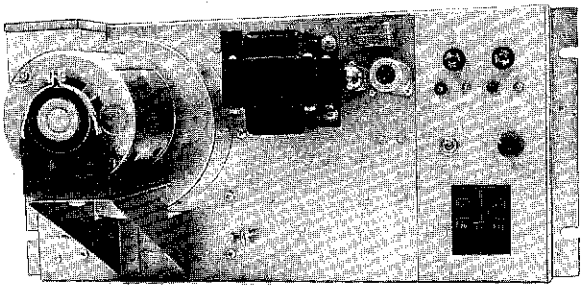
TB 702-6 TO 13.6V XDS2-2
TB 702-12 TO PTT - XDS2-1
MODIFICATIONS MADE TO ECS PW SUPPLY

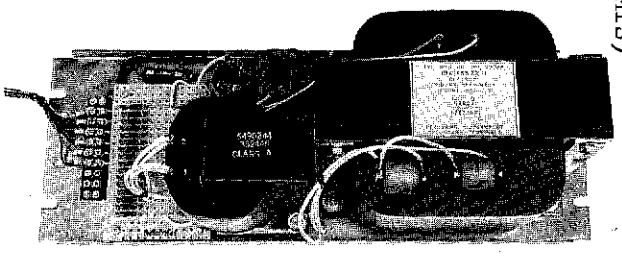
MOBILE RADIO

# MASTR® II

## RF POWER AMPLIFIER POWER SUPPLY 19D402530G1,G2



MAIN CHASSIS – FRONT VIEW



TRANSFORMER CHASSIS

19D402530G1,G2

### SPECIFICATIONS *

| | |
|---|---|
| Used With | Power Amplifiers<br>EF-4-A (25-50 MHz)<br>EF-5-A (144-174 MHz)<br>19D423414G1, G2 (406-512 MHz) |
| Power Input | 117 VAC ±20%, 50/60 Hz |
| Power Output | 2000 VDC @ 250 mA for PA Plate<br>300 VDC @ 25 mA for PA Screen<br>6 VDC @ 3 amperes for Filaments<br>140 VDC for Antenna Relay |
| Tubes | (1) 6680/12AU7 (clamper circuit) |
| Duty Cycle | Continuous |
| Temperature Range | -30°C to +60°C (-22°F to +140°F) |
| Dimensions (H x W x D)<br>Main Chassis<br>Transformer Chassis | <br>8-3/4" x 19" x 14-1/2"<br>7" x 19" x 8-1/2" |
| Weight<br>Main Chassis<br>Transformer Chassis | <br>31 pounds<br>57 pounds |

*These specifications are intended primarily for the use of the serviceman. Refer to the appropriate Specification Sheet for the complete specifications.

GENERAL ELECTRIC

# TABLE OF CONTENTS



## ILLUSTRATIONS



**WARNING**

No one should be permitted to handle any portion of the equipment that is supplied with high voltage; or to connect any external apparatus to the units while the units are supplied with power. KEEP AWAY FROM LIVE CIRCUITS.

## DESCRIPTION

General Electric Power Supply 19D402530G1, G2 supplies the filament, grid, antenna relay and high voltage to Power Amplifier Models 4EF4A1-3, 4EF5A1 and 19D423414G1, G2. The power supply consists of a main chassis and a transformer chassis, mounted separately in the station cabinet. The overall height of the two panels is 15-3/4".

Voltages provided by the power supply are:

- 2000 VDC -- B+ to PA
- 300 VDC -- PA screen grid
- 6 VDC -- Filaments and relays
- 140 VDC -- Antenna relay
- 8 VDC -- Drive relay (K454) on power supply chassis.

The high voltage output (2000 VDC) is taken from C451-1 and connected to PO#2 on the power amplifier through the station harness. The remaining voltages are fed to the power amplifier through a 4-wire cable (part of the PA) which connects to the power supply at J451.

Jacks are provided on the main chassis front panel to meter the grid current and filament voltage. The high B+ voltage is metered through the plate voltage meter located on the cabinet metering panel. Voltages are not exposed on the front side of the power supply panels. The rear cabinet door is interlocked for protection against exposure to high voltages. The high voltage indicator lamp illuminates when the high voltage supply is ON. The lamps turns off when the cabinet rear door is opened and the high voltage at C451-1 is discharged to ground by shorting bar S4.

The blower (BM451) is used to cool the PA tube and is mounted on the front of the power supply.

The main power supply chassis contains all circuit components with the following exceptions: Power transformer T452 cabinet blower thermostat K455, filament choke L451, fuse F452, resistors R457, R469, R1 through R32, capacitors C455, C456, C458, C459 and high-voltage supply rectifiers CR33 through CR36. These components are mounted on the transformer chassis.

## CIRCUIT ANALYSIS

The high side of the 117-VAC input to the Power Supply is connected to TB451-9 and 10, and the neutral side is connected to TB451-7 and -8. Switch S452 is the control voltage ON-OFF switch with fuse F451 (1 amp) in series with the line. S451 is the supply switch to the plate transformer and blower BM451.

Filament Supply (Figure 1 and Figure 2)

The filament power circuit supplies a regulated (±5%) 6 VDC to the EF-4-A and EF-5-A PA tube filaments.

With the Control Switch (S452) in the ON position, power is supplied to the primary of the filament voltage transformer T451. The output across the two brown secondary wires of T451 is rectified by a

