Heathkit of the Month #130:
by Bob Eckweiler, AF6C

ELECTRONIC TEST EQUIPMENT

Heathkit IT-17
Tube Checker

Introduction:

There is a lot of retro amateur, audio and test equipment still in use that rely on vacuum tubes. However, testing those tubes can be a problem in today's environment. In the nineteen-fifties and sixties one only had to go to the local drug store, supermarket, or neighborhood radio store and use the self-service tube tester found in most of those places. Today, it's a different story. Even the few remaining electronic stores seldom have tube testing capability. Many audiophiles, who treasure the sound from vacuum tube amplifiers, have found having a tube tester available, almost a necessity. The Heathkit IT-17 **(Figure 1)** is one such tester in the Heathkit family.

After WW-II ended many GIs went into the then-lucrative radio and TV service industry. In 1949 Heathkit, seeing the need for an inexpensive tube checker, added the TC-1 to its growing list of test equipment kits. Over the ensuing years Heath sold eight different models; some of these models could also be purchased as a portable tube checker with a cover and handle. Heath's tube checkers can be grouped into three series: The TC series (1949 - 1962), three models. The IT series (1962 - 1981), also three models; and the TT series (1961 - 1973), two models.

Figure 1: The Heathkit IT-17 Tube Checker which sold from mid-1967 - 1977. It replaced the IT-21 and was superseded by the IT-3117.

The TC Series Tube Checkers:

TC-1:

The Heathkit TC-1 was introduced in the March 1949 issue of *Radio News* magazine[1]. By then Heath was selling over a dozen different kit models, When the TC-1 was introduced (**Figure 2**) it was shown with two thumb wheels for the roller chart. It appears this was changed to a single thumb wheel in the production units. The filament selector switch also changed from 15 to 14 positions, removing a Filament **OFF** (fully CCW) position. The TC-1 came with nine tube sockets plus a blank socket position where an additional socket could be installed. The sockets and blank are located in two clusters of five sockets, one on each side of the meter. See **Figure 3**. Clockwise from the ten o'clock position, the left cluster has a 4-prong, 5-prong, 7-prong and 6-prong socket. The central socket is a 5-prong Hytron socket. The 7-prong socket also contains a pilot-light test

Here is a link to the index of Heathkit of the Month (HotM) articles:

http://www.w6ze.org/Heathkit/Heathkit_Index.html

1. Notes begin on page 16

Figure 2: Heathkit announcement for the TC-1 from the 1949 Radio News (page 73). The photo appears to be a prototype with the two thumb wheels to the right of the roll-chart (one above, and one below).

socket. The right cluster, clockwise from ten o'clock, has an octal socket, loctal socket, blank, and miniature 9-prong socket. The central socket is a miniature 7-prong socket. The TC-1 price remained at $29.50 over its lifetime.

TC-2:

In the Fall of 1953 Heathkit replaced the TC-1 with the TC-2. Electrically, the circuit remained the same with the exception that two #47 pilot lamps were added to illuminate the roll chart. The roll chart mechanism on the TC-1 and TC-2 came as an assembly with the chart already installed. The TC-2 initially sold for $29.50, most of its lifetime, but was raised to $34.95 just a few months before it was superseded by the TC-3.

Originally the TC-2 came in the "Pre-classic"[2] style used also by the TC-1. Later, during its production, it was restyled to an early version of the "Classic I"[3] style with a dark gray panel and new gray knobs. Like the Heathkit IT-1[4] Isolation Transformer, it kept the pin-striping around the panel and the squared corners.

Portable TC-1P and TC-2P

Both the TC-1 and TC-2 were available in a portable model carrying a 'P' suffix for an additional $5 **(Figure 4)**. The non-portable models came in a birch wood cabinet. The portable models came with a hinged birch cover and a carrying handle added. The portable cabinet was vinyl covered, including the inside of the lid. The vinyl cover changed color when the TC-2 style was changed. Heath offered a way

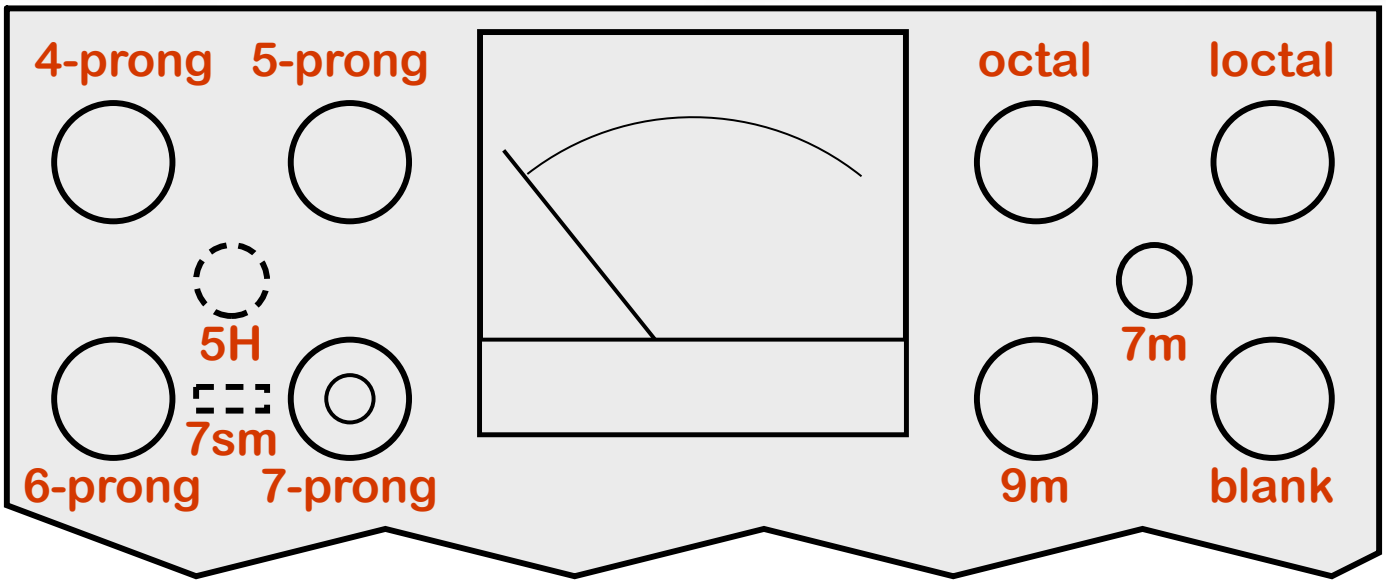


Figure 3: Socket location for the nine sockets (plus blank position) on the TC-1 and TC-2 tube checkers. 5H is the 5-pin Hytron socket. 7m and 9m are the 7 and 9 pin miniature tube sockets respectively. In the center of the large 7-prong socket is the lamp-test socket. Loctal is a locking 8-prong socket for tubes designed for rugged operation and were often used in tube based car radios. The TC-3 is similar except the 5-pin Hytron socket was replaced with a tiny 7-pin socket for subminiature tubes with wire leads (7-sm).

to convert a TC-1 or TC-2 to a portable model (discussed later).

TC-3:

The TC-3 first appeared in Heathkit's ad in *Radio News* magazine in the January 1959 issue (page 77). It sold for $39.95, $5 more than the TC-2 advertised in the December 1958 issue. It remained at that price until the IT series of tube testers, beginning with the IT-21, were introduced in the March 1962 Heath catalog. That catalog also introduced the updated TT-1A Tube Tester.

