ASSEMBLING AND USING YOUR *Heathkit*

VACUUM TUBE VOLTMETER

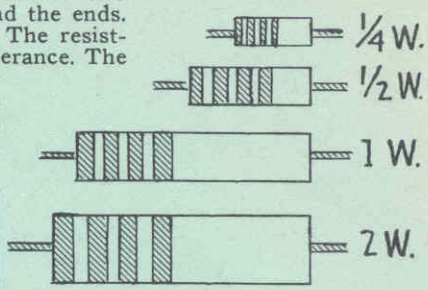
MODEL V-2

THE HEATH COMPANY
BENTON HARBOR, MICH.

PRICE $1.00

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 uninsulated 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 uninsulated 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.



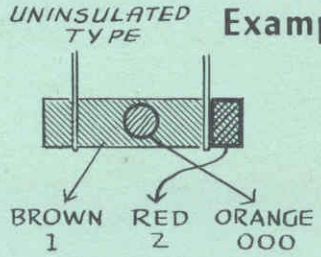
WATTAGE SIZES

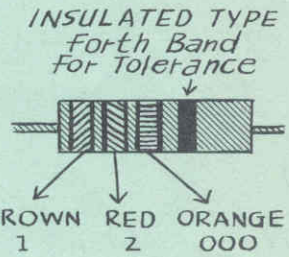
WATTAGE. Resistors are rated as to wattage (power dissipation) according to size. The chart shows approximate sizes which vary with manufacturers. To determine wattage size necessary multiply current through resistor in amperes by voltage drop across resistors in volts. Example — A plate loading resistor 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 × .01A. = 1 Watt.

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

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

Examples





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.

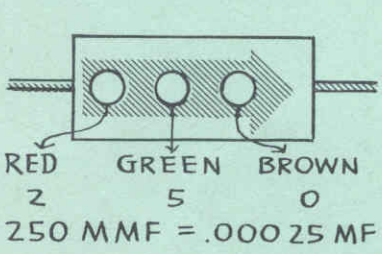
Condenser Code

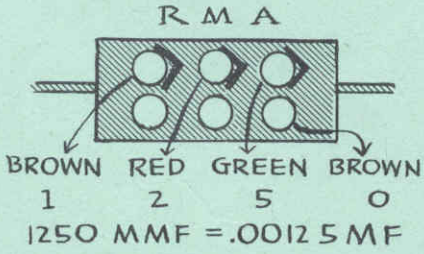
Condensers use the same code as resistors and are read in micromicrofarads.

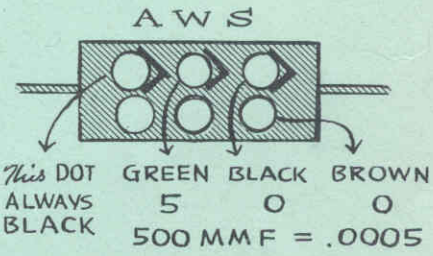
If there is one row of dots, they are read in direction of arrow or if manufacturer's name appears in the same direction as name. If two rows of dots appear, it can either be of two different codes: The RMA or the AWS (American War Standard). In the RMA, the top row of dots are the first three figures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

Examples







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.