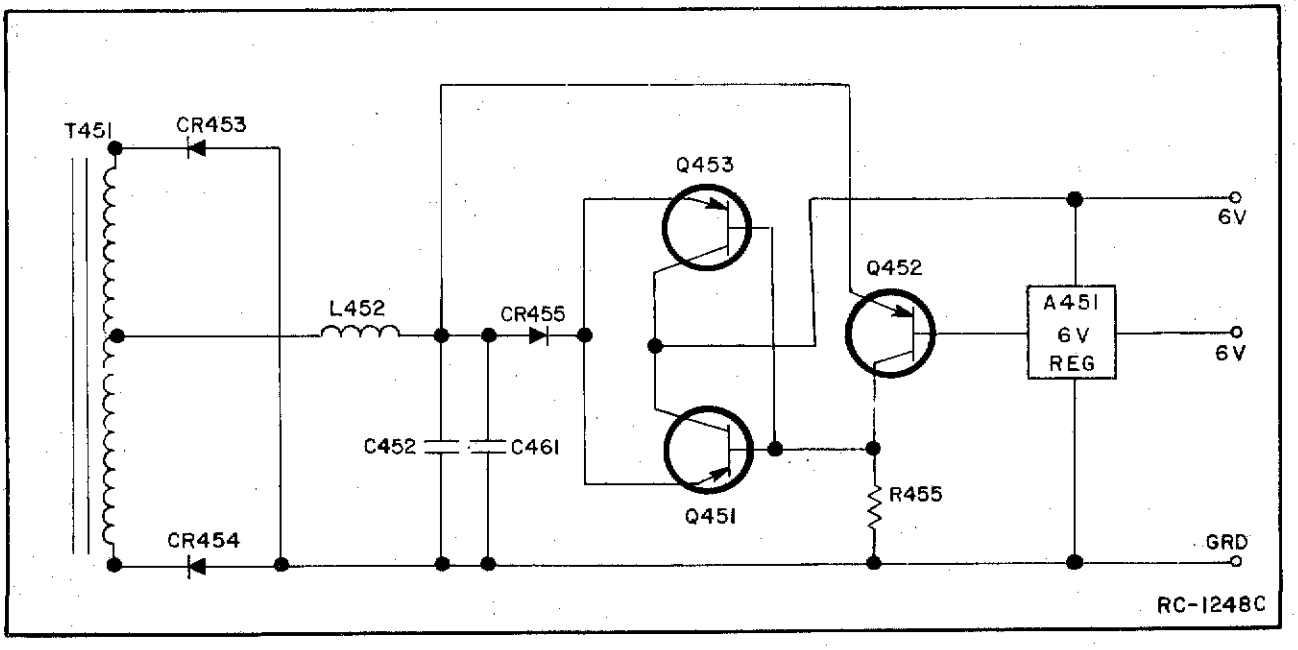



Figure 1 - Filament Supply

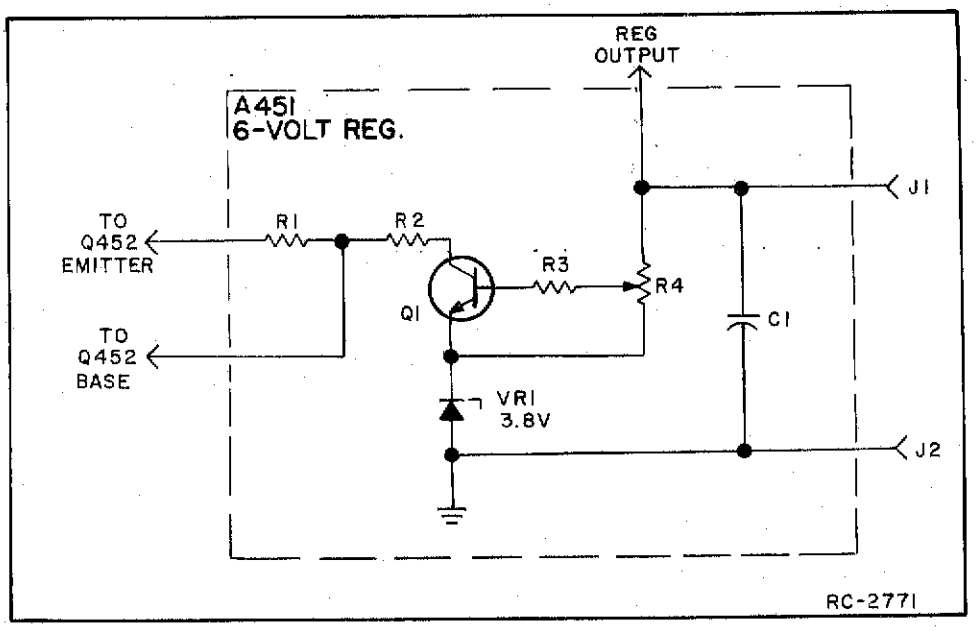



Figure 2 - 6-Volt Regulator

full-wave rectifier circuit, CR453 and CR454. The output at the center tap of T451 is filtered by choke input filter L452 and capacitors C452 and C461. The filter circuit output is applied through voltage dropping rectifier CR455 to the emitters of Q453 and Q451. If the output of Q453 and Q451 attempts to rise, the base of Q1 (located on the 6-volt Regulator board A451) is made more positive. This decreases the positive voltage at the base of driver transistor Q452. Q452 will then conduct more heavily, causing a greater voltage drop across R455. The bases of Q451 and Q453 will become more positive, thereby reducing the conduction of Q451 and Q453 and keeping the voltage at the output terminal at a ±5% regulated voltage level.

If the output of Q453 and Q451 drops, Q1 conducts less, decreasing the forward bias on Q452 and reducing the voltage drop across R455. This will cause Q451 and Q453 to conduct more heavily and hold the output voltage within the ±5% regulated level.

Filament measuring jacks (J1 and J2) are provided on the A451 board as an aid to servicing the equipment and are accessible from the rear of the supply. Use a DC voltmeter to measure the filament voltage at J1 and J2.

R4 seldom requires adjustment. It is adjusted to 6 VDC for use with power amplifier type EF-4-A and EF-5-A at the factory for the proper ±5% regulation required from the A451 circuit.

## High Voltage Plate Supply (Figure 3)

The high voltage supply provides 2000 volts for the PA tube plate circuit. The full-wave bridge rectifier circuit consists of eight silicon rectifiers in each leg of the bridge (32 rectifiers total). The bridge circuit is connected across the secondary of power transformer T452. The rectified output is filtered by choke L451 and capacitor C451. R457, R469, C458, and C459 form a ringing suppression circuit. The high voltage output is taken off at terminal 1 of C451 and is connected to the power amplifier through the station harness.

## Screen Voltage Supply (Figure 4)

The screen voltage supply provides 300 VDC for the PA tube screen grids. Screen voltage is obtained for the PA tube by use of a voltage divider in the plate supply circuit of the high voltage power supply. The voltage divider network (R462, R460, and R461) also serves as a bleeder. The screen voltage may be varied by adjusting the screen control R461 located on the front of the power supply chassis. Resistors R465, R466, and R467 are the voltage dividers for the metering terminal TB451-2.

The screen voltage supply maintains a constant power output, limiting screen current.

## Overload and Overload Hold Circuit (Figure 5)

Silicon controlled rectifier (SCR1) is driven by excessive current in the secondary of the high voltage supply. When SCR1 fires, it shunts the drive to trigger transistor Q1. SCR1 operates until the drive is removed from the PA.

