

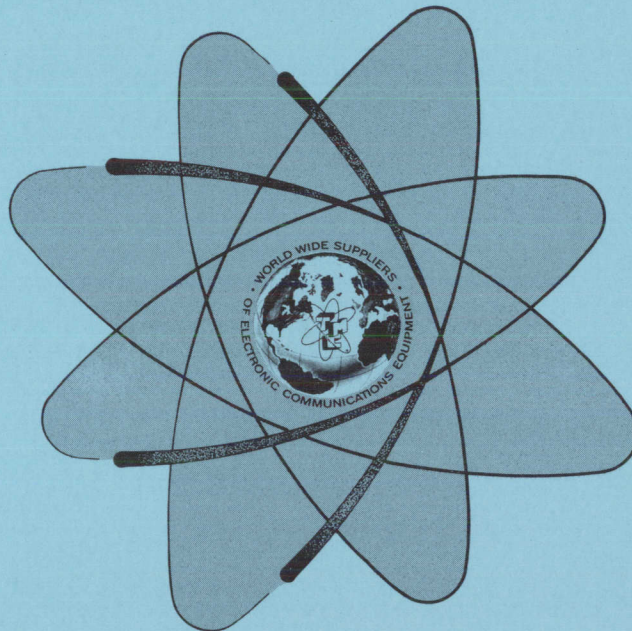
TECHNICAL MANUAL

for

LINEAR POWER AMPLIFIER

MODEL PAL-500-4

MF/HF LINEAR POWER AMPLIFIER



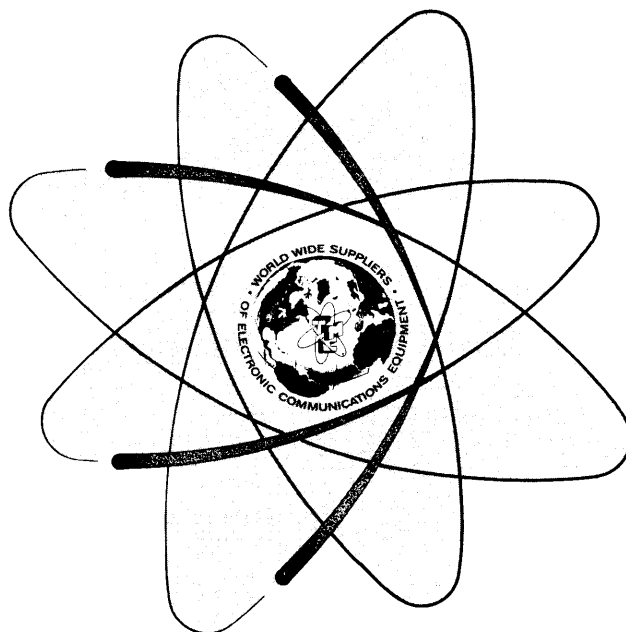
THE TECHNICAL MATERIEL CORPORATION
MAMARONECK, N.Y.

OTTAWA, ONTARIO

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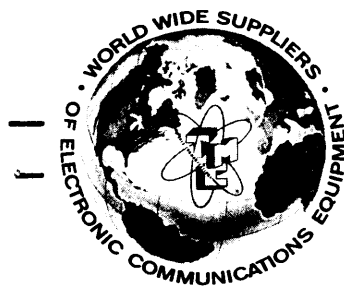


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THE TECHNICAL MATERIEL CORPORATION

C O M M U N I C A T I O N S E N G I N E E R S

700 FENIMORE ROAD

MAMARONECK, N. Y.

W a r r a n t y

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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.
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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.

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*Electron tubes also include semi-conductor devices.

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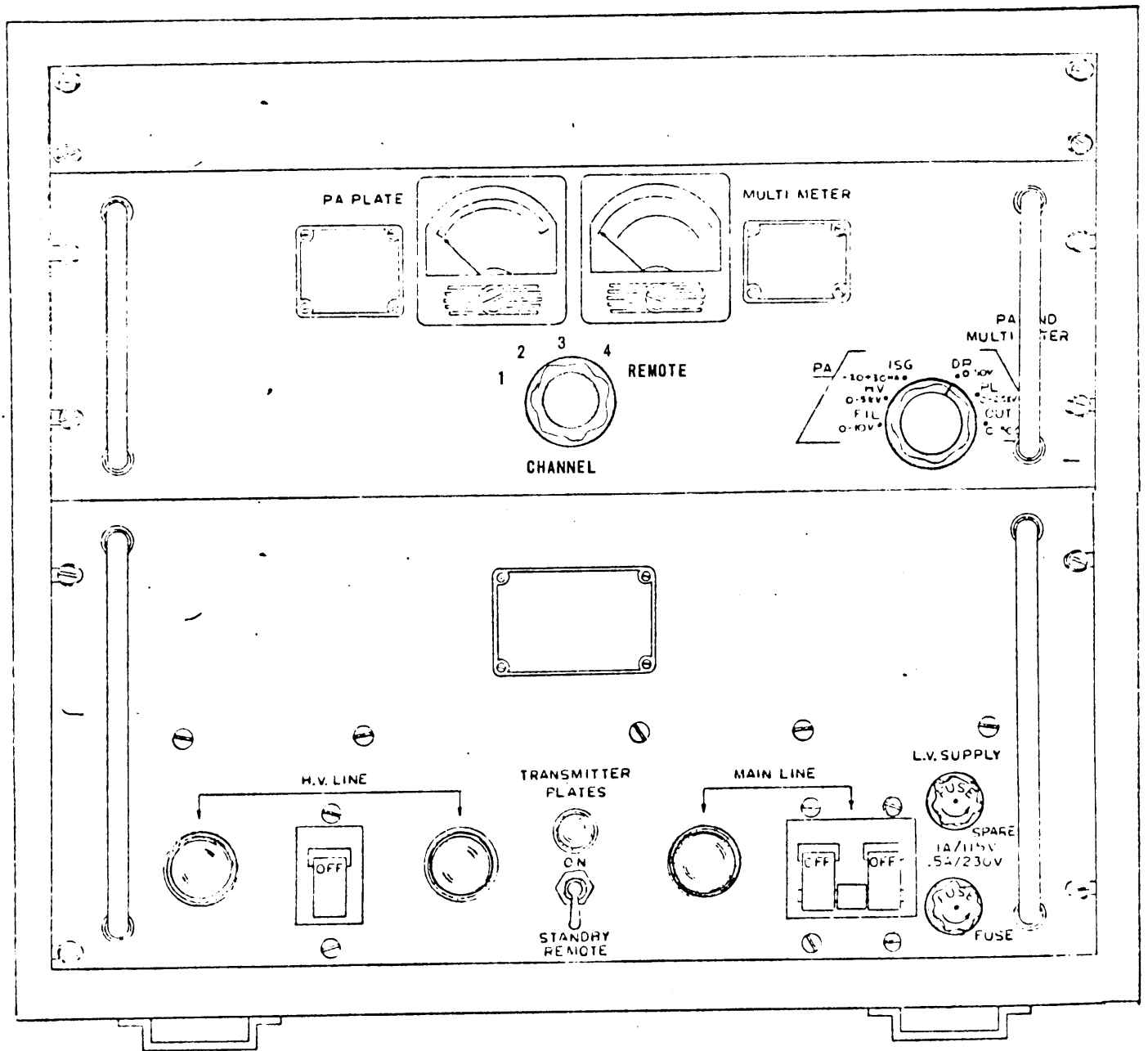


Figure 1-1. PAL-500-4

SECTION 1

GENERAL INFORMATION

1-1. GENERAL

The PAL-500-4 (figure 1-1) is a four channel, fixed frequency low power transmitter system capable of providing 500 watts peak envelope power. The system consists of the model PSP-500 Power Supply and the RFE-2-4 Linear Power Amplifier. This system operates in the frequency range of 2 to 32 MHz. The system is capable of operating on the following modes: CW, MCW, AME, SSB, DSB and ISB. The system may be remotely controlled to provide the following operational functions: PA plates on-off, CW key, PTT (press to talk), and a selection of PTT modes between A3J (fully suppressed carrier), A3A (-20 db suppressed carrier) and A3H (full carrier).

For FSK and FAX modes of operation additional terminal equipments are required. This system is FCC type accepted under Part 81 and is type approved by the Department of Transport in Canada.

1-2. PHYSICAL DESCRIPTION

The Model PAL-500-4 is composed of two small and compact units; the Linear Power Amplifier, Model RFE-2-4 (5-1/4 inch panel) and the Power Supply, Model PSP-500 (8-3/4 inch panel). The entire unit occupies only 14 inches of panel space for standard rack mounting which makes it ideal for console, table top, mobile, and shipboard installations.

1-3. FUNCTIONAL DESCRIPTION

The combination of the TMC Model SBE, Mode Selector, Transmitting, and the PAL-500-4 provides a compact transmitting system capable of producing single, double or independent sideband signals with any degree of carrier insertion.

The PAL-500-4 has been carefully designed with no compromise in workmanship or component quality. A pair of 4CX350A Beam Power Amplifier tubes in parallel with a pi network provide unbalanced output from 50 to better than 600 ohms. Particular attention has been given to the suppression of distortion products, amplifier stability, power supply hum content and dynamic impedance. Full interlock, overload and fuse protection have been provided for the safety of the operating personnel and protection of the equipment. A filtered forced air blower system is included as an integral part of the equipment. An effective ALDC (Automatic Load and Drive Control) system has been included to limit the distortion produced when high drive peaks occur.

1-4. TECHNICAL SPECIFICATIONS

See Table 1-1.

