

ASSEMBLING AND  
USING YOUR

*Heathkit*

VACUUM TUBE VOLTMETER  
MODEL V-2



THE HEATH COMPANY  
BENTON HARBOR, MICH.

PRICE \$1.00

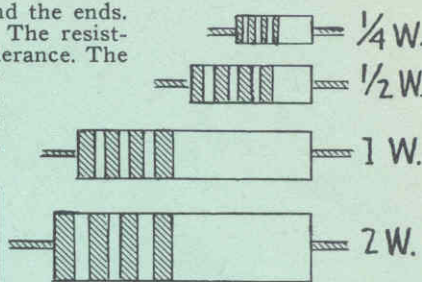
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## USEFUL INFORMATION FOR KIT BUILDERS

Resistors are identified by a color code used in several bands around the resistors. There are two general types of resistors. One, the un-insulated type, has the connecting wires bound around the ends. The other, the insulated type, has the wire connected internally and coming out the ends. The resistance code uses three bands or colors, while a fourth, usually silver or gold, indicates the tolerance. The colors are arranged so that the first two indicate the first two figures of the resistance, while the third indicates the number of digits (zeros or multiplier) which follow the first two figures. On un-insulated resistors, the body is the first figure, the end color the second figure, and the dot the number of digits. On insulated resistors, the band nearest the end is the first figure, the next band is the second figure and the third band the number of digits.

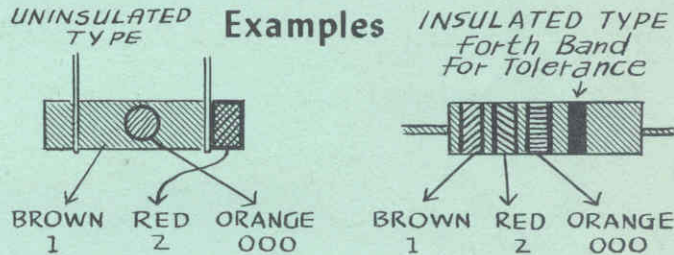


WATTAGE SIZES

**WATTAGE.** Resistors are rated as to wattage (power dissipation) according to size. The chart shows approximate sizes which vary with manufacturers. To determine wattage size necessary multiply current through resistor in amperes by voltage drop across resistors in volts. Example — A plate loading resistor for a tube drawing 10 milliamperes (.01 Amperes) has a voltage on one side of 300 volts and on the other side 200 volts, giving a drop of 100 volts. Therefore 100 volts  $\times$  .01A. = 1 Watt.

A higher wattage resistor can always be substituted for smaller size.

Uninsulated Insulated	Body Color First Ring	End Color Second Ring	Dot Color Third Ring
Color	First Figure	Second Figure	Number of Digits
Black	0	0	None
Brown	1	1	0
Red	2	2	00
Orange	3	3	0,000
Yellow	4	4	0,000
Green	5	5	00,000
Blue	6	6	000,000
Violet	7	7	0,000,000
Grey	8	8	00,000,000
White	9	9	000,000,000



### Some Popular Sizes of Resistors

RESISTANCE IN OHMS	BODY OR FIRST BAND	END OR SECOND BAND	DOT OR THIRD BAND
50	Green	Black	Black
250	Red	Green	Brown
1500	Brown	Green	Red
30,000	Orange	Black	Orange
220,000	Red	Red	Yellow
1 Megohm	Brown	Black	Green

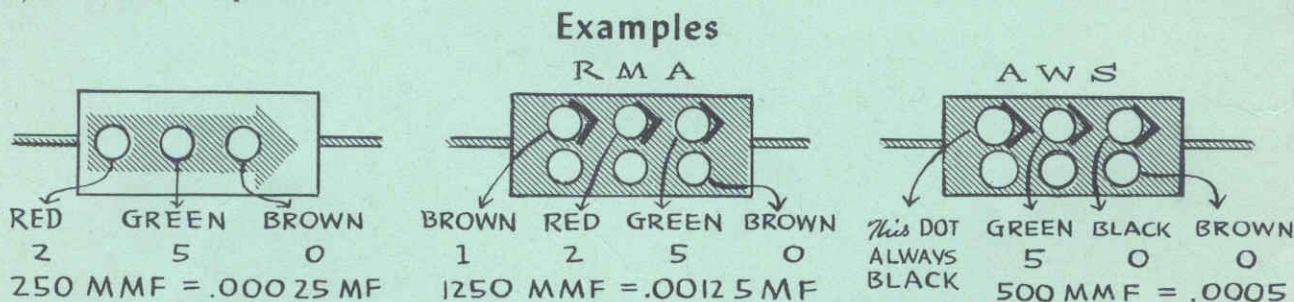
The fourth ring or other end may be silver (10% tolerance) or gold (5% tolerance) or it may be omitted entirely which indicates 20% tolerance.

### Condenser Code

Condensers use the same code as resistors and are read in micromicrofarads.

If there is one row of dots, they are read in direction of arrow or if manufacturer's name appears in the same direction as name. If two rows of dots appear, it can either be of two different codes: The RMA or the AWS (American War Standard). In the RMA, the top row of dots are the first three figures (carried to three figures), the bottom row are left to right the voltage rating, tolerance, and decimal multiplier.

In the AWS code, the top row of dots are the first three figures while the bottom row are, left to right, characteristic, tolerance, and decimal multiplier.



### Some Commonly Used Sizes of Condensers

MMF.	MF.	FIRST DOT	SECOND DOT	THIRD DOT
10	.00001	Brown	Black	Black
50	.00005	Green	Black	Black
100	.0001	Brown	Black	Brown
250	.00025	Red	Green	Brown
500	.0005	Green	Black	Brown
1000	.001	Brown	Black	Red
3000	.003	Orange	Black	Red
10,000	.01	Brown	Black	Orange

The tolerance rating corresponds to the color code, i.e., red — 2%, green — 5%, etc.

The voltage rating corresponds to the code multiplied by 100. Example: Orange dot — 300 volt rating; Blue — 600 volt rating.

## ASSEMBLING THE HEATHKIT MODEL V2 VACUUM TUBE VOLTMETER

The construction of the Heathkit VTVM is not difficult but consideration must be given to the fact that it is a delicate precision instrument which deserves the best of workmanship. Thoroughly familiarize yourself with the layout, schematic and pictorial diagram. Do not rush the construction. Make a good mechanical joint of each connection and then solder it with the best quality of rosin core radio type solder. Hold each joint rigid until cool and then test by attempting to pull the joint loose. Most difficulty in construction results from improper wiring and poor soldered connections. Some resistances in this circuit are quite critical and poor solder connections will greatly change or affect the accuracy.

Begin by checking the parts against the parts list. Identify each part. This will avoid throwing away any small parts in the packing. Use the charts to identify resistors and condensers.

The instrument will last many years and care taken in construction will result in much better operation.

Remember that all parts are reversed when working with the chassis upside down and errors in wiring may occur. Mark the values shown on parts list beside part number on schematic diagram.

Do not change the design. Many models and circuits were tested before this model was chosen and several thousand dollars worth of laboratory equipment is needed to do a complete testing job on any other design.

From time to time, small changes in parts will be made by the Heath Company. All parts supplied will work just as well as the part for which it was substituted, 47,000 ohm resistors (which is the new radio manufacturers rating for 50,000 ohms) may be substituted for 50,000 ohms or a one watt resistor may be substituted for  $\frac{1}{2}$  watt, etc. All substitutions will be of equal or better quality than the original and will be made in order that a minimum delay will occur in filling your order.

The newer types of insulated resistors have a higher wattage rating. The  $\frac{1}{4}$  watt size is now rated at  $\frac{1}{2}$  watt and these are used in this kit. Bolts and nuts are counted mechanically and if a few are missing please secure locally.

Resistors and controls have a tolerance rating of plus or minus 20% unless otherwise stated. Therefore, a one megohm unit may test between 800,000 and 1,200,000 ohms. The Heathkit circuits are designed to accommodate these variations. The precision resistors supplied with Heathkits are marked with K equal to 1,000 and M equal to 1,000,000. Therefore, 90K is 90,000 ohms and 9.9M is 9.9 megohms. The socket connections are numbered on the bottom of the sockets. They are fastened into the chassis with the wavy metal rings which are forced over the bottom of the socket and into the grooves in the socket. The end of the ring can be held in the groove and the rest of the ring forced over and into the groove with a screw driver. Note that the keyways in all sockets face the panel. Mount the controls. The calibrate controls have only screw driver slots while the adjust controls have a sufficient shaft to accommodate a knob. On some controls and jacks, a locating pin must be removed before mounting to prevent damage to the unit.

Install the power transformer with the leads above the two holes in the chassis allowing them to connect to the sockets and switch. Use a solder lug under each transformer mounting bolt below the chassis. Install insulated terminal strip below chassis with machine screw.