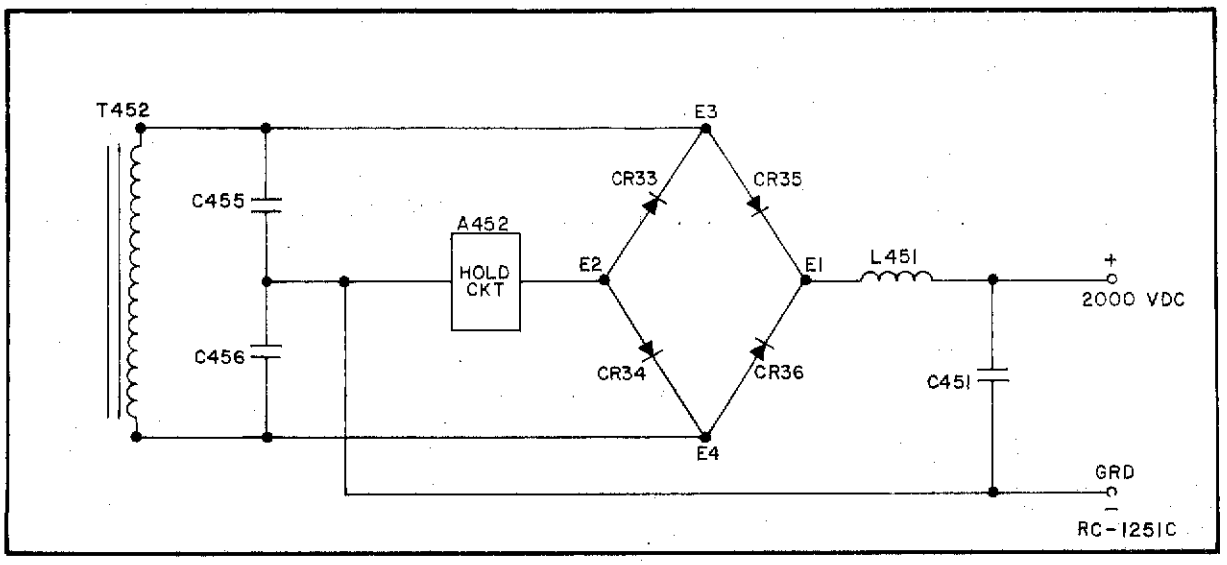



Figure 3 - High Voltage Supply

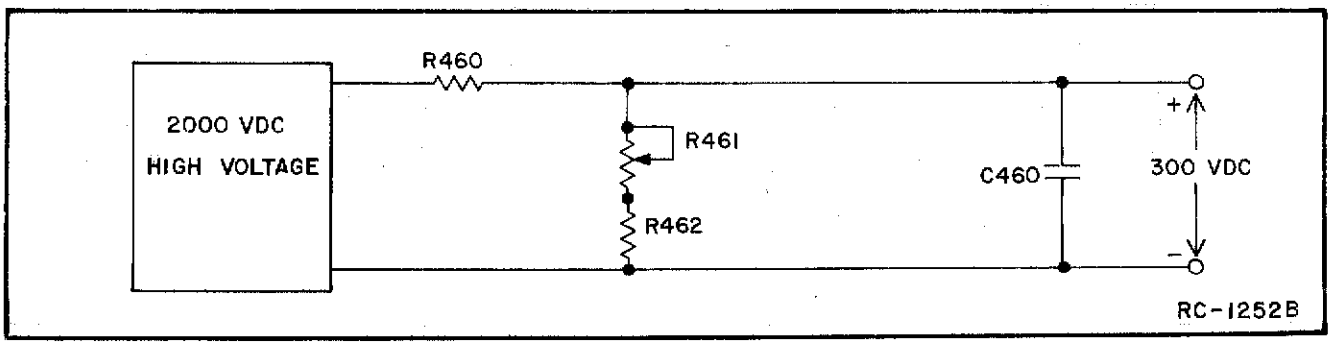



Figure 4 - Screen Voltage Supply

Grid Drive Circuit (Figure 5)

Q1 keys grid drive relay K454, when driven by the self-developed grid bias from the PA tube. Indicator lamp DS453 becomes illuminated as soon as the drive relay becomes energized. Grid current can be measured at grid jack J452 located on the front of the power supply chassis.

Drive Relay K454 (Figure 5)

Drive relay K454 is energized only when adequate current exists in the grid circuit. When K454 is energized, it causes (1) the Grid current indicator lamp to light; (2) the filament voltage dropping resistor to be shorted out; (3) the PA screen to become ungrounded; (4) a set of contacts to close in series with the plate relay coil K453 so that the antenna relay becomes energized.

Opto-Coupler U1 (Figure 5)

Opto-Coupler U1 and Q2 with associated circuitry on the A452 board provides additional protection by unkeying the grid drive relay K454 when the PTT lead goes open (unkeyed).

Opto-Coupler U1 is turned off when the PTT line is open (ungrounded) since TB451-6 is connected to 13.8 Volts and TB451-12 is connected to PTT in the system. With U1 turned off, Q2 is turned on, grounding the base of Q1 turning it off. The grid drive relay K454 unkeys shutting down the RF Power Amplifier.

When the PTT lead is grounded (keyed) U1 is turned on, turning off Q2. With Q2 turned off, Q1 is now under the influence of SCR1 overload protection.

Drive Relay Supply (Figure 5)

The drive relay supply is a half-wave rectifier circuit (CR452, C454, and R452) across the yellow-yellow secondary leads of T451 to provide a 8 VDC keyed voltage to grid drive relay K454.

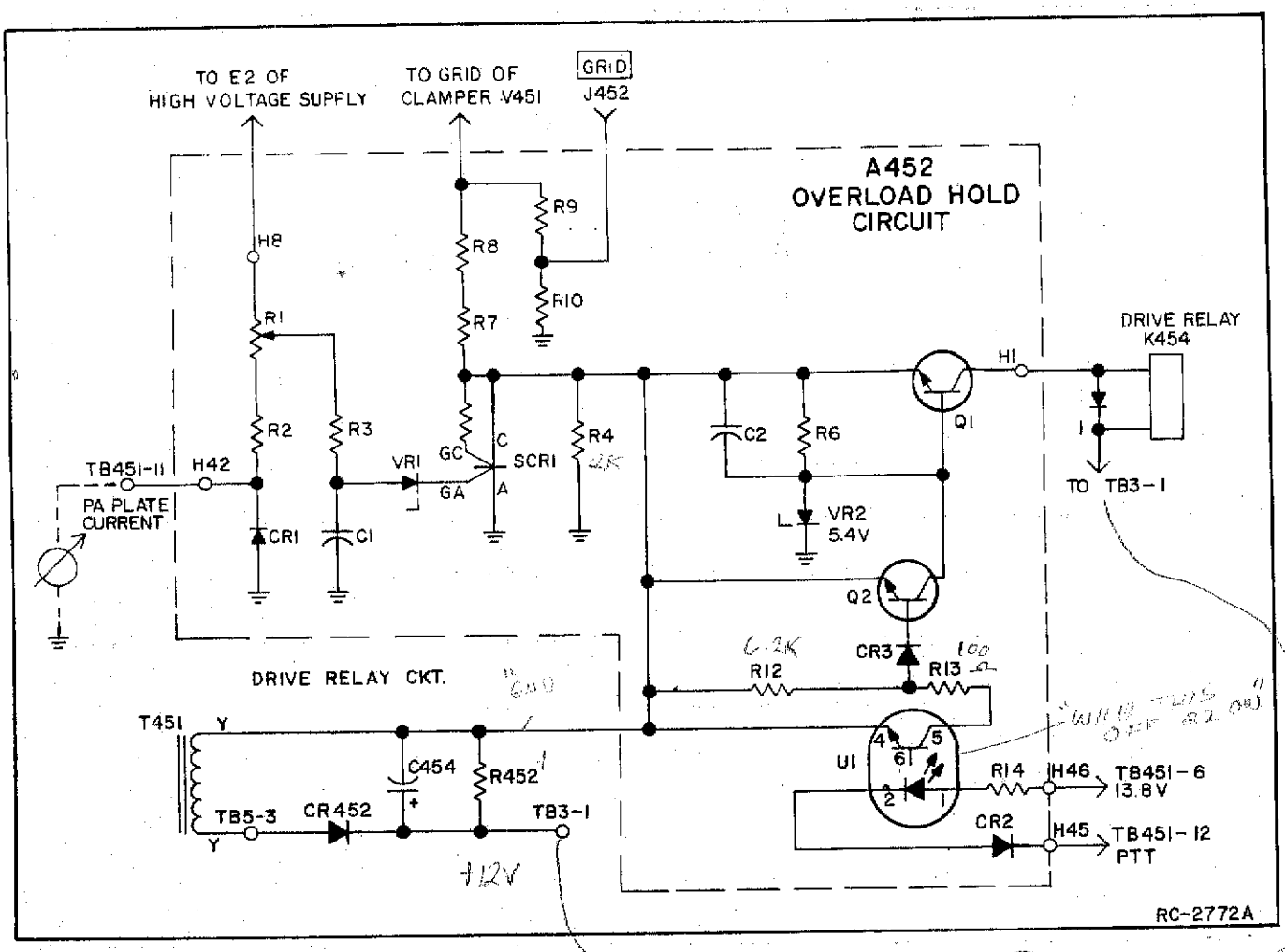



Figure 5 - Overload Hold and Drive Relay Circuit

## Screen Clamping Circuit

The V451 clamper tube (6680) is connected to the PA screen to hold the PA screen in a safe level when the self-developed bias on the PA tube is shut off. With no grid drive present, the clamper conducts, lowering its own plate voltage and the PA screen voltage. This action holds the PA plate current at a safe level. With grid drive present, the clamper cuts off and allows the circuit to rise to its normal level.