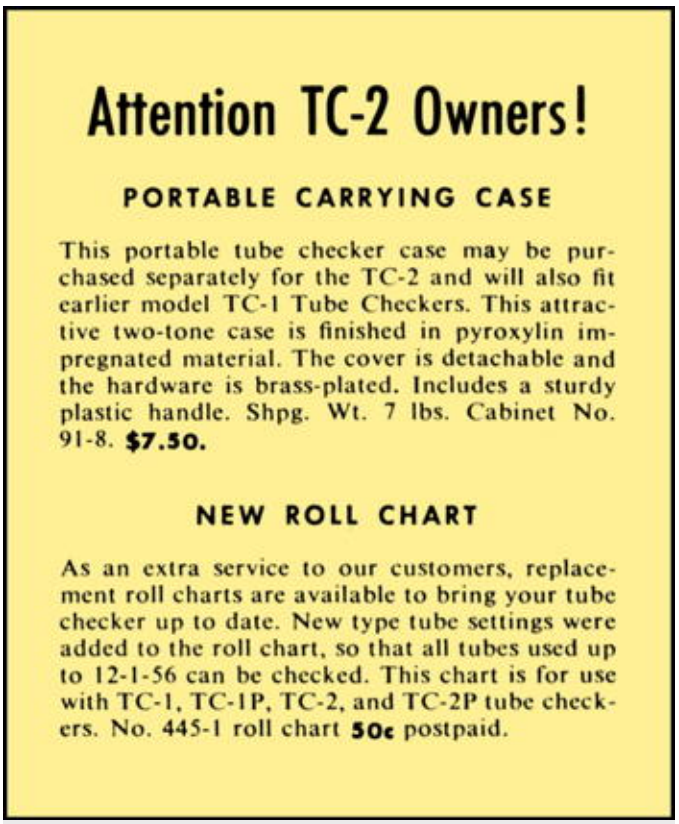
Figure 4: The TC-2P after styling change. (1954 Summer Catalog).

The TC-3 came with a new roll chart mechanism with left and right thumb wheels. Its circuit has many changes. A new power transformer (54-72) has multiple primary taps and additional secondary filament taps. The **SET LINE** voltage adjustment changed from a 250 Ω, 25 watt rheostat, which likely produced a fair amount of heat, to a 10-position rotary switch, which also includes the power **OFF** function, replacing the separate slide switch. The SET LINE switch selects one of multiple primary taps to set the correct line voltage in 5-volt steps. The filament selection switch now has 20 positions: adding back OFF, adding 0.63 V, 2.35 V, 3.15 V, 4.2 V, 4.7 V, 9.45 V, 19.6 V, and deleting 0.75 V and 3.3 V **(**see **Table I).** The SPST slide switch used for AC power on the earlier models has been replaced with a SPDT slide switch, allowing the user to select

between a **SHORT** or a new, more sensitive, **LEAKAGE** test. The TC-3 still includes 9 test sockets plus the blank location, but the 5-prong Hytron socket has been replaced with a tiny 7-pin[5] inline socket designed for sub-miniature vacuum tubes with wire leads. This socket is located between the 6-pin and large 7-pin sockets, and the plate/grid cap lead was relocated to where the Hytron socket had been located. The TC-3 was also given a major styling change. The cabinet is metal with a handle and rounded corners. A separate portable model with a cover was no longer sold. Also, the meter, as well as the roll chart, were now illuminated.

Accessories for TC Series Tube Checkers:

For those who wanted to upgrade their TC-1 or TC-2 to portable use, Heath sold a Cabinet (No. 91-8) for $7.50, as well as an updated roll chart



Attention TC-2 Owners!

PORTABLE CARRYING CASE

This portable tube checker case may be purchased separately for the TC-2 and will also fit earlier model TC-1 Tube Checkers. This attractive two-tone case is finished in pyroxylin impregnated material. The cover is detachable and the hardware is brass-plated. Includes a sturdy plastic handle. Shpg. Wt. 7 lbs. Cabinet No. 91-8. **$7.50.**

NEW ROLL CHART

As an extra service to our customers, replacement roll charts are available to bring your tube checker up to date. New type tube settings were added to the roll chart, so that all tubes used up to 12-1-56 can be checked. This chart is for use with TC-1, TC-1P, TC-2, and TC-2P tube checkers. No. 445-1 roll chart **50¢** postpaid.

Figure 5: Portable Cabinet and new Roll Chart Accessories offered in the 1957 Summer Catalog.

AVAILABLE FILAMENT VOLTAGES			
Filament Voltage	**TC-1**	**TC-2**	**TC-3, IT-21, IT-17, IT-3117**
OFF	OFF *	(no)	OFF
0.63 / 0.75	0.75		0.63
1.4	1.4		
2	2.0		
2.35			2.35
2.5	2.5		
3.15 / 3.30	3.3		3.15
4.2			4.2
4.7			4.7
5	5.0		
6.3	6.3		
7.5	7.5		
9.45			9.45
12.6	12.6		
19.6			19.6
25	25.0		
32	32.0		
50	50.0		
70	70.0		
110	110.0		
Notes:	*** Included on some early units**		

TABLE I

(**Figure 5**). In the TC-2 manual Heath offered a special socket for acorn type tubes. It used the blank hole and required enlarging the hole and drilling some bolt holes. A picture tube test adapter #355 ($4.50) was available to test a picture tube while in its cabinet; it had a 4' cable and plugged into the octal tube checker socket.

The TT-1 and TT-1A Tube Tester:

In 1961, near the end of the TC-3 production, Heath announced the TT-1 Tube Tester at a price almost three-and-a-half times the that of the TC-3 ($134.95). While the TC series of tube checkers are emission-type checkers, testing the cathode emission to determine the performance of the tube under test, the TT-1 is a more advanced mutual conductance tube tester. Not long after its introduction it was updated to the TT-1A **(Figure 6)** which added additional sockets and more functions. The introduction of the TT-1A occurred in the March 1962 catalog (page 30) accompanied an introduction of the IT-21 tube checker which replaced the TC-3. Along with the TT-1A Heath offered a TTA-1-1 for $19.95[6]. This was a kit to update older TT-1s to the new TT-1A. The TT-1(A) deserves an article of its own, and won't be covered here.

Figure 6: The TT-1A Mutual Conductance Tube Tester. (March 1962 Catalog - page 30)

The IT Series of Tube Checkers:

The IT-21 was introduced in March of 1962. It sold for $44.95 and was the first of three tube checkers in the IT series. The series consists of the IT-21, IT-17 and IT-3117. Like the TC series, these are emission-type tube checkers. Many other types of test equipment also carried the IT prefix designation (possibly for "Instrument, Test").

Around 1960 RCA introduced the Nuvistor and 9-pin Novar tube styles. And GE introduced its line of 12-pin Compactron tubes. These tubes quickly found their way into TV's and Heath's own line of amateur radio equipment. New style tube sockets (two in the case of the Nuvistor) were included in the IT series tube checkers.

IT-21:

The circuit of the IT-21 is identical to the TC-3 but extended to handle up to 12-pin tubes. Heath also added five new tube sockets; eliminated the blank expansion socket and the subminiature 7-pin socket; the 7-pin miniature socket was moved from the right side to the left side of the meter, and the 9-pin miniature socket was replaced with a 10-pin socket that fits 9 and 10-pin miniature tubes (it is a 9-pin socket with a tenth socket hole in the center.). The IT-21 uses the same power transformer as used in the TC-3, so it offers the same selection of filament voltages.

