MODEL SP-2717A
REGULATED
HIGH VOLTAGE
POWER SUPPLY

595-2705-02

OPERATION/SERVICE MANUAL

HEATH
ZENITH

HEATH ZENITH

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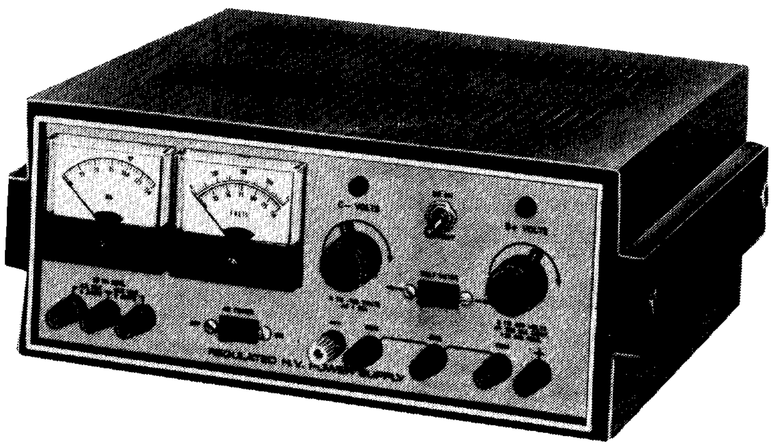

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

This Regulated HV (High Voltage) Power Supply is a compact, convenient source of variable regulated high voltage, variable bias voltage, and filament voltage for laboratories and workshops. Separate panel meters are provided for accurate monitoring of the DC output current and voltage. All output binding posts are insulated from the chassis to allow the high (B+) and bias (C−) voltages to be used as either negative or positive voltage sources.

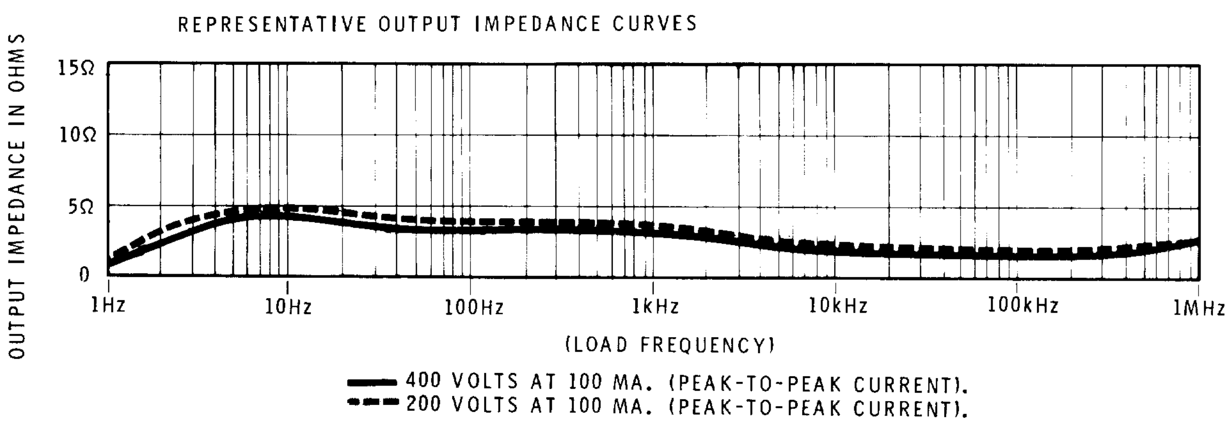
Separate transformers are used for filament and high voltage supplies so the filament circuit may be left on while switching off the high voltage circuit. This eliminates repeated tube warmup time.

A meter switch permits you to monitor either the high voltage or the bias voltage on the front panel voltmeter. The special taper C− VOLTS control provides a finer adjustment of low values of bias voltage. Built-in circuit protection prevents damage if the bias voltage output circuit should accidentally be short circuited or overloaded, and the input circuit of the Regulated High Voltage Power Supply is fused for additional protection against overload conditions or short circuits. You will find that all of these features, plus the attractive compact styling, will make this Power Supply a useful and valuable asset on your workbench.

SPECIFICATIONS

B+ VOLTS OUTPUT

Voltage	0 to 400 volts DC, regulated.
Current	0 to 100 mA continuous; 125 mA intermittent.
Regulation	Output variation less than 1% from no load to full load for output of 100 to 400 volts DC. Output variation less than ±1% for a ±10% variation of the 120 volt or 240 volt AC input source.
Ripple	Less than 10 millivolts RMS ripple, jitter and noise.
Output Impedance	Less than 10 Ω from DC to 1 MHz. (See Representative Output Impedance Curves.)



C− AND FILAMENT VOLTS OUTPUT

C− Volts	0 to − 100 volts DC at 1 mA.
Filament Voltage	6.3 volts AC at 4 amperes, or 12.6 volts AC at 2 amperes. NOTE: The 6.3 volt and 12.6 volt AC outputs may be used at the same time provided the total combined power does not exceed 25 volt-amperes.

GENERAL

Output Binding Posts	Common and + (B+ voltage). Common and − (C− voltage). 6.3 VAC at 4 amperes. 12.6 VAC at 2 amperes. Chassis Ground.
Front Panel Controls	AC Power switch. DC On-Standby switch. Voltmeter switch. C− volts control. B+ volts control.
Circuit Board Controls	Zero Voltage Adjust. 400 Volt Adjust.
Meters:	
Volts, Dual Scale	0 to 400 and 0 to 150 volts DC (accuracy: ±3% of full scale).
Milliamperes	0 to 150 mA (accuracy: ±2% of full scale).
Tube And Diode Complement	1 — 6AU6, control amplifier. 2 — 6L6GC series regulators. 9 — Silicon diodes. 10 — Zener diode voltage regulators.
Power Requirements	110 — 130 volts or 220 — 260 volts, 50/60 Hz AC. 150 watts maximum.
Fuse	1.5 ampere (110-130 VAC operation). NOTE: A 1.0 ampere fuse (not supplied) is recommended for 220-260 VAC operation.
Dimensions	13.38″ wide, 11.75″ deep, 5.5″ high. (34 cm wide, 29.9 cm deep, 14 cm high).
Net Weight	16 lbs. (7.26 kgs.)

OPERATION

Figure 1 (fold-out from this page) explains the function of the front panel controls. The following two examples show how to use the Regulated High Voltage Power Supply to provide filament, B+, C− power for a circuit. If 230-volt operation is required, perform the necessary modifications described below.

220-260 VOLT PRIMARY WIRING

When shipped, this instrument is ready for operation from a 110-130 volt AC source. If 220-260 volt AC operation is desired, remove the top cover of the power supply and perform the following instructions:

1. Refer to Figure 2A and remove the two jumper wires from the terminals located on transformer T1 and on transformer T2.
2. Refer to Figure 2B and install a jumper wire between terminals 2 and 3 of each transformer. Solder each connection.
3. Remove the fuse (located near transformer T2) and install a 1-ampere slow-blow fuse.
4. Reinstall the instrument cover.