Proceed with the wiring by connecting the transformer leads, the ground or chassis connections to the sockets, and the filament connections. Twist the leads carrying AC coming from the power transformer.

The actual wiring is shown in prints V61A and V62A. The location of the wires is not critical but locations shown have proven very satisfactory. Note that the center tap of the high voltage winding of the transformer is connected to the insulated terminal strip. Install the filter condenser (V27), observing polarity, and the resistors as shown.

The selector and range switches should now be wired. Nearly every case of difficulty in assembling this kit has occurred in wiring these switches. Many are the result of poor soldering connections on the range switch. Observe that there are flat sides on the knob shafts and wire the switches so that these will be on the side toward the bottom of the cabinet. Use care to prevent rosin from running onto the contacts as this will result in erratic operation.

All connections to the switches are shown on the pictorial diagrams and if these connections are correct the position of the switches on the panel is not important but should be approximately as shown on print V61A.

Mount the panel to the chassis by fastening it with the nuts of the adjust controls. Use the washers supplied under these nuts to avoid marring the panel. Mount the pilot light and toggle switch. Mount the range and selector switches and the input jacks. The AC and common jacks are insulated from the panel with the insulated shoulder washers supplied. The common jack must have a good soldered ground connection with chassis itself and is insulated from the panel only to insure that a good soldered connection to the chassis will be made. Mount the balance of the resistors, wire the switches and install the line cord. Mount and connect the meter. Upon completion of the wiring, recheck all connections. A suggested way is to follow each connection in the instrument and mark it on the circuit diagram with a colored pencil. In this manner, any connections overlooked or incorrect will be disclosed.

The battery mounting bracket and strap (V83) is wired up by connecting two adjacent solder lugs together, and soldering conveniently long leads to the other two solder lugs. This places the two batteries in series giving 3 Volts. The bracket is then mounted in the cabinet with the long screw and is held in place with a regular nut against the bracket. The flashlight cells are installed one upright and one inverted and are held in place by a metal strip over the long center bolt and thumb nut over it. Two flashlight cells are supplied for use as the ohm meter battery. One of these cells is used as the calibrating battery for the DC ranges. Do not use this cell until the calibration is completed.

If wiring is in order, plug cord into 110V 60 cycle AC current. Set selector switch to DC + and turn instrument on. Allow one minute for instrument to warm up. Varying the zero adjust should allow the pointer to zero or move to over one-half way across

the scale. Leave the instrument on while the test leads and prod are assembled. The black unshielded lead is the common or ground connection and has the alligator clip at outer end. The AC and ohms lead is unshielded red wire with red test prod at outer end. The DC prod uses shielded wire and is assembled as shown with phone plug at one end and black test prod at other.

To assure maximum accuracy over a long period, the tubes used must be aged. This is best done by leaving the instrument on continuously for 48 hours before calibration.

A preliminary calibration can be made, however, after one-half hour. Insert the test leads and check the small flashlight cell supplied for calibration purposes. If the meter reads backwards, reverse the leads from the switch to meter.

In changing the range switch on AC from 30 Volt and 10 Volt ranges to 3 Volt range, a change in the zero setting of the meter pointer will be observed. A small amount of this (not more than .3 Volt on 3 Volt range) is normal and will decrease as the tubes are aged. Some 6SN7 and 6H6 tubes, however, are sufficiently unbalanced to cause a great deal more change. If possible, these should be exchanged for other tubes locally as they are entirely satisfactory for radio use but not for VTVM use. Except in extreme cases, it is impossible for the Heath Company to exchange these tubes as they are guaranteed only as satisfactory for radio use. The zero setting should be corrected on each of the ranges used.

#### TO CALIBRATE DC

The instrument is calibrated on DC with the flashlight cell which has the exact voltage marked on it.

With instrument turned off, set the meter pointer exactly on zero with adjustment on front of meter. Turn power on. Set the selector to DC + and range to 3 Volts.

Short or connect the DC test prod and common lead together and adjust zero control until meter reads exactly zero (ignore any change after test leads are disconnected). Connect leads to battery and adjust DC calibrate controls until meter reads voltage shown on battery. Read on 30 Volt scale by dropping the 0 (zero) so that  $1\frac{1}{2}$  Volts is exactly one-half scale or at 15 on the 30 Volt range. Remove leads and short together to check zero position. Again connect to battery and repeat calibration procedure several times until certain of both zero and correct battery setting.

#### TO CALIBRATE AC

To calibrate the AC, set selector switch V28 to AC range switch V75 to 300 V. Connect the common and AC test leads to the 110V AC line and adjust the AC calibrating control V24 until the scale reads 110V. Most power companies maintain the power within 5% of this figure, and it is sufficiently accurate for service work. If greater accuracy is desired, the instrument should be calibrated against a known AC standard voltage. This completes the calibration and the instrument is ready for use.

This calibration should be repeated after 48 hour continuous aging of tubes or after several weeks of use after which the instrument should not vary from calibration except when tubes are changed.

To use the ohmmeter, set the zero adjust while the selector is on DC positive. Turn

the selector to ohms, and the pointer will swing to the right side of the scale. Adjust the ohms adjust until the pointer is exactly on the heavy line at the right end of the scale at 10 on the 10V scale. Unknown resistances can now be read by connecting them between the common and the ohms test leads. For very low resistance connect the leads directly together and reset the zero adjust to correct for resistance of leads before measurement.

CAUTION: Never leave the instrument on ohms, as it greatly shortens the life of the ohmmeter battery.

### RF TEST PROBE KIT

A test probe in kit form for use in measuring RF voltages of up to about 20 Volts is available for \$6.50. The kit contains all parts necessary for the construction of the probe, including 1N34 crystal detector, condensers, resistor, cable and connectors. This probe and cable is simply plugged into the instrument in place of the regular DC test probe assembly and read on the lower regular DC ranges.

Order No. 309 RF Test Probe Kit--\$6.50.

### TELEVISION TEST PROBE KIT

A test probe in kit form for use in testing the high DC voltages in Television receivers up to 10,000 volts is available for \$4.50.

The kit contains all parts necessary for the construction of the probe, including precision multipliers of 1% accuracy, cable and connectors.

This probe and cable is simply plugged into the instrument in place of the regular DC test probe assembly and 0-10,000 Volts is read on the 0-10 scale, with range switch set at 300V the full scale indication is 3000 Volts.

Order No. 310 TV High Voltage Probe Kit--\$4.50.

### IN CASE OF DIFFICULTY

One, recheck entire wiring. Most cases of trouble result from wrong or reversed wiring.

Two, check tubes.

Three, if pointer swings to right side of scale and stays there when set to DC + there is an open resistor or defective switch contact in V28A range switch.

Four, check voltages of power supply. The correct voltages measured from chassis are Pin 8 of 6X5 tube 60 to 70 Volts positive. From chassis to insulated terminal strip 80 to 90 Volts negative. From chassis to contact 7 of 6X5, contact 7 of 6H6 and contact 7 of 6SN7 should be 5 to 6 Volts AC.

Five, check to see that red banana jack is not shorted to chassis and that black banana jack is properly grounded to chassis. Check continuity through DC test prod and be certain that shielding is not shorting the connection.

Six, if you are unable to obtain results, write the Heath Company giving all information possible, voltages obtained, any indication on meter, etc. which will help us.

Seven, if desired, your instrument may be returned to the factory. The Heath Company will check and put it into operating condition for a charge of \$3.00 plus any parts or alterations required due to damaged or improper construction. Attach a tag giving your name and address and trouble experienced with the instrument. Pack carefully

with plenty of padding over face of meter. Mark fragile--delicate instrument and ship to us prepaid. Instrument will be returned charges collect.

**ACCURACY:** The accuracy of most meters is rated at 2% of full scale on DC and 5% of full scale on AC. The Heathkit VTVM easily fulfills these requirements. When comparing with other instruments, consideration should be given to the possibility that the other instruments variation might be the opposite of the Heathkit making a possible variation of 4% on DC and 10% on AC.

**USING THE VTVM DECIBEL SCALE:** Because the human ear does not respond to volume of sound in proportion to signal strength, a unit of measure called the "bel" was adopted. The "bel" is more nearly equivalent to human ratios. Normally the reading is given in 1/10 of a "bel" or "decibel".

Various signal levels are adopted by various manufacturers as standard or "0" decibels.

The Heathkit VTVM DB scale uses a standard of 6 milliwatts into a 500 ohm line as "0" decibels. This corresponds to 1.73 VAC on the 0-10 scale. From this figure, the various AC ranges of the VTM may be converted to db by the following chart.