Since the tube checker now handles 12-pin tubes, the number of lever switches went from 10 to 13; one for each tube pin and one for the plate/grid cap lead. The neon "leak/short" lamp went from an NE-51 in a lamp socket to a neon lamp assembly that mounts with a speednut .

Figure 7 shows the location for the twelve tube sockets on the IT-21. With the exception of the

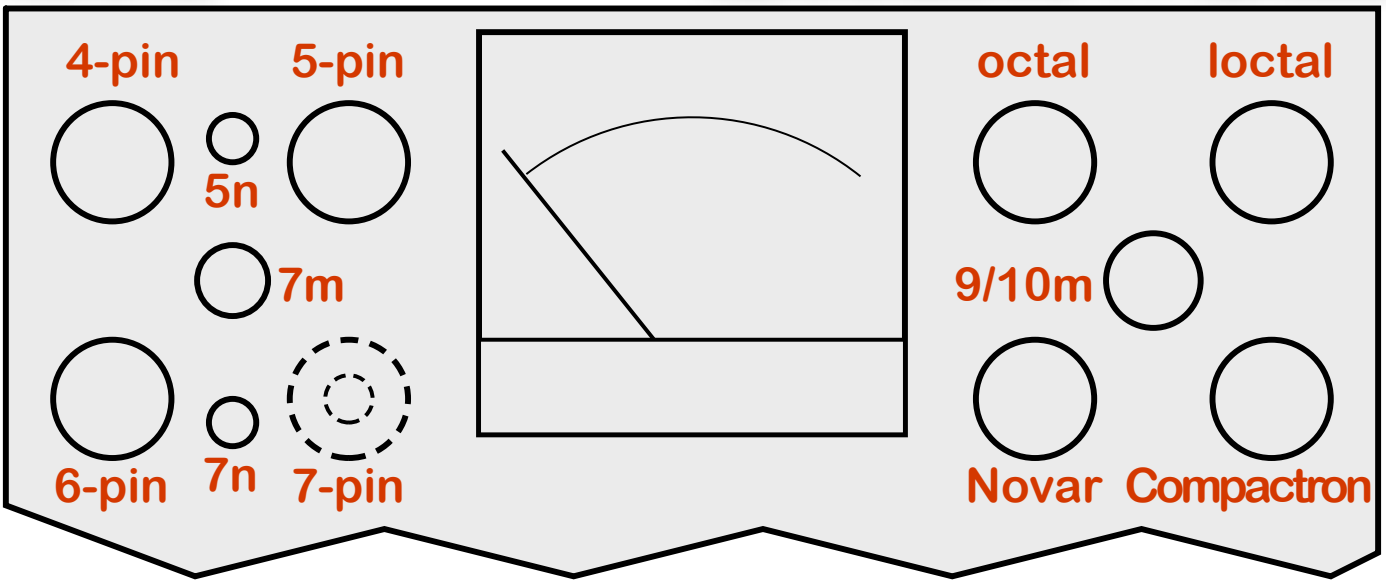


Figure 7: Socket location for the tube sockets on the IT-21 IT-17 and IT-3117 tube checkers. 5n and 7n are the 5 and 7-pin Nuvistor sockets respectively. 7m is the 7-pin miniature tube socket, which moved to the other side from the TC-series. IT- 9/10m is the 9-pin miniature socket with a center tenth pin. The large 7-pin socket is missing from the IT-3117.

large 7-pin socket with integral pilot lamp test socket, which is missing from the IT-3117, the sockets remained constant over the three IT series tube checkers.

The IT-21 remained in production into 1967. Throughout its lifetime it sold for $44.95.

IT-17:

The IT-17 replaced the IT-21, even though it is a lower number. It appears to have been introduced for $44.95, but by the main 1968 catalog the price had risen to $49.95. It featured a styling change to the "New Look" style[7]. The IT-17 added a three-wire power cord with an integral ground lead and came with an adapter for two-wire outlets. The rotary switches that came with the kit carried new part numbers (possibly from a new manufacturer) but were functionally identical. The neon 'leakage' lamp was changed to an NE2H in a separate holder - lens assembly. New stick-on rubber feet replaced the feet that mounted through a hole in earlier units. Later in this article the IT-17 will be more thoroughly discussed.

The IT-17 was manufactured until 1977. It last appeared in the Winter 1977 catalog, selling for $99.95. Without fanfare, its replacement, the IT-3117, was introduced in the Spring 1977 catalog.

IT-3117:

Like its predecessor it had a style change to the "Post New Look" style[8]. The IT-3117 initially sold for $99.95. Missing from the IT-3117 is the large 7-pin socket with its built-in lamp test socket, otherwise it is electrically identical to the IT-17.

The IT-3117 remained in production for only about five years. The last catalog in the author's collection listing the IT-3117 is the Winter 1981/1982 catalog. (#856). In that catalog its cost was $179.95.

Table II lists the tube socket types available on the TC and IT series tube checkers and the side of the meter they are located on.

HEATHKIT TUBE CHECKERS (EMISSION) SOCKETS LEFT OF THE METER									
Model	4-Pin Socket	5-Pin Socket	7-Pin & Lamp Socket	6-Pin Socket	5-Pin Hytron Socket	7-Pin Sub-miniature Socket	5-Pin Nuvistor Socket	7-Pin Miniature Socket	7-Pin Nuvistor Socket
TC-1	√	√	√	√	√			Note 1	
TC-2	√	√	√	√	√			Note 1	
TC-3	√	√	√	√		√		Note 1	
IT-21	√	√	√	√			√	√	√
IT-17	√	√	√	√			√	√	√
IT-2117	√	√		√			√	√	√
Notes:	**1:** Socket located on right side of meter;								

HEATHKIT TUBE CHECKERS (EMISSION) SOCKETS RIGHT OF THE METER								
Model	8-Pin Octal Socket	8-Pin Loctal Socket	Blank Socket (spare)	9-Pin Compactron Socket	9-Pin Miniature Socket	9-Pin Novar Socket	7-Pin Miniature Socket	9/10-Pin Miniature Socket
TC-1	√	√	√		√		√	
TC-2	√	√	√		√		√	
TC-3	√	√	√		√		√	
IT-21	√	√		√		√	Note 2	√
IT-17	√	√		√		√	Note 2	√
IT-2117	√	√		√		√	Note 2	√
Notes:	**2:** Socket located on left side of meter;						**TABLE II**	

A CLOSER LOOK at the IT-17:

The Heathkit IT-17 top panel layout can be viewed as nine columns of items. **Table III** lists the top panel controls in each column (left to right). Text in the table that is capitalized bold is the nomenclature as printed on the panel.

The IT-17 is an emission checker, it checks the emission capability of the tube's cathode to determine the status of the tube. It also can check for tube element shorts, element leakage, and open elements.

Heathkit IT-17 Circuit Basics:

A schematic of the IT-17 is shown in **Figure 13** on **Page 22.** The circuit can be divided into various segments. A good place to start is the tube socket wiring and the element switch bank.

Socket Wiring & Element Switch Bank:

The sockets are all wired together. Pin-1 of each socket is connected together and wired to the common terminal of switch **'A'** of the bank of 13 lever-switches. Likewise all socket pin-2s are wired together and to the common terminal of lever switch **'B'**, etc. up to pin 12 connecting to

lever switch **'M'**[9]. the 13th lever switch **'N'** connects to the lead that connects to a plate or grid cap on a tube that has one.