NOTE: Electrical regulations in some areas require a special line cord and/or plug for 240-volt operation. Replace if necessary.

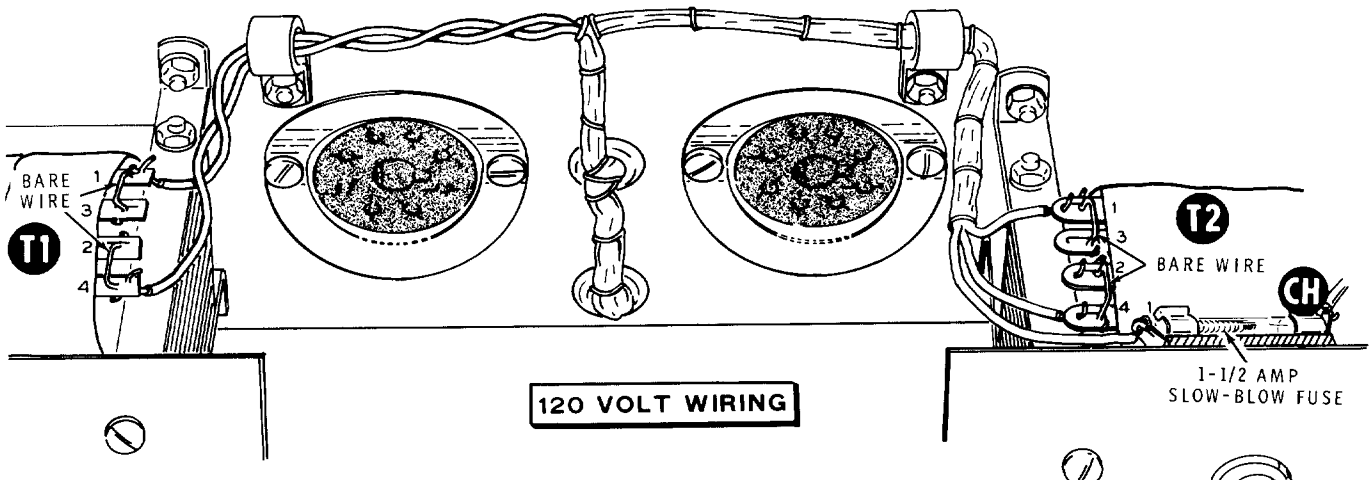


Figure 2A

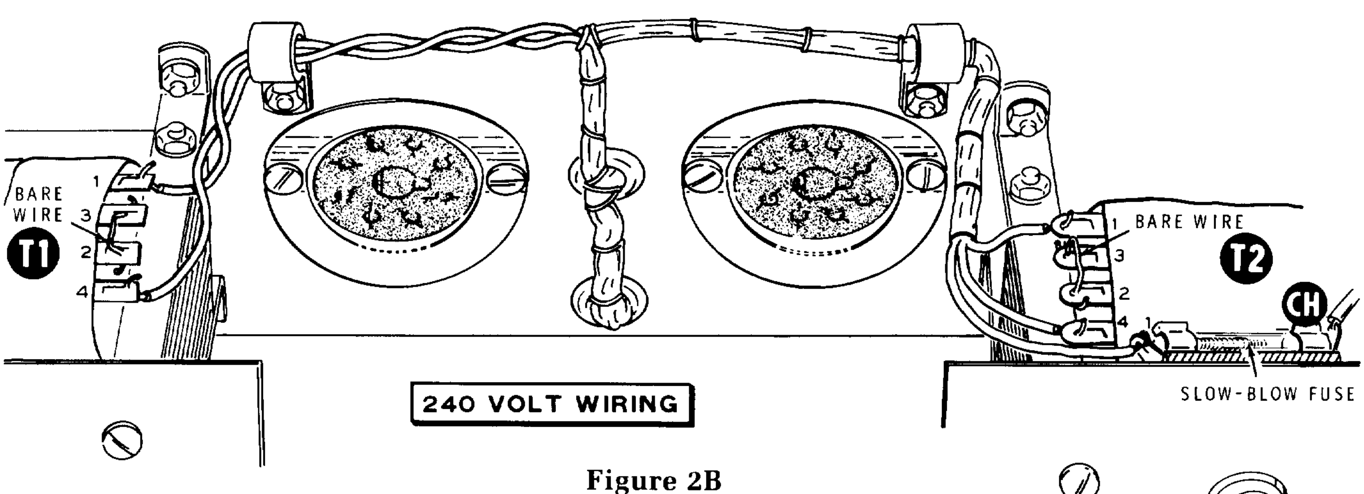


Figure 2B

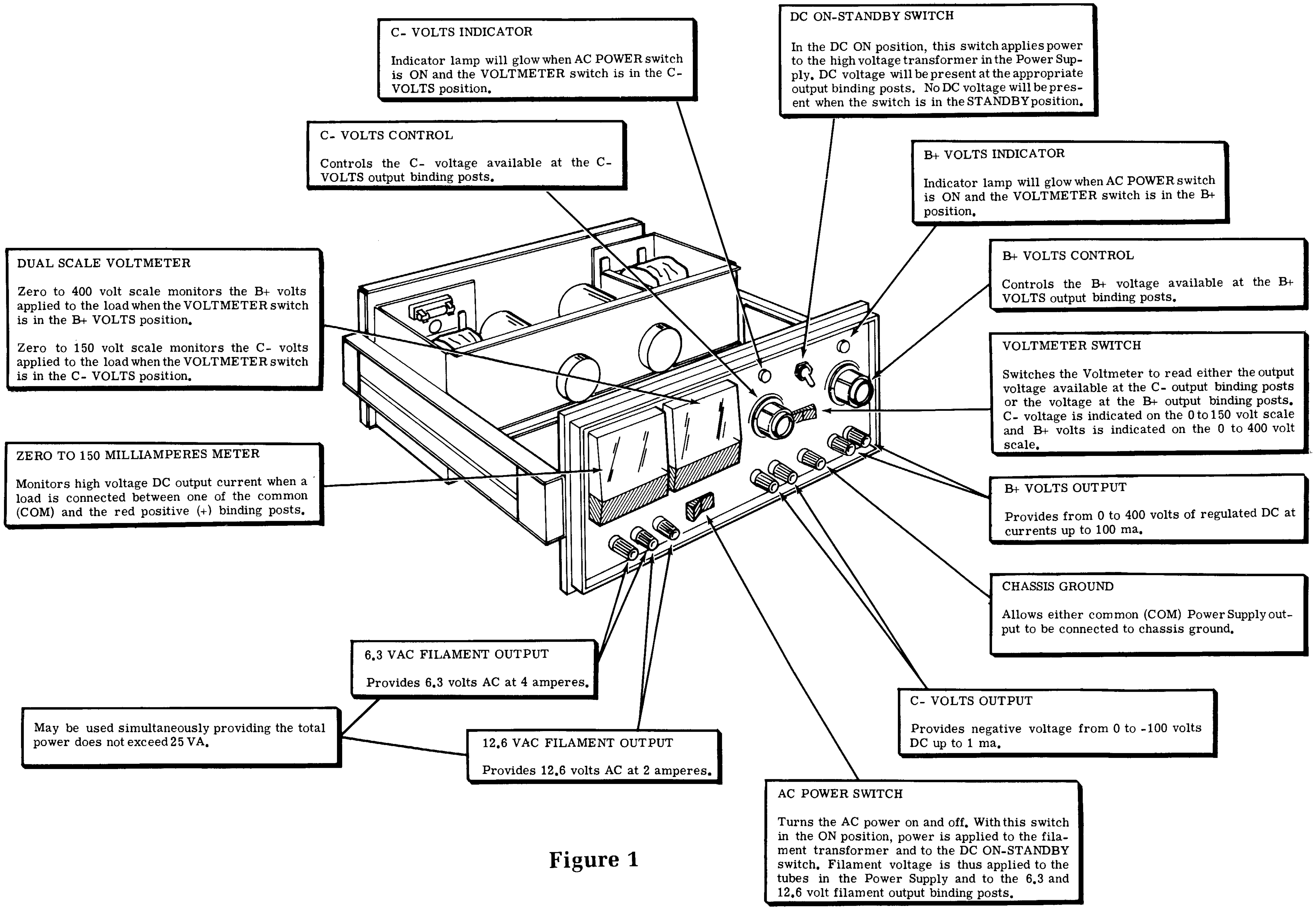
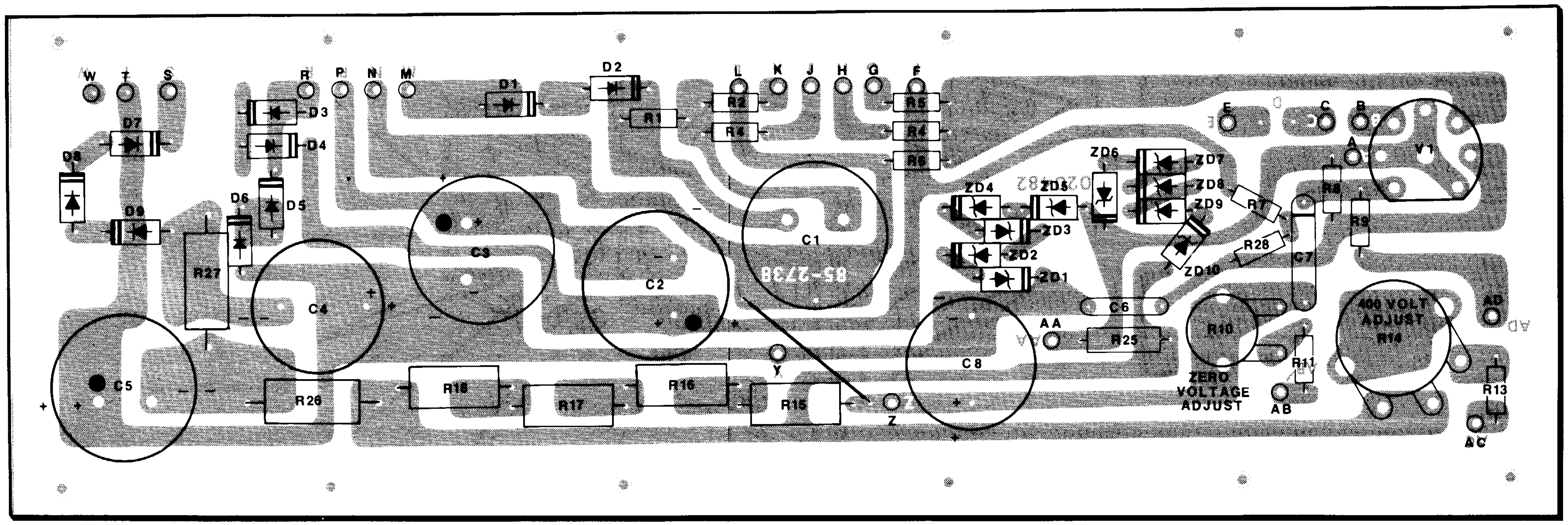

C- VOLTS INDICATOR
Indicator lamp will glow when AC POWER switch is ON and the VOLTMETER switch is in the C- VOLTS position.
DC ON-STANDBY SWITCH
In the DC ON position, this switch applies power to the high voltage transformer in the Power Supply. DC voltage will be present at the appropriate output binding posts. No DC voltage will be present when the switch is in the STANDBY position.
C- VOLTS CONTROL
Controls the C- voltage available at the C- VOLTS output binding posts.
B+ VOLTS INDICATOR
Indicator lamp will glow when AC POWER switch is ON and the VOLTMETER switch is in the B+ position.
DUAL SCALE VOLTMETER
Zero to 400 volt scale monitors the B+ volts applied to the load when the VOLTMETER switch is in the B+ VOLTS position.
Zero to 150 volt scale monitors the C- volts applied to the load when the VOLTMETER switch is in the C- VOLTS position.
B+ VOLTS CONTROL
