PRICE $2.00

Assembling and Using Your...

Heathkit

12 WATT AMPLIFIER

MODEL UA-1

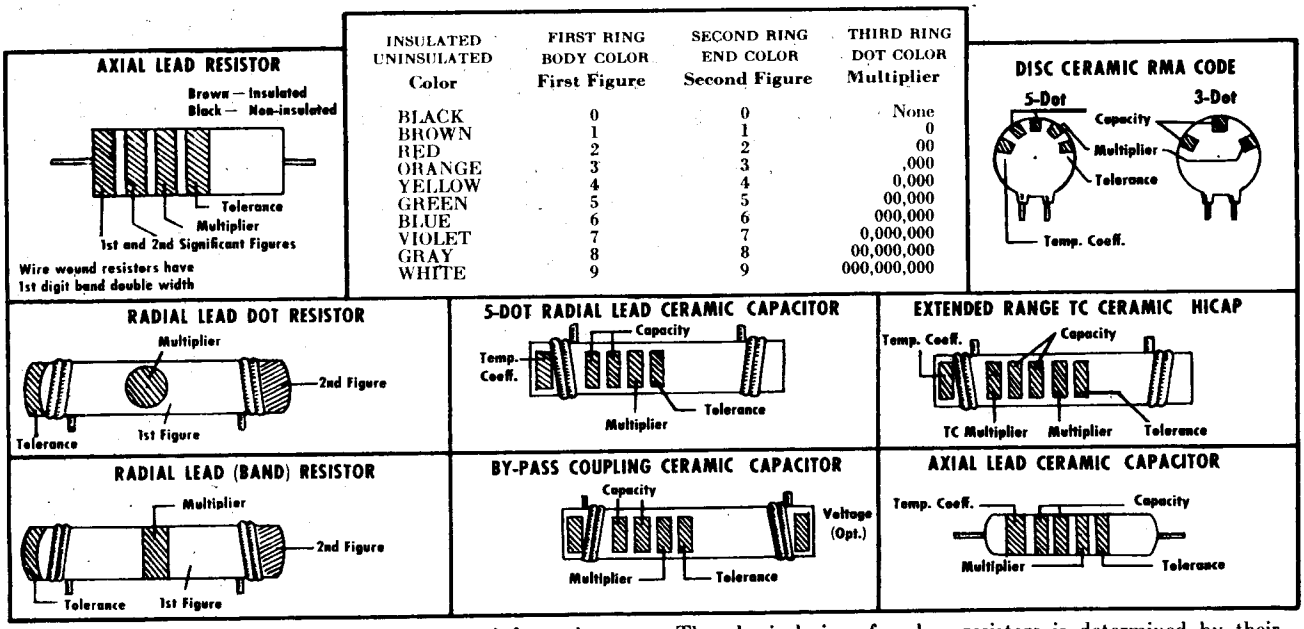
HEATH COMPANY

A Subsidiary of Daystrom Inc.

BENTON HARBOR, MICHIGAN

595-186

STANDARD COLOR CODE — RESISTORS AND CAPACITORS

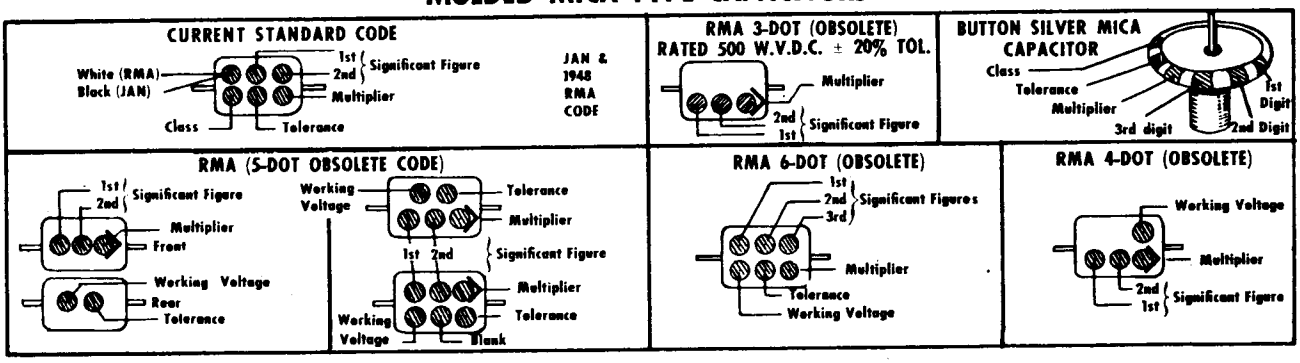


INSULATED UNINSULATED Color	FIRST RING BODY COLOR First Figure	SECOND RING END COLOR Second Figure	THIRD RING DOT COLOR Multiplier
BLACK	0	0	None
BROWN	1	1	0
RED	2	2	00
ORANGE	3	3	,000
YELLOW	4	4	0,000
GREEN	5	5	00,000
BLUE	6	6	000,000
VIOLET	7	7	0,000,000
GRAY	8	8	00,000,000
WHITE	9	9	000,000,000

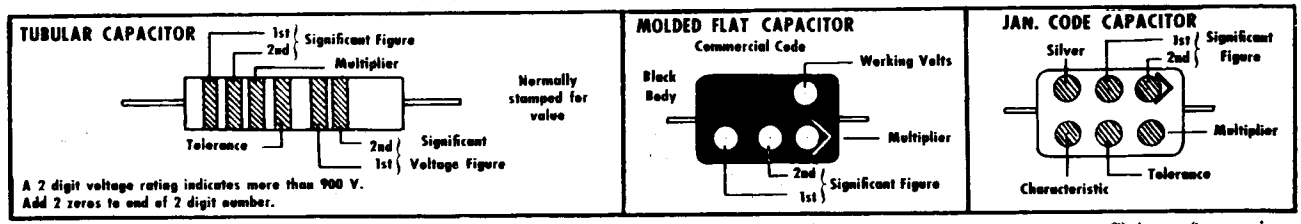
The standard color code provides all necessary information required to properly identify color coded resistors and capacitors. Refer to the color code for numerical values and the zeroes or multipliers assigned to the colors used. A fourth color band on resistors determines tolerance rating as follows: 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 ½ watt. Higher wattage rated resistors when specified are progressively larger in physical size. Small wire wound resistors ½ watt, 1 or 2 watt may be color coded but the first band will be double width.

MOLDED MICA TYPE CAPACITORS



MOLDED PAPER TYPE CAPACITORS



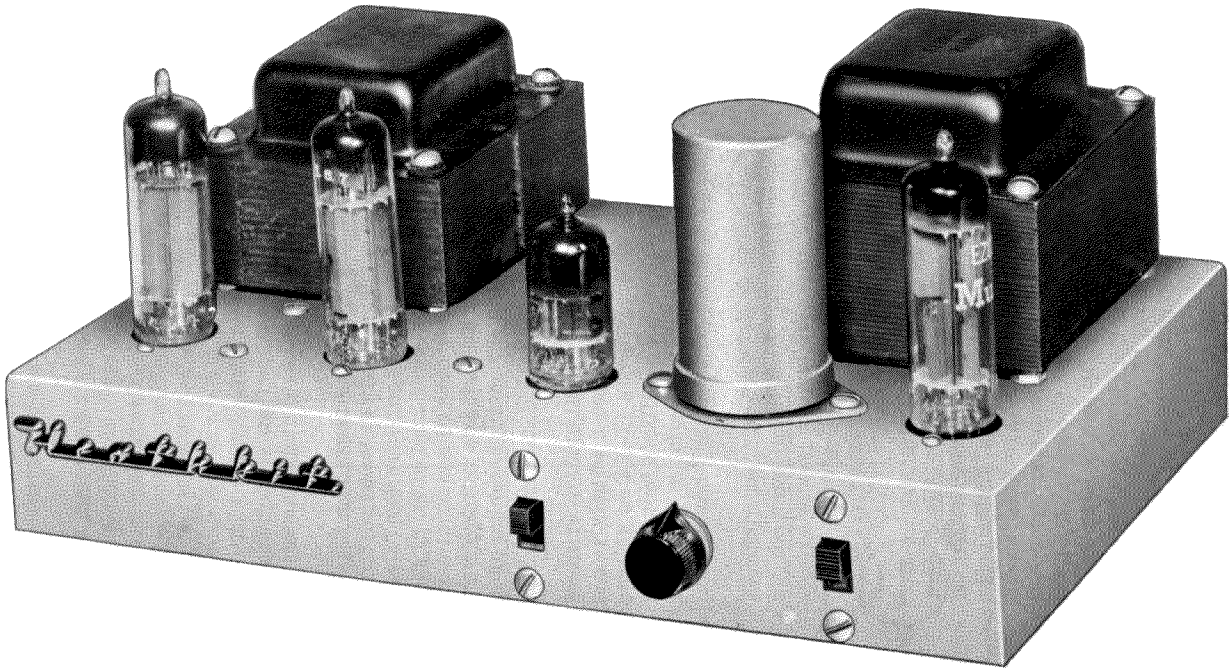
The tolerance rating of capacitors is determined by the color code. For example: red = 2%, green = 5%, etc. The voltage rating of capacitors is obtained by multiplying the color value by 100. For example: orange = 3 × 100 or 300 volts. Blue = 6 × 100 or 600 volts.

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.

Courtesy of Centralab

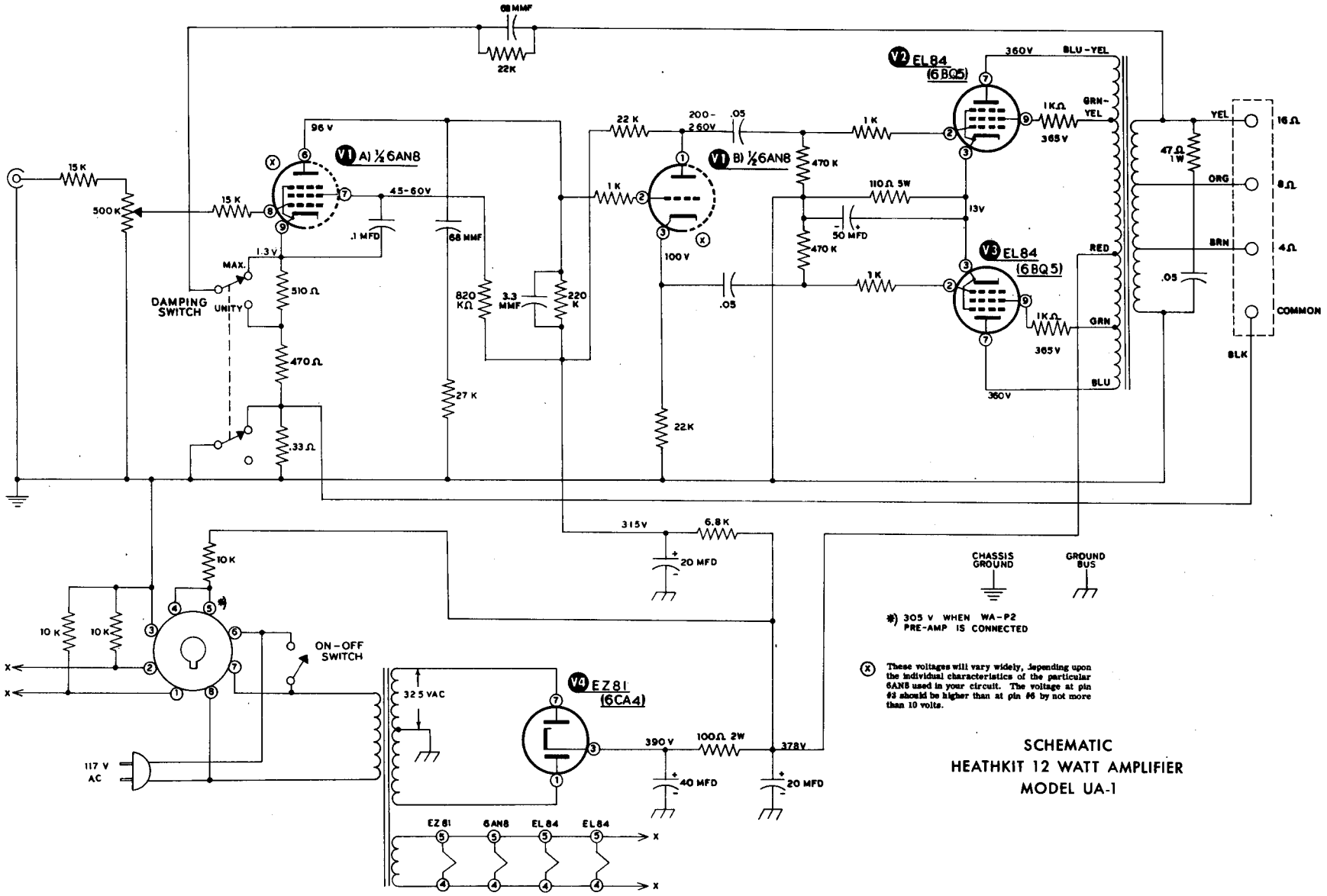
ASSEMBLY AND OPERATION OF THE HEATHKIT 12 WATT AMPLIFIER

MODEL UA-1



SPECIFICATIONS

Power Output:	12 watts.
Frequency Response:	± 1 db from 20 to 20,000 cycles at 12 watts output.
Hum and Noise:	73 db below 12 watts. 63 db below 1 watt.
Output Impedances:	4, 8, and 16 ohm.
Damping Factor:	Switched for unity or maximum. Maximum damping ratio = 15.66
Tube Complement:	1 - 6AN8 1 - EZ81 (6CA4) 2 - EL84 (6BQ5)
Input and Output Terminations:	Input - standard (phono) jack. Output - 4-screw terminal strip.
Power Requirements:	117 volts, 50-60 cycles, 75 watts.
Accessories:	Octal socket on rear for preamp power. Supplies 300V at 10 ma. Power switched on and off either at the front panel, or remotely at the preamplifier, by means of connections to the octal socket.
Dimensions:	10" wide x 6 1/2" deep x 4 3/4" high.
Finish:	Satin gold enamel.
Net Weight:	10 1/2 lbs.
Shipping Weight:	12 1/2 lbs.