The lever switches each have three positions top (**T**), center (unmarked) and bottom (**B**). When in the center position the corresponding socket pin is connected to the selected filament voltage. All socket pins, not currently involved in the test, stay in the center filament voltage position.

The bottom lever switch position connects the corresponding tube pin element to common. Common is the zero voltage side of the filament transformer. The low side of the high voltage winding is connected to common through the 200 Ω **PLATE** control.

The top lever switch position connects the corresponding pin to the leakage circuit when the spring loaded **TEST** switch is in its normal **SHORT–ADJ. LINE** position. When moved to the TEST position it is connected to an AC voltage and series resistance set by the **TYPE** switch.

Line Voltage Adjust Circuit:

Tube checker calibration tends to be very sensitive to AC line voltage. Thus, most checkers have a way to correct for line voltage variations. In the TC-1 and TC-2 this is accomplished using a rheostat in the AC line to the transformer. In the later checkers, including the IT-17, a SET LINE switch and a tapped transformer primary winding is used. The switch can correct, in 5 volt increments, line voltages from 95 VAC to 135 VAC. The switch is set so that the meter reads within the **LINE TEST** block on the meter face. Refer to the main IT-17 schematic. The meter circuit for the line adjustment is shown in **Figure 8**. The circuit is

HEATHKIT IT-17 TOP PANEL LAYOUT

Column 1:	
SHORT - LEAKAGE:	Switch, Slide, SPDT
Thumbwheel	Lefthand Chart Drive Wheel
Column 2:	
Tube Socket	Large 4-pin
Tube Socket	Large 6-pin
FILAMENT	Switch, Rotary, 1P 20 positions; **OFF**, **.63**, **1.4**, **2**, **2.35**, **2.5**, **3.15**, **4.2**, **4.7**, **5**, **6.3**, **7.5**, **9.45**, **12.6**, **19.6**, **25**, **32**, **50**, **70**, **110**.
PLATE	Potentiometer, 200Ω, 2Watt. 11 large Dots: **0**, **10**, **20**, **30**, **40**, **50**, **60**, **70** ,**80**, **90**, **100**, with 4 small dots between each large dot.
Column 3:	
Tube Socket	5-pin Nuvistor
Tube Socket	7-pin miniature
Tube Socket	7-pin Nuvistor
Column 4:	
Tube Socket	Large 5-pin
Tube Socket	Large 7-pin with Lamp Test Socket
Column 5 (Center):	
Meter	0 - 1 mA, 100 Ω with 3 scales:
Meter Scale 1	11 large marks: **0**, **10**, **20**, **30**, **40**, **50**, **60**, **70** ,**80**, **90**, **100**, with one small mark between each large mark.
Meter Scale 2	**BAD** (Red), **?** (Yel.), **GOOD** (Grn.)
Meter Scale 3	**LINE**, black block mark, **TEST**
Tube Chart window	Two sets of five column descriptions **TUBE**, **TYPE**, **FIL.**, **PLATE**, **TOP(T)**, **BOTTOM(B)**
Switch Bank	13 SP3T Lever Switches marked: **A**, **B**, **C**, **D**, **E**, **F**, **G**, **H**, **J**, **K**, **L M**, **N**. up pos: **T**(op), Down pos: **B**(ottom) Center Pos is unmarked.
Column 6:	
Tube Socket	Octal 8-pin
Tube Socket	Novar 9-pin
Column 7:	
Grid/Plate cap lead	Pull out wired tube cap connector
Tube Socket	9-pin / 10-pin miniature
SHORT	Neon lamp
Column 8:	
Tube Socket	Loctal 8-pin
Tube Socket	Compactron 12-pin
SET LINE	Switch , Rotary, 1P 10 positions Power OFF (CCW), arrow to full CW
TYPE	Switch, Rotary, 2P 4 Positions; **1**, **2**, **3**, **4**
Column 9:	
SHORT ADJ. LINE / TEST:	Switch, Slide, DPDT, Spring-return when slid, switch is in **TEST** pos.
Thumbwheel	Righthand Chart Drive Wheel

TABLE III

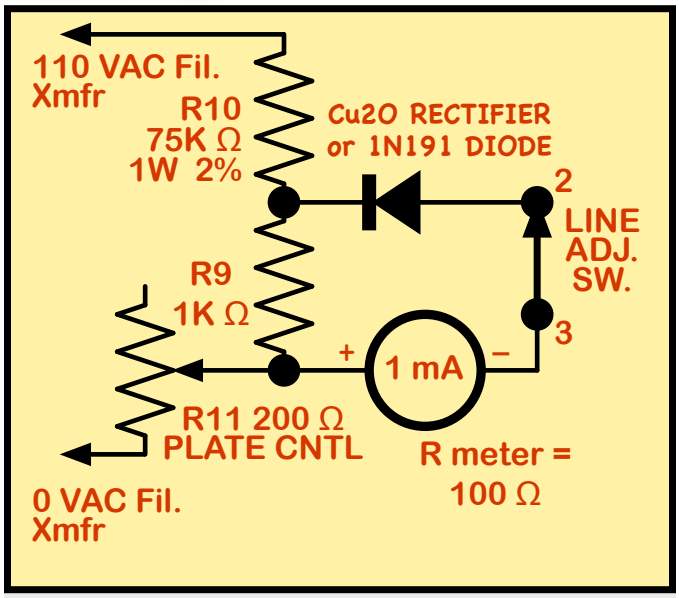


FIGURE 8: Meter circuit used to set the SET LINE switch. Note that in the main schematic the diode is shown reversed. This is discussed in the text.

straight forward. R9 and R10 are a voltage divider. The resulting voltage across R9 is rectified by a copper oxide (Cu_2O) rectifier or germanium diode, and the resulting half-wave voltage will produce an average current of ½ milliamp (half-scale) through the meter when the line voltage is corrected to 115 VAC. If you are repairing or refurbishing one of these kits R9 and R10 should be checked to be sure they are in tolerance so the meter will give an accurate reading when setting the SET LINE switch.

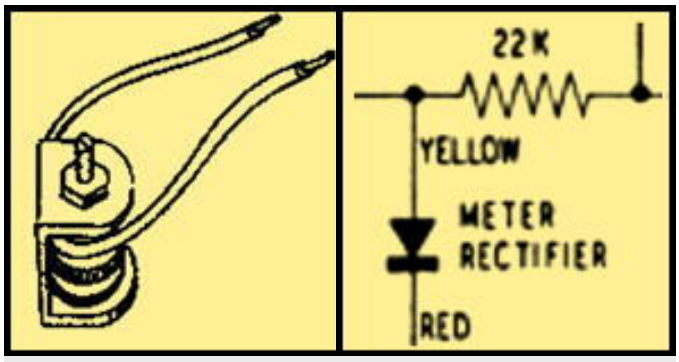


FIGURE 9: A: is a drawing of the 57-6 instrument rectifier. **B:** shows the 57-6 rectifier in the IB-2 manual correctly oriented with correct lead colors.

The early tube checkers including the IT-21 and early IT-17 use a copper-oxide instrument rectifier. This type rectifier is often used for AC rectification in VOMs. Sometime during the IT-17 production run the rectifier was replaced with a germanium diode[10] (1N191). It is interesting to note that the rectifier/diode has been shown reversed starting with the TC-1 schematic and continued to be shown reversed until the IT-3117 manual, four models and some 28 years later!