**CAUTION**

K454 and V451 are connected in paralled to protect the power amplifier tube when the transmitter is unkeyed. If V451 goes bad, pins 9 and 10 of K454 may weld together. If relay K454 is replaced, check V451.

## External Interlock (Figure 6)

The external interlock switch is mounted on the rear of the equipment cabinet and is connected to TB451-4 and -5 on the power supply chassis. Opening the rear door opens the interlock switch, causing K454 to de-energize. This opens the primary of the plate supply and turns OFF the Plate indicator light DS451. A shorting bar shorts the high voltage terminal on C451 to ground when the cabinet rear door is opened.

## Air Flow Switch K451 (Figure 6)

Air Flow switch K451 (thermostat) with resistor R453 is located in the air duct of the blower mounted on the main power supply chassis. If the air fails and the thermostat temperature exceeds 200°F K451-1 and -2 will open, causing plate relay, K453 to de-energize and open the primary of the plate supply.

Antenna Relay Supply (Figure 6)

The 140 VDC is supplied to the antenna relay located on the left rear of the power amplifier chassis. The 140 VDC is a keyed voltage derived from a half-wave rectifier circuit consisting of CR451 and C453 across the 117 VAC line. The output is measured from TB452-7 and -8.

Plate Relay (Figure 6)

When plate relay K453 is energized, 117 VAC is supplied to plate transformer T452. Plate relay K453 is connected in series with the grid drive relay (K454) to allow the proper grid current to develop before the 117 VAC is applied to the T452 primary.

Cabinet Blower Thermostat K455 (Figure 6)

Thermostat for optional cabinet blower (K455) is located on the transformer chassis. A lead from the thermostat is brought out to TB451-6 for connection to the cabinet blower. The high side of the thermostat connects to the line through fuse F452. Whenever the temperature inside the cabinet exceeds 120°F, the thermostat cuts in, allowing the blower to operate. When the temperature in the cabinet drops to 100°F, the thermostat cuts off, causing the blower to stop.

Time Delay Relay K456 (Figure 6)

The thermal time delay relay K456 is actuated by the 6-volt filament circuit. It provides a 45-second time delay before closing a set of contacts in the primary circuit of the plate supply. This delay allows sufficient time for PA tube filament to warm up before plate voltage is applied to the PA tube.

INDICATORS

Plate (DS451)

Plate indicator lamp (red) on the main chassis front panel becomes illuminated when the PA plate high voltage is turned ON.

Time Delay (DS452)

Time Delay lamp (amber) on the main chassis front panel becomes illuminated when the time delay (K456) is energized.

Grid (DS453)

Gride lamp (amber) on the main chassis front panel becomes illuminated when the proper grid bias is present at the PA tube grid.

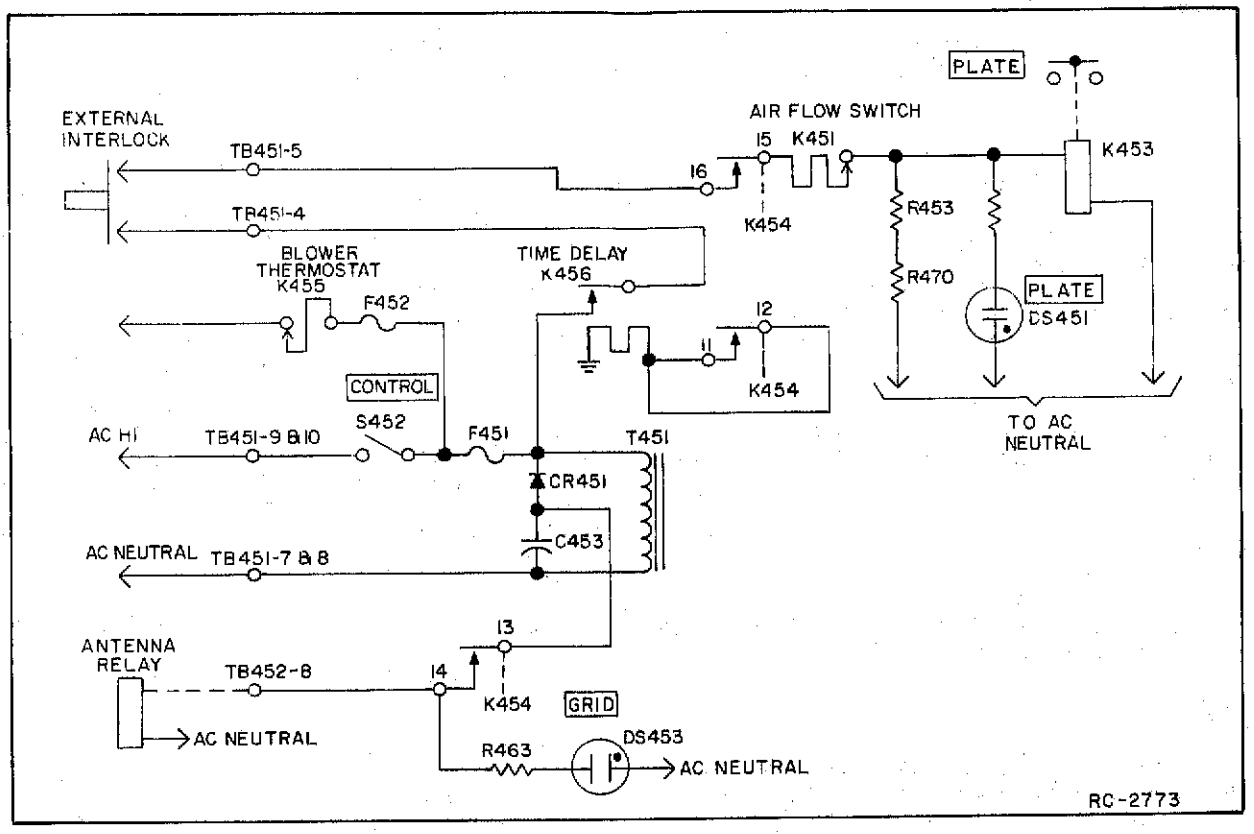



Figure 6 - Plate Relay and Antenna Relay Supply

Plate (DS454)

Plate lamp (red) on the rear of the main chassis becomes illuminated when the PA plate high voltage is turned ON.

