

## CALIBRATION

NOTE: New Multimeters may exhibit a small amount of calibration drift due to "burn-in" stabilization. Therefore, it is suggested that you recalibrate your Multimeter after an initial period of use; one month, for example. You may also wish to regularly recalibrate your Multimeter at three to six month intervals, or as required, to insure optimum accuracy during use.

If in any of the following steps you do not obtain the indicated results, refer to the "In Case of Difficulty" section. Locate and repair any problem before you continue with the calibration.

WARNING: When the line cord is connected to an AC outlet, hazardous voltages will be present at several places. These are shown by the boxed-in areas in Figure 2-1 in the "Illustration Booklet."

- ( ) Plug in the Multimeter, turn it on, and allow it to warm up for 30 minutes. Also read the operational statements on Figure 3-1 in the "Illustration Booklet."
- ( ) Plug the test leads into the front panel connectors (red lead to red connector; black lead to black connector).
- ( ) Remove the cover from the Multimeter. (The screws will not come out).

Refer to Figure 2-1 for the following steps.

- ( ) Set the ZERO ADJ, DC CAL, and CLOCK ADJ controls fully counterclockwise.
- ( ) Set the other seven controls to their centers of rotation (slots vertical to the circuit board).

- ( ) Set the RANGE switch to 2.
- ( ) Set the FUNCTION switch to DCV. The display should show  $-\infty$ . No other display segments should be lit.
- ( ) Set the ZERO ADJ control to a display of  $\infty$ . (It may be necessary to rotate the DC CAL control clockwise slightly.)
- ( ) Connect the test leads together.
- ( ) Rotate the ZERO ADJ control until the display just shows  $-\infty$ . Then **slowly** turn the control until the display **just changes to  $\infty$** . Only a slight adjustment is needed.
- ( ) Touch the red test probe to the DC CAL TP (test point) at the loop end of R91 (2000 $\Omega$ , red-black-red). Hold the probe at the test point and rotate the DC CAL control slowly clockwise while you watch the display. The count should increase, reach a maximum, and then decrease. Rotate the control fully counterclockwise and then slowly advance it until the display shows about 20 counts **less** than the observed maximum. Remove the test probe from the test point.

NOTE: In the next step, if you are unable to obtain a reading of at least  $\infty$ , obtain the nearest possible reading with the CLOCK ADJ control. Then leave the control set at this point and proceed.

- ( ) Turn the FUNCTION switch to OHMS and adjust the CLOCK ADJ control for a display of between  $\infty$  and  $\infty$ .



## DC VOLTS CALIBRATION

NOTE: Refer to the calibration voltage value written on the label on the side of the transformer to perform the following step. Observe that the calibration voltage number has four digits, whereas the Multimeter can display only three digits. Convert the number to three digits by dropping the fourth digit if it is 4 or less, or by increasing the third digit by one if the fourth digit is 5 or more. For example:

$$1.943 = 1.94$$

$$1.946 = 1.95$$

$$2.037 = 2.04$$

If the rounded-off number is 2.00 or higher, the 2 will not be displayed in the following steps, and the "overrange" indicator will be lit:

$$2.11 = \cdot 111$$

- ( ) Turn the FUNCTION switch to DCV.
- 1. ( ) Connect the test leads together and, if necessary, adjust the ZERO ADJ control to show **0.00**.
- 2. ( ) Touch the red test probe to the DC CAL TP at the loop end of R91.
- 3. ( ) Rotate the DC CAL control fully counterclockwise. Then turn it clockwise until the display matches the value of the rounded-off calibration voltage. *1.678*
- 4. ( ) Remove the test probe from the DC CAL test point.
- ( ) Return the RANGE switch to 2 and repeat the previous four steps one time. Then finish by leaving the RANGE switch in the 20 position.

NOTE: In the previous adjustments you "roughly" calibrated the DC voltmeter function of your Multimeter in order to perform the measurement in the next step. This measurement reflects whether the AC line voltage is high, low, or of an average value, since it has a slight effect on the DC calibration test point voltage used to calibrate your Multimeter. After you complete this measurement, you may need to apply a small correction factor to the DC calibration number for only this **particular** calibration for the line voltage condition **at this time**.

