OPERATION

Refer to Pictorial 4-1 (Illustration Booklet, Page 9) for a brief description of the controls and displays for your Digital Scale.

AUTO/MANUAL SWITCH

Normally, the AUTO/MANUAL switch should be left in the AUTO position. When you step on the platform, power is automatically applied and the displays will indicate your weight. Power will not be automatically applied with any weight less than the turn-on sensitivity; it will then be necessary to manually turn the displays on. To do this, place the AUTO/MANUAL switch to the MANUAL position. With the switch in the MANUAL position, the displays will remain lit and the batteries will discharge. Do not leave the switch in the MANUAL position any longer than necessary.

ZERO CONTROL

The front ZERO control provides a fine adjustment for zeroing your scale. To zero the scale: place the AUTO/MANUAL switch to MANUAL and turn the zero knob until each of the four displays reads zero; then place the AUTO/MANUAL switch back to AUTO.

Occasionally check to make sure the scale is zeroed.

Tare

Measuring the contents of a container, but not the container itself, is known as "tare." For a "tare" measurement, perform the following:

1. Place the AUTO/MANUAL switch to the MANUAL position.
2. Place the empty container in the center of the platform.
3. Adjust the front ZERO knob until each of the four displays reads zero.
4. Add the contents to the container and read the contents weight on the display.
5. Remove the container from the platform.
6. Rezero the scale with the front ZERO knob.
7. Place the AUTO/MANUAL switch to AUTO.

DISPLAY

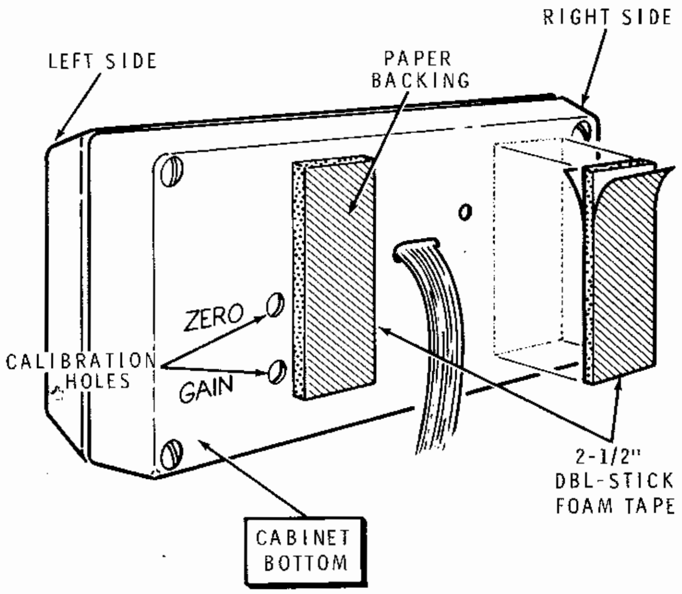
NOTE: When you first use the scale, allow 3 to 4 seconds for the reading to stabilize.

The tenths digit will display in .1 increments (.1-.2-.3-etc.) or in .2 increments (.2-.4-.6-etc.). This is determined by the position of the jumper wire on the display circuit board (connector AA for .1 or connector AB for .2). Normally, the jumper wire should be connected to AB. When you measure non-stationary (body) weight, several factors can cause the tenths digit to change back and forth; movement on the platform, how and where the weight is placed, and whether the floor is flat and level. This digit change is less noticeable when the display reads every two numbers (.2) than every one (.1). When you weigh stationary items, the .1 display may be more desirable.

You can leave the tenths digit blank (so it will not light) by removing IC104. The display will then read only whole numbers but they will not be rounded off. For example, if you weigh 165.8 pounds, the display will read 165, not 166.

You can read the weight displayed on your Digital Scale in pounds or in kilograms, depending on your original wiring. If you desire to change your display at a later time, refer to Pictorial 1-3 and change resistor R21 or the jumper wire as directed. Then follow the "Adjustments" procedure and recalibrate your scale using the number you recorded on Page 38.

