TECHNICAL MANUAL

for

LINEAR POWER AMPLIFIER MODEL LPA-2

THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y. OTTAWA, CANADA

Printed in U.S.A.

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WORLD WIDE SUPPLIERS OF ELECTRONIC COMMUNICATIONS EQUIPMENT

THE TECHNICAL MATERIEL CORPORATION

COMMUNICATIONS ENGINEERS

700 FENIMORE ROAD MAMARONECK, N. Y.

Warranty

The Technical Materiel Corporation, hereinafter referred to as TMC, warrants the equipment (except electron tubes,* fuses, lamps, batteries and articles made of glass or other fragile or other expendable materials) purchased hereunder to be free from defect in materials and workmanship under normal use and service, when used for the purposes for which the same is designed, for a period of one year from the date of delivery F.O.B. factory. TMC further warrants that the equipment will perform in a manner equal to or better than published technical specifications as amended by any additions or corrections thereto accompanying the formal equipment offer.

TMC will replace or repair any such defective items, F.O.B. factory, which may fail within the stated warranty period, PROVIDED:

1. That any claim of defect under this warranty is made within sixty (60) days after discovery thereof and that inspection by TMC, if required, indicates the validity of such claim to TMC's satisfaction.

2. That the defect is not the result of damage incurred in shipment from or to the factory.

3. That the equipment has not been altered in any way either as to design or use whether by replacement parts not supplied or approved by TMC, or otherwise.

4. That any equipment or accessories furnished but not manufactured by TMC, or not of TMC design shall be subject only to such adjustments as TMC may obtain from the supplier thereof.

Electron tubes*furnished by TMC, but manufactured by others, bear only the warranty given by such other manufacturers. Electron tube warranty claims should be made directly to the manufacturer of such tubes.

TMC's obligation under this warranty is limited to the repair or replacement of defective parts with the exceptions noted above.

At TMC's option any defective part or equipment which fails within the warranty period shall be returned to TMC's factory for inspection, properly packed with shipping charges prepaid. No parts or equipment shall be returned to TMC, unless a return authorization is issued by TMC.

No warranties, express or implied, other than those specifically set forth herein shall be applicable to any equipment manufactured or furnished by TMC and the foregoing warranty shall constitute the Buyers sole right and remedy. In no event does TMC assume any liability for consequential damages, or for loss, damage or expense directly or indirectly arising from the use of TMC Products, or any inability to use them either separately or in combination with other equipment or materials or from any other cause.

*Electron tubes also include semi-conductor devices.

PROCEDURE FOR RETURN OF MATERIAL OR EQUIPMENT

Should it be necessary to return equipment or material for repair or replacement, whether within warranty or otherwise, a return authorization must be obtained from TMC prior to shipment. The request for return authorization should include the following information:

1. Model Number of Equipment.
2. Serial Number of Equipment.
3. TMC Part Number.
4. Nature of defect or cause of failure.
5. The contract or purchase order under which equipment was delivered.

PROCEDURE FOR ORDERING REPLACEMENT PARTS

When ordering replacement parts, the following information must be included in the order as applicable:

1. Quantity Required.
2. TMC Part Number.
3. Equipment in which used by TMC or Military Model Number.
4. Brief Description of the Item.
5. The *Crystal Frequency* if the order includes crystals.

PROCEDURE IN THE EVENT OF DAMAGE INCURRED IN SHIPMENT

TMC's Warranty specifically excludes damage incurred in shipment to or from the factory. In the event equipment is received in damaged condition, the carrier should be notified immediately. Claims for such damage should be filed with the carrier involved and not with TMC.

All correspondence pertaining to Warranty Claims, return, repair, or replacement and all material or equipment returned for repair or replacement, within Warranty or otherwise, should be addressed as follows:

THE TECHNICAL MATERIEL CORPORATION
Engineering Services Department
700 Fenimore Road
Mamaroneck, New York

RECORD OF CORRECTIONS MADE

Change No.	Date of Change	Date Entered	Entered By

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Figure 1-1. Front Angle View of, Linear Power Amplifier, Model LPA

SECTION 1
GENERAL INFORMATION

1-1. FUNCTIONAL DESCRIPTION.

The Linear Power Amplifier, model LPA (figure 1-1) provides 1000 watts (PEP) peak envelope power, over a frequency range of 1.9 MHz to 26 MHz. Any eight desired frequencies within its operating range of 1.9 to 26 MHz may be preselected for Auto-tuning and Remote Control. Full rated carrier output operation requires a 50 watt average driver power, or a 100 watt PEP drive for reduced carrier Two Tone input. Although primarily designed for Voice Duty Cycle, SSB Operation, the LPA may also be used for Voice Duty AM or CW operation with no modifications. The unit is wired for 115 volt primary power, but is adaptable to 230 volt primary power, with a slight wiring modification. The LPA is suitable for amateur, pipeline, or any point to point commercial communication need, which requires a medium power, fixed channel operation. It has a selection of 8 or less preset Auto Tuned Frequencies within the 1.9 MHz to 26 MHz frequency range.

An optional frequency of 1.6 MHz to 1.9 MHz may be incorporated at customers request.

1-2. PHYSICAL DESCRIPTION.

The Linear Power Amplifier model LPA, is a compact high power unit. It measures 8 3/4 inches high x 19 inches wide x 18 inches deep, and weighs 70 pounds. The front panel contains a minimum of controls, and also two meters and two indicator lamps. The control and ALDC potentiometers are located behind the name plate. All input and output jacks, and fuses are conveniently located on the rear panel.

1-3. TECHNICAL SPECIFICATIONS.

FREQUENCY RANGE:	1.9 to 26 MHz. (Optional 1.6-1.9 MHz)
MODES OF OPERATION: (with appropiate exciter)	AM, AME, SSB, ISB, FSK, FAX, CW AND MCW.
OUTPUT IMPEDANCE:	50 ohms nominal. Output will accomodate a load with up to 2:1 VSWR.
INPUT SIGNAL:	50 ohms nominal.
TUNING:	All tuning and bandswitching accomplished from the front panel (no plug-in components)
SIGNAL DISTORTION RATIO:	Approximately 30 db below either tone of a standard two-tone test at 1 kw PEP.
HARMONIC SUPPRESSION:	With external filter, spurious and harmonic suppression is at least 40 db down from full PEP output.
ALDC:	An Automatic Load and Drive Control Circuit is incorporated to generate a DC voltage for external control of an associated exciter.
METERING:	Total plate current. RF output indication.
ENVIRONMENTAL CONDITIONS:	Designed to operate in any ambient temperature between 0° and 50°C, and any value of humidity up to 90%.
COOLING:	Forced air cooling.
SAFETY FEATURES:	Full interlock protection. With overload and fuse protection.
INSTALLATION DATA:	Weight: 70 lbs. Size: 8 3/4" x 19" x 18"
PRIMARY POWER REQUIREMENTS:	115/230 volts, single phase, 50/60 cycles AC, approximately 1,300 watts under full power output, 220 watts on standby.
LOOSE ITEMS:	Mating RF connectors.
OPTIONS/ACCESSORIES:	Equipment Cabinet - A full range of cabinet height are available to house the LPA itself, or with optional exciter unit.

SECTION 2
INSTALLATION

2-1. INITIAL INSPECTION.

The LPA has been tested and calibrated before shipment. Only minor preparations are required to put it into operation.

After unpacking the equipment, inspect all packing material for parts which may have been shipped as loose items (connectors, cables, technical manuals, etc.). With respect to equipment damage for which the carrier is liable, The Technical Materiel Corporation will assist in describing methods of repair and the furnishing of replacement parts.

2-2. 115 VOLT VS 230 VOLT OPERATION.

The LPA operates on 115 of 230 volt ac, 50 to 60 cycle, single phase power source. It is factory wired for 115 volts. If 230 volt operation is desired, the connections on the primary ac input transformer T101 and high voltage transformer T102 must be changed (refer to figure 2-1).

2-3. INSTALLATION.

When the unit is properly mounted connect the input and output cables to their proper jacks and plugs as indicated by (figure 2-3).

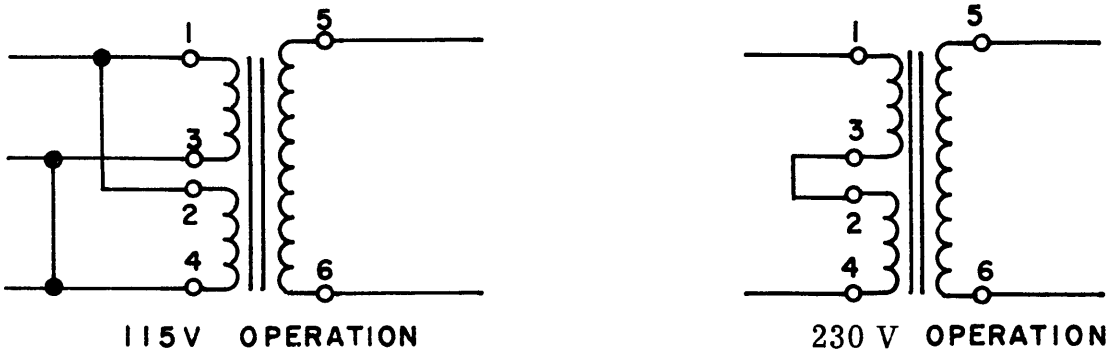

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Figure 2-1. 115V to 230V Transformer Wiring Diagram