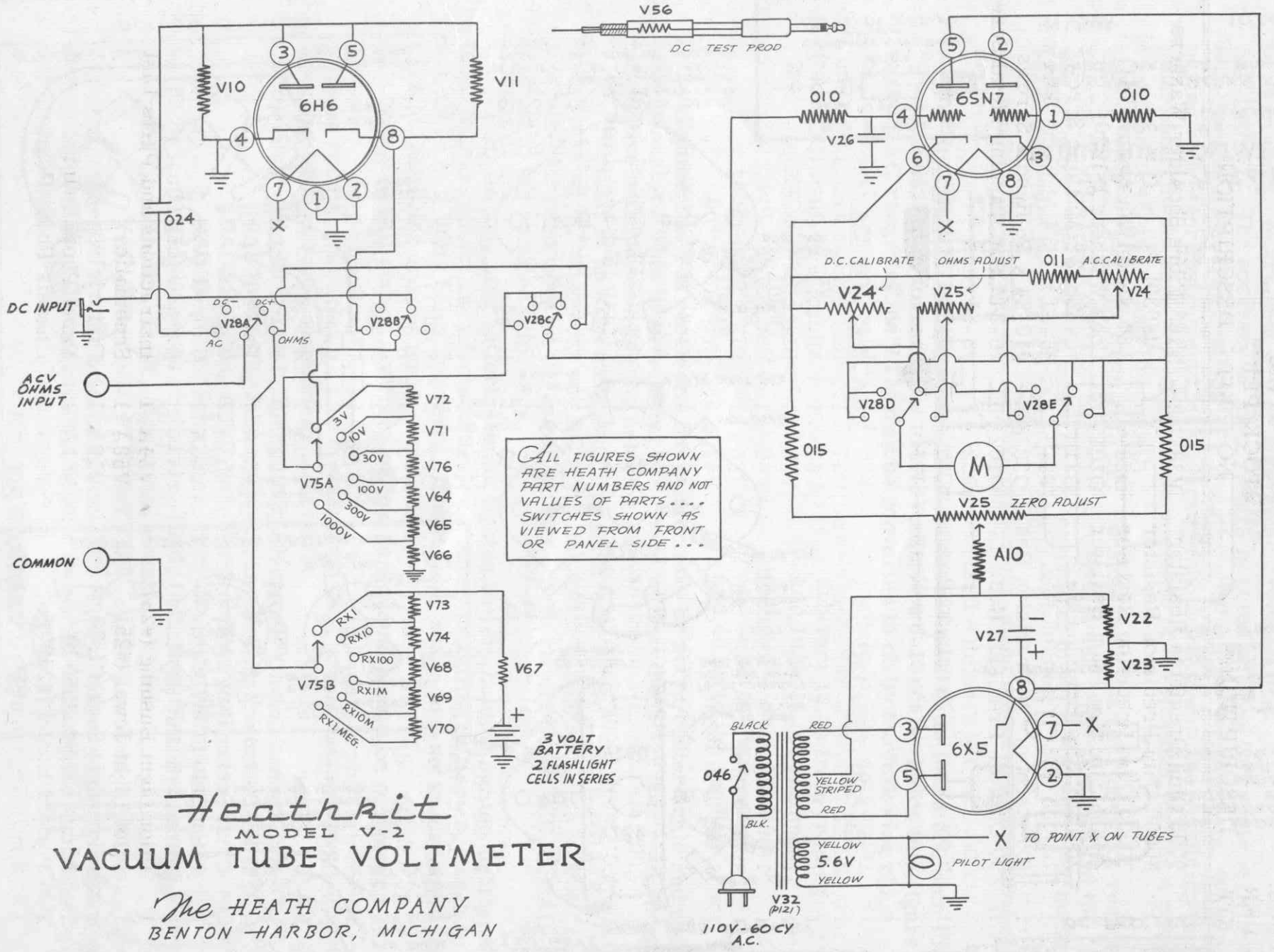
Many excellent articles on the construction and use of vacuum tube voltmeters have appeared in radio magazines. A few are:

RADIOCRAFT, June, 1945, Electronic Ohmnichecker
RADIO NEWS, January, 1947, Home Constructed VTVM
RADIO NEWS, July, 1946, Vacuum Tube Voltmeter
RADIO NEWS, November, 1945, Electronic Voltohmmeter
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
V68	1	9000 Ohm Precision Resistor
V66	1	30000 Ohm Precision Resistor
V65	1	70000 Ohm Precision Resistor
V69	1	90000 Ohm Precision Resistor
V64	1	200000 Ohm Precision Res.
V76	1	700000 Ohm Precision Res.
V70	1	9.9 Megohm $\frac{1}{2}$W Precision Res.
V73	1	90 Ohm 1% Precision Res.
V74	1	900 Ohm 1% Precision Res.
V71	1	2 Megohm 1% Precision Res.
V72	1	7 Megohm 1% Precision Res.
V67	1	9.5 Ohm 1W 5% Resistor
V23	1	15000 Ohm 10% Resistor
V22	1	20000 Ohm 10% Resistor
O15	2	2000 Ohm Resistors
O11	1	10000 Ohm Resistor
A10	1	47000-51000 Ohm Resistor
V11	1	200000 Ohm Resistor
V56	1	1 Megohm Resistor
O10	2	3.3 Megohm Resistors
V10	1	18 Megohm Resistor
V26	1	.003 MFD Mica Condenser
O24	1	.01 MFD 1000V Tubular Cond.
V27	1	12 MFD 150 V Electrolytic Condenser
V25	2	5000 Ohm Control Ohms Adjust and Zero Adjust
V24	2	10000 Ohm Controls AC and DC Calibrate
V28	1	5 Pole 4 Pos. Rotary Switch (B119238)
V75	1	2 Pole 6 Pos. Rotary Sw.
O94	1	SPST Slide Switch
G44	1	6SN7 Tube
V30	1	6X5 Tube
V31	1	6H6 Tube
O54	3	Octal Sockets
O43	3	Octal Socket Rings
O39	1	Pilot Bulb (T-47)
O40	1	Pilot Light Nut (#27)
O41	1	Pilot Light Bushing (#28)
O42	1	Pilot Light Jewel (#25)
O52	1	Pilot Light Socket (#20)
V48	2	Acorn Knobs (#2500)
O51	2	Pointer Knobs (#2300)
O38	1	Single Terminal Strip
V38	2	5/16" Fibre Shoulder Washers (#630)
O28	5	3/8" Nickel Washers (#741)
O101	7	Lock Washers (#1220)
O31	5	#6-32 x 3/8 Machine Screws
V84	1	#6-32 x 1 3/4 Machine Screws
O30	2	#10-24 x 3/8 Handle Screws
O102	8	#6-3/8" Self Tapping Metal Screws
O32	8	#6-32 Nuts
S22	2	#6-32 x $\frac{1}{4}$" Nuts for Switch
O33	7	Control Nuts (#737)
V86	1	Wing Nut
V36	1	Black Banana Jack (Common Post)
V37	1	Red Banana Jack (AC-Ohm Post)
V87	1	Microphone Jack (DC Post)
V39	1	Black Banana Plug
V40	1	Red Banana Plug
V88	1	PL68 Phone Plug
V42	1	Red Test Prod
V43	1	Black Test Prod
V44	1	Alligator Clip
V45	1	Length Black Test Lead Wire
V46	1	Length Red Test Lead Wire
V47	1	Length Shielded Test Lead Wire
V34	2	Flashlight Cells (one calibrated)
V82	1	Battery Mounting Bracket Strap
V83	1	Battery Mounting Bracket
O34	4	Rubber Feet (#716)
O35	3	3/8" Rubber Grommets (#905)
O37	4	Soldering Lugs
V50	1	Roll Hookup Wire 10 ft.
1P22	1	Length Spaghetti (8")
O78	1	Line Cord
O79	1	Handle (#5374)
V49A	1	200 Micro Ampere Meter
V32	1	Power Transformer (P121)
V51A	1	Panel (V2)
V52	1	Chassis
V53A	1	Cabinet (V2)
O83	1	Introductory Sheet (F.O.)
V54A	1	Instructions and Parts List
V58A	1	Schematic
V59A	1	Pictorial
V61A	1	Panel Photo Print
V62A	1	Chassis Photo Print



ALL FIGURES SHOWN ARE HEATH COMPANY PART NUMBERS AND NOT VALUES OF PARTS.... SWITCHES SHOWN AS VIEWED FROM FRONT OR PANEL SIDE...

