

ASSEMBLING
AND USING
YOUR

Heathkit

VARIABLE VOLTAGE
REGULATED
POWER SUPPLY
MODEL PS-2

595-34

HEATH COMPANY

BENTON HARBOR,
MICHIGAN

THE WORLD'S *Finest* TEST EQUIPMENT IN KIT FORM

STANDARD COLOR CODE — RESISTORS AND CAPACITORS

AXIAL LEAD RESISTOR Brown — Insulated Black — Non-insulated Wire wound resistors have 1st digit band double width	<table><tr><th>INSULATED UNINSULATED Color</th><th>FIRST RING BODY COLOR First Figure</th><th>SECOND RING END COLOR Second Figure</th><th>THIRD RING DOT COLOR Multiplier</th></tr><tr><td>BLACK</td><td>0</td><td>0</td><td>None</td></tr><tr><td>BROWN</td><td>1</td><td>1</td><td>0</td></tr><tr><td>RED</td><td>2</td><td>2</td><td>00</td></tr><tr><td>ORANGE</td><td>3</td><td>3</td><td>,000</td></tr><tr><td>YELLOW</td><td>4</td><td>4</td><td>0,000</td></tr><tr><td>GREEN</td><td>5</td><td>5</td><td>00,000</td></tr><tr><td>BLUE</td><td>6</td><td>6</td><td>000,000</td></tr><tr><td>VIOLET</td><td>7</td><td>7</td><td>0,000,000</td></tr><tr><td>GRAY</td><td>8</td><td>8</td><td>00,000,000</td></tr><tr><td>WHITE</td><td>9</td><td>9</td><td>000,000,000</td></tr></table>	INSULATED UNINSULATED Color	FIRST RING BODY COLOR First Figure	SECOND RING END COLOR Second Figure	THIRD RING DOT COLOR Multiplier	BLACK	0	0	None	BROWN	1	1	0	RED	2	2	00	ORANGE	3	3	,000	YELLOW	4	4	0,000	GREEN	5	5	00,000	BLUE	6	6	000,000	VIOLET	7	7	0,000,000	GRAY	8	8	00,000,000	WHITE	9	9	000,000,000	DISC CERAMIC RMA CODE
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RADIAL LEAD DOT RESISTOR 	5-DOT RADIAL LEAD CERAMIC CAPACITOR 	EXTENDED RANGE TC CERAMIC HICAP 																																												
RADIAL LEAD (BAND) RESISTOR 	BY-PASS COUPLING CERAMIC CAPACITOR 	AXIAL LEAD CERAMIC CAPACITOR 																																												

The standard color code provides all necessary information required to properly identify color coded resistors and capacitors. Refer to the color code for numerical values and the zeroes or multipliers assigned to the colors used. A fourth color band on resistors determines tolerance rating as follows: Gold = 5%, silver = 10%. Absence of the fourth band indicates a 20% tolerance rating.

The physical size of carbon resistors is determined by their wattage rating. Carbon resistors most commonly used in Heathkits are $\frac{1}{2}$ watt. Higher wattage rated resistors when specified are progressively larger in physical size. Small wire wound resistors $\frac{1}{2}$ watt, 1 or 2 watt may be color coded but the first band will be double width.

MOLDED MICA TYPE CAPACITORS

CURRENT STANDARD CODE 	RMA 3-DOT (OBSOLETE) RATED 500 W.V.D.C. ± 20% TOL. 	BUTTON SILVER MICA CAPACITOR
RMA (5-DOT OBSOLETE CODE) 	RMA 6-DOT (OBSOLETE) 	RMA 4-DOT (OBSOLETE)

MOLDED PAPER TYPE CAPACITORS

TUBULAR CAPACITOR Normally stamped for value A 2 digit voltage rating indicates more than 900 V. Add 2 zeros to end of 2 digit number.	MOLDED FLAT CAPACITOR Commercial Code 	JAN. CODE CAPACITOR
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The tolerance rating of capacitors is determined by the color code. For example: red = 2%, green = 5%, etc. The voltage rating of capacitors is obtained by multiplying the color value by 100. For example: orange = 3×100 or 300 volts. Blue = 6×100 or 600 volts.