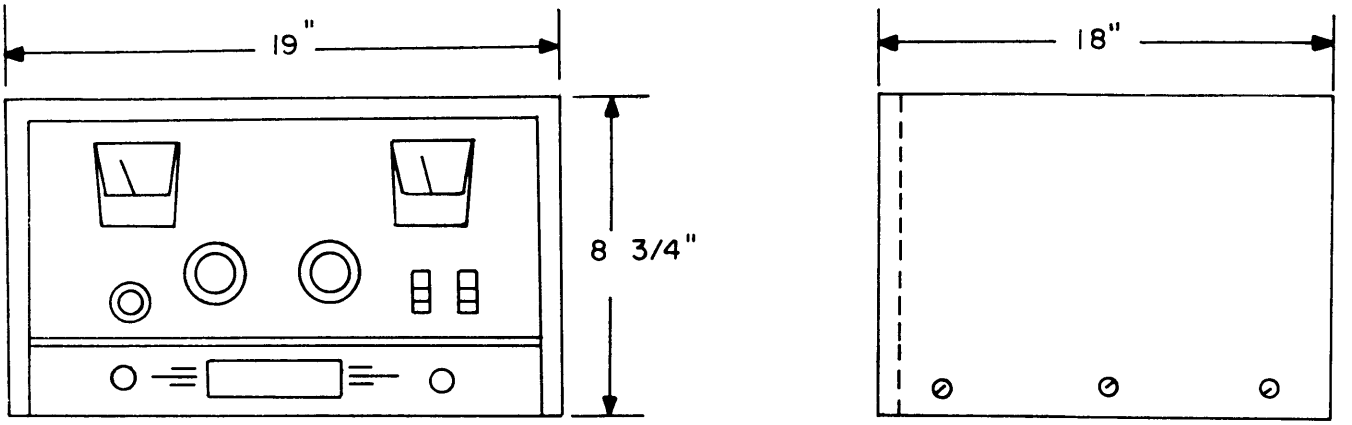

Figure 2-2. Outline Dimensional Drawing

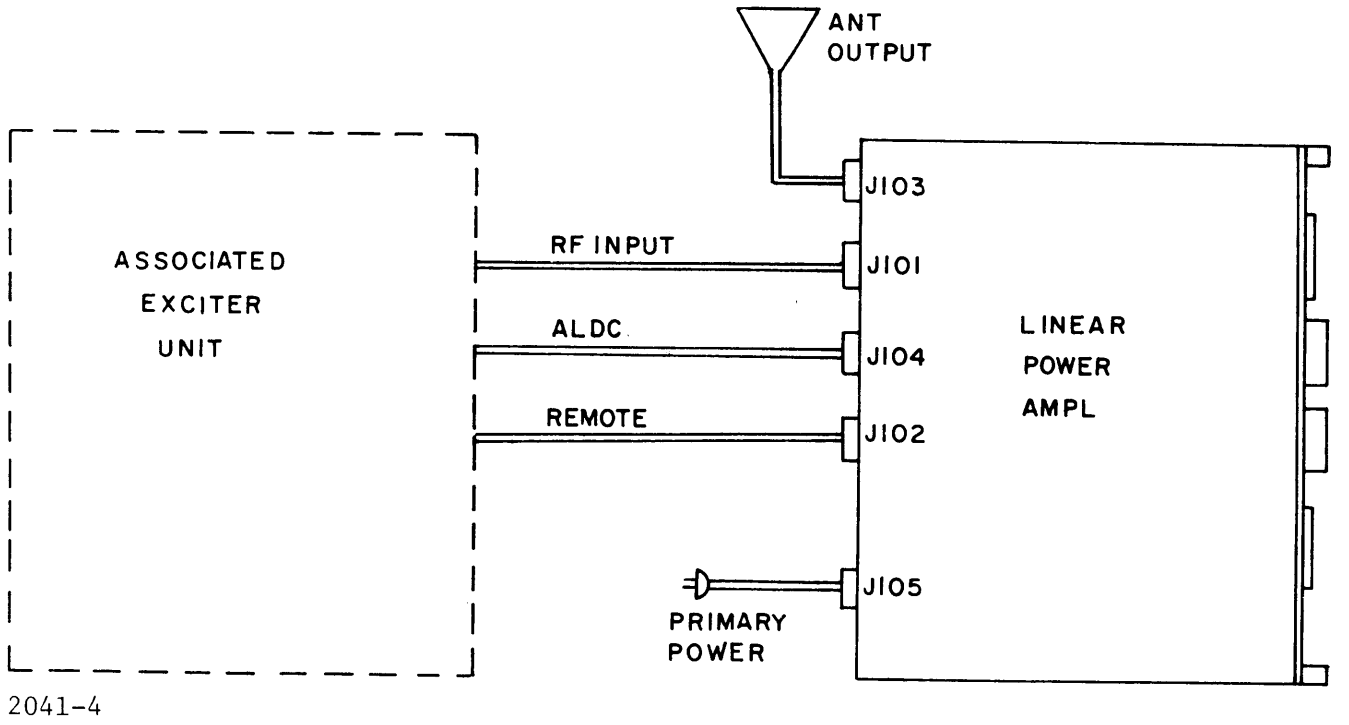

Figure 2-3. Interconnect Cabling Diagram

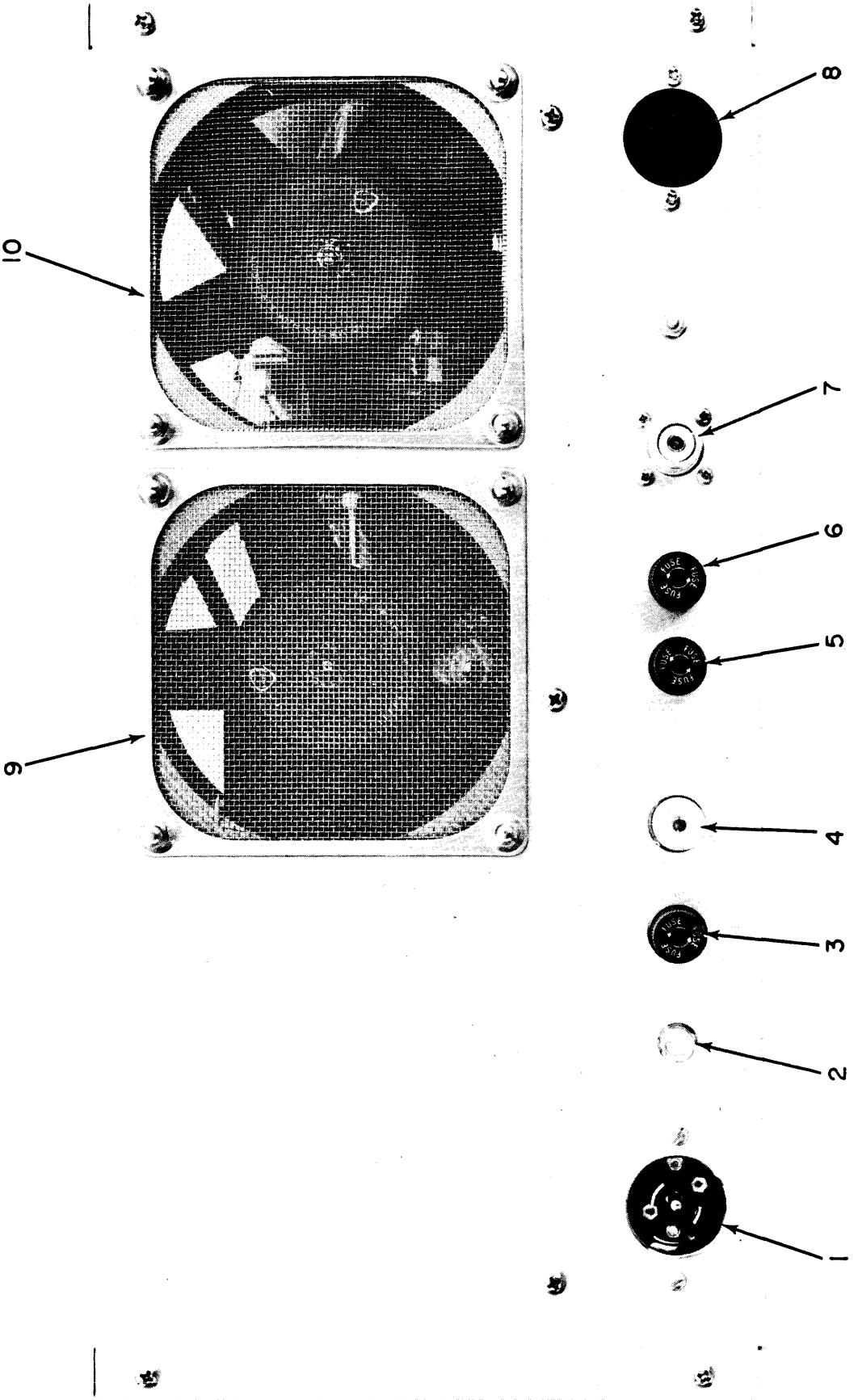

Figure 2-4. Rear Panel View of Jacks, Fuses and Blowers

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Table 2-1. Rear Panel Components

Number Designation	Panel Designation and Symbol Numbers	Description
1	AC plug, J105	Primary power input.
2	ALDC jack, J104	Output jack for ALDC.
3	AC line fuse, F103	Protects high voltage power supply.
4	Output jack, J103	Couples output path to antenna.
5	Low voltage fuse, F102	Protects rectifier circuit, CR103.
6	Filament fuse, F101	Protects filaments of P.A. Tubes.
7	Input jack, J101	Couples rf input to P.A. Tubes.
8	Remote jack, J102	Couples the d.c. control voltage from LPA to the exciter and from exciter back to LPA.
9	Blower, B101	Provides cooling for LPA.
10	Blower, B102	Provides cooling for LPA.