Heathkit

MODEL V-2

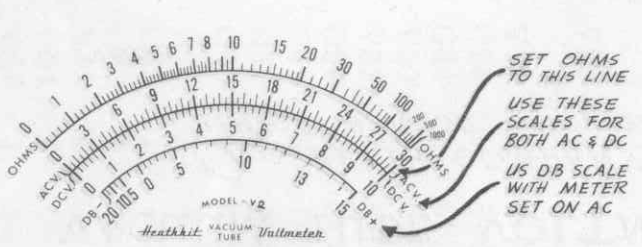
VACUUM TUBE VOLTMETER

The HEATH COMPANY

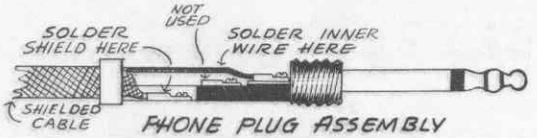
BENTON HARBOR, MICHIGAN

V58A

11/24/48

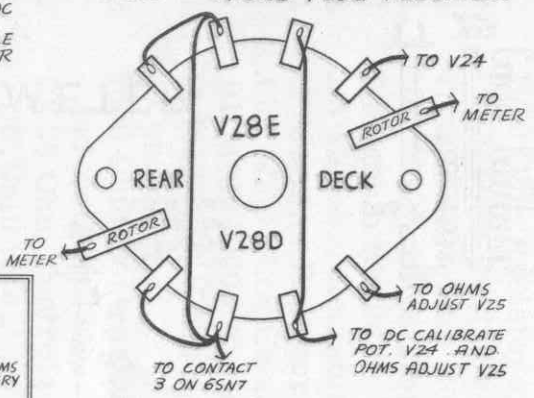


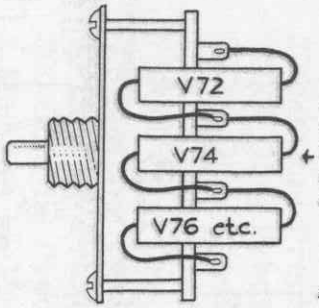
Note: To use 3 Volt range drop 0 (zero) from 30 Volt scale. To use 100 Volt range add 0 (zero) to 10 Volt scale. To use 300 Volt range add 0 (zero) to 30 Volt scale. To use 1000 Volt range add two 0 (zeros) to 10 Volt scale. Use both voltage scales on both AC and DC.



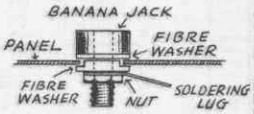
PHONE PLUG ASSEMBLY

DC TEST PROD



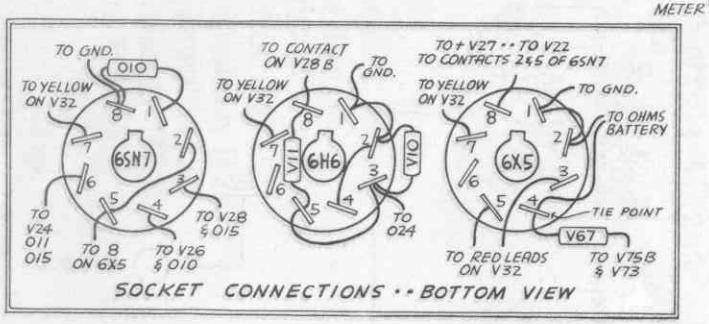


ACTUAL METHOD OF MOUNTING RESISTORS ON V29 - SEE SIMPLIFIED VIEW FOR WIRING CONNECTIONS . . .