TABLE 1-1. TECHNICAL SPECIFICATIONS, PAL-500-4

<u>ITEM</u>	<u>CHARACTERISTICS</u>
FREQUENCY RANGE:	2 to 32 megacycles continuous, bandswitched. (Four fixed frequency channels; customer selected.)
OUTPUT POWER:	500 watts 2 tone PEP.
OPERATING MODES:	With appropriate exciter; CW, MCW, SSB, ISB, DSB, FS or pulse operation.
OUTPUT IMPEDANCE:	Will match any unbalanced load from 70 to 150 ohms at ± 20 degrees in the range 2 to 4 megacycles. Will match any unbalanced load from 50 to 600 ohms at ± 45 degrees in the range 4 to 32 megacycles.
OUTPUT CONNECTION:	Type C coaxial.
INPUT IMPEDANCE:	70 ohms nominal, coaxial.
INPUT REQUIREMENTS:	Less than 100 milliwatts will produce full output.
INPUT CONNECTION:	Type BNC coaxial (RG-59/U).

TABLE 1-1. TECHNICAL SPECIFICATIONS, PAL-500-4 (continued)

<u>ITEM</u>	<u>CHARACTERISTICS</u>
DISTORTION PRODUCTS:	At full PEP output, 3rd order distortion products are at least 40 db below either tone of a standard two tone test.
HARMONIC SUPPRESSION:	Second - at least 40 db from PEP output.
ALDC:	An Automatic Load and Drive Control is provided to limit distortion during high drive peaks.
PRIMARY POWER REQUIREMENTS:	115/230 volts, 50/60 cycle, single phase, 1150 watts under 500 watts PEP output conditions.
SAFETY:	Full interlock protection. Full overload and fuse protection.
COOLING:	Filtered, forced air blower system.
TEMPERATURE, HUMIDITY:	Designed to operate in any ambient temperature between 0 degrees and 50 degrees C for any value of relative humidity up to 90%.
RUGGEDNESS:	The unit is designed for mobile application with the addition of shock mounts.
TUBE COMPLEMENT:	RFE-2-4 Linear RF Amplifier. 2 each 4CX350A RF Amplifiers 1 each 6CL6 Controlled Amplifier 1 each 6146 Driver
MOUNTING:	Standard WE relay rack.
SIZE: RFE-2-4 PSP-500	19" wide x 5-1/4" high x 17" deep 19" wide x 8-3/4" high x 13" deep
WEIGHT: RFE-2-4 PSP-500	30 lbs. 60 lbs.
SHIPPING WEIGHT:	140 lbs. gross
COMPONENTS AND CONSTRUCTION:	Equipment is manufactured in accordance with JAN/MIL specifications wherever practicable.

SECTION 2
INSTALLATION

2-1. UNPACKING AND HANDLING

The PAL-500-4 is shipped from the factory in a wooden crate to ensure maximum protection from damage in transit. The inside of the crate contains additional packing material to protect the unit not only from breakage due to shock, but also from the elements. Inspect all packing for parts shipped as loose items.

As soon as the PAL-500-4 is unpacked, it should be visually inspected to make sure that it is not damaged. This examination should include the testing of each front panel control for ease of operation. All the covers of the units should be removed, and the inside of the units checked carefully for damaged components and loose items. Check all tubes for damage and correct seating in the tube sockets. Replace all covers.

The PAL-500-4 can be mounted in any standard 19 inch relay rack. The front panels of the RFE-2-4 and the PSP-500 of which the PAL-500-4 is comprised are 5-1/4 inch and 8-3/4 inches high respectively. It is recommended that a minimum of 1-3/4 inches of free space be allowed above the RFE-2-4 unit.

Make cable connections as shown in Figure 2-1.

2-2. POWER REQUIREMENT

The primary power requirement for the PAL-500-4 is 115/230 volts, 50/60 cycle, single phase, 1500 watts under 500 watts PEP output conditions. Figure 7-2 illustrates the connections required for 115 vac or 230 vac operation.

2-3. EQUIPMENT LOCATION

Before installing the PAL-500-4, consideration must be given to its location.

a. Accessibility

The PAL-500-4 must be located so that an operator can comfortably reach all of the front panel controls. Sufficient clearance around the unit must be allowed to provide access to the rear panel connections so that the unit may be removed for servicing.

b. Ventilation

The electron tubes inside this unit generate heat. To prevent heat buildup, a filtered, forced air blower system is used for cooling and sufficient clearance around the unit must be allowed to ensure that the air flow is not restricted.

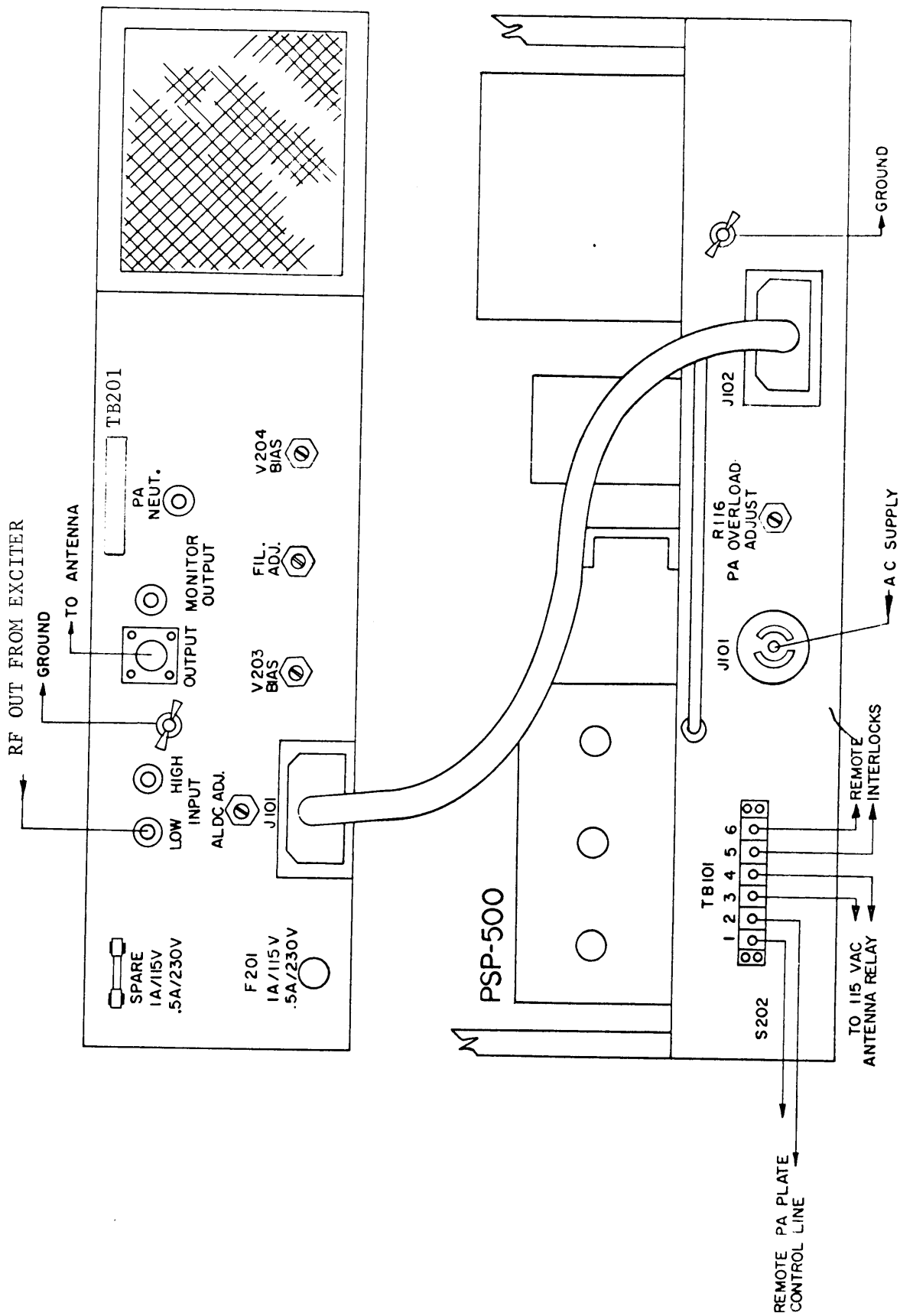


Figure 2-1. Rear Panel Connections and Adjustments

SECTION 3

OPERATOR'S SECTION

3-1. CONTROLS AND INDICATORS

Before attempting to operate the PAL-500-4, the operator should become familiar with the controls and indicators listed in table 3-1. The index number listed in the table are those assigned in figure 3-1. Each description in the table indicates the type of control or indicator and what its purpose is. It is important to stress that the descriptions are not operating procedures.

TABLE 3-1. OPERATOR CONTROLS AND INDICATORS

<u>INDEX NO.</u>	<u>PSP-500(See Fig. 3-1b) CONTROL OR INDICATOR</u>	<u>FUNCTION</u>
1	MAIN LINE ON/OFF switch and circuit breaker.	In the "ON" position this switch applies ac power to the amplifier and provides line overload protection.
2	H.V. ON/OFF switch and circuit breaker.	The H.V. Line switch must be switched on before voltage can be applied to the final plates. It also provides overload protection when tripped by excessive PA plate current.
3	TRANSMITTER PLATES ON/STANDBY-REMOTE switch.	When in the STANDBY-REMOTE position, the switch keeps the H.V. Line interlock relay K102 de-energized. The contacts of relay K101 in parallel with S103 produce the same effect when K101 is remotely energized. Switching S103 ON or energizing K101 in turn energized K102. As a result the high voltage and screen grid voltage are applied to the final PA tubes.
4	MAIN LINE ON/OFF indicator.	Indicates when the main line switch is on.
5	H.V. LINE ON/OFF indicator.	Indicates when the H.V. line switch is on.
6	H.V. overload indicator	Indicates when the H.V. circuit breaker has tripped due to overload.
7	P.A. PLATES ON/STANDBY indicator.	Indicates when the H.V. is applied to the final PA tubes.