SECTION 3
OPERATOR'S SECTION

3-1. GENERAL.

The Linear Power Amplifier, model LPA is a one kilowatt power amplifier. The unit has manual or automatic slaving to a suitable exciter, such as TMC model TTR-20.

The controls and indicators are listed in(table 3-1) and are illustrated in (figure 3-2).

3-2. PRELIMINARY PROCEDURES.

Prior to applying Power to the LPA, ensure that it is installed in accordance with the instructions contained in section 2, and that all external cables are properly connected.

3-3. MANUAL OPERATION.

1) Place AC ON/OFF switch (7) to the ON position.

2) Place MANUAL/TUNE/AUTO/switch (11) to MANUAL position.

3) Select desired operating frequency with CHANNEL SELECTOR (3).

4) Place HIGH VOLTAGE switch (5) to the ON position.

5) Increase the Associated EXCITER rf drive until an indication of RF input is seen on PA PLATE CURRENT meter (4), with TUNE CONTROL (2), peak OUTPUT meter (1). The PA PLATE CURRENT meter (4) will also indicate a dip at the point of resonance.

6) Turn up Associated EXCITER rf drive until PA PLATE CURRENT meter (4) reads 400 ma.

3-4. AUTOMATIC OPERATION.

1) Place AC ON/OFF switch (7) to the ON position.

2) Select desired frequency by turning CHANNEL SELECTOR (3).

3) Place HIGH VOLTAGE (5) to the ON position.

4) Increase rf drive on Associated EXCITER unit until a 150 ma reading is obtained on PA PLATE CURRENT meter (4).

5) Place MANUAL/TUNE/AUTO switch (11) to the AUTO position. (The TUNING CONTROL (2) should respond to the CHANNEL SELECTOR and automatically tune to frequency).

NOTE

If the READY lamp fails to light after performing Step 5, the prepositioned CHANNEL CONTROL (9) is out of adjustment, and therefore must be corrected before proper AUTO-TUNING can be achieved. (Refer to steps 7 through 10).

6) Increase rf drive on associated EXCITER unit until a 400 ma reading is obtained on PA PLATE CURRENT meter (4).

7) Manually tune unit according to paragraph 3-3 steps 1-5.

8) Place MANUAL/TUNE/AUTO switch (11) to the TUNE position.

9) Adjust the CHANNEL CONTROL (9) that corresponds to the position of the CHANNEL SELECTOR (3). (When CHANNEL CONTROL is properly adjusted, READY lamp will light).

10. Place MANUAL/TUNE/AUTO switch (11) to AUTO, and perform step 6 above.

3-5. PROCEDURE FOR INCORPORATING A CHANGE IN FREQUENCY SELECTION, AND SETTING CHANNEL CONTROLS.

The channel controls (R105-R112) are factory set to the customers pre-selected frequencies and should not require any adjustment.

When a different frequency, or frequencies from those already preset is desired, the CHANNEL CONTROLS first must be set to a reference point, from which the AUTO-TUNE circuits can operate. When making a channel or frequency change the following procedure should be used.

CAUTION

All power to the unit must be turned off.

1) On printed circuit board Z101 remove the desired channel jumper wire, from the undesired frequency band terminal and connect it to the desired

frequency band terminal.

The frequency band terminals may be connected to more than one channel if required. (see figure 3-1).

2) Manually tune unit according to paragraph 3-3, steps 1-5.

3) Place MANUAL/TUNE/AUTO switch (11) to the tune position.

4) To establish a reference point, adjust appropriate CHANNEL CONTROL (9) corresponding to the position of the CHANNEL SELECTOR (3). When CHANNEL CONTROL (9) is properly adjusted READY lamp (10) will light.

5) This procedure should be followed for all frequencies that were reset.

3-6. INCORPORATION OF 1.6-1.9 MHz BAND.

A 1.6-1.9 MHz band can be incorporated in the unit at the customers request. This is accomplished by adding capacitors C133, C149, and C154 into the tuning circuit.

A jumper must also be connected to the desired channel terminal and connected to band terminal 11 on Z101.

Table 3-2 Controls And Indicators

Number Designation	Panel Designation	Description
1	OUTPUT meter	Indicates rf output, peak when tuning transmitter.
2	TUNING control	Controls tuning of Plate tank circuit.
3	CHANNEL selector	Enables selection of desired channel.
4	P.A. current meter	Indicates PA plate current.
5	H.V. breaker	Controls application of High Voltage.
6	H.V. (High Voltage Indicator lamp)	Indicates when High Voltage is being applied.
7	AC breaker	Controls application of primary AC power.

Table 3-2 Controls And Indicators CON'T

Number Designation	Panel Designation	Description
8	ALDC Adj. resistor	Sets bias for ALDC diode CR107.
9	Channel Controls	Provides reference for Auto tuned circuits.
10	READY indicator lamp	Tune indicator.
11	MANUAL/TUNE/AUTO switch	Selects Manual or Auto operation of Amplifier.

Program Board Z101

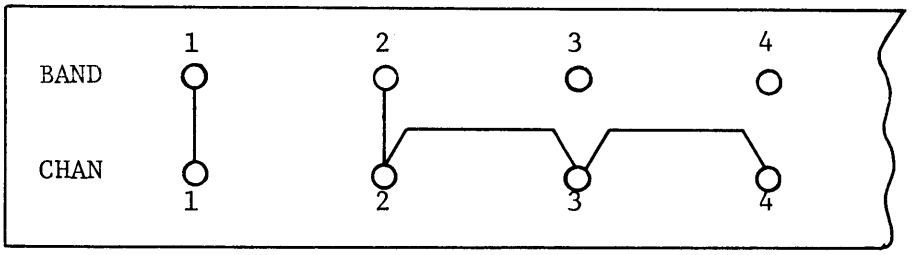

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Figure 3-1. Typical Multiple Channel Connector Diagram

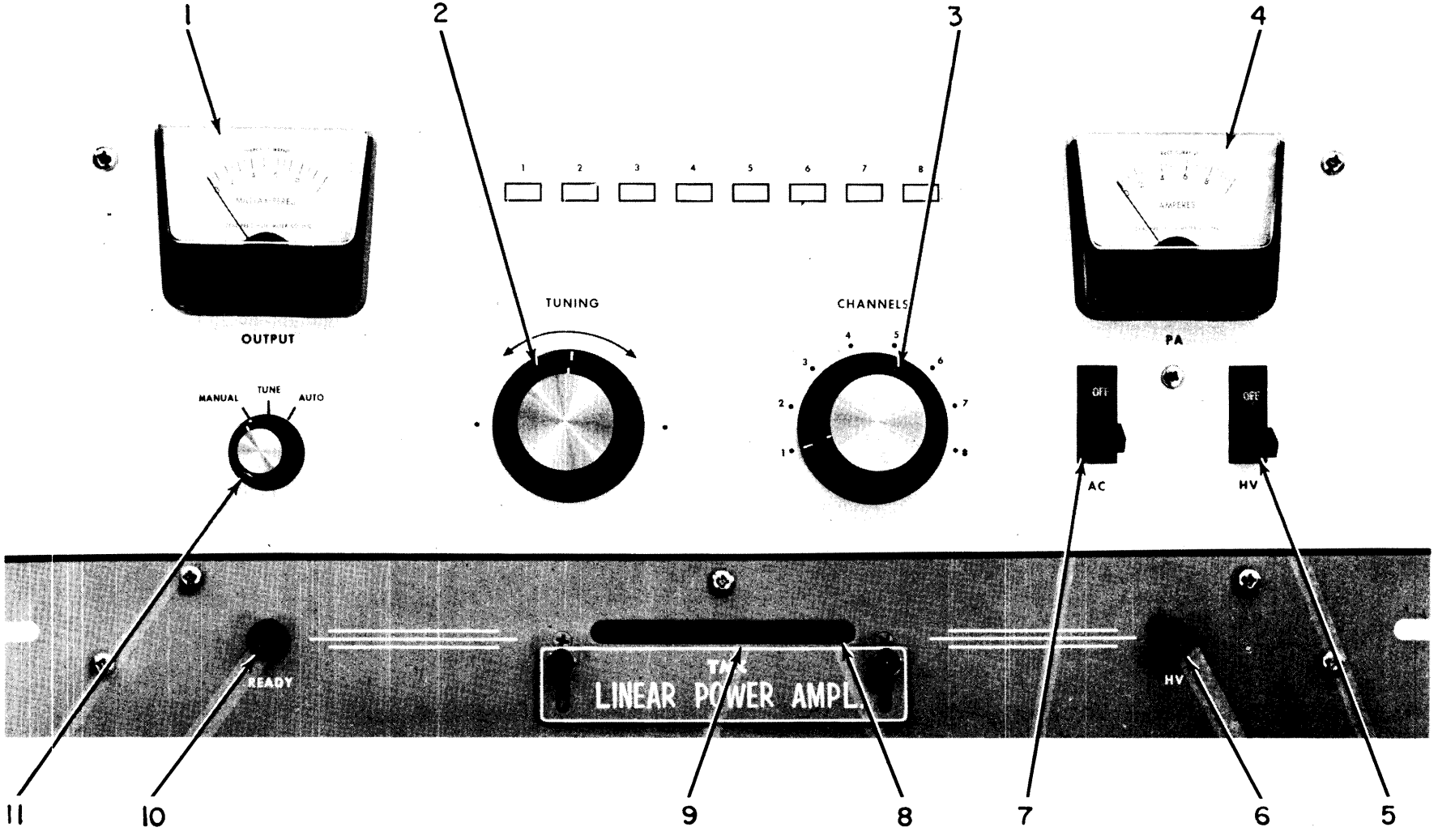

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Figure 3-2. Controls and Indicators

SECTION 4
PRINCIPLES OF OPERATION

4-1. GENERAL.

