

ASSEMBLING AND
USING YOUR

Heathkit

Signal Tracer
Model T-2



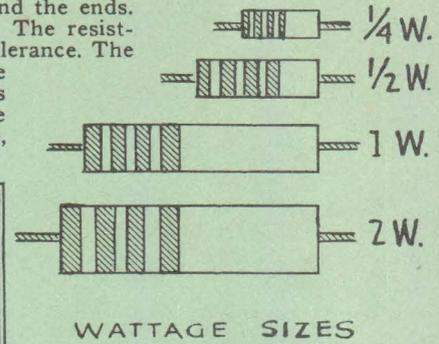
THE HEATH COMPANY
BENTON HARBOR, MICH.

595-7

PRICE \$1.00

USEFUL INFORMATION FOR KIT BUILDERS

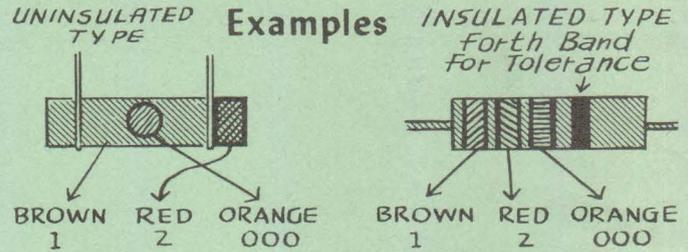
Resistors are identified by a color code used in several bands around the resistors. There are two general types of resistors. One, the un-insulated type, has the connecting wires bound around the ends. The other, the insulated type, has the wire connected internally and coming out the ends. The resistance 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. 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	0,0000
Green	5	5	00,0000
Blue	6	6	000,0000
Violet	7	7	0,000,0000
Grey	8	8	00,000,0000
White	9	9	000,000,0000



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

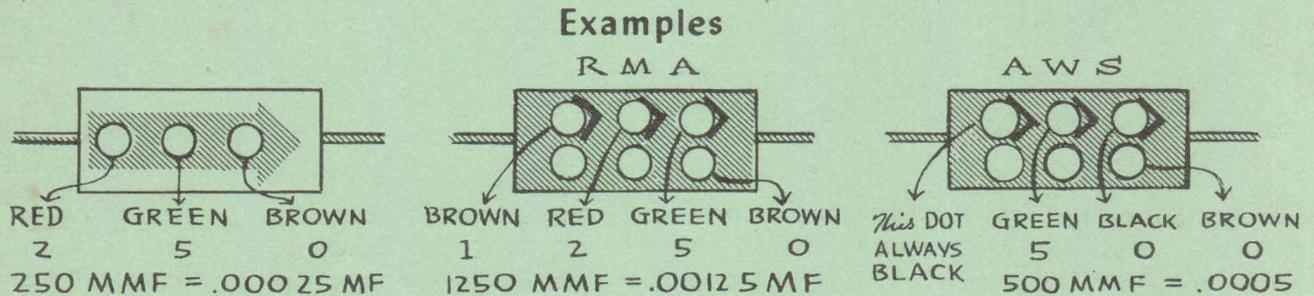
The fourth ring or other end may be silver (10% tolerance) or gold (5% tolerance) or it may be omitted entirely which indicates .20% tolerance.

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 T-2 SIGNAL TRACER

The construction of the Heathkit Signal Tracer is not difficult but consideration should be given the fact that a test instrument will be useful for many years and care taken in construction will be repaid many times. Test equipment is the best assistant available in service and research work and it deserves the most careful workmanship possible. Thoroughly study and familiarize yourself with the instructions, pictorial diagrams and circuit. Do not rush the construction. Make a good mechanical joint of each connection, then solder it with best quality rosin core radio type solder. (DO NOT USE FLUXES OR ACID CORE SOLDER.) Hold each joint rigid while solder cools and then test by attempting to pull joint loose.

Most difficulty in construction results from poor soldering (and use of wrong solder) and reversed connections (remember that in working on the bottom of the chassis and rear of panel that all locations are reversed).

Check the parts carefully against the parts list. Identify each part (using the charts on covers of instruction manual). Be sure to check the packing to avoid throwing away any of the small parts. Mark the values of condensers and resistors on the schematic diagram beside the part number.