- ( ) Touch the test probe to the +V TP (bracket of Q15) and observe the reading. If the reading is less than 7.8, subtract .003 from the number on the calibration label. If the reading is greater than 8.6, add .003 to the number. If the reading was between 7.8 and 8.6, no adjustment is required. After you have added or subtracted as required, round off the result to obtain a "corrected" calibration number. Write this number down in a convenient place (not on the calibration label) for use later.
- ( ) Remove the test probe from the +V TP.
- ( ) Turn the RANGE switch to 2.
- ( ) Turn the FUNCTION switch to OHMS.
- ( ) Rotate the CLOCK ADJ control fully counterclockwise. Then turn it clockwise for a display of **1.90**.

### NOTES:

1. This time, the reading must be within 5 digits (no less than **1.85**, or no more than **1.95**). If you are unable to calibrate within these limits, refer to the "In Case Of Difficulty" section of the Manual. If your Multimeter is operating from a 60 Hz power line during calibration, this "infinity" (open-circuit) display will be approximately **1.90**.
2. If you calibrate your Multimeter using 60 Hz power source, recalibrate it before you use it on a 50 Hz power source. Also do not use a meter calibrated on 50 Hz on a 60 Hz power source. It will be inaccurate at the higher portions of the range.
- ( ) Turn the FUNCTION switch to DCV.

NOTE: The following procedure determines which of the two transistors in the Q1 and Q4 positions is better to use in the Q1 position to prevent Multimeter warm-up drift from showing negative at turn-on.

- ( ) Adjust the ZERO ADJ control as close as possible to the point where the display changes from **-0.00** to **0.00** but still shows **0.00** most of the time.

- ( ) Disconnect the line cord.
- ( ) Interchange the transistors at Q1 and Q4. Make sure you properly reinstall each transistor.
- ( ) Connect the line cord and, without touching any switches or controls, observe the display. If the display is **0.00**, disregard the next step and proceed. If the display is **-0.00**, perform the next step and then proceed.

If the display obtained in the last step was **-0.00**, disconnect the line cord, interchange the transistors at Q1 and Q4 to their original positions, reconnect the line cord, and then continue with the calibration.

Due to the interaction between controls, repeat the following procedure as many times as required until each calibration display is properly obtained.

- A. Connect the test leads together and adjust the ZERO ADJ control so that the display just changes from **0.01** to **0.00** and then is stable at **0.00**.
- B. Turn the FUNCTION switch to OHMS and adjust the CLOCK ADJ control to show an "infinity" display between **0.85** and **0.95**.
- C. Turn the FUNCTION switch to DCV, touch the test probe to the DC CAL TP, and adjust the DC CAL control until the display shows the "corrected" calibration number.

1.68

### AC VOLTS CALIBRATION

- 1. ( ) Set the front panel switches as follows:
 

FUNCTION	DCV
RANGE	2
- 2. ( ) Touch the test probe to AC REF TP and adjust the control for a display of **1.65**.

NOTE: The display may vary between **1.64** and **1.65** and **1.66**. A proper adjustment will cause it to read **1.65** most of the time.

- 3. ( ) Remove the test probe from the AC REF TP.
- 4. ( ) Turn the FUNCTION switch to ACV.
- 5. ( ) Touch the test probe to the AC REF TP again and allow the display to stabilize.

NOTE: Do Not change the position of the AC REF ADJ control in the next step.

- 6. ( ) Adjust the AC CAL control for a display of **1.00**.

NOTE: The display may vary between **0.99**, **1.00**, and **1.01**.

- ( ) Repeat the previous six steps until you obtain the correct displays in both switch positions.
- ( ) Remove the test probe from the AC REF TP.

### OHMS CALIBRATION

- ( ) Turn the FUNCTION switch to OHMS.

You will calibrate the five OHMS ranges in the following steps. Touch the test probe to the indicated OHMS CAL TP for each range and adjust the indicated control for a **1.00** display. The decimal point should be at the indicated position as shown under the "Display Reading" column in the following chart.

RANGE SWITCH	OHMS CAL TP (Test Point)	CAL CONTROL	DISPLAY READING
( ) 200Ω	200	200	1.00
( ) 2 KΩ	2K	2K	0.00
( ) 20 KΩ	20K	20K	0.00
( ) 200 KΩ	200K	200K	0.00
( ) 2 MΩ	2M	2M	0.00



- ( ) Repeat the steps in the previous chart as many times as necessary until you obtain the proper reading for each switch position.
- ( ) Turn off the Multimeter.
- ( ) Unplug the line cord.