NOTE: Due to the mechanical function in your Digital Scale, the repeatability will vary ±.5% of the reading. This means, if you stand on the platform, get off and back on again, the two readings may not agree. They may vary .5% from each other. However, as the scale "breaks in," these variations will become less. The scale is not affected by most carpeting.



Detail 3-13A

WALL MOUNTING

Refer to Pictorial 3-13 for the following steps.

1. ( ) Locate the double-stick foam tape and cut it into two 2-1/2" lengths.

NOTE: Do not cover the calibration holes when you perform the following step.

2. ( ) Refer to Detail 3-13A and remove the paper backing from one length of the double-stick foam tape. Press the tape onto the left side of the display cabinet bottom.

3. ( ) In the same manner, install the remaining length of double-stick foam tape onto the right side of the display cabinet bottom.

4. ( ) Position the platform assembly in its predetermined location.

5. ( ) Remove the remaining paper backing from both lengths of double-stick foam tape and press the display cabinet onto its predetermined location. NOTE: It may be necessary to rezero the front ZERO control.

This completes the "Wall Mounting." Proceed to "Operation."

LOW BATTERY INDICATOR

The low battery indicator (LO BAT) will light to indicate that only a small percentage of the batteries' charge is left. However, the displayed weight will still be correct for several more operations. The purpose of the indicator is mainly to let you know when it is time to install fresh batteries.

The battery contacts can be coated with a thin film of silicone grease to reduce the chance of corrosion. Use the silicone grease supplied with your kit.

BATTERY LIFE

Typically, dry cell battery life is approximately one year. This assumes two operations per day, each day of the year. Alkaline batteries offer twice as much operating time as standard dry cells. The current drain from the batteries is approximately the same as a flashlight.

CLEANING

Both the display inlay and the window are made of vinyl and the platform is baked enamel. Use any detergent or vinyl cleaner when you clean them. Do not use abrasive cleansers.

IN CASE OF DIFFICULTY

This part of the Manual provides you with information that will help you locate and correct difficulties which may occur in your Digital Scale. This information is divided into two sections. The first section, "General," contains suggestions of a general nature in the following areas:

- Visual check and inspection.
- Precautions to observe when bench testing.

The second section, "Troubleshooting," contains a series of "Conditions" and "Possible Causes." Start your troubleshooting procedure by first reading the following "General" section. Then proceed to the appropriate "Condition" and "Possible Cause."

GENERAL

Visual Checks

1. About 90% of the kits that are returned for repair do not function properly due to poor soldering. Therefore, you can eliminate many troubles by a careful inspection of connections to make sure they are soldered as described in the "Soldering" section of the "Assembly Notes." Reheat any doubtful connections and be sure all the wires are soldered at places where several wires are connected. Check carefully for solder bridges between circuit board foils.
2. Check to be sure that all transistors and IC's are in their proper locations, and are installed correctly.
3. Check the value of each part. Be sure that the proper part has been wired into the circuit, as shown in the Pictorial diagrams and as called out in the wiring instructions. It would be easy, for example, to install a 2200 Ω (red-red-red) resistor in a step that calls for a 220 Ω (red-red-brown) resistor.
4. Recheck the wiring. Trace each lead in colored pencil on the Pictorial as you check it. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something you have consistently overlooked.
5. Check all component leads connected to the circuit boards. Make sure the leads do not extend too far through the circuit board and make contact with other connections or parts.
6. Check all of the wires that are connected to the circuit boards or terminal strip to be sure the wires do not touch the platform bottom or other lugs. Make sure all wires are properly soldered.
7. If the difficulty still is not cured, read the "Precautions for Bench Testing" section, and the section titled "Troubleshooting."

Precautions for Bench Testing

- Be cautious when testing transistors and integrated circuits. Although they have almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage and current than other circuit components.

- Be careful so you do not short any terminals to ground when you make voltage measurements. If the probe should slip, for example, and short out a bias or voltage supply point, it may damage one or more components.

Do not remove any components or circuit boards while the Digital Scale is turned on.

When you make repairs to the Digital Scale, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged resistor, make sure you find out what (wiring error, etc.) caused the resistor to become damaged. If the cause is not eliminated, the replacement resistor may become damaged when the scale is put back into operation.