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 ohms resistors (which is the new radio manufacturer's rating for 50,000 ohms) may be substituted for 50,000 ohms or a one watt resistor may be substituted for one-half 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, condensers and potentiometers have a normal tolerance rating of plus or minus 20% unless marked otherwise. Therefore, a 1 megohm unit may test between 800,000 and 1,200,000 and be satisfactory. Heathkit circuits are designed to accommodate these variations. Socket connections are numbered on the bottom of the sockets. Sockets are fastened into the chassis with the wavy metal rings which fit into the groove in the side of the socket. To install, hold one end of the ring in the groove and the balance of the ring is then forced over the socket and into the groove with a screw driver.

Note the direction of the keyways in the sockets from the pictorial diagram.

Begin the construction by mounting the sockets, power transformer, output transformer and bath-tub condenser, adding solder lugs where indicated. Note: Solder wires to output transformer lugs #1, #3, and #5 before mounting. Wire the power supply section first followed by the filaments and ground connections. The resistors and molded condensers are now added. Assemble the panel by mounting the several jacks. The jacks are held in place by the special washer with sharp points which is forced over the body of the jack. Mount the speaker grill and speaker and the upper selector switch. The panel is held to the chassis by the gain control potentiometer and the lower rotary selector switch. Complete the wiring by making all connections from the panel to the chassis. Install the line cord. Assemble the prod as shown on the circuit diagram. Remove enough of the shielding on the cable to prevent shorting of the crystal. Solder the short ground BRAID to the shield. The cable with crystal attached is inserted into the prod (having first removed the cap from the solderless tip of the test prod) and the lead from the crystal pulled through the hole in the prod tip. This lead is wrapped around the groove in prod tip and the cap replaced locking it in place. To avoid strain on the crystal lead, it is suggested that several match sticks be pressed into the prod beside the shielded lead making the cable tight in the prod. Install the phone plug on the other end of the cable as shown.

Upon completion of the wiring, recheck all connections. A suggested way is to follow each con-

nection 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. If wiring is in order, insert tubes and connect to 110V 60 cycle AC. After warm up period, advance the gain control and touch prod tip. If loud hum is heard in the speaker (providing switches are set in correct position), the tracer is in proper operating order.

USE OF SIGNAL TRACER

The gain control determines the sensitivity of the instrument and allows the signal being followed to be adjusted to a suitable volume.

The slide switch O94 should be in the internal position. The selector switches should be in positions 4 and 5 to properly match the 6K6 tube in this instrument.

To trace a receiver, set the dial of receiver under test to known local station or preferably a signal from a test oscillator. Turn gain control full on, connect ground clip of tracer prod to B-. (On AC-DC radios, a small potential may exist which may be eliminated by reversing either the plug on radio or tracer or both.) Note: B- and chassis may not be at the same potential in some AC-DC receivers. Hum and distortion may be minimized by placing a condenser of a few MMF in series with the test prod. A reduction in signal strength due to detuning is to be expected when checking receivers having relatively large inductances and small capacities in the tuned circuits.

Start at the antenna coil and touch the prod tip to first the secondary, continuing through the RF, and IF coils (always to the high or plate and grid sides of the coils) continuing through the audio section by connecting progressively to the grid and plate of each section at tube socket. When the signal stops, the difficulty lies in the stage just preceding. To illustrate--if the signal appears at the plate or primary connection of a coil but not at the secondary or grid of the coil, the fault is between the plate and grid. The gain of each stage is indicated by the amount the gain control of the tracer must be reduced to maintain equal volume. Power supply filters may be checked by touching the prod to each section and noting the reduction in hum (no reduction indicates defective filter condenser). Distortion, noise or hum may be followed through a radio in the same manner and isolated. The Heathkit Signal Tracer may be used for many other trouble shooting purposes which appear desirable to the user. The crystal diode in the probe is in effect a crystal detector which will respond to any frequency up to 200 megacycles.

The selector switches make 30 different impedance ratios available which make the instrument a valuable test speaker. To use as a test speaker for receivers or amplifiers with output transformers, connect to jacks C (common or grounded side) and VC (voice coil) with slide switch to "external." To use as a test speaker for receivers or amplifiers without an output transformer, connect to jacks "P" and "B+" (for single ended output) or "P" "B+" and "P" (for push pull output) with slide switch in internal position, and adjust the selector switches for proper matching to the tubes using the chart on the panel. A mismatch of 30 percent will not adversely affect operation. When used as a test speaker, be sure the power is turned off turning the gain control all the way counter clockwise till the switch clicks.

