TC 162

MIGHTY MITE VII TUBE TESTER SERVICE MANUAL

SENCORE

"the all american line"

SAFETY PRECAUTIONS

When testing electronic equipment, there is always a danger present. Unexpected high voltages can be present at unusual locations in defective equipment. The technician should become familiar with the device that he is working on and observe the following precautions.

1. An isolation transformer should always be used on equipment having the chassis tied to one side of the AC power line.
2. When making test lead connections to high voltage points, remove the power, if this cannot be done, be sure to avoid contact with other equipment or metal objects. Place one hand in your pocket as a safety precaution and stand on an insulated floor to reduce the possibility of shock.
3. Discharge filter capacitors before connecting test leads to them. Capacitors can store a charge that could be dangerous to the technician.
4. Be sure your equipment is in good order. Broken or frayed test leads can be extremely dangerous and can expose the technician to dangerous potentials.
5. Remove the test leads immediately after the test has been completed to reduce the possibility of shock.
6. Do not work alone when working on hazardous circuits. Always have another person close by in case of accident. Remember, even a minor shock can be the cause of a more serious accident, such as falling against the equipment, or coming in contact with high voltages.

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INSTRUCTION MANUAL FOR THE SENCORE TC162 MIGHTY MITE VII TUBE TESTER

DESCRIPTION

New receiving tubes for the television and electronic industry have been introduced at a very rapid rate, even with transistors making great strides. These tubes now contain many more internal connections that require isolation before testing. The Sencore engineering staff has kept pace with this increase and change in technology on the Mighty Mite by adding an all new pin elimination system. This enables the Mighty Mite to check more tubes than ever before. The new Mighty Mite still uses the tests that have made the Mighty Mite the standard in tube testing. Here are the features of the Mighty Mite:

* Full load cathode current check to pick out the weak tubes other testers might miss.

* 100 megohms grid leakage sensitivity to find the tough dog tubes fast.

* Stethoscopic shorts test of 300K to pick out true shorts in the tube.

* Pin elimination switches for faster isolation and elimination of false shorts.

* Burn out proof meter, even if a shorted tube is tested.

* FET balanced bridge circuitry for instant on action and greater accuracy.

* Steel and aluminum case for that professional look and maximum protection of the Mighty Mite for years of service.

SPECIFICATIONS

Cathode Emission Test: Full load current drawn through tube up to 120mA. Max applied voltage, 40 VAC RMS.

Grid Leakage Test: Good area, infinity to 200 megohms, ? area, 200 to 100 megohms and the Bad area 100 megohms or less.

Shorts Test: 300,000 ohms or less will cause shorts light to come on. Maximum applied voltage, 40 VAC RMS.

Power: 105 to 125 VAC, 50/60 Hertz at 32 watts maximum.

TESTS THE MIGHTY MITE WILL MAKE

Cathode Emission: The Mighty Mite tests all tubes at near their full rated cathode current level for the best emission check. This is very important as many testers do not test at this high level of current and can pass many tubes as good that will not work satisfactorily in the circuit. This test is very important on high power tubes such as rectifiers, horizontal and sound output tubes.

Grid Leakage Test: Grid leakage or grid emission in a tube can upset many circuits, including the AGC, Chroma, Video, Sync, and others. Grid currents as low as one microamp can change the bias in these circuits causing many headaches. The Mighty Mite detects grid currents as low as one-half a microamp or 100 megohms to pick out these trouble making tubes that are often missed by other tube checkers. As soon as the tube is warm enough to indicate cathode emission, the grid leakage test can be performed.

Shorts Test: The Sencore "Stethoscopic" shorts test picks out true shorts between elements in the tube of 300,000 ohms or less. Above this value, the shorts light may flicker indicating a high resistance short in the tube. The applied voltage is kept below the 50 volt maximum to prevent possible damage to frame grid and nuvistor type tubes. This prevents the Mighty Mite from damaging tubes and introducing a short in the tube that was not there before. Pin elimination switches allow the isolation of extra pin connections on the different tube bases so that only a true short will show up on the shorts light.