TABLE 3-1. OPERATOR CONTROLS AND INDICATORS (continued)

INDEX NO.	RFE-2-4 (See Fig. 3-1a) CONTROL OR INDICATOR	FUNCTION
1	MULTIMETER.	Multimeter scale indications are as follows: ISG - PA screen grid current PA HV - PA high voltage FIL - PA filament voltage DR -- RF drive to PA stage RF PL - PA plate voltage OUT - RF output voltage
2	CHANNEL switch.	Selects channel of operation (1, 2, 3 or 4) or in REMOTE position allows channel to be selected remotely.
3	PA PLATE meter.	This meter indicates PA plate current.
4	MULTIMETER switch.	Permits selective indication of the PA filament voltage, the PA screen grid current, the PA high voltage, the RF voltage at the output of the driver, the RF voltage at the plate and the output of the power amplifier.

3-2. INITIAL SET UP

Proceed as follows:

- (1) Turn "H.V. LINE SWITCH" off.
- (2) Turn "TRANSMITTER PLATES" switch to "STANDBY."
- (3) Turn multimeter switch to "PA FIL."
- (4) Turn "MAIN LINE" switch "ON."
- (5) Multimeter needle should point to "FIL. ADJ." mark, equivalent to 6 volts. If not, adjust "FIL. ADJ." control on rear.
- (6) Rotate bias potentiometers R213 and R221 and the ALDC potentiometer R228 to the fully anti-clockwise position. All these controls are located on the rear of the RFE-2-4 unit. See figure 2-1.

3-3. TUNING PROCEDURE

The tuning of the PAL-500-4 will be carried out using the following steps:

NOTE

STEPS 11 and 12 APPLY ONLY ON INITIAL TUNE-UP AFTER INSTALLATION. (UNLESS BIAS SETTINGS NEED RE-ADJUSTMENT).

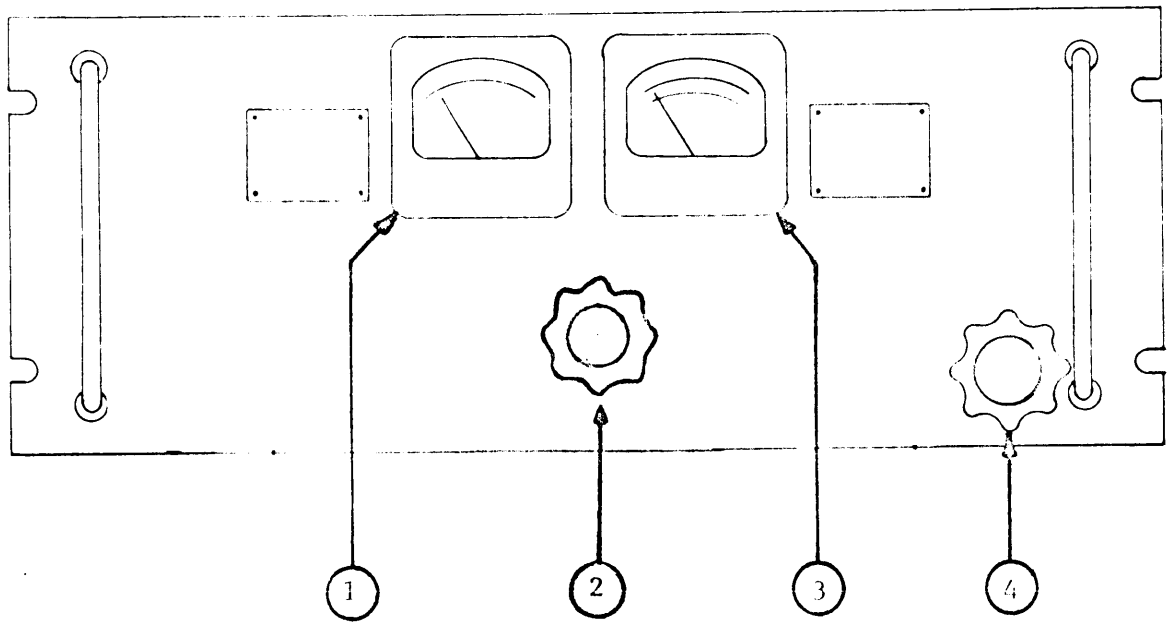


FIG. 3-1a PANEL CONTROLS RFE-2-4

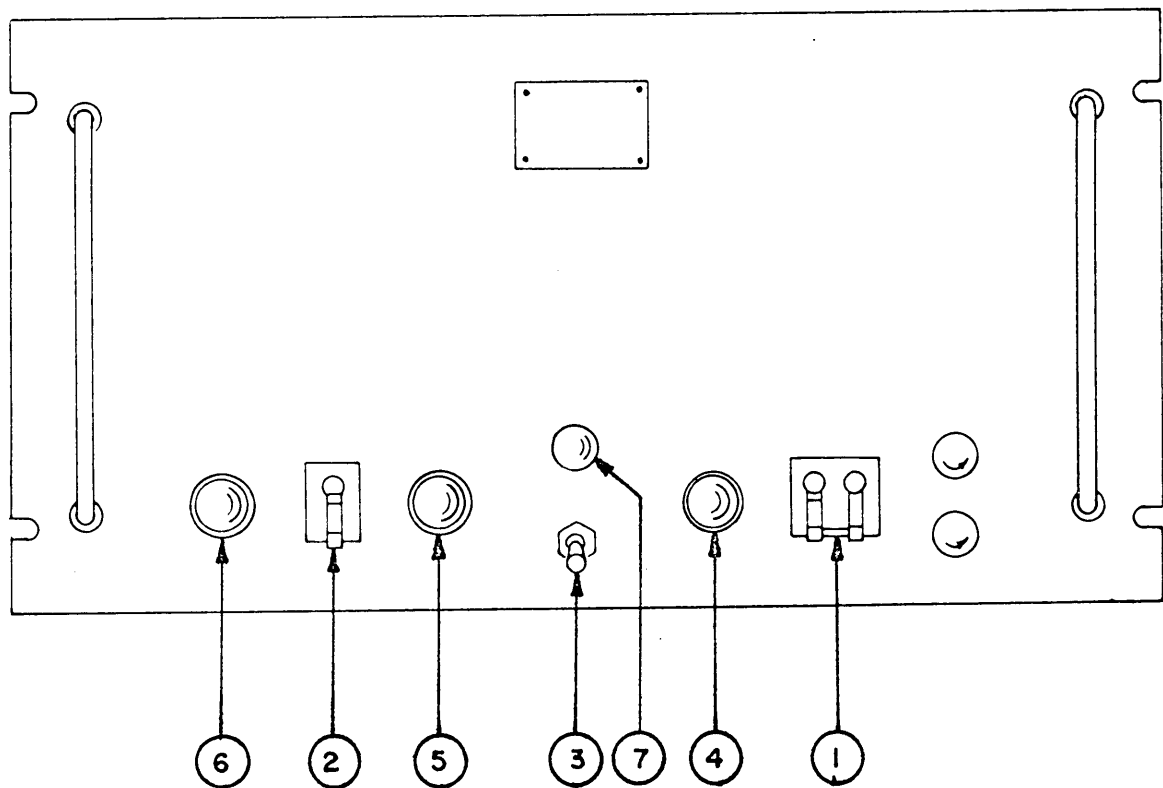


FIG. 3-1b PANEL CONTROLS PSP-500

1. Temporarily set the following controls in the positions located:
H.V. LINE - OFF
TRANSMITTER PLATES - STANDBY
2. Turn MAIN LINE switch ON.
3. Turn MULTIMETER switch to PA FIL. Meter needle should point to "FIL. ADJ." mark (equivalent to 6 volts). If it does not, adjust FIL, ADJ. on rear of RFE-2-4 chassis.
4. Set the CHANNEL switch to the desired output channel.
5. Set the MULTIMETER switch to RF DR.
6. Turn the associated exciter on and tune to (or select) the desired output frequency and mode of operation. Adjust exciter output for very low output level. Consult the associated technical manual for the exciter operation.
7. Turn the TRANSMITTER PLATES switch ON.
8. Observe the multimeter and insure that the reading is below 20 on the meter. Readjust exciter gain as necessary.
9. Reduce the exciter output to zero; check to make sure load or antenna is connected to J205. (Output).
10. Turn the high voltage switch on.
11. Switch multimeter to read high voltage. Reading at this point will be 3000 volts approximately.
12. Switch on Plate Switch. Slowly adjust potentiometer R213 until V203 is drawing 125 ma plate current, using plate current meter as the indicator. Adjust R221 until total plate current V203 and V204 is 220 ma.
13. Apply drive slowly from the exciter while observing the PA PLATE meter. The drive level will be correct when the meter indicates 300 ma of PA plate current.
14. Increase exciter drive until desired output power is achieved. (Typical MULTIMETER readings are shown in Tables 3-2, 3-3 and 3-4).

NOTE

If at any time during the tuning procedure an amplifier shows signs of instability or self oscillation, it should be neutralized as described in the maintenance section of this handbook.