Controls the B+ voltage available at the B+ VOLTS output binding posts.
VOLTMETER SWITCH
Switches the Voltmeter to read either the output voltage available at the C- output binding posts or the voltage at the B+ output binding posts. C- voltage is indicated on the 0 to 150 volt scale and B+ volts is indicated on the 0 to 400 volt scale.
ZERO TO 150 MILLIAMPERES METER
Monitors high voltage DC output current when a load is connected between one of the common (COM) and the red positive (+) binding posts.
B+ VOLTS OUTPUT
Provides from 0 to 400 volts of regulated DC at currents up to 100 ma.
CHASSIS GROUND
Allows either common (COM) Power Supply output to be connected to chassis ground.
6.3 VAC FILAMENT OUTPUT
Provides 6.3 volts AC at 4 amperes.
C- VOLTS OUTPUT
Provides negative voltage from 0 to -100 volts DC up to 1 ma.
May be used simultaneously providing the total power does not exceed 25 VA.
12.6 VAC FILAMENT OUTPUT
Provides 12.6 volts AC at 2 amperes.
AC POWER SWITCH
Turns the AC power on and off. With this switch in the ON position, power is applied to the filament transformer and to the DC ON-STANDBY switch. Filament voltage is thus applied to the tubes in the Power Supply and to the 6.3 and 12.6 volt filament output binding posts.