In the design of Heathkits, the temperature coefficient of ceramic or mica capacitors is not generally a critical factor and therefore Heathkit manuals avoid reference to temperature coefficient specifications.

HEATHKIT

MODEL PS-2

VARIABLE VOLTAGE REGULATED POWER SUPPLY



SPECIFICATIONS

Power Requirements	105-125 V 50/60 Cycle AC
Overall Size	7 $\frac{1}{2}$ " high x 13 $\frac{1}{4}$ " wide x 7 $\frac{1}{2}$ " deep
Kit Weight.	15 pounds
Meter	4 $\frac{1}{2}$ " Streamlined case Range: 0-500 Volts DC 0-200 Ma. DC
Tubes	1 5V4G Rectifier 2 type 1619 Control Tubes 1 6SJ7 Control Amplifier 1 0C3/VR105 Regulator Tube
Output	Continuously variable 160 to 450 volts, no load.
Regulation	Linear from 0 to 15 ma. at 400 volts output " " 0 to 40 ma. at 350 " " " " 0 to 70 ma. at 300 " " " " 0 to 100 ma. at 250 " " " " 0 to 130 ma. at 200 " "

It is not difficult to construct this instrument if the instructions are carefully followed. Do not rush the construction. Take time to do a first class job to insure years of troublefree operation. Hurried work increases the chances of mistakes and subsequent difficulties. **THEREFORE, READ THIS MANUAL FULLY THROUGH BEFORE STARTING THE ASSEMBLY.**

Begin by checking the parts against the parts list. Identify each part, using the charts on the inside of the cover of this manual where necessary. Thus, you will avoid throwing away any small parts with the packing.

Familiarize yourself with the layout by studying the pictorial diagrams and other data. Then proceed by following the construction notes.

Read the note on soldering on the inside of the back cover. Make a good mechanical joint of each connection with clean metal to clean metal. Use only good quality rosin core radio type solder. Pastes or acids are difficult to remove and minute amounts left combine with moisture from the air forming a corrosive product. Weeks or months later corrosion may result in untimely failure. This corrosive product is also a fairly good conductor and may cause short circuits which damage the instrument.

NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTES ARE USED.
(When in doubt about solder, it is recommended that a new roll plainly marked "Rosin Core Radio Solder" be purchased.)

Small changes in parts may be made by the Heath Company. All parts supplied will work just as well as the part for which it was substituted. All substitutions will be of equal or better quality than the original, and will be made in order that a minimum delay will occur in filling your order.

Composition resistors and controls have a tolerance rating of plus or minus 20% unless otherwise stated. Therefore, a 100K ohm resistor may test between 80K and 120K ohms. Frequently condensers show an even greater variation such as minus 50% to plus 100%. This Heathkit is designed to accommodate such variations. (The letter "K" is frequently used to indicate a multiplier of 1000.)

CONSTRUCTION NOTES

Completion of this Heathkit is very simple, and no detailed step-by-step instructions have been supplied. The large pictorial wiring diagrams, with the specific notes given below, make it possible to complete the assembly and wiring of the power supply quite easily.

The chassis and the panel are assembled and wired separately so far as possible, then fastened together. We suggest that you follow the wiring pictorials for best wire placement. Although exact position of leads is not critical in this instrument, the method illustrated may save time and confusion.

Note that the chassis is not used for any ground returns in the circuit. This makes the application of the power supply more flexible, since either negative or positive output terminals may be grounded. If necessary, neither side of the power supply need be connected to chassis or ground.

Use insulated tubing furnished over leads of resistors and condensers where they might accidentally short to other conductors or metal parts.

Tube socket pins are numbered from 1 to 8 starting at the keyway and reading clock-wise when viewed from the bottom. Refer to Figure 3.

