PRICE $1.00

HEATHKIT®
ASSEMBLY MANUAL

HEATHKIT by Daystrom

AUDIO GENERATOR

MODEL IG-72

HEATH COMPANY • BENTON HARBOR, MICHIGAN

RESISTOR AND CAPACITOR COLOR CODES

RESISTORS

The colored bands around the body of a color coded resistor represent its value in ohms. These colored bands are grouped toward one end of the resistor body. Starting with this end of the resistor, the first band represents the first digit of the resistance value; the second band represents the second digit; the third band represents the number by which the first two digits are multiplied. A fourth band of gold or silver represents a tolerance of ±5% or ±10% respectively. The absence of a fourth band indicates a tolerance of ±20%.

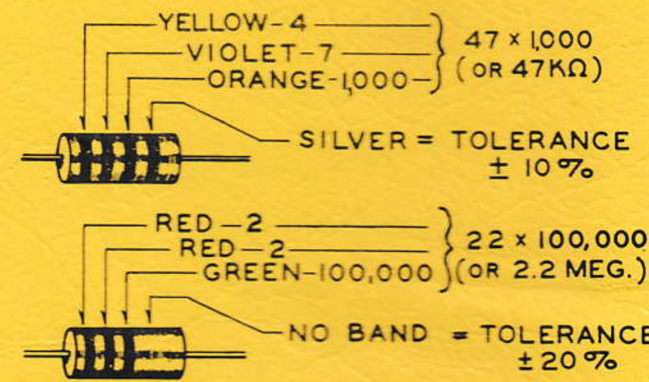
The physical size of a composition resistor is related to its wattage rating. Size increases progressively as the wattage rating is increased. The diameters of 1/2 watt, 1 watt and 2 watt resistors are approximately 1/8", 1/4" and 5/16", respectively.

The color code chart and examples which follow provide the information required to identify color coded resistors.

CODE

COLOR	1st DIGIT	2nd DIGIT	MULTIPLIER
BLACK	0	0	1
BROWN	1	1	10
RED	2	2	100
ORANGE	3	3	1,000
YELLOW	4	4	10,000
GREEN	5	5	100,000
BLUE	6	6	1,000,000
VIOLET	7	7	10,000,000
GRAY	8	8	100,000,000
WHITE	9	9	1,000,000,000
GOLD	-	-	.1
SILVER	-	-	.01

EXAMPLES



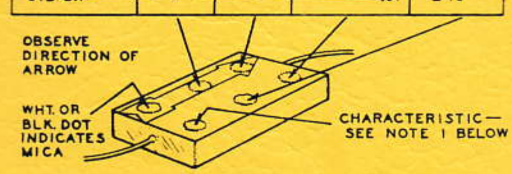
CAPACITORS

Generally, only mica and tubular ceramic capacitors, used in modern equipment, are color coded. The color codes differ somewhat among capacitor manufacturers, however the codes shown below apply to practically all of the mica and tubular ceramic capacitors that are in common use. These codes comply with EIA (Electronics Industries Association) Standards.

MICA

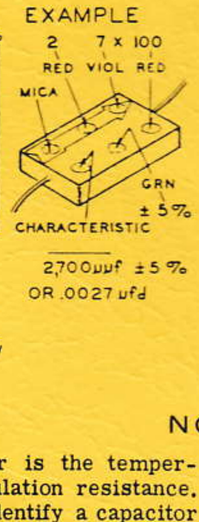
CODE

COLOR	1st DIGIT	2nd DIGIT	MULTIPLIER	TOLER. %
BLACK	0	0	1	±20
BROWN	1	1	10	—
RED	2	2	100	± 2
ORANGE	3	3	1,000	± 3
YELLOW	4	4	10,000	—
GREEN	5	5	—	± 5
BLUE	6	6	—	—
VIOLET	7	7	—	—
GRAY	8	8	—	—
WHITE	9	9	—	—
GOLD	-	-	.1	—
SILVER	-	-	.01	± 10



(VALUE IN μμf—SEE NOTE 3 BELOW)

EXAMPLE



2,700μμf ±5%
OR .0027μfd

TUBULAR CERAMIC

Place the group of rings or dots to the left and read from left to right.

CODE

COLOR	1st DIGIT	2nd DIGIT	MULTIPLIER	TOLER. %	
				[illegible]	[illegible]
BLACK	0	0	1	±20	±20
BROWN	1	1	10	±0.1	±1
RED	2	2	100	—	±2
ORANGE	3	3	1,000	—	±2.5
YELLOW	4	4	10,000	—	—
GREEN	5	5	—	±0.5	±5
BLUE	6	6	—	—	—
VIOLET	7	7	—	—	—
GRAY	8	8	—	±0.25	—
WHITE	9	9	—	±1.0	±10

(VALUE IN μμf—SEE NOTE 3 BELOW)

EXAMPLE

NOTES:

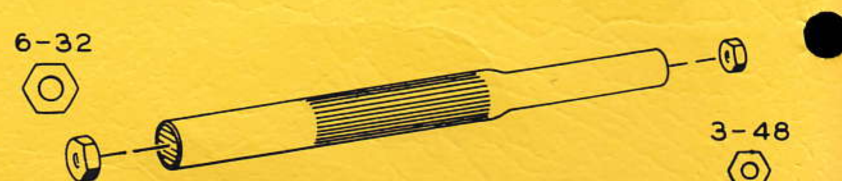
1. The characteristic of a mica capacitor is the temperature coefficient, drift capacitance and insulation resistance. This information is not usually needed to identify a capacitor but, if desired, it can be obtained by referring to EIA Standard, RS-153 (a Standard of Electronic Industries Association.)

2. The temperature coefficient of a capacitor is the predictable change in capacitance with temperature change and is expressed in parts per million per degree centigrade. Refer to EIA Standard, RS-198 (a Standard of Electronic Industries Association.)

3. The farad is the basic unit of capacitance, however capacitor values are generally expressed in terms of μfd (microfarad, .000001 farad) and μμf (micro-micro-farad, .000001 μfd); therefore, 1,000 μμf = .001 μfd, 1,000,000 μμf = 1μfd.

USING A PLASTIC NUT STARTER

A plastic nut starter offers a convenient method of starting the most used sizes: 3/16" and 1/4" (3-48 and 6-32). When the correct end is pushed down over a nut, the pliable tool conforms to the shape of the nut and the nut is gently held while it is being picked up and started on the screw. The tool should only be used to start the nut.



Assembly and Operation of the HEATHKIT by Daystrom AUDIO GENERATOR

MODEL IG-72

HEATH COMPANY,
BENTON HARBOR,
MICHIGAN

a subsidiary of
DAYSTROM, INCORPORATED

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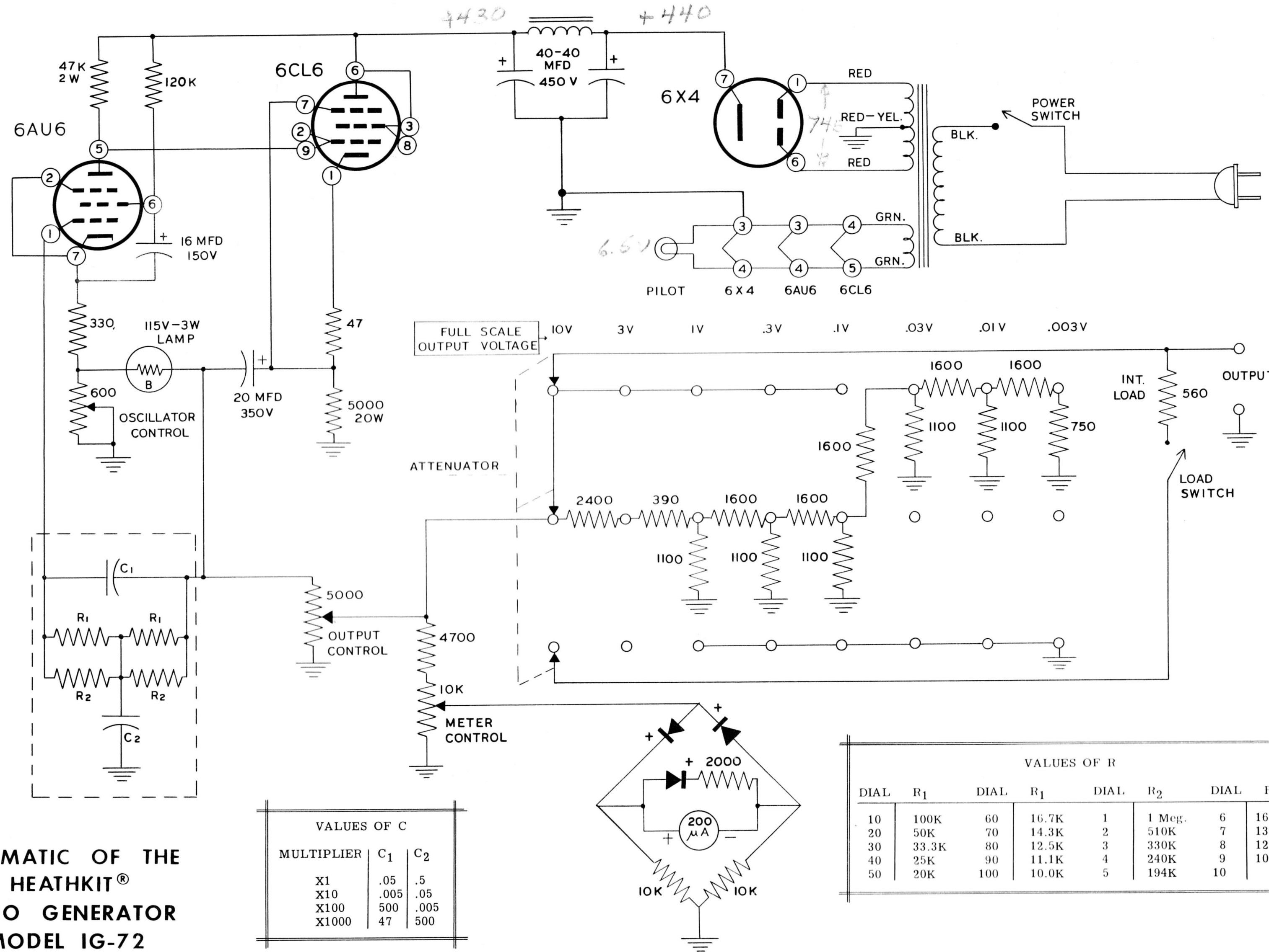


SCHEMATIC OF THE HEATHKIT® AUDIO GENERATOR MODEL IG-72

VALUES OF C

MULTIPLIER	C_1	C_2
X1	.05	.5
X10	.005	.05
X100	500	.005
X1000	47	500

VALUES OF R

DIAL	R_1	DIAL	R_1	DIAL	R_2	DIAL	R_2
10	100K	60	16.7K	1	1 Meg.	6	163K
20	50K	70	14.3K	2	510K	7	139K
30	33.3K	80	12.5K	3	330K	8	122K
40	25K	90	11.1K	4	240K	9	109K
50	20K	100	10.0K	5	194K	10	

SPECIFICATIONS

Frequency Range:	10 cycles - 100 kc
Tuning Method:	Switch-selected, 2 significant figures and multiplier.
Frequency Accuracy:	±5%
Output Voltage Ranges:	0-10 volts into Hi-Z (10 KΩ min.) 0-3 volts into Hi-Z (10 KΩ min.) 0-1 volts, 0-.3 volts, 0-.1 volts, 0-.03 volts, 0-.01 volts, 0-.003 volts: Into external load of approximately 600 Ω or with internal load into external Hi-Z.
Source Impedance:	0-10 volt range - varies between 0 and 1000 Ω. 0-3 volt range - varies between 800 and 1000 Ω. 0-1 volt range and below - 600 Ω (External Load) 290 Ω (Internal Load)
DB Ranges:	-60 db to +22 db (-10 to +2 on meter, -50 to +20 on attenuator in 10 db steps).
DBM Ranges (600 Ω Ext. Load):	-60 dbm to +2 dbm (0 dbm = 1 mw-600 Ω)
Output Indication:	Voltage and db scales on meter.
Output Meter Accuracy:	±5% of full scale when properly terminated.
Distortion:	Less than 0.1% from 20-20,000 cycles.
Tube Complement:	6X4, 6AU6 and 6CL6
Power Requirements:	105-125 volts, 50-60 cycles, 40 watts
Dimensions:	9 1/2" wide x 6 1/2" high x 5" deep
Shipping Weight:	8 lbs.