The Linear Power Amplifier, model LPA is a compact high power unit capable of 1000 watts (PEP) peak envelope power. The unit may be either manually or auto tuned to one of eight channels by employing the appropriate exciter.

The other features include a safety interlock system, an ALDC circuit and a forced air cooling system.

4-2. FUNCTIONAL BLOCK DIAGRAM ANALYSIS (refer to figure 4-1.)

a) GENERAL- When switch S101 is closed primary ac power is applied to the LPA. It supplies transformer T101, and blower motors B101 and B102. The secondary winding of the filament transformer T101 provides output taps for the filaments of power amplifier tubes V101 and V102, and also supplies voltage to the Bridge Rectifier circuit CR103. The bridge rectifier, provides the dc control voltage for several components within the unit. They are interlock relay K102, printed circuit boards Z102, Z103, Rotary solenoid drive switches SZ101 and SZ102, and components in the associated exciter unit.

When high voltage switch S102 is closed primary power is applied to the doubler rectifier. The rectified dc output voltage goes through several filter components before being applied to the plates of power amplifier tubes V101 and V102.

Relays K101 and K103 are also energized at this time providing an input path for the exciter signal and an output path for the amplified 1kw (PEP) output signal to the antenna. The r-f input signal to the LPA must be from an exciter capable of delivering a maximum of 50 watts average power. The r-f input signal enters through jack J101 and relay K101. The signal is then applied to the cathode circuit of the two parallel triodes, and raised to a 1kw level before passing through the plate tuning and loading stages.

It then goes through output transformer T103, relay K103, to output jack J103.

When the PA rf output signal is too high the ALDC circuit incorporated in the output circuit, controls the level of the exciter input signal to the power amplifier tubes.

When switch S107 A and B is in the manual position drive motor B103 is deenergized and manual tuning of capacitor C123 maybe performed.

When switch S107 A and B is in the AUTO position the automated circuitry controls the operation of the tuning and loading functions of the LPA. Tuning Capacitor, C123 is then motor driven to obtain the desired frequency.

b. AUTO-TUNE DESCRIPTION.

In order to select the proper band two solenoid switches SZ101, and SZ102, and a program board Z101 are used. When a positive 24 volts dc is applied to solenoid switch SZ102 either by the front panel control or from a remote position, band selection switches S105A, B, and C are driven to the desired channel. The 24 vdc control voltage is then able to pass through switch S105B to the appropriate channel and band terminals of program board Z101. The control voltage is then coupled to solenoid drive switch SZ101, which drives switches S106A Coil Bandswitch S106B, and Transformer Bandswitch S106C to the desired band.

The method used for resonating the plate tuning capacitor, C123 is the null searching type. Switch S105C places the appropriate Channel Control located on Z103 in the auto-tune circuit. An error signal is developed between the selected Channel Control and feedback potentiometer R104. The error signal is then amplified in Z102 and produces a CW or CCW signal that operates the drive motor B103, until a zero error signal is obtained, between R104 and the channel control on Z103.

4-3. 1 KILOWATT POWER AMPLIFIER.

The RF Amplifier Section of the LPA employs two 8163 power triodes in a parallel plate, grounded grid cathode driven configuration. The tubes are self biasing and therefore require no external bias supply. The PA output circuit is tuned by the paralled plate tank circuit and loaded by output transformer T103 to match antenna impedance

a. CIRCUIT ANALYSIS. The rf input signal passes through input jack J101 and is supplied to bypass relay KJ01. When high voltage circuit breaker S102 is activated, the signal is passed through coupling capacitor, C101 to the cathodes of V101 and V102. If Switch S102 is deactivated, the signal is bypassed to relay K103 and goes out to the antenna. The 10 vac secondary of transformer T101, supplies 5 vac to each of the series connected filaments of V101 and V102. The center tap of the 10 vac secondary is used for metering PA PLATE CURRENT. The PA PLATE CURRENT meter M101 is grounded and forms the cathode return for the plate and grid current and is bypassed through C103. RF choke L103 is located between the meter and the filament center tap. If M101 or L103 becomes open no plate current will flow.

The PA tubes employ zero bias. When a signal is applied to the tubes they are designed to operate efficiently as long as the plate circuit is properly tuned. Under no signal conditions, the quiescent value of a tube is approximately 180 ma; the plate current is kept to a safe level so damage to the unit will not occur. Two parasitic suppressors PS101 and PS102 are incorporated in the output plate circuit to limit unintended self sustaining oscillations. The amplified plate signal is tuned by various band combinations of tuning capacitor C123, high frequency coil L108, tank coil L109, and coil bandswitch S106B. The transformer bandswitch S106C provides additional reactance for output transformer T103. Both switches S106B and C are controlled by rotary solenoid drive switch SZ101.

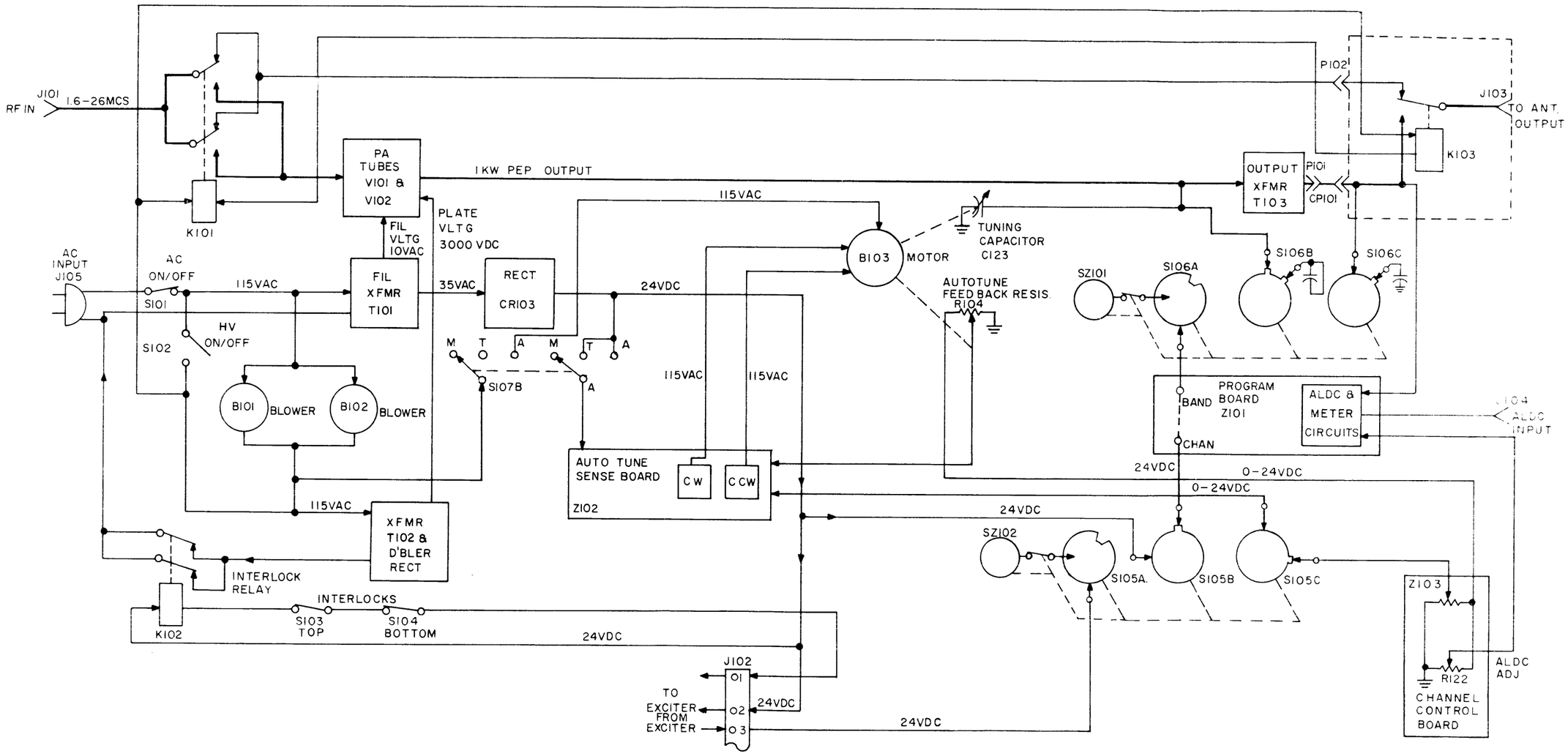

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Figure 4-1. Functional Block Diagram of LPA

b. THE TANK COIL BANDSWITCH The wiper of switch S106B, the coil bandswitch wafer is grounded. The different bands are made, by various portions of the tank coil L109, being grounded by switch S106B.

In position 1, the bandswitch is placed in parallel with tuning capacitor C123, and capacitor network C130, C131 and C132 to form Band 1, (1.9-2.4 MHz).
In position 2, the tuning capacitor, C123 is in parallel with the total series inductance of both high frequency coil L108 and tank coil L109 to form Band 2, (2.4 - 4 MHz).
In position 3, switch S106B grounds the first tap of coil L109 to form Band 3, (4 - 6 MHz).
In position 4, switch S106B grounds the second tap of coil L109 to form Band 4, (6 - 8 MHz).
In position 5, a jumper is across contacts 5 and 6 of coil L109. This allows the first and third taps of L109 to be grounded to form Band 5, (8 - 10 MHz).
In position 6, the second and third taps of L109 are grounded to form Band 6, (10 - 12 MHz).
In position 7, the fourth tap and high frequency coil L109 are grounded to form Band 7, (12 - 18 MHz).
In position 8, the fourth tap and high frequency coil L108 are grounded to form Band 8, (18 - 23 MHz).
In position 11, which is optional, tuning capacitor C123, and capacitor network C133, C149 and C154, are placed in parallel with switch S106B to form Band 11 (1.6 - 1.9 MHz).

c. THE TRANSFORMER BANDSWITCH. The transformer bandswitch wafer S106B selects different capacitors for each band to act as added reactance for the output transformer T103. Capacitor C142 serves not only as parallel capacitance to all switch positions but also increases the current carrying capabilities of the capacitance configuration.