The original rectifier in the TC-1 had bare wire leads and a red dot marking one as the 'positive terminal' which should be the diode cathode. The schematic shows the dot at the correct place but corresponding to the rectifier's anode. From the TC-2 to the early IT-17 checkers a different copper oxide rectifier is used, Heath #57-6, shown in **Figure 9A**. This rectifier has two leads; the anode lead is yellow, and the cathode lead is red, as shown correctly in **Figure 9B**, which is from the IB-2 schematic. As long as the builder had the colored leads installed correctly the rectifier polarity would be correct.

In the later IT-17 and IT-3117 a 1N191 germanium diode is installed across a two-lug terminal strip (AD), replacing the instrument rectifier. It is installed with the banded end (cathode) on terminal 1 which is wired to lug 3 of terminal strip (AB) which is the junction of **R9** and **R10**. The improperly oriented diode was finally corrected in the manual for the IT-3117. The schematic is shown correctly, as is figure 1 in the 'Introduction' section of the manual. **Figure 10** is a comparison of figure 1 Line Test Circuits of the IT-17 and IT-3117 manuals.

Short and Leakage Testing :

Tube checkers can check for shorts and leakage between the tube elements. Generally these are

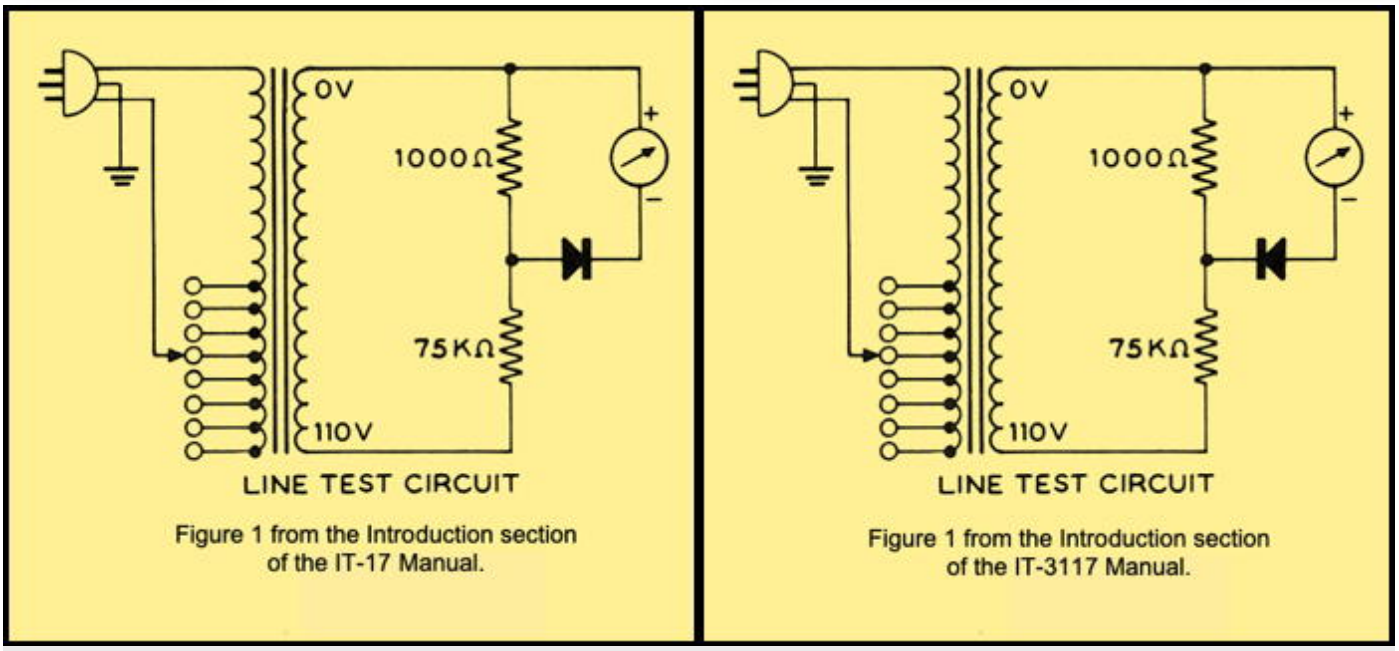


FIGURE 10: On the left is Figure 1 from the IT-17 Manual Introduction section. And on the right is the same Figure 1 from the IT-3117 manual. Note the diode is finally shown oriented correctly after some 28 years. The incorrect orientation would make the meter go downscale.

not direct shorts, but high resistance shorts. **Figure 11** shows the circuit. Shorts and leakage are indicated by a neon lamp. AC from the 100 volt tap on the power transformer is coupled to the lamp by C1. R1 is the required series resistor that limits the current. Typical bulb current, when lit is 0.7 mA. A neon bulb has an extremely high internal resistance until the voltage across it reaches its firing voltage. R2 is across the lamp circuit when the SHORT - LEAKAGE switch is in the SHORT position. Should there be leakage between the point **X** on the schematic and common below about 250 KΩ the voltage drop across R2 will reach a tad over 50 volts and the neon lamp will fire. Since the voltage is AC the lamp will remain on for the remainder of the half-cycle, and repeat each half cycle. In the LEAKAGE position R3, a 2.2 Meg Ω resistor, is added in series with R2. The neon lamp will now fire should the leakage from point **X** to common be less than about 2 Meg Ω.

Figure 11 on the right shows the lever switches set for testing a 6C4 triode. This setting was obtained from the Tube Chart shown here:

TUBE	TYPE	FIL.	PLATE	TOP	BOTTOM
6C4	2	6.3	25	**A E** F	**D** G

All other lever switches are set to their center position and, except for switch **'C'**, do not play a role in the testing of this tube. Some of the chart switch positions are shown in bold, These switches remain in their designated position. The non-bold switches, if moved one at a time to each of their other two positions, will check each tube element for a short or leakage to any of the other tube elements.

Quality (Emission) Testing :

Emission testing of a vacuum tube is accomplished by measuring the capability of the cathode to emit electrons. **Figure 12** shows the 'Quality' test circuit. The circuit is shown with the spring-loaded SHORT - LINE-ADJ switch