INTRODUCTION

The Heathkit Model IG-72 Audio Generator is a simple, yet versatile instrument. While simple in layout and easy to construct, the carefully assembled instrument provides ease of operation in a multitude of test setups encountered in audio laboratories. The wide range of repeatable frequencies and the metered low distortion output voltages covering nearly all values encountered in audio work contained in the conveniently small cabinet will entitle this instrument to a preferred spot in the laboratory.

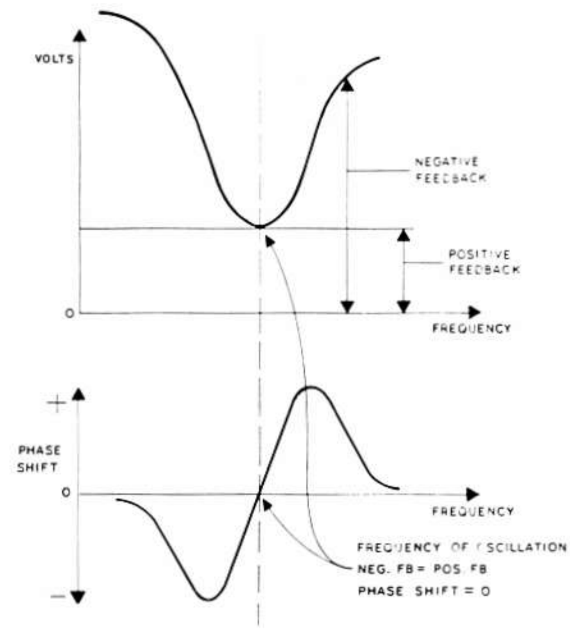
The excellent performance of which this design is capable will not be realized in the finished instrument, UNLESS the assembler uses the best workmanship of which he is capable. Poor soldering technique, corrosive fluxes (acid core, so-called non-corrosive pastes), hurried and careless construction and failure to follow procedures outlined in this manual are the most prevalent causes for unsatisfactory operation. Protect your investment in time and money and reap the reward of personal satisfaction that money cannot buy, by doing a first class job of constructing this kit.

CIRCUIT DESCRIPTION

The circuit of this instrument may be divided into four parts: the power supply, the oscillator, the attenuator and the metering circuit.

The power supply uses the conventional power transformer full wave rectifier circuit feeding a ripple filter consisting of two condensers and a choke.

The oscillator uses a 6AU6 pentode voltage amplifier and a 6CL6 triode-connected cathode follower. Regenerative feedback from the 6CL6 to the 6AU6 cathode is applied through the tungsten filament candelabra based lamp.

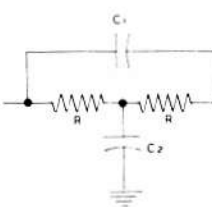


Degenerative feedback is applied from the 6CL6 through a "notch" network to the grid of the 6AU6. The resultant oscillation occurs at the "notch" frequency, where degeneration is minimum and phase shift is zero.

The "notch" network is a capacitor-shunted bridged-T type. The "notch" occurs at a frequency: $F = \frac{1}{2 \pi RC}$

where $C = \sqrt{C_1 C_2}$

The amplitude of oscillation is maintained at a nearly constant value by the tungsten lamp. The regenerative feedback is applied through a voltage divider consisting of the lamp and the "oscillator" control. An increase in output signal increases the lamp current, the lamp temperature and the lamp resistance. This reduces the amount of feedback applied to the 6AU6 cathode and the resultant output. A balanced condition is thus obtained. The "oscillator" control is used to set the nominal output level.



"NOTCH NETWORK"

The "notch" network consists basically of two resistances and two condensers. From the relationship shown it is evident that a decrease in capacities by a factor of 10 will increase the frequency by a factor of 10. As the values of C_1 and C_2 were chosen with a 10:1 ratio, five condensers can do the job of four pair or eight, in achieving four decade ranges.

For frequency variation within the steps of 10 times provided by the multiplier switch, the value of R is changed. For a multiplier switch setting of X1 a resistance (R) of 100 KΩ will produce a frequency of 10 cycles. As F and R are inversely proportional, 20 cycles or twice the frequency, requires half the resistance, or 50 KΩ. Likewise, 30 cycles or three times the frequency requires 1/3 the resistance or 33.3 KΩ. The 0-100 "cycle" switch uses two decks, each deck switching four resistors as follows: 100 KΩ, 50 KΩ, 33.3 KΩ, 25 KΩ. 100 K // 25 K = 20 K; 50 K // 25 K = 16.7 K; 33.3 K // 25 K = 14.3 K; 100 K // 33.3 K // 25 K = 12.5 K; 50 K // 33.3 K // 25 K = 11.1 K; 100 K // 50 K // 33.3 K // 25 K = 10 K. These resistance values produce frequencies of 10 to 100 cycles in steps of 10 cycles. (// means "in parallel with.")

Frequency variations within a 10 cycle span are produced by the 0-10 "cycle" switch. Here the same reasoning and circuitry are used as above but the actual resistance values are substantially ten times larger. These resistance values are connected in parallel with the first switch and produce one cycle increments.

The attenuator reduces the output voltage from the 6CL6 cathode-follower through a continuously variable 5 KΩ "output" control, and then through a step attenuator. The attenuator system is designed for 600 Ω output up through 1 volt and high impedance output at the 3 and 10 volt positions. The 600 Ω positions may be terminated by an internal load for high impedance work or this load may be disconnected when an external 600 Ω load is used. In the 3 and 10 volt positions, the internal load is automatically disconnected. The attenuator operates in steps of 10 db.

The metering circuit measures the voltage at the arm of the "output" control. A portion of this voltage, determined by the "meter" control, is rectified by a half-bridge using crystal diodes. Non-linearity of the diodes at low signal level is compensated by a third diode across the meter. The meter carries three scales: 0-10 volt, 0-3 volt, and -10 to +2 db. When the instrument is operated with the proper termination, the meter and attenuator will indicate the output level at the binding posts.

STEP-BY-STEP ASSEMBLY INSTRUCTIONS

A kit of parts can be assembled into the finished product in a variety of ways; from pictorials, photographs or from circuit diagram alone. However, even experienced and skilled professional persons have discovered that a combination of pictorials and step-by-step written instructions provide the fastest, most convenient way. This also guards against the disappointment of failure to operate after construction is completed, due to a single minor hard-to-find omission.

The written assembly instructions in this manual are divided into small operations or steps. Each step is a complete operation. Read the entire step through, then do that operation and check it off as completed. After an interruption, it is easy to find where you left off by the check marks. Read over the last checked step and you are all ready to continue.

In the mechanical assembly, use lockwashers under all 6-32 nuts and between all controls or switches and the mounting surface.

In the wiring (S) means solder this connection and (NS) means do not solder yet, as more wires will be connected to this point. If more than one wire is to be soldered at a connection point, the instructions will appear as follows (S) (3) which means solder this connection which should have three wires connected to it. This will provide a running check of multiple connections.

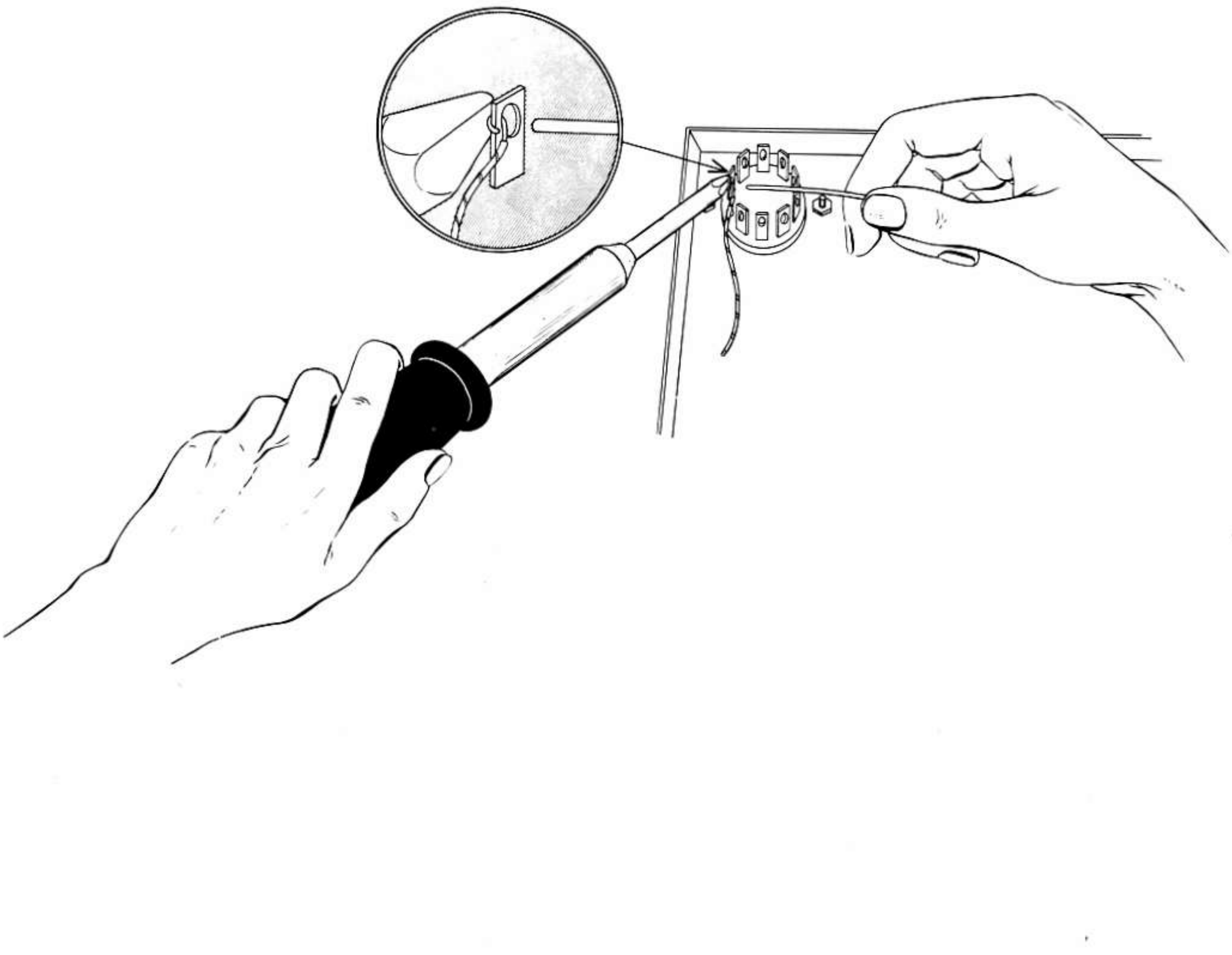
PROPER SOLDERING PROCEDURE

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 because of poor or improper soldering.