The output transformer bands are formed as follows:

POSITION	FREQUENCY (MHz)	COMPONENT
1	1.9-2.4	C143
2	2.4-4	C144
3	4-6	C145
4	6-8	C147
5	8-10	C142 (open)
6	10-12	ground
7	12-18	ground
8	18-26	ground
9	1.6-1.9	C142 (open)

The higher frequencies are supplemented by the reactance of C129, which is located between the transformer tap and output end.

After completion of the tuning cycle the amplified signal is transmitted through the output circuit, to the antenna.

d. RF OUTPUT INDICATION AND ALDC. Voltage divider C134 - C135 provides the monitor for both the ALDC and r-f indication circuits, on one half of Z101. In the ALDC circuit a positive 24 volts is applied to one side of R122, the ALDC adjustment potentiometer, and to the ALDC signal on the wiper. The desired ALDC signal level is rectified by CR107, filtered by the pi filter combination of C138, L111 and C140, and appears at J104 to be fed back to the driver. The rf for the indicator circuit is rectified by CR108, filtered by the pi network, C139, L113, C141 and fed through meter multiplier resistor R121 to the rf meter M102. Indication on the RF output meter is relative and indicates only the presence of rf which may be used as a tuning aid. A maximum relative reading on any frequency indicates plate resonance.

4-4. AUTO-TUNE CIRCUITS.

GENERAL. The Auto-Tune system in the LPA is basically made up of three different smaller systems. These smaller systems must function together to perform the following operations:

1. Select the proper band for the desired frequency.
2. Resonate the plate by tuning the plate tuning capacitor.
3. Select the proper output transformer band to properly match the plate impedance to the antenna.

a. AUTO-TUNE BANDSWITCHING DESCRIPTION. The LPA may be remotely tuned by the 24 vdc control voltage passing to an eight position non-shorting, single wafer connected to remote jack J201. It also may be front panel controlled by connecting a jumper between terminal 2 and the appropriate channel on remote jack J201. When a channel selection is made by either a remote unit or from the front panel, the 24 vdc control voltage from rectifier CR103 is placed on the appropriate position of switch S105A. The control voltage is applied to the wiper of S105A and activates rotary solenoid driver switch SZ102. Since S105B and C are ganged to S105A, these switches respond and move to the same position as S105A. The 24 vdc is then coupled from S105B through the jumper of channel and band terminals of program board Z101, to the appropriate position on switch S106A. It then goes through the wiper of S106A to activate rotary solenoid drive switch SZ101. Switch S106B and C now respond and move to the same position as S106A.

b. CIRCUIT ANALYSIS. As previously stated the system is null searching type. A 24 vdc voltage is applied across the auto-tune feedback potentiometer R104, as well as the channel control on Z103. The wiper of R104 is ganged to the tuning capacitor, C123 as well as the Drive Motor B103. All three components turn simultaneously during auto-tuning or can be turned simultaneously during manual operation by the front panel control. When switch S105C is rotated to the desired channel by rotary solenoid driver switch SZ102, the desired channel control wiper is switched in and fed to the auto-tune sense board Z102.

The wiper of the auto-tune feedback potentiometer is also connected to the auto-tune sense board input. If the wipers on both the feedback potentiometer and the channel controls are in exactly the same position, the voltage between either wiper and ground will be equal, and the voltage between both wipers will be zero. When this occurs, this is a null condition and the sense board "sees" no voltage. In the motor operate function it is only necessary that the Feedback Potentiometer Wiper R104, be in a different position than the channel control on Z103. If the auto-manual switch (S107) is in the auto position, the sense board's logic circuit will then "see" this error voltage and feed it to the amplifier which operates the motor relays K1 or K2. The clockwise or counterclockwise motor relay will energize, depending upon the polarity of the error voltage. When the auto-manual switch S107 is in the auto position, the motor will receive 115V from either of the motor relays and run until the feedback potentiometer R104 acheives a null condition with respect to the selected channel control. When this null condition is reached, the logic circuit no longer sees an error signal and turns off the Relay Amplifier which stops motor B103. The READY lamp DS102 will now light since the unit is ready for auto-tuning.

4-5. HIGH VOLTAGE SUPPLY.

When High Voltage Circuit Breaker S102 is activated, primary current flows to Transformer T102, and also to H.V. indicator lamp DS101. The High Voltage Supply is a doubler type, which provides 2000 vdc under full load to the plates of the PA tubes. When the primary power is applied to the primary of T102, the voltage is stepped up to 1500 vdc on the secondary. It then flows through surge current limiting resistors R102 and R103 and is rectified and doubled by diodes CR101 and CR102, and the filter combination. The filter combination is made of C110 thru C117 in series with each other, and with equalizing bleeder resistors R112 thru R119, one each in parallel with each capacitor. The High Voltage is then passed thru the decoupling network consisting of C124, L107, C125, C143 and C106 to the plates of V101 and V102.

4-6. INTERLOCK CIRCUITS.

GENERAL - The HIGH VOLTAGE Supply in the LPA is a doubler type which is interlock and circuit breaker protected both for the protection of the operator as well as the equipment. There are two internal interlocks and one external interlock in the unit. The internal interlocks break one side of the primary line when either the top or bottom covers are opened. The external interlock appears on pins, on the remote jack and may also be used to control the High Voltage from a remote point. When the external interlock is not used, a jumper must be placed in the circuit from Pin #1 on J102 to ground Pin 11 on J102.

a. OPERATION. The primary input voltage to the High Voltage Transformer T102 is controlled on one side by interlock Relay K102, a 24 volt relay, and on the other side by the High Voltage Circuit Breaker S102. In the interlock circuit, a positive 24 volts is applied to one side of the Relay K102, while on the other side, there are two series interlock switches S103 and S104 which connect between K102 and Pin 1 on Jack J102.

4-7. AC CIRCUIT DESCRIPTION.

The standard input power for the LPA is 110 vac but with a slight wiring modification will operate on 220 vac. Power is applied by means of a detachable 3 wire power cable to power input jack J105. The line is by-passed at J105 by C102 and C103. The Main Power Circuit Breaker S101 appears across one side of the line and the AC HV circuit breaker S102 is taken from the load side of S101. The filament, capacitor, drive motor and fan fuse is also located on the loadside of S101. Both sides of the line to the filament transformer T101 are by-passed respectively by C106 and C107, and contain chokes L104 and L105. The Capacitor Drive Motor B103, has Auto-Manual Switch S107 in series with one side of the line input while the other side is in series with the Auto-Tune Sense Board.

The 24 volt supply is protected by Fuse F102 before being rectified by CR103 and filtered by C150. All points requiring 24 vdc are supplied from this point.

Both sets of contacts on K102 are paralleled to carry maximum primary current. When H.V. Circuit Breaker S102 is activated, relays K101 and K103 and Transformer T102, become energized.

SECTION 5
MAINTENANCE

5-1. INTRODUCTION.

Maintenance may be divided into three categories: operator's maintenance preventive maintenance, and corrective maintenance. Corrective maintenance is sometimes considered as consisting of information useful in locating and diagnosing equipment troubles and maladjustments, existing and/or pending, and information necessary to remedy the equipment troubles and maladjustments. By using the following procedures a trouble may also be localized to a particular section.

The LPA has been designed to provide long-term, trouble-free operation under continous duty conditions. It is recommended that any necessary maintenance be done by a competent maintenance technician familiar with trouble-shooting techniques.

5-2. PREVENTIVE MAINTENANCE.

a. In order to prevent failure of the equipment due to corrosion, tube failure, dust, or other destructive elements, it is suggested that a schedule of preventive maintenance be set up and adhered to.

b. At periodic intervals (at least every six months) the equipment should be removed from the rack for cleaning and inspection. All accessible covers should be removed and the wiring and all components inspected for dirt, corrosion, charring, discoloring, or grease; in particular, the tube sockets should be carefully inspected for deterioration. Dust may be removed with a soft brush or a vacuum cleaner if one is available. Remove dirt or grease from other parts with any good dry cleaning fluid.

WARNING

When using trichlorentyhlene, make certain that adequate ventilation exists. Avoid prolonged contact with skin.

c. While unit is out of the rack and covers are removed, check the tubes, all of which are accessible from the top of the chassis.

d. Remove any accummulated dust with a small brush or vacuum cleaner from blower screens.

e. Carefully inspect for loose solder connections or screws, especially those on solder lugs. Recommended time interval is every 6 to 12 months, depending on the amount of vibration encountered in service.

5-3. ALIGNMENT OF AUTO-TUNE FEEDBACK RESISTOR R104.

The LPA is designed to auto-tune within the top 180° half of the tuning capacitor C123. To do this, the resistance of potentiometer R104 must be adjusted in relation to the capacitance of C123.

CAUTION

Remove all power before performing the following operation.

Use the following procedures when aligning potentiometer R104 (Refer to figure 5-2).