SCHEMATIC
HEATHKIT 12 WATT AMPLIFIER
MODEL UA-1

CIRCUIT DESCRIPTION

The Heath UA-1 Amplifier is a three stage feedback amplifier employing a 6AN8 triode-pentode as the voltage amplifier and phase-inverter, and EL-84 pentodes as output tubes.

The input signal is applied to the 6AN8 pentode grid, after being coupled through the 15 K isolating resistors and across the 500 K ohm level control. The pentode acts as a voltage amplifier, and "DC" couples the signal to the grid of the triode phase inverter. The 22 K ohm ±5% resistors, acting as a split load, couple the signal to the output grids through .05 mfd capacitors. The output tubes are operating in a partial triode condition, that is, with the screen leads connected at given points between the plate and B+ connections. In this manner, the purity of waveform of triode operation could be increased by connecting the screen lead (on the transformer) more toward its plate connection. Conversely, the high gain characteristic of pentode operation, could be increased by connecting this screen lead closer to the B+ connection on the transformer. This transformer has been optimized to give the best compromise between the two modes of operation. Degenerative feedback is taken from the secondary of the transformer and fed back to the cathode of V-1A to widen the frequency response of the amplifier.

The use of some of the confusing "do-jiggers" installed hither and yon in the circuit may be explained as follows:

In the cathode circuit of V-1A we find the "damping" switch. "Unity Damping", simply stated, means that the source impedance at the amplifier output terminals will exactly match the load impedance connected to it.

Maximum (max) damping, is that condition where the source impedance at the amplifier is less than the load impedance. For an example, if the amplifier source impedance (in the 16 ohm position) is one ohm, and the load is 16 ohms, there would be a 16 to 1 damping ratio.

In the "max" position, 18 db of voltage feedback is returned to the cathode of V-1A and the .33 ohm resistor is shorted out, connecting the "common" output lug directly to ground.

In the "Unity" position, the voltage feedback is cut in half by returning the voltage feedback connection to approximately the half-way point on the cathode resistance. Current feedback is introduced by removing the short from the .33 ohm resistor and forcing the load current to return to ground through it. The result of this is to change the output impedance to exactly 16 ohms in the "unity" damping position.

The 68 mmfd and 27 Kohm "step network" in the plate circuit of V-1A controls the upper frequency cut-off point of the amplifier, and thus controls the amplifiers "transient stability". Its effects, along with the effects of the 3.3 mmfd capacitor and the other 68 mmfd capacitor, can most easily be observed on an oscilloscope when a 10 kc square wave is connected to the amplifier input. Altering of these values will change the flatness of the top and bottom of the square wave, thus making the amplifier less stable to fast rising waveforms.

The 50 mfd capacitor from the common cathode of the output stage to ground, will decrease the intermodulation distortion. The 47 ohm resistor along with the .05 mfd capacitor in series with it, is to load down the amplifier at high frequencies. Its effects can be seen when a 10 kc square wave is put through the amplifier and the load is removed. Without this network, in an unloaded state, the amplifier could easily break into oscillation.

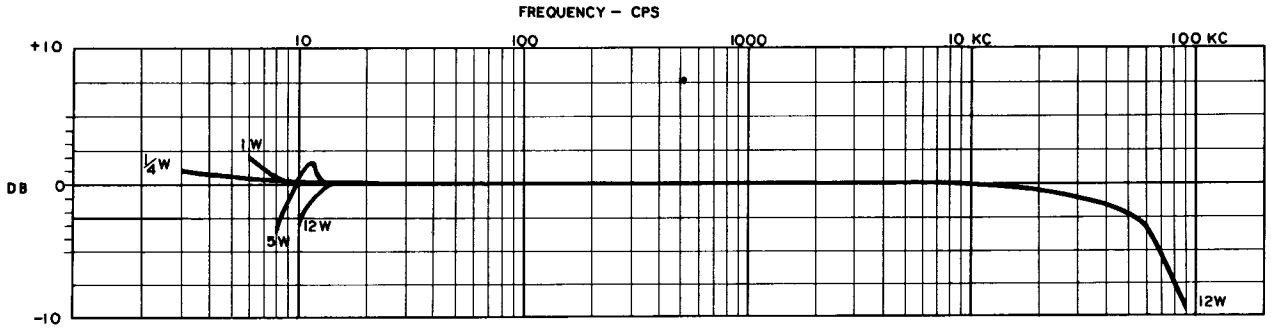
Positive voltage is supplied to the amplifier and pre-amp power plug by a conventional full-wave power supply, employing an EZ-81 rectifier. Note that the on-off switch may be operated locally by the switch shown on the diagram, or remotely in the pre-amplifier, by essentially shorting across pins #6 and 7 of the octal power socket.

An additional item that would be well to keep in mind is that all the tests mentioned, especially those involving 10 kc square waves, are usually made using a 16 ohm resistor for load (noninductive resistor). This is to eliminate any possible inaccuracies due to load variations.

The reason that square waves are so often used in testing high fidelity amplifiers is that the ultimate in amplifier quality is demanded to pass them well. Let us use the 10 kc square wave we have spoken of, as an example. How well the corners are reproduced indicates the amount of high-frequency response. The sharper the corners are, the better the high-frequency. The very application of the square wave would send an amplifier with poor stability into wild oscillations and the square wave wouldn't even be recognizable. The more stability the amplifier has, the closer the top and bottom of the square wave are to being flat.

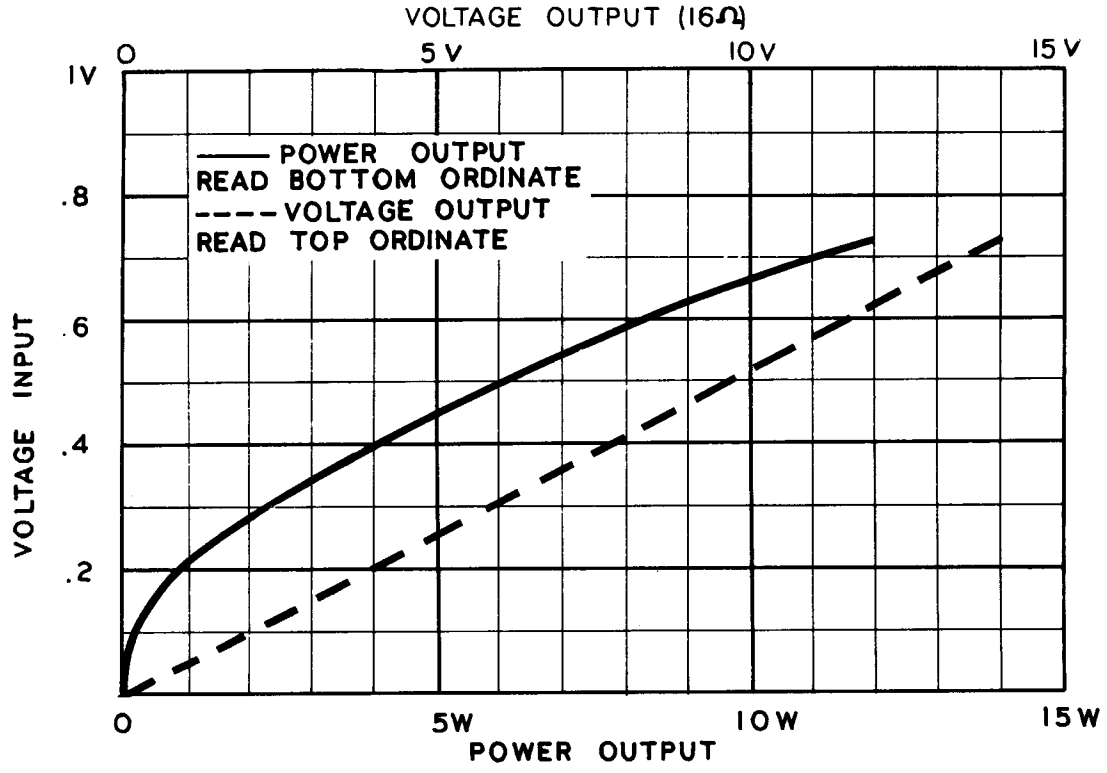
Power Output:..... 12 watts

Frequency Response:.....±1 db from 20 to 20, 000 cycles at 12 watts output.



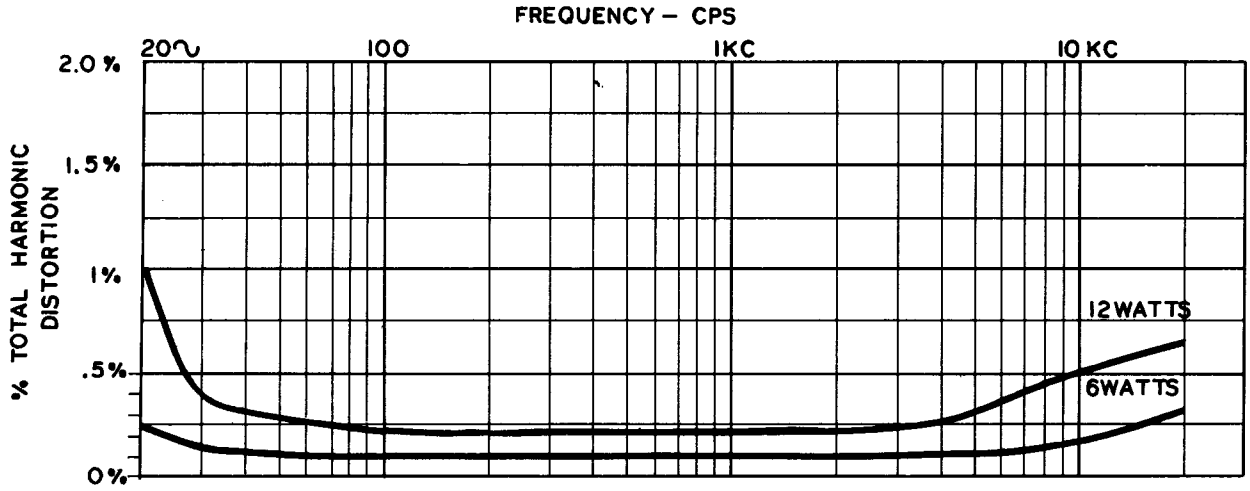
Sensitivity:..... Variable from zero to full output by means of the "level" control on the front panel.

The graph below shows the input voltage required for the various power output levels with the level control at maximum.

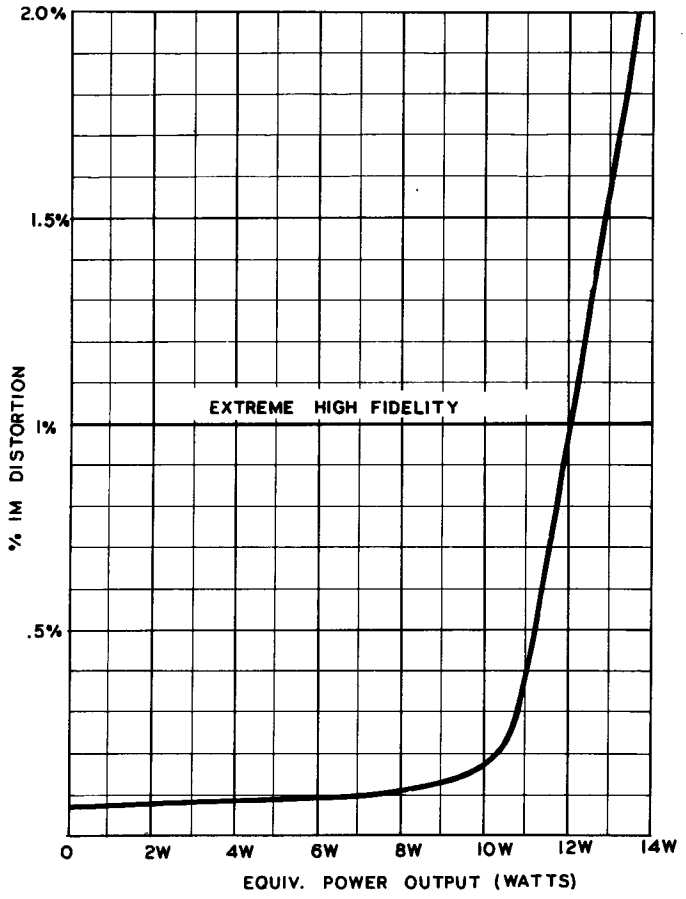


Harmonic Distortion:

The graph below shows the per cent of harmonic distortion versus frequency at full power and at the half power level. Authorities agree that 2% harmonic distortion is tolerable in high fidelity equipment and .7% or less is completely imperceptible to the ear, even to the most highly trained observers.



Intermodulation Distortion:



Test Conditions:

Load Impedance:.....	16.1 ohm dummy load, resistive.
Line Voltage:.....	117 V, 60 cycle, regulated.
Instruments used:.....	Heathkit AG-9A Audio Oscillator with inherent distortion less than .1%.
	Hewlett-Packard, Model 400 D, AC Voltmeter.
	Hewlett-Packard Model 330 B, Distortion Analyzer (Harmonic).
	Heathkit Model AA-1 (for intermodulation distortion).
	D. C. Voltage measurements made on "Acton VTVM", type No. 810.