Figure 1

CIRCUIT BOARD X-RAY VIEW



(Viewed from foil side)

EXAMPLE 1

Figure 3 shows the Regulated High Voltage Power Supply being used to provide operating voltages for a tube in a typical RF amplifier stage.

The filament of the tube is connected to the two binding posts marked 6.3 VAC on the Power Supply. The grid return resistor is connected to the white (−) binding post to provide the required bias (C−) voltage. The B+ lead is connected to the red (+) binding post to provide power for the plate and screen grid of the tube. The common lead should be connected to either COMMON binding post of the Power Supply.

In this circuit application, a jumper wire is normally connected between the GND (ground) and either of the COM (common) binding posts on the Power Supply. This may prevent a shock hazard and will allow additional test equipment to be connected without upsetting any measurements. The jumper wire may not be required during some types of experiments.

With the METER SWITCH in the C− VOLTS position the C− VOLTS control should be adjusted for the desired bias voltage. The VOLTS meter will indicate the bias voltage on the black (0 to 150) scale. With the METER SWITCH in the B+ VOLTS position, the B+ VOLTS control should be adjusted for the desired B+ voltage as indicated on the VOLTS meter red (0 to 400) scale. The MILLIAMPERES meter will indicate the current flowing in the B+ circuit. NOTE: The red triangle at the 100 point on the meter scale indicates the maximum current that can be safely drawn for continuous operation.

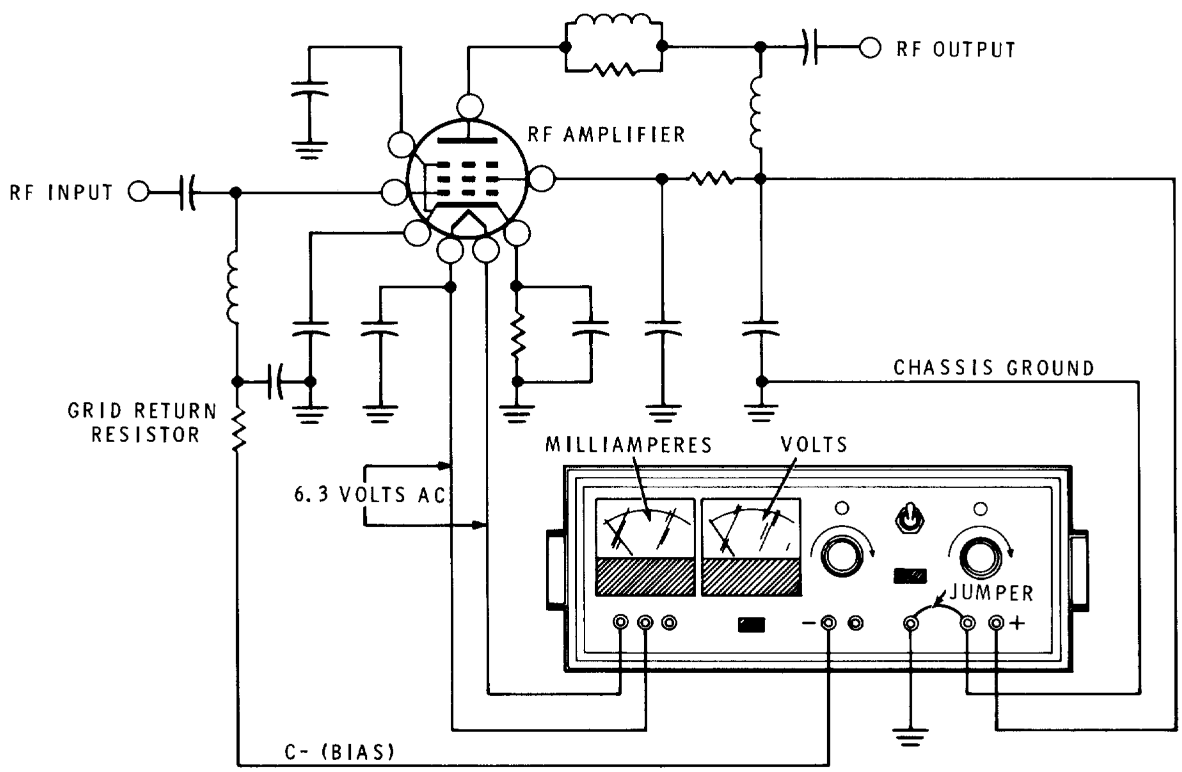


Figure 3

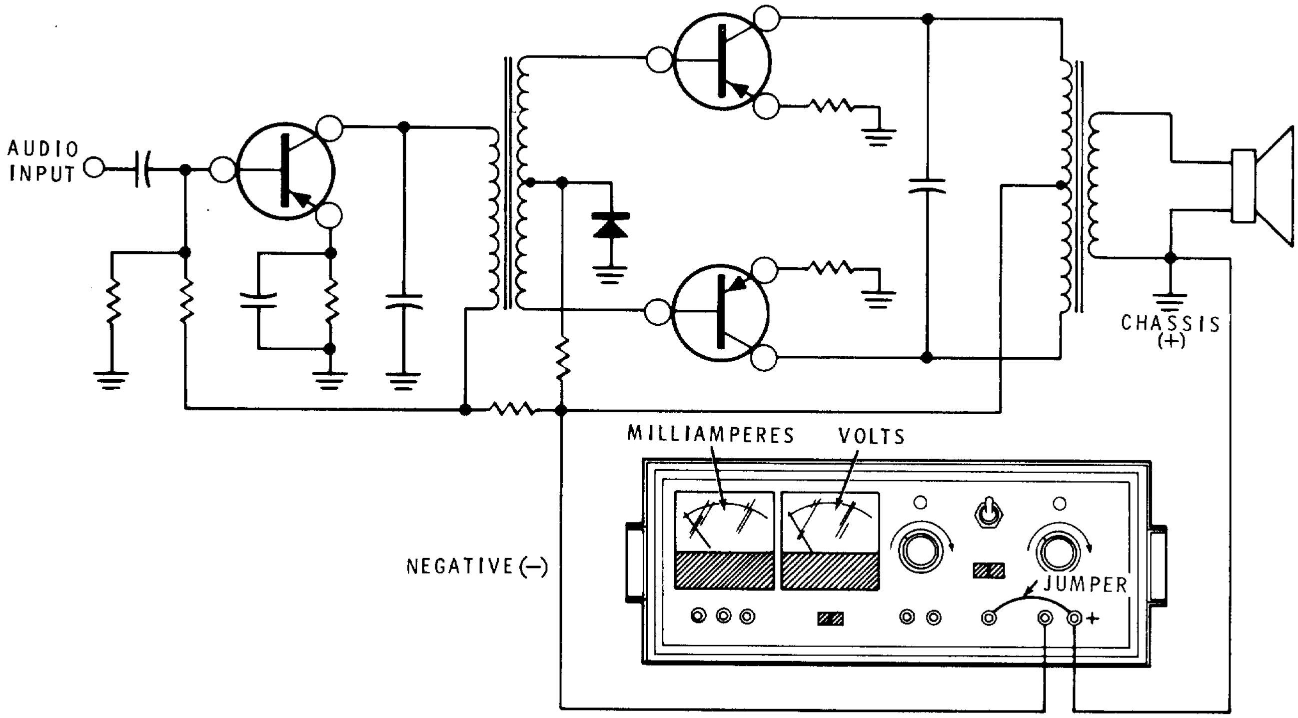


Figure 4

EXAMPLE 2

Figure 4 shows the Regulated High Voltage Power Supply being used to provide operating voltage for a typical transistor audio amplifier. This circuit requires a DC voltage which is negative (−) with respect to the amplifier chassis. NOTE: Transistors are usually low voltage devices. Use care not to apply too much voltage.