1. Loosen set screw on anti-backlash gear (GR213-5).
2. Slide gear along the shaft of R104, until it disengages from the gear assembly.
3. Turn the capacitor rotor, until the plates are in the upper 180° half of C123. (Point of maximum capacitance).
4. Connect one lead of ohmmeter to ground and the other lead to the wiper of R104.
5. Adjust the R104 until a 30 ohm reading is indicated on ohmmeter.
6. Spring load the gear about 5 or 6 teeth.

7. Slide gear back until it engages with gear assembly, and tighten set screw. (Do not move the position of R104 while sliding gear into place.

8. The proper adjustment has been made when the resistance of R104 increases, as the capacitance of tune capacitor C123 is decreased.

Table 5-1. Preliminary Inspection Procedure

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDY
All electrical connections at rear of transmitter.	Open connections, dirt, frayed, cables.	Tighten, replace or as necessary.
Antenna connections	Loose connections, dirt frayed cables.	Tighten replace or clean as necessary.
Knobs, screws, connectors.	Loose or missing hardware.	Tighten or replace
Resistors	Cracks, chipping blistering, discolcration, and other signs of overheating.	Replace as necessary.
Capacitors	Leaks, bulges, discoloration.	Replace as necessary.
Tubes	Poor seating.	Secure firmly in place.
Meters	Bent needle, cracked case, broken glass.	Replace as necessary.

CAUTION

The operating or maintenance personnel must observe certain safety precautions anytime the top or bottom cover is removed. When the top or bottom is removed, the interlock circuit will prevent the High Voltage from being applied, but it must be remembered that primary ac power (115vac or 220vac) is still able to supply the filament transfromer T101, and the blowers. To prevent any occurrence of a shock hazard, the plug should be removed from the wall. The RF Drive should be off, particularly when the bottom cover is removed. The same caution applied to any High Voltage device should hold true for the LPA.

5-4. LPA TEST PROCEDURE.

When performing the following tests on the LPA refer to (figure 5-1) for equipment set up, and (table 5-2) for the proper equipment to be used.

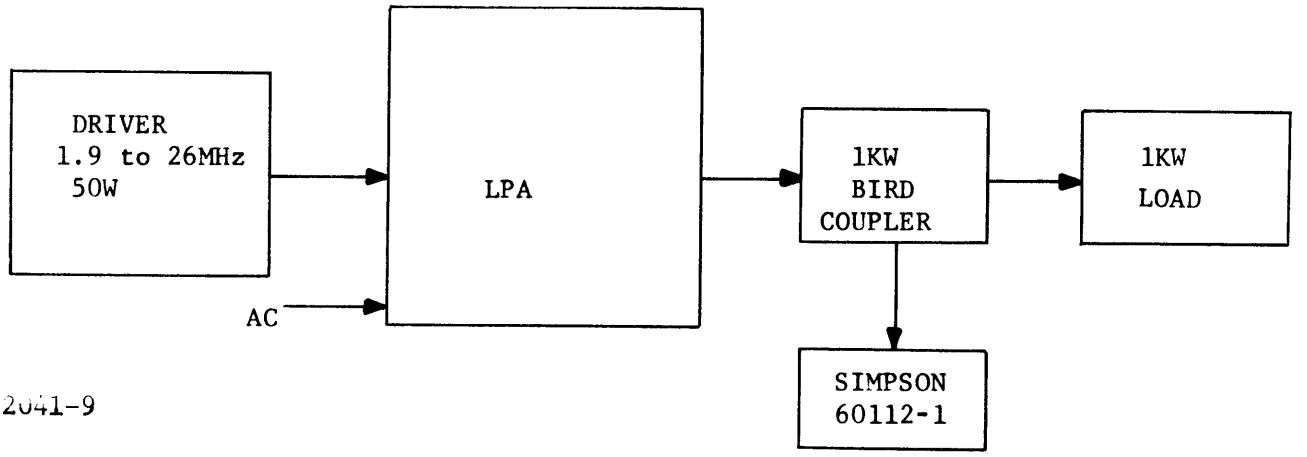

Figure 5-1. Test Equipment Diagram

Table 5-2. Test Equipment

Equipment	Capabilities	Make
Driver	Frequency - 1.9 to 26MHz Power - 50 watts to 100 watts	
Coupler	Power Consumption - 1 kw	Bird Coupler or Equivalent
Test Meter		Simpson (60112-1) or Equivalent
Dummy Load	Power Consumption - 1 kw	

CAUTION

The same caution applied to any other High voltage device against shock hazard, should be observed by competent operating and maintenance personnel when working on the LPA. When the top and bottom covers have been removed, the operator should be aware of not only the high voltage points, but also the location of the AC Voltage and RF Drive.

1. When the LPA is being operated out of its cabinet, or rack and without top or bottom covers, the interlock switches S103 and S104 should be CLOSED, and a jumper wire placed between pin 1 and pin 11 on J102.
2. Adjust the test equipment (driver) to generate any frequency between 1.9MHz and 26MHz.
3. Reduce the RF output from test equipment (driver) to minimum.
4. Turn AC switch S101 to ON. The filaments on V101 and V102 should light and the blowers B101 and B102 should start.
5. Adjust the channel selector, S105 on the LPA to the channel corresponding to the frequency of the driver. The ledex solenoid in the bandswitch assembly S106, should activate and turn to the band corresponding to the channel selector switch S105.
6. Turn the manual, tune, auto switch S107, to MANUAL position.
7. Turn the high voltage switch S102 to ON, the PA plate meter M101 should read approximately 120ma indicating the presence of high voltage on the plates of V101 and V102.
8. The operation of interlocks S103 and S104 may be checked, by turning S103 or S104 ON and OFF. The following conditions will exist with an interlock open and the AC power applied: the ledexes S105 and S106 and the blowers will operate, the filaments of V101 and V102 will remain lit.
9. Turn AC switch ON. CLOSE interlock switches, Turn high voltage switch ON.

10. Adjust RF Drive for an indication of approximately 180ma on PA plate meter M101.

11. Adjust tune control for resonant peak on test meter (Simpson 60112-1). The RF output meter M102 should also reach a peak of approximately 1/2 to 3/4 scale. This resonant peak is used as a tuning aid.

12. Increase the driver output until the PA meter M101 reads 400ma. With a reading of 400ma on the PA meter the test meter should read between 400 500 watts.

13. Turn the high voltage switch S102 to OFF. The output test meter should now read betweem 15 and 50 watts. This is the RF input drive and is also an indication that the RF switching relay (K103) is working.

14. Turn the high voltage switch S102 to ON. Check the dc voltage at J104 (ALDC out). The dc voltage should read between 0 and -15 volts when the ALDC pot is varied.

15. Turn high voltage switch S102, OFF.

16. Tune control should still be set at RESONANCE.

17. Turn manual, tune, auto switch S107 to TUNE position.

18. Select the preposition pot (R105 to R112) corresponding with the channel in use.

19. With alignment tool, adjust the pot until READY light comes ON.

20. Turn switch S107, to the AUTO position. The green READY light should remain on.

21. Turn switch S107, to the MANUAL position.

22. Turn the tune control approximately 30 degrees clockwise or counterclockwise.

23. Turn Switch S107 to the AUTO position. This should activate the motor M101 that will turn the tune capacitor C123 until the green READY light comes ON capacitor C123 should then stop turning.

24. Turn the high voltage switch to ON. The LPA should still be at resonance and generating the same power output as when it was tuned manually.

25. The seven other channels should also adjust to a selected frequency within their corresponding channels, using this auto tune circuit alignment procedure.

5-5 REMOTE OPERATION CHECK.

1. Turn AC switch to ON, on the LPA.

2. Turn the remote eight position rotary switch to each position. The channel select switch should turn to the same position as the remote switch. The bandswitch S106 should also turn as the channel select switch turns.

Table 5-3. Equipment Troubleshooting Chart

STEP	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF ABNORMAL INDICATION
1	Connect antenna or dummy load to LPA and check that all covers and components are secured.		
2	Place AC ON/OFF switch (7) to ON position.	Filaments in power Tubes V101 and V102 glow.	Check line fuse F101 (IF fuse repeatedly burns out check for short in Filament Transformer T101 and Blowers B101 and B102, and associated circuitry).
		Blower B101 and B102 energize.	Check Fuse F103 Check Blower Screens and clean them if necessary.
		Interlock Relay K102 energizes.	Check Power Supply CR103 and associated circuitry.
3	Place High Voltage ON/OFF switch, to ON.	High Voltage Indicator (6) lights.	Check fuse F103 (If fuse F103 repeatedly burns out check for short in power transformer T102 and associated circuitry).
		Relay K101 and K103 energize.	Check for an open in associated circuitry.
4	Place High Voltage ON/OFF switch (5) to OFF.		
5	TUNE and LOAD the LPA following, MANUAL TUNE PROCEDURES in (paragraph 3-3).	PA PLATE CURRENT meter indicates a rise as rf drive on exciter is increased.	Check exciter unit for rf output. (Refer to exciter manual). Check RF input to PA tubes.

STEP	OPERATION	NORMAL INDICATION	PROBABLE CAUSE OF ABNORMAL INDICATION
			Check PA tubes V101 and V102 for PLATE VOLTAGE. Check PA PLATE CURRENT meter and associated circuitry. Check TUNE and LOAD output circuits of PA tubes for an open or misalignment. Replace PA Tubes V101 and V102
		At point of resonance PA PLATE CURRENT meter will indicate dip. Turn up rf drive until PA PLATE CURRENT meter(4) indicates 400 ma.	
6	Remove all power from LPA. Refer to AUTOMATIC OPERATION Procedures paragraph (3-4) and follow steps 1-4.		
7	Turn Channel Selector on Exciter Unit to desired channel.	LPA Channel Selector and Tuning controls should rotate to same Channel position as Exciter, and Tune to frequency. Motor B103 energizes and should drive in a CW or CCW direction. At point of resonance PA PLATE CURRENT meter (4) indicates a dip.	Check Power Supply CR103 for correct output. Check rotary driven sideband switch SZ102 and SZ101. Check 115 VAC input to motor. Check setting of related potentiometer on Z103(as described in paragraph 3-5). Check inputs to Z102 and the transistor relay circuits in Z102. Check PA TUBES OUTPUT TUNING circuit. Replace PA tubes V101 and V102. Check TUNE CAPACITOR C123.