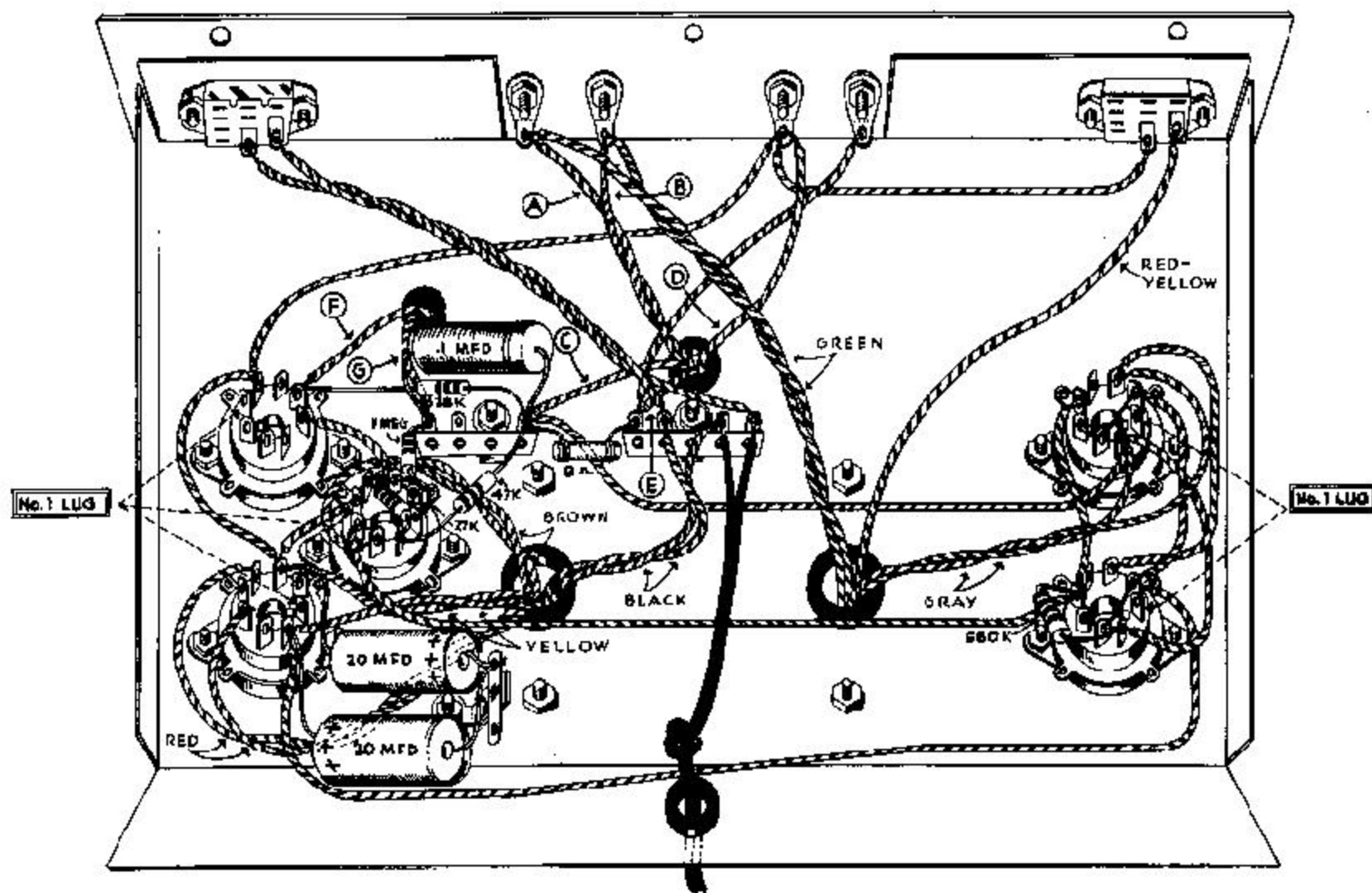


FIGURE 2
BOTTOM CHASSIS PICTORIAL

CHASSIS:

Fasten the tube sockets to the chassis with the keyway of the sockets in the position shown by the wiring pictorial (Figure 2) and using a 6-32 x 3/8 screw with a lockwasher under each nut. Install the five rubber grommets in the chassis holes provided.