AC VOLTS SCALE

DECIBEL SCALE

0-3V.	Subtract 10 db from reading
0-30V.	Add 10 db to the reading
0-100V.	Add 20 db to the reading
0-300V.	Add 30 db to the reading
0-1000V.	Add 40 db to the reading

In alignment of FM receivers, the pointer may be set at center scale and used as zero indicator. This is also useful in service work as the meter then reads negative or positive without resetting the selector switch.

The Heathkit is an extremely sensitive electronic AC voltmeter and as the human body picks up AC when near any AC wires, the meter will indicate this pick up. Never touch the AC prod when on the lower ranges. Zero should be set with the AC prod shorted to the common clip.

**CAUTION:** In mounting batteries do not tighten battery holding nut too tightly as this tends to pull contact away from batteries. After installing batteries, check to see that there is 3 Volts being delivered. If ohmmeter scale does not immediately swing to right, batteries are not making contact.

Low batteries will reduce accuracy on low ranges and should be replaced.

Many excellent articles on the construction and use of vacuum tube voltmeters have appeared in radio magazines. A few are:

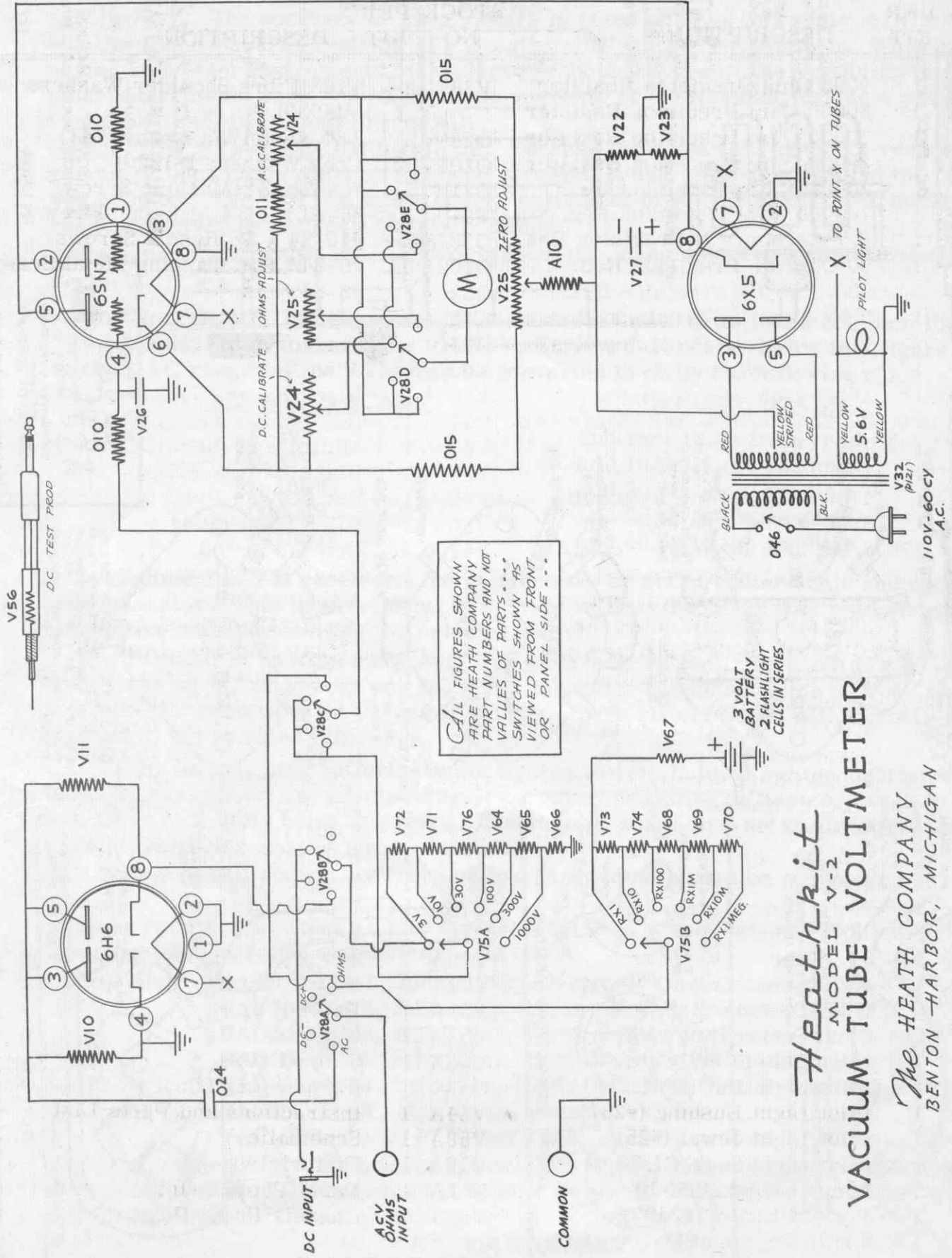
- RADIOCRAFT, June, 1945, Electronic Ohmmeter
- RADIO NEWS, January, 1947, Home Constructed VTVM
- RADIO NEWS, July, 1946, Vacuum Tube Voltmeter
- RADIO NEWS, November, 1945, Electronic Voltmeter
- RADIO NEWS, February, 1946, Universal Test Instrument
- RADIOCRAFT, May, 1945, Practical VTVM
- VACUUM TUBE VOLTMETERS, A Book by John F. Rider

Prices subject to change without notice. The Heath Company reserves the right to change the design of its instruments without incurring liability for equipment previously supplied.

## V2 VACUUM TUBE VOLTMETER PARTS LIST

STOCK NO.	PCS. PER KIT	DESCRIPTION	STOCK NO.	PCS. PER KIT	DESCRIPTION
V68	1	9000 Ohm Precision Resistor	V38	2	5/16" Fibre Shoulder Washers (#630)
V66	1	30000 Ohm Precision Resistor	O28	5	3/8" Nickel Washers (#741)
V65	1	70000 Ohm Precision Resistor	O101	7	Lock Washers (#1220)
V69	1	90000 Ohm Precision Resistor	O31	5	#6-32 x 3/8 Machine Screws
V64	1	200000 Ohm Precision Res.	V84	1	#6-32 x 1 3/4 Machine Screws
V76	1	700000 Ohm Precision Res.	O30	2	#10-24 x 3/8 Handle Screws
V70	1	9.9 Megohm 1/2W Precision Res.	O102	8	#6-3/8" Self Tapping Metal Screws
V73	1	90 Ohm 1% Precision Res.	O32	8	#6-32 Nuts
V74	1	900 Ohm 1% Precision Res.	S22	2	#6-32 x 1/4" Nuts for Switch
V71	1	2 Megohm 1% Precision Res.	O33	7	Control Nuts (#737)
V72	1	7 Megohm 1% Precision Res.	V86	1	Wing Nut
V67	1	9.5 Ohm 1W 5% Resistor	V36	1	Black Banana Jack (Common Post)
V23	1	15000 Ohm 10% Resistor	V37	1	Red Banana Jack (AC-Ohm Post)
V22	1	20000 Ohm 10% Resistor	V87	1	Microphone Jack (DC Post)
O15	2	2000 Ohm Resistors	V39	1	Black Banana Plug
O11	1	10000 Ohm Resistor	V40	1	Red Banana Plug
A10	1	47000-51000 Ohm Resistor	V88	1	PL68 Phone Plug
V11	1	200000 Ohm Resistor	V42	1	Red Test Prod
V56	1	1 Megohm Resistor	V43	1	Black Test Prod
O10	2	3.3 Megohm Resistors	V44	1	Alligator Clip
V10	1	18 Megohm Resistor	V45	1	Length Black Test Lead Wire
V26	1	.003 MFD Mica Condenser	V46	1	Length Red Test Lead Wire
O24	1	.01 MFD 1000V Tubular Cond.	V47	1	Length Shielded Test Lead Wire
V27	1	12 MFD 150 V Electrolytic Condenser	V34	2	Flashlight Cells (one calibrated)
V25	2	5000 Ohm Control Ohms Adjust and Zero Adjust	V82	1	Battery Mounting Bracket Strap
V24	2	10000 Ohm Controls AC and DC Calibrate	V83	1	Battery Mounting Bracket
V28	1	5 Pole 4 Pos. Rotary Switch (B119238)	O34	4	Rubber Feet (#716)
V75	1	2 Pole 6 Pos. Rotary Sw.	O35	3	3/8" Rubber Grommets (#905)
O94	1	SPST Slide Switch	O37	4	Soldering Lugs
G44	1	6SN7 Tube	V50	1	Roll Hookup Wire 10 ft.
V30	1	6X5 Tube	1P22	1	Length Spaghetti (8")
V31	1	6H6 Tube	O78	1	Line Cord
O54	3	Octal Sockets	O79	1	Handle (#5374)
O43	3	Octal Socket Rings	V49A	1	200 Micro Ampere Meter
O39	1	Pilot Bulb (T-47)	V32	1	Power Transformer (P121)
O40	1	Pilot Light Nut (#27)	V51A	1	Panel (V2)
O41	1	Pilot Light Bushing (#28)	V52	1	Chassis
O42	1	Pilot Light Jewel (#25)	V53A	1	Cabinet (V2)
O52	1	Pilot Light Socket (#20)	O83	1	Introductory Sheet (F.O.)
V48	2	Acorn Knobs (#2500)	V54A	1	Instructions and Parts List
O51	2	Pointer Knobs (#2300)	V58A	1	Schematic
O38	1	Single Terminal Strip	V59A	1	Pictorial
			V61A	1	Panel Photo Print
			V62A	1	Chassis Photo Print