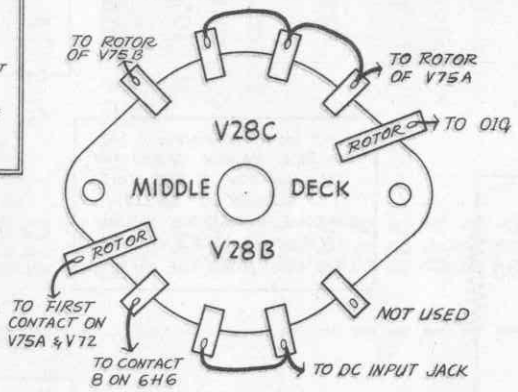


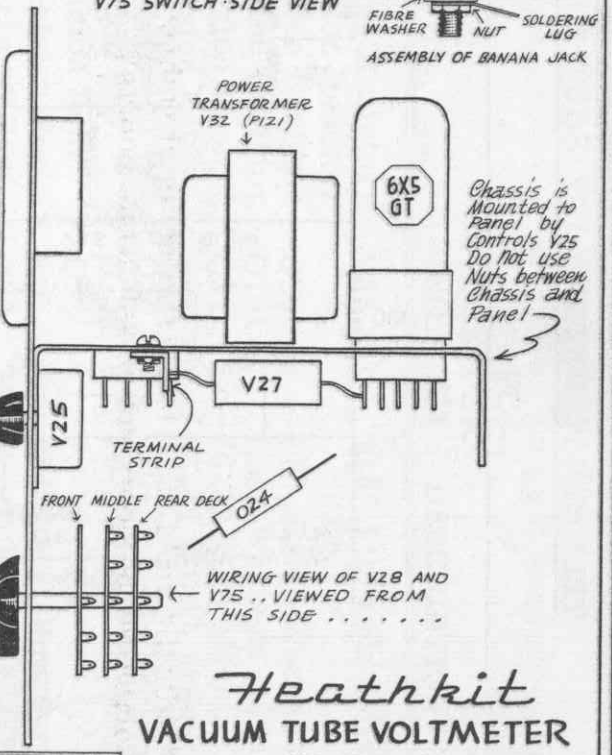
ASSEMBLY OF BANANA JACK

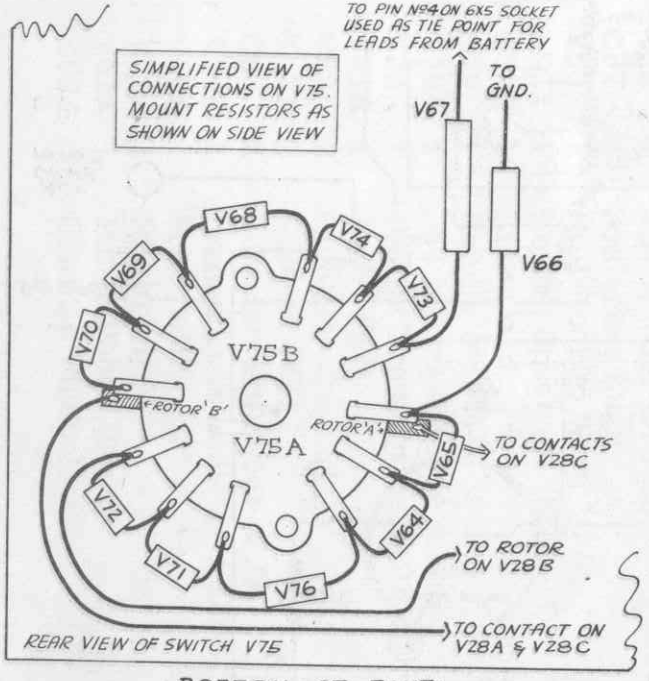
V75 SWITCH - SIDE VIEW



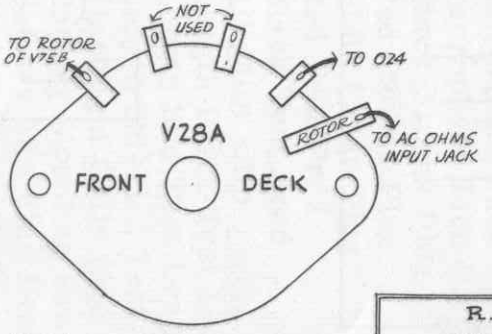