The power transformer should be positioned with the green and gray leads toward the 1619 tube sockets. Use 8-32 hardware to mount the transformer, placing lockwashers under each nut. Mount the four-lug terminal strip and one of the three-lug terminal strips, using 6-32 x 3/8 screws, lockwashers and nuts.

Cut power transformer leads to proper length and connect as shown in the pictorial diagram. (Do not connect the green or red-yellow leads until panel assembly is mounted on chassis.) Wire the chassis except for leads to the panel controls.

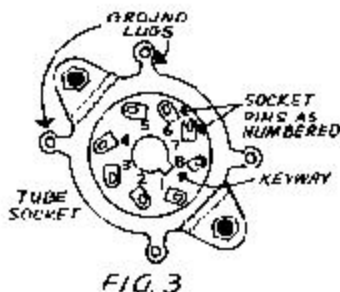


FIG. 3

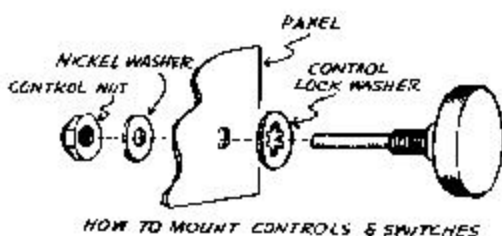


FIG. 4

PANEL: Set the chassis aside temporarily and start mounting parts on the front panel. Mount the voltage control with a control lock-washer between control and panel and with a nickel control washer between panel and control nut. Mount the pilot light assembly with the bracket toward the top. Mount the meter switch using a control lockwasher, flat washer, and nut so that the lugs are toward the meter. Refer to Figures 4 and 5 for assembly details.

Install the meter using the hardware furnished with the instrument. Fasten the top meter screws first, using the lower right hand screw to attach the remaining three lug terminal strip.

Wire the meter switch and voltage control, leaving leads long enough to reach below the chassis as required.

PANEL AND CHASSIS

Attach the front panel to the chassis using 6-32 hardware to mount the two slideswitches. These screws are also used to fasten the chassis to the panel. Install the binding posts on the front panel as shown in Figure 6. Complete wiring of the panel control leads to chassis terminal strips.

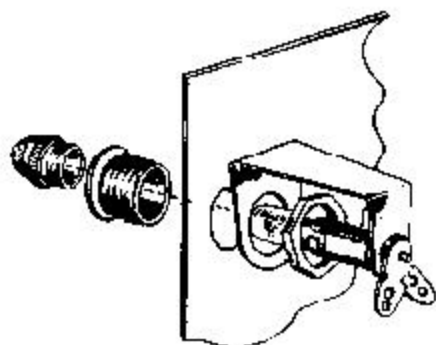
Place the power line cord through the grommet in the rear of the chassis. Tie a knot for strain relief and wire to the four lug terminal strip as shown.

This completes the wiring of the variable voltage power supply. Before attempting to try out the unit, check the wiring very closely against the schematic diagram to make sure that the construction is complete and proper.

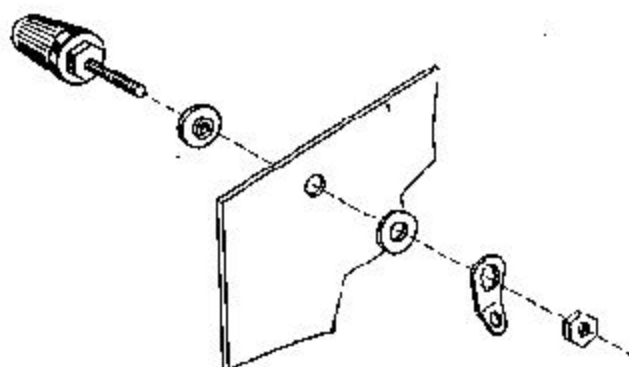
Prepare the cabinet by installing the handle with 10-24 screws and by pushing the rubber feet into the holes in the bottom. Fasten the unit in the cabinet with eight sheet metal panel screws, and two screws in the rear of the cabinet.