**CAUTION:** In the next step you will install the cabinet top. Be sure none of the controls are touched or changed.

- ( ) Install the cabinet top on the cabinet bottom. Be sure no wires are pinched between the cabinet halves.

**NOTE:** The built-in calibration standards provide accuracy within the specifications for your Multimeter. However, if you wish to improve the accuracy at any time, you can recalibrate your Multimeter with precision AC and DC voltage and resistance standards. The precision standards should be accurate within one-tenth of the appropriate Specifications on Page 70.

## OPERATION

ALLOWABLE RANGE	DISPLAY RANGE
	Does not function

**DUTY CYCLE**

Since the power consumption of the Digital Multimeter is very low, you may wish to leave the instrument on continuously during the daily work period. Always allow a 30 minute warmup period from a cold start to insure best accuracy. However, the Multimeter will provide serviceable accuracy after a few minutes of warmup. A "touch-up" of the ZERO control (through the front panel) may be necessary during warmup.

## SAFETY PRECAUTIONS

**CAUTION:** Always observe basic safety rules any time you make voltage measurements. Always handle the test leads by their insulated portions and do not touch the exposed tips.

When you make high voltage measurements, remove the power from the unit under test and then connect the test leads. If this is not possible, be careful to avoid accidental contact with nearby objects which could provide a ground return path. Keep one hand behind you to minimize accidental shock hazard and be sure to stand on a properly insulated floor or floor covering. Do not switch ranges when high voltages and high currents are at the Multimeter inputs; to do so may cause switch contact arcing.

**CAUTION:** 700 volts rms is the maximum AC voltage allowable on the 20, 200, and 2K ranges; and 250 volts rms is the maximum on the 2 (Vold) range.

Set the FUNCTION switch to 2K or the desired lower range.

Set the RANGE switch to 2K or the desired lower range.