OPERATION

ACQUAINTING YOURSELF WITH THE MIGHTY MITE

The Mighty Mite is extremely simple and easy to set up for tube testing. The A - PIN ELIMINATION switch, B - FILAMENT switch, C - LOAD switch, and D - SET UP switch are set according to the set up chart. The tube is inserted into the proper socket numbered one to thirteen as indicated in the set up chart and the desired function is selected by the FUNCTION switch and the results read on the meter or SHORTS light. No damage to the tester will result if a shorted tube is tested.

OPERATING THE MIGHTY MITE

The following is the basic operating procedure of the Mighty Mite. Each tube section is tested independently and the emission test is made for each section. The shorts test need be made only once for each tube.

1. Plug the Mighty Mite AC cord into a grounded three prong receptacle of 105 to 125 volts AC, 50 to 60 Hertz.

2. Locate the tube in the set up chart. The tubes are listed numerically and alphabetically. Looking to the right of the tube, note the set up

information for the controls, A, B, C, D and socket. Some tubes have more that one listing indicating the tube has more than one section to be tested. Each section of the multiple tube is tested seperately.

3. Push the PIN ELIMINATION switches listed under A down to eliminate those pins. If none are listed, leave all switches in the up position. Set the B, C and D switches to the positions indicated and insert the tube into the socket listed. Where more than one setting is listed, make the emission and grid leakage test on each section. The shorts test need be made only once.

4. Set the Function switch to SHORTS and check the front panel METER ZERO adjust for a 0 indication on the meter. Rotate the "D" switch slowly through all its positions noting the SHORTS light on the front panel. The light will glow if a short of 300K or less exists in the tube. In some tubes, a normal short will exist between the heater and cathode. These are noted in the set up chart by an asterisk(*). If the shorts light glows on the H-K position on these tubes, no short exists that will effect the operation of the tube. If the SHORTS light glows, then a short is present. If the short is present on two or more elements, then the tube should be rejected for shorts.

5. If the tube passes the SHORTS test, rotate the Function switch to the EMISSION position and read the emission quality of the tube on the top scale of the meter. A tube indicating in the questionable area (?), may or may not be rejected depending upon you and your customer.

6. If the tube reads in the GOOD area of the meter and passes the EMISSION test, switch to GRID LEAKAGE and read the grid leakage of the tube on the bottom scale of the meter. This is a very important check and will show up a lot of troublesome tubes that may otherwise check good. If the meter is indicating in the GOOD area of the meter but slowly rising, wait a minute or so to see if the meter will finally climb into the BAD area of the meter. On heavy power tubes, such as a horizontal output tube, do not make a grid leakage check after an extended emission check. If the tube is left in the emission check position for several minutes, the grid will heat up and when switched to grid leakage will read higher than normal. Allow the tube to cool slightly before the grid leakage check. You can expedite the grid leakage check by raising the filament voltage for a few seconds. This is not the same overheating as was caused in the emission check, but will show up grid leakage. If the grid leakage indication climbs into the BAD area on the meter, reduce the filament voltage and see if the meter remains in the bad area. If it does so, then the tube will give trouble in the circuit and should be replaced. If the meter drops off rapidly back into the GOOD area, then the tube is good.

If the tube passes all the above tests, it can be considered good and should not be replaced. If the tube is in the questionable area on any test, it is up to you or your customer to decide if the tube should be replaced. Show

your customer the action of the meter indication on the tube and explain what will happen. In this manner, the Mighty Mite becomes your customer convincer on new tube sales.

ADDITIONAL TESTS AND FUNCTIONS OF THE MIGHTY MITE

TUBE LIFE EXPECTANCY TEST

If the meter needle climbs very slowly into the GOOD area or Questionable area of the meter on the Emission test, the life expectancy of the tube can be considered much less than if the meter indicated GOOD in a shorter period of time. Also, if the needle should climb into the GOOD area and then "fall off", life expectancy can be considered much less. We can not recommend that you replace these tubes. That decision is up to you or your customer.

FILAMENT WARM UP TIME

When replacing a costly horizontal output tube in a television receiver, it is a good idea to not only check the horizontal oscillator for emission and other standard tests, but to also check the length of time it takes to warm up. If the horizontal oscillator tube is slower in warming up than the output tube, the output tube will draw heavy current and its life will be shortened considerable. Checking the warm up time of the oscillator tube and making sure that it is as fast or faster than the output tube can reduce the chance of a call back later for the same trouble and keep your customer's confidence high in your service ability.