The transformer can be used as a matching transformer only, by connecting the amplifier or receiver as above and "C" and "SEC" terminals to an external speaker. The slide switch should then be in the external position.

To use the tracer as an audio amplifier or small public address system, connect either a phonograph pickup or high impedance crystal microphone to the input terminals and use either the internal speaker or a remote external speaker. For visual signal tracing, insert the AC test prod from a vacuum tube voltmeter into the "P" connection. Connect the GND connection of the tracer to the common or GND connection of the VTVM. The VTVM should be set on the correct AC scale. Signal levels and gain per stage may be read directly in volts or db. In checking intermittents, the tracer and VTVM may be left at a known setting and will indicate any change instantly. The "P" connection may also be connected to an oscilloscope for visual tracing.

IN CASE YOU HAVE DIFFICULTIES

1. Recheck entire wiring. Most cases of trouble result from incorrect or reversed wiring.
2. Check all voltages at the sockets. Measurements given below were taken with an 11 megohm input resistance Heathkit VTVM. A normal variation of + or - 15% are to be expected. All are measured between chassis and socket pin.

	6SH7	6K6	6X5
Pin 1	0	0	0
2	5-6½ VAC.	0	0
3	0	250 to 280V.	200-240VAC.
4	0 (No Signal)	250 to 280V.	Not Used
5	0	0	200-240VAC.
6	25-35V	Not Used	Used as Tie Point
7	0	5 to 6½ VAC.	5 to 6½ VAC.
8	90 -120V. No Signal	13 to 18V.	260 to 300V.

3. Check phone plug and test prod for shorts to shielding.
4. If oscillation is evident, try reversing the brown and blue leads from the output transformer, as shown in the pictorial diagram.
5. If residual hum level is too high, try reversing the two black primary leads from the power transformer.

SERVICE

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

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

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

NOTE: Before returning this unit, be sure all parts are securely mounted. Attach a tag to the instrument giving name, address and trouble experienced. Pack in a rugged container, preferably wood, using at least three inches of shredded newspaper or excelsior on all sides. Do not ship in original carton only as this carton is not considered adequate for safe shipment of the completed instrument. Ship by prepaid express, if possible. Return shipment will be made by express collect. Note that a carrier cannot be held liable for damage in transit if packing, in his opinion, is insufficient.

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

WARRANTY

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

The assembler is urged to follow the instructions exactly as provided. The Heath Company assumes no responsibility or liability for any damages or injuries sustained in the assembly of the device or in the operation of the completed instrument.