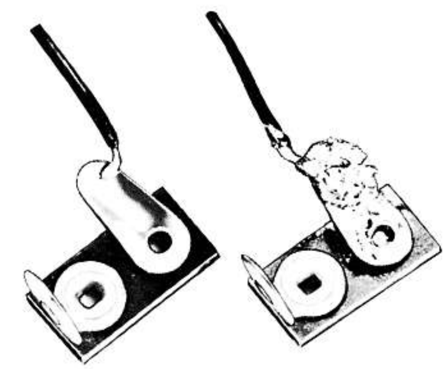
Correct soldering technique is extremely important. Good solder joints are essential if the performance engineered into the kit is to be fully realized. If you are a beginner with no experience in soldering, a half-hour's practice with odd lengths of wire and a tube socket will be a worthwhile investment.

ROSIN CORE SOLDER HAS BEEN SUPPLIED WITH THIS KIT. THIS TYPE OF SOLDER MUST BE USED FOR ALL SOLDERING IN THIS KIT. ALL GUARANTEES ARE VOIDED AND WE WILL NOT REPAIR OR SERVICE EQUIPMENT IN WHICH ACID CORE SOLDER OR PASTE FLUXES HAVE BEEN USED. IF ADDITIONAL SOLDER IS NEEDED, BE SURE TO PURCHASE ROSIN CORE (60:40 or 50:50 TIN-LEAD CONTENT) RADIO TYPE SOLDER.

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 that 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.

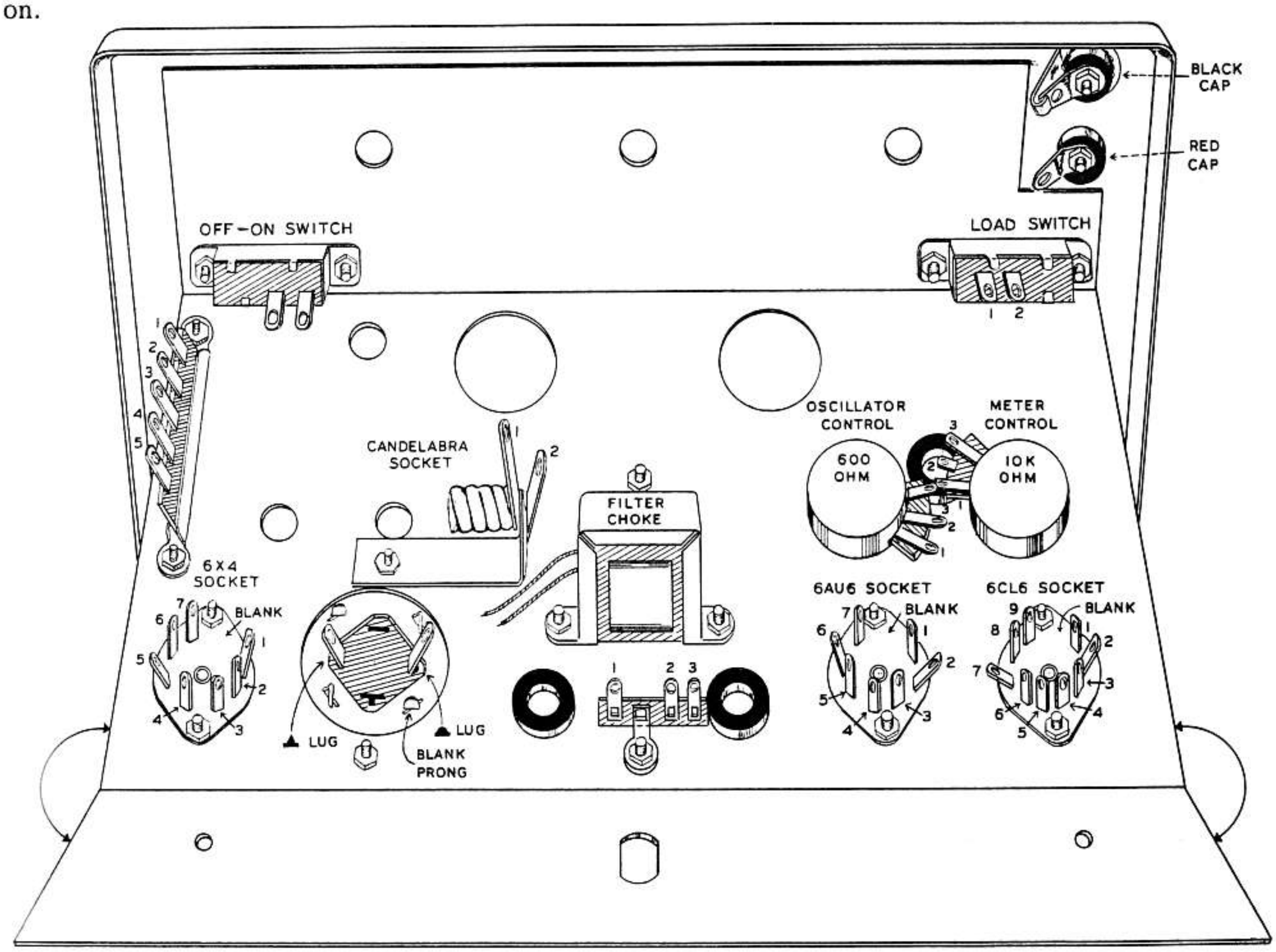


A poor solder joint will usually be indicated by its appearance. The solder will stand up in a blob on top of the connection, with no evidence of flowing out caused by actual "wetting" of the contact. A crystalline or grainy texture on the solder surface, caused by movement of the joint before it solidified 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.

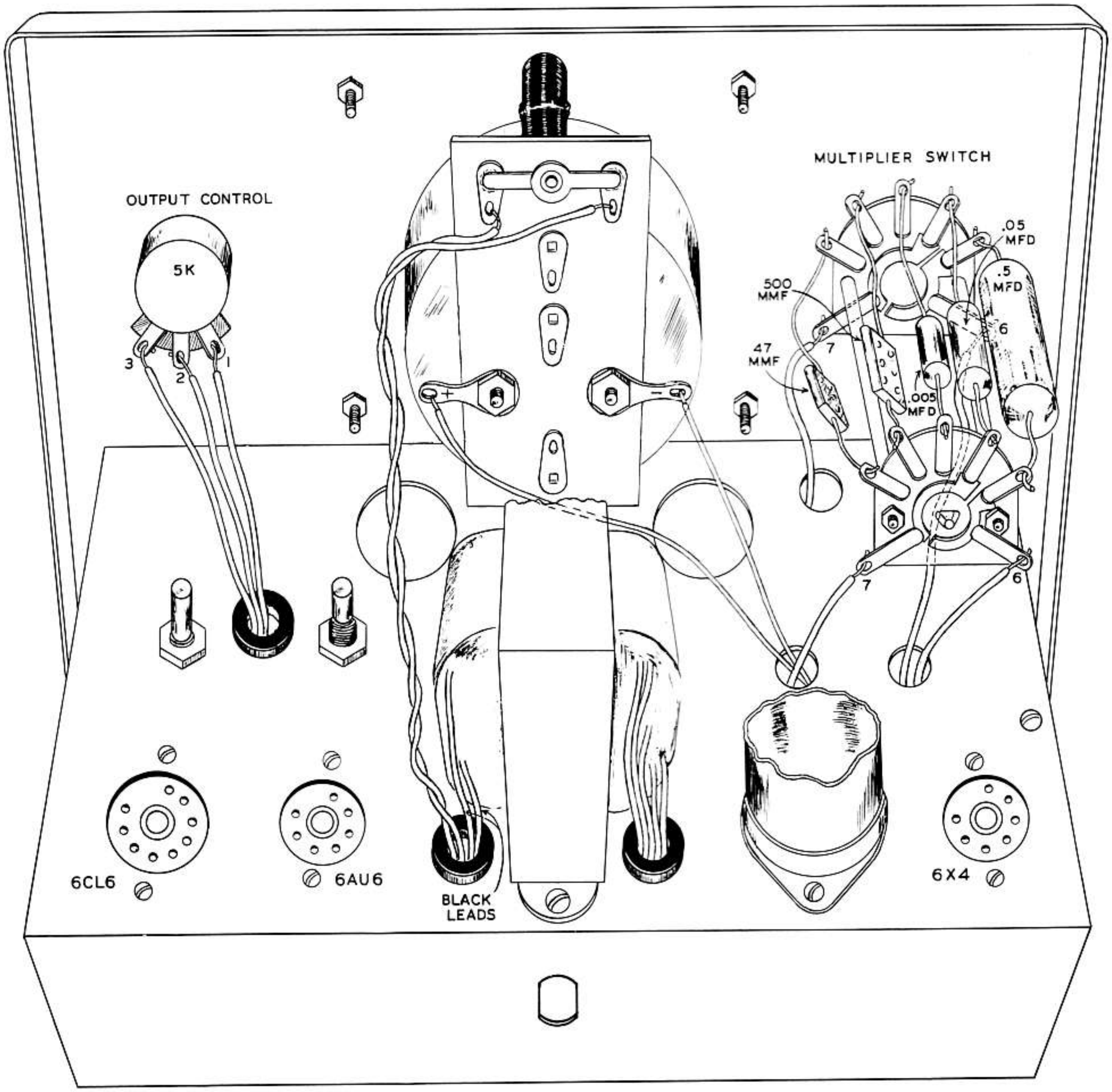


A good, clean, well-tinned soldering iron is also important to obtain consistently perfect connections. For most wiring, a 25 to 100 watt iron, or the equivalent in a soldering gun, is very satisfactory. Smaller irons generally will not heat the connections enough to flow the solder smoothly over the 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 this precaution and use reasonable care during the assembly of the kit. This will insure the wonderful satisfaction of having the instrument operate perfectly the first time it is turned on.



PICTORIAL 1


OUTPUT CONTROL
5K
3
2
1
MULTIPLIER SWITCH
.05
MFD
.5
MFD
500
MMF
47
MMF
7
6
.005
MFD
7
6
6CL6
6AU6
BLACK
LEADS
6X4

Pictorial 2

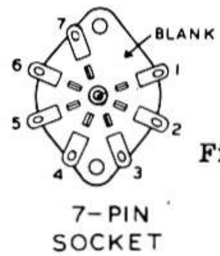


Figure 1

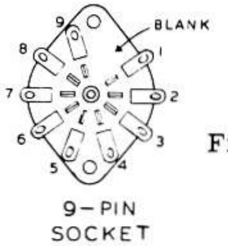


Figure 2

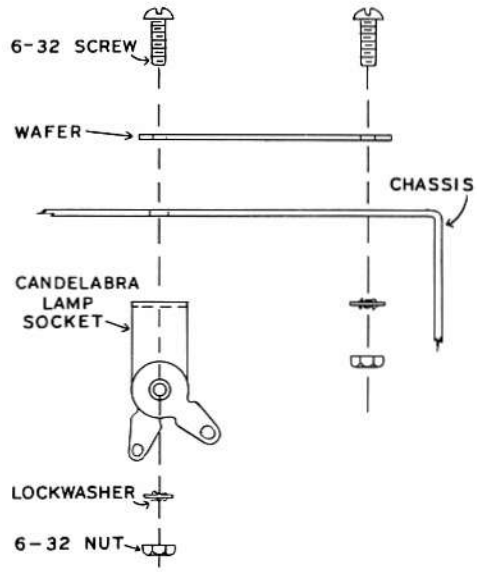


Figure 3

NOTE: The term "6-32 hardware," means that a 6-32 x 3/8" screw, #6 lockwasher and a 6-32 nut is to be used, unless specified otherwise.