THEORY OF OPERATION

The Heathkit PS-2 Variable Voltage Regulated Power Supply Kit consists of a conventional power supply system utilizing a 5V4G tube as a full wave rectifier followed by a simple capacity filter. The output is connected to the load terminals through the plate-cathode resistance of the paralleled 1619 tubes. This resistance may be considered as a variable resistor controlled by the 6SJ7 tube connected so that variations in the output voltage will be reflected as grid voltage fluctuations on the 6SJ7. Corresponding changes in plate current to the tube will appear as bias voltage variations on the grids of the 1619 tubes, since the 680K ohm resistor is common to the plate of the 6SJ7 and the grids of the 1619 tubes. The manual control of the output voltage is accomplished by varying the normal grid bias of the control amplifier tube by proper adjustment of the 100K manual voltage control potentiometer. The time-delay of the regulating system is negligible so that even hum components in the output voltage are greatly reduced. The OC3/VR105 tube is used to stabilize the cathode bias of the 6SJ7 tube. The metering circuit is conventional. For maximum flexibility, neither side of the output voltage is connected to chassis. Thus the instrument may be used for applications requiring a grounded positive, such as a bias supply for amplifier circuits. A separate winding on the power transformer supplies 6.3 volts at 4.0 amperes AC for operation of tube filaments, etc.



PILOT LIGHT ASSEMBLY
FIG. 5



BINDING POST ASSEMBLY
FIG. 6

USES

There are a multitude of uses for a supply of this type which immediately come to mind. It is a convenient source of high voltage DC which in many cases will take the place of batteries. In addition, it has a standard 6.3 V AC output independent of the DC output.

1. The unit lends itself admirably as a source of reference voltages for meter calibration. For checking DC voltmeters, a standard meter and the meter to be calibrated are connected in parallel across the power supply output. DC milliammeters are calibrated by connecting the standard meter, the meter to be calibrated, and a proper value of resistance in series across the supply output. Where standard meters are not available, the meter built into the PS-2 serves nicely as a reference standard.
2. A variable voltage power supply is extremely useful for making characteristic curve runs on vacuum tubes.
3. Development of circuitry is expedited as the supply can be readily used to power experimental hookups and "breadboard" designs.
4. The unit can be used for supplying the "B" voltage on battery operated radio sets being serviced when no "B" batteries are available.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Most cases of trouble result from wrong connections. Often having a friend check the wiring will reveal a mistake consistently overlooked.
2. Check the tubes.
3. Remove the 5V4G rectifier tube and check the voltage at the HV leads as well as the filament voltage windings.
4. Check the filter condenser and then the remainder of the small components.

SERVICE

In the event continued operational difficulties of the completed instrument are experienced, may we remind you that the Heath Company has provided a technical consultation service. Every effort will be made to assist you through correspondence. May we emphasize that in all correspondence this instrument should be referred to as the Model PS-2 Variable Voltage Regulated Power Supply.

The facilities of the Heath Company Service Department are also available. Your instrument may be returned for inspection and repair for a service charge of \$3.00 plus the cost of any additional material that may be required. This service policy applies only to a completed instrument constructed in accordance with the instructions as stated in the manual. Instruments that show evidence of acid core solder or paste fluxes will be returned not repaired.

The Heath Company is willing to offer its utmost cooperation to assist you in obtaining proper operation of your instrument. The repair service is available until one year from the date of purchase.

WARRANTY

The Heath Company limits its warranty on any part supplied with any Heathkit (except tubes, meters, and rectifiers, where the original manufacturer's guarantee only applies) to the replacement within three (3) months of said part which, when returned with prior permission, postpaid, was in the judgment of the Heath Company, defective at the time of sale.

The assembler is urged to follow the instructions exactly as provided. The Heath Company assumes no responsibility for the operation of the completed instrument, nor liability for any damages or injuries sustained in the assembly or operation of the device.