Stability:

The UA-1 Amplifier has been designed to be completely stable under all operating conditions. It may be operated with no load without damaging any of the amplifier components. Shunt capacities of .06 mfd, and more across the amplifier output, even with no resistive load at all, cause no instabili ty or oscillation.

INTRODUCTION

The UA-1 has the title of "Universal Amplifier" since its size, price, and operational features suggest a great multitude of applications. Except for its lower power output, it has been designed to offer the same high fidelity performance as its big brothers in the Heath line, the W-3, 4, 5, 6 and 7.

Basically, of course, since it works with the Heath WA-P2 Pre-Amplifier, it presents a good starting point for those of you who want to keep initial expenses down and "grow" a larger hi-fi system over a period of time. In stereo applications, two UA-1's may be used, or your present system may be converted to stereo by adding a UA-1 (and the other necessary units) to your present system. Some of the other uses would include: small wired music systems for the home or small business; as the additional amplifier used with the electronic crossover; and as a line bridging amplifier for unbalanced lines. These, and many more uses, are aided by the provisions which have been made for switching the amplifier on and off, either on the chassis or, in a remote location such as on the WA-P2.

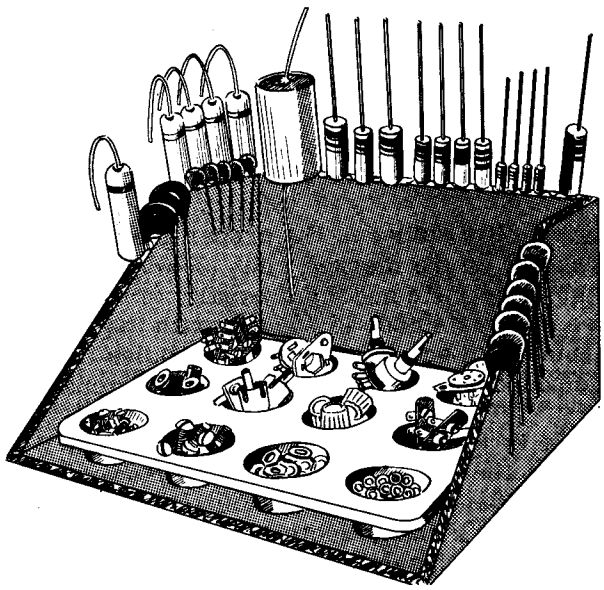
NOTES ON ASSEMBLY AND WIRING

This manual is supplied to assist you in every way to complete the instrument with the least possible chance for error. We suggest that you take a few minutes now and read the entire manual through before any work is started. This will enable you to proceed with the work much faster when construction is started. The large fold-in pictorials are handy to attach to the wall above your work space. Their use will greatly simplify the completion of the kit. These diagrams are repeated in smaller form within the manual. We suggest that you retain the manual in your files for future reference, both in the use of the instrument and for its maintenance.

UNPACK THE KIT CAREFULLY AND CHECK EACH PART AGAINST THE PARTS LIST. In so doing, you will become acquainted with each part. Refer to the charts and other information shown on the inside covers of the manual to help you identify any parts about which there may be a question. If some shortage is found in checking the parts, please notify us promptly and return the inspection slip with your letter to us. Hardware items are counted by weight and if a few are missing, please obtain them locally if at all possible.

Resistors and controls generally have a tolerance rating of ± 20% unless otherwise stated in the parts list. Therefore a 100 KΩ resistor may test anywhere from 80 KΩ to 120 KΩ. (The letter K is commonly used to designate a multiplier of 1000.) Tolerances on condensers are generally even greater. Limits of +100% and -50% are common for electrolytic condensers. The parts furnished with your Heathkit have been specified so as to not adversely affect the operation of the finished instrument.

In order to expedite delivery to you, we are occasionally forced to make minor substitutions of parts. Such substitutions are carefully checked before they are approved and the parts supplied will work satisfactorily. By checking the parts list for resistors, for example, you may find that a 1200Ω resistor has been supplied in place of a 1 KΩ as shown in the parts list. These changes are self-evident and are mentioned here only to prevent confusion in checking the contents of your kit.



Most kit builders find it helpful to separate the various parts into convenient catagories. Muffin tins or molded egg cartons make convenient trays for small parts. Resistors and capacitors may be placed in the edge of a piece of corrugated cardboard until they are needed. Values can be written on the cardboard next to each component. The illustration shows one method that may be used. Read through the entire manual before starting construction. In this way you will become familiar with the techniques employed in the building of your kit. As a further deterrent to errors, read each step of the construction and wiring completely before performing that step.

Read the notes on soldering and wiring on the inside rear cover. Crimp all leads tightly to the terminal before soldering. Be sure both the lead and terminal are free of wax, corrosion or other foreign substances. Use only the best rosin core solder, preferably a type containing the new activated fluxes such as Kester "Resin-Five," Ersin "Multicore" or similar types.

Unless otherwise indicated, all wire used is insulated. Wherever there is a possibility of the bare leads on resistors and capacitors shorting to other parts or to chassis, the leads should be covered with insulated sleeving. This is indicated in the instructions by the phrase "use sleeving." Bare wire is used where the lead lengths are short and the possibility of short circuits are non-existent.

Leads on resistors, capacitors and transformers are generally much longer than they need to be to make the indicated connections. In these cases, the excess leads should be cut off before the part is added to the chassis. In general, the leads should be just long enough to reach their terminating points. Not only does this make the wiring much neater but in many instances, the excessively long leads will actually interfere with proper operation of the instrument.

The pictorials indicate actual chassis wiring and designate values of the component parts. We very strongly urge that the chassis layout, lead placement and grounding connections be followed exactly as shown. While the arrangement shown is probably not the only satisfactory layout, it is the result of considerable experimentation and trial. If followed carefully, it will result in a stable instrument operating at a high degree of accuracy and dependability.

Space has been provided for you to check off each operation as it is completed. This is particularly important in wiring and it may prevent omissions or errors, especially where your work is interrupted frequently as the wiring progresses. Some kit builders have also found it helpful to mark each lead in colored pencil on the pictorial as it is added.

PROPER SOLDERING PROCEDURE

Only a small percentage of Heathkit purchasers find it necessary to return an instrument for factory service. Of these, by far the largest proportion function improperly due to poor or improper soldering.

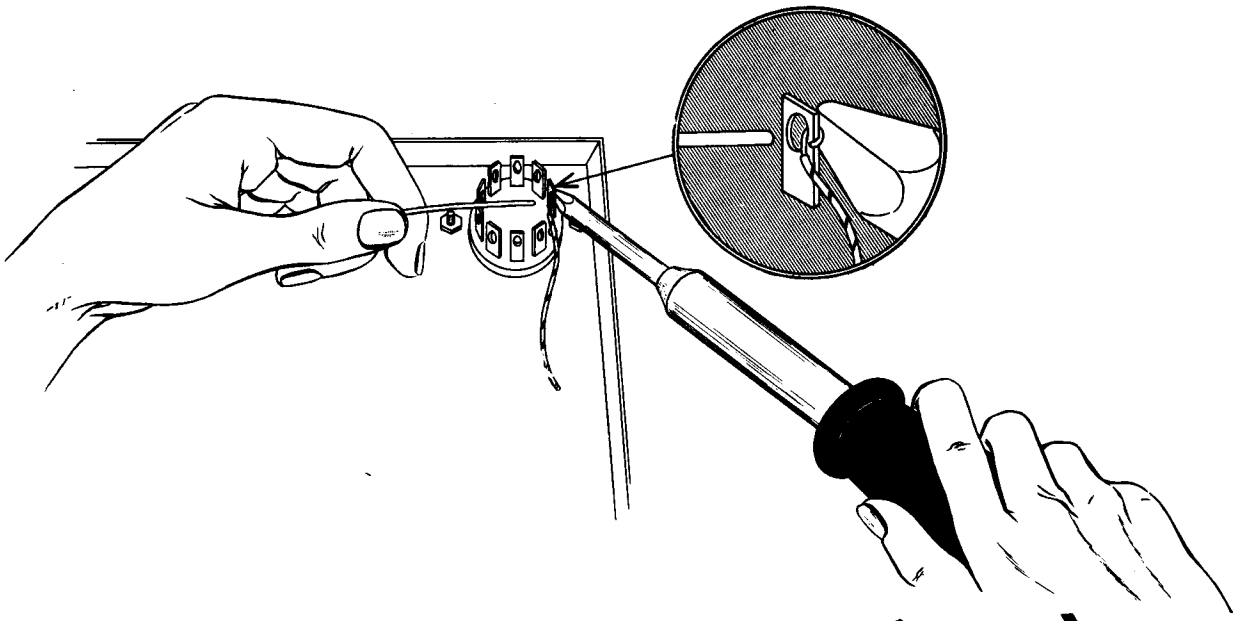
Correct soldering technique is extremely important. Good solder joints are essential if the performance engineered into the kit is to be fully realized. If you are a beginner with no experience in soldering, a half-hour's practice with odd lengths of wire and a tube socket will be a worthwhile investment.

High quality solder of the proper grade is most important. There are several different brands of solder on the market, each clearly marked "Rosin Core Radio Solder." Such solders consist of an alloy of tin and lead, usually in the proportion of 50:50. Minor variations exist in the mixture such as 40:60, 45:55, etc. with the first figure indicating the tin content. Radio solders are formed with one or more tubular holes through the center. These holes are filled with a rosin compound which acts as a flux or cleaning agent during the soldering operation.

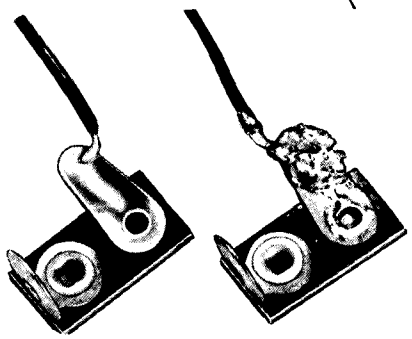
NO SEPARATE FLUX OR PASTE OF ANY KIND SHOULD BE USED. We specifically caution against the use of so-called "non-corrosive" pastes. Such compounds, although not corrosive at room temperatures, will form residues when heated. The residue is deposited on surrounding surfaces and attracts moisture. The resulting compound is not only corrosive but actually destroys the insulation value of non-conductors. Dust and dirt will tend to accumulate on these "bridges" and eventually will create erratic or degraded performance of the instrument.

> NOTE: ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE INSTRUMENTS IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. WHEN IN DOUBT ABOUT SOLDER, IT IS RECOMMENDED THAT A NEW ROLL PLAINLY MARKED "ROSIN CORE RADIO SOLDER" BE PURCHASED.

If terminals are bright and clean and wires free of wax, frayed insulation and other foreign substances, no difficulty will be experienced in soldering. Crimp or otherwise secure the wire (or wires) to the terminal, so a good joint is made without relying on solder for physical strength. To make a good solder joint, the clean tip of the soldering iron should be placed against the joint to be soldered so that the terminal is heated sufficiently to melt solder. The solder is then placed against both the terminal and the tip of the iron and will immediately flow out over the joint. Refer to the sketch below. Use only enough solder to cover wires at the junction; it is not necessary to fill the entire hole in the terminal with solder. Excess solder may flow into tube socket contacts, ruining the socket, or it may creep into switch contacts and destroy their spring action. Position the work so that gravity tends to keep the solder where you want it.



A poor solder joint will usually be indicated by its appearance. The solder will stand up in a blob on top of the connection, with no evidence of flowing out caused by actual "wetting" of the contact. A crystalline or grainy texture on the solder surface, caused by movement of the joint before it solidified is another evidence of a "cold" connection. In either event, reheat the joint until the solder flows smoothly over the entire junction, cooling to a smooth, bright appearance. Photographs in the adjoining picture clearly indicate these two characteristics.



A good, clean, well-tinned soldering iron is also important to obtain consistently perfect connections. For most wiring, a 60 or 100 watt iron, or the equivalent in a soldering gun, is very satisfactory. Smaller irons generally will not heat the connections enough to flow the solder smoothly over the joint and are recommended only for light work, such as on etched circuit boards, etc. Keep the iron tip clean and bright. A pad of steel wool may be used to wipe the tip occasionally during use.

Take these precautions and use reasonable care during assembly of the kit. This will insure the wonderful satisfaction of having the instrument operate perfectly the first time it is turned on.

HELPFUL HINTS

1. Don't apply too much solder to the solder joint. Don't apply the solder to the iron only, expecting that it will roll down to the connection. Try to follow the instructions and illustrations on the preceding page as closely as possible.

2. For that close resistor connection (such as between adjacent pins of a tube socket) hold the resistor body in one hand and gently bend the leads close to its body with the index finger of the other hand. Don't do this more than once to the same lead since some resistor leads could break off with continuous bending.

3. Don't bend a lead more than once around a connecting point. If it should have to come off due to a mistake or for maintenance it will be much easier to remove.

4. Keep your soldering iron clean (see above). Wipe it quickly from time to time with steel wool or a rag (don't let the rag burn, natch). This will keep solder from slobbering over the solder joints and help the iron to heat better.

5. Tinning a lead -- Heat the stripped lead with the soldering iron and apply solder to it. While the lead is still hot, shake off the excess solder by rapping the hand that holds the lead sharply against the workbench.