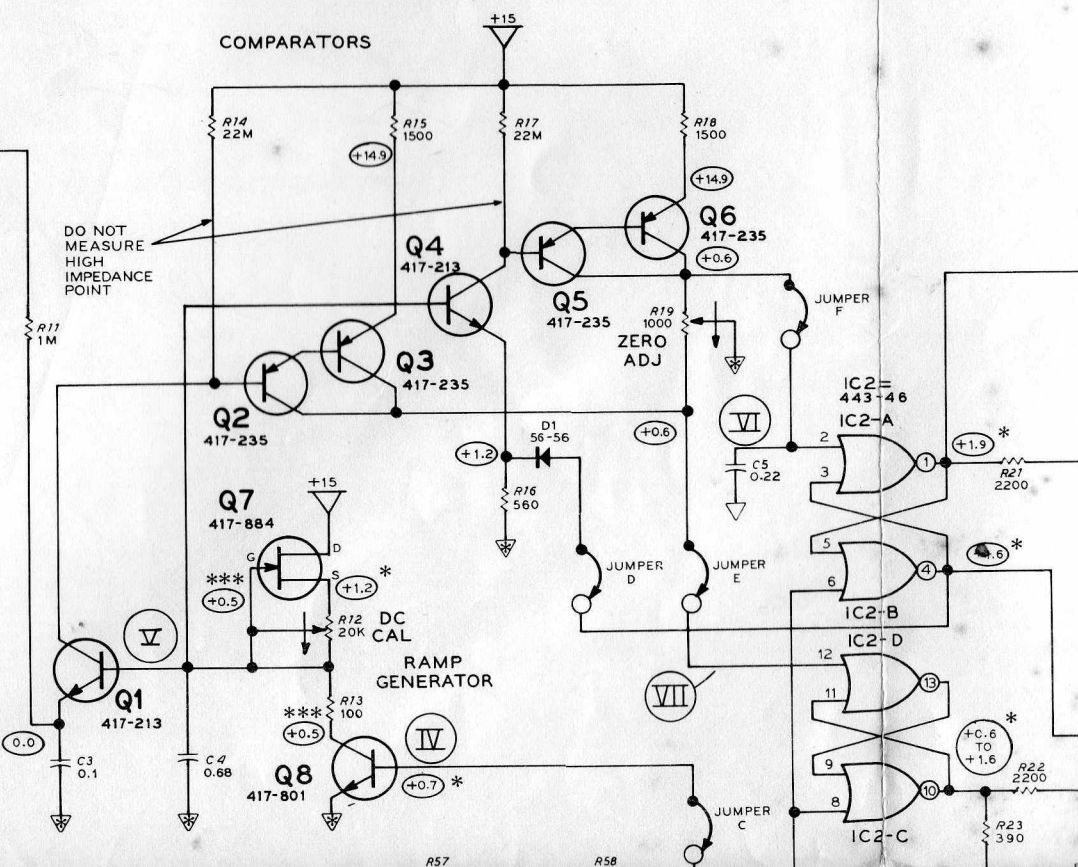
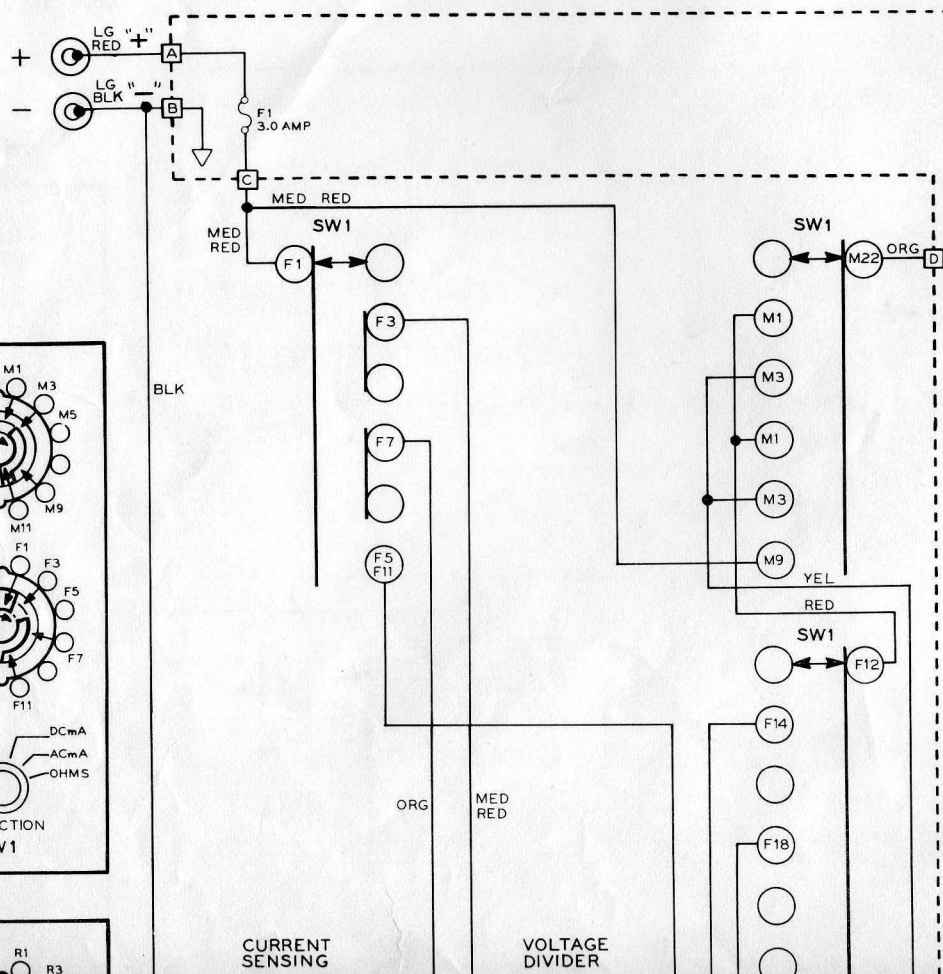
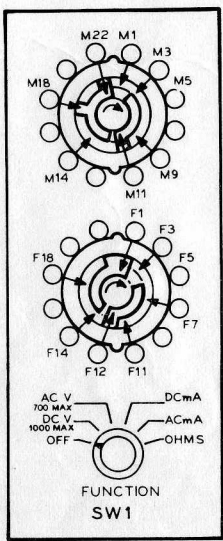
Connect the black test lead to circuit ground or to the circuit low point.