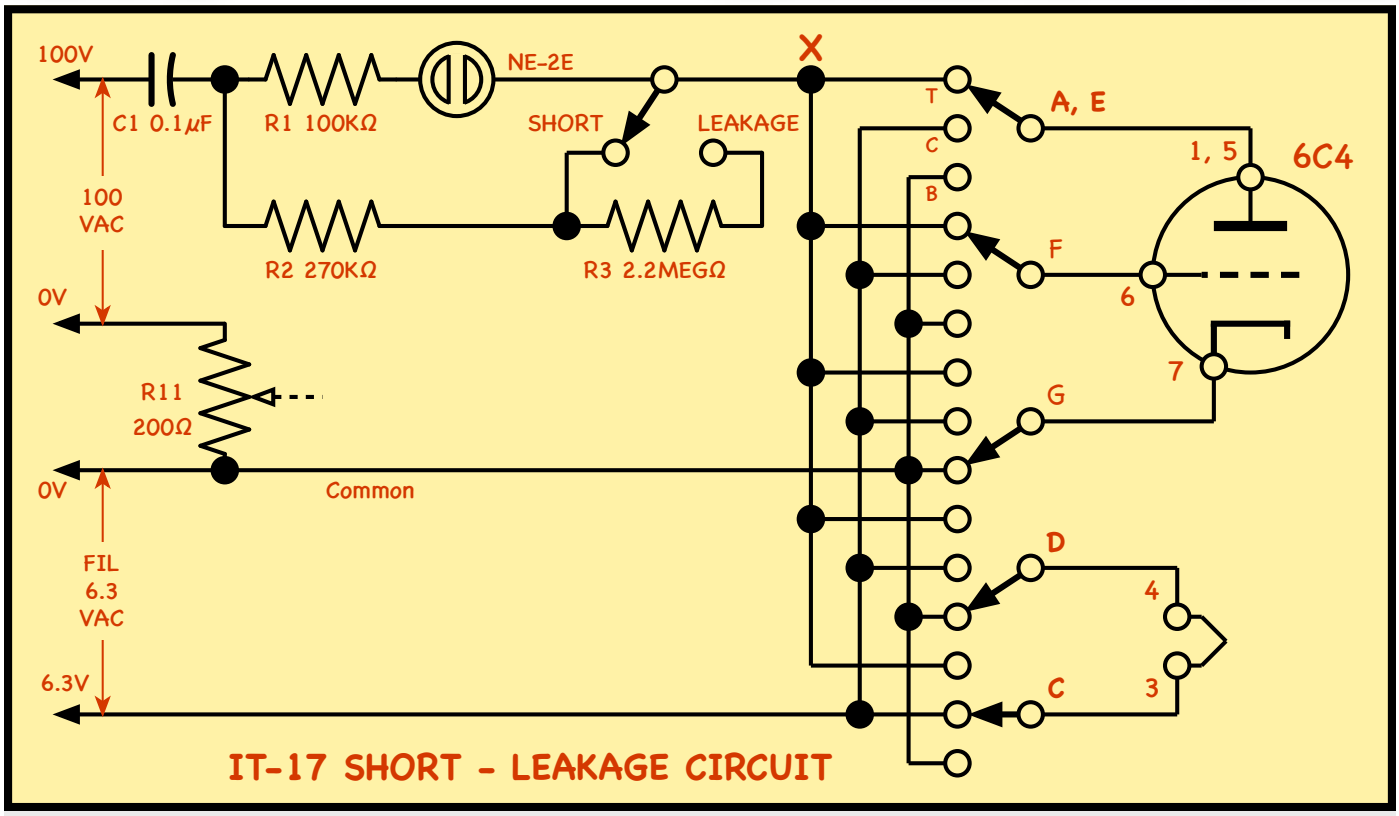


FIGURE 11: The SHORT - LEAKAGE circuit, shown testing a 6C4 triode tube. The switches **A**, **C**, **D**, **E**, F and G are shown set, per the 6C4 tube chart. Switches **A**, **E**, F are set to T (top). Switches **D** and G are set to B (bottom) and the remaining switches including switch **C** are set to the center position. The switches that are not in bold on the chart are, in turn, moved to their other two positions and then returned. If the neon lamp lights it signifies a short. To test for leakage repeat after moving the switch to LEAKAGE.

TYPE SWITCH SETTINGS

The IT-17 has a TYPE switch with four positions. It is set per the Tube Chart for each particular tube. The IT-17 Manual states the four types:

TYPE 1 – *for low cathode current tubes (below 4 mA), usually diode types.*

TYPE 2 – *for tube types with cathode current between 3 and 15 mA. These are usually filament type tubes with the exception of diodes.*

TYPE 3 – *for tube types with cathode current greater than 8 mA. These are usually indirect-heated cathode types with the exception of diodes.*

TYPE 4 – *for gas control tubes, gaseous rectifiers, and eye or target tubes.*

TABLE IV

in the TEST position. Emission testing is done by treating the tube under test as a diode. The plate and all grids[11] are connected together and act as the diode's anode. The cathode is connected to common and the filament/heater is fed with the required voltage. One side of the filament is also connected to common, as some tubes use the filament as the cathode[12]. The lever switches are shown in position for testing a 6BA6 pentode tube, the TYPE switch is shown set to position '2', the filament switch (not shown) is set to 6.3 volts, and the PLATE control is set to '23' as given by the roll chart:

TUBE	TYPE	FIL.	PLATE	TOP	BOTTOM
6BA6	2	6.3	23	A B E F	**D** G

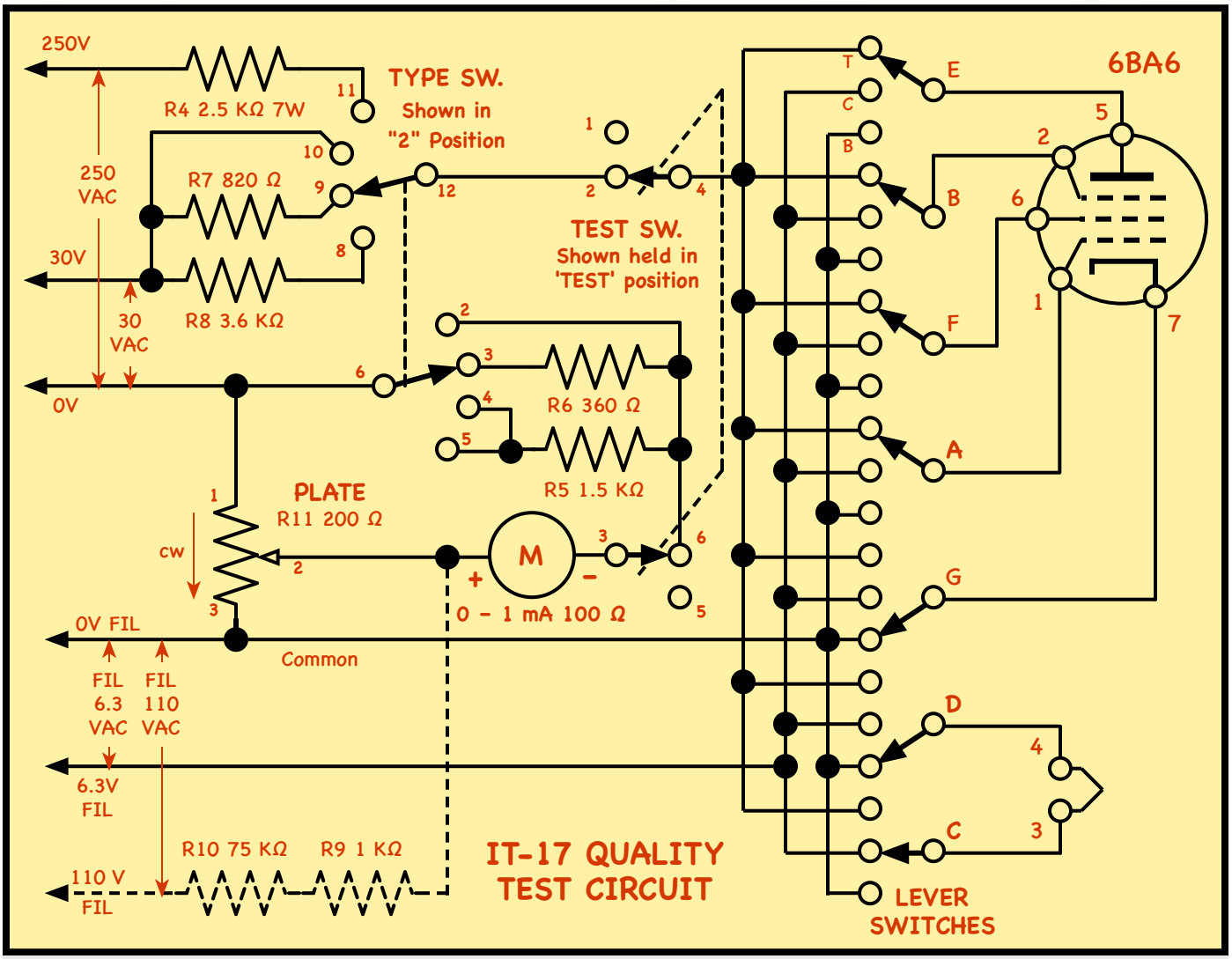


FIGURE 12: The QUALITY TEST circuit, shown testing a 6BA6 pentode tube. The switches A, B, **C** ,**D**, E, F, G are shown set, per the 6BA6 tube chart. Switches A, B, E, F are set to T (top). Switches **D** and G are set to B (bottom) and the remaining switches including switch **C** are set to the center position. The TYPE switch is set to '2' as shown, and the PLATE control is set to '23'. The spring-loaded TEST switch is then moved to the TEST position, and the meter is read. An indication in the green indicates a tube with adequate emission.

Note that all the grids and the plate lever switches are set to the top (T) position and the cathode and one side of the filament are set to the bottom (B) lever position. The other side of the filament is set to the center lever position. The TYPE switch has two sections. One section selects the plate voltage and plate load resistance (30 volts and 820 Ω). The second section selects a series resistance (360 Ω) to set the meter sensitivity. A description of the four positions for the TYPE switch is given in **Table IV**[13].

With the spring loaded test switch held in the test position 30 volts of plate voltage is applied to the 6AU6 plate and grids. AC current path is from the 30V transformer tap, through R7 to the top (T) position of the lever switch, through the tube (where it is rectified), to the cathode, to common, and then through the PLATE control (R11), and to the 0V side of the HV transformer secondary winding. The meter reads the voltage across pins 1 and 2 of the PLATE control indicating the emission current. If the

cathode emission of the tube is not deteriorated, the meter will read in the green area of the scale.

The circuit involving resistors R9 and R10, shown dashed, plays no part in the reading. They are residual set line circuitry and even though their current passes between pins 2 and 3 of the PLATE control that current is returning to the 0V side of the filament secondary winding and doesn't affect current returning through the meter to the 0V side of the HV secondary.

Heathkit IT-17 Assembly:

Assembly is straightforward and aided by two wiring harnesses. However, there are a large number of wires that still need to be installed. Initially the twelve tube sockets, two slide switches and neon leakage indicator are installed on the front panel. Then the tube sockets are wired so all pins of the same number connect together; Heath provided ten different colors of hookup wire, and uses the standard resistor color code for the socket pins: Brown for the #1 contacts, red for the #2 contacts, orange for the #3 contacts, etc. #10 contacts use black and #11 and #12 contacts repeat brown and red. First the five right sockets are wired as a group and then the seven left sockets. Later a wiring harness will connect them together.

Mechanical assembly of the chassis begins, and the chassis, meter, panel escutcheon and front panel are joined. The bank of 13 lever switches are installed as a single unit. Then the chart roller mechanism is assembled (less the chart), and attached to the chassis. It is attached to the chassis by two screws, and to the front panel by the FILAMENT, TYPE and SET LINE switches and the PLATE control.

The large wiring harness is installed next, connecting the two tube socket groups to the bank of lever switches, as well as numerous other connections. The small wiring harness is then installed, interconnecting numerous controls.

Most of the small components: resistors, the capacitor, etc. are now wired in.

The large power transformer is mounted and wired up next. It has thirty-four leads coming out of it. Nine of those wires go to the SET LINE switch, nineteen go to the FILAMENT switch. The line cord is then added.

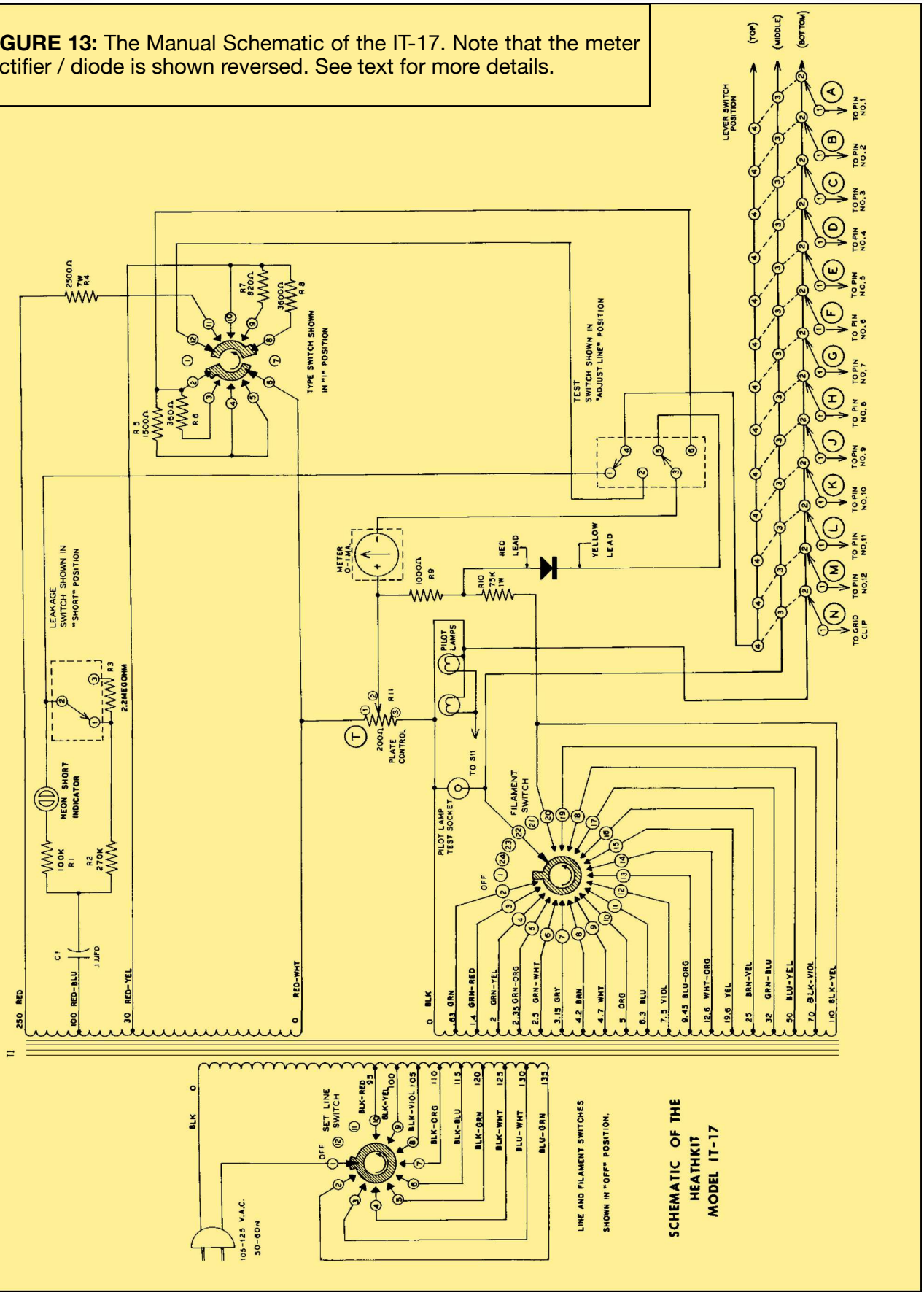
Finally one end of the roll chart is installed onto the drive roller with the special tape provided, and the chart is carefully rolled onto the drive roller. The other end of the roll chart is then fastened with tape to the take-up roller. Finally the take-up tension springs are installed to keep tension on the roll chart.