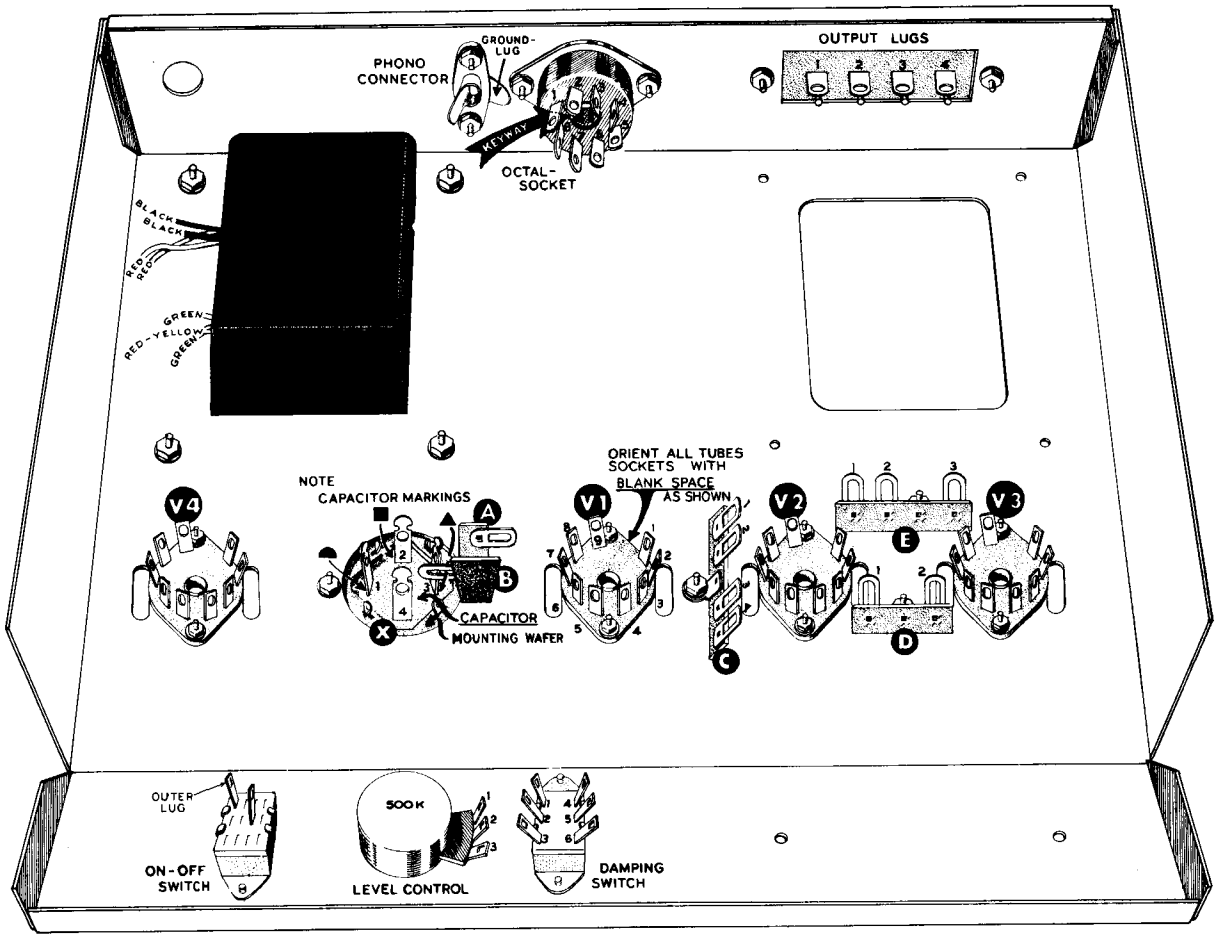
6. Two or more connections to the same solder lug -- a common mistake is to neglect soldering the connections on the bottom. Make sure all the wires are soldered.

The abbreviation "NS" indicates that the connection should not be soldered as yet, for other wires will be added. When the last wire is installed, the terminal should be soldered and the abbreviation "S" is used to indicate this. Note that a number appears after each solder (S) instruction. This number indicates the number of leads connected to the terminal in question.

For example, if the instructions read, "Connect a 47 KΩ resistor from socket E1 (S-2)," it will be understood that there will be two leads connected to the terminal at the time it is soldered. This additional check will help avoid errors.

We suggest you do the following before any work is started:
1. Attach the large fold-in pictorials to the wall above your workbench.
2. Go through the entire assembly and wiring instructions. This is an excellent time to read the entire instruction section through and familiarize yourself with the procedure.
3. Lay out all parts so that they are readily available. Refer to the general information inside the front and back covers of this manual to help you identify components.

The following instructions are presented in a simple, logical, step-by-step sequence to enable you to complete your kit with the least possible confusion. Be sure to read each step all the way through before you start to do it. When the step is completed, check it off in the space provided.



PICTORIAL 1

( ) Start the Amplifier by mounting the "damping switch" (6 lugs, either way up) using 6-32 screws in the tapped holes.

( ) Using 6-32 hardware, mount the two lug on-off switch with the outer lug facing toward the top of the chassis.

( ) Install the four 9 pin sockets (V-1, V-2, V-3 and V-4); use 3-48 screws, nuts and washers. Be sure to mount these sockets to the under side of the chassis with the blank spaces toward the middle section of the chassis. See Pictorial 1. A nut starter will be helpful in starting the nuts.

( ) Using 6-32 screws, nuts and washers, mount the capacitor mounting wafer to the upper side of the chassis between tubes V-1 and V-4. Use the mounting screw on the side closest V-1 to secure terminal lugs "A" and "B". Terminal "B" is the taller and should point to tube V-4.

( ) Using 6-32 screws, nuts, and washers, mount terminal strips C, D, and E in their proper places, as shown in the Pictorial. (Note that terminals D and F are not interchangeable, only terminal F will mount on the #8 transformer screw.)

( ) Mount the four lug, screw-type terminal strip in the "output lugs" position on the outside of the chassis with 6-32 hardware (screws, nuts and lockwashers).

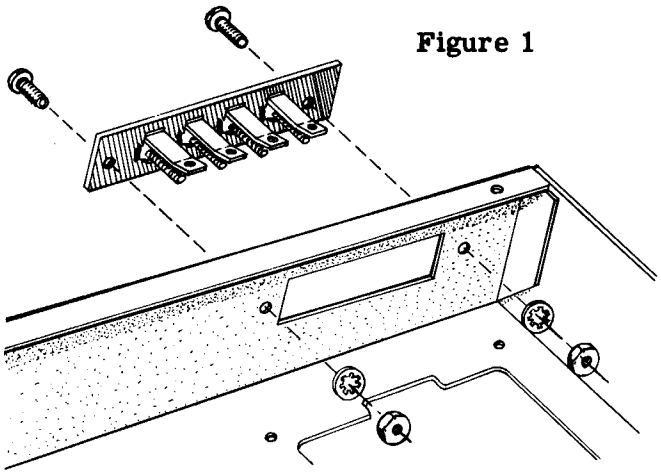


Figure 1

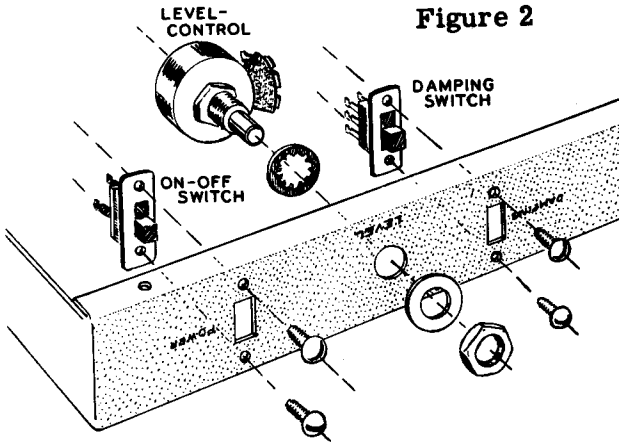


Figure 2

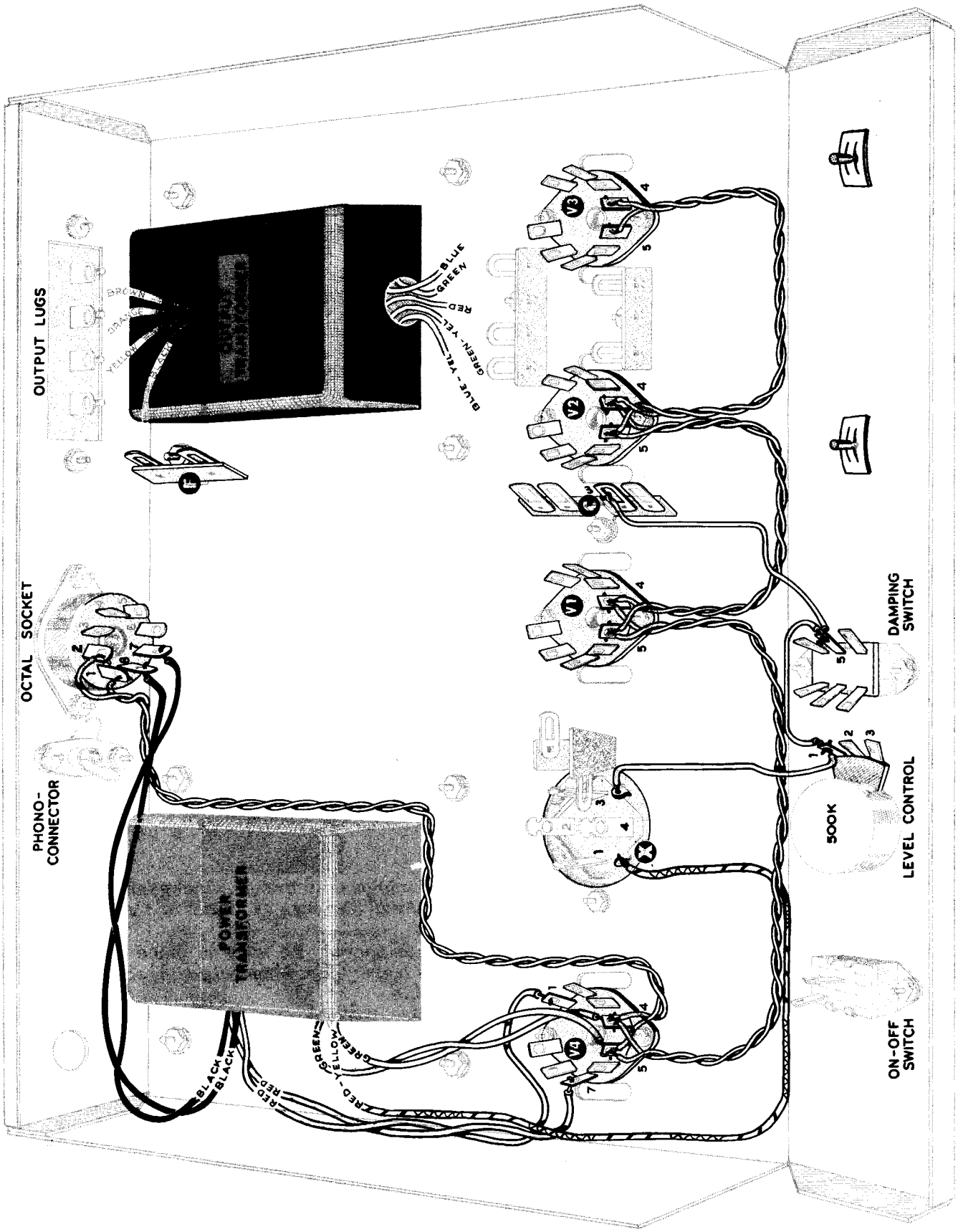
( ) Mount the 500 K ohm "level" control next to the damping switch using a lockwasher, nickel-washer, and control nut, as shown in Figure 2. Align the lugs as shown in the pictorial.

( ) Using 6-32 hardware, mount the phono connector as shown. Be sure to place it such that the ground lug (on the outside of the connector) is facing toward the output lugs.

( ) Mount the octal socket from inside the chassis using 6-32 hardware. Be careful to align the keyway to face toward the phono connector.

( ) Mount the power transformer on top of the chassis near V-4 and secure it with 8-32 nuts, and lockwashers. (Do not loosen the #8 nuts already on the transformer.) Tighten nuts equally.

( ) Mount the filter capacitor in the capacitor mounting wafer oriented as shown in the pictorial. This is done by inserting the four case lugs through the holes in the mounting wafer. It is then locked in place by twisting each case lug slightly with a pair of pliers. Hold condenser tightly in place while the lugs are twisted. (Note capacitor markings in pictorial.)


OUTPUT LUGS
OCTAL SOCKET
PHONO-CONNECTOR
POWER TRANSFORMER
BLUE
GREEN
RED
BLUE - YEL.
GREEN - YEL.
BLACK
BLACK
RED
RED
GREEN - YELLOW
DAMPING SWITCH
500K
LEVEL CONTROL
ON-OFF SWITCH
V1
V2
V3
V4
X

PICTORIAL 2

( ) Mount the output transformer on top of the chassis using 8-32 hardware to secure it. Orient the four, solid color leads toward the four output lugs, and place terminal strip F on the mounting screw nearest the octal socket.

( ) Slide the two mounting studs of the "Heathkit" name through the 7/32" holes in the left side of the front panel. Place one Tinnerman speed nut over each mounting stud on the inside of the panel.

( ) Twist the two black, power transformer leads together and route them along the corner of the chassis to the octal socket. Cut the leads to the proper length, strip them, and connect one to pin 7 (NS) and the other to pin 8 (NS).