METERING

PA Plate Voltage

The PA plate voltage meter M904 is mounted on the cabinet meter panel and is connected to TB451-1 and -2 on the power supply chassis. R467 is the plate voltage metering resistor.

PA Plate Current

The PA Plate Current Meter is mounted on the cabinet meter panel and is connected as shown in Figure 5. Note that both the PA screen current (approximately 25 mA) and PA plate current pass through the meter. To obtain actual plate current, subtract 25 mA from the meter reading.

Grid

To measure grid voltage, insert the probe from one of the tuning meters on the cabinet meter panel into grid jack J452 on the power supply chassis. R10 is the metering resistor for J452.

Filament

The filament metering jacks (J1 & J2) are located on the 6-VDC regulator board (A451).

## ADJUSTMENT

The following adjustments have been made at the factory. They should be checked and adjusted only during periodic maintenance checks and when troubleshooting.

FILAMENT

Measure output at test points J1 and J2 on 6-VDC regulator board A451. Adjust R4 for 6 VDC.

SCREEN

Refer to "Alignment Procedure" in Power Amplifier Maintenance Manual for adjustment of screen control R461.

PLATE OVERLOAD

Plate Overload potentiometer R1 on the A452 board has been set at the factory to maintain plate current at 350 mA. A plate current of 375 mA turns on SCR1, causing the plate voltage to drop out.

## MAINTENANCE

To obtain optimum performance from the equipment, a program of regular preventive maintenance should be followed. This preventive maintenance should include the following:

1. A mechanical inspection of the unit for loose, broken or damaged components.
2. A check of the input voltage.
3. Measurement of PA PLATE voltage, PLATE current, GRID current (J452), and FILAMENT (J1 and J2). A log should be kept of these readings when the equipment is first installed so that tube or component failures can be anticipated and the defect corrected before trouble becomes serious.
4. Check clamper tube V451.
5. Blower and relay maintenance as described in the sections below:

BLOWER

The blower which is installed on the Power Supply and used for cooling the PA tube on the Power Amplifier should be cleaned periodically to maintain its efficiency. The motor bearings should be repacked with Cherron Type BRB-2 grease every thrity-six months.

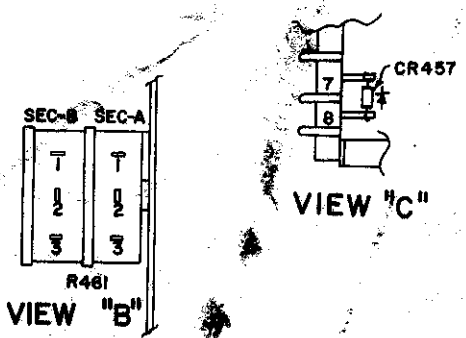
RELAYS

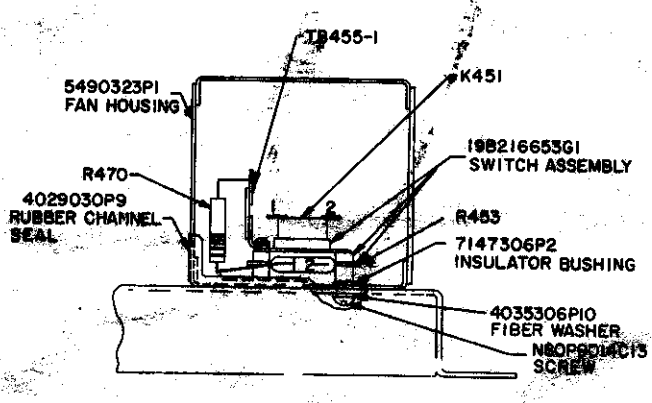
The relays in these units require little care. However, they should be inspected periodically to assure maximum operating efficiency. If the contacts become pitted, they should be cleaned with a burnishing tool to smooth out any metallic deposits. When relay contacts carry little or no current, the contacts do not clean themselves and an insulating coating is apt to form. This coating may be removed by cleaning the contacts with a burnishing tool. Do not oil the relay bearings. When relays are in dusty locations, lubricated bearings will collect dust and grit and will wear more rapidly than non-lubricated bearings. Some of the relays used are of the multiple-contact type and, in the unenergized position, should have contact spacings of approximately 0.1625 to 0.125 inch. More important, the contact spacings on any multiple-contact relay should be equal so that the contact pressures will be equal when the relay is energized. The back pressure of the antenna relay should be at least 15 grams. Low back pressure will shorten the life of contacts, due to excessive arcing, and may also cause noise in the receiver, due to chatter of the antenna relay contact.