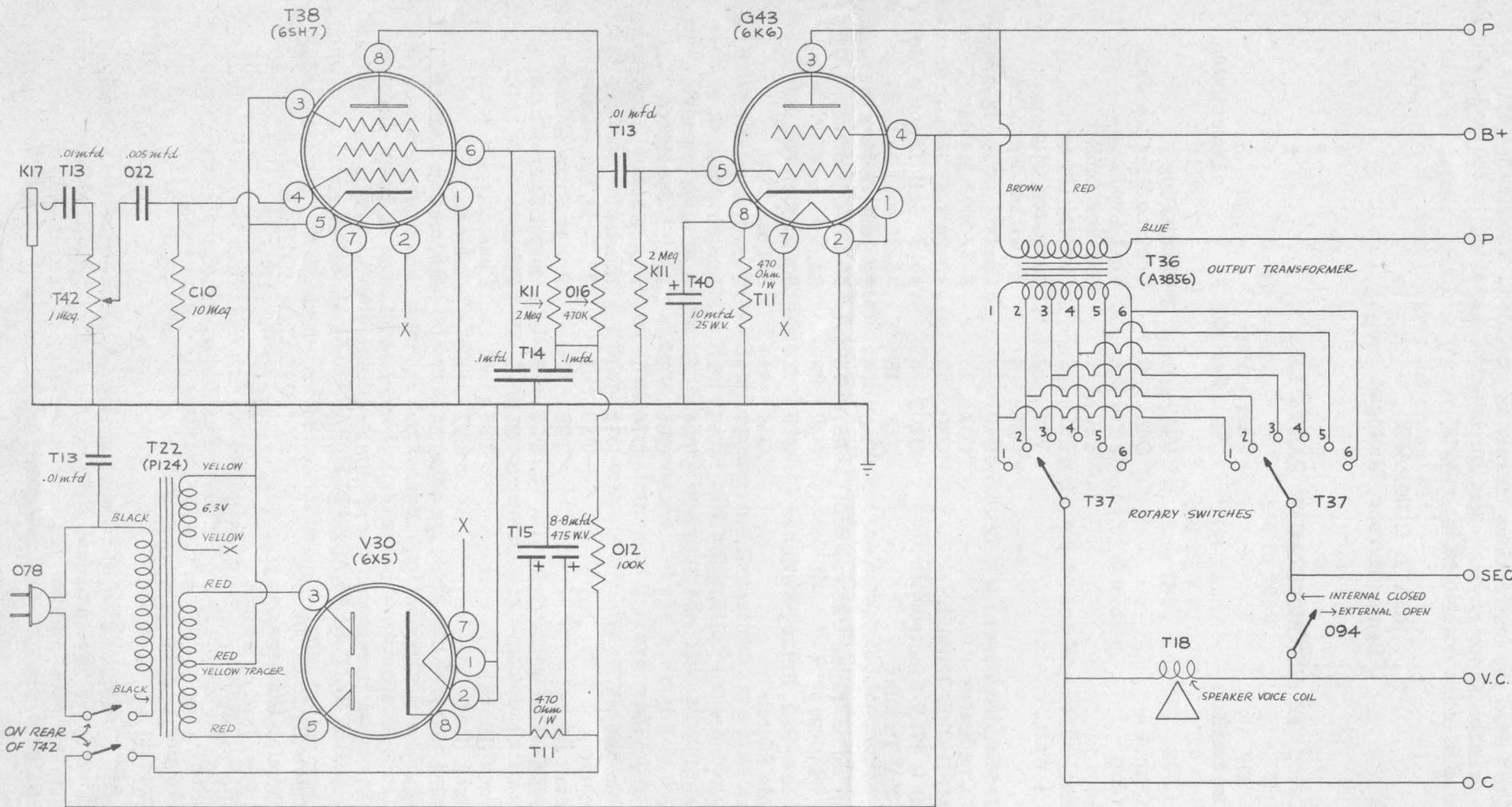
HEATH COMPANY
Benton Harbor, Michigan

T2 SIGNAL TRACER PARTS LIST

Part No.	Part Per Kit	Description	Part No.	Part Per Kit	Description
Resistors			✓V41	1	Phone Plug
✓O12	1	100,000 Ohm	✓O44	6	Locking Ring for Jack
✓O16	1 ⁽²⁾	470,000 Ohm	✓V42	1	Test Prod
✓K11	2	2 Megohm	✓T19	1	Speaker Grill
✓C10	1	10 Megohm	✓T21	1	Crystal Diode
✓T11	2	470 Ohm 1 Watt	✓V44	1	Alligator Clip
Condensers			✓O28	4	$\frac{3}{8}$ " Nickel Washers
✓O22	1	.005 MFD Moulded Paper	✓O101	3	Control Lock Washers
✓T13	3	.01 MFD Condenser	✓O31	13	6-32 x $\frac{3}{8}$ " Machine Screws
✓T14	1	Dual .1 MFD 400V Bathtub	✓O30	2	10-24 x $\frac{3}{8}$ " Handle Screws
✓T15	1	Dual 8 MFD 475V Electrolytic	✓O102	8	#6- $\frac{3}{8}$ " Self Tapping Metal Screws
✓T40	1	10 MFD 25V Tubular	✓S22	13	#6-32 x $\frac{3}{8}$ " Nuts
Control--Switches			✓O33	4	$\frac{3}{8}$ " Control Nuts
✓T42	1	1 Megohm Audio Taper Control with DPST Switch	✓TS72	13	#6 Lock Washers
✓T37	2	Single Pole 6 Pos. Rotary Switches	✓O37	3	Solder Lugs
✓O94	1	SPST Slide Switch	✓O35	2	$\frac{3}{8}$ " Rubber Grommets
Tubes			✓O34	4	Rubber Feet
✓G43	1	6K6 Tube	✓V47	1	Length Shielded Test Lead Wire
✓T38	1	6SH7 Tube <i>GSK7</i>	✓RF17	1	Length Braid
✓V30	1	6X5 Tube	✓T24	1	Roll Hook-up wire
Knobs--Sockets--Terminal Strips			✓O81	1	Length Spaghetti
✓O51	3	Pointer Knobs	✓O78	1	Line Cord
✓O54	3	Octal Sockets	✓O79	1	Handle
✓O43	3	Octal Socket Rings	✓T18	1	4" P. M. Speaker
✓SW37	1	3 Lug Terminal Strip	✓T22	1	Power Transformer (P124)
Miscellaneous			✓T36	1	Output Transformer
✓V77B	1	Banana Jack (Black)	✓T25A	1	Panel
✓V77R	5	Banana Jack (Red)	✓T26A	1	Chassis
✓M28	6	Banana Jack Insert	✓T32	1	Cabinet
✓K17	1	Phone Jack	✓T2	1	Instruction Manual