In this application, the red (+) binding post on the Power Supply is connected to the chassis of the audio amplifier. The COM (common) binding post is connected to the negative (−) lead of the amplifier. A jumper wire may be connected between the red (+) binding post and the black (GND) binding post. The chassis of the amplifier and the Power Supply will now be at the same potential. With the METER SWITCH in the B+ VOLTS position, the B+ VOLTS control should be adjusted for the required supply voltage. Note that the current flow in the amplifier circuit would be indicated by the MILLIAMPERES meter.

CIRCUIT DESCRIPTION

Refer to the Schematic (fold-out from Page 13) and to the Block Diagram while reading the Circuit Description.

The Regulated High Voltage Power Supply is a power source that allows the B+ current to vary over a wide range (from 0 to 100 mA depending on the load) and still maintain the output voltage at its original value.

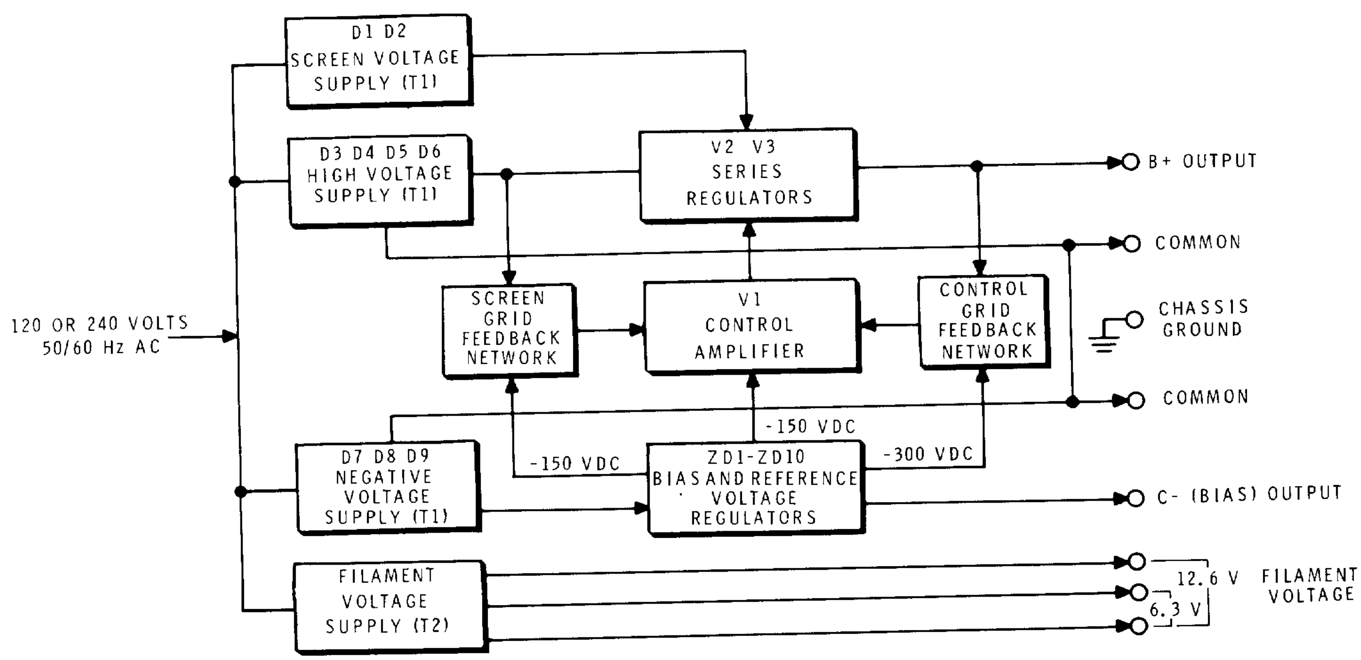
High B+ voltage is supplied by a full-wave voltage doubler circuit consisting of diodes D3, D4, D5, D6, and capacitors C2 and C3. This high B+ voltage is applied to the plate of the two pentode, series regulator tubes, V2 and V3. The cathodes of V2 and V3 are connected to the positive (+) output binding post through milliammeter M2.

Pentode operation is superior to triode operation in most wide range series regulator applications because there is a lower voltage drop across a pentode than there is across a triode. To allow V2 and V3 to operate as pentodes, a separate built-in power supply is used to provide screen grid voltage for V2 and V3.

This supply uses silicon diodes D1 and D2 in a half-wave rectifier circuit followed by C1A, R1, and C1B as a filter network. The filtered DC voltage from this circuit is applied through parasitic suppressor resistors R2 and R3 to the screen grids of series regulator tubes V2 and V3.

Series regulator tubes V2 and V3 act as a large variable resistor whose effective resistance is controlled by the voltage applied to their control grids. Tube V3 produces this control voltage and operates as a DC voltage feedback amplifier.

B+ volts control R12 is part of a voltage divider network connected between the B+ bus (cathode of V5 and V6) and the regulated negative 300 volt supply. Adjustment of R12 varies the voltage applied through resistor R9 to the control grid of DC voltage feedback amplifier V1. The value of the voltage developed at the plate of V1 depends upon the voltage that is applied to the control grid of V3 from the arm of R12. The voltage at the plate of V1 is applied through parasitic suppressor resistors R4 and R5 to the control grids of series regulator tubes V2 and V3.



BLOCK DIAGRAM

When the output load is removed, the voltage at the cathodes of V2 and V3 will tend to surge upward slightly. Resistor R12 (the B+ volts control) is part of the voltage divider network in this cathode circuit, therefore, a voltage change will be produced at the control grid of tube V1. This control grid voltage will increase slightly and tube V1 will conduct more heavily. This increased conduction will result in a decrease in the voltage at the plate of V1 with a corresponding decrease in voltage at the control grids of V5 and V3. The decrease in control grid voltage will increase the effective resistance of series regulator tubes V2 and V3 and lower the output voltage at the cathodes (B+ bus) of V2 and V3 to the original value set by the B+ volts control.