LIFE TEST OR FILAMENT VOLTAGE SENSITIVITY

Some tubes may check good on the emission test and pass the other tests in the Mighty Mite, but still not operate properly in the receiver. These tubes may have a filament sensitive cathode. This means that the emission from the tube will change with a change in the applied filament voltage to the tube. This is caused from a low power line or defective power transformer in the receiver. These type of tubes can be most troublesome in series string receivers. To test for this trouble, simply push the LIFE TEST switch while monitoring the emission of the tube on the meter. A new tube will not change its reading at all while a filament sensitive tube will drop in emission. If the tube falls into the questionable area (?) on the meter, it will give trouble in the circuit and should be replaced. On a house call, be sure to show your customer the action and show how the tube checks on the Mighty Mite.

REJUVENATION

If you wish to rejuvenate a small tube, merely increase the filament voltage by setting switch "B" one setting higher for ten to fifteen seconds. This will super heat the cathode and boil out more emitting material from under the oxide coating. This is only a temporary measure as rejuvenation of a receiving tube will not last very long.

SETTING UP THE MIGHTY MITE FOR NEW TUBES

New tubes can sometimes be a problem as they may not be listed in the set up chart. This can be especially true on new receivers just introduced by the set manufacturers. With an understanding of the set up controls and what each does, you can set the Mighty Mite up from a tube manual or even the schematic of the receiver itself.

A PIN ELIMINATION

The A PIN ELIMINATION switch is used to isolate internal connections to the same pins or elements on the tube so that a test may be made. For example, the tube basing shown in figure 1 is a 9QL basing. The control grid is tied to pins 2 and 6, the screen grid to pins 1 and 7 and pin 9 is an internal connection that could be connected to any pin inside of the tube. To eliminate any shorts indication other than that which are true shorts in the tube, the A PIN ELIMINATION switches 6, 7, and 9 would be set in the down position to open these pins before the test is made. All the numbers correspond to the tube base pin number except for socket number 10, the compactron, pin 11 is connected to PIN ELIMINATION switch number 1. If no isolation is needed, all switches should be in the uppermost position. After each tube is tested, push the RESET switch to the left to place all switches in the up position. Each can be moved independently of each other, either up or down or set with the RESET switch.

B FILAMENT

This switch selects the filament voltage applied to the tube under test from 1 (one) to over 50 volts. The twelve position switch selects a range of voltage and with the unique design of the filament transformer, the tube under test will load the transformer to obtain the correct voltage for testing. When setting up a new tube, simply set the B FILAMENT switch to the correct voltage or voltage range.

C LOAD

This switch selects the proper AC voltage to be applied to the plate of the tube as well as the correct load resistor so that the tubes designed current can be set and the tube checked under full load. The current ranges for the settings of the C LOAD switch are as follows:

C LOAD switch	Cathode Current	C LOAD switch	Cathode Current
A	50 mA plus	F	2-7 mA
B	20-50 mA	G	.7-2 mA
C	15-30 mA	H	.5-.8 mA
D	10-16 mA	J	.5 mA or less
E	6-12 mA		

The current that the C LOAD switch is set to is the normal cathode current under normal bias conditions as listed in the tube manual. If a tube manual is not handy, then using Ohms law, compute the cathode current by the voltage drop across the cathode or plate load resistor in the circuit or from the schematic.

D SETUP

The "D" switch is used to pick up the control grid for the test on the tube. It was discovered many years ago, that approximately 97% of the electrons would go to the control grid when checking cathode emission so that this is now used as the pick-up element. In the example of Figure 1, the "D" switch would be set to one of the control grids that is not isolated. If pin 6 were to be isolated, then the "D" switch would be set to pick up pin 2.

The only exception to the above is on socket number 10 where pin 11 on the tube base is picked up with the first position of the "D" switch.

Sockets number 3 and 8 are wired identical except that socket number 8 has three pins not connected. This socket is used to isolate extra connections where more than two base pins are connected to the same element such as in the 1X2 high voltage rectifier. The seven pin sockets 4 and 7 are alike except that the filament pins on socket 4 are 3 and 4 while on socket 7 they are 1 and 7.