Refer to Pictorial 1 for the following steps.

( ) Mount the two 7-pin and one 9-pin wafer type tube sockets on the chassis with 3-48 screws and nuts. See Figures 1 and 2 for identification. Note the position of the blank spaces in Pictorial 1 on Page 6. Observe that the sockets mount below the chassis.

( ) Mount the condenser mounting wafer on top of the chassis. At the same time, install the candelabra lamp socket as shown in Figure 3.

( ) Install the three 3/8" rubber grommets in positions shown in Pictorial 1.
( ) Mount the 5-lug terminal strip with 6-32 hardware as shown.
( ) Mount the filter choke below the chassis with 6-32 hardware.
( ) Mount the power transformer on top of the chassis. Also install the 3-lug terminal strip as shown in Figure 4.
( ) Mount the 600 Ω oscillator control with a control lockwasher and a control nut. See Figure 5.
( ) Mount the 10 KΩ meter control in the same manner.

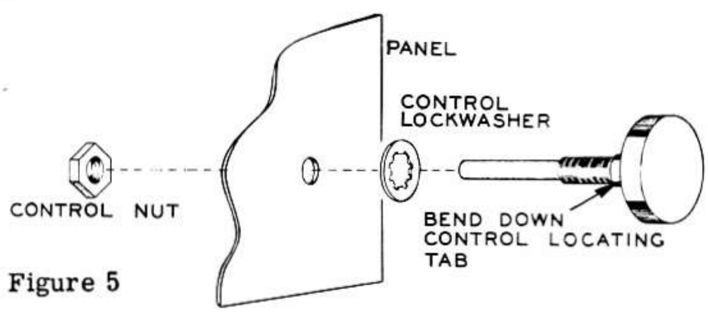


Figure 5

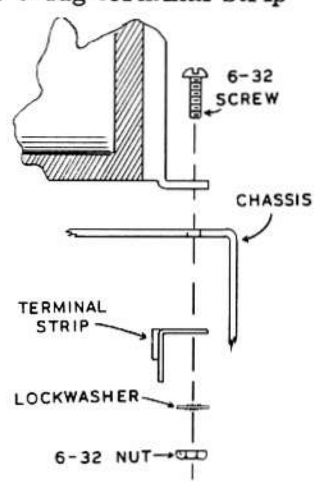


Figure 4

( ) Fasten the panel to the chassis by installing the slide switches. Use 6-32 hardware, with the screw through the panel, the chassis and the switch. Note the position of each switch in Pictorial 1 (lugs inward). Check the alignment of the three holes in the panel and chassis before tightening the screws.

( ) Install the binding posts. Use binding post base, insulator bushings, solder lug and 6-32 nut. See Figure 6. On the one nearest the edge of the panel, include a larger control solder lug between the bushing and the inside of the panel.
( ) Install the 5 KΩ output control on the panel with a lockwasher between control and panel and a nickel washer between control nut and panel. See Pictorial 2 for position.
( ) Install the multiplier switch in the same manner.

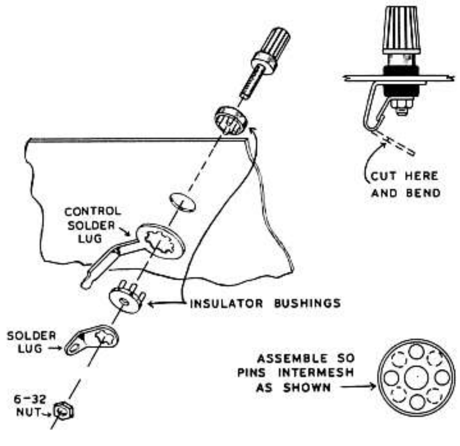


Figure 6

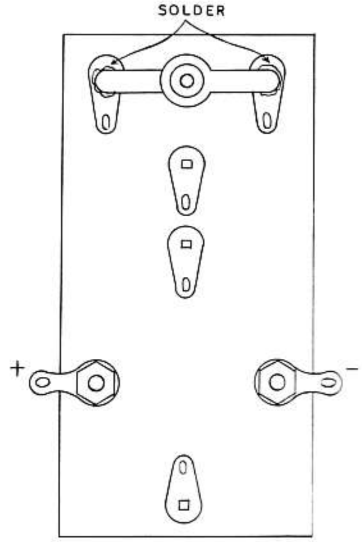


Figure 7

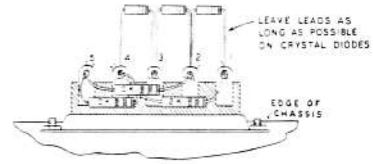


Figure 8

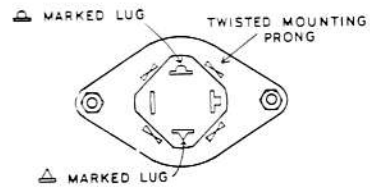


Figure 9

METER SUB-ASSEMBLY

( ) Install the meter on the front panel with the hardware supplied in the meter box.

( ) Remove one nut and the solder lug from each meter stud. NOTE: Hold the inner nut while loosening the outer nut, so no strain is placed on the plastic meter housing. Run the remaining nut down on the meter stud.

( ) Install the terminal board on the meter studs with the solder lugs and nuts that came on the meter.

( ) Slip the 3/8" fiberglas sleeving over the pilot lamp and install the lamp in its socket. Slip the sleeving against the panel.

( ) Solder the pilot light socket to the terminals as shown in Figure 7 (S).

WIRE THE 5-LUG STRIP

( ) Connect a 2KΩ resistor between lug 1 (NS) and lug 4 (NS). See Figure 8 and Pictorial 3.

( ) Connect a 10 KΩ resistor between lug 4 (NS) and lug 5 (NS).

( ) Connect another 10 KΩ resistor between lug 2 (NS) and lug 5 (NS). Make sure the lead wires do not touch connections to lug 4.

( ) Connect a 5 1/2" wire between lug 4 (NS) and the negative (-) lug (S) on the meter.

( ) Connect a 7 1/2" wire between lug 2 (NS) and the positive (+) lug (S) on the meter.

( ) Connect a crystal diode with the cathode lead (see page 23 for coding of cathode on diodes) to lug 1 (S) (2). Connect the other lead to lug 2 (NS). Leave leads as long as possible.

( ) Connect a second crystal diode with the cathode lead to lug 2 (S) (4). Connect the other lead to lug 3 (NS). Leave leads as long as possible.

( ) Connect a third crystal diode with the cathode lead to lug 3 (NS). Connect the other lead to lug 4 (S) (4). Leave leads as long as possible.

( ) Install the filter condenser on top of the chassis by passing the mounting prongs through the slots in the mounting wafer, (make sure the condenser is properly positioned) and twist the prongs 1/8 turn with a pair of pliers. See Figure 9 and Pictorial 1 on Page 7.

CHASSIS WIRING

Refer to Pictorial 3 (fold-out from Page 15).

( ) Place the transformer leads through the grommets and connect the red-yellow lead to a twisted mounting prong (NS) on the filter condenser.

( ) Connect the red leads to pin 1 (S) and pin 6 (S) on the 6X4 socket.

( ) Connect the green leads to pin 3 (NS) and pin 4 (NS) on the 6X4 socket.

( ) Connect a wire between pin 3 (NS) on the 6X4 socket and the twisted mounting prong (S) (2) on the filter condenser.

( ) Twist two 6 1/2" lengths of wire together and connect one end to pin 3 (S) (3) and pin 4 (S) (2) on the 6X4 socket. Connect the other end to pin 3 (NS) and pin 4 (NS) on the 6AU6 socket.

( ) Twist two 2 1/2" lengths of wire together and connect one end to pin 3 (NS) and pin 4 (NS) on the 6AU6 socket. Connect the other end to pin 4 (S) and pin 5 (S) on the 6CL6 socket.

( ) Twist two 11" lengths of wire together and connect one end to pin 3 (S) (3) and pin 4 (S) (3) on the 6AU6 socket. Place the other end through the nearest grommet and connect to the pilot light terminals (S) on the meter terminal board as shown in Pictorial 2 on Page 7.

( ) Connect a wire between pin 7 (S) on 6X4 socket and ▲ marked lug (NS) on the filter condenser.

( ) Connect one lead from the filter choke to the ▲ marked lug (S) (2) on the filter condenser.

( ) Connect the other lead of the filter choke to the ▬ marked lug (NS) on the filter condenser.

( ) Connect a wire between the ▬ marked lug (S) (2) on the filter condenser and pin 3 (NS) on the 6CL6 socket.

( ) Twist two 11 1/2" lengths of wire together and connect one end to the OFF-ON slide switch (S). Connect the other end to lug 2 (NS) and lug 3 (NS) on the terminal strip.

( ) Connect one black transformer lead to lug 3 (S) (2) and the other black lead to lug 1 (NS) on the terminal strip.

( ) Connect a wire between a second twisted mounting prong (S) on the filter condenser and through lug 2 (NS), through lug 3 (NS) on the 600 Ω oscillator control to lug 1 (NS) on the 10 KΩ meter control.

( ) Connect a wire between lug 1 (S) on the candelabra socket and lug 1 (NS) on the 600 Ω oscillator control.

( ) Connect a 330 Ω resistor between lug 1 (S) (2) on the oscillator control, through pin 7 (S) to pin 2 (NS) on the 6AU6 socket.

( ) Connect a wire between pin 5 (S) on the 6AU6 socket and pin 9 (S) on the 6CL6 socket.

( ) Connect a 120 KΩ resistor between pin 6 (NS) (use sleeving over this lead) on the 6AU6 socket and through pin 8 (S) to pin 3 (NS) on the 6CL6 socket.

( ) Connect a 47 Ω resistor between pin 1 (S) and pin 7 (NS) on the 6CL6 socket.

( ) Connect a 47 KΩ 2 watt resistor between pin 2 (S) and through pin 6 (S) to pin 3 (S) on the 6CL6 socket.

( ) Connect a 16 μfd 150 volt electrolytic condenser with the positive (+) lead to pin 6 (S) (2) and the negative (-) lead to pin 2 (S) (2) on the 6AU6 socket. Use sleeving on both leads. Place condenser close to chassis.

( ) Place the line cord through the hole in the rear edge of the chassis. Connect one lead to lug 1 (S) (2) and the other lead to lug 2 (S) (2) on the terminal strip.

( ) Install the line cord strain relief in the hole in the rear edge of the chassis as shown in Pictorial 3.

( ) Connect a 20 μfd 350 volt electrolytic condenser with the negative (-) lead to lug 2 (NS) on the candelabra socket and the positive lead (+) to pin 7 (NS) on the 6CL6 socket. Use sleeving on these leads.

( ) Connect a 5000 Ω 20 watt resistor between pin 7 (S) (3) on the 6CL6 socket and lug 2 (S) (2) on the oscillator control. Leave the leads fairly long and dress as shown in Figure 10.

( ) Connect a 7 1/2" wire between lug 2 (NS) on the candelabra socket and lug 3 (S) on the output control.