This means that any variation of the B+ output voltage caused by a change in output load is immediately amplified by voltage feedback amplifier V1 and applied to the control grids of series regulator tubes V2 and V3. This causes a corresponding increase or decrease in the effective resistance of the series regulators and will restore the B+ output voltage to the value originally set by the B+ volts control.

Screen voltage for control amplifier V1 is taken from a voltage divider network consisting of resistors R7, R28, and R8 connected between the + high voltage source and the regulated −150 volt source. The + high voltage varies with line voltage changes. This voltage is taken from the junction of R28 and R8 and applied to the screen grid of control amplifier V1. The resistance values are chosen to provide substantially zero output impedance.

An increase in line voltage and/or a decrease of the output load current will result in a momentary increase in output voltage above the level set by the B+ volts control. A corresponding increase in the resistance of the series regulator circuit of V2 and V3 will occur. This resistance increase will immediately lower the output voltage to its original set value. Conversely, the output voltage will momentarily decrease and then return to its original set value if the line voltage should decrease and/or the output load current increase.

Diodes D7, D8, and D9 produce a negative voltage which is filtered by C4, R27, and C5. Regulator diodes ZD1 through ZD10, which are connected in series across this negative voltage source, supply additional filtering and provide stable voltages of −150 and −300 volts DC. These two regulated negative voltage sources provide a reference voltage for control amplifier V1 and the DC voltage divider networks.

C− volts control R19 is connected across the −150 volt DC voltage source. This variable voltage is applied through current limiting resistor R20 to the negative (−) output binding post. This control has a nonlinear taper that allows fine adjustment of low values of the negative (bias) output voltage. Current limiting resistor R20 prevents damage in case the negative output circuit should be overloaded or accidentally shorted.

A high voltage bleeder network, consisting of resistors R15, R16, R17, and R18 in series, is connected between the high B+ voltage source (B+ bus) and the −300 DC voltage source. This bleeder network provides a minimum current path and maintains current flow through series regulator tubes V2 and V3 when there is no load connected across the B+ volts output.

Voltmeter switch S3 is shown in the B+ volts position. In this position , resistor R22 and meter M1 are connected in series between the B+ bus and the common bus, and the meter will monitor the high voltage B+ available at the positive (+) output binding post. This switch position also connects resistor R24 to point A on the filament transformer T2, causing the red panel lamp to light and show that the B+ volts output is being monitored.

With voltmeter switch S3 in the C− volts position, resistor R21 and meter M1 are connected in series between the common bus and the C− bus. The meter will monitor the C− volts available at the negative (−) output binding post. In this C− volts position, resistor R23 is connected to point A on filament transformer T2. This causes the amber panel lamp to light, showing that the C− volts output is being monitored.

Zero Voltage Adjust control R10 and 400 Volt Adjust control R14 are adjusted so the output indicated by meter M1 is zero with the B+ volts control turned fully counterclockwise, and 400 volts with the B+ volts control turned fully clockwise. This provides a full range of zero to 400 volts DC output. Resistors R11 and R13 determine the range of controls R10 and R14.

With AC Power switch S1 in the On position and DC On-Standby switch S2 in the Standby position, power is applied only to transformer T2. T2 supplies low voltage AC for the filaments of tubes V1, V2, V3, and 6.3 volts and 12.6 volts AC for external filament circuits connected to the filament binding posts. Power is also applied via switch S1 to the red or amber panel lamps.

With DC On-Standby switch S2 in the On position, power is applied to high voltage transformer T1. T1 provides high voltage AC for the screen voltage supply, high B+ voltage supply, and the −300 volt C− bias supply. Using separate filament and high voltage transformers allows the high voltage DC circuit to be switched to the Standby position, removing all DC high voltages from the equipment or circuits under test or development. The filament of tubes in the Power Supply and in the external circuits remain in a normal operating condition.

RECALIBRATION

Refer to Figure 5 for the following steps. Remove the instrument top cover.

WARNING: When the line cord is connected to an AC outlet, high AC voltage is present at several places on the chassis. See Figure 5. Also, when the Power Supply is turned on, high voltage DC will also be present. Be careful that you do not contact these high voltage areas or an electrical shock will result.

1. Place the DC ON — STANDBY switch in the STANDBY position.
2. Turn the C− VOLTS and the B+ VOLTS controls fully counterclockwise.
3. Place the VOLTMETER switch in the B+ VOLTS position.
4. Check the position of the meter pointers. Carefully turn the slotted adjustment screw in the front of the meter until the pointers are at the zero (0) mark on the scale.
5. From the top of the circuit board, use a screwdriver and turn the ZERO VOLTAGE ADJUST control fully counterclockwise.
6. In a like manner, turn the 400 VOLT ADJUST control fully clockwise.