SOCKET SETUP

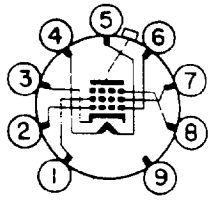
The sockets on the Mighty Mite have the filament pins prewired to eliminate the extra setup that is involved. The actual pin connections can be seen on the schematic diagram of the unit. Note that the two octal sockets have different filament connections. Socket number 1 is for filaments on pins 2 and 7 while socket number 2 is for filaments on pins 7 and 8. Sockets 3, and 8 have filaments on pins 4 and 5 while socket number 13 is for special Hi-Fi tubes with filaments on pins 1 and 2.

There are two novar sockets that are wired identical. Socket number 5 is for the standard novar based tubes while socket number 12 is for the magnoval based tubes. The pins on the magnoval based tubes are larger in diameter than the standard novar base and can damage the novar socket. All magnoval tubes are checked in socket number 12 to prevent damage to the regular novar socket number 5. When selecting the socket for a new tube, select the socket for the filament wiring as well as the socket the tube should fit into.

EXAMPLE OF SETTING UP THE MIGHTY MITE

Lets use for our example, the 6JE6 shown in Figure 1. This tube is a standard novar based tube with the control grid tied to two pins on the tube base.

BASING 9QL



BOTTOM VIEW

TERMINAL CONNECTIONS

Pin 1 – Grid #2
Pin 2 – Grid #1
Pin 3 – Cathode
Pin 4 – Heater
Pin 5 – Heater
Pin 6 – Grid #1
Pin 7 – Grid #2
Pin 8 – Grid #3
Pin 9 – Internal connection – do not use
Cap – Plate

Fig. 1 - 9QL Tube basing

FIRST: Determine the socket to use. In this case, the tube is a standard novar base tube so that socket number 5 will be used.

SECOND: All the pins that must be isolated for testing must be noted. In this example, we have the control grid on pins 2 and 6 and the screen grid on pins 1 and 7 with pin 9 possibly connected to some pin internally. With the A PIN ELIMINATION switch, we will isolate the extra pins. For our example, we will push switches 6 and 7 down or to the isolation position along with switch 9 to eliminate any possibility of this pin causing a false indication.

THIRD: Determine the filament voltage. In this case, it is the 6JE6 so that the filament switch "B" will be set to 6. The first set of numbers on the tube generally indicate the filament voltage of the tube. On foreign tubes, consult a substitution guide to find the filament voltage and characteristics that can be used to check the tube.

FOURTH: Select the current range that the tube is to be checked at using the information under "SETTING UP THE MIGHTY MITE FOR NEW TUBES", the C LOAD switch section. For our example, the A position would be used as the 6JE6 draws a very heavy plate current under normal use.

MAINTENANCE

DISASSEMBLY INSTRUCTIONS

To remove the Mighty Mite from its case for adjustment of the internal calibration control or for any repairs that may be necessary:

1. Remove the two screws at the top of the front panel.
2. Remove the two screws on the back of the case near the bottom of the unit.

The front panel should now be lifted from the case, exposing the internal circuits of the Mighty Mite for calibration or trouble shooting. To reassemble the Mighty Mite, simply reverse the procedure.

CALIBRATION

The Mighty Mite should seldom change its calibration through its normal life. With the calibration module described below, you will not only be able to recalibrate the Mighty Mite, but periodically check its calibration and insure yourself of top performance. The module is constructed from an octal plug or an old octal tube base and is inserted into socket number one on the Mighty Mite. Figure 2 shows the schematic of the test module.

CR1 = Silicon Diode, 100PIV @ .5AMP
R1 = 100 Meg (4-22 MEG and 1-12 MEG in series)
R2 = 270K
R3 = 1K, 1%

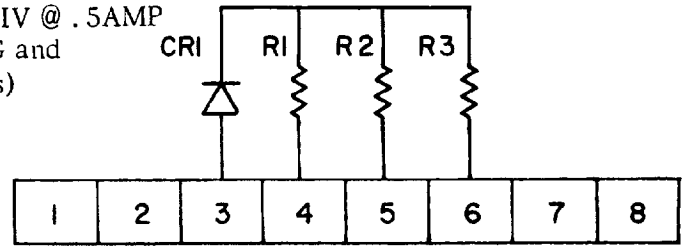


Figure 2. Cal Module Schematic

There are two calibration controls on the printed circuit board in the Mighty Mite. See Figure 3 for their location. The grid leakage must be set first and then the emission control. The grid leakage control is in series with the meter and will affect both emission and grid leakage calibration. Using the test module described above, plug it into socket number one and set the four front panel controls with the following settings.