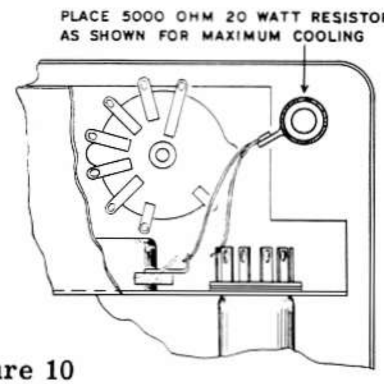


Figure 10

( ) Connect a 3 1/2" wire between lug 3 (S) (2) on the oscillator control and lug 1 (S) on the output control.

( ) Connect a wire between lug 5 (S) (3) on the 5-lug terminal strip and the nearest twisted mounting prong (NS) on the filter condenser.

( ) Connect an 8 1/2" wire between lug 3 (S) (3) on the 5-lug terminal strip and lug 2 (S) on the meter control.

CYCLE SWITCH SUB-ASSEMBLY:
Check only one (√) ( ) for each operation.
**See NOTE below.

( )( ) Locate switch #63-108 and position it as shown in Figure 11.

( )( ) Connect a 50 KΩ precision resistor between lug 9 (S) (double clip) on the front section and through lug 9 (S) to lug 10 (NS) on the rear section.

( )( ) Connect a 100 KΩ precision resistor between lug 10 (S) on the front section, through lug 10 (S) (2) to lug 1 (NS) on the rear section.

( )( ) Connect a 25 KΩ precision resistor between lug 1 (S) on the front section, through lug 1 (S) (2) to lug 2 (NS) on the rear section.

( )( ) Connect a 33.3 KΩ precision resistor between lug 2 (S) on the front section, through lug 2 (S) (2) to lug 3 (NS) on the rear section.

( )( ) Connect a 50 KΩ precision resistor between lug 4 (S) (double clip) on the rear section, through lug 4 (S) to lug 5 (NS) on the front section.

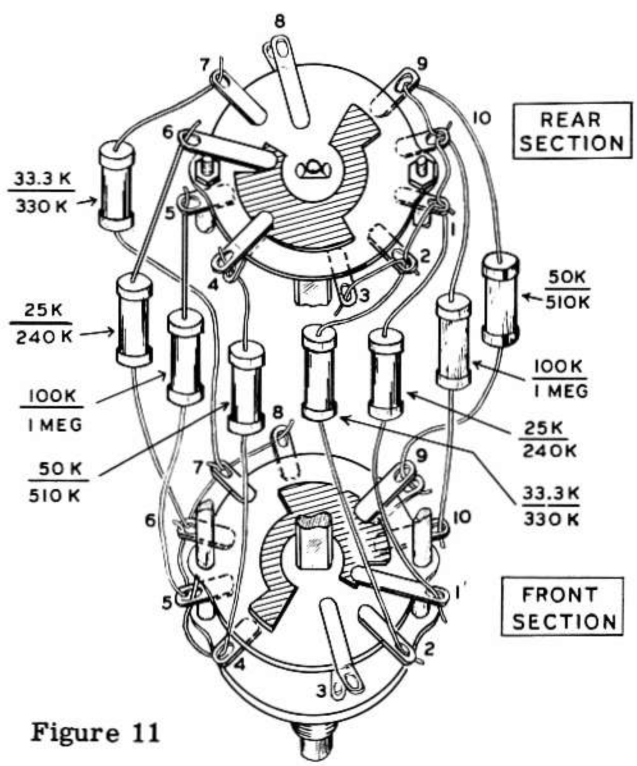


Figure 11

( )( ) Connect a 100 KΩ precision resistor between lug 5 (S) on the rear section, through lug 5 (S) (2) to lug 6 (NS) on the front section.

( )( ) Connect a 25 KΩ precision resistor between lug 6 (S) on the rear section, through lug 6 (S) (2) to lug 7 (NS) on the front section.

( )( ) Connect a 33.3 KΩ precision resistor between lug 7 (S) on the rear section, through lug 7 (S) (2) to lug 8 (NS) on the front section.

**Now repeat each step and check the second (✓) for each operation, as the second CYCLE switch is wired. Substitute 510 KΩ 5% for 50 KΩ, 1 megohm 5% for 100 KΩ, 240 KΩ 5% for 25 KΩ and 330 KΩ 5% for 33.3 KΩ.

( ) Install the precision cycle switch through chassis and panel with lockwasher, nickel washer and control nut in the 0-100 position.

( ) Install the 5% cycle switch in the same manner in the 0-10 position.

( ) Connect a 47 μμf condenser between lug 1 (S) on the front and lug 1 (S) on the rear of the multiplier switch.

( ) Connect a 500 μμf condenser between lug 2 (S) on the front and lug 2 (S) on the rear.

( ) Connect a .005 μfd condenser between lug 3 (S) on the front and lug 3 (S) on the rear.

( ) Connect a .05 μfd condenser between lug 4 (S) on the front and lug 4 (S) on the rear.

( ) Connect a .5 μfd condenser between lug 5 (S) on the front and lug 5 (S) on the rear.

( ) Connect a 4 1/2" wire between lug 6 (S) on the front of the multiplier switch and a third twisted mounting prong (S) (2) on the filter condenser.

( ) Connect a 3 1/2" wire between lug 7 (S) on the front of the multiplier switch and lug 3 (NS) (double lug) on the front of the precision cycle switch.

( ) Connect a 3" wire between lug 3 (S) (2) (double lug) on the front of the precision cycle switch and lug 3 (NS) (double lug) on the front of the 5% cycle switch.

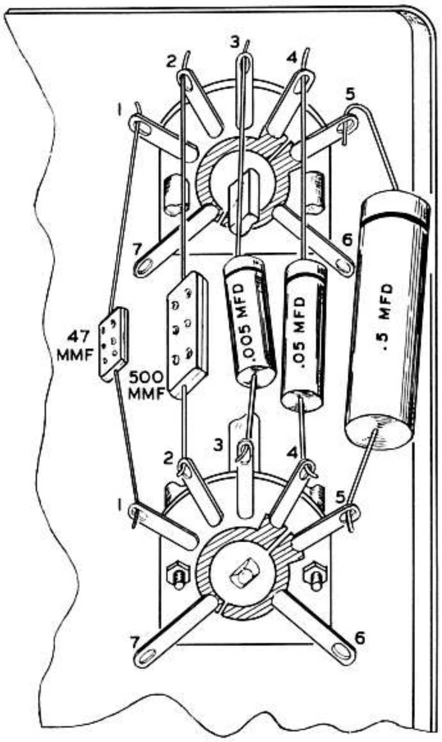


Figure 12

( ) Connect a 4 1/2" wire between lug 3 (S) (2) (double lug) on the front of the 5% cycle switch and pin 1 (S) on the 6AU6 socket.

( ) Connect a 3" wire between lug 8 (S) (2) on the front of the precision cycle switch and lug 8 (NS) on the front of the 5% cycle switch.

( ) Connect a 2" wire between lug 8 (S) (3) on the front of the 5% cycle switch and lug 3 (NS) on the rear of the precision cycle switch.

( ) Connect a 3" wire between lug 3 (NS) on the rear of the precision cycle switch and lug 3 (S) (2) on the rear of the 5% cycle switch.

( ) Connect a 4 1/2" wire between lug 3 (S) (4) on the rear of the precision cycle switch and lug 6 (S) on the rear of the multiplier switch.

( ) Connect a 3" wire between lug 8 (S) (double lug) on the rear of the precision cycle switch and lug 8 (NS) (double lug) on the rear of the 5% cycle switch.

( ) Connect a 1 1/2" wire between lug 8 (NS) (double lug) on the rear of the 5% cycle switch and lug 2 (S) (3) on the candelabra socket.

( ) Connect a 4" wire between lug 8 (S) (3) (double lug) on the rear of the 5% cycle switch and lug 7 (S) on the rear of the multiplier switch.

Dress all preceding wires so they will not interfere with operation of the switches.

ATTENUATOR SWITCH SUB-ASSEMBLY

( ) Locate switch #63-107 and position it as shown in Figure 13.

( ) Connect a 750 Ω resistor between lug 2 (NS) and lug 8 (NS) on the front section.

( ) Connect a 1600 Ω resistor between lug 8 (S) (2) and lug 7 (NS) on the front section.

( ) Connect an 1100 Ω resistor between lug 4 (NS) and lug 7 (NS) on the front section.

( ) Connect another 1600 Ω resistor between lug 7 (S) (3) and lug 6 (NS) on the front section.

( ) Connect another 1100 Ω resistor between lug 6 (NS) and lug 4 (NS) on the front section.

( ) Connect a third 1600 Ω resistor between lug 6 (S) (3) on the front section and lug 7 (NS) on the rear section.

( ) Connect a bare wire (cover with sleeving) between lug 5 (S) on the front section and lug 8 (S) on the rear section.

( ) Connect a 3" bare wire between lug 4 (S) (3) and after slipping a 1/2" length of sleeving on, place the lead through lug 2 (NS) on the front section. Leave the excess bare wire for eventual connection to a binding post.

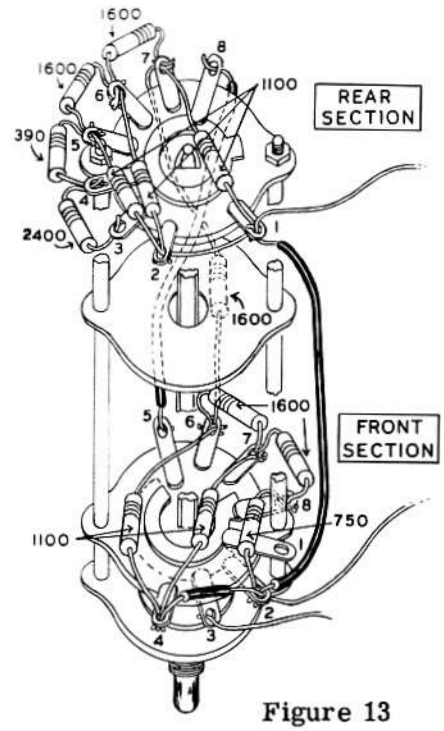


Figure 13

( ) Connect a 1 1/2" bare wire to lug 3 (S). Leave the other end for eventual connection to the load switch.

( ) Connect a 3" bare wire to lug 2 (S) (3) on the front section and after slipping on a 1" length of sleeving, place through lug 1 (NS) on the rear section. Leave the excess length for eventual connection to the controls.

( ) Connect a third 1100 Ω resistor between lug 1 (NS) and lug 7 (NS) on the rear section.

( ) Connect a fourth 1600 Ω resistor between lug 7 (S) (3) and lug 6 (NS) on the rear section.

( ) Connect a fourth 1100 Ω resistor between lug 2 (NS) and lug 6 (NS) on the rear section.

( ) Connect a fifth 1600 Ω resistor between lug 6 (S) (3) and lug 5 (NS).

( ) Connect a fifth 1100 Ω resistor between lug 5 (NS), through lug 2 (S) (2) to lug 1 (S) (3).

( ) Connect a 390 Ω resistor between lug 5 (S) (3) and lug 4 (NS).

( ) Connect a 2400 Ω resistor between lug 4 (S) (2) and lug 3 (NS).

( ) Again referring to Pictorial 3, connect a 560 Ω resistor between lug 2 (S) on the load switch, through the nearest binding post solder lug (S). Leave the excess lead wire for eventual connection to the attenuator switch.