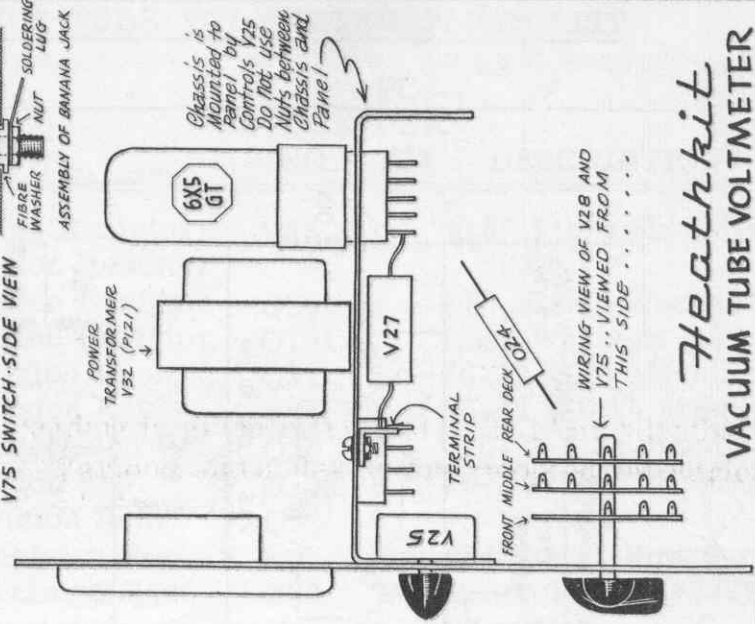
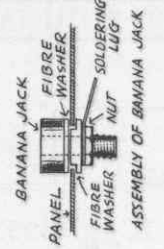
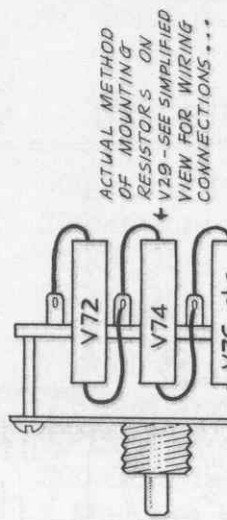
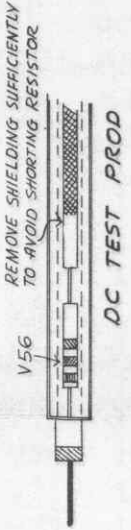


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MODEL V-2  
VACUUM TUBE VOLTMETER

The HEATH COMPANY  
BENTON HARBOR, MICHIGAN

V58A

11/24/48



# Heathkit

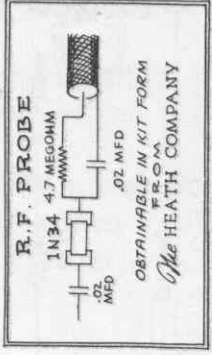
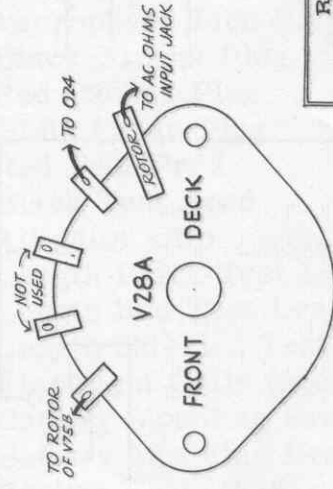
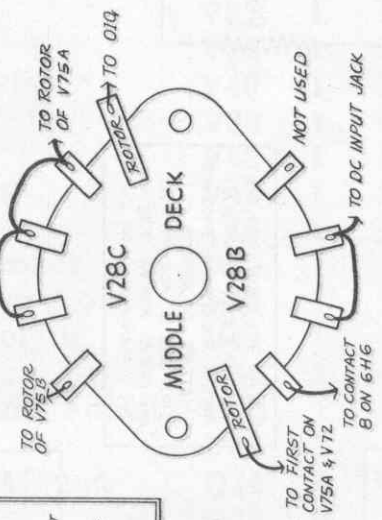
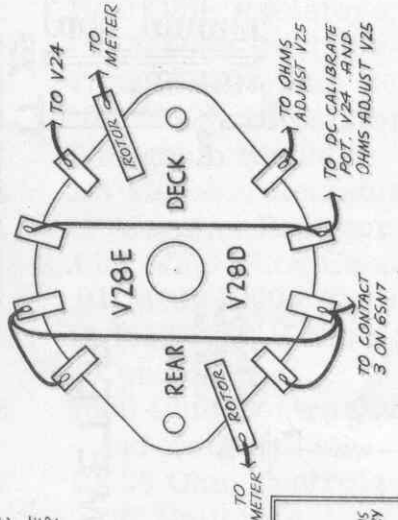
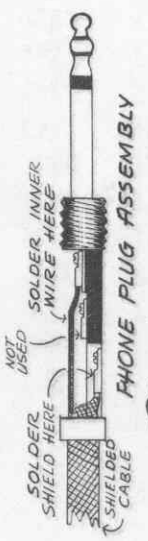
## VACUUM TUBE VOLTMETER

MODEL V-2  
PICTORIAL DIAGRAMS

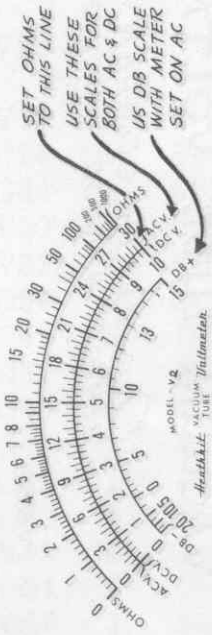
THE HEATH COMPANY  
BENTON HARBOR, MICH.

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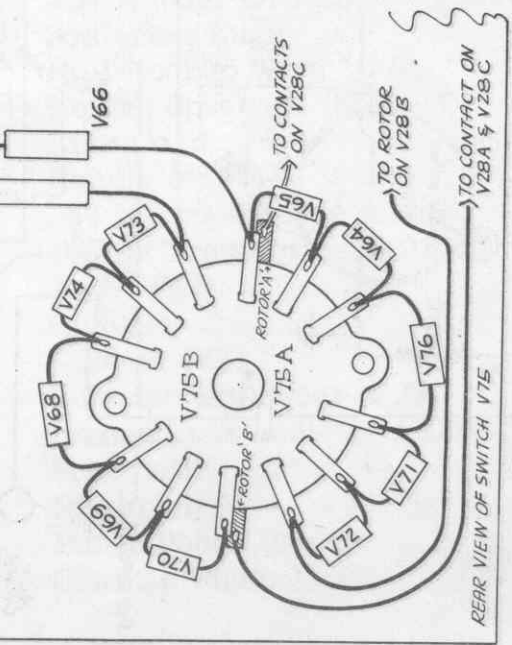
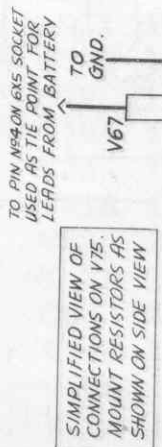
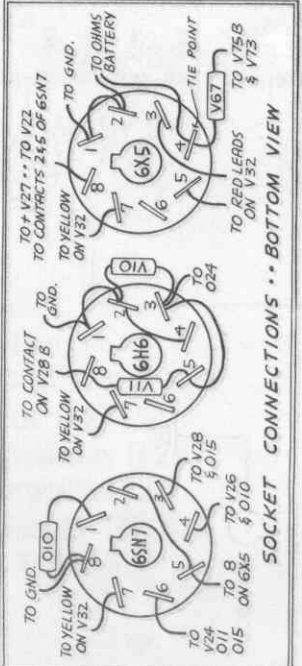
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WIRING VIEW OF ALL DECKS OF SWITCH V28 VIEWED FROM REAR OF CABINET. BOTTOM OF CABINET IS AT TOP OF EACH DECK (7244 MAY BE MOUNTED EITHER WAY HOWEVER)....