TABLE 3-2. SINGLE TONE CW MODE

<u>SWITCH POSITION</u>	<u>READING</u>	<u>VALUE</u>
ISG	-5	-5ma
RF DR	45	45 V
RF PL	0.7	700 V
RF OUT*	1.2	120 V

PA PLATE METER 300 ma

TABLE 3-3. SINGLE TONE INPUT

<u>SWITCH POSITION</u>	<u>READING</u>	<u>VALUE</u>
ISG	-10	-10ma
RF DR	10	10 V
RF PL	.7 KV.	700 V
RF OUT*	1.2	120 V

PA PLATE METER 340 ma

TABLE 3-4. TWO TONE INPUT

<u>SWITCH POSITION</u>	<u>READING</u>	<u>VALUE</u>
ISG	-8 to -10	-8 to -10ma
RF DR	8 to 15	8 to 15 V
RF PL	.85 KV.	850 V
RF OUT*	1.6	160 V

PA PLATE METER 380 ma

*RF output measurements can indicate a wide range of voltages since the actual loading of an antenna may involve a great variety of impedances and reactances. Values are for a 50 ohm load.

3-4. OPERATOR'S MAINTENANCE

CAUTION

NEVER REPLACE A FUSE WITH ONE OF A HIGHER RATING UNLESS BRIEF CONTINUED OPERATION IS MORE IMPORTANT THAN PROBABLE DAMAGE TO THE EQUIPMENT. IF A FUSE BURNS OUT IMMEDIATELY AFTER REPLACEMENT, DO NOT REPLACE IT A SECOND TIME UNTIL THE CAUSE HAS BEEN LOCATED AND CORRECTED.

The PSP-500-4 Power Supply contains 5 protective devices.

The action of one or more of them will disable all or part of the PAL-500-4 system. they are as follows:

<u>SYM.</u>	<u>FUNCTION</u>	<u>IND.</u>
CB101	MAIN POWER SWITCH (CIRCUIT BREAKER)	DS101
F101	LV MAIN FUSE HV SWITCH	DS101
CB102	(CIRCUIT BREAKER)	DS103
S101	TOP COVER (INTERLOCK)	DS102-3
S102	BOTTOM COVER INTERLOCK	DS102-3

The RFE-2-4 contains three protective devices:

<u>SYM.</u>	<u>FUNCTION</u>	<u>IND.</u>
S204	TOP COVER INTERLOCK	DS102-3
S205	BOTTOM COVER INTERLOCK	DS102-3
F201	FILAMENT FUSE	All heaters and Blower

In the event that any of the indicator lamps marked IND above should fail to light, check the protective device listed on the corresponding line or lines. If such action does not lead to the source of failure, check the lamp itself.

In most instances where a failure is experienced but not accompanied by a blown fuse or open switch, a faulty tube will be responsible. Trouble-some tubes are best found by the substitution method. Do not leave replace-

ment tubes in the equipment unless the originals are proven defective.

WARNING

THE VOLTAGES USED IN THIS EQUIPMENT ARE SUFFICIENTLY HIGH TO ENDANGER LIFE. ALL PERSONNEL ARE ADVISED TO BE THOROUGHLY FAMILIAR WITH THESE UNITS BEFORE TROUBLE-SHOOTING THEM IN A POWER-ON CONDITION. ALWAYS USE CAUTION.

SECTION 4

PRINCIPLES OF OPERATION

4-1. LINEAR POWER AMPLIFIER MODEL RFE-2-4

The RFE-2-4, which operates as a class AB1 linear amplifier, uses a pair of 4CX350A beam power amplifiers in parallel to a pi network to provide an unbalanced output of 50 or 70 ohms. The final amplifiers are driven by a pentode driver stage which employs R.F. feedback to improve the linearity. The driver stage is preceded by an automatic load and drive control (ALDC) to limit the distortion produced when high peaks or load changes occur.

The RFE-2-4 requires less than 100 milliwatts excitation to produce full output. A choice of input connections is provided to accommodate inputs between 100 milliwatts and 1 watt. The output connections on the RFE-2-4 consist of a type C coaxial connector providing full R.F. output, and a BNC connector providing 1/300th of the R.F. output for monitoring purposes. The monitoring output may be terminated in any resistive load of 50 ohms or higher.

The unit has four separate fixed frequency channels. The frequencies for the channels are customer selected, but within the range of 2-32 mcs.

Complete metering facilities are provided by a MULTIMETER and a PA PLATE meter, the functions of which are explained under CONTROLS and INDICATORS, Table 3-1.

Referring to the RFE schematic Figure 7-1 contained at the rear of this manual, it will be seen the drive can be applied to either J202 or J203, depending upon the level of excitation available. The Signal is coupled via C212 to the grid of the control amplifier V201, 6CL6. The screen grid of this amplifier is directly grounded. However, since the cathode is -150 V, with respect to the chassis, and the plate 150 Volts positive, the screen grid

is 150 Volts positive with respect to the cathode and 150 Volts negative with respect to the plate. The plate circuit has a parasitic suppressor, PS201, the signal being coupled via C282 to the appropriate tuned circuit selected by S201 A and B for the frequency of operation. Plate voltage for V201 is applied via network L201, L202 and feed-through decoupling capacitor C279. ALDC is applied to this first stage in the form of bias derived from the ALDC rectifier CR202 (See simplified schematic ALDC circuit, Figure 4-5).

Coupling of the driver stage V202 is via C221 to grid of V202. A grid stopper resistor in this grid helps to stabilize the stage. The driver stage plate circuitry is almost identical to the previous stage with the signal being coupled to the final amplifier tubes V203 and V204 grids via C240 and C243. Neutralization of the driver stage is achieved by feeding back a small amount of signal voltage from the plate of the driver tube V202 via driver neutralizing capacitor C223 to the grid circuit.

The final amplifier is a pair of parallel connected 4CX350A beam tetrodes V203 and V204. The screen grids are operated at a regulated potential of 360 Volts positive. The plates having 2000 Volts positive applied. Bias for each of the two tubes is adjustable by means of R213, R221, from the rear of the unit. The grid leads having parasitic suppressors PS203, PS203 directly at the grid pin of each tube. The plate is tuned by a "PI" Network tank circuit. The output of the unit is brought out through J205. A small portion of the output (1/300th) appears at the monitor output jack J204. This is derived from the capacitive divider C274 and C275. Another capacitive divider across the output comprising C277 and C278 is used for the RF output metering circuit. Other metering of this stage includes metering of RF drive voltage, RF plate voltage, B+ and filament voltages, screen and plate current metering (See simplified metering circuit schematic, Figure 4-6).

The final tubes are forced air cooled by blower B201, through the air system sockets of V203, V204. It is essential to have the R/F section bottom cover in place at all times while the unit is operating.

Neutralization of the final amplifier stage is effected by C214 (adjustable from rear of unit).

4-2. POWER SUPPLY MODEL PSP-500 (Refer to PSP schematic Figure 7-2)

a. High Voltage

This supply is of a conservative design containing high voltage silicon rectifier stacks. Rectification is full wave and is followed by a choke input filter network providing a plate voltage of 2000 volts to the final RF stage. Excellent regulation of the power supply is maintained due to the low internal impedance of the silicon rectifiers.

b. Low Voltage

The lower voltage power supply contains a silicon diode, full wave rectifier. This supply provides a voltage of 150 volts to the plates of the ALDC and driver stages, a voltage of -150 volts (regulated) bias voltage for the final amplifier, and screen voltage to the driver stage.

c. Input Voltage

The equipment is wired for operation on 115 volt, 50/60 cycle power line supply. 230 volt, 50/60 cycle operation may be had on special order or by following the instructions provided on the RFE-2-4 and PSP-500 schematic diagrams.

d. Overload Control Circuit

The plate overload breaker removes the high B+ voltage when the current drawn from the high voltage supply becomes excessive, thus protecting the final amplifier tubes.