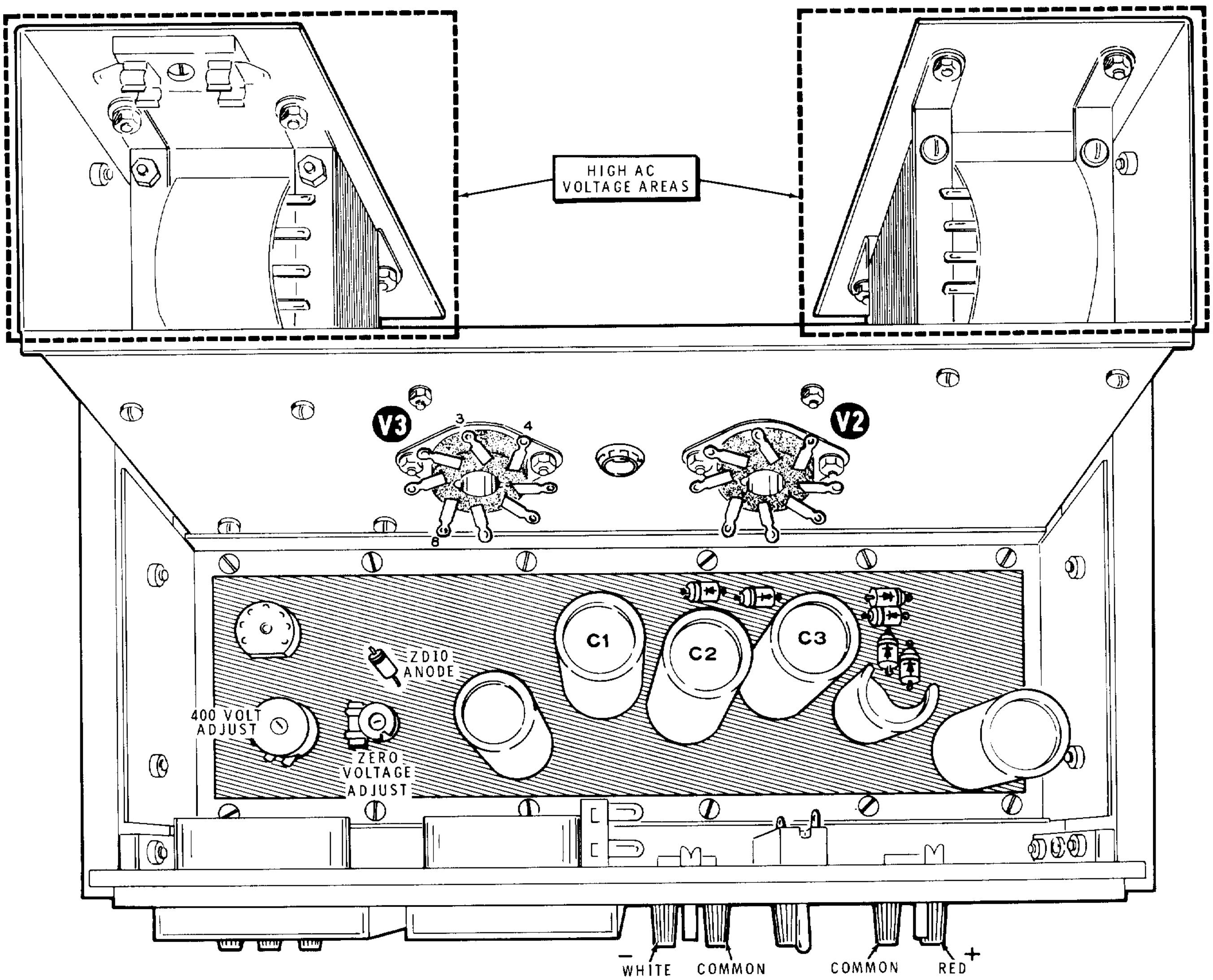


Figure 5

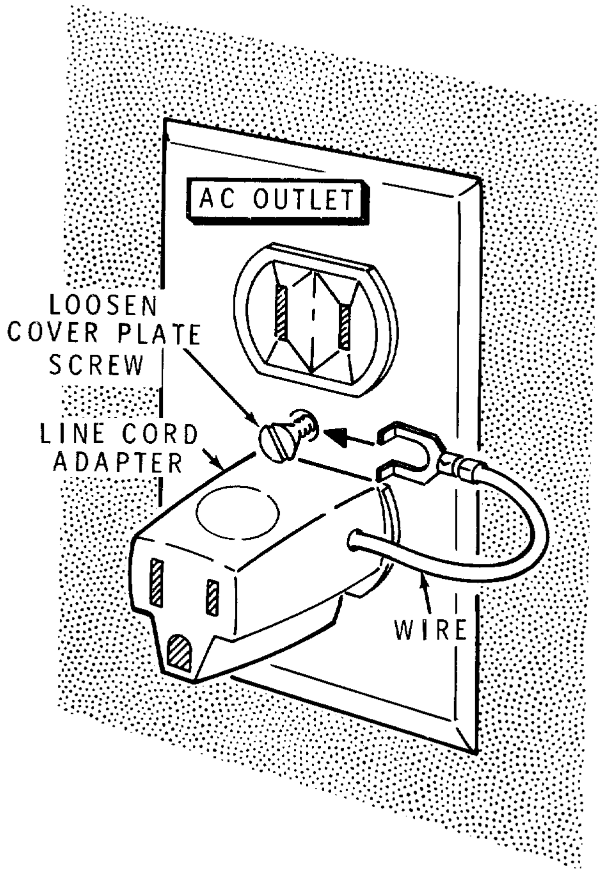


Figure 6

Use a line cord adapter if the sockets in your AC outlets are not the 3-prong type. Mount the line cord adapter as follows:

7. Refer to Figure 6 and insert the adapter into the 2-prong socket in the AC outlet.

8. Loosen the screw in the outlet cover plate and slide the spade lug on the adapter wire under the screw head. Then securely tighten the screw.

9. Insert the line cord plug into the adapter and place the AC POWER switch in the ON position. Be sure the DC ON-STANDBY switch is in the STANDBY position.

10. Allow several minutes for the filaments in the tubes to reach normal operating temperatures. Then place the DC ON-STANDBY switch in the DC ON position.

11. Voltage regulator tubes V1 and V2 should now glow faintly and the VOLTS meter pointer should indicate upscale from zero, or slightly to the right of the zero point on the scale.

12. The MILLIAMPERES meter should indicate zero current since there is no load connected to the B+ output circuit of the Power Supply.

NOTE: The adjustment of the ZERO VOLTAGE ADJUST and the 400 VOLT ADJUST controls interact with each other. Repeat the adjustments in the following four steps several times so that when the B+ VOLTS control is fully clockwise, the VOLTS meter reads at the 400 mark on the scale. The VOLTS meter should read at the zero mark on the scale when the B+ VOLTS control is fully counterclockwise.

13. With the B+ VOLTS control fully counterclockwise, adjust the ZERO VOLTAGE ADJUST control on the top of the circuit board until the VOLTS meter indicates zero volts.

14. With the B+ VOLTS control fully clockwise, adjust the 400 VOLT ADJUST control on the top of the circuit board until the VOLTS meter reads 400 volts.

15. Repeat the two steps just performed until the VOLTS meter indicates zero with the B+ VOLTS control turned fully counterclockwise, and 400 volts with the B+ VOLTS turned fully clockwise.

16. Place the VOLTMETER switch in the C− VOLTS position. The amber lamp on the front panel should now light.

17. Turn the C− VOLTS control through its full left to right rotation. The VOLTS meter should indicate zero volts with the C− VOLTS control turned fully counterclockwise and well above 100 volts with the control turned fully clockwise.

This completes the Recalibration section. Reinstall the instrument top cover.

PARTS LIST

The Key numbers relate to the X-Ray View, Chassis Photograph, and Schematic.

RESISTORS

(All resistors are 1/2-watt, 5% unless otherwise specified.)