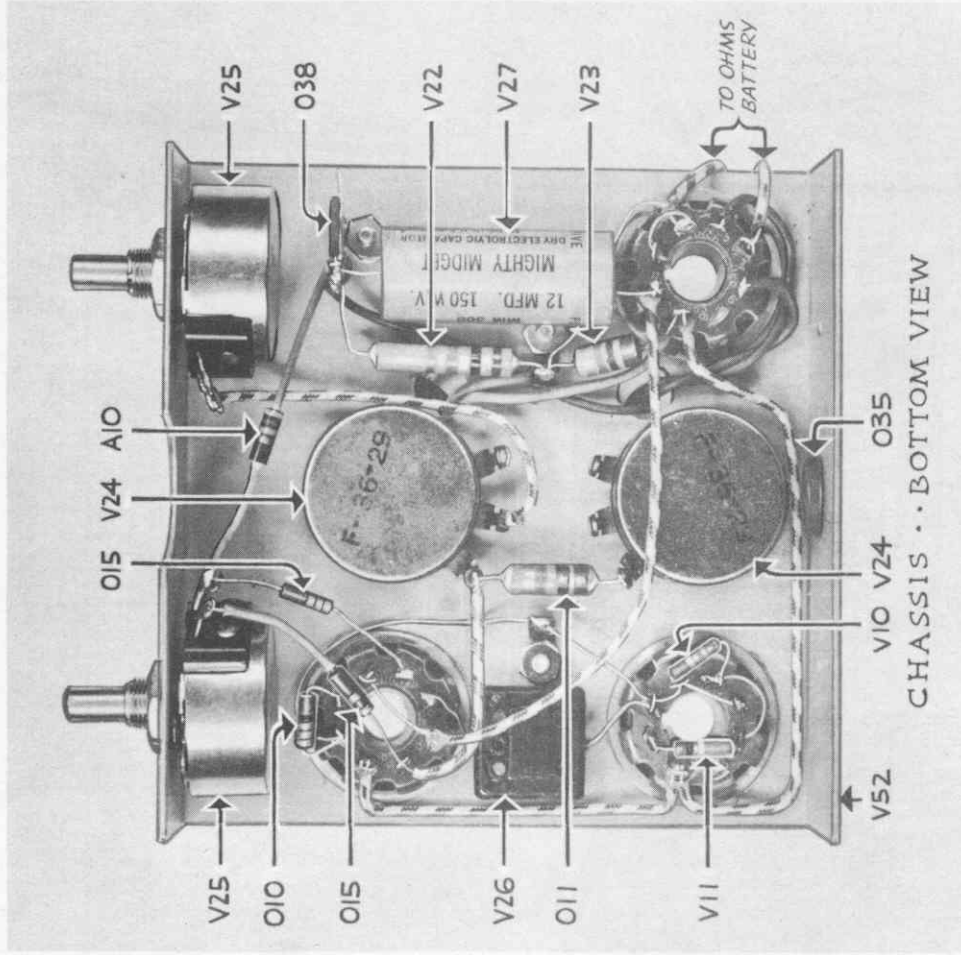
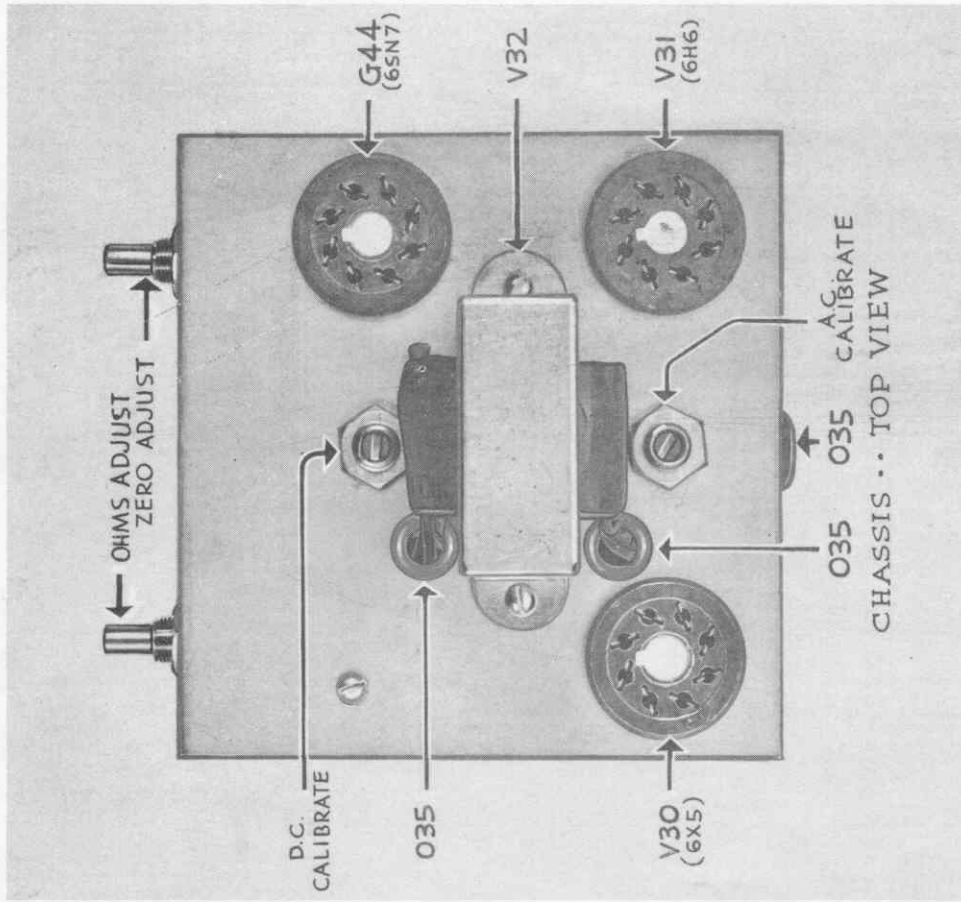


Note: To use 3 Volt range drop 0 (zero) from 30 Volt scale. To use 100 Volt range add 0 (zero) to 10 Volt scale. To use 300 Volt range add 0 (zero) to 30 Volt scale. To use 1000 Volt range add two 0 (zeros) to 10 Volt scale. Use both voltage scales on both AC and DC.



BOTTOM OF PANEL

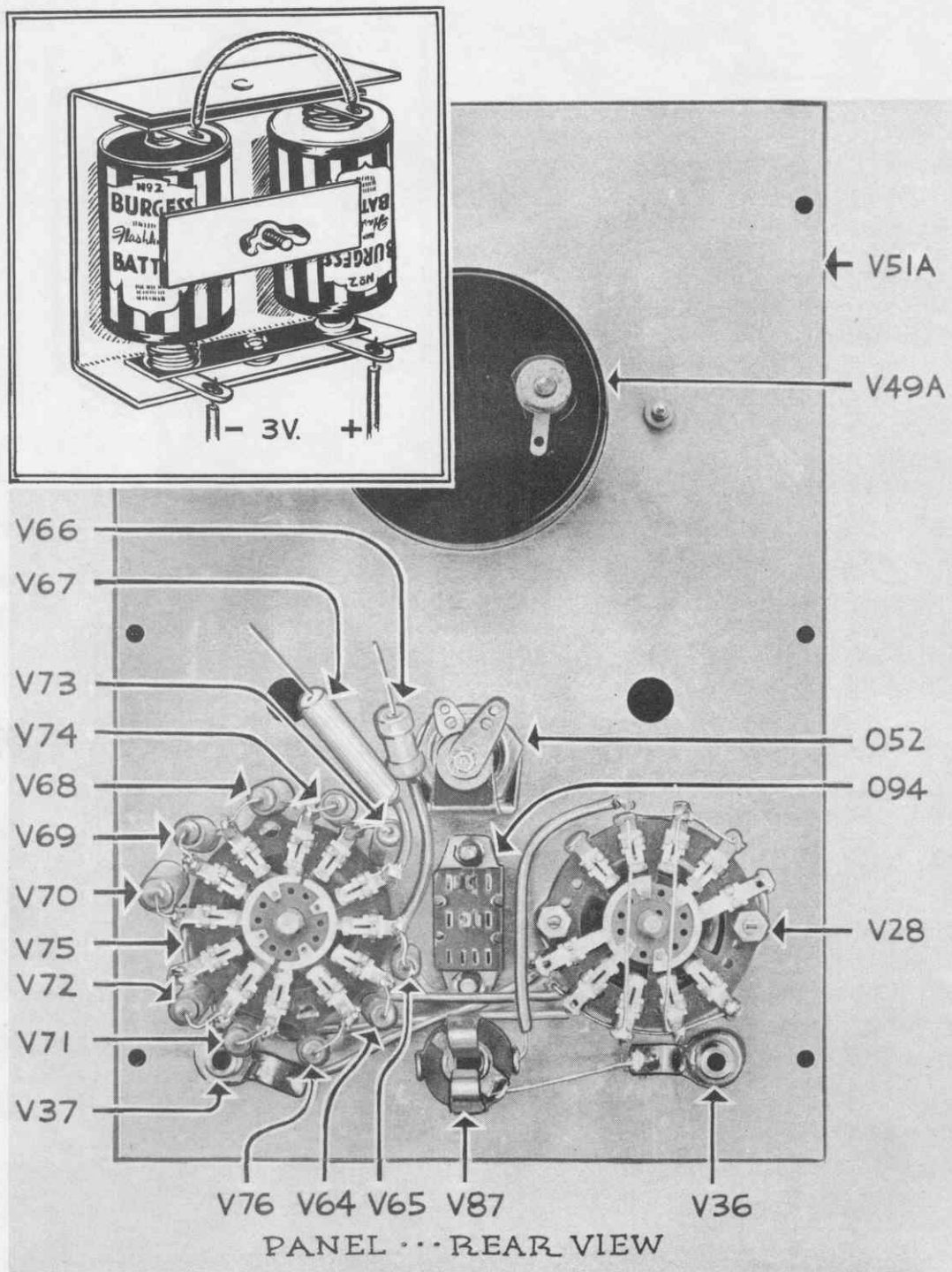
# Heathkit MODEL V-2 VACUUM-TUBE VOLTMETER