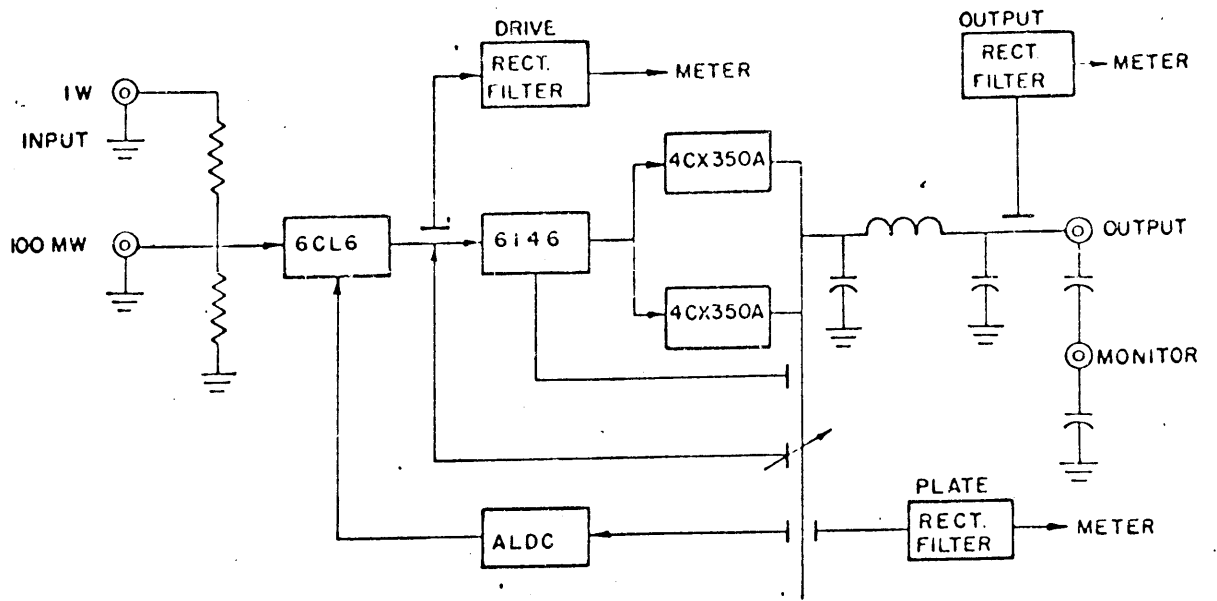


Figure 4-1. Simplified Block Diagram

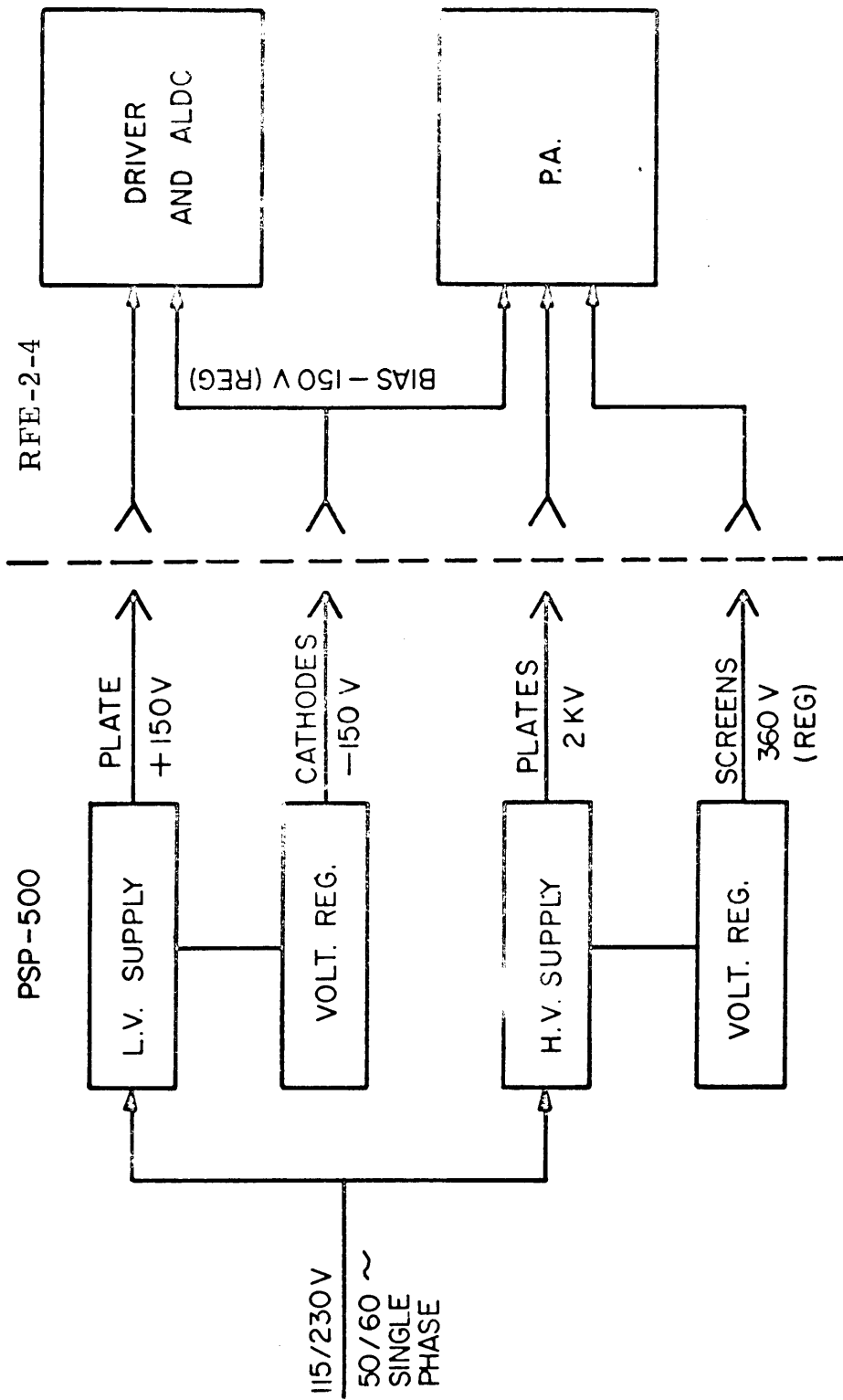


Figure 4-2. Simplified Block Diagram PAL-500-4

SECTION 5
MAINTENANCE

5-1. GENERAL

The Model PAL-500-4 (PSP-500 and RFE-2-4) is designed to provide trouble-free operation under continuous duty conditions. It is recommended that any necessary maintenance be undertaken by competent technicians familiar with linear RF amplifier-transmitter techniques.

5-2. PREVENTIVE MAINTENANCE

(1) To prevent failure of the equipment due to corrosion, dust, or other destructive elements, it is recommended that a schedule of preventive maintenance be established and adhered to.

(2) At periodic intervals (at least every six months) the equipment should be removed from the rack or enclosure for cleaning and inspection. All accessible covers should be removed and all terminal boards, wiring harnesses, tube sockets, etc. should be inspected for dirt, corrosion, charring, or grease. Dust can be removed with a soft brush or vacuum cleaner if one is available. Remove dirt or grease from electrical parts with trichlorethane.

(3) Carefully inspect soldered connections and machine screw fastenings for looseness and corrosion. Inspect ceramic insulators for cracks and dirt. Never use an acid core solder when making repairs.

5-3. CORRECTIVE MAINTENANCE

a. General

Before any alignment or internal adjustment of the equipment is attempted it should be established that all tubes and fuses are in working order. See Operator's Maintenance, paragraph 3-4, section 3, for instructions.

b. Initial Power Checks

- (1) Replace covers on the PSP-500 power supply.
- (2) Reconnect cable from PSP-500 to RFE-2-4.
- (3) Close the interlocks, S204 and S205, of the RFE-2-4 by pulling their shafts outward.
- (4) Be sure that HV LINE switch is off.
- (5) Turn MAIN LINE breaker ON. See that tube filaments light.
- (6) Rotate the MULTIMETER switch through all its positions. The multimeter pointer should deflect only when switch is in the FIL position.
- (7) Adjust R216, FIL ADJ. pot on the rear skirt of the RFE-2-4 chassis, if necessary, so that multimeter reading is at the Red Mark.
- (8) Bias controls R213 and R221 must be turned fully counter clockwise.
- (9) Measure the voltage from pin C of V203 to ground. About -50 volts dc should be indicated with transmitter plates switch ON.
- (10) Voltage measured from pin 2 of V201 to ground must be -143 to -157 volts dc.
- (11) Use a reliable VTVM to see that the following voltages are as indicated:

<u>FROM</u>	<u>TO</u>	<u>DC VOLTAGE</u>
Plate Cap. V202	Ground	90 to 150
Pin 6 of V201	Ground	90 to 150
Pin 3 of V202	Ground	40 to 70
Pin 4 of V202	Ground	-120 to -130
Pin 5 of V202	Ground	-140 to -150
Pin 2 of V201	Ground	-145 to -155
Pin 1 of V201	Ground	-140 to -150

- (12) Turn power off and replace cover on the RFE-2-4 RF deck.

c. Driver Section Alignment

- (1) Any of the following capacitors which have been replaced or accidentally misadjusted should be set to their center values (approximate): C203, C204 or C223.

- (2) See that TRANSMITTER PLATES and HV LINE switches are OFF.

Turn the MAIN LINE switch ON.

- (3) Pull out the Cover Interlock switches (S204, 205) and wait three minutes.

- (4) Turn the MULTIMETER selector switch to the FIL position; adjust R216 if the meter needle is not at the FIL.ADJ. mark.

- (5) Set the MULTIMETER switch to the RF DR position.

- (6) Turn the CHANNEL switch to position 1.

- (7) Adjust the associated exciter to apply low level drive at channel 1 frequency.

- (8) Tune T201 and T204 of the RFE-2-4 for a peak reading on the MULTIMETER while adjusting the drive to keep meter readings below 20 volts.

- (9) Remove drive. If the MULTIMETER continues to read, readjust C223 and repeat step 8 (above) until there is no sustained reading when drive is removed. This must be repeated until the desired results are achieved.

- (10) Reduce the exciter output level temporarily to minimum.

- (11) Set the CHANNEL switch of the RFE-2-4 to position 2.

- (12) Adjust the exciter to apply low level drive at channel 2 frequency.

- (13) Tune T202 and T205 for peak indication on the MULTIMETER while controlling the exciter output to keep meter readings below 20 volts as before.

- (14) Remove drive. If the multimeter continues to read readjust C223 as before and repeat procedure starting with step 8.

- (15) Set the CHANNEL switch to position 3.

- (16) Adjust the associated exciter to apply low level drive at channel 3 frequency.

- (17) Tune T203 and T206 of the RFE-2-4 for a peak reading on the MULTIMETER while adjusting the drive to keep meter readings below 20 volts.

(18) Tune trimmer C204 for peak indication on the MULTIMETER; maintain a meter reading of less than 20 volts by use of the exciter output drive control.

(19) Remove drive. If the MULTIMETER continues to read, readjust C223 and repeat procedure beginning with step number 8 until there is no sustained reading when drive is removed.

(20) Adjust associated exciter to apply low level drive at channel 4 frequency.

(21) Tune L208 and T207 for peak indication on the MULTIMETER while controlling the exciter output drive to keep the meter readings below 20 volts.

(22) Tune trimmer C203 for a peak indication on the MULTIMETER while again keeping the reading below 20 volts by use of the exciter output drive control.