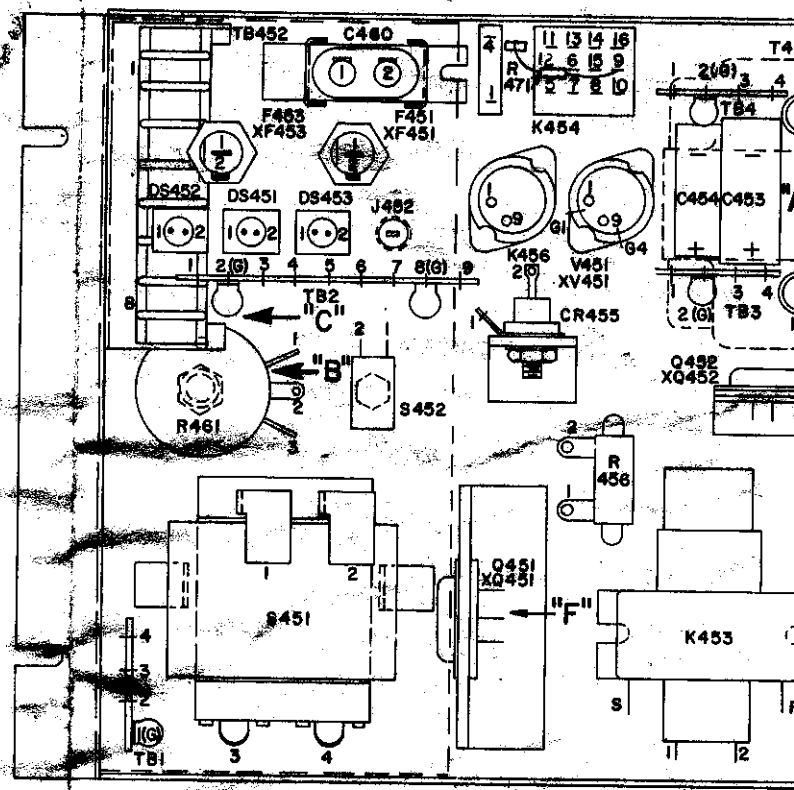
# TROUBLESHOOTING PROCEDURES

## QUICK CHECKS

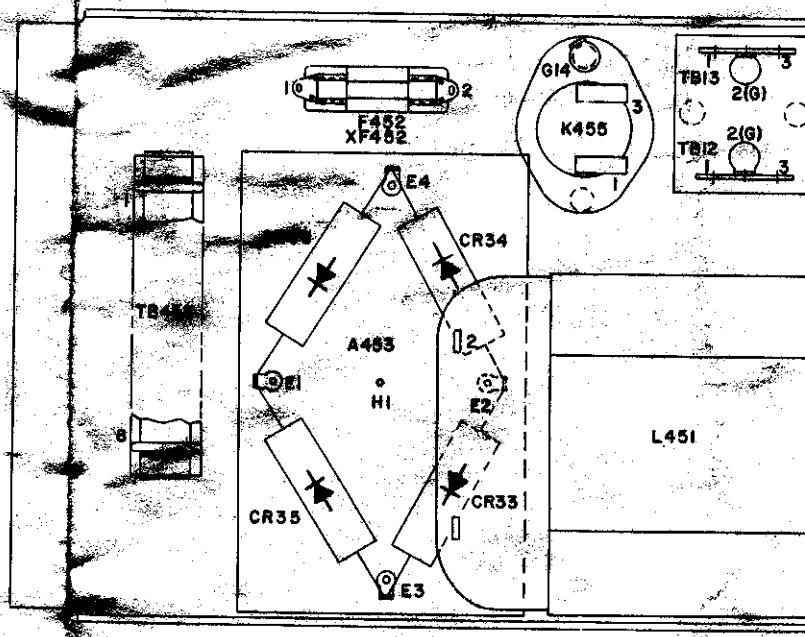
| SYMPTOM | CHECK THE FOLLOWING |
|---|---|
| No power supply output voltages when unit is keyed. | 1. Fuses F451, F452, and F453. |
| | 2. TB451-8-9 for 117 VAC unregulated if used. |
| | 3. TB451-8-10 for 117 VAC unregulated, if used. |
| | 4. TB452-1-2 for 117 VAC. |
| | 5. TB453-1-2 for 117 VAC. |
| | 6. K454 should become energized, when RF is applied to the PA. |
| | 7. S452, T451, CR451, C453, and K456 for opens or shorts. |
| No 2000 VDC reading on PA Plate Voltmeter (M904). | 1. C451, R469, R457, C458, C459, and BM451 for opens or shorts. |
| | 2. CR33 through CR36 on rectifier board (A453). |
| | 3. T452, C455, and C456 for opens or shorts. |
| No Grid Voltage at J452. | R461, C460, K454 for opens or shorts. |
| No 140 VDC at TB452-7-8. | C453 and CR451 for opens or shorts. |
| No 6 VDC at J1 & J2. | Q1, R4, C1, Q452, Q453, Q451, CR455, and R455 for opens or shorts. Open F453. |
| No 8 VDC at TB3-1. | 1. CR452, C454, R452 for opens or shorts. |
| | 2. Check for 8 VDC across T451 yellow-yellow leads. |
| No screen current reading on PA plate current meter (M904). | 1. 2000 VDC must be operating properly, then check R460, R461, R462, and C460 for opens or shorts. |
| | 2. Check 12AU7. |
| Blower does not operate. | K462, K455, K451, and R453 for opens or shorts. Open F452. |