*The* HEATH COMPANY  
 BENTON HARBOR, MICH.

11/24/48  
 V62-A

# Heathkit MODEL V-2 VACUUM-TUBE VOLTMETER

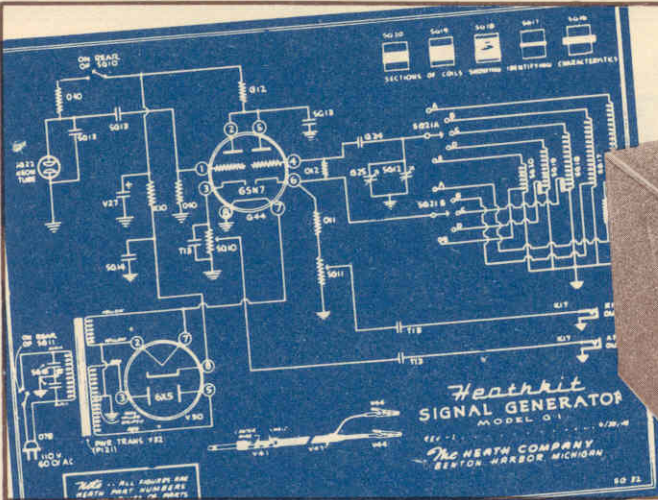


11/24/48  
V61-A

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BENTON HARBOR, MICH.



## HEATHKIT RF SIGNAL GENERATOR KIT



Every shop needs a good signal generator. The Heathkit fulfills every servicing need, fundamentals from 150Kc. to 30 megacycles with strong harmonics over 100 megacycles covering the new television and FM bands. 110V 60 cycle transformer operated power supply.

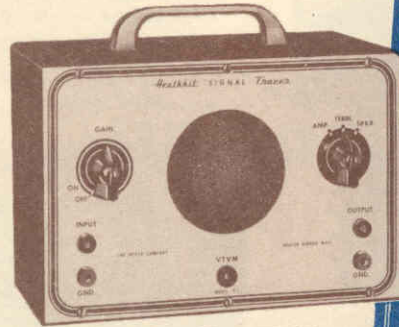
400 cycle audio available for modulation or audio testing. Uses 6SN7 as RF oscillator and audio amplifier. Complete kit has every part necessary and detailed blueprints and instructions enable the builder to assemble it in a few hours. Large easy to read calibration. Convenient size 9" x 6" x 4 3/4". Shipping weight 4 1/2 lbs.

**\$19.50**

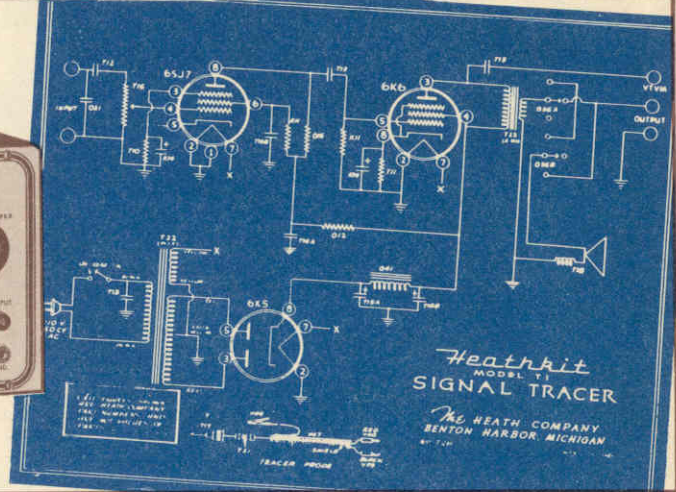
*Nothing ELSE TO BUY*

## HEATHKIT SIGNAL TRACER KIT

Let a Heathkit Signal Tracer do the tedious watching of intermittents while you go on to other profitable jobs. Follow the signal from the antenna to the defective part in a matter of seconds. Triples the repairs per man in many shops. A Heathkit Signal Tracer Kit pays for itself in a matter of days of operation. Locates faults immediately. Internal amplifier available for speaker testing and internal speaker available for amplifier testing. Connection for VTVM on panel allows visual tracing and gain measurements. Also tests phonograph pickups, microphones, PA systems, etc. Frequency range to 200 Mc. Complete ready to assemble. 110V 60 cycle transformer operated. Supplied with 3 tubes, diode probe, 2 color panel, all other parts. Easy to assemble, detailed blueprints and instructions. Shipping weight 10 lbs.

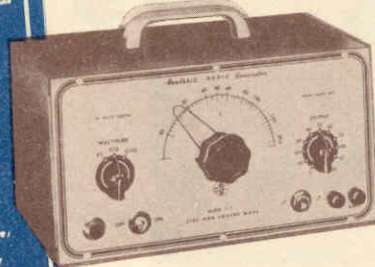
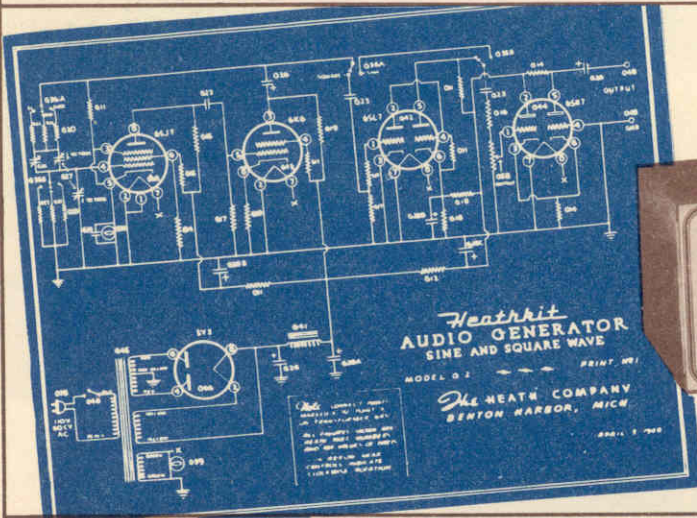


**\$19.50**



## HEATHKIT SINE AND SQUARE AUDIO GENERATOR KIT

Experimenters and servicemen working with a square wave for the first time invariably wonder why it was not introduced before. The characteristics of an amplifier can be determined in seconds compared to several hours of tedious plotting using older methods. Stage by stage, amplifier testing is as easy as signal tracing. The low distortion (less than 1%) and linear output ( $\pm$  one db.) make this Heathkit equal or superior to factory built equipment selling for three or four times its price. The circuit is the popular RC tuning circuit using a four gang variable condenser. Three ranges 20-200, 200-2,000, 2,000-20,000 cycles are provided by selector switch. Either sine or square waves instantly available at toggle switch. All components are of highest quality, cased 110V 60 cycle power transformer, Mallory F.P. filter condensers, 5 tubes, calibrated 2 color panel, grey crackle aluminum cabinet. The detailed instructions make assembly an interesting and instructive few hours. Shipping weight 13 lbs.