Refer to the "X-Ray Views," "Identification Charts," and the "Schematic Diagram" to locate the various components.

Use a high impedance voltmeter and an oscilloscope to make the specified measurements in this section.

In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your warranty is located inside the front cover.

SHIPPING

IMPORTANT: If it is necessary to ship the Digital Scale to Heath Company or to a Heathkit Electronic Center, remove the batteries and the lever arms from inside the platform. Detach the support bracket from the platform and wrap it in paper or packing material. Wrap the lever arms and both platform halves all separately to protect the finish and prevent them from being damaged during shipment. Store the support bracket hardware in a safe place so you do not lose it. **DO NOT** allow any hardware to come in contact with the fine strain-gauge wires or damage may occur.

Troubleshooting Chart

This chart lists the "Condition" and "Possible Cause" of several malfunctions. If a particular part or parts are mentioned (Q1 for example) as a possible cause, check that part to see if it was installed and/or wired correctly. It is also possible, on rare occasions, for a part to be faulty and require replacement.

In addition to the following chart, also refer back to the charts in the "Calibration" section of the Manual for additional information.

CONDITION	POSSIBLE CAUSE
No number displayed; no light.	1. Battery or batteries. 2. IC6, Q1, Q201, and associated circuits. NOTE: If IC6 is suspect, interchange with IC5.
One of the segments of a digit is not lit.	1. LED or associated IC (101, 102, 103, 104.) NOTE: Interchange the suspected bad IC with a known good IC.
One or more of the four digits does not light.	1. LED or associated IC's (101, 102, 103, 104). See above note.
Decimal point does not light.	1. LED, R122.
Low battery indicator is lit; fresh batteries installed.	1. Check batteries for polarity. 2. Q101, IC1D and associated circuits. 3. R29, 31, and 32.
Reading varies more than one count after being on more than 4 to 5 seconds with no weight applied.	1. Batteries (if LO BAT is on). 2. C8, C9, C12, ZD1, IC6, R14, R134.
Weight varies more than specified limits with weight on platform.	1. Lever arms bent. 2. Binding at contact point on transducer. 3. Damaged pivots.
Scale does not come on in AUTO position, or stays on and will not shut off.	1. Check leaf switch for bent contacts. 2. Sleeving not covering pins on lever arms properly. 3. Sleeving too long on lever arm pins.
Scale does not read correct weight.	1. Lever arm is not positioned properly at end of transducer. See Detail 3-12C, Page 42. 2. Transducer and associated wiring.

SPECIFICATIONS

Display	4-digit, .5" character LED. Low battery indicator LED.
Display Update Rate	Approximately 1 second.
Full Scale	300 pounds (136 kilograms).
Resolution	1 part in 3000.
Accuracy	±1% or ±1 count, whichever is greater.
Repeatability	±.5% of reading or ±1 count.
*Overload Capacity	50% of full capacity.
Primary Controls	Zero (tare adjust 20 pounds typical). Platform switch. ON-Off (Manual/Auto) switch.
Operating Temperature Range	32° to 122°F (0 to 50°C). Requires readjustment of zero control.
Secondary Controls	Coarse Zero. Gain. Jumper for selecting .1 or .2 pounds.
Platform	Die cast aluminum with vinyl inlay. 11-1/2" long × 11-1/2" wide × 1-5/8" high. (29.21 × 29.21 × 4.13 cm).
Cabinet Size	6" long × 3-1/2" wide × 1-1/2" high. (15.24 × 8.89 × 3.81 cm).
Net Weight	5.4 pounds (2.4 kilograms).
Transducer	Foil strain gauges (bridge configuration).
Power Requirements	Six "C" type dry cell or alkaline batteries.
Current Drain	250 mA (approximately).

*Reduced accuracy above 300 lbs. Scale will reach stops at approximately 350 lbs. Not damaged by weight up to 450 lbs.

CIRCUIT DESCRIPTION

Refer to the Schematic Diagram (fold-in) and the Block Diagram (Illustration Booklet, Page 9) as you read this "Circuit Description."

The Digital Scale circuitry consists of three basic sections: the transducer (or sensor), the analog to digital converter, and the display circuits.