	A	B	C	D	SKT
GRID LEAKAGE CALIBRATION	All Up	1	D	4	1

Set the FUNCTION switch to SHORTS and set the meter to zero with the METER ZERO control. Switch to GRID LEAKAGE and adjust R21, the Grid Leakage Cal Control until the meter reads on the line between ? and BAD on the Grid Leakage scale. Switch back to SHORTS and recheck the meter zero. To check and calibrate the Emission Cal control, use the following settings:

	A	B	C	D	SKT
Emission Calibration	All Up	1	D	3	1

Set the FUNCTION switch to SHORTS and recheck the meter zero. Switch to EMISSION and adjust R22, the Emission Cal control until the meter reads 60 on the Emission scale of the meter.

To check the shorts indicating circuit of the Mighty Mite, switch back to SHORTS and rotate the "D" switch through all its positions. Normal shorts **SHOULD OCCUR ON POSITIONS 5 AND 6.**

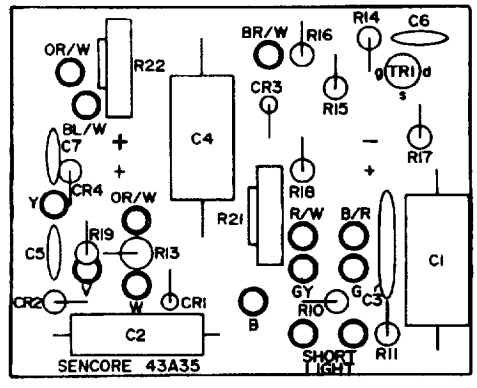


Fig. 3 - P.C. Board layout

CIRCUIT DESCRIPTION

The new Mighty Mite VII represents a unique breakthrough in tube checkers, being the first completely solid state tube checker. The new Mighty Mite uses the new FET or Field Effect transistor in place of the usual tube giving instant on action for faster and more accurate tube testing. Now, there is no need for the tube in the tester to warm up and stabilize before checking can begin and the change in calibration that goes along with the aging tube are also gone with the new solid state Mighty Mite.

The basic circuit of the Mighty Mite is a balanced bridge circuit meter amplifier consisting of FET TR1 and diode CR4. The zener diode represents a constant current source and takes the place of the second FET needed for the bridge circuit. The METER ZERO control on the front panel is just like the zero control of a VTVM and balances the circuit so with no signal input, the meter reads zero. When a voltage is impressed on the gate of the FET TR1, the bridge is unbalanced and the meter will read in proportion to the applied signal.

The cathode emission test puts an AC voltage between the control grid of the tube under test and the cathode with a load resistor in series to develop a pulsating DC voltage across. The C LOAD switch selects the different size load resistors and applied voltage so that a full range of current is available from less than .5 mA to 120 mA. The tube under test rectifies the applied AC voltage and develops across the load resistors R3 through R9. The pulsating DC voltage is coupled through the filter network of R22 and C7 to smooth it to a pure DC voltage. This voltage is applied to the gate of TR1 through an additional isolation and filtering network of R14, R15, R16 and C6. The resultant DC voltage upsets the balance of the circuit causing the meter to read upscale in proportion to the emission quality of the tube.

In the grid leakage test, the control grid of the tube under test is made negative to all other elements in the tube by connecting the grid to ground through the 30 megohm gate resistor consisting of R15 and R16, and applying a positive 8 volts to all other elements in the tube. If the tube has any grid leakage or contamination causing the tube grid to emit electrons, the flow of electrons will be through the gate resistor. Any current flow through the resistor will cause a voltage drop across the resistor causing an unbalance in the bridge circuit and the meter to read in proportion to the amount of grid current in the tube under test. A leakage of 100 megohms or less will cause the meter to read into the BAD area. A leakage of 100 to 200 megohms will cause a meter reading in the questionable area and a leakage of 200 megohms or more will read in the GOOD area on the meter. A leakage of 100 megohms represents a grid current in the tube under test of .5 microamps.