**\$34.50**

*Nothing ELSE TO BUY*

## Heathkit ELECTRONIC SWITCH KIT

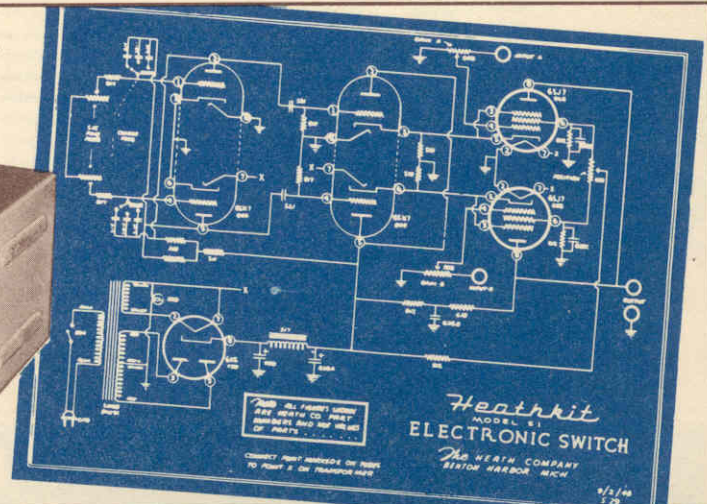
DOUBLES THE UTILITY OF ANY SCOPE

An electronic switch used with any oscilloscope provides two separately controllable traces on the screen. Each trace is controlled independently and the position of the traces may be varied. The input and output traces of an amplifier may be observed one beside the other or one directly over the other illustrating perfectly any change occurring in the amplifier. Distortion—phase shift and other defects show up instantly. 110 Volt 60 cycle transformer operated. Uses 5 tubes (1—6X5, 2—6SN7's, 2—6SJ7's). Has individual gain controls, positioning control, and coarse and fine sweeping rate controls. The cabinet and panel match all other Heathkits. Every part supplied including detailed instructions for assembly and use. Shipping weight 11 lbs.



**\$34.50**

*Nothing ELSE TO BUY*



Features  
that make

# Heathkits

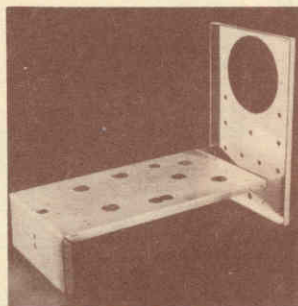
the best  
kits . . . .

## 1 KITS THAT FIT

Heathkit chassis are precision punched to fit the quality parts supplied. The grey crackle aluminum cabinet and the two color panels are die punched to assure proper fitting.

Many builders have written marveling at the ease with which assembly can be accomplished.

The chassis are specially engineered for easy assembly and wiring — there are no small tight corners which cannot be reached — the ends of the chassis are left open in order that installation of parts and soldering can be done with both hands.



## 6 BEST OF PARTS

You will find many famous names on the parts in your Heathkit. Mallory switches and filter condensers, Chicago Transformer Corporation and Electrical Assembly Transformers, Centralab Potentiometers, Belden Cable, IRC & Allen Bradley resistors, G.E. tubes, Cinch and Amphenol sockets with silver plated contacts, Defance variable condensers, Eby binding post and many other quality parts. The finest of parts are used to assure long trouble-free service from Heathkits.



## 2 PRECISION PARTS

Wherever required, the finest quality 1% ceramic resistors are supplied. These require no aging and do not shift. No matching of common resistors is required. You find in Heathkit the same quality voltage divider resistors as in the most expensive equipment.

The transformers are designed especially for the Heathkit unit. The scope transformer has two electrostatic shields to prevent interaction of AC fields.

These transformers are built by several of the finest transformer companies in the United States.



## 7 MODERN STYLING

Heathkits have brought a new conception of beauty to laboratories and service benches. Many organizations have standardized on Heathkits to make their shops appear attractive and uniform.

The panels are produced in grey and maroon and the modern streamline aluminum handles give the instruments a pleasant professional appearance.

There is no waste space or false effort to appear large in Heathkits — space on service benches is at a premium and the size of Heathkit instruments is kept as small as is consistent with good engineering design.



## 3 COMPLETE KITS

When you receive your Heathkit you are assured of every necessary part for the proper operation of the instrument.

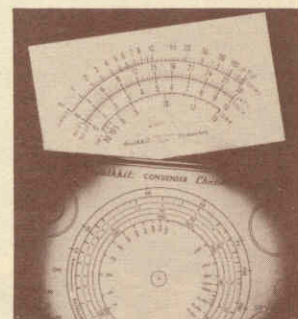
Beautiful cabinets, handles, 2 color panels, all tubes, test leads where they are a necessary part of the instrument, quality rubber line cords and plugs, rubber feet for each instrument, all scales and dials ready printed and calibrated. Every Heathkit is 110V 60 cy. power transformer operated by a husky transformer especially designed for the job.



## 8 LARGE EASILY READ CALIBRATIONS

No charts or calculations are necessary to use any Heathkit properly. All scales are simple and plainly marked.

The operator instantly knows the proper use of the instrument and can proceed confidently. No multiplication is required as each scale is calibrated independently of the others.



## 4 COMPLETE INSTRUCTION MANUALS

Everyone is pleased at the thorough instructions covering the assembly of each Heathkit instrument. Every detail of the assembly is covered, together with sections on the use of the instrument and trouble shooting instructions in case of difficulty. Actual photos of the assembled instrument enable fast and accurate assembly, clear schematics and pictorial diagrams of the confusing parts such as rotary switches enable the wiring to be completed quickly.



## 9 IDEAL FOR SCHOOLS

Heathkits have been adopted as standard equipment of many of the largest universities and colleges. The low cost plus the fact that the students learn by actual assembly make them ideal training mediums. Many high schools and small colleges are finding that they too can have a modern physics and electronics laboratory by using Heathkits.

Some of the largest technical schools recommend Heathkits to their students as the best means of securing the necessary equipment to start their own shops.



## 5 BEST OF ENGINEERING . . .

Heathkits are the result of many years experience in the test equipment field. Heathkit oscilloscopes have been under development and test since 1943 and most other instruments now being produced have had over two years of thorough testing.

As proof of their design, Heathkits have been adopted by many of the largest Universities and laboratories in the United States. Thousands of engineering students are receiving their training using Heathkits.

## 10 WHY NOT BUILD YOUR OWN . . .

The great strides made in electronics during the war have made it hard for everyone to keep abreast of new developments. By actually assembling modern test equipment knowledge is gained in the most practical manner. Further a complete knowledge of the instrument allows greater flexibility of use and many possible uses suggest themselves.

Lastly with the cost of everything shooting upward any means of eliminating costs is welcomed. This reduction is a remarkable saving, as can be seen by comparing Heathkit prices with comparable built up test equipment.

**HEATH COMPANY BENTON HARBOR, MICH.**

# HEATHKIT FM AND TELEVISION SWEEP GENERATOR KIT

## Features

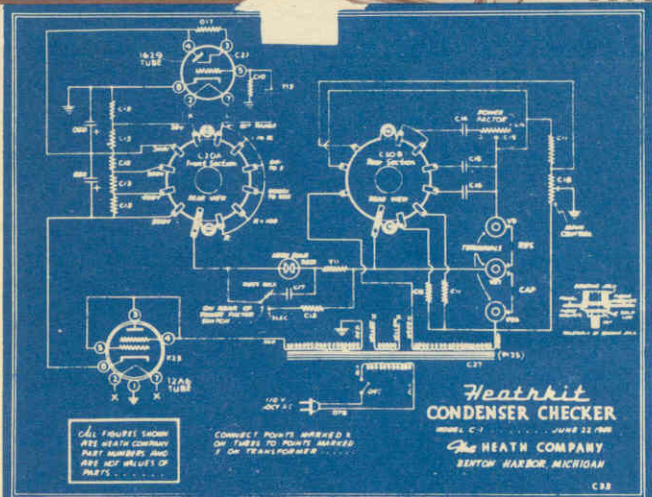
- ★ 5 tube circuit.
- ★ Covers 2 Mc to 226 Mc.
- ★ 110V 60 cy transformer operated.
- ★ Supplies either RF or FM.
- ★ Variable sweep width 0 to app. 10 Mc.
- ★ Large calibrated dial.
- ★ Variable phasing control.
- ★ Sweep output for scope.
- ★ No band switching necessary.
- ★ Uses new miniature HF tubes.

A necessity for television and FM. This Heathkit completely covers the entire FM and TV bands. 2 megacycles to 230 megacycles. The unit is 110V 60 cy power transformer operated. Uses two 6J6 tubes, two 6C4 tubes and a 6X5 rectifier. An electronic sweep circuit is incorporated allowing a range of 0 to 10 Mc. A sawtooth horizontal sweeping voltage and phase control are provided for the oscilloscope.

The coils are ready assembled and precision adjusted to exact frequency. As in all Heathkits, the best of parts are supplied, Mallory filter condenser, zero coef. ceramic condensers, all punched and formed parts, grey crackle cabinet, 5 tubes, test leads, etc. Better get it built now and be ready for the FM and TV business. Shipping wt. 6 lbs.