The transducer consists of a metal beam with deflection-sensing strain gauges bonded to it. When you apply a weight to the transducer, it deflects and causes the strain gauges to change resistance. The resistance change is converted into voltage and amplified. The amplified voltage is converted from an analog signal into digital form by the A to D (analog to digital) converter stages. The digital signal is fed to the decoder drivers and finally to the LED displays.

INPUT

The input stage consists of the transducer and an amplifier. The transducer consists of a metal beam with four strain gauges (SG201 through SG204) bonded to it. Each strain gauge is constructed of a fine metal foil made of a special alloy. The strain gauges are arranged in a grid pattern and connected to the metal beam in a bridge configuration. As you apply weight to the scale, the transducer deflects, and the strain gauges change resistance. This resistance change unbalances the bridge and develops a voltage, which is applied through resistors R17 and R18, to the inputs at pins 2 and 3 of amplifier IC3. A voltage difference between pins 2 and 3 of amplifier IC3 is amplified, and is present at its output, pin 6. The gain of amplifier IC3 is set by resistors R19, R21 and R24. Capacitors C6 and C7 minimize any input lead noise. Capacitor C8 sets the frequency response and reduces any power supply noise. Control R14 and resistor R16 compensate for unbalances in the input circuit.

A TO D CONVERTER

The A to D converter consists of four basic stages: the integrator, comparator, oscillator and counters. Other circuits contribute to these stages; they will also be discussed, along with the above, at the proper time. The A to D converter applies the dual slope (ramp down and ramp up) technique to convert the analog (input) voltage into digital form.

Integrator

Integrator IC5 has two inputs which control the state of its output. One input receives the input voltage, while the other input remains fixed. The fixed input provides a reference level for switching the output to either a high or a low state. A time constant is provided for IC5 which causes its output to ramp down or up as shown in Pictorial 5-1 (Illustration Booklet, Page 9). When the input voltage is higher than the reference voltage, the output ramps down. When the input voltage is less than the reference voltage, the output ramps up.

Comparator

Comparator IC1A operates the same as integrator IC5. It has two inputs, one that is fixed at a reference level, which control the state of its output. Its output does not ramp up and down, however. It is either at a high or a low state, since no time constant is involved.

Oscillator

Oscillator IC1B provides a standard of measurement for counters IC105 and IC106. IC1B is a free running oscillator which provides a continuous series of pulses to the counters. The operating frequency is set by resistors R9, R11, R12, R13 and capacitor C5.

Counters

IC105 and IC106 make up four decade counters. The first decade counter at IC106 receives pulses at its input from the free running oscillator, IC1B. When IC106 counts nine pulses and starts counting the tenth, a pulse at its output is transferred to the input of the second decade counter, also at IC106. When the second decade counter reaches the 9-to-0 transition, a pulse is transferred from its output to the input of the third decade counter at IC105. The 9-to-0 transition continues for each remaining decade counter. The first counter provides count information for the tenths display; the second counter, units; the third, tens; and the fourth, hundreds.

WEIGHT ON THE SCALE

The following sequence of events takes place when weight is applied to the scale.

As weight is applied on the platform top, the transducer deflects. The four strain gauges (SG201 through SG204), which are connected in a bridge configuration, become unbalanced and a voltage is developed. This voltage comprises the analog input voltage, which is applied to the inputs at pins 2 and 3 of amplifer IC3, where it is amplified. The output at pin 6 of IC3, is applied to switch IC4B at pin 3. At this time, switch IC4B is closed and IC4C is open. The signal voltage passes through IC4B and goes to the input at pin 2 of integrator IC5. The heavier the weight applied to the scale, the more positive the input voltage at pin 2 will be. The input voltage at pin 2 is higher than the reference voltage at pin 3; therefore, the output at pin 6 of integrator IC5 begins to decrease (ramp down) at a constant rate.