The shorts test uses the Sencore Stethoscopic approach where each and every element in the tube is checked against all other elements. A capacitor voltage divider of C1 and C2 is placed across the upper winding of the primary of the filament transformer. The AC voltage at this point is 75 volts and the capacitor C1 drops this to approximately 34 volts RMS that

is applied to nuvistors and frame grid tubes to prevent arc over and breakdown in these tubes. C3, a .1 capacitor is in series with the shorts test to prevent any DC action of the tube from lighting the shorts light. A true short will cause both elements of the neon bulb to light. If the short is 300,000 ohms or less, the shorts light will glow, but if the short is higher in resistance, the shorts light may only flicker.

The power supply for the FET and the leakage tests consists of diode CR1 and filter capacitor C4. The necessary AC voltage is taken from the 22 volt tap on the primary of the filament transformer T1. Zener diode CR2 and resistor R13 regulate the supply voltage of 8 volts so that the voltage remains constant regardless of the line voltage applied to the unit.

TROUBLE CHART

SYMPTOM	PROBABLE CAUSE	CORRECTIVE MEASURE
No meter indication on any position of Function switch.	CR1, CR2, TR1 CR3	Check diodes and power supply voltage. Check FET with FET tester and check meter for open with ohm meter.
Grid leakage measures OK, but no emission readings.	S3, T1 Grid leakage	Check resistors on C load switch with ohm meter. Check transformer for opens and Grid leakage switch position for open contacts.
Short indicator glows on one anode when checking for shorts.	Shorted or leaky	Check C3 for shorted or leaky condition and replace.
Bad tubes indicate very good or full scale	open load resistor R3 to R9 or open contacts on emission position	Check R3 to R7 for opens with ohm meter. Check contacts on Function switch.
Shorts light will not glow, even with a direct short	Open C3, open contacts on function switch	Check C3 for open and replace. Check contacts on switch.
Emission OK, but Grid leakage readings not right or absent.	Open contacts on function switch. Leakage CAL off.	Check contacts on switch. Check and reset Leakage CAL pot.

SERVICE AND WARRANTY

You have just purchased one of the finest tube checkers on the market today. The Sencore Mighty Mite has been inspected twice and tested twice at the factory to insure the best quality instrument to you. If something should happen, the Mighty Mite is covered by a standard 90 day warranty as explained on the warranty policy enclosed with your instrument.

For the best work on out of warranty repairs, send your Mighty Mite directly to the factory service department. Be sure to state the nature of your problem to insure faster service.