HEATH COMPANY
Benton Harbor, Michigan

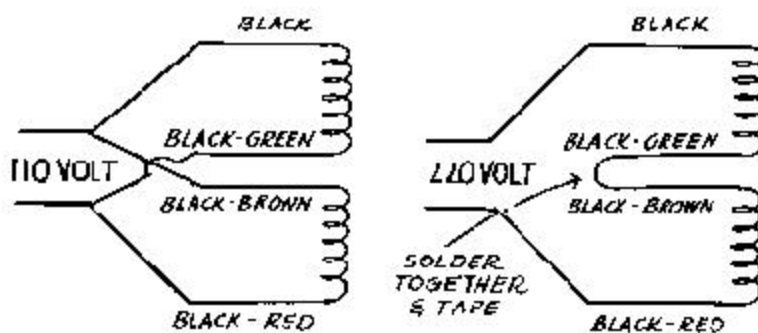
Parts List

Part No.	Qty.	Description	Part No.	Qty.	Description
Resistors			Wire		
1-20	1	10K ohm Composition resistor	344-1	1	Length Hookup wire
1-23	1	27K " " "	346-1	1	Length Spaghetti
1-24	1	33K " " "	89-1	1	Line cord
1-25	1	47K " " "	Tubes		
1-34	1	660K " " "	411-13	1	6SJ7 Tube
1-35	1	1 Megohm " " "	411-28	2	1619 Tubes
2-19	1	9 ohm Precision " "	411-35	1	5V4G Tube
2-44	1	500K " " "	411-41	1	OC3/VR105 Tube
2-57	1	1700 " " "	Transformer and Meter		
Condensers			54-14	1	Power Transformer
23-11	1	0.1 mfd. Paper condenser	407-18	1	Meter
25-16	2	20 mfd. 350 v. Electrolytic condenser	Chassis, Panel, and Cabinet		
Controls and Switches			200-M30	1	Chassis
10-25	1	100K ohm control	203-31	1	Panel
63-3	1	SPDT Rotary switch	90-4	1	Cabinet
60-1	2	SPST Slide switches	211-1	1	Handle
Sockets, Terminals, Knobs			Hardware		
434-2	5	Octal tube sockets	250-8	10	#6 x 3/8" Sheet metal screws
431-1	1	Single lug terminal strip	250-9	17	6-32 x 3/8" Machine screws
431-3	2	Three lug terminal strips	250-18	4	8-32 x 3/8" " "
431-5	1	Four lug terminal strip	250-19	2	10-24 x 3/8" " "
462-9	2	Pointer knobs	250-22	2	#8 Set screws (for knobs)
Pilot Lamp Assembly			252-3	21	6-32 x 1/4" Hex nuts
414-22	1	Pilot lamp socket	252-4	4	8-32 x 3/8" " "
455-1	1	Pilot lamp bushing	252-7	2	Control nuts
413-1	1	Pilot lamp jewel	252-12	1	Pilot Light nut
412-1	1	#47 panel lamp	253-1	4	#6 Flat fiber washers
Binding Post Assembly			253-2	4	#6 Shoulder fiber washers
427-2	4	Binding post bases	253-10	2	Control flat washers
100-M16	4	Binding post caps	254-1	17	#6 lockwashers
			254-2	4	#8 " "
			254-4	2	Control " "
			259-1	4	#8 Solder lugs
			261-1	4	Rubber feet
			73-1	3	3/8" Rubber grommet
			73-2	2	3/4" " "



WIRING OF EXPORT TYPE
110/220 VOLT POWER
TRANSFORMERS

These transformers have a dual primary for use on either 110 Volts or 220 Volts.
Wire as shown.



HELPFUL KIT BUILDING INFORMATION

Before attempting actual kit construction read the construction manual through thoroughly to familiarize yourself with the general procedure. Note the relative location of pictorials and pictorial inserts in respect to the progress of the assembly procedure outlined.

This information is offered primarily for the convenience of novice kit builders and will be of definite assistance to those lacking thorough knowledge of good construction practices. Even the advanced electronics enthusiast may benefit by a brief review of this material before proceeding with kit construction. In the majority of cases, failure to observe basic instruction fundamentals is responsible for inability to obtain desired level of performance.