(23) Remove drive. If MULTIMETER continues to read, readjust C223 and repeat procedure beginning with step number 8 until there is no sustained reading when drive is removed.

5-4. NEUTRALIZATION

The neutralization procedures for this transmitter are carried out before shipping, and it should not normally be necessary to readjust in the field. Should it be found necessary for example in the event of a tube change, then the following procedure should be adopted.

It should be noted at this point that there are two stages in the PAL-500-4 which require neutralizing, i.e. the driver stage V202 and the final stage V203 and V204. The driver stage neutralizing is described fully in the section on driver alignment.

a. Neutralization of P.A.

WARNING

BE CERTAIN THAT THE HIGH VOLTAGE OVERLOAD BREAKER STAYS IN OFF POSITION THROUGHOUT THE NEUTRALIZATION PROCESS.

- (1) Turn ALDC ADJ. to extreme counter clockwise position.
- (2) Connect AC VTVM to the plates of power amplifiers.
- (3) Disconnect lead from C215. (Feed back loop).
- (4) Short H.V. supply across C249 with a length of wire. Turn on transmitter plates switch.
- (5) Apply drive from an exciter (single tone) and adjust the drive control to 20 volts on multimeter.
- (6) Adjust P.A. neutralizing capacitor C214 for a peak indication on the VTVM for approximately 0.9 vrms.
- (7) Disconnect VTVM and remove drive.
- (8) Turn off the transmitter plates switch.
- (9) Remove short across H.V. supply.
- (10) Connect the feedback cable to C215.

Parts List Model PSP-500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C101	CAPACITOR: fixed, paper 4 uf, 600 VDCW	CP41B1FF405K
C102	Same as C101	
C103	CAPACITOR: electrolytic 50 uf, 50 VDCW	CE63C500G
C104	CAPACITOR: fixed, paper 4 uf, 3000 VDCW	CP70E1FL405K
C105	Same as C104	
C106	Same as C104	
C107	CAPACITOR: fixed, 0.1 uf, 600 V.	CN100-22
C108	CAPACITOR: fixed, paper, 2 uf, 600 V.	CP53B1EF205K
C109	Same as C108	
C111	CAPACITOR: fixed, disc .05 uf, 600 V.	CC10006
C112	Same as C111	
CB101	CIRCUIT BREAKER: Two Pole, 15/7.5 A.	SW298
CB102	CIRCUIT BREAKER: Single Pole 100 ma	SW215
CR101	RECTIFIER: silicon	RX10004
CR102	Same as CR101	
CR103	RECTIFIER: High Voltage Stack, 1.5 A, 12 KV PIV	DD10002
CR104	Same as CR103	
CR105	DIODE: Zener, 150V, 5%, 10 W. Reversed Polarity	1N3011RE
CR106	DIODE: Zener, 180V, 5%, 10 W	1N3014B
CR107	Same as CR106	
F101	FUSE: Slow Blow, 1/2 A, 250 V.	FU102-.5
F101	FUSE: Slow Blow, 1 A, 250 V.	FU102-1
F101	FUSE: Slow Blow, 1/2 A, 250 V.	FU102-.5

Parts List Model PSF-500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
F101	FUSE: Slow Blow, 1 A, 250 V.	FU102-1
DS101	LAMP: Incandescent, D.C. Bayonet, 3 W, 120 V.	BI102-3
DS102	Same as DS101	
DS103	Same as DS101	
DS104	LAMP: Neon Glow, miniature, 1/25 W.	BI100-51H
J101	RECEPTACLE: Twist Lock, Male	JJ175
J102	RECEPTACLE: Connector, Female	JJ158-S
K101	RELAY: Sensitive, 200 mw, 2500 ohms, DPDT	RL10032
K102	RELAY: Power, 115 VDC, 3 P, NO	RL10033
L101	REACTOR: filter, 15 H, 100 ma	TF50C0
L102	Same as L101	
L103	REACTOR: Filter, 7 H, 300 ma	TF190
R101	RESISTOR: fixed, composition, 2200 ohms, 5%, 2 W.	RC42GF222J
R102	RESISTOR: fixed, WW 10K ohms, 10 W.	RW109-34
R103	RESISTOR: fixed, composition, 100K ohms, 5%, 2 W.	RC42GF104J
R104	RESISTOR: fixed, WW 5000 ohms, 10 W.	RW109-32
R105A	RESISTOR: fixed, WW 80K ohms, 50 W.	RW105-48
R105B	Same as R105A	
R106	RESISTOR: fixed, composition, 56 ohms, 5%, 2 watt	RC42GF560J
R107	RESISTOR: fixed, WW, 100K ohms, 20 W.	RW110-43
R109	RESISTOR: fixed, composition, 20 megohms, 5%, 2 watt	RC42GF206J
R110	Same as R109	

Parts List Model PSP-500

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R111	Same as R109	
R112	Same as R109	
R113	Same as R109	
R114	RESISTOR: fixed, composition, 220K ohms, 5%, 2 watt	RC42GF224J
R115	RESISTOR: fixed, WW 20 ohms, 5 W.	RW107-11
R116	RESISTOR: variable, WW 100 ohms, 25 W.	RA75AXA101AK25
R117	RESISTOR: fixed, composition, 43 ohms, 5%, 2 watt	RC42GF430J
R119	RESISTOR: fixed, composition, 18K ohms, 5%, 1/2 watt	RC20GF183J
R120	RESISTOR: fixed, WW 50 ohms, 25 W.	RW111-7
R121	Same as R120	
R122	RESISTOR: fixed, WW 10 ohms, 3 W.	RW123-100J
R123	Same as R122	
S101	SMITCH: Interlock	SW219
S102	Same as S101	
S103	SWITCH: Toggle DPST	ST22K
T101	TRANSFORMER: Power PRI: 115/230 VAC SEC: 810 VCT, 100 ma	TF10027
T102	TRANSFORMER: Power PRI: 115/230 VAC SEC: 4800 VCT, 300 ma	TF189
XDS101	SOCKET: Lamp, D.C. Bayonet, Green Jewel	TS124-2
XDS102	SOCKET: Lamp, D.C. Bayonet, Red Jewel	TS124-1
XDS103	SOCKET: Lamp, D.C. Bayonet, Yellow Jewel	TS124-6
XDS104	SOCKET: Lamp, Miniature Bayonet, White Jewel	TS10007-9-5
XF101	HOLDER: Fuse	FH103

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
B201	BLOWER: air	BL-100
	FILTER: air	AD102-4
C201	CAPACITOR: fixed, mica	CM111E130J5S
C202	CAPACITOR: fixed, mica	CM111E300J5S
C203	CAPACITOR: trimmer 4-30 uuf	CV11C300
C204	Same as C203	
C205	CAPACITOR: fixed, mica	CM111E111J5S
C206	CAPACITOR: fixed, feed thru, 2000 mmf	CK70AW202M
C207	Same as C202	
C208	Same as C202	
C209	CAPACITOR: button mica, 1000 mmf	CB21QW102K
C210	Same as C202	
C211	Same as C205	
C212	CAPACITOR: mica, 1600 mmf	CM-100-11
C213	CAPACITOR: variable air, 6.9-46 uuf	CB103-2
C214		
C215	CAPACITOR: fixed ceramic	CC109-6
C216	CAPACITOR: fixed ceramic	CC109-2
C217	CAPACITOR: fixed ceramic	CC109-38
C218	Same as C209	
C219	CAPACITOR: button mica	CB21QW151K
C220	CAPACITOR: mica	CM20F102J
C221	Same as C220	
C222	CAPACITOR: button mica	CB21QW471K

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C223	CAPACITOR: trimmer 1.5 — 7 uuf	CV-11A070
C224	Same as C209	
C225	Same as C206	
C226	Same as C206	
C227	CAPACITOR: Mylar, 0.1 mfd	CN108C1003J
C228	CAPACITOR: mica, .01 mfd	CM35C103J03
C229	Same as C206	
C230	Same as C209	
C231	CAPACITOR: fixed, electrolytic, 50 mfd	CE63C500G
C232	Same as C220	
C233	Same as C209	
C234	Same as C228	
C235	CAPACITOR: fixed, ceramic, 3 mmf	CC21SL030C
C236	Same as C219	
C237	Same as C209	
C238	Same as C209	
C239	Same as C209	
C240	Same as C220	

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C243	Same as C220	
C244	Same as C209	
C245	Same as C209	
C246	Same as C209	
C247	Same as C217	
C248	Same as C209	
C249	Same as C217	
C250	Same as C209	
C251	Same as C228	
C252	Same as C206	
C253	Same as C206	
C254	Same as C206	
C255	Same as C206	
C256	Same as C206	
C257	Same as C206	
C258	Same as C206	
C259	Same as C206	
C260	Same as C206	
C261	Same as C206	
C262	Same as C206	
C263	Same as C206	
C264	Same as C206	
C265	Same as C228	

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C266	Same as C228	
C267	Same as C228	
C268	CAPACITOR: paper, 1 mfd.	CP69B1EF105K
C269	Same as C227	
C270	Same as C227	
C271	Same as C228	
C272	Same as C227	
C273	Same as C213	
C274	Same as C209	
C275	CAPACITOR: fixed, ceramic HV, 3 mmf	CC-109-1
C276	Same as C213	
C277	CAPACITOR: fixed, ceramic HV, 10 mmf	CC-109-5
C278	Same as C219	
C279	Same as C206	
C280	Same as C206	
C281	CAPACITOR: mica, 100 mmf.	CM15F101G03
C282	Same as C220	
C283	Same as C209	
C284	Same as C206	
C285	Same as C206	

