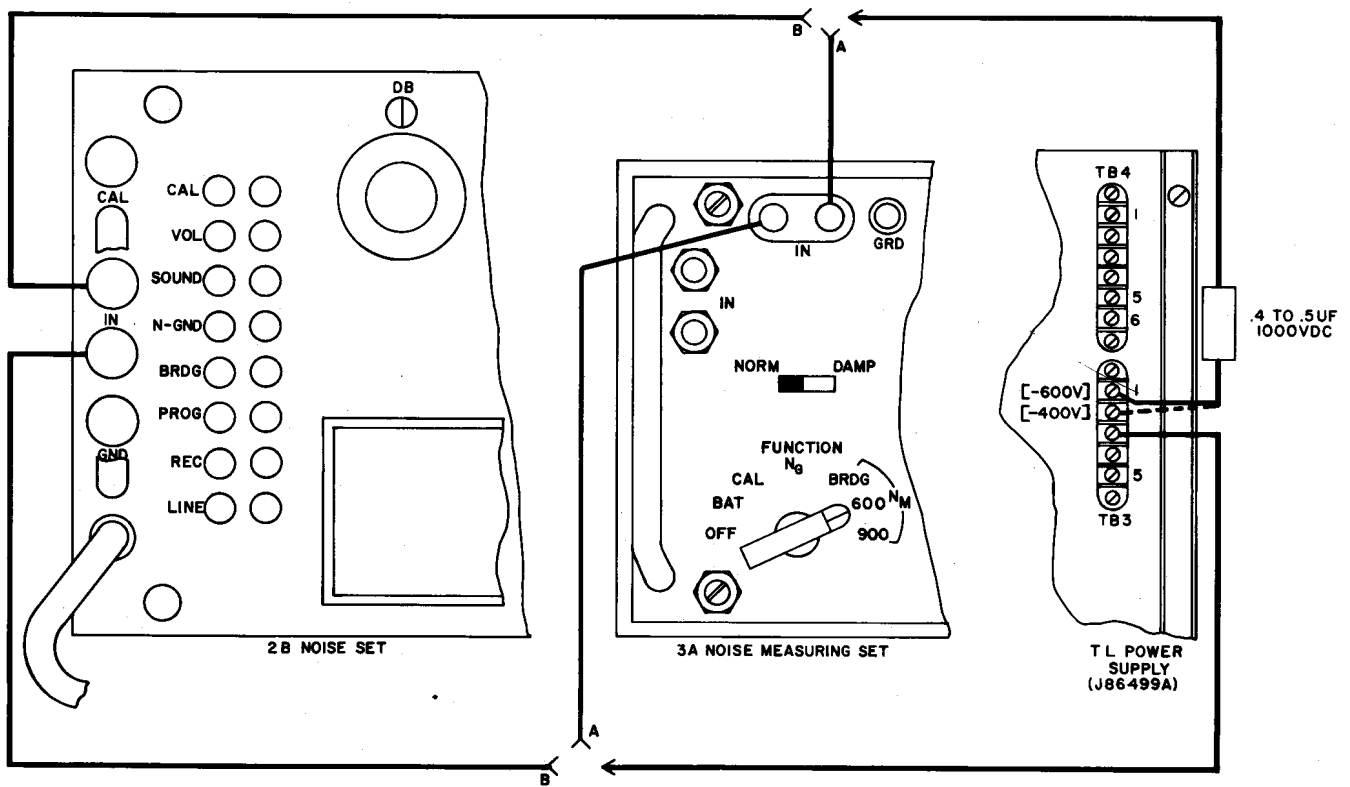


Fig. 4—Ripple or Noise Test Connections at Power Supply