HEATHKIT REPLACEABLE PARTS AVAILABLE

T15	Dual 8MFD Electrolytic Condenser	\$1.00 each
T40	10MFD 25V Tubular Condenser40 "
T37	Single Pole 6 Pos. Rotary Switch68 "
T42	1 Megohm Audio Taper Control-DPST Sw.92 "
T18	4" P. M. Speaker	2.75 "
T22	Power Transformer	3.90 "
T36	Output Transformer	1.60 "
T25A	Panel85 "
T32	Cabinet.	2.55 "



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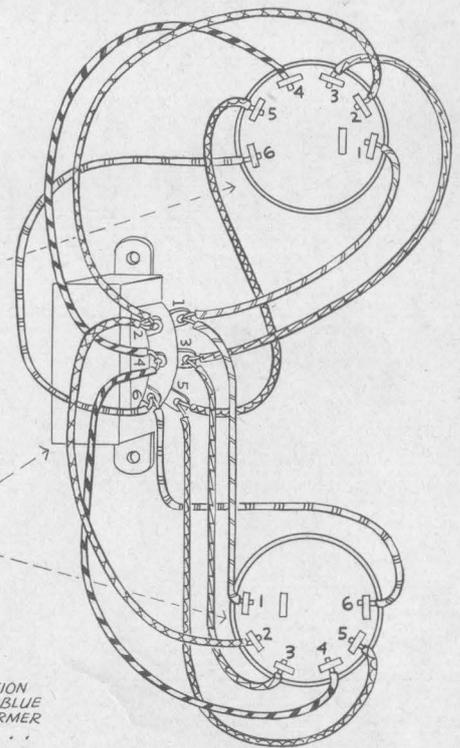
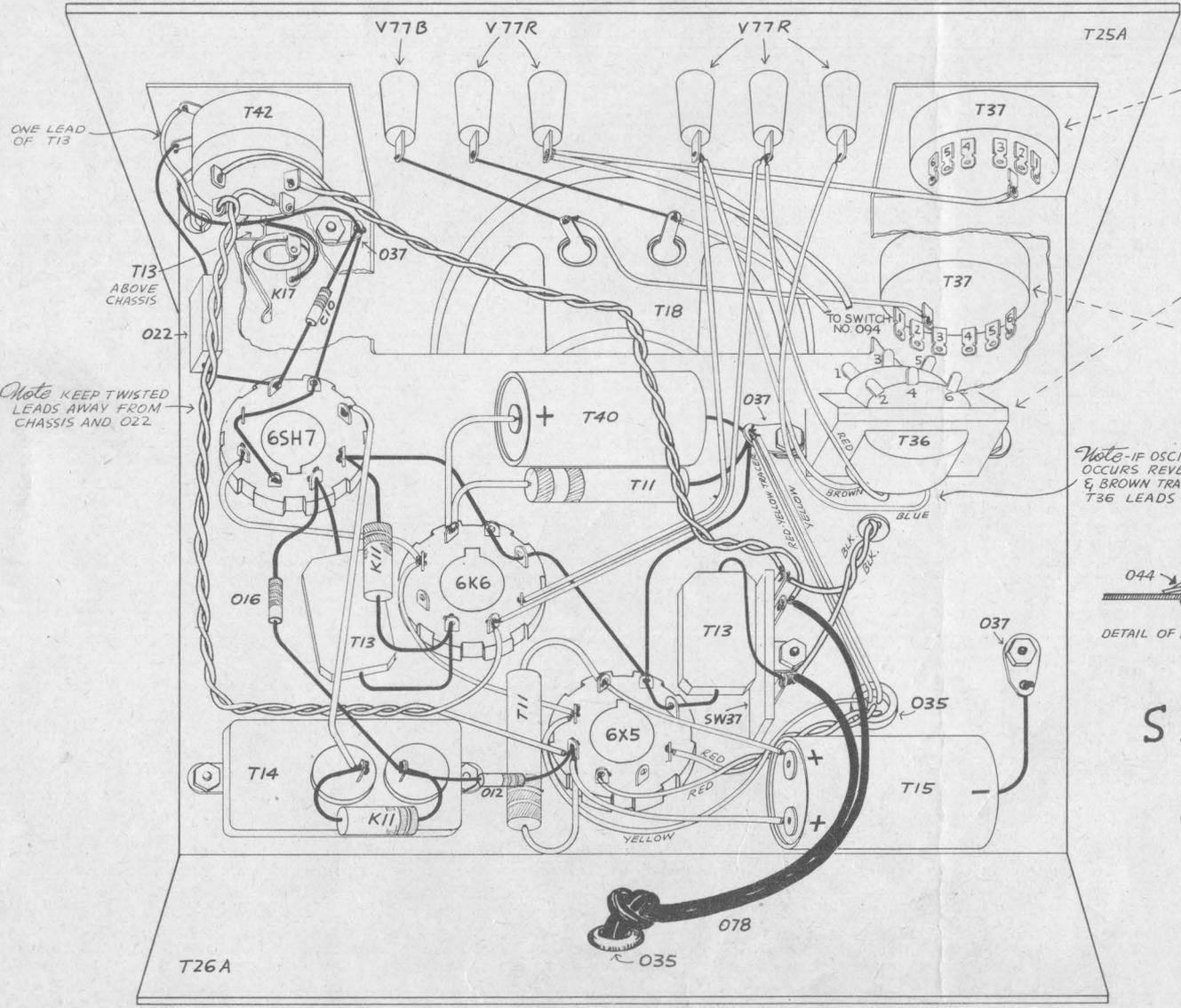
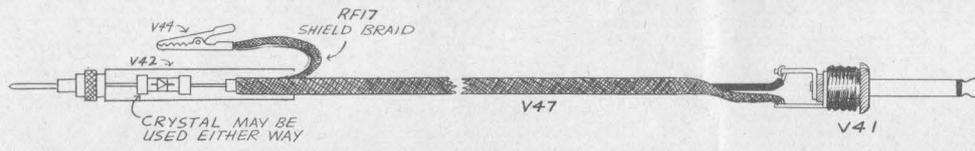
MODEL T-2 SIGNAL TRACER