( ) Twist the two green power transformer leads together and route them to pins 4 (NS) and 5 (NS) of V-4.

( ) Twist the two red power transformer leads together, cut them to the proper length and connect one to pin 1 (S1) of V-4, and the other to pin 7 (S1) of V-4.

( ) Connect the red-yellow lead to the capacitor case lug (S1) near X-1.

( ) Twist two 11" lengths of hookup wire together and strip all four ends.

( ) At one end of the twisted pair, connect one lead to pin 1 (NS) and the other lead to pin 2 (NS) of the octal socket.

( ) At the other end of the pair, connect one lead to pin 4 (NS) and the other to pin 5 (NS) of V-4.

( ) Twist two 6 1/2" lengths of hookup wire together and strip all four ends.

( ) At one end of this twisted pair, connect one lead to pin 4 (S3) and the other to pin 5 (S3) of V-4.

( ) At the other end of this pair, connect one lead to pin 4 (NS) and the other pin 5 (NS) of V-1. Route this lead (and the next two leads also) along the front corner of chassis.

( ) Twist two 5" lengths of hookup wire together and strip all four ends.

( ) At one end of the pair, connect one lead to pin 4 (S2) and the other to pin 5 (S2) of V-1.

( ) At the other end, connect one lead to pin 4 (NS) and the other lead to pin 5 (NS) of V-2.

( ) Twist two 5" lengths of hookup wire together and strip all four ends.

( ) At one end of the twisted pair, connect one lead to pin 4 (S2) and the other lead to pin 5 (S2) of V-2.

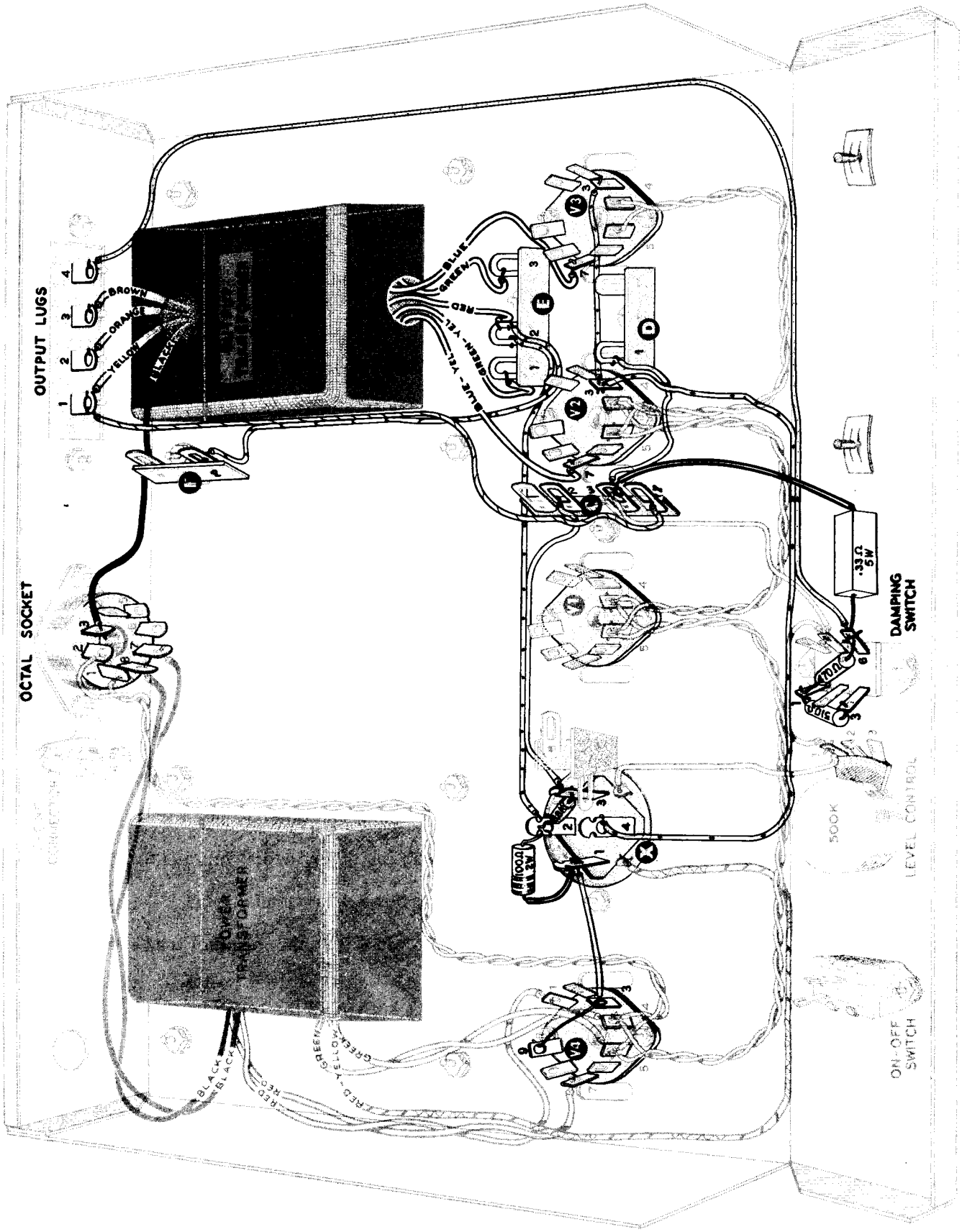
( ) At the other end of the pair, connect one lead to pin 4 (S1) and the other lead to pin 5 (S1) of V-3.

This completes the wiring of the filament circuit.

( ) Connect a lead from the capacitor case lug between X-3 and X-4 (S1) to lug 1 (NS) of the 500 K ohm level control.

( ) Connect a lead from lug 1 of the 500 K ohm control (S2) to lug 5 (NS) of the damping switch.

( ) Connect a lead from lug 5 (S2) of the damping switch to terminal C-3 (NS).


OUTPUT LUGS
BROWN
ORANGE
YELLOW
BLACK
OCTAL SOCKET
BLUE
GREEN
RED
BLUE - YEL.
GREEN - YEL.
V1
V2
V3
D
E
.33Ω 5W
DAMPING SWITCH
100Ω 1W
500K
LEVEL CONTROL
ON-OFF SWITCH
POWER TRANSFORMER
BLACK
BLACK
RED
RED
GREEN
RED - YELLOW

PICTORIAL 3

( ) Connect a lead from terminal C-3 (NS) to terminal D-1 (NS).

( ) Connect a lead from pin 3 (NS) of V-2, routed along the corner of the chassis to capacitor lug X-4 (S1).

( ) At one end of a length of hookup wire, strip off approximately 1 1/4" of insulation. Pass this wire through pin 3 of V-4 to pin 9. Solder the wire to both pins.

( ) Connect the other end of this wire to capacitor lug X-1 (NS).

( ) Connect a length of hookup wire from capacitor lug X-2 (NS) to terminal E-2 (NS).

( ) Connect a length of hookup wire from capacitor lug X-3 (NS) to terminal C-2 (NS).

( ) Connect a length of hookup wire from terminal E-2 (NS) to terminal F-2 (NS).

( ) Connect a length of hookup wire from pin 3 (S2) of V-2 to pin 3 of V-3 (NS).

( ) Connect a length of hookup wire from terminal C-4 (NS) to "output lug" 1 (NS).

( ) Connect a length of hookup wire from lug 6 (NS) of the damping switch to "output lug" 4 (S1).

ON THE OUTPUT TRANSFORMER

( ) Cut the solid blue lead to length and connect it to pin 7 (S1) of V-3.

( ) Cut the solid green lead to the proper length and connect it to terminal E-3 (NS).

( ) Cut the blue-yellow lead to the proper length and connect it to pin 7 (S1) of V-2.

( ) Cut the green-yellow lead to the proper length and connect it to terminal E-1 (NS).

( ) Cut the red lead to the proper length and connect it to terminal E-2 (S3).

( ) Connect the black lead to pin 3 (NS) of the octal socket.

( ) Connect the brown lead to lug 3 (S1) of the "output lugs".

( ) Connect the orange lead to "output lug" 2 (S1).

( ) Connect the yellow lead to "output lug" 1 (NS).

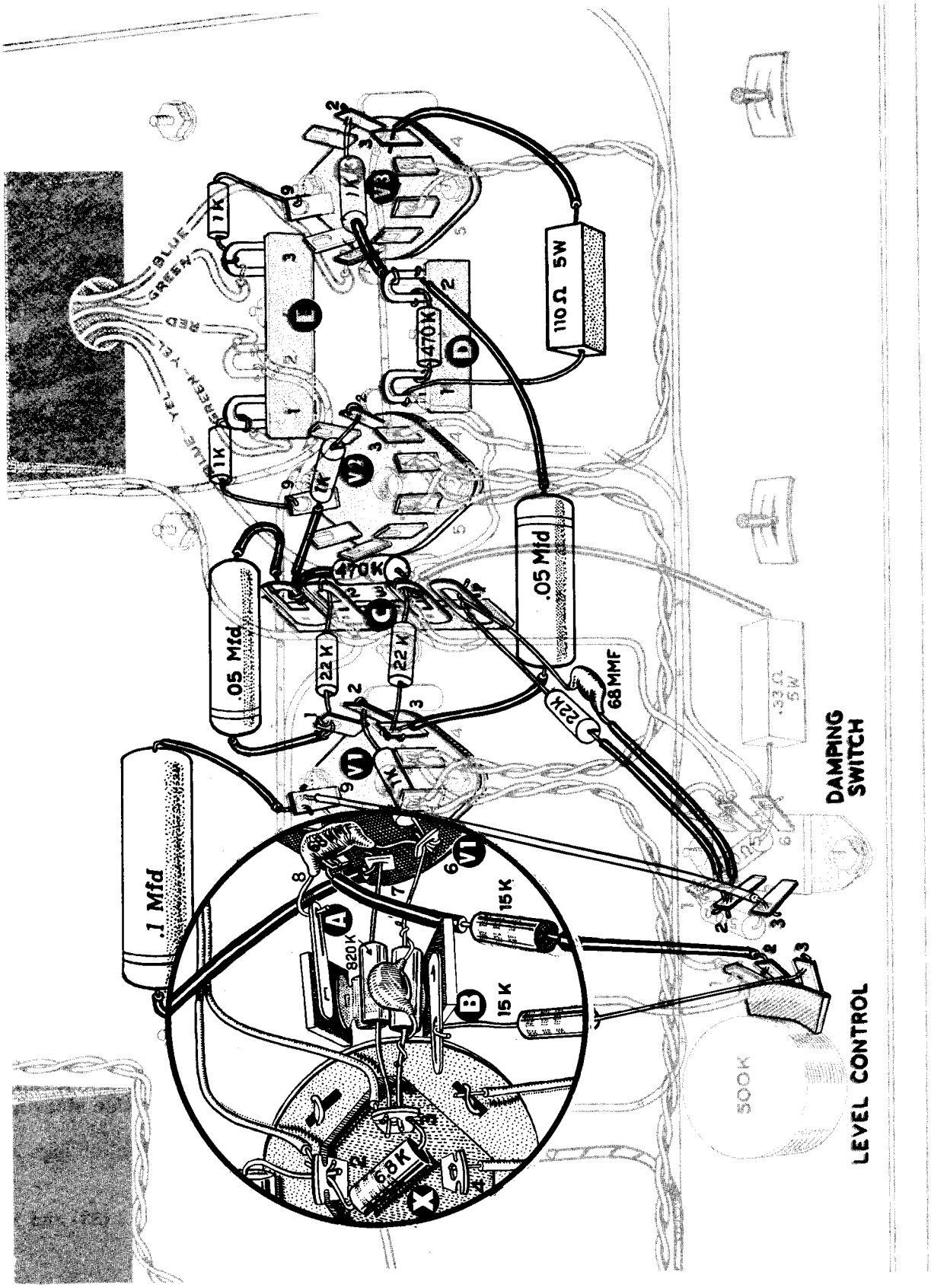
( ) Connect the 510 ohm resistor (green-brown-brown) from lug 1 (NS) to lug 3 (NS) of the damping switch.

( ) Connect a 470 ohm resistor (yellow-purple-brown) from lug 1 (S2) to lug 6 (NS) of the damping switch.

( ) Connect the .33 ohm 5 watt resistor (square) from lug 6 (S3) of the damping switch to terminal C-3 (NS). Place the resistor body flat against the inside of the front panel. (Use sleeving).

( ) Connect the 100 ohm (brown-black-brown) 2 watt resistor between the capacitor lugs X-1 (S2) and X-2 (NS). Use sleeving.

( ) Connect the 6.8 K ohm (blue-gray-red) resistor between capacitor lugs X-2 (S3) and X-3 (NS). Place the resistor body over the center portion of the capacitor.


.1 Mfd
.05 Mfd
.05 Mfd
68K
820K
15K
15K
470K
470K
22K
22K
68MMF
22K
1K
1K
1K
1K
1K
1K
470K
110Ω 5W
.33Ω 5W
500K
BLUE
GREEN
RED
GREEN - YEL.
BLUE - YEL.
DAMPING SWITCH
LEVEL CONTROL
V1
V2
V3
A
B
C
D
E
X

PICTORIAL 4

( ) Connect a 820 KΩ (gray-red-yellow) resistor from capacitor lug X-3 (NS) to pin 7 (NS) of V-1. Route the resistor body between terminal "A" and "B".

( ) Wrap the leads of the 3.3 mmfd disc capacitor around the 220 K resistor (red-red-yellow) as shown in Figure 3. Wrap each capacitor lead around its resistor lead twice, clip off the excess, and solder it with just a dab of solder.