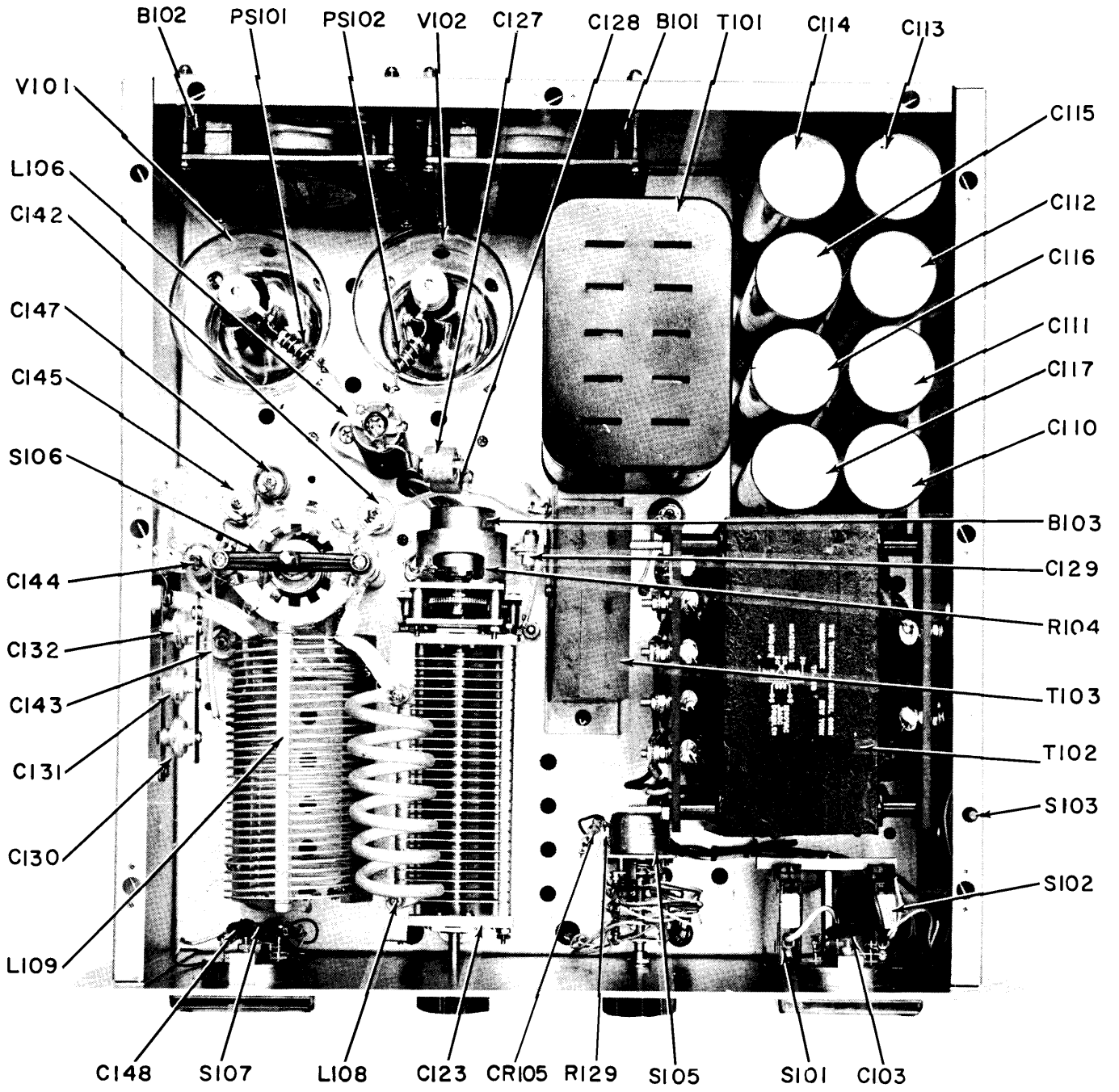

Figure 5-2. Top View, Showing Internal Components of LPA (B101 and B102 relocated on exterior of rear panel)