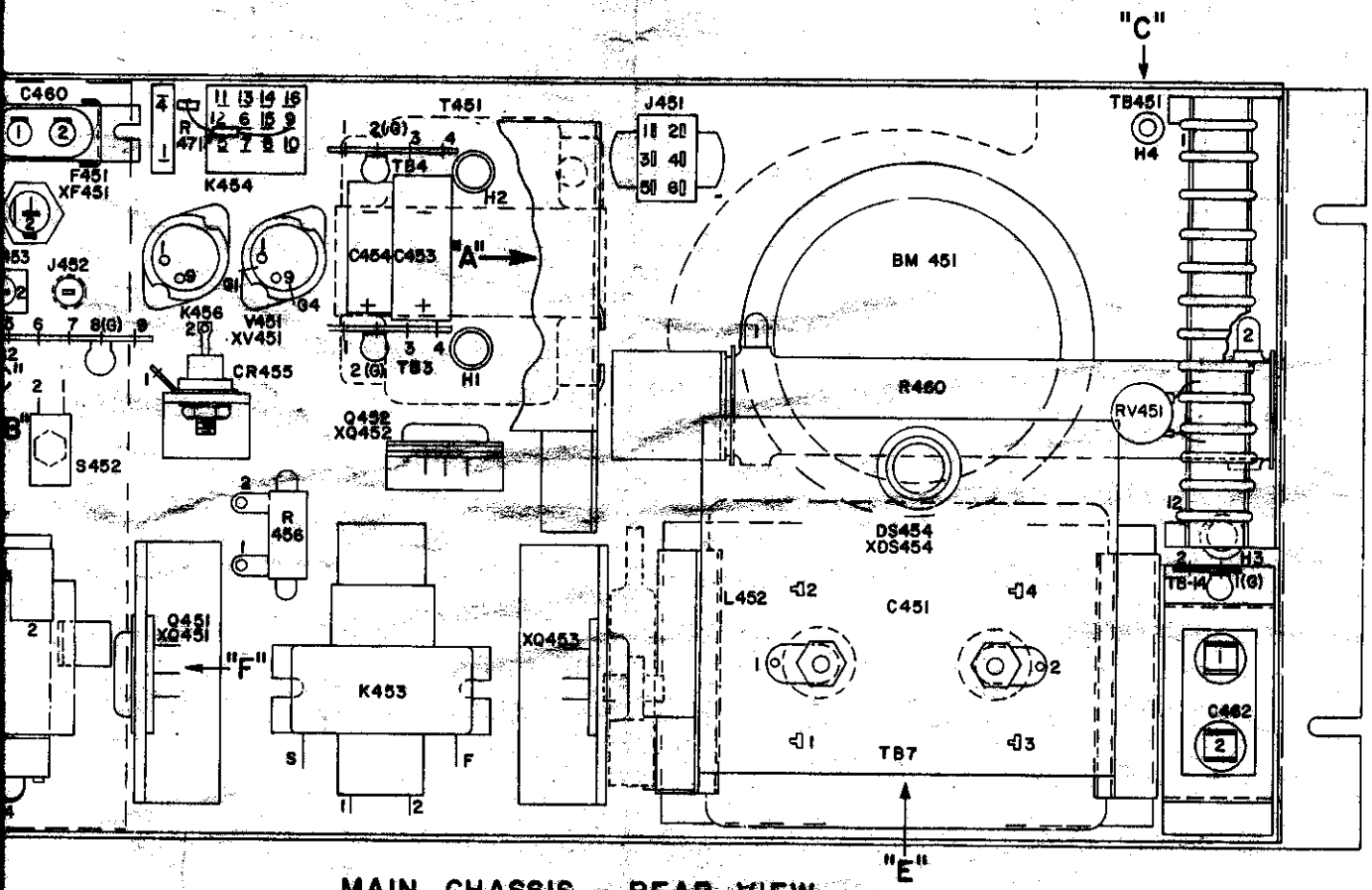

MAIN C



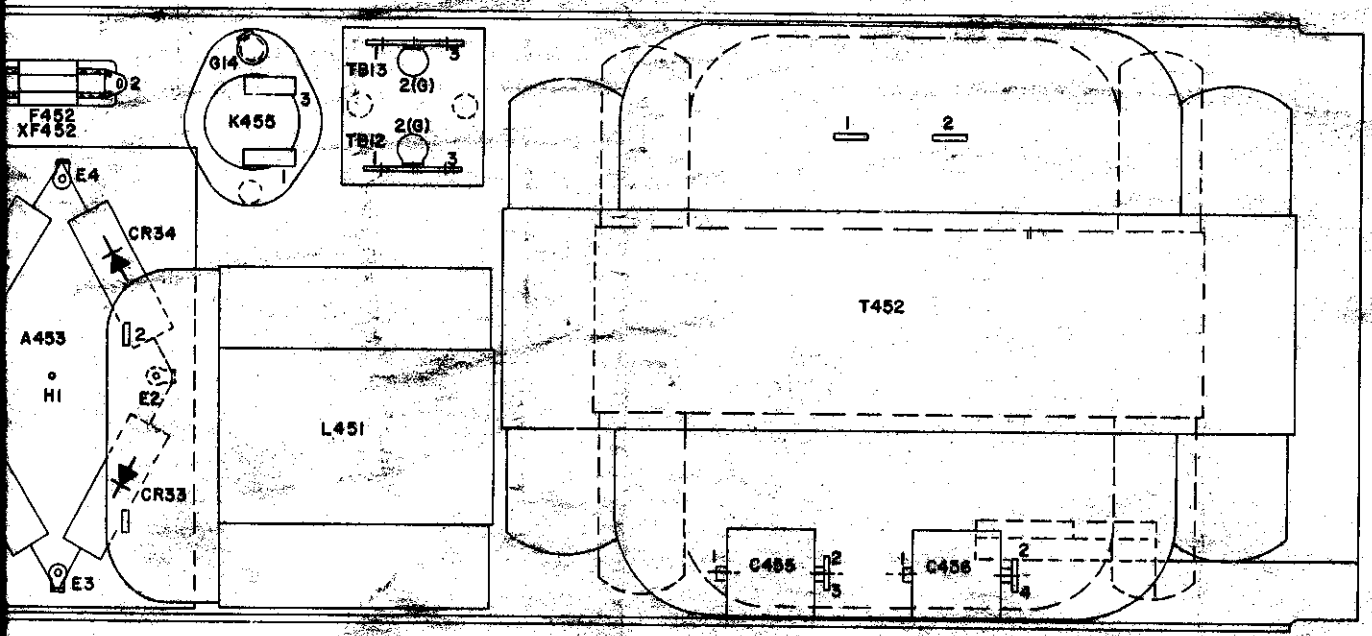

TRANSFORMER C

## OUTLINE DIAGRAM

POWER SUPPLY MODEL 19D402530G1, G2




MAIN CHASSIS - REAR VIEW




TRANSFORMER CHASSIS - REAR VIEW

## VOLTA

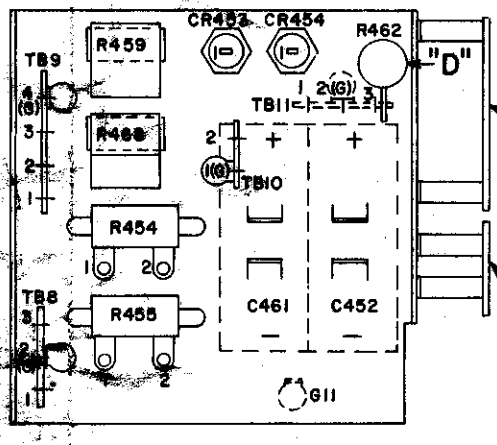
CONDITIONS OF

1. ALL ME
ALL CA
2. VOLTAG
METER,
A- WH
FI
3. ALL ME
FULL S
4. ALL DC
MARKED
5. RESIST

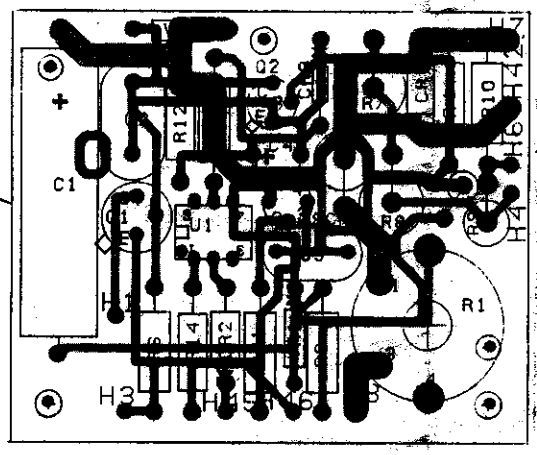
| NUMBER | |
|---|---|
| TB451-1 | |
| -2 | |
| -3 | |
| -4 | |
| -5 | |
| -6 | |
| -7 | |
| -8 | |
| -9 | |
| -10 | |
| -11 | |
| -12 | |
| TB452-1 | |
| -2 | |
| -3 | |
| -4 | |
| -5 | |
| -6 | |
| -7 | |
| -9 | |
| J452-1 | |
| -2 | |
| -3 | |
| -4 | |
| C451-1 | |

* OPERA
** DETER
*** MEASU

## PTT, OVERLOAD & RF SENSING

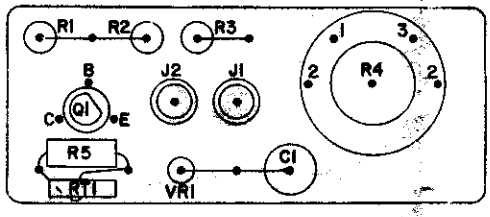



VIEW "A"




(19C327778, Rev. 0)
(19B227694, Sh. 1, Rev. 0)
(19B227694, Sh. 2, Rev. 0)

## 6-VDC REGULATOR A451




## VOLTAGE & RESISTANCE READINGS

CONDITIONS OF MEASUREMENT:

1. ALL MEASUREMENTS MADE FROM INDICATED POINT TO CHASSIS WITH ALL CABLES DISCONNECTED FROM UNIT.
2. VOLTAGES ARE TYPICAL READINGS ON A 20,000 OHM-PER-VOLT DC METER, UNLESS OTHERWISE NOTED.
   A- WHERE TWO VOLTAGES ARE GIVEN FOR ONE POINT (I.E. 0 6.0 V) FIRST READING IS FOR "STANDBY" AND SECOND IS FOR "TRANSMIT".
3. ALL MEASUREMENTS MADE WITH A METER RANGE THAT GIVES ONE-THIRD TO FULL SCALE DEFLECTION OF THE METER.
4. ALL DC VOLTAGES ARE POSITIVE WITH RESPECT TO CHASSIS, UNLESS MARKED "−" FOR NEGATIVE.
5. RESISTANCE ARE TYPICAL READINGS WITH ALL VOLTAGES REMOVED.

| NUMBER | VOLTAGE ± 10% | RESISTANCE ± 20% | FUNCTION |
|---|---|---|---|
| T8451-1 | | 0 | GROUND |
| -2 | | 430K | PLATE VOLTAGE |
| -3 | | --- | -------- |
| -4 | 117 VAC | --- | CABINET INTERLOCK |
| -5 | 117 VAC | --- | CABINET INTERLOCK |
| -6 | 117 VAC * | --- | BLOWER |
| -7 | 117 VAC NEUTRAL | --- | -------- |
| -8 | 117 VAC NEUTRAL | --- | -------- |
| -9 | 117 VAC HIGH | --- | UNREGULATED PLATE |
| -10 | 117 VAC HIGH | --- | REGULATED CONTROL |
| -11 | --- | --- | -------- |
| -12 | --- | --- | -------- |
| T8452-1 | 117 VAC NEUTRAL | --- | T452 PRIMARY |
| -2 | 117 VAC HIGH | --- | T452 PRIMARY |
| -3 | | 0 | T452 CENTER TAP |
| -4 | 117 VAC HIGH | --- | ------ |
| -5 | 117 VAC HIGH | --- | T451 PRIMARY |
| -6 | 117 VAC NEUTRAL | --- | ----- |
| -7 | --- | --- | ANTENNA RELAY |
| -8 | 140 VDC | --- | ANTENNA RELAY |
| J452-1 | 0 | 0 | GROUND |
| -2 | 5.5 TO 6 VDC | 0 | FILAMENT |
| -3 | -35 TO -105 VDC | 5100 | GRID |
| -4 | 150 TO 300 VDC ** | 5K TO 50K | SCREEN |
| C451-1 | 2000 VDC *** | 85K TO 135K | HIGH VOLTAGE |