Heathkit IT-17 Preliminary Checks:

Before the assembly is put into its cabinet, some simple checks are made. With the SET LINE switch fully counter-clockwise, the unit is plugged in to an AC outlet. Moving the SET LINE one position clockwise should cause the lamps to light and the meter to move upscale. As the SET LINE switch is moved further clockwise the lamps should brighten and the meter move further upscale. Return the switch to the point where the meter reads within the small LINE TEST block on the meter face.

Some simple AC voltage checks are made. Each position of the FILAMENT switch is checked for the correct voltage by setting lever switch E to the bottom position and all the other lever switches to the center position. Then measuring the AC voltage from pin 1 to pin 5 of the octal tube socket as the FILAMENT switch is rotated through its positions.

FIGURE 13: The Manual Schematic of the IT-17. Note that the meter rectifier / diode is shown reversed. See text for more details.



The higher 30, 100 and 250 VAC are then measured using a chart provided in the manual. Heath recommends using the checker to check some known good vacuum tubes before installing it into the cabinet..

Testing Tubes With the Heathkit IT-17:
The Heathkit manual description of how to use the IT-17 outlines a 12-step process. Instead of duplicating it here, the Notes include a link to pages 30, 31 and part of page 32 of the manual.[14]

These pages also include information on how to test a tube that you have a data sheet on but that isn't on the roll chart.

Socket Adapters for other Tubes:
If you find you need to frequently test a tube that will not fit any of the provided sockets, it is easy to build an adapter socket. If the socket needed is eight pins or less, mount the new socket (or sockets) on a convenient chassis or box and wire the pins to a short cable with an octal plug on the end. Again follow the rule of wiring pin one of all the sockets to pin one of the plug, two to two, three to three, etc. Now plug the octal plug into the octal socket on the tube checker. If the tube is not on the roll chart, the manual instructs you how to develop your own data for the tube. (See the second paragraph under "Testing Tubes With the Heathkit IT-17"). If you need more than eight pins, you'll need to find or fabricate a plug that fits the Novar or Compactron sockets.

Restoring the Heathkit IT-17:
If you have an IT-17 (or one of the other Heathkit emission type tube checkers) and want to restore it for good use, here are some suggestions:

The switches should be cleaned. All the rotary and lever switches are easily accessible. Be careful to keep any cleaning liquid away from the roller chart. This is especially true when cleaning the lever switch bank. Both of the slide switches on the author's unit needed cleaning. Sometimes the only way to clean them is to take them apart. The spring loaded SHORT-ADJ. LINE - TEST switch has yet to be cleaned. Hopefully it will not need disassembly.

To be sure the tube tester reads accurately, it is important to check all the resistors. There are only ten. R4 and R10 are special and will likely test good. The remainder are ½ watt carbon composition resistors and may have drifted through the years. . One source said the ½ watt carbon composition resistors were all 10% tolerance. On the author's IT-17 R5 through R8 are 5% and the remainder are 10%, however, that may have been done by a previous owner. R9 should probably be changed to 5% also since it is in the set line circuit.

The previous owner of the author's IT-17 evidently had the plastic chart window come off. It appears difficult to reinstall, since it involves removal of the complete chart mechanism. If it turns out the escutcheon needs removal to replace the window, that would require separating the chassis from the front panel. Instead, the previous owner taped the plastic window to the outside front of the escutcheon. That's going to be problematic to fix.

The Eico 667 Tube Tester Comparison:
In the shack is an Eico 667 Dynamic Conductance Tube Tester that was refurbished after it was bought used. It is interesting that the Eico tester lever switches have six positions instead of three. They are, from top to bottom: Open, Control Grid, Plate, Screen Grid, Filament and Ground. Control grid and screen grid voltages can be set and the tube can be tested dynami-

cally. Rectifiers and diode tubes are tested for cathode emission only.

Comments:

It is interesting that Heath uses the name Tube Checker for The TC and IT series and Tube Tester for the more sophisticated TT-1(A) dynamic mutual conductance unit.

A Tri-band Single Bander:

I'm looking for a copy of the manual for the Dynalab kit that modifies any Heathkit Singlebander HW-12, HW-22 or HW-32 into a three-band transceiver[15]. There are actually three kits and possibly three manuals depending on which kit you are starting with: THW-12, THW-22, THW-32. Any one of them would suffice. Pete Juliano - N6QW recently obtained a radio modified with this kit installed and has it working on two of the bands, but very low output on 20 meters. There is some early documentation floating around on the web; it's written by Robert Christie of Jamaica, NY. Pete already has this documentation. Please contact me if you have any other information - thanks.

FIGURE 14: is a photograph of Pete's THW-32 that he purchased off eBay, after he cleaned it up considerably. Originally an HW-32, it has been converted to a tri-band radio. Pete is looking for the THW-32 conversion manual that came with the kit.

73, from AF6C

Notes:

1. Issues of Radio (Television) News are available online at: https://www.worldradiohistory.com/Radio_News_Master_-Page_Guide.htm.
2. Chuck Penson - WA7ZZE, ***Heathkit Test Equipment Products*** (ISBN 978-0-615-99133-)7 page iv. Here Chuck discusses six distinct industrial styles that Heath test equipment went through over the approximately 45 years the company was in business.
3. Ibid, page v.
4. Heathkit of the Month #18 IT-1 Isolation Transformer: https://www.w6ze.org/Heathkit/Heathkit_018_IT1.pdf
5. With the TC-3, Heath now refers to pins instead of prongs for the tubes and tube socket connections.
6. https://www.w6ze.org/Heathkit/HeathSpecSheets/TEQ/TTA-1-1%20[596-M517]%202-23-62.pdf
7. Chuck Penson - WA7ZZE, ***Heathkit Test Equipment Products*** page v.
8. Ibid, page vi.
9. The 13- bank of lever switches are marked 'A' thru 'H' and 'J' thru 'N'. The is no switch 'I' so it won't be confused with 1 on the tube data chart.
10. This was probably a change caused by the rectifier no longer being available, or perhaps for cost savings.
11. Except on tubes where the suppressor grid is internally tied to the cathode.
12. Generally "filament" is used for tubes where the cathode and filament are the same element. Indirectly heated cathodes are heated by "heaters".
13. This can be found in the New Tubes section of the USING YOUR TUBE CHECKER section of the IT-17 manual. (Included in Note 14 link).
14. IT-17 Operations Link: https://www.w6ze.org/Heathkit/IT-17/IT-17%20Operation.pdf
15. Dynalab QST Ad: https://www.w6ze.org/Heathkit/IT-17/Dynalab%20Ad%20QST.pdf

Notes for HotM #130 (IT-17) 2/2026

Remember if you are getting rid of any old Heathkit Manuals or Catalogs, please pass them along to me for my research.

Thanks - AF6C