RECOMMENDED TOOLS

The successful construction of Heathkits does not require the use of specialized equipment and only basic tools are required. A good quality electric soldering iron is essential. The preferred size would be a 100 watt iron with a small tip. The use of long nose pliers and diagonal or side cutting pliers is recommended. A small screw driver will prove adequate and several additional assorted screw drivers will be helpful. Be sure to obtain a good supply of rosin core type radio solder. Never use separate fluxes, paste or acid solder in electronic work.

ASSEMBLY

In the actual mechanical assembly of components to the chassis and panel, it is important that the procedure shown in the manual be carefully followed. Make sure that tube sockets are properly mounted in respect to keyway or pin numbering location. The same applies to transformer mountings so that the correct transformer color coded wires will be available at the proper chassis opening.

Make it a standard practice to use lock washers under all 6-32 and 8-32 nuts. The only exception being in the use of solder lugs—the necessary locking feature is already incorporated in the design of the solder lugs. A control lock washer should always be used between the control and the chassis to prevent undesirable rotation in the panel. To improve instrument appearance and to prevent possible panel marring use a control flat nickel washer under each control nut.

When installing binding posts that require the use of fiber insulating washers, it is good practice to slip the shoulder washer over the binding post mounting stud before installing the mounting stud in the panel hole provided. Next, install a flat fiber washer and a solder lug under the mounting nut. Be sure that the shoulder washer is properly centered in the panel to prevent possible shorting of the binding post.

WIRING

When following wiring procedure make the leads as short and direct as possible. In filament wiring requiring the use of a twisted pair of wires allow sufficient slack in the wiring that will permit the twisted pair to be pushed against the chassis as closely as possible thereby affording relative isolation from adjacent parts and wiring.

When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown baked enamel coating. After the transformer leads have been trimmed to a suitable length, it is necessary to scrape the enamel coating in order to expose the bright copper wire before making a terminal or soldered connection.

In mounting parts such as resistors or condensers, trim off all excess lead lengths so that the parts may be installed in a direct point-to-point manner. When necessary use spaghetti or insulated sleeving over exposed wires that might short to nearby wiring.

It is urgently recommended that the wiring dress and parts layout as shown in the construction manual be faithfully followed. In every instance, the desirability of this arrangement was carefully determined through the construction of a series of laboratory models.

SOLDERING

Much of the performance of the kit instrument, particularly in respect to accuracy and stability, depends upon the degree of workmanship used in making soldered connections. Proper soldered connections are not at all difficult to make but it would be advisable to observe a few precautions. First of all before a connection is to be soldered, the connection itself should be clean and mechanically strong. Do not depend on solder alone to hold a connection together. The tip of the soldering iron should be bright, clean and free of excess solder. Use enough heat to thoroughly flow the solder smoothly into the joint. Avoid excessive use of solder and do not allow a flux flooding condition to occur which could conceivably cause a leakage path between adjacent terminals on switch assemblies and tube sockets. This is particularly important in instruments such as the VTVM, oscilloscope and generator kits. Excessive heat will also burn or damage the insulating material used in the manufacture of switch assemblies. Be sure to use only good quality rosin core radio type solder.

Antenna General		Resistor General		Neon Bulb		Receptacle two-conductor	
Loop		Resistor Tapped		Illuminating Lamp		Battery	
Ground		Resistor Variable		Switch Single pole Single throw		Fuse	
Inductor General		Potentiometer		Switch double pole single throw		Piezoelectric Crystal	
Air core Transformer General		Thermistor		Switch Triple pole Double throw		1000 =	K
Adjustable Powdered Iron Core		Jack two conductor		Switch Multipoint or Rotary		1,000,000 =	M
Magnetic Core Variable Coupling		Jack three conductor		Speaker		OHM =	Ω
Iron Core Transformer		Wires connected		Rectifier		Microfarad =	MF
Capacitor General		Wires Crossing but not connected		Microphone		Micro Microfarad =	MMF
Capacitor Electrolytic		A. Ammeter V. Voltmeter		Typical tube symbol 		Binding post Terminal strip	
Capacitor Variable		G. Galvanometer MA. Milliammeter uA. Microammeter, etc.				Wiring between like letters is understood	

Courtesy of I. R. E.

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