SHIPPING WEIGHT  
6 POUNDS

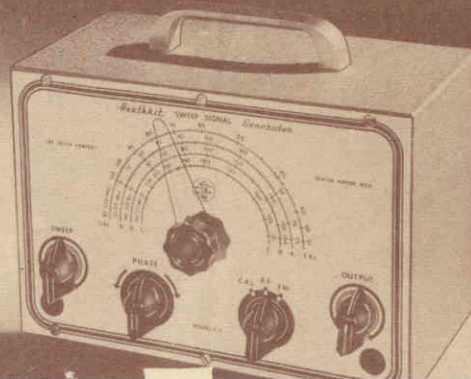
**\$19.50**  
Nothing  
ELSE TO BUY



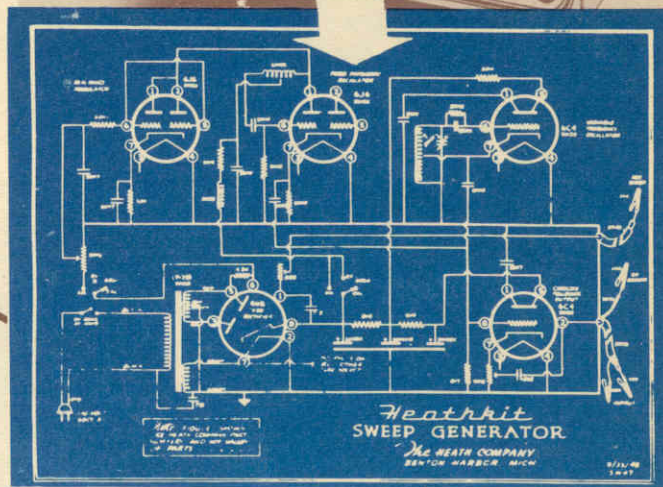
The HEATH COMPANY  
BENTON HARBOR, MICHIGAN

### Why BUILD YOUR OWN TEST EQUIPMENT

1. You save two-thirds in cost. With increasing prices of most everything, labor costs are an important factor. Eliminating assembly labor costs, we can offer the Heathkit Oscilloscope, VTVM and Signal Generator at a total of only \$83.50—about the cost of a factory-built VTVM alone.
2. You have all the fun and learn while you save. The thrill of assembling these beautiful instruments makes them seem more your own to be used with justifiable pride. Through knowledge of construction gained in assembly, better use can be made of the instruments and you can keep them in better repair if need arises.



**\$24.50**  
Nothing  
ELSE  
TO BUY



# HEATHKIT CONDENSER CHECKER KIT

## Features

- ★ Bridge type circuit.
- ★ Magic eye indicator.
- ★ 110V transformer operated.
- ★ All scales on panel.
- ★ Power factor scale.
- ★ Measures resistance.
- ★ Measures leakage.
- ★ Checks paper-mica-electrolytics.

Checks all types of condensers, paper-mica-electrolytic-ceramic over a range of .00001 MFD to 1000 MFD. All on readable scales that are read direct from the panel. NO CHARTS OR MULTIPLIERS NECESSARY. A condenser checker anyone can read without a college education. A leakage test and polarizing voltage for 20 to 500 volts provided. Measures power factor of electrolytics between 0% and 50%. 110V 60 cycle transformer operated complete with rectifier and magic eye tubes, cabinet, calibrated panel, test leads and all other parts. Clear detailed instructions for assembly and use. Why guess at the quality and capacity of a condenser when you can know for less than a twenty dollar bill. Shipping weight 7 lbs.

Sec. 562, P. L. & R.  
U. S. POSTAGE

**1¢ Paid**

Benton Harbor, Mich.  
Permit No. 273



# RMA Color Code on Transformers

## I.F. TRANSFORMERS

**Blue** — Plate Lead  
**Red** — B + Lead  
**Green** — Grid  
**Black** — Ground or AVC

If center tapped other grid is green and black striped.

## AUDIO TRANSFORMERS

**Blue** — Plate Lead  
**Red** — B + Lead  
**Brown** — Other Plate on Push Pull  
**Green** — Grid Lead  
**Black** — Ground Lead  
**Yellow** — Other Grid on Push Pull

## POWER TRANSFORMERS PRIMARY — BLACK

**High Voltage Plate — Red**  
 Center Tap Red and Yellow Striped  
**Rectifier Filament — Yellow**  
 Center Tap Yellow and Blue  
**Filament No. 1 — Green**  
 Center Tap Green and Yellow  
**Filament No. 2 — Brown**  
 Center Tap — Brown and Yellow  
**Filament No. 3 — Slate**  
 Center Tap — Slate and Yellow

## Soldering

The most important thing in good soldering is to heat the joint and allow the solder to flow into it. The solder should melt from contact with the joint rather than with the iron. Never use pastes or acids in radio work.

Use only rosin core solder. Never depend on the solder to hold a joint. Always make a firm connection with the wire before applying solder. To tin a soldering iron (soldering cannot be done with the bare copper) file the surface lightly while the iron is hot and then quickly apply a generous amount of rosin core solder while the filed surface is still bright. Wipe off excess solder with a cloth.

Tin all four sides of the tip in this manner.
























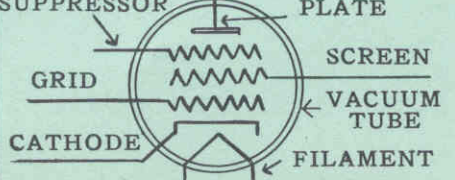

The terminals must be clean, and preferably tinned. On some terminals that are hard to solder to (nickel plated f.i.) it is desirable to pre-tin the surface before installation or connection. Clean (scrape or sandpaper) the surface, heat with iron and apply rosin core solder liberally. Wipe off or shake off excess solder.

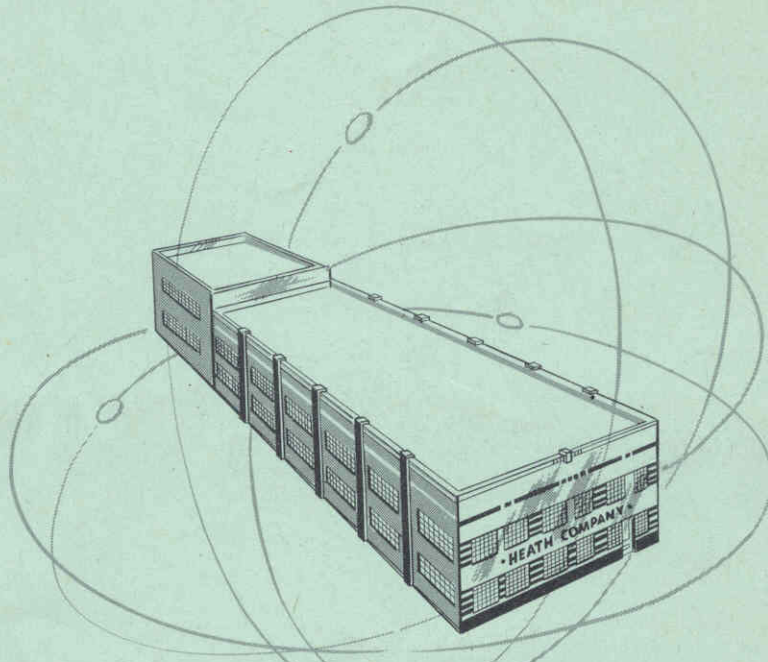
## Recommended Tools

A good electric soldering iron (100 watt with small tip)  
 Long or needle nose pliers 6".  
 Diagonal or side cutting pliers (5" or 6").  
 An assortment of screw drivers flat and Phillips type.

File. Round and flat types.  
 Purchase quality tools and you will enjoy and use them many years.  
 American Beauty soldering irons, Plomb, and Williams pliers are recommended.

## Symbols Used in Radio Circuits

	ANTENNA OR AERIAL		VARIABLE CONDENSER		QUARTZ CRYSTAL
	CHASSIS OR GROUND		ELECTROLYTIC CONDENSER SHOWING POLARITY		CONNECTION OF TWO WIRES
	AIR CORE COIL		SWITCH		NO CONNECTION
	AIR CORE TRANSFORMER OR COIL		ROTARY SWITCH		FUSE
	R.F. CHOKE		SPEAKER		PHONE PLUG
	FILTER OR IRON CORE CHOKE . . .		METER	K =	1000
	IRON CORE TRANSFORMER		PILOT LIGHT	M =	1,000,000
	FIXED RESISTOR		PHONE JACK		OHM.
	VARIABLE RESISTOR OR POTENTIOMETER			MF =	MICROFARAD
	FIXED CONDENSER			MMF =	MICRO MICROFARAD



THE HEATH COMPANY  
BENTON HARBOR, MICH.