Figure 3

( ) Connect this same resistor (and capacitor) from pin 6 (NS) of V-1 to capacitor lug X-3 (S4).

( ) Connect a 1 K ohm resistor (brown-black-red) from pin 2 (S1) of V-1 to pin 6 (NS) of V-1.

( ) Connect a 22 K ohm resistor (red-red-orange) from pin 1 (NS) of V-1, to terminal C-2 (S2).

( ) Connect a 22 K ohm resistor (red-red-orange) from pin 3 (NS) of V-1 to terminal C-3 (NS).

( ) Using insulated sleeving, connect a 470 K ohm resistor (yellow-purple-yellow) between terminals C-1 (NS) and C-3 (S5).

( ) Connect a 1 K ohm resistor (brown-black-red) from pin 9 (S1) of V-2 to terminal E-1 (S2).

( ) Using insulated sleeving, connect a 1 K ohm (brown-black-red) resistor from pin 2 (S1) of V-2 to terminal C-1 (NS).

( ) Connect a 1 K ohm (brown-black-red) resistor from pin 9 (S1) of V-3 to terminal E-3 (S2).

( ) Connect a 470 K ohm (yellow-purple-yellow) resistor between terminals D-1 (NS) and D-2 (NS).

( ) Connect the 110 ohm 5 watt (square) resistor from pin 3 (S2) of V-3 to terminal D-1 (S3). Use sleeving.

( ) Using insulated sleeving, connect a 1 K ohm resistor (brown-black-red) from pin 2 (S1) of V-3 to terminal D-2 (NS).

( ) Using insulated sleeving, connect a .05 mfd capacitor from pin 3 (S2) of V-1 to terminal D-2 (S3).

( ) Using insulated sleeving, connect a .05 mfd from pin 1 (S2) of V-1 to terminal C-1 (S3).

( ) Using insulated sleeving, connect a 22 K ohm resistor (red-red-orange) from lug 2 (NS) of the damping switch to terminal C-4 (NS).

( ) Using insulated sleeving, connect a 68 mmf capacitor from lug 2 (S2) of the damping switch to terminal C-4 (S3).

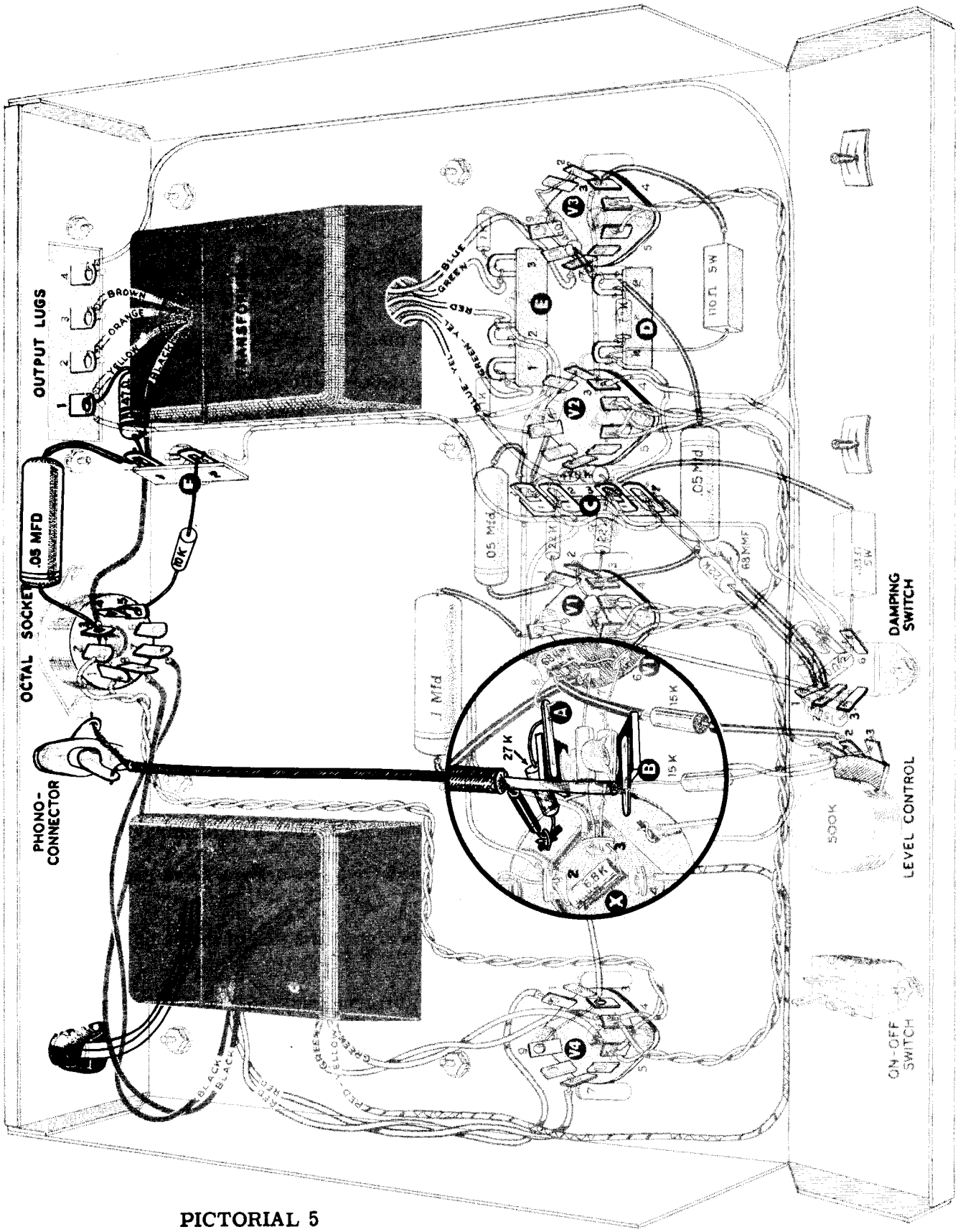
( ) Using insulated sleeving, connect the .1 mfd capacitor from pin 7 (S2) of V-1 to pin 9 (NS) of V-1.

( ) Using insulated sleeving, connect a 15 K ohm resistor (brown-green-orange) from pin 8 (S1) of V-1 to lug 2 (S1) of the 500 K ohm control.

( ) Connect a 15 K ohm resistor (brown-green-orange) from lug 3 (S1) of the 500 K ohm control to terminal "B" (NS).

( ) Connect a 68 mmfd capacitor from pin 6 (S3) of V-1 to terminal "A" (NS).

( ) Connect a length of hookup wire from pin 9 (S2) of V-1 to lug 3 (S2) of the damping switch.


OUTPUT LUGS
BROWN
ORANGE
YELLOW
BLACK
OCTAL SOCKET
.05 MFD
PHONO-CONNECTOR
BLUE
GREEN
RED
BLUE - YEL.
GREEN - YEL.
.05 Mfd
.1 Mfd
68MMF
27 K
15 K
500K
110Ω 5W
DAMPING SWITCH
LEVEL CONTROL
ON-OFF SWITCH
BLACK
RED
YELLOW
GREEN

PICTORIAL 5

( ) Connect a 27 K ohm resistor (red-purple-orange) from terminal "A" (S2) to the capacitor ground lug (NS) between X-2 and X-3.

In the next few steps, having to do with cable preparation, refer to Figure 4.

( ) Clip the short piece of insulated cable to a length of 5" and remove 1" of the outer insulation from one end. Unravel the shielding from around the inner conductor, twist it to form a separate lead, and slip insulated sleeving over it. Remove the insulation 1/4" back from the end of the inner conductor. Remove 3/4" of the outer insulation from the other end of the cable. Twist the sleeving as before, strip the inner conductor (and shorten it if necessary).

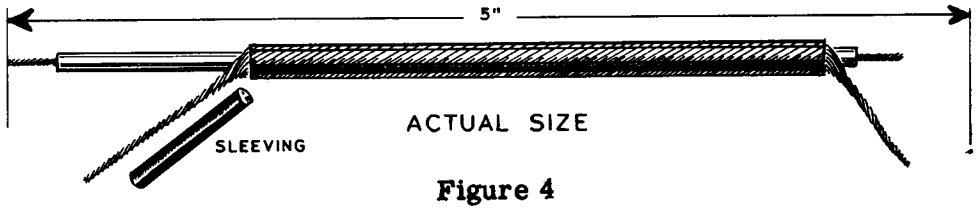


Figure 4

( ) At the end of the cable prepared first, connect the 1" sleeve-covered shield to the capacitor ground lug between X-2 and X-3 (S2).

( ) At this same end of the cable, connect the center conductor to terminal "B" (S2).

( ) Connect the other end of the cable's shield (3/4") to the ground lug of the phono connector (NS).

( ) Connect the center conductor of the cable to the center conductor of the phono connector (S1).

( ) Connect a 47 ohm 1 watt resistor (yellow-purple-black) from terminal F-1 (NS) to output lug 1 (S3).

( ) Insert one lead of a 10 K 1 watt resistor (brown-black-orange) through pin 5 to pin 4 of the octal socket. Solder the lead to both pins.

( ) Connect the other end of this 10 K ohm resistor to terminal F-2 (S2).

( ) Connect a .05 mfd capacitor from pin 3 (NS) of the octal socket to terminal F-1 (S2). Use sleeving.

( ) Insert the line cord through the hole in the rear chassis apron (near the power transformer), and guide it down the corner of the chassis, under the phono connector, to the octal socket.

( ) Place the line cord strain insulator on the line cord 4 3/4" from the end (not the plug end). Squeeze the two segments of the strain insulator together with long nose pliers and insert it through the 7/16" chassis hole from the outside of the chassis. See Figure 5.

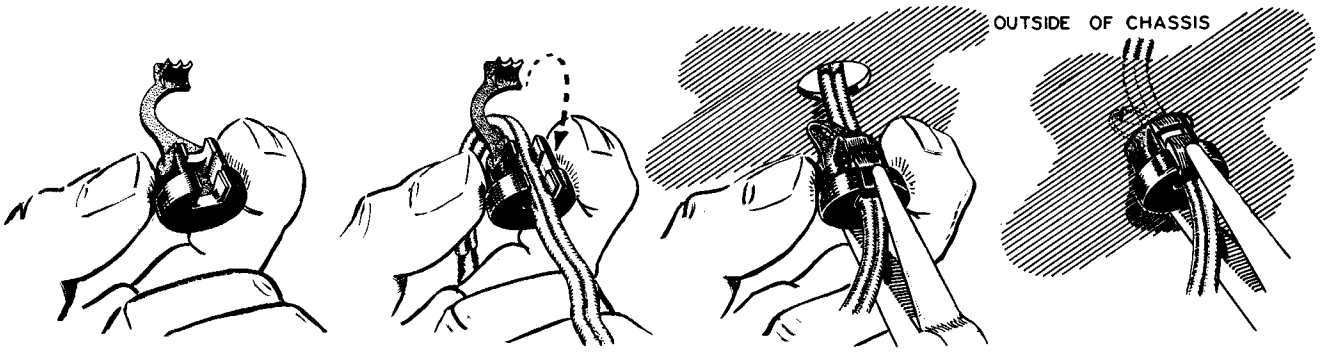
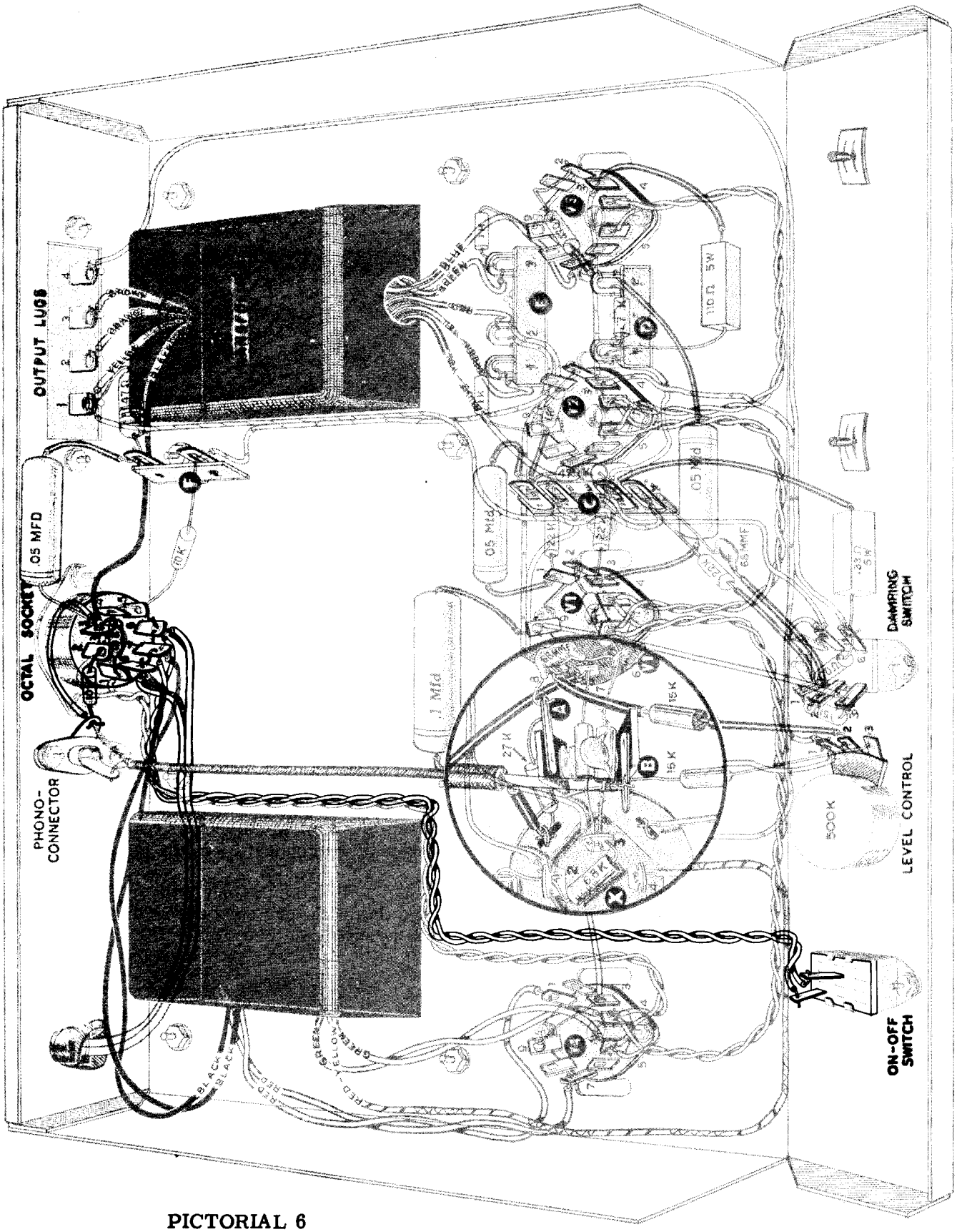


Figure 5


OUTPUT LUGS
OCTAL SOCKET
.05 MFD
PHONO-CONNECTOR
DAMPING SWITCH
LEVEL CONTROL
ON-OFF SWITCH
500K
110Ω 5W
.05 Mfd
.1 Mfd
68 MMF
27K
15K
68K
BLUE
GREEN
BLACK
RED
YELLOW

PICTORIAL 6

( ) Connect one line cord lead to pin 6 (NS) of the octal socket.