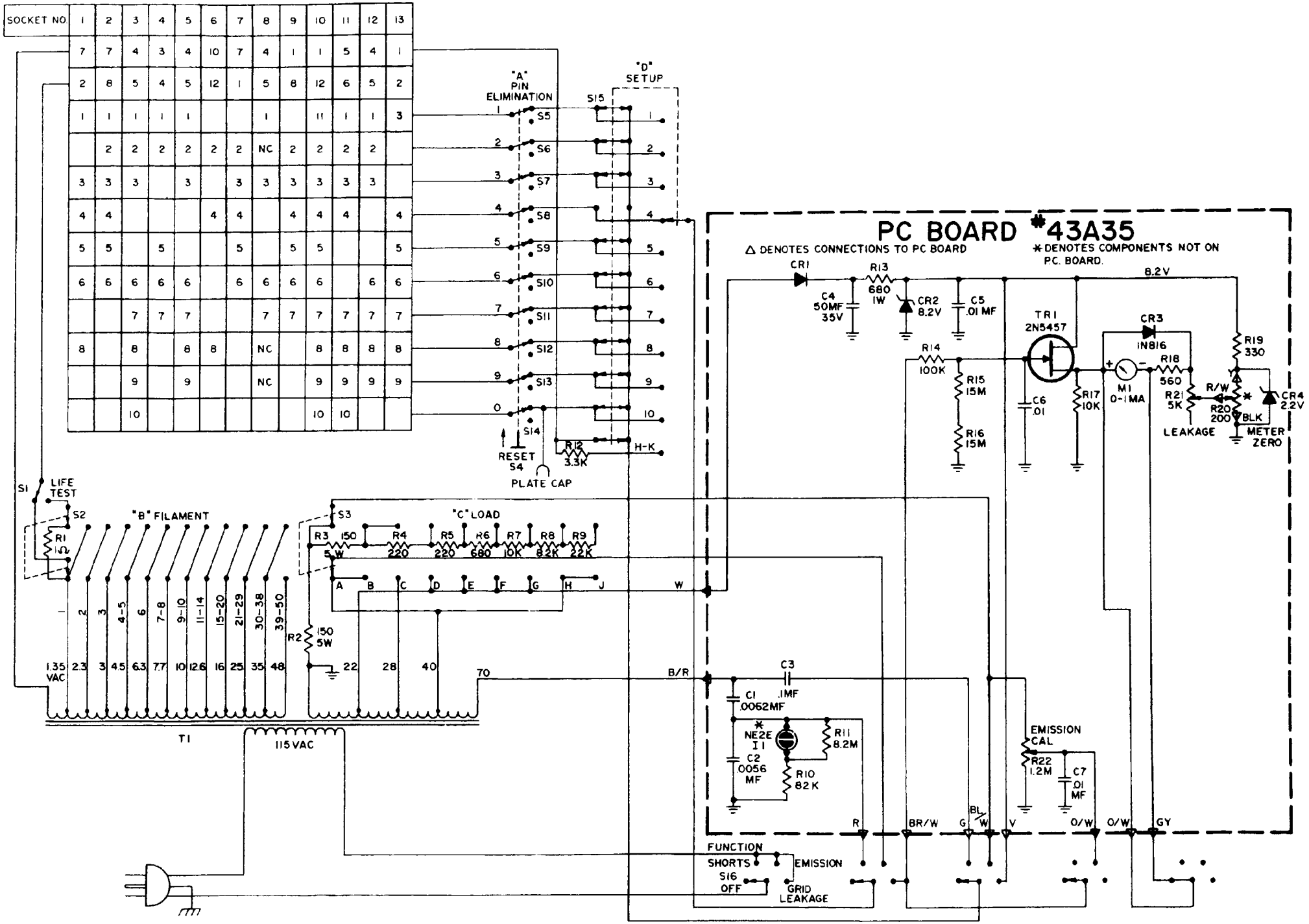
If you wish to repair your own Mighty Mite, we have included a schematic, parts list, and a trouble chart to help you. Any of the necessary parts may be ordered directly from the Sencore service department.

We reserve the right to examine defective components before an in-warranty replacement is issued.

MIGHTY MITE PARTS LIST

SCHEMATIC #	PART #	DESCRIPTION	PRICE
R2, 3	14B49-9	150 ohm 5 watt, 10%	.50
R20	15C1-12	200 ohm, 30% control	1.50
R21	15C7-14	5K vert Mt. PC control	.75
R22	15C7-8	1.2 meg vert mt PC control	.75
C1	25G81	.0062 mfd, 5% 500V poly	.25
C2	24G143	.0056 mfd, 125V poly	.25
TR1	19C11-1	FET, 2N5457	1.25
CR1	16S10	Diode, .5A, 400 PIV	
CR2	50C4-2	Zener diode, 8.2 volts	
CR3	50C7-1	Diode, 1N816	
CR4	50C4-4	Zener diode, 2.2 volts	
S1	25G6	1P2P slide spring return	
S2	25A154	2P12P rotary	2.50
S3	25A157	2P9P rotary	3.25
S4	25A156	1P3P, no detent reset	
S5 to S14	25A155	1P2P, 1/2 toggel slide	
S15	25A158	2P11P rotary	3.25
S16	25A153	5P4P rotary	
M1	23B34	Meter, O-1 mA	20.00
T1	28B46	Transformer, filand pwr	9.95
	36G2	Grid Cap lead	

(PRICES SUBJECT TO CHANGE WITHOUT NOTICE)



LAST R- R22
LAST C- C7
LAST CR- CR4

TC162 MIGHTY MITE VII

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