( ) Install the attenuator switch with lockwasher, nickel washer and control nut through the chassis and panel. Position as shown.

( ) Connect the bare wire from lug 1 on the rear section of the attenuator switch to lug 1 (S) (2) on the meter control.

( ) Connect a 4700 Ω resistor between lug 3 (S) on the meter control and lug 3 (NS) on the rear section of the attenuator switch.

( ) Connect a 5" wire between lug 2 (S) on the output control and lug 3 (S) (3) on the rear section of the attenuator switch.

( ) Connect the bare wire from lug 3 on the front section of the attenuator switch to lug 1 (S) on the load switch.

( ) Connect the bare wire from lug 2 on the front section of the attenuator switch to both the large and small solder lugs (S) on the binding post in the corner of the panel.

( ) Connect the bare wire left on the other binding post to lug 1 (S) on the front section of the attenuator switch.

This completes the wiring of the instrument. Shake out all the loose solder bits and wire clippings. Inspect the wiring carefully. Check lead dress (bare leads contacting metal parts, components touching moving parts) and inspect each connection carefully for proper soldering.

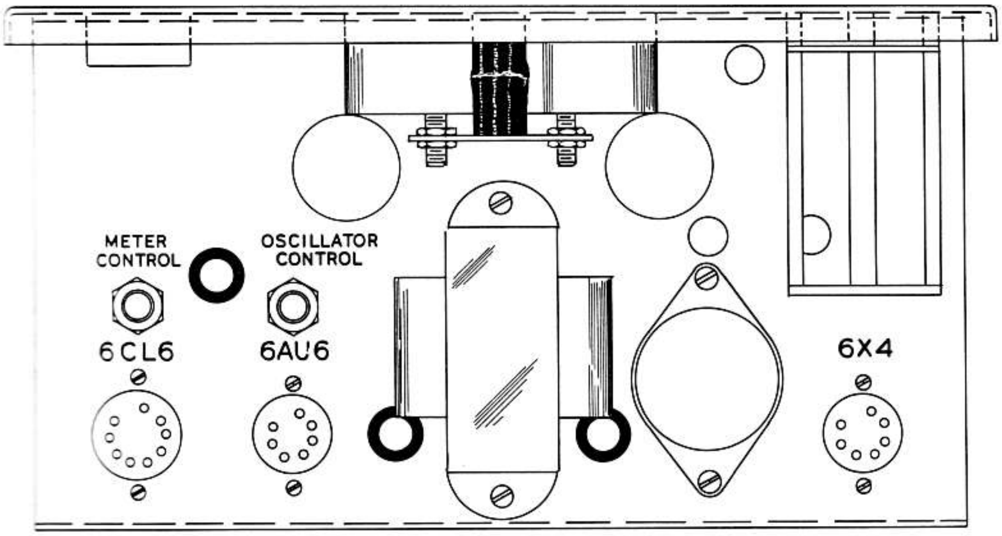


Figure 14

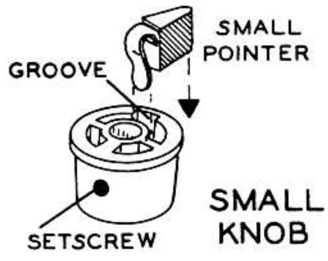
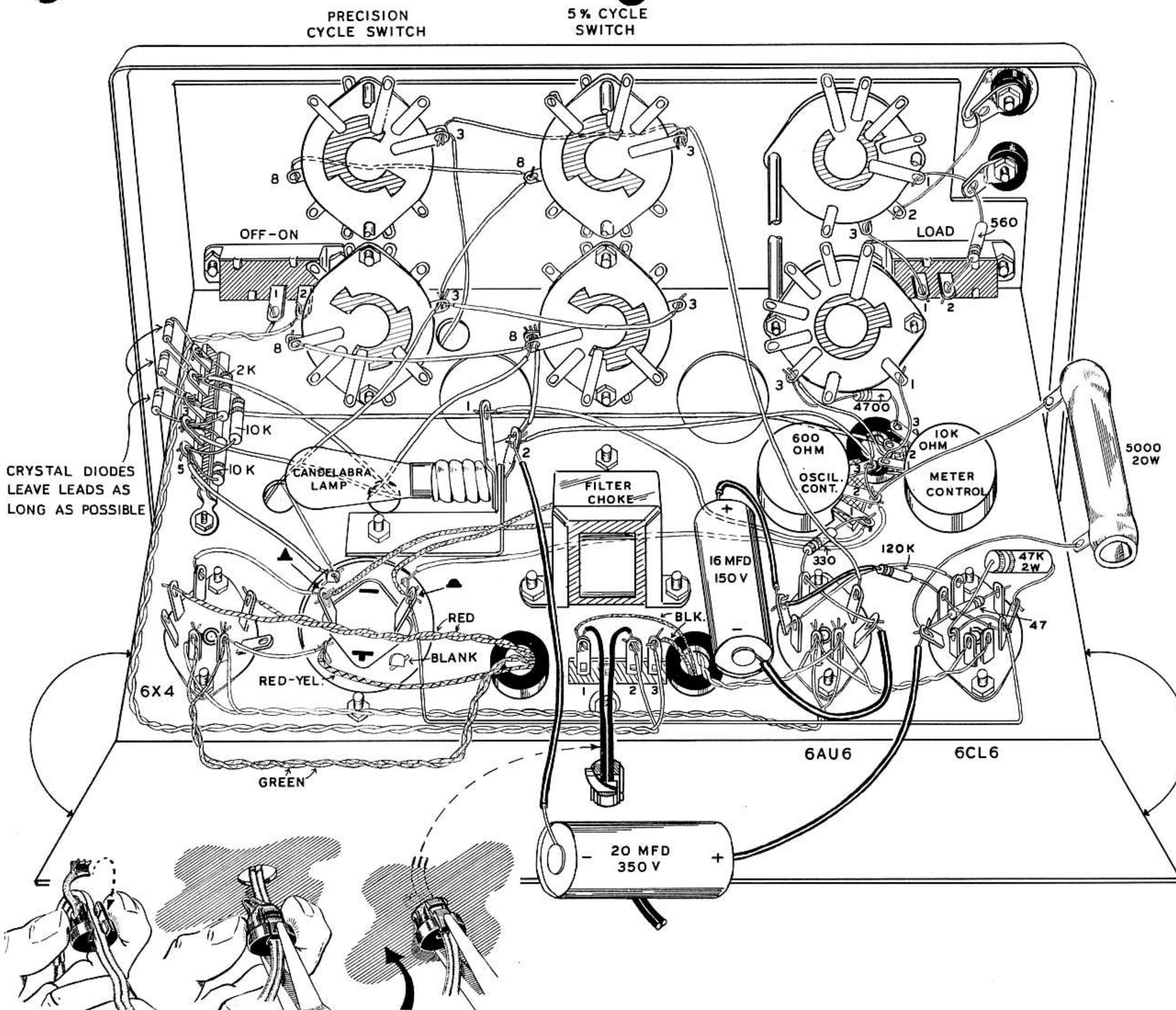


Figure 15

( ) Refer to Figure 15 and attach the knob pointers on the five knobs.

( ) Turn all the controls and switches to their full counterclockwise position.


PRECISION
CYCLE SWITCH
5% CYCLE
SWITCH
OFF-ON
LOAD
560
2K
10K
10K
CRYSTAL DIODES
LEAVE LEADS AS
LONG AS POSSIBLE
CANDELABRA
LAMP
FILTER
CHOKE
16 MFD
150 V
600
OHM
OSCIL.
CONT.
10K
OHM
METER
CONTROL
4700
5000
20W
330
120K
47K
2W
47
RED
BLANK
RED-YEL.
BLK.
6X4
6AU6
6CL6
GREEN
20 MFD
350 V
OUTSIDE OF CHASSIS

Pictorial 3

(✓) Install the five knobs on the shafts of the panel controls with the pointers at the extreme counterclockwise marking on the panel, and tighten the setscrews.

( ) Install the 3 watt 115 volt candelabra lamp and the 6X4, 6AU6, and 6CL6 tubes in their proper sockets. See Figure 14.

( ) Install the handle on the cabinet with 10-24 screws.

( ) Mount the four rubber feet with 6-32 x 1/2" screws, #8 flat washers, #6 lockwashers, and 6-32 nuts as shown in Figure 16.

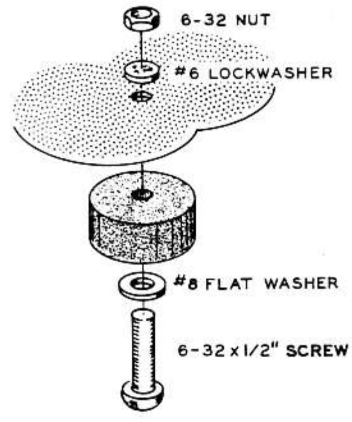


Figure 16

INITIAL TEST AND ADJUSTMENT

Plug the line cord into a 105-125 volt 50-60 cycle outlet. Do not plug into an outlet of higher voltage or lower frequency, or a DC outlet, as an incorrect power source will damage the transformer.

Turn power switch on and observe tubes and pilot lamp as they light up. If they do not light, turn power off and investigate filament circuit wiring. Set OSCILLATOR and METER controls about midway. Set precision (0-100) CYCLE switch to 10 or more and advance OUTPUT control. This should show a reading on the meter.

Calibrate the meter. NOTE: If in the following test the OUTPUT control is left off or fully counterclockwise, it will be severly damaged. Proceed as follows: Turn both CYCLE switches to 0. Turn the OUTPUT control to maximum clockwise. Turn the ATTENUATOR to maximum clockwise (10 volt or +20 db). Connect a wire between the red output binding post and one of the pilot light terminals on the meter terminal board. Use the terminal that gives a meter indication. Turn the METER control to produce a meter reading of 6.3 volts on the 0-10 scale (a little over half-way up the scale). Now remove the wire.

If an accurate AC voltmeter of adequate sensitivity (at least 500 Ω per volt on the 10 volt range for instance) is available, it should be used in preference to the above procedure. In that case: select a suitable frequency (between 50 and 3000 cycles, depending on the AC meter used) with the CYCLE and MULTIPLIER switches and connect the meter to the output of the generator. Adjust the METER control to produce equal readings on the two meters.

Adjust the OSCILLATOR control as follows: No connections to the output terminals. OUTPUT control at maximum. CYCLE switches and MULTIPLIER to 10 cycles or more. Turn OSCILLATOR control to give just over full scale reading on the meter. Select various frequencies between 10 cycles and 100 kc and if the output drops below full scale, readjust OSCILLATOR control for full scale. Do not adjust OSCILLATOR control higher than necessary as higher than nominal distortion will result.

This completes the adjustment of the instrument. Install the generator in the cabinet and fasten with the two #6 sheet metal screws through the rear of the cabinet into the chassis.

IN CASE OF DIFFICULTY

If upon completion of careful construction, the instrument fails to operate as specified, proceed as follows:

1. Check the wiring carefully step-by-step. Often having a friend check for you will locate an error consistently overlooked.
2. Inspect visually for malfunctioning, such as tubes lighting, discoloring of resistors through overheating, etc.
3. Inspect electrically with a voltmeter. The nominal voltages between tube socket pins and chassis are tabulated below. Nominal voltages were measured with a VTVM with 11 megohm input resistance. Lower resistance meters may give lower readings in some instances (particularly pin 6 on the 6AU6). Normal deviations due to line voltage and component variation may reach ±20%.