( ) Connect the other side of the line cord to pin 8 (S2) of the octal socket.

( ) Twist two 10" segments of hookup wire together, strip the insulation away from all four ends.

( ) At one end of the pair, connect a lead to each lug of the on-off switch. Solder both connections.

( ) At the other end of this pair, connect one lead to pin 6 (S2) of the octal socket, and connect the other lead to pin 7 (S2) of the octal socket.

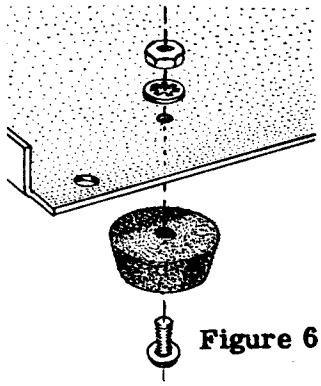


Figure 6

( ) Connect a short piece of hookup wire from pin 3 (NS) of the octal socket to the ground lug (NS) of the phono connector.

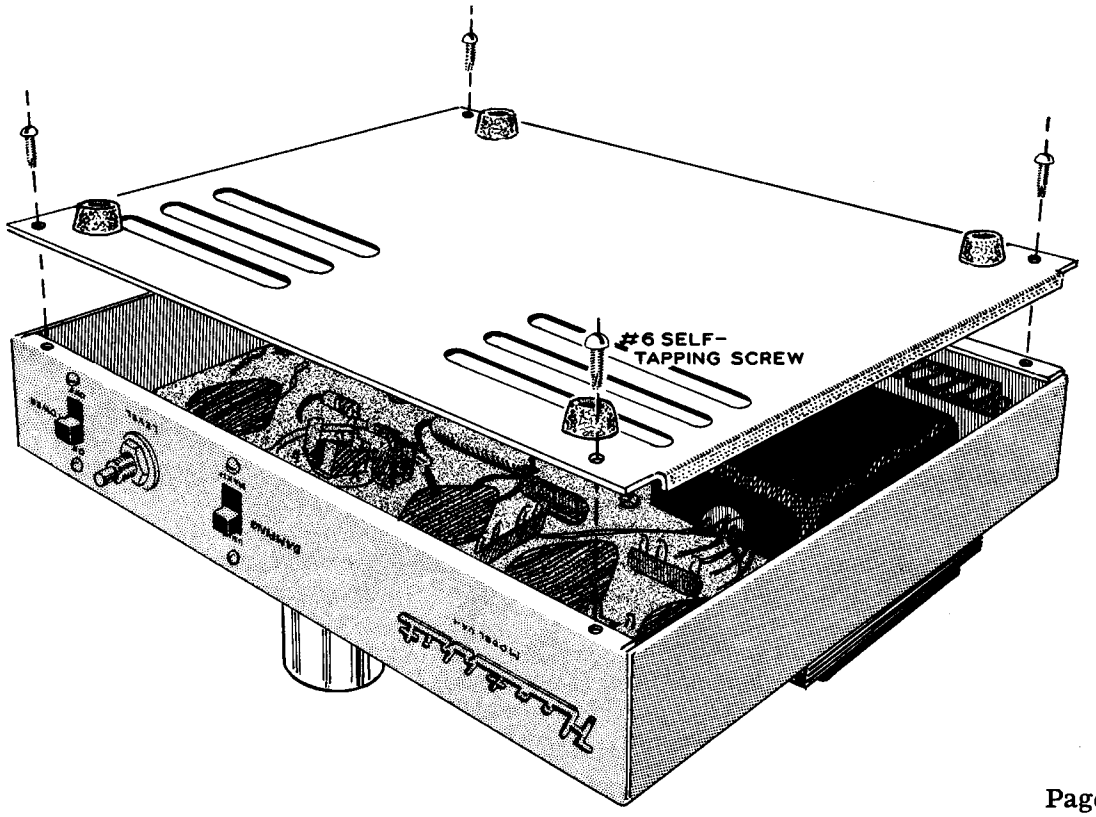
( ) Connect a 10 K resistor (brown-black-orange) from pin 1 (S2) of the octal socket to pin 3 (S4).

( ) Connect a 10 K ohm resistor from pin 2 of the octal socket (S2) to the ground lug of the phono connector (S3).

( ) Install the four felt feet in the four inside holes on the bottom cover. Insert a 6-32 x 1/2" stove head screw through each felt foot, insert it through the bottom cover. Install a lock-washer and 6-32 nut. and tighten the screw until the center of the felt is pulled up snug to the cover and 3/16" to 1/4" of the screw can be measured above the nut.

( ) Shake out all loose solder bits and clippings. Check the wiring carefully for any bare leads touching metal parts or other bare wires. Recheck all solder joints.

( ) Install the bottom cover with the ventilating holes under the tube sockets with the #6 self-tapping screws. Be careful not to tighten the screws too tight, lest the threads be stripped and the cover would be difficult to remove.



( ) Install tubes in their proper sockets; V-1 = 6AN8, V-2 and V-3 = EL-84's and V-4 = EZ-81.

NOTE: Both a black knob and a black control cover have been supplied with the kit for your convenience. The cover is for those who wish to set the gain and leave it at that setting. The knob is for those who will be adjusting the gain frequently.

If you intend to use the cover, merely install it over the knurled control shaft.

If you intend to use the knob, start the set screw in the threads; place it on the control shaft and tighten the screw.

IN CASE OF DIFFICULTY

If this amplifier fails to operate properly, proceed as follows:

1. Check the wiring over carefully, step by step, or if possible have a friend check it with you. Even the most experienced electronic engineers and technicians have found that after working on a unit for some time, they will repeatedly overlook a simple mistake, where someone else with a fresh outlook will find it immediately.

2. Check for visual malfunctioning, such as overheated and discolored resistors, bare wires touching the metal chassis, etc.

3. Read the circuit description to understand the principles of operation.

4. Check the tubes.

5. Check the voltages in your amplifier against those given on the schematic. The voltages given were taken with a "Vacuum Tube Voltmeter" with 11 megohms input resistance. Lower resistance meters may give lower readings, especially when used in places where it might load down the circuit such as the input grid of a tube. Normal deviation due to line voltage and component variations could reach ±20%.

6. Finding a faulty component in a feedback amplifier can be very difficult, since any distortion found in the output signal also appears back at the input through the feedback loop. To simplify such "troubleshooting", the following procedure is suggested:

   First - place the "Damping" switch in the "Max" position. This eliminates the current feedback and connects the "common" output terminal directly to ground.

   Second - open the feedback loop between terminal C-4 and the 16 ohm output lug.

The trouble can now be tracked down using normal trouble-shooting methods. In this "open loop" state, a UA-1 amplifier operating normally would operate approximately as follows:

A 1000 cycle sine-wave input signal, of .09 volts R. M. S. amplitude, will appear at the grid of V-1B with an amplitude of approximately 9.3 volts. At each EL-84 grid, the amplitude will be approximately 9.1 volts. In the output, across a 16 ohm load, 12 watts, or 13.85 volts will appear.

These voltages, of course, are subject to tube aging, line voltage variations, and component variations and thus may vary somewhat from the figures given.

If by intelligent investigation in the manner outlined above, your problems still are not solved, write to the Heath Company, Engineering Consultation Department. State the name and model (Universal 12 watt amplifier, UA-1) of your amplifier, and give all symptoms, voltages and other information that may help to analyze your difficulty.

APPLICATIONS

As the designation UA-1 (universal amplifier) implies, there are a large number of applications for this amplifier. A number of possibilities will be listed, and it is quite likely other uses will be found. We shall attempt to cover the most encountered applications, and hope that this information will prove to be a guidepost for other, more unusual uses.

Primarily the unit is designed for conventional operation monaurally with any standard preamplifier, such as the Heathkit WA-P2 or the more elaborate SP-1 and SP-2 models. When used with the WA-P2, the preamplifier power plug should be plugged into the octal socket provided on the rear apron, and the audio lead plugged into the jack on the same apron. The amplifier power switch must be turned "off" when used with the WA-P2, since the power switching function will be controlled at the preamp. Set the damping switch for best operation with the speaker used. In the case of the SS-1 or SS-2, the switch should be set to "MAX", and with other speakers, the best sounding setting would be logical.

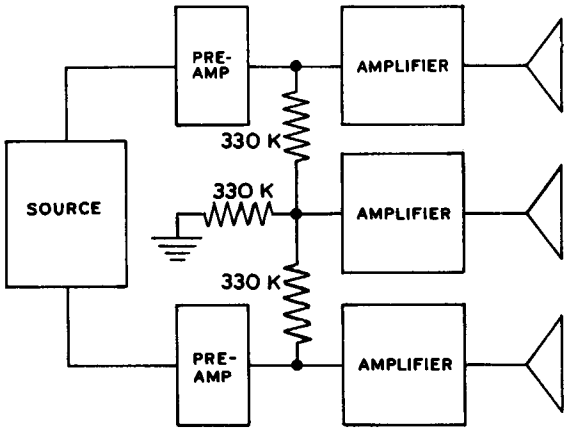
In connecting to the amplifier output terminals, connect one speaker lead to the "common" terminal. Connect the other lead to the terminal that matches the impedance of your speaker, either 4 ohms, 8 ohms, or 16 ohms.

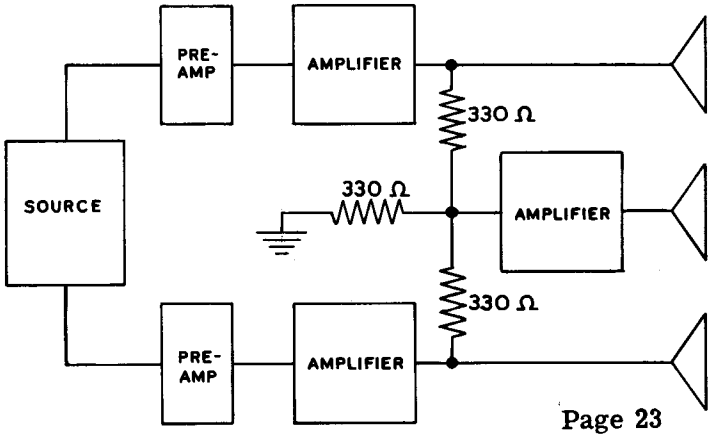
Connections to the Heathkit SP-1 or SP-2 preamplifiers and any other self-powered units are very straightforward. It is only necessary to connect the cable from the preamp audio output jack to the amplifier input on the rear apron, and turn the power switch "on", assuming the power cord will be plugged into the switched power outlet normally provided on this type of preamplifier. If no such outlet is provided on the preamplifier used, it will be necessary to either turn the power on using the switch provided on the UA-1, or to incorporate a master switch for the entire system.

An ideal application of the UA-1 would be as a high or low (or both) channel amplifier(s) for use with an electronic crossover such as the Heathkit XO-1. Plenty of power is available to drive any conventional speaker. If used as a high channel amplifier, the damping switch should be at "MAX"; if employed in the low frequency channel, set the damping to match the speaker.