**DC VOLTAGE MEASUREMENTS**

**CAUTION:** 1000 VDC is the maximum DC voltage allowable between the + and inputs on the 20, 200, and 2K ranges; and 250 volts DC is the maximum on the 2 (Vold) range.

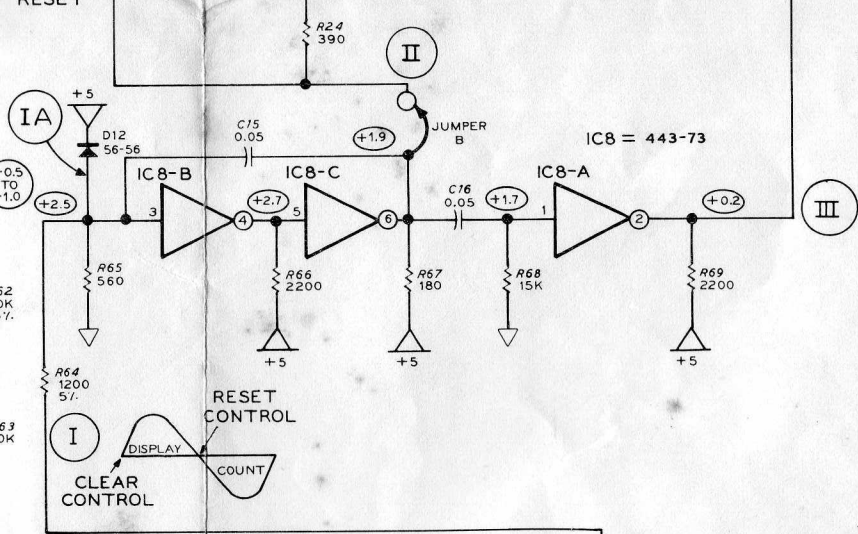
Set the FUNCTION switch to DCV.

Set the RANGE switch to 2K or the desired lower range.