TUBE	Pin 1	Pin 2	Pin 3	Pin 4	Pin 5	Pin 6	Pin 7	Pin 8	Pin 9
6X4	320AC	NC	X	X	NC	320AC	420		
6AU6	1.5	4	X	X	200	140	4		
6CL6	210	200	410	X	X	410	210	410	200

NC - no connection. X - heater voltage (one pin 0 volts, other pin 6.3 volts AC.)
Generator frequency set to 10 cycles or higher.

Discrepancies of indicated voltages warrant investigation of the particular circuit involved. Wiring errors or faulty components may be found with inspection or resistance measurements.

Consider the characteristics of the circuit by rereading the circuit description. An understanding of the theory will aid in locating and correcting difficulties.

If intelligent investigation along the lines indicated does not solve your problem, write to the Heath Company describing your difficulty in detail, giving all symptoms, voltages and other data that may aid in correcting your trouble. Be sure to state model and name of instrument, IG-72 Audio Generator. You will receive a prompt reply to guide your further efforts.

APPLICATION

This instrument lends itself to the many applications in audio laboratories where a near-perfect sine wave signal within its amplitude and frequency limits is required. Some of the applications are as follows:

Signal source for bridge measurements.
Signal source for harmonic distortion measurements.
Signal source for external modulation of RF signal generators.
Signal source for testing of audio amplifiers for gain and frequency response.

OPERATION

The instrument produces a low distortion sine wave signal voltage of adjustable amplitude and frequency. To select the desired frequency, adjust the 0-100 knob to the first significant figure, adjust the 0-10 knob to the second significant figure and turn the multiplier to the desired value.

Example: For a frequency of 35 cycles, set the 0-100 knob to 30, the 0-10 knob to 5 and the multiplier to X1.

Example: For a frequency of 72 kc, set the 0-100 knob to 70, the 0-10 knob to 2 and the multiplier to X1000.

To select the desired output amplitude into a high impedance load (10 KΩ or more): Set the LOAD switch to internal, the ATTENUATOR to the nearest full scale value above the desired output; adjust the OUTPUT control to give the desired output on the appropriate meter scale.

Example: Desired voltage 7.3 volts. Set ATTENUATOR to 10 volts full scale. Turn OUTPUT to give a 7.3 volt reading on the 0-10 volt scale.

Example: Desired voltage .025 volts. Set ATTENUATOR to .03 volts full scale. Turn OUTPUT to give a 2.5 volt reading on the 0-3 volt scale.

To select the desired output amplitude into an external 600 Ω load (1 volt maximum): Set the LOAD switch to external and proceed as above.

USING THE DB SCALE

The decibel is a ratio of two power levels and is used in comparative expressions. It may be applied to voltage levels if the impedances are identical. It may be used as a quantitative indication for one power or voltage level if the other level is defined. In this instrument, the db scale is based on a reference or standard level of 0 db = 1 milliwatt in 600 Ω. If used with a 600 Ω external load, the meter reading is expressed in dbm and the reference level is automatically defined.

If the instrument is used with loads differing from 600 Ω but substantially less than 10 KΩ, correction factors for the voltage reduction in the attenuator and for the db level may be calculated.

If the instrument is used with high impedance loads, the relation between two signal levels may be expressed as a number of db difference.

Example: A device requires a signal of .61 volts on one input jack for a certain output. It requires a signal of .012 volts on another input jack for the same output. How many db difference between the two input jacks?

.61 volts is - 2 db (on meter) ±0 db (on attenuator) = -2
.012 volts is -6 db (on meter) -30 db (on attenuator) = -36
level difference is (-2) - (-36) = 34 db.

NOTE: Theoretically the input impedances should be equal in the above example. The method described is generally more useful than calculating the power level at each input (using voltage and input impedance and using the formula:

$$db = 10 \log \frac{P_1}{P_2} = 10 \log \frac{E_1{}^2/R_1}{E_2{}^2/R_2}$$

for equal impedances this reduces to:

$$db = 10 \log \frac{(E_1)^2}{(E_2)} = 20 \log \frac{E_1}{E_2}$$

Although theoretically correct, erroneous impression may be gained by using the above approach: Changing a 10 KΩ grid resistor to 10 megohm decreases the power level by a factor of 100 or 20 db. Yet the input voltage is unchanged.

For further information see: Langford-Smith; Radiotron Designer's Handbook, 4th Ed. Ch. 19

ACCURACY

As the output of this instrument is a signal voltage of a certain frequency and a certain amplitude a certain amount of accuracy of those two factors may be expected.

Frequency is primarily determined by the "notch" network and thus the precision of the components in this network. Nominal tolerance on the precision resistors is 1%, on the condensers 2%. The influence of the 5% resistors is at most, a tenth of the effect of the precision resistors, so their maximum contribution is not more than 1/2%. Allowing for temperature effects, stray capacities and phase shift of the amplifiers at the frequency limits, the maximum frequency error is expected to fall within 5% of the indicated frequency.

Output voltage depends on a number of factors. Meter calibration is the task of the constructor and it should be borne in mind that many standard meters are subject to frequency errors. Iron vane and dynamometer instruments rarely maintain their rated accuracy above 150 cycles. Rectifier instruments begin to drop at about 5 to 10 kc. The output voltage is further affected by the attenuator. Here 5% resistors are used and the resultant accuracy should fall within 5%. The attenuator accuracy also depends on the load resistance, particularly on the 3 volt range, where a 12 KΩ load makes the output 1/2 db less than indicated and a 2000 Ω load causes a 3 db error.

On the 1 volt range and below, a high impedance load will be subject to twice the indicated voltage (6 db high) if the internal load is not used.

On the 10 volt range however, loading, while lowering the output voltage, will not cause error because the meter indicates the output voltage directly. Loads of less than 10 KΩ may increase the distortion and very low resistance loads effectively short out the 6CL6 output and cause oscillation to cease, when the output control is set at maximum.

The meter and its circuit contribute additional inaccuracies at voltages differing from the calibration voltage. The meter movement may deviate as much as 2% of the full scale value due to the discrepancy between the nominal meter curve on which the scale is based and the characteristics of the particular movement in an instrument. The meter rectifiers are non-linear at low voltages but this deviation is effectively compensated for by the third diode. Considering all the factors affecting the accuracy of the output voltage, it is expected to fall within 5% of indicated value.

BIBLIOGRAPHY

This manual is written to enable the owner of this instrument to successfully assemble and operate it. It is not an exhaustive treatise on the subject of Audio Generators and their use. Further information may be obtained from the many fine textbooks and excellent magazine articles available from most libraries. A few of these sources are listed below.

Harris; Electrical Measurements, Wiley 1952
Terman and Pettit; Electronic Measurements, McGraw-Hill 1952
Turner; Basic Electronic Test Instruments, Rinehart 1953
Savant; How to Design Notch Networks, Electronics, May 1953
Sulzer; Wide Range RC Oscillator, Electronics, Sept. 1950
Sulzer; Low Distortion Transistor Oscillator, Electronics, Sept. 1953
Sulzer; Low Distortion Oscillator, Electronics, May 1955

There are also various articles in:
Tele-Tech, Sept. 1950, p. 73
Radio and Television News, June 1951, p. 62; Jan. 1953, p. 62; July 1953 p. 58
Radio Electronics, Nov. 1951, p. 34; July 1954, p. 54
Audio Engineering, Aug. 1952, p. 13; February 1953, p. 21
Electronics, October 1953, p. 174

REPLACEMENTS

Material supplied with HEATHKIT products has been carefully selected to meet design requirements and ordinarily will fulfill its function without difficulty. Occasionally, improper operation can be traced to a faulty 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 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. 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 in this manual and your best efforts, you are still unable to obtain proper performance, 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 your benefit. This service is available to you at no charge. Its primary purpose is to provide assistance for those who encounter difficulty in the construction, operation or maintenance of HEATHKIT equipment. It is not intended, and is not equipped to function as a general source of technical information involving kit modifications nor anything other than the normal and specified performance of HEATHKIT equipment.

Although the Technical Consultants are familiar with all details of this kit, the effectiveness of their advice will depend entirely upon the amount and the accuracy of the information furnished by you. In a sense, YOU MUST QUALIFY for GOOD technical advice by helping the consultants to help you. Please use this outline:

1. Before writing, fully investigate each of the hints and suggestions listed in this manual under In Case Of Difficulty. Possibly it will not be necessary to write.

2. When writing, clearly describe the nature of the trouble and mention all associated equipment. Specifically report operating procedures, switch positions, connections to other units and anything else that might help to isolate the cause of trouble.

3. Report fully on the results obtained when testing the unit initially and when following the suggestions under "IN CASE OF DIFFICULTY." Be as specific as possible and include voltage readings if test equipment is available.

4. Identify the kit model number and date of purchase, if available. Also mention the date of the kit assembly manual. (Date at bottom of Page 1.)

5. Print or type your name and address, preferably in two places on the letter.

With the preceding information, the consultant will know exactly what kit you have, what you would like it to do for you and the difficulty you wish to correct. The date of purchase tells him whether or not engineering changes have been made since it was shipped to you. He will know what you have done in an effort to locate the cause of trouble and, thereby, avoid repetitious suggestions. In short, he will devote full time to the problem at hand, and through his familiarity with the kit, plus your accurate report, he will be able to give you a complete and helpful answer. If replacement parts are required, they will be shipped to you, subject to the terms 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 completed instrument to the Heath Company for inspection and necessary repairs and adjustments. You will be charged a minimal service fee, plus the price of any additional parts or material required. However, if the completed kit is returned within the Warranty period, parts charges will be governed by the terms of the Warranty. State the date of purchase, if possible.

Local Service by Authorized HEATHKIT Service Centers is also available in some areas and often will be your fastest, most efficient method of obtaining service for your HEATHKIT equipment. Although you may find charges for local service somewhat higher than for factory service, the amount of increase is usually offset by the transportation charge you would pay if you elected to return your kit to the Heath Company.

HEATHKIT Service Centers will honor the regular 90 day HEATHKIT Parts Warranty on all kits, whether purchased through a dealer or directly from Heath Company; however, it will be necessary that you verify the purchase date of your kit.

Under the conditions specified in the Warranty, replacement parts are supplied without charge; however, if the Service Center assists you in locating a defective part (or parts) in your kit, or installs a replacement part for you, you may be charged for this service.

HEATHKIT equipment 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.

THIS SERVICE POLICY APPLIES ONLY TO COMPLETED EQUIPMENT CONSTRUCTED IN ACCORDANCE WITH THE INSTRUCTIONS AS STATED IN THE MANUAL. Equipment that has been modified in design will not be accepted for repair. If there is evidence of acid core solder or paste fluxes, the equipment will be returned NOT repaired.

For information regarding modification of HEATHKIT equipment 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 equipment stores. Although the Heath Company sincerely welcomes all comments and suggestions, it would be impossible to design, test, evaluate and assume responsibility for proposed circuit changes for special purposes. Therefore, such modifications must be made at the discretion of the kit builder, using information available from sources other than the Heath Company.

SHIPPING INSTRUCTIONS

In the event that your instrument must be beturned for service, these instructions should be carefully followed.