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C286	Same as C213	
C287	Same as C213	
C288	Same as C276	
C289	Same as C276	
C290	CAPACITOR: fixed ceramic	CC109-37
C291	Same as C290	
C292	Same as C290	
C293 thru C297	Same as C217	
CR201	DIODE: silicon, 1N303	1N303
CR202	Same as CR201	
CR203	Same as CR201	
CR204	DIODE: sccond, dev	1N645A
CR205	Same as CR204	
CR206 thru CR213	DIODE: sccond dev	1N712
CR214	DIODE: sccond dev	1N547
CR215	Same as CR214	
F201	FUSE: slow-blow 1 amp 250V	FU102-1
F201	FUSE: 1/2 amp 230V	FU102-.5
J201	CONNECTOR: receptacle male	JJ158-P
J202	CONNECTOR: receptacle, BNC	UG625/U
J203	Same as J202	
J204	Same as J202	
J205	CONNECTOR: receptacle, C	UG568*/U

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L201	INDUCTOR: RF, encapsulated, 120 uh	CL-10006-6
L202	Same as L201	
L203	Same as L201	
L204	Same as L201	
L205	Same as L201	
L206	INDUCTOR: RF, encapsulated, 680 uh	CL-10006-7
L207	COIL: RF, 50 uh	CL-10013
L208	COIL: tunable, 16-32 Mc/s driver	CL-10029-1
L209	Same as L201	
L210	INDUCTOR: RF, encapsulated, 27uh	CL-10006-2
L211	Same as L206	
L212	COIL: RF, 50 uh	CL-10012
L213	Same as L206	
L214	Same as L210	
L215	Same as L201	
L216	Same as L201	
L217	Same as L201	
L218	Same as L210	
L219	INDUCTOR: RF, encapsulated, 8.5 uh	CL-10023-2
L220	Same as L219	
L221	Same as L210	
L222	Same as L206	
L223	Same as L219	
L224	Same as L219	
L225	Same as L210	
L226	INDUCTOR: RF, encapsulated, 1.0 uh	CL-10006-3

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
L227	Same as L206	CL10023-1
L228	Same as L201	
L229	Same as L201	
L230	Same as L201	
L231	Same as L201	
I 232	INDUCTOR: RF, encapsulated, 4.5 uh	
I 233	Same as L232	
I 234	Same as I.201	
L235	Same as L201	
L236	COIL: RF, 185 uh	
L237	Same as L201	
L239	Same as L210	
L240	Same as L210	
L241	Same as L210	
M202	MULTIMETER	
M201	METER: 500 ma	
PS-201	SUPPRESSOR: parasitic	
PS-202	SUPPRESSOR: parasitic	
PS-203	SUPPRESSOR: parasitic	
PS-204	Same as PS203	
R201	RESISTOR: fixed, composition,	
R202	RESISTOR: fixed, composition, 2200 ohm, ± 5%, 1/2 w.	RC20GF222J
R203	RESISTOR: fixed, composition, 8200 ohm, ± 5%, 1/2 w.	RC20GF822J

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R204	Not used	
R205	Same as R202	
R206	RESISTOR: fixed composition	RC42GF181J
R207	RESISTOR: fixed composition	RC20GF470J
R208	Same as R207	
R209	RESISTOR: fixed composition	RC20GF333J
R210	RESISTOR: fixed composition	RC20GF224J
R211	RESISTOR: fixed composition	RC20GF120J
R212	RESISTOR: fixed composition	RC42GF561J
R213	RESISTOR: variable	RV4LAYS A503A
R214	RESISTOR: fixed composition	RC32GF223J
R215	RESISTOR: fixed composition	RC32GF153J
R216	RESISTOR: variable wirewound	RA75AXAOR5AK25
R217	RESISTOR: fixed composition	RC32GF823J
R218	RESISTOR: fixed composition	RC42GF221J
R219	RESISTOR: fixed composition	RC42GF101J
R220	RESISTOR: fixed composition	RC20GF104J
R221	Same as R213	
R222	RESISTOR: fixed composition	RC20GF156J
R223	RESISTOR: fixed composition	RC20GF133J
R224	Same as R203	
R225	RESISTOR: fixed composition	RC20GF125J
R226	RESISTOR: fixed composition	RC20GF100J
R227	Same as R202	

Parts List Model RFE-2-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
R228	Same as R213	
R229	RESISTOR: fixed, composition	RC20GF473J
R230	RESISTOR: fixed, composition	RC20GF754J
R231	Same as R202	
R232	RESISTOR: fixed, composition	RC20GF332J
R233	RESISTOR: fixed, composition	RC32GF153J
R234	RESISTOR: fixed, composition	RC20GF272J
T201	COIL: tunable	CL10020
T202	COIL: tunable	CL10021
T203	COIL: tunable	CL10022
T204	Same as T201	
T205	Same as T202	
T206	Same as T203	
T207	COIL: tunable, tapped	CL10029-2
T208	TRANSFORMER: RF, fixed	TF-10020
T209	TRANSFORMER: RF	TF10019
T210	TRANSFORMER: power	TF180
V201	TUBE: 6CL6	6CL6
V202	TUBE: driver 6146	6146
V203	TUBE: PA 4CX350A	4CX350A
V204	TUBE: PA 4CX350A	4CX350A
XV201	SOCKET: tube 9 pin	TS103-PO1
XV202	SOCKET: tube, octal	TS101-PO1
XV203	SOCKET: tube, Air system	TS132
XV204	SOCKET: tube, Air system	TS132

Parts List Miscellaneous

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
P101	PLUG: twist Lock Female	JJ (Part of CA555-3)
P102	CONNECTOR: plug Male	PL160-P (Part of CA10136)
P201	CONNECTOR: Plug, female	PL160-5 (Part of CA10136)
P202	CONNECTOR: Plug, BNC	UG88*/U
P203	Same as P202	
P204	Same as P202	
P205	CONNECTOR: plug	UG573*/U
W101	CABLE: power	CA555-3
W102	CABLE:	CA10136-110

DRIVER BAND SWITCH
S201-A,B

POS.	BAND (Mc)
1	2-4
2	4-8
3	8-16
4	16-32

UNLESS OTHERWISE SPECIFIED
ALL RESISTORS ARE IN OHMS, 1/2 WATT
ALL CAPACITORS ARE IN μ F.
ALL COILS & TRANSFORMERS ARE IN μ H.

CHANGES NECESSARY TO CONVERT TO
230 V OPERATION
F201 CHANGED FROM 1AMP TO 1/2 AMP
T201 REMOVE JUMPERS MARKED
CONNECT A JUMPER BETWEEN
TERMINALS 2 & 3