SOCKET CONNECTIONS . . BOTTOM VIEW





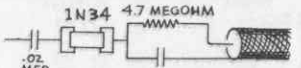


BOTTOM OF PANEL



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

R.F. PROBE



OBTAINABLE IN KIT FORM FROM The HEATH COMPANY

Heathkit

VACUUM TUBE VOLTMETER

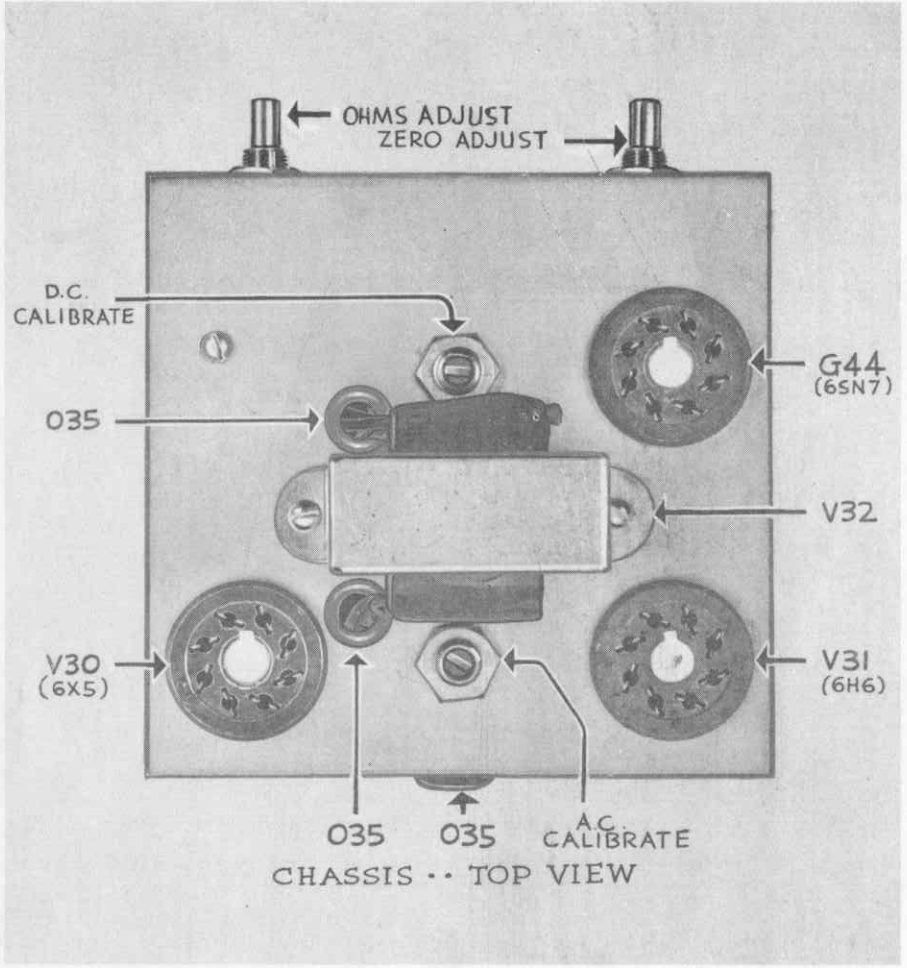
MODEL V-2

PICTORIAL DIAGRAMS

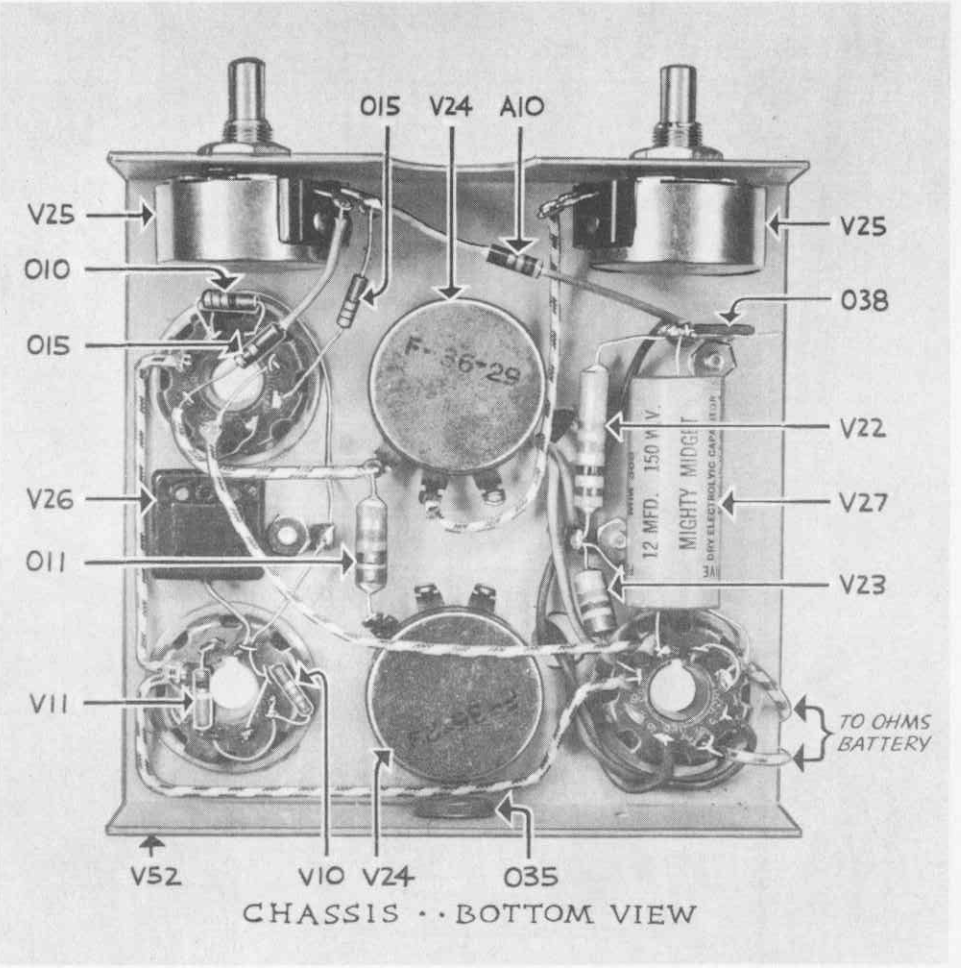
The HEATH COMPANY
BENTON HARBOR, MICH.