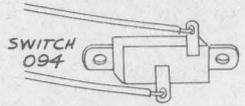
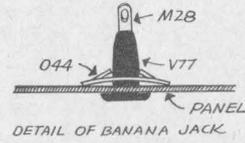
The HEATH COMPANY
BENTON HARBOR, MICH

MEG. = 1,000,000 Ohms.....
K = 1,000 Ohms.....

CONNECT POINTS MARKED
X ON TUBES TO SAME LETTER
MARKED ON TRANSFORMER.



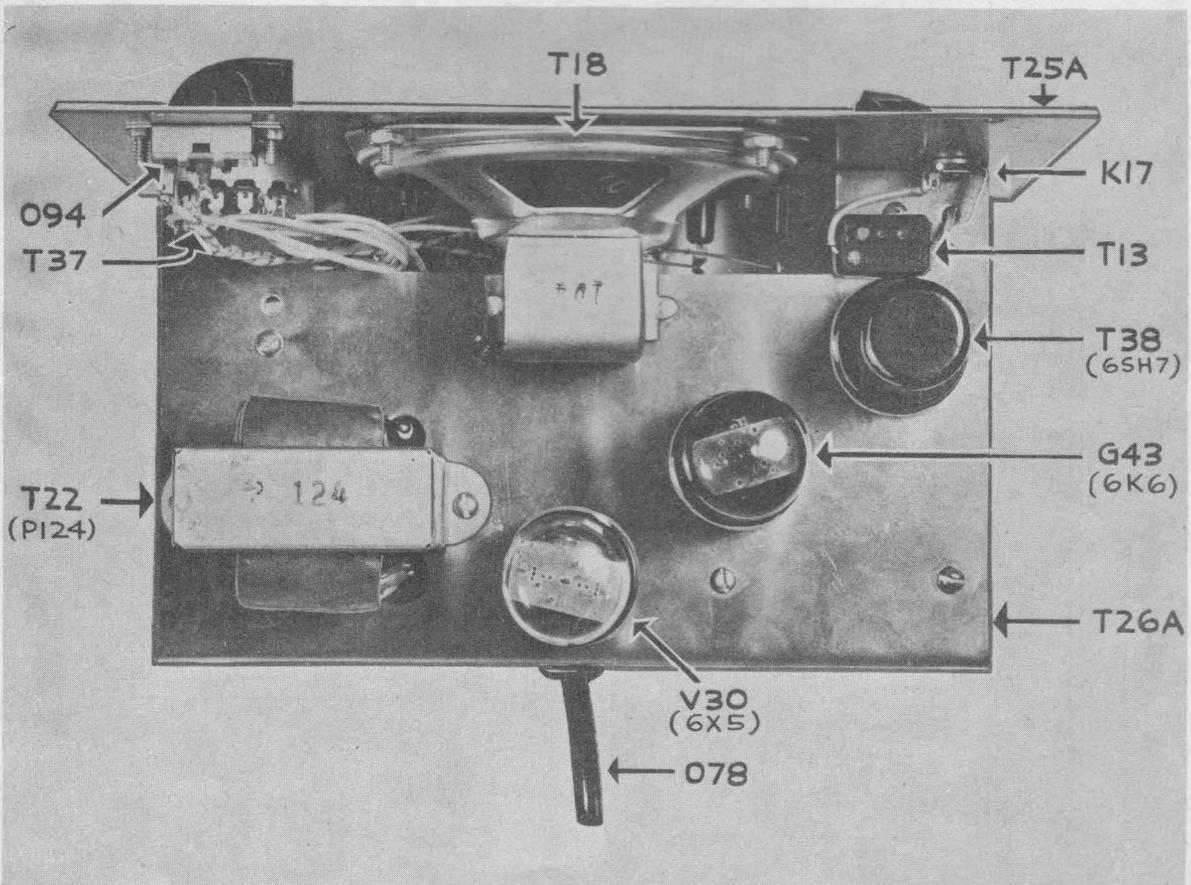
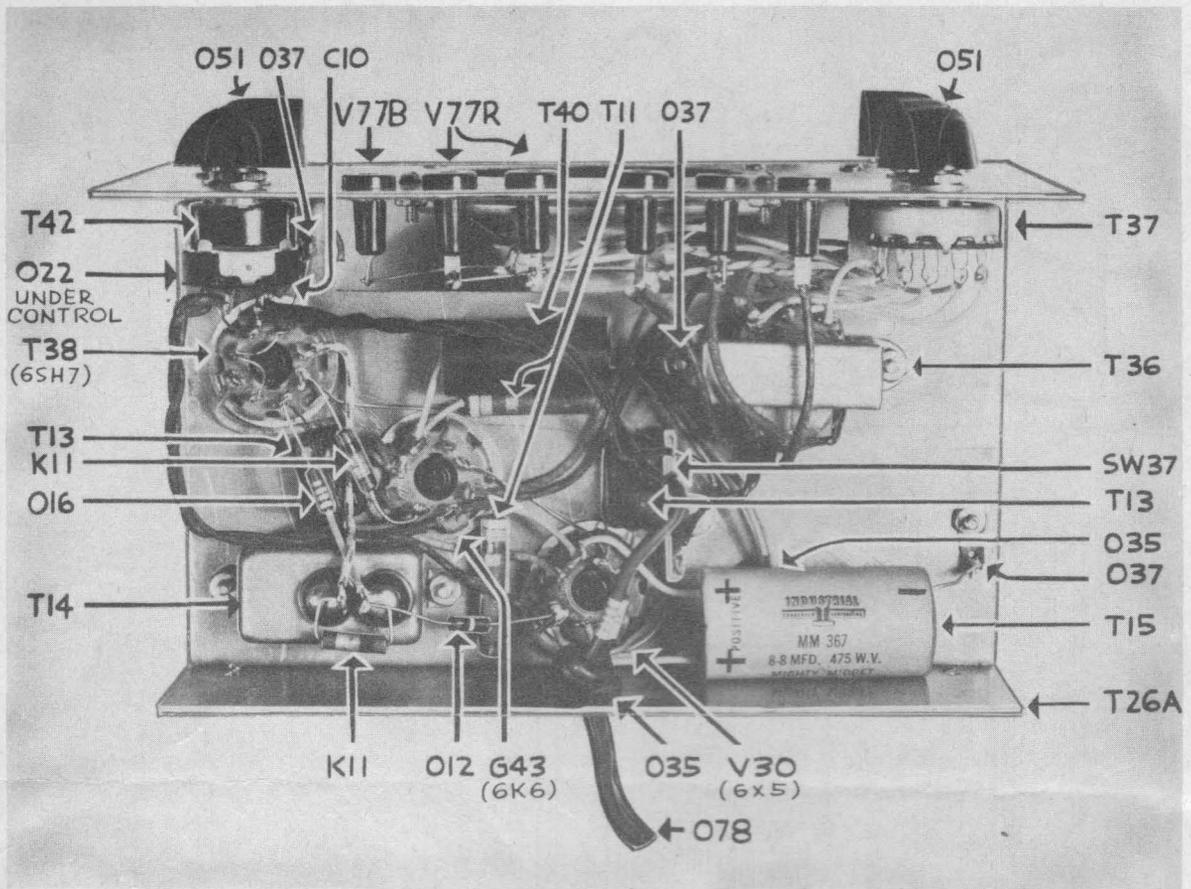
Note-IF OSCILLATION OCCURS REVERSE BLUE & BROWN TRANSFORMER T36 LEADS