Wrap the equipment in heavy paper, exercising care to prevent damage. Place the wrapped equipment in a stout carton of such size that at least three inches of shredded paper, excelsior, or other resilient packing material can be placed between all sides of the wrapped equipment and the carton. Close and seal the carton with gummed paper tape, or alternately, tie securely with stout cord. Clearly print the address on the carton as follows:

To: HEATH COMPANY
Benton Harbor, Michigan

ATTACH A LETTER TO THE OUTSIDE OF THE CARTON BEARING YOUR NAME, COMPLETE ADDRESS, DATE OF PURCHASE, AND A BRIEF DESCRIPTION OF THE DIFFICULTY ENCOUNTERED. Also, include your name and return address on the outside of the carton. Preferably affix one or more "Fragile" or "Handle With Care" labels to the carton, or otherwise so mark with a crayon of bright color. Ship by insured parcel post or prepaid express; note that a carrier cannot be held responsible for damage in transit if, in HIS OPINION, the article is inadequately packed for shipment.

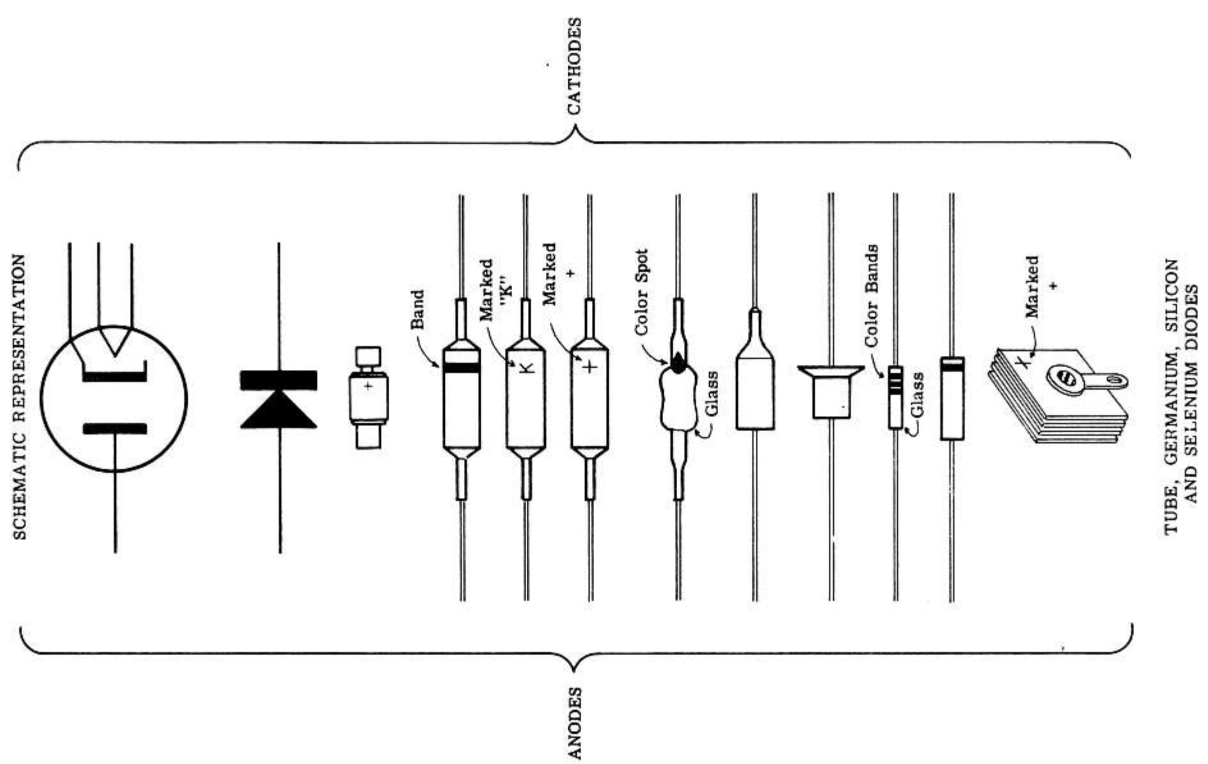
All prices are subject to change without notice. The Heath Company reserves the right to discontinue instruments and to change specifications at any time without incurring any obligation to incorporate new features in instruments previously sold.

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

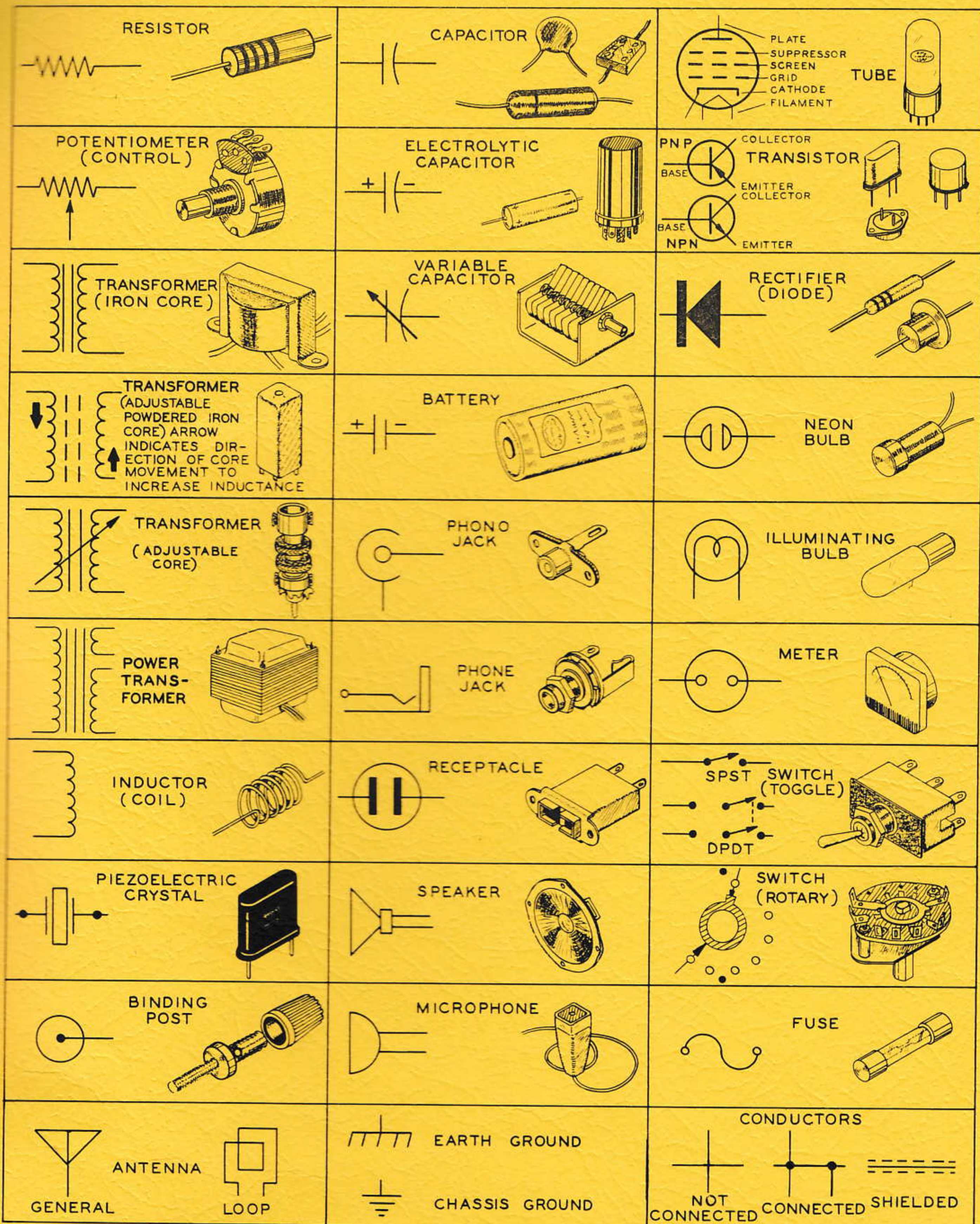


PART No.	PARTS Per Kit	DESCRIPTION
Resistors		
1-1	1	47 Ω
1-4	1	330 Ω
1-94	1	390 Ω
1-95	1	560 Ω
1-96	1	750 Ω
1-97	5	1100 Ω
1-98	5	1600 Ω
1-90	1	2000 Ω
1-89	1	2400 Ω
1-16	1	4700 Ω
1-20	2	10 KΩ
1-99	2	240 KΩ
1-87	2	330 KΩ
1-100	2	510 KΩ
1-101	2	1 megohm
1-121	1	120 KΩ
1B-10	1	47 KΩ 2 watt
3T-2	1	5000 Ω 20 watt
2-97	2	25 KΩ precision
2-98	2	33.3 KΩ precision
2-99	2	50 KΩ precision
2-11	2	100 KΩ precision
Condensers		
20-1	1	47 μμf mica
20-55	1	500 μμf mica
23-67	1	.005 μfd paper
23-68	1	.05 μfd paper
23-69	1	.5 μfd paper
25-5	1	16 μfd 150 v electrolytic
25-16	1	20 μfd 350 v electrolytic
25-37	1	40-40 μfd 450 v electrolytic
Controls-Switches		
10-34	1	600 Ω control
10-7	1	5000 Ω control
10-8	1	10 KΩ control
60-1	2	SPST slide switch
63-8	1	4-pos. switch MULTIPLIER
63-107	1	8-pos. switch ATTENUATOR
63-108	2	11-pos. switch CYCLE
Tubes-Lamp-Sockets		
411-11	1	6AU6 tube
411-63	1	6CL6 tube
411-64	1	6X4 tube
412-2	1	115 v 3 watt lamp
412-4	1	#50 pilot lamp
434-15	2	7-pin wafer socket
434-16	1	9-pin wafer socket
434-23	1	Candelabra socket
434-47	1	Pilot lamp socket

PART No.	PARTS Per Kit	DESCRIPTION
Binding Posts-Terminals-Knobs		
75-17	4	Insulator bushing
100-M16B	1	Binding post cap, black
100-M16R	1	Binding post cap, red
427-2	2	Binding post base
431-3	1	3-lug terminal strip
431-19	1	5-lug terminal strip
431-23	1	Terminal board
462-139	5	Knob
463-27	5	Knob pointer
Choke-Transformer-Diode-Meter		
46-3	1	Filter choke
54-57	1	Power transformer
56-4	3	Crystal diode
407-85	1	Meter
Hardware		
250-2	6	3-48 screw
250-8	2	#6 sheet metal screw
250-9	12	6-32 x 3/8" screw
250-48	4	6-32 x 1/2" screw
250-83	2	#10 x 1/2" handle screw
252-1	6	3-48 nut
252-3	18	6-32 nut
252-7	7	Control nut
253-9	4	#8 flat washer
253-10	5	Nickel control washer
254-1	16	#6 lockwasher
254-4	7	Control lockwasher
259-1	2	#6 solder lug
259-10	1	Control solder lug
Sheet Metal Parts		
90-235	1	Cabinet
200-M123	1	Chassis
203-80F755-756-757	1	Panel
Wire-Sleeving		
89-1	1	Line cord
340-2	1	Length bare wire
344-1	1	Length hookup wire
346-1	1	Length sleeving
346-6	1	Length 3/8 sleeving
Miscellaneous		
73-1	3	Rubber grommet
75-24	1	Line cord strain relief
211-15	1	Handle
261-9	4	Rubber feet
481-3	1	Condenser mounting wafer
331-6		Solder
595-562	1	Instruction manual

TYPICAL COMPONENT TYPES

This chart is a guide to commonly used types of electronic components. The symbols and related illustrations should prove helpful in identifying most parts and reading the schematic diagrams.



595-562

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