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
R1	6-102	1000 Ω
R2	6-101	100 Ω
R3	6-101	100 Ω
R4	6-102	1000 Ω
R5	6-102	1000 Ω
R6	6-474	470 kΩ
R7	6-474	470 kΩ
R8	6-154	150 kΩ
R9	6-105	1 MΩ
R10	10-384	500 kΩ control
R11	6-684	680 kΩ
R12	10-257	500 kΩ control
R13	6-244	240 kΩ
R14	10-162	200 kΩ control
R15	1-6-2	27 kΩ, 2-watt
R16	1-6-2	27 kΩ, 2-watt
R17	1-6-2	27 kΩ, 2-watt
R18	1-6-2	27 kΩ, 2-watt
R19	10-216	50 kΩ control
R20	6-223	22 kΩ
R21	6-1503-12	150 kΩ, 1%
R22	6-4003-12	400 kΩ, 1%
R23	6-680	68 Ω
R24	6-680	68 Ω
R25	6-333-1	33 kΩ, 1-watt
R26	1-14-2	3000 Ω, 5-watt
R27	1-14-2	3000 Ω, 5-watt
R28	6-474	470 kΩ

CAPACITORS

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
C1	25-955	22 μF electrolytic
C2	25-956	68 μF electrolytic
C3	25-956	68 μF electrolytic
C4	25-955	22 μF electrolytic
C5	25-957	47 μF electrolytic
C6	27-34	0.2 μF Mylar*
C7	27-37	0.056 μF Mylar*
C8	25-955	22 μF electrolytic
C9	23-59	0.05 μF paper
C10	25-955	22 μF electrolytic

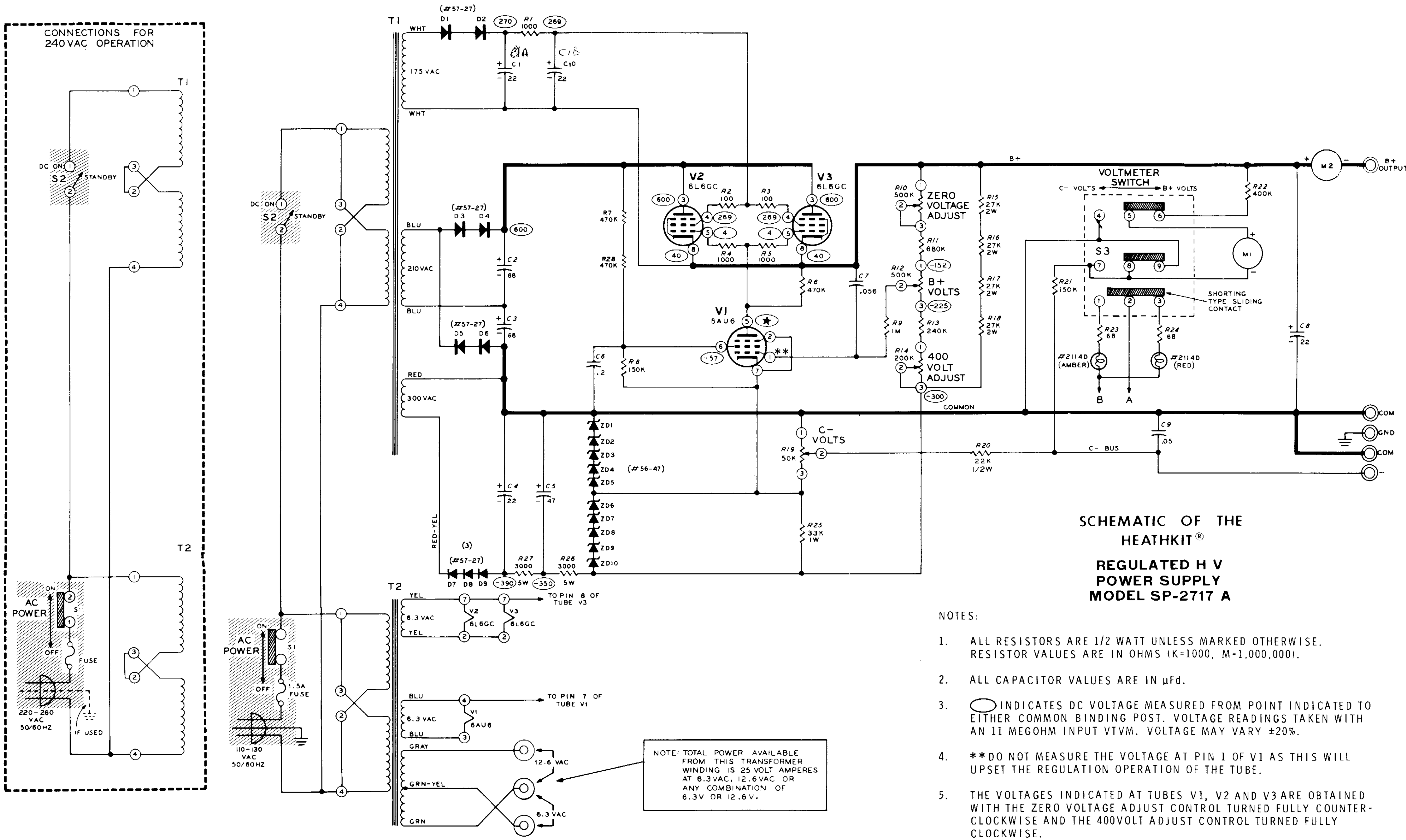
DIODES — TUBES

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
D1 through D9	57-27	1N2071
ZD1 through ZD10	56-47	MZ-1000-23 or 1N4750A
V1	411-11	6AU6
V2	411-8	6L6GC
V3	411-8	6L6GC

GENERAL COMPONENTS

CIRCUIT Comp. No.	HEATH Part No.	DESCRIPTION
M1	407-123	Voltmeter
M2	407-124	Milliameter
S1	60-24	AC power switch
S2	61-9	DC switch
S3	60-34	Voltmeter switch
T1	54-185	Power transformer
T2	54-184	Filament transformer
	412-31	2114D lamp
	421-25	1.5 ampere slow-blow fuse

*DuPont registered trademark.



SCHEMATIC OF THE HEATHKIT®

REGULATED H V POWER SUPPLY MODEL SP-2717 A

NOTES:

1. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS (K=1000, M=1,000,000).
2. ALL CAPACITOR VALUES ARE IN µFd.
3. ◯ INDICATES DC VOLTAGE MEASURED FROM POINT INDICATED TO EITHER COMMON BINDING POST. VOLTAGE READINGS TAKEN WITH AN 11 MEGOHM INPUT VTVM. VOLTAGE MAY VARY ±20%.
4. ** DO NOT MEASURE THE VOLTAGE AT PIN 1 OF V1 AS THIS WILL UPSET THE REGULATION OPERATION OF THE TUBE.
5. THE VOLTAGES INDICATED AT TUBES V1, V2 AND V3 ARE OBTAINED WITH THE ZERO VOLTAGE ADJUST CONTROL TURNED FULLY COUNTER-CLOCKWISE AND THE 400VOLT ADJUST CONTROL TURNED FULLY CLOCKWISE.
6. (★) VARIES DEPENDING ON THE VOLTAGE THAT IS APPLIED TO PIN 1.
7. PARTS IN SHADED AREAS ARE CRITICAL FOR CONTINUED SAFETY. REPLACE THEM ONLY WITH PARTS OF THE SAME RATING OR WITH THE PROPER HEATH PARTS.