* OPERATE ABOVE 50° C

** DETERMINED BY THE SETTING OF R461 (SCREEN ADJUSTMENT)

*** MEASURED ON METER M904.

## POWER SUPPLY OUTPUT READINGS

| STAGE | TEST POINT | OUTPUT |
|---|---|---|
| FILAMENT | J1 & J2 | 6 VDC |
| GRID | J452 & GROUND | 2.5 VDC (0.7 TO 2.5 VDC EF-6-A POWER AMPLIFIER) |
| SCREEN * | ADJUST R461 | 250 MA |
| PA PLATE ** | M904 METER | 2000 VDC |
| ANTENNA RELAY | TB3-4(+) & TB4-3(−) | 140 VDC |
| GRID DRIVE RELAY | TB3-1(+) & TB4-1(−) | 8 VDC |

* SCREEN IS ADJUSTED BY R461 TO OBTAIN 250 MA MAX. ON PLATE CURRENT METER.

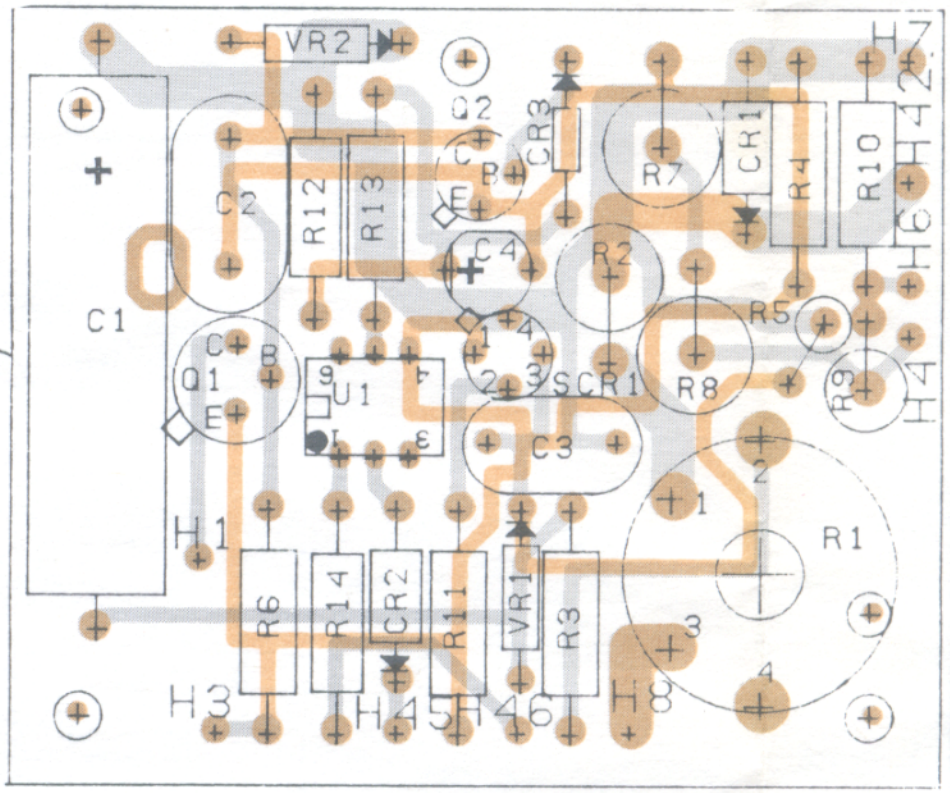
** WITH METER SWITCH IN PLATE VOLTAGE POSITION, CHECK VOLTAGE READING ON PLATE VOLTAGE METER.

RUNS ON SOLDER SIDE

RUNS ON BOTH SIDES

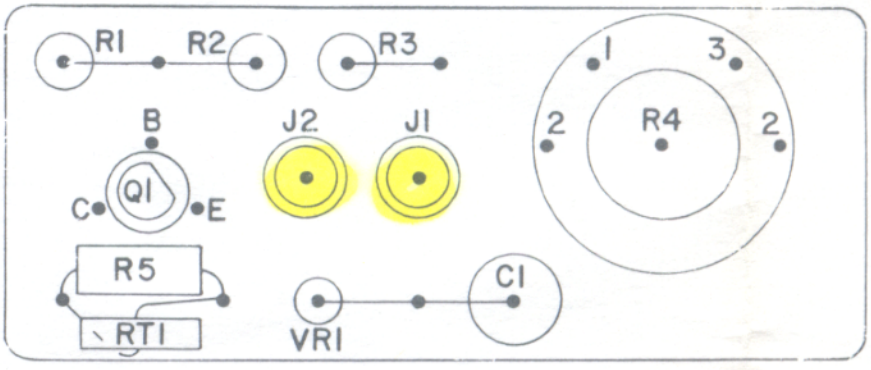
RUNS ON COMPONENT SIDE

# PTT, OVERLOAD & RF SENSING




(19C327778, Rev. 0)
(19B227694, Sh. 1, Rev. 0)
(19B227694, Sh. 2, Rev. 0)

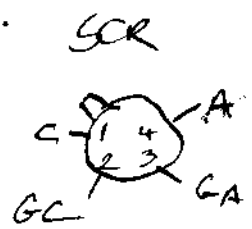
# 6-VDC REGULATOR A451

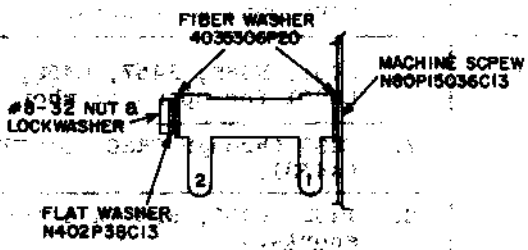


LEAD IDENTIFICATION
FOR Q1 AND Q2

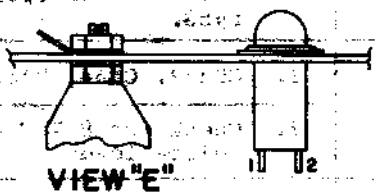

TOP VIEW

NOTE: LEAD ARRANGEMENT, AND NOT CASE SHAPE, IS DETERMINING FACTOR FOR LEAD IDENTIFICATION.

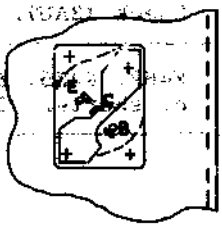



VIEW "D"




VIEW "E"
(PARTIAL)




VIEW "F"