No V59A 11/24/'48

Heathkit MODEL V-2 VACUUM-TUBE VOLTMETER



CHASSIS · · TOP VIEW

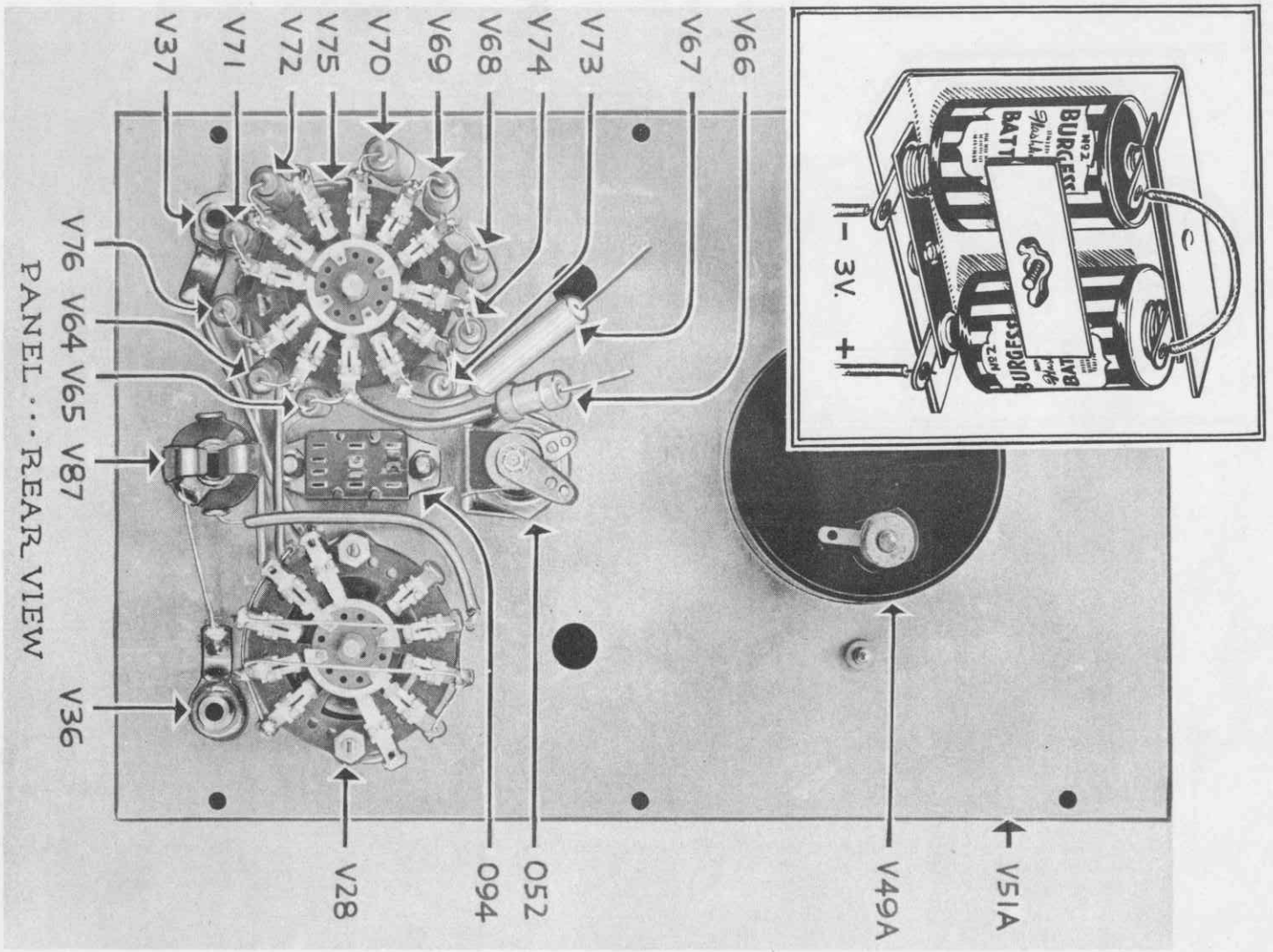


CHASSIS · · BOTTOM VIEW

The HEATH COMPANY
BENTON HARBOR, MICH.

11/24/48
V62-A

Heathkit MODEL V-2 VACUUM-TUBE VOLTMETER



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11/24/48
V61-A

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.

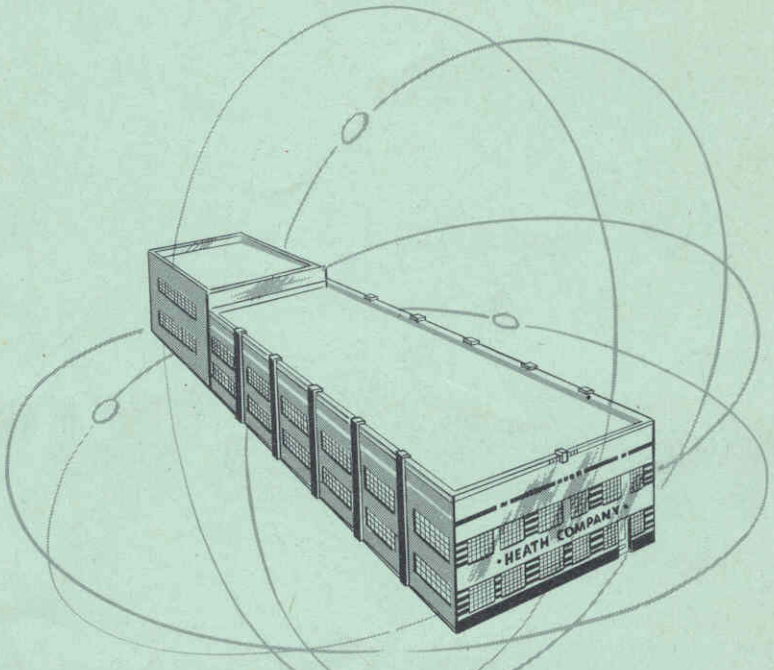
The terminals must be clean, and preferably tinned. On some terminals that are hard to solder to (nickel plated f.i.) it is desirable to pre-tin the surface before installation or connection. Clean (scrape or sandpaper) the surface, heat with iron and apply rosin core solder liberally. Wipe off or shake 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	SUPPRESSOR, PLATE, SCREEN, GRID, VACUUM TUBE, CATHODE, FILAMENT	MF = MICROFARAD
FIXED CONDENSER		MMF = MICRO MICROFARAD



THE HEATH COMPANY
BENTON HARBOR, MICH.

C83 4-17-48