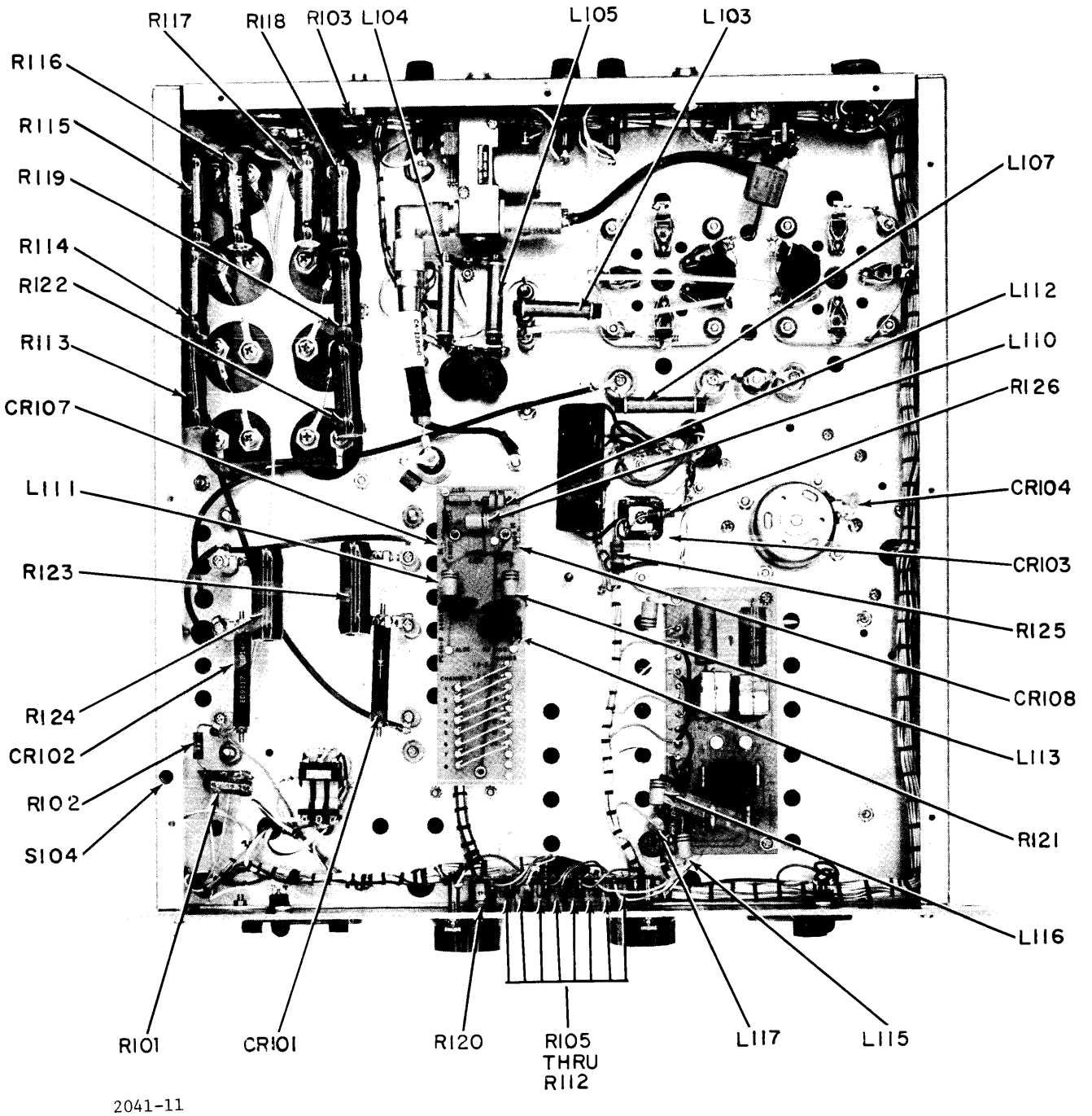

Figure 5-3. Bottom View, Showing Internal Components of LPA

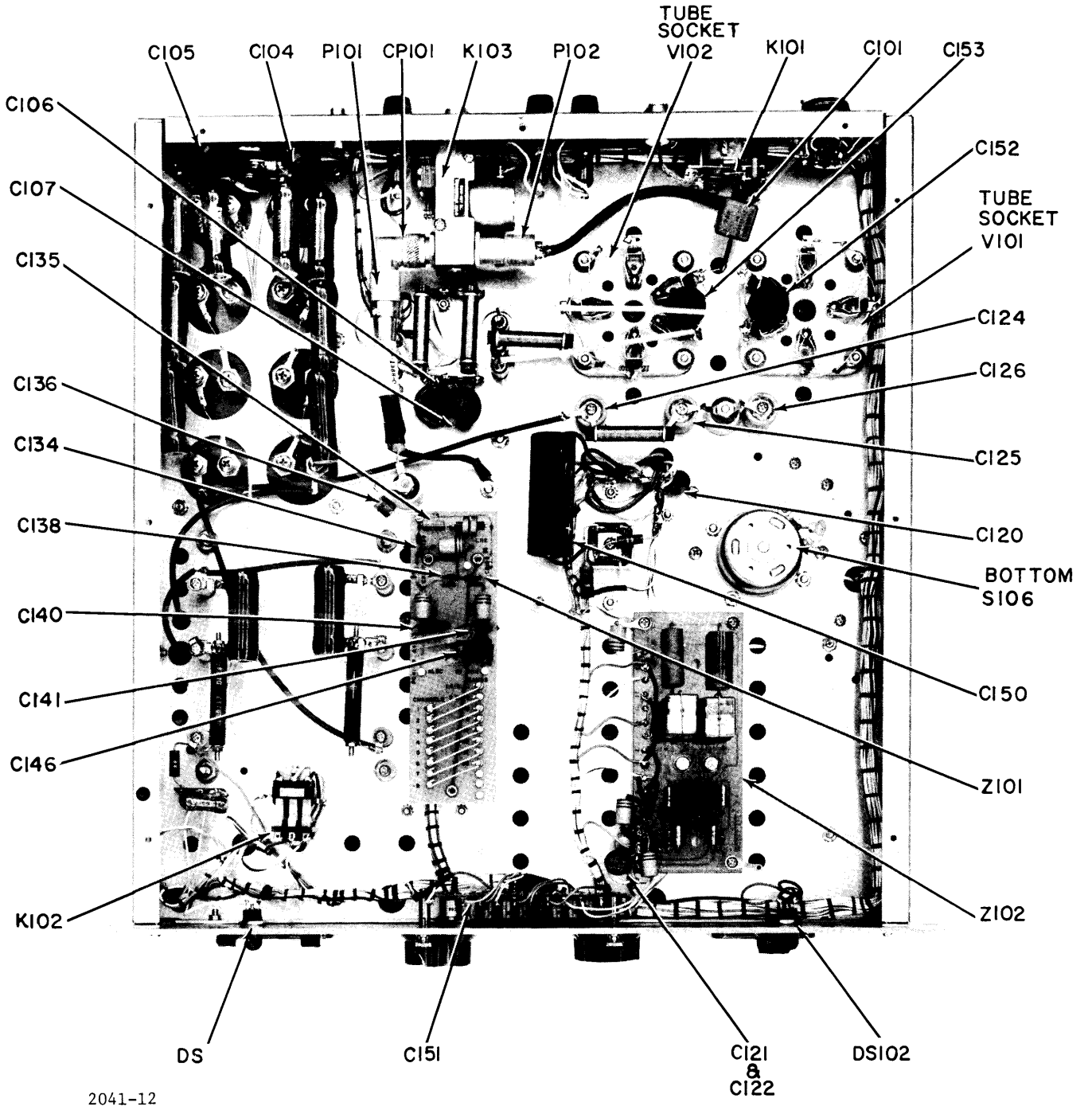

Figure 5-4. Bottom View, Showing Internal Components of LPA

SECTION 6
PARTS LIST

6-1. INTRODUCTION

The parts list presented in this section is a cross-reference list of parts identified by a reference designation and TMC part number. In most cases, parts appearing on schematic diagrams are assigned reference designations in accordance with MIL-STD-16. Wherever practicable, the reference designation is marked on the equipment, close to the part it identifies. In most cases, mechanical and electro-mechanical parts have TMC part numbers stamped on them.

To expedite delivery when ordering any part, specify the following:

a. Reference symbol.

b. Description as indicated in parts list.

c. TMC part number.

d. Model and serial numbers of the equipment containing the part being replaced; this can be obtained from the equipment nameplate.

For replacement parts not covered by warranty (refer to warranty sheet in front of manual), address all purchase orders to:

The Technical Materiel Corporation
Attention: Sales Department
700 Fenimore Road
Mamaroneck, New York

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
B101	Fan Axial	BL106-5
B102	Fan Axial	BL106-5
B103	Motor, Alternating Current	M0136
C101	Capacitor, Fixed, Mica	CM35C103J03
C103 thru C108	Capacitor, Fixed, Ceramic	CC100-32
C110 thru C117	Capacitor, Fixed, Electrolytic	CE112-1
C118 thru C122	Capacitor, Fixed, Ceramic	CC100-32
C123	Capacitor, Variable, Air	CB175
C124 thru C128	Capacitor, Fixed, Ceramic	CC109-38
C129	Capacitor, Fixed, Ceramic	CC116-4
C130 thru C132	Capacitor, Fixed, Ceramic	CC116-5
C134	Capacitor, Fixed, Ceramic	CC100-16
C135	Capacitor, Fixed, Mica	CM15F151J03
C136	Capacitor, Fixed, Mica	CM15B100K03
C138	Capacitor, Fixed, Ceramic	CC100-29
C139	Same as C138	
C140	Capacitor, Fixed, Ceramic	CC100-32
C141	Same as C140	
C142	Capacitor, Fixed, Ceramic	CC116-5

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C143	Capacitor, Fixed, Ceramic	CC116-9
C144	Capacitor, Fixed, Ceramic	CC116-7
C145	Capacitor, Fixed, Ceramic	CC116-5
C146	Capacitor, Fixed, Ceramic	CC100-32
C147	Capacitor, Fixed, Ceramic	CC109-19
C148	Capacitor, Fixed, Ceramic	CC100-32
C149	Capacitor, Fixed, Ceramic	CC109-38
C150	Capacitor, Fixed, Electrolytic	CE116-8VN
C151 thru C153	Capacitor, Fixed, Ceramic	CC100-32
C155	Capacitor, Fixed, Ceramic	CC100-32
CP101	Adapter, Connector-UHF	UG646/U
CR101	Rectifier, Semiconductor Device	DD140
CR102	Same as CR101	
CR103	Rectifier, Semiconductor Device	DD142-1
CR104	Semiconductor Device, Diode	1N538
CR105	Same as CR104	
CR107	Semiconductor Device, Diode	1N34A
CR108	Same as CR107	
DS101	Lamp, Incandescent	BI110-9
DS102	Same as DS101	
F101	Fuse, Cutting	FU100-3
F102	Fuse, Cutting	FU100-2
F103	Fuse, Cutting	FU102-2
J101	Connector, Receptacle-UHF	S0239A
J102	Socket, Electron Tube	IS100-5

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
J103	Connector, Plug UHF	PL259A/TEF
J104	Adapter, Connector-UHF	UG625/U
J105	Connector, Recptacle-ML	JJ175
K101	Release, Armature	RL116AC2C115
K102	Release, Armature	RL116DC3C024
K103	Release, Armature-Reference	RL139-4-110AC
L103 thru L105	Coil, Reference, Fixed	CL178
L106	Coil, Reference, Fixed	CL166-2
L107	Coil, Reference, Fixed	CL178
L108	Coil, Frequency, HI	CL417-4
L109	Coil, Tank	CL428
L110	Coil, Reference, Fixed	CL140-6
L111	Same as L110	
L112	Coil, Reference, Fixed	CL100-5
L113 thru L117	Coil, Reference, Fixed	CL140-6
M101	Ammeter, Marking Terminal Board	MR201-3
M102	Ammeter, Direct Current	MR201-2
P101	Connector, Plug, UHF	PL259A/TEF
PS101	Suppressor, Parasitic	AX391
PS102	Same as PS101	
R101	Resistor, Fixed, Wire Wound, 5W	RW107-41
R102	Resistor, Fixed, Composition	RC32GFIR0JYY

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R103	Resistor, Fixed, Composition	RC20GF105J
R104	Resistor, Variable, Composition	RV4NAYSC152AY
R105 thru R112	Resistor, Variable, Composition	RV119-1-502
R113 thru R119	Resistor, Fixed, Wire Wound-20W	RW110-35
R120	Resistor, Variable, Composition	RV119-1-104
R121	Resistor, Fixed, Composition	RC20GF153J
R122	Resistor, Fixed, Wire Wound-20W	RW110-35
R123	Resistor, Fixed, Wire Wound-25W	RW111-6
R124	Same as R123	
R125	Resistor, Fixed, Composition	RC42GF470J
R126	Resistor, Fixed, Composition	RC32GF1ROJYY
R127	Same as R126	
R128	Resistor, Fixed, Composition	RC20GF122J
R129	Resistor, Fixed, Composition	RC32GF3R3J
R130	Resistor, Fixed, Wire Wound, 25 ohms, 5 watt	RW107-12
S101	Circuit Breaker-SPST	SW461-2
S102	Circuit Breaker-SPST	SW461-1
S103	Switch, Push-Pull	SW219
S104	Same as S103	
S105A,B,C	Coil, Reference, Fixed	SW459
S106A	Switch, Rotary	SW460
S106C	Switch, Section, Rotary	SW106-2
S107A,B	Switch, Rotary	SW120

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
T101	XFMR, Filament, 115 vac/230 vac, 50/60 Hz	TF369
T102	XFMR, Power, Step-up, 115 vac/230 vac, 50/60 Hz	TF368
T103	XFMR, Reference	TR189
V101	Tube, Electron	8163/3-400Z
V102	Same as V101	
W101	Wiring Harness Branched	CA1386
XDS101	Light, Indicator-Red	TS153-1
XDS102	Light, Indicator-Green	TS153-2
XF101	FUSEHOLDER	FH100-1
XF102	FUSEHOLDER	FH100-1
XF103	Same as XF102	
XV101	Socket, Electron Tube	TS125-2
XV102	Same as XV101	
Z101	Board, Assembly, ALDC	A-4643
Z102	Board, Auto Tune	AZ114
Z103	Board, Assembly, Resistor	A-4681

SECTION 7
SCHEMATIC DIAGRAMS