* C241 & C242 ARE INTEGRAL PARTS
OF V203 & V204 SOCKETS

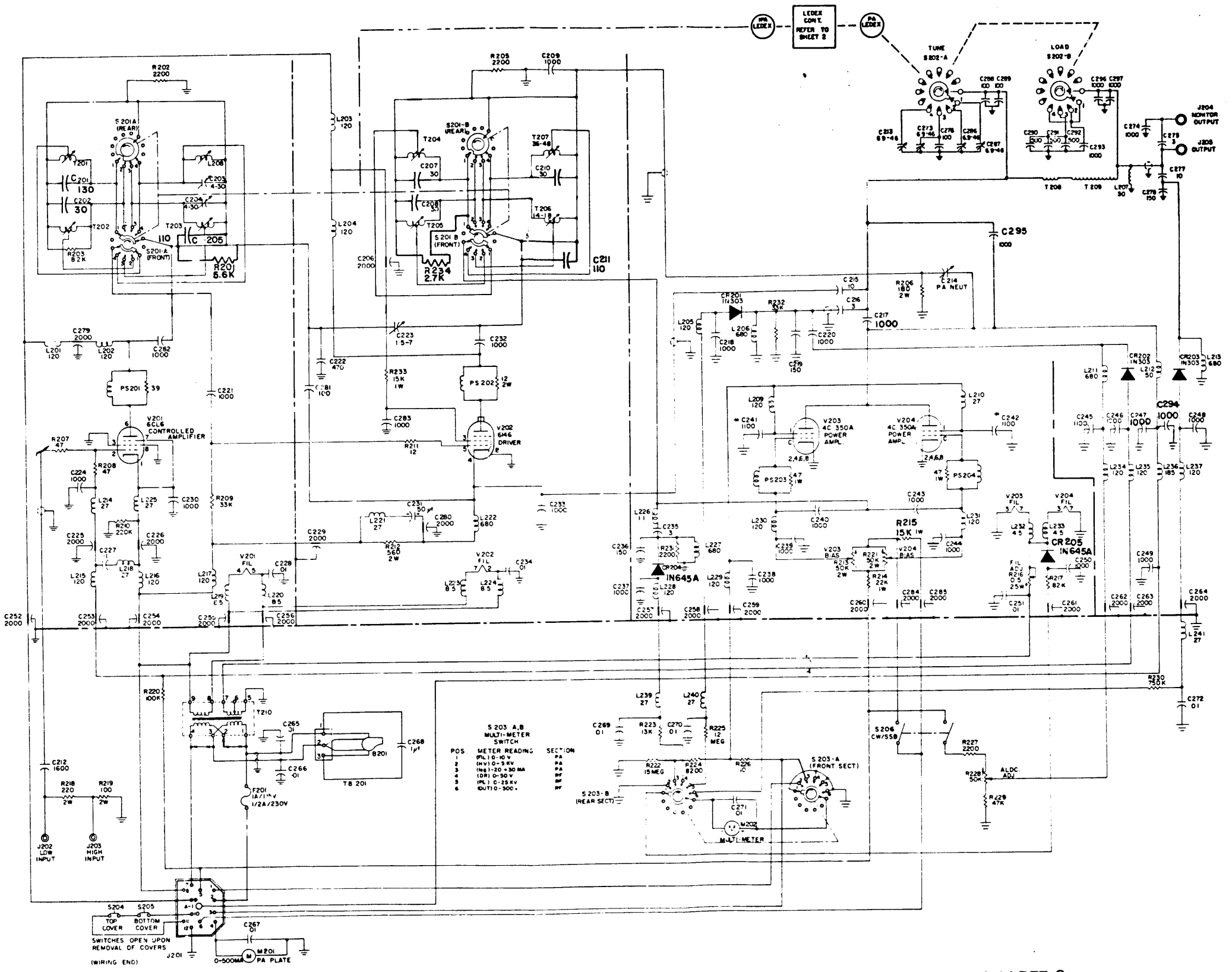


Figure 7-1. Schematic Diagram Model RFE-2

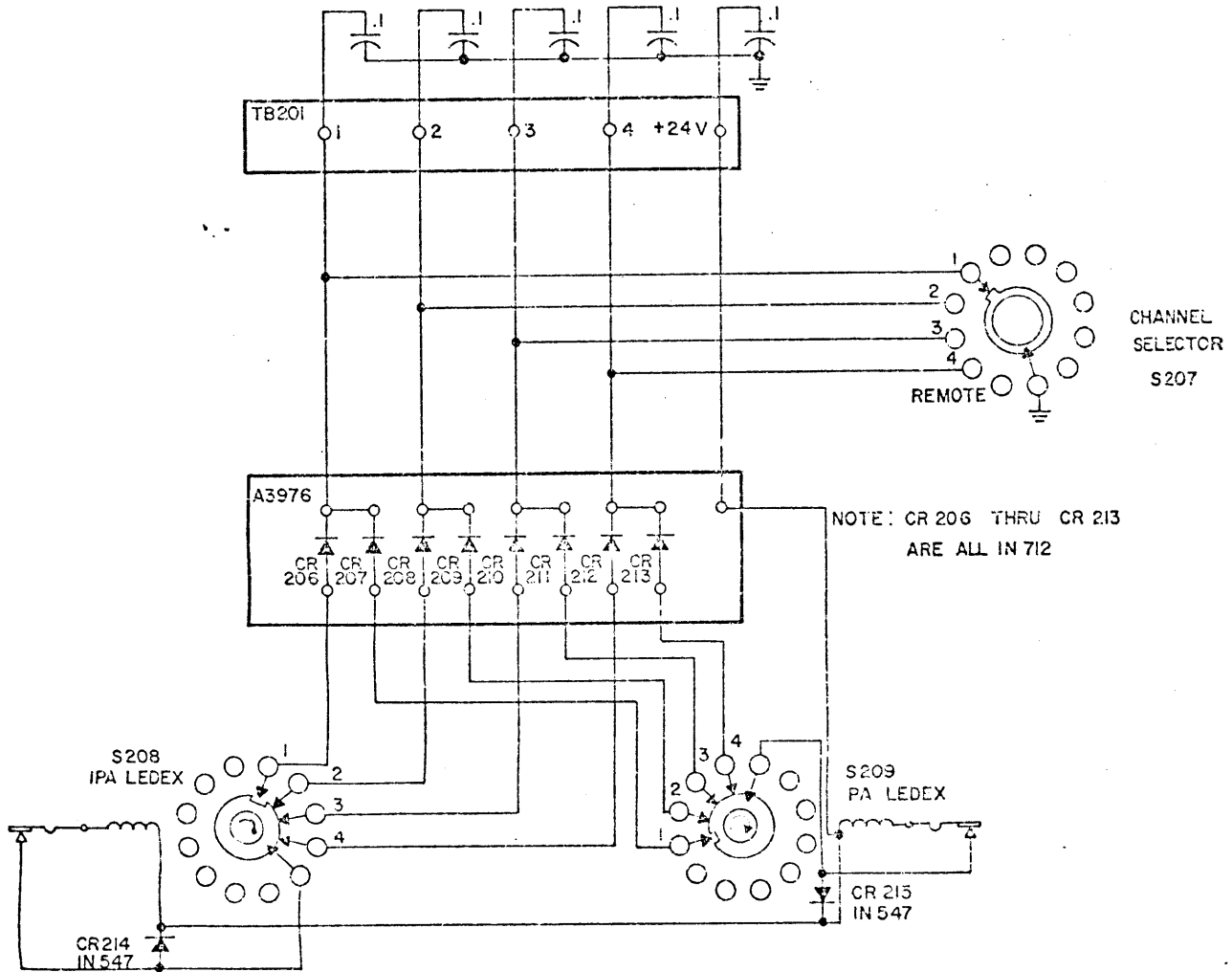
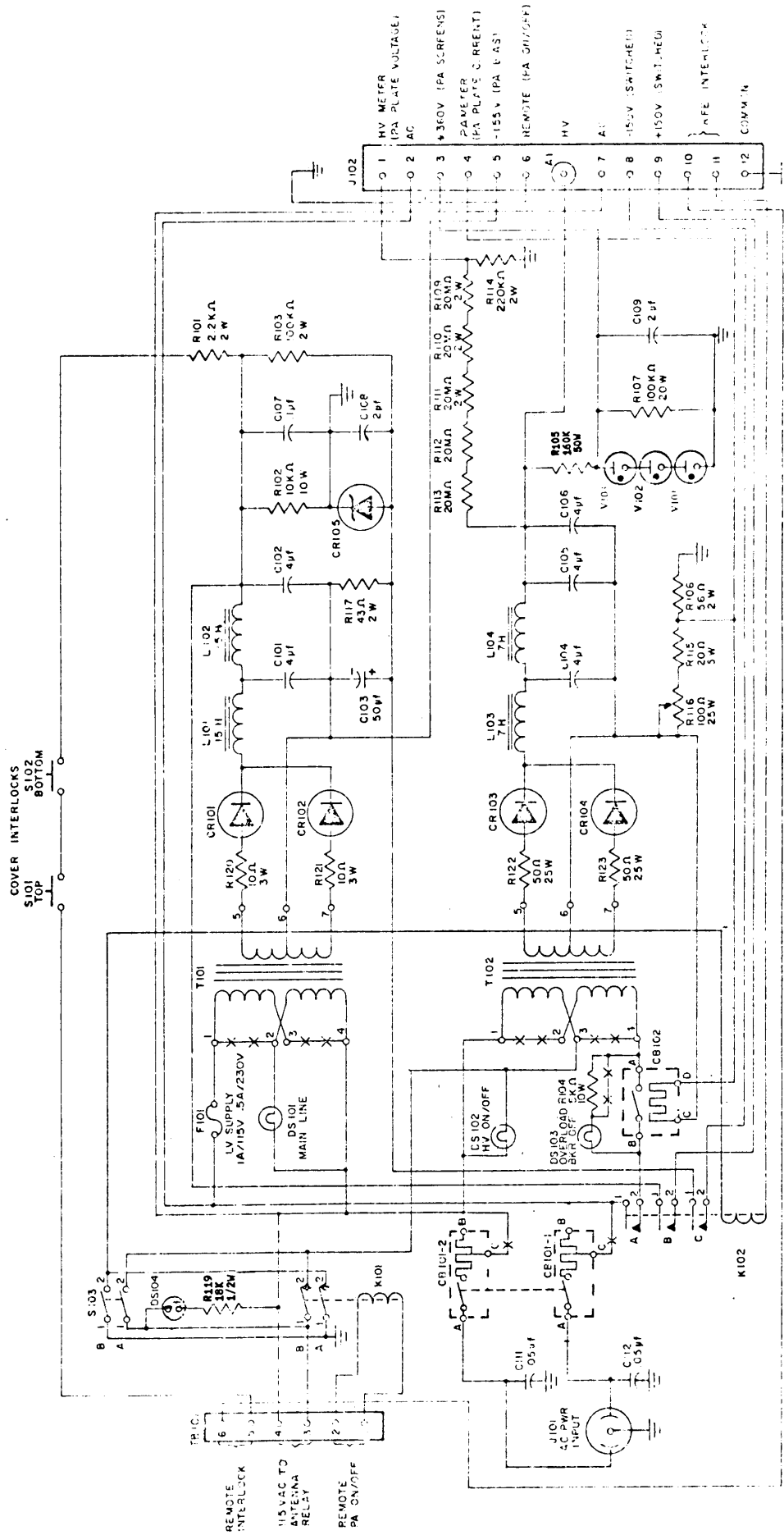


Figure 7-1. Schematic Diagram Model RFE-2
(Sheet 2)



COVER INTERLOCKS
S101 TOP
S102 BOTTOM

CHANGES NECESSARY TO CONVERT TO 230V OPERATION
 T101 REMOVE JUMPERS MARKED *-*-* AND CONNECT JUMPERS BETWEEN TERMINALS 2 & 3.
 T102 SAME AS T101.
 CB101 REMOVE LEADS FROM TERM "C" AND CONNECT TO TERM "B". (MARKED *-*)
 R104 REMOVE AND DISCARD JUMPER MARKED *-*.
 F101 CHANGE FROM 1AMP TO 1/2 AMP.

NOTES
 1- ALL FUSIBLES ARE 5/8" BLOW
 2- T101 TERMINALS 1, 6 & 7 ORIGINALLY NUMBERED UNLESS REMOTE INTERLOCK IS REQUIRED.

Figure 7-2. Schematic Diagram Model PSP-500