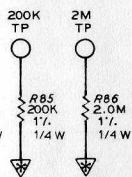


DO NOT MEASURE HIGH IMPEDANCE POINT

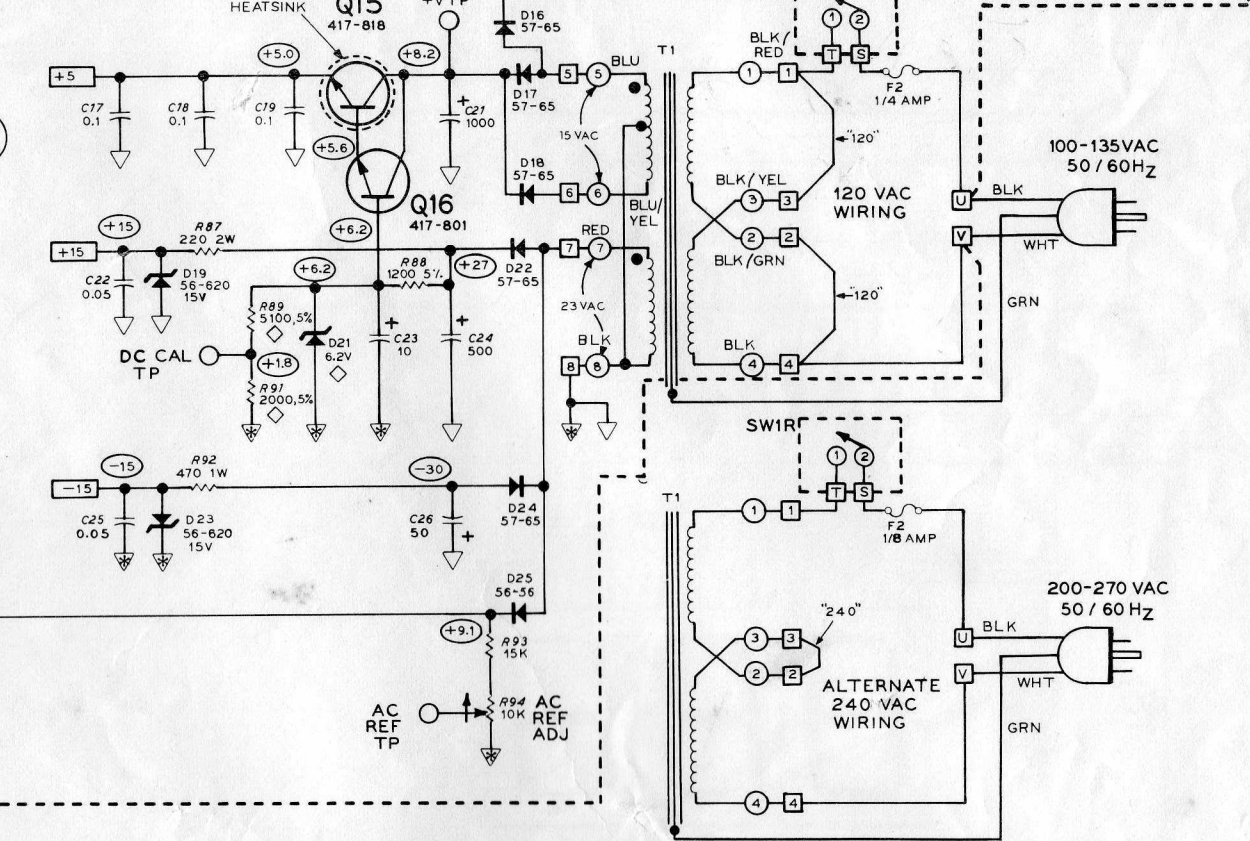




ISTORS



POWER SUPPLY



\*\* INDICATES MEASUREMENT FOR ANY DISPLAY. USE ONLY A METER OF 10MΩ INPUT IMPEDANCE OR HIGHER.

\*\*\* INDICATES MEASUREMENT MAY VARY DEPENDING ON DISPLAY. USE ONLY A METER OF 10MΩ IMPEDANCE OR HIGHER.

9. 

P	DIGIT (P1, P2, OR P3)
2	
B	

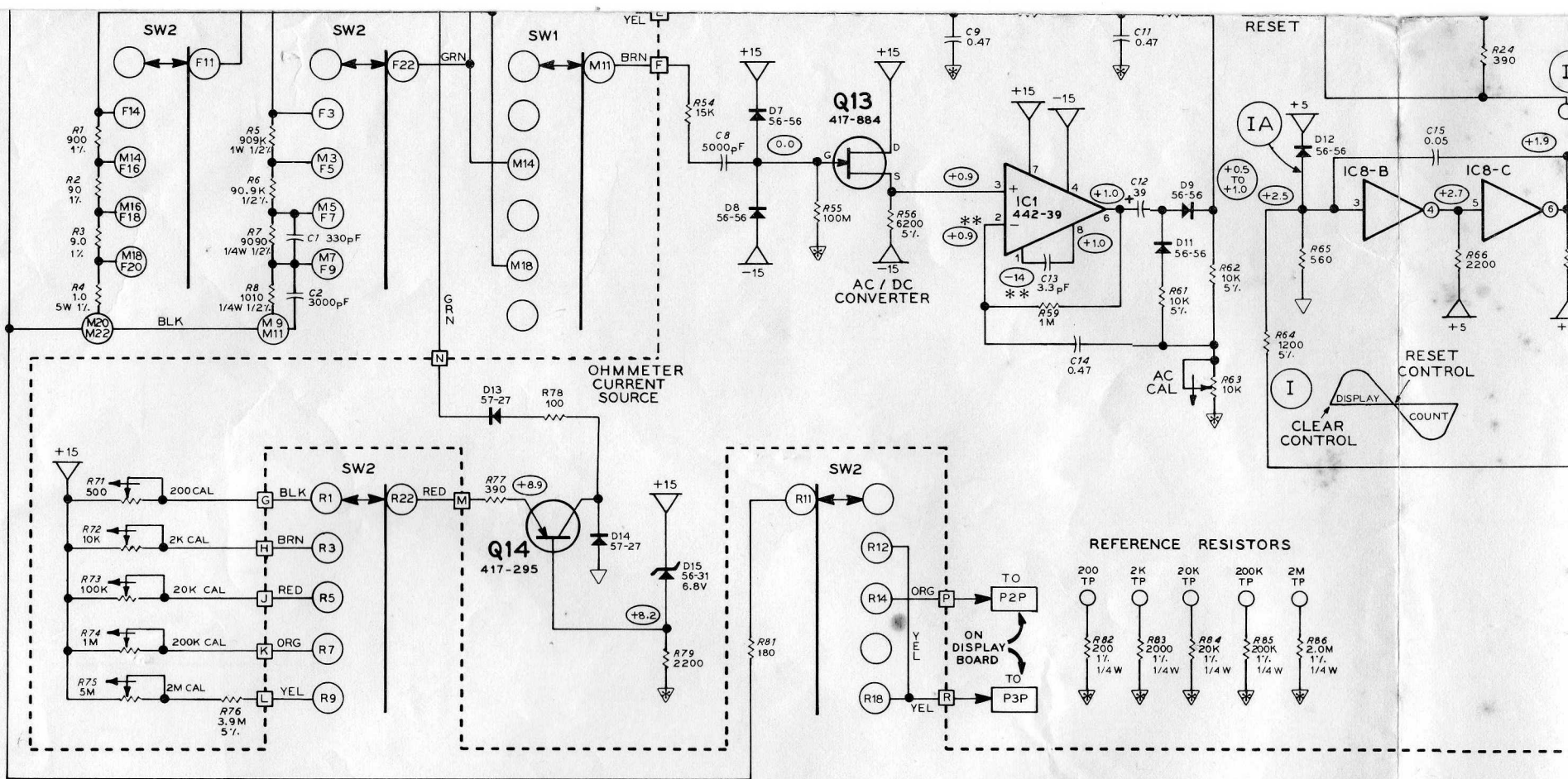
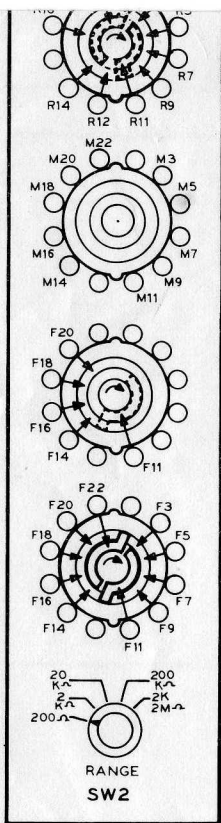
10. INDICATES WIRE CONNECTION POINT TO CIRCUIT BOARD.