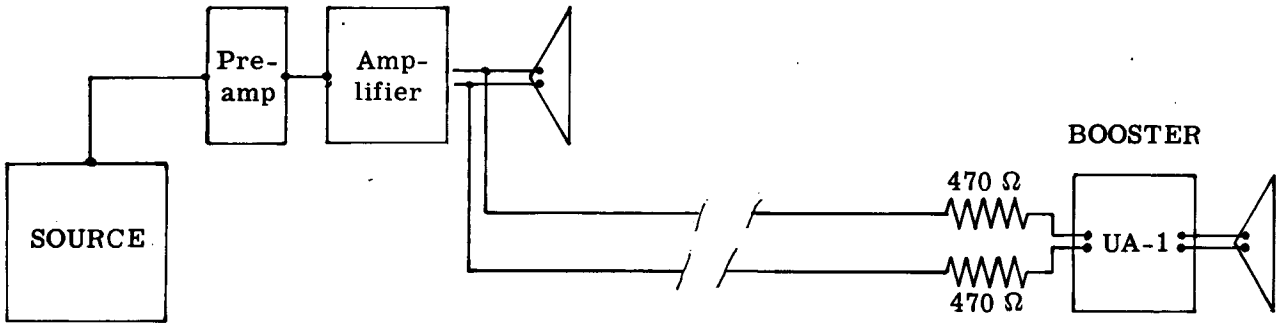
Probably one of the more common uses of this amplifier will be in stereo applications since it lends itself very well to low cost, high quality, stereo reproduction. Connections to the WA-P2 or SP-2 preamplifiers would be made in exactly the same manner as was directed in previous paragraphs, with the exception, of course, of having two channels instead of only one.

For those who wish to add a center channel to their stereo system, we offer the following methods of connecting your UA-1. A mixing pad will have to be constructed to bridge between the output of the other two channels. This pad, constructed as shown in the accompanying diagram, can be connected either to the amplifier outputs, or to the preamplifier outputs. Of the two methods, connecting to the preamplifier output is preferred, since there would be somewhat less distortion.





In those cases where a repeating amplifier is needed, just connect the amplifier input across what would normally be the speaker leads from the source amplifier. In case it isn't easy to determine which of the input leads is the ground lead, connect a 470 ohm resistor in series with each one.



An example of this type of installation would be in the case where a public address or music system speaker is desired at some distance from where the amplifier is located. Often in these cases, the line losses are enough to cause insufficient power out at the speaker: hence a repeating amplifier.

We hope that these thumbnail sketches, have been useful to you. As was mentioned before, there are many other possible uses, but most of them will be simple modifications of the ones already described.

REPLACEMENTS

Material supplied with Heathkits has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally improper instrument operation can be traced to a faulty tube or component. Should inspection reveal the necessity for replacement, write to the Heath Company and supply all of the following information:

A. Thoroughly identify the part in question by using the part number and description found in the manual parts list.
B. Identify the type and model number of kit in which it is used.
C. Mention the order number and date of purchase.
D. Describe the nature of defect or reason for requesting replacement.

The Heath Company will promptly supply the necessary replacement. Please do not return the original component until specifically requested to do so. Do not dismantle the component in question as this will void the guarantee. If tubes are to be returned, pack them carefully to prevent breakage in shipment as broken tubes are not eligible for replacement. This replacement policy does not cover the free replacement of parts that may have been broken or damaged through carelessness on the part of the kit builder.

SERVICE

If, after applying the information contained in this manual and your best efforts on the unit, you are still unable to obtain proper performance from the Amplifier, it is suggested that you take advantage of the technical facilities which the Heath Company makes available to its customers.

The Technical Consultation Department is maintained for the purpose of providing Heath customers with a personalized technical consultation service; this service is available to you without charge. The technical consultants are thoroughly familiar with all details of the Amplifier and can usually localize the trouble from a suitable description of the difficulty encountered. It is, of course, necessary that you provide full and complete information concerning your problem when writing to the Technical Consultation Department for assistance. For instance, clearly identify the kit involved, giving the purchase date and, if possible, the invoice number; describe

in detail the difficulty that you have encountered; state what you have attempted to do to rectify the trouble, what results have been achieved, and include any information or clues that you feel could possibly be of value to the consultant who handles your problem. Failure to provide complete descriptive details may lead to incorrect assumptions on the part of the consultant and needless delay in the solution to your problem. Quite frequently, when the information given the consultant is complete, concise and reliable, a diagnosis of the difficulty can be made with confidence and specific instructions given for its correction. If replacement of a component is involved in the correction, the component will be shipped to you, subject to the terms and conditions of the Warranty.

The Factory Service facilities are also available to you, in case you are not familiar enough with electronics to provide our consultants with sufficient information on which to base a diagnosis of your difficulty, or in the event that you prefer to have the difficulty corrected in this manner. You may return the complete Amplifier to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a fixed fee of $4.00, plus the price of any additional parts or material required. However, if the Amplifier is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase and give invoice number, if possible.

Local Service by Authorized Heathkit Dealers is also available and often will be your fastest, most efficient emthod of obtaining service for your Heathkits. Although you may find charges for local service somewhat higher than those listed in Heathkit manuals (for factory service), the amount of increase is usually offset by the transportation charges you would pay if you elected to return your kit to the Heath Company.

Heathkit dealers will honor the regular 90 day Heathkit Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company. It will be necessary that you verify the purchase date of your kit by presenting your copy of the Heath Company invoice to the authorized dealer involved.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if your local dealer assists you in locating a defective part (or parts) in your Heathkit, or installs a replacement part for you, he may charge you for this service.

Heathkits purchased locally and returned to Heath Company for service must be accompanied by your copy of the dated sales receipt from your authorized Heathkit dealer in order to be eligible for parts replacement under the terms of the Warranty.

THESE SERVICE POLICIES APPLY ONLY TO COMPLETED INSTRUMENTS CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUALS. Instruments that are not entirely completed or instruments that are modified in design will not be accepted for repair. Instruments showing evidence of acid core solder or paste fluxes will be returned NOT repaired.

For information regarding modifications of Heathkits for special applications, it is suggested that you refer to any one or more of the many publications that are available on all phases of electronics. They can be obtained at or through your local library, as well as at most electronic outlet stores. Although the Heath Company welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for specific purposes. Therefore, such modifications must be made at the discretion of the kit builder, according to information which will be much more readily available from some local source.

SHIPPING INSTRUCTIONS

Before returning a unit for service, be sure that all parts are securely mounted.

ATTACH A TAG TO THE INSTRUMENT GIVING NAME, ADDRESS AND TROUBLE EXPERIENCED.

Pack in a rugged container, preferably wood, using at least three inches of shredded newspaper or excelsior on all sides. DO NOT SHIP IN THE ORIGINAL KIT CARTON AS THIS CARTON IS NOT CONSIDERED ADEQUATE FOR SAFE SHIPMENT OF THE COMPLETED INSTRUMENT. Ship by prepaid express if possible. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damage in transit if packing, in HIS OPINION, is insufficient.

All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

WARRANTY

Heath Company warrants that for a period of three months from the date of shipment, all Heathkit parts shall be free of defects in materials and workmanship under normal use and service and that in fulfillment of any breach of such warranty, Heath Company shall replace such defective parts upon the return of the same to its factory. The foregoing warranty shall apply only to the original buyer, and is and shall be in lieu of all other warranties, whether express or implied and of all other obligations or liabilities on the part of Heath Company and in no event shall Heath Company be liable for any anticipated profits, consequential damages, loss of time or other losses incurred by the buyer in connection with the purchase, assembly or operation of Heathkits or components thereof. No replacement shall be made of parts damaged by the buyer in the course of handling or assembling Heathkit equipment.

NOTE: The foregoing warranty is completely void and we will not replace, repair or service instruments or parts thereof in which acid core solder or paste fluxes have been used.

HEATH COMPANY

PARTS LIST

PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
1-6	1	470 ohm 1/2 watt
1-9	5	1 K ohm 1/2 watt
1-9A	1	10 K ohm 1 watt
1-19	1	6.8 K ohm 1/2 watt
1-20	2	10 K ohm 1/2 watt
1-21	2	15 K ohm 1/2 watt
1-29	1	220 K 1/2 watt
1-33	2	470 K ohm 1/2 watt
1-58	3	22 K ohm 1/2 watt
1-63	1	510 ohm 1/2 watt
1-68	1	820 K ohm 1/2 watt
1-124	1	27 K ohm 1/2 watt
1-15A	1	47 ohm 1 watt
1-20B	1	100 ohm 2 watt
3-10E	1	110 ohm 5 watt
3-11E	1	.33 ohm 5 watt 5%
Capacitors		
20-76	2	68 mmf silvered mica 5%
21-33	1	3.3 mmf 10% 500 V
23-47	1	.1 mfd
23-61	3	.05 mfd
25-62	1	40-20-20 mfd at 450-450-400V + 50 mfd at 50 V electrolytic
Transformers, Tubes and Controls		
10-74	1	500 K ohm control
51-29	1	Output transformer
54-63	1	Power transformer
60-1	1	SPST slide switch
60-2	1	DPDT slide switch
411-68	1	6AN8 tube
411-108	2	EL84 tube (6BQ5)
411-110	1	EZ81 tube (6CA4)
Hardware and Wire		
250-2	8	3-48 x 1/4" screw
250-9	15	6-32 x 3/8" screw
250-10	4	6-32 x 1/2" stove head screw
250-46	4	6-32 x 1/2" self-tapping screw

PART No.	PARTS Per Kit	DESCRIPTION
Hardware and Wire (cont.)		
252-1	8	3-48 hex nut
252-3	15	6-32 hex nut
252-4	8	8-32 hex nut
252-7	1	3/8 - 32 x 1/8" control nut
252-16	2	Tinnerman speed nut
253-10	1	3/8" x 5/8" x .032 control washer
254-1	15	#6 lockwasher
254-2	8	#8 lockwasher
254-4	1	Control lockwasher
254-7	8	#3 lockwasher
343-3	1	Length shielded cable
344-1	1	Length hookup wire
346-1	1	Length 1/16" sleeving
Terminal Strips, Sockets and Connectors		
431-2	1	2-lug terminal strip
431-3	1	3-lug terminal strip
431-5	1	4-lug terminal strip
431-13	1	4-lug screw type terminal strip
431-15	1	1-lug terminal strip
431-25	1	1-lug terminal strip (tall)
431-32	1	2-lug terminal strip for #8 screws
434-16	4	9 pin tube socket
434-42	1	Phono connector
434-2	1	Octal tube socket
438-4	1	Single prong phono
481-3	1	4 prong insulated mounting wafer
Miscellaneous		
75-24	1	Line cord strain relief insulator
89-1	1	Line cord
263-5	4	Felt feet
391-2	1	Logo "Heathkit" black
462-17	1	Pointer knob
200-M140F228-229	1	Chassis
205-M104	1	Bottom cover plate
595-186	1	Manual
252-20	1	Plastic cap nut

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.

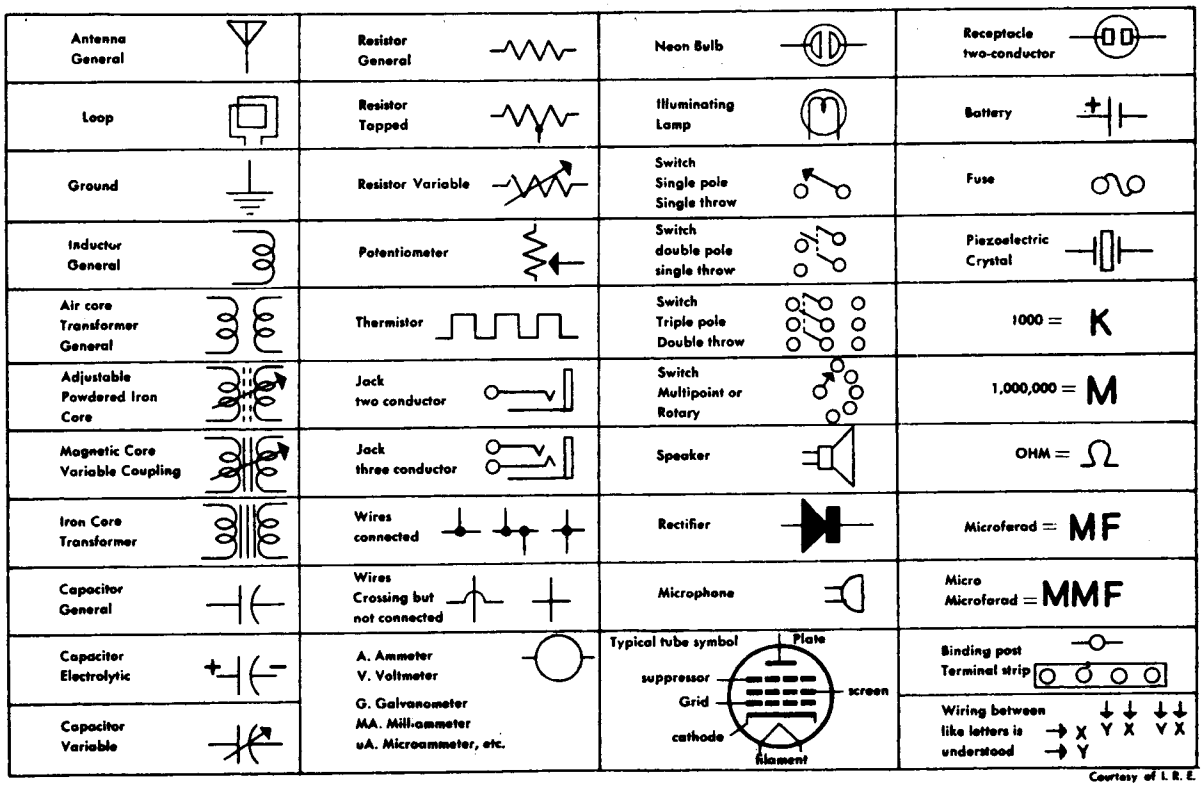
When removing insulation from the end of hookup wire, it is seldom necessary to expose more than a quarter inch of the wire. Excessive insulation removal may cause a short circuit condition in respect to nearby wiring or terminals. In some instances, transformer leads of solid copper will have a brown 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.



Courtesy of I. R. E.

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