Heathkit SIGNAL TRACER MODEL - T2

The HEATH COMPANY
BENTON HARBOR, MICHIGAN

Heathkit SIGNAL TRACER ... MODEL T-2



The HEATH COMPANY ... BENTON HARBOR, MICH.

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.

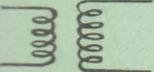
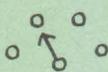
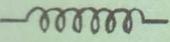
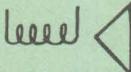
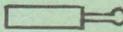
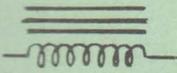
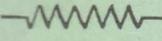
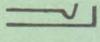
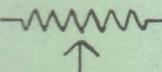
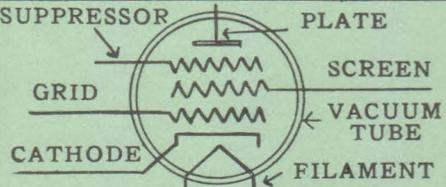
The terminals must be clean, and preferably tinned. On some terminals that are hard to solder to (nickel plated f.i.) it is desirable to pre-tin the surface before installation or connection. Clean (scrape or sandpaper) the surface, heat with iron and apply rosin core solder liberally. Wipe off or shake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

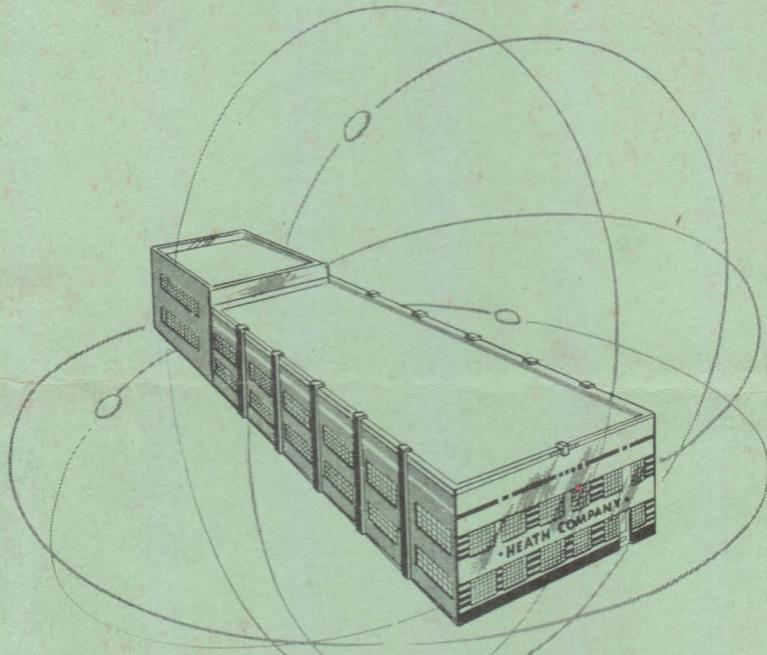
Recommended Tools

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.