11. WAVEFORMS CORRESPOND TO 60Hz OPERATION AND THUS REPEAT EVERY 16.7 MILLISECONDS. ALSO SEE "WAVEFORMS" IN "IN CASE OF DIFFICULTY".

12. NC DENOTES NO CONNECTION.

13. TP DENOTES TEST POINT.

14. INDICATES CLOCKWISE ROTATION OF CONTROL.



**SCHEMATIC OF THE  
HEATH  
MODEL IM/SM-1210  
DIGITAL MULTIMETER**

Part of 595-1873-05

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**NOTES:**

1. FUNCTION SWITCH SW1 IS SHOWN IN OFF POSITION. RANGE SWITCH SW2 IS SHOWN IN 200Ω POSITION.
2. ALL RESISTOR VALUES ARE IN OHMS: K=1,000; M=1,000,000.
3. ALL RESISTORS ARE 1/2 WATT, 10% UNLESS OTHERWISE INDICATED.
4. ALL CAPACITORS ARE IN μF UNLESS OTHERWISE INDICATED.
5. INDICATES LOW-NOISE GROUND.
6. INDICATES POWER GROUND.

7. INDICATES PARTS FROM 100-1686.

8. ALL VOLTAGES ARE DC AND MEASURED FROM "-" INPUT AT A LINE VOLTAGE OF 120 VAC (OR 240 VAC). VOLTAGES MAY VARY ±20%. RANGE SWITCH SW1 IN DCV; FUNCTION SWITCH SW2 IN 2.

INDICATES MEASUREMENT FOR ANY DISPLAY USING METER OF 20,000Ω/VOLT OR GREATER.

\* INDICATES MEASUREMENT MAY VARY DEPENDING ON DISPLAY. MAY USE METER OF 20,000Ω/VOLT OR GREATER.

\*\* INDICATES METER ONLY A METER OR HIGHER.

\*\*\* INDICATES METER ONLY A METER OR HIGHER.

9. 

P	DIGIT (P1, P2, ...)
B	

**REFERENCE RESISTORS**