Oscillator IC1B provides a continuous series of pulses for decade counters IC105 and IC106 to count. At the time the output of integrator IC5 begins its down ramp, counters IC105 and IC106 begin at 0 to count the oscillator pulses. When the counters reach the 7999 to 8000 transition, a positive control pulse at pin 6 of counter IC105 is coupled through capacitor C1 to the set input at pin 8 of flip flop IC2B. This switches the $\overline{Q}$ output at pin 12 of IC2B to a low state, which opens switch IC4B and disconnects the signal voltage from the input at pin 2 of integrator IC5. The Q output at pin 13 of IC2B is switched to a high state, which closes switch IC4C and places the input at pin 2 of IC5 to ground. The input at pin 2 of integrator IC5 is now at a lower potential than the reference voltage at pin 3, and the output at pin 6 of integrator IC5 starts its up ramp.

Counters IC105 and IC106 continue to count up from 8000 until the up ramp voltage at pin 6 of integrator IC5 crosses the threshold (fixed) voltage at pin 4 of comparator IC1A. At that point, a positive pulse from the output at pin 2 of IC1A is applied to the reset input at pin 10 of flip flop IC2B. This changes the $\overline{Q}$ output at pin 12 back to a high state and the Q output at pin 13 to a low state. Switches IC4C and IC4D switch back to their original states. At the same time, the number of pulses in counters IC105 and IC106, are transferred to the latches at IC's 101 through 104. There they are held and displayed. These displayed numbers are directly proportional to the input voltage at pin 2 of integrator IC5.

The positive pulse from pin 2 of comparator IC1A is also coupled to the reset input at pin 4 of another flip flop, IC2A. This flip flop synchronizes the output at pin 2 of comparator IC1A with the output pulses at pin 1 of the free running oscillator IC1B. This allows control of the latch inputs, at pin 5 of the latching IC's 101 through 104, only when the output at pin 1 of oscillator IC1B and the output at pin 2 of comparator IC1A are in their high states. The $\overline{Q}$ output at pin 2 of IC2A cannot go high until both its reset and clock inputs (pins 4 and 3) are high. This minimizes variations in the tenths count display.

The negative-going portion of the pulse at pin 2 of comparator IC1A is coupled through capacitor C12 to momentarily open switch IC4D. This allows a positive pulse from pin 11 of IC4D to reset pins 7 and 15 of counters IC105 and IC106, which clears them (return to 0).

This completes the analog to digital conversion cycle. As soon as counters IC105 and IC106 are cleared, they begin counting up again from 0. At the same time, the output at pin 6 of integrator IC5 starts its down ramp as before, and the conversion cycle begins again.

NO WEIGHT ON THE SCALE

With no weight applied to the platform top, the display reads 000.0. This occurs in the following manner:

Since the up ramp output at pin 6 of integrator IC5 starts with counters IC105 and IC106 at 8000, they will continue to count up from 8000 to 9999, the next number being 0000. The input voltage at pin 2 of integrator IC5, is adjusted by the front Zero control, R14, so that the up ramp at pin 6 of integrator IC5 crosses comparator IC1A's threshold level when counters IC105 and IC106 are at 0000. Therefore, if the Zero adjust control is set one count (.1 lb.) below 0000, the display will read 999.9. If the Zero adjust control is set one count above 0000, the display will read 000.1.

LOW BATTERY INDICATOR

IC1D compares the battery voltage with the voltage present at the junction of resistors R31 and R32. When the battery voltage becomes low enough, such that the voltage at the junction of resistors R3 and R4 reaches the threshold level at pin 11 of IC1D, the output at pin 13 goes to a low state and turns transistor Q101 on. This lights the LED at pin 5 of V101.

POWER SUPPLY

The power supply source voltage is obtained from six "C" cell batteries which provide 9 volts to the regulator. The regulator consists of IC6, Q1, Q201 and their associated circuits. The output voltage at the collector of Q1 is sampled by resistors R37 and R38. The voltage at the junction of these resistors is compared with the zener voltage at ZD1. Any difference between these voltages is amplified by IC6 and applied to the base of transistor Q1 through resistor R41. Transistor Q1 is controlled in such a way that its output is always constant. This regulated output provides the necessary regulation for the input circuits and the A to D converter. Transistor Q201 provides regulation for the display circuits. The control voltage for Q201 is obtained from the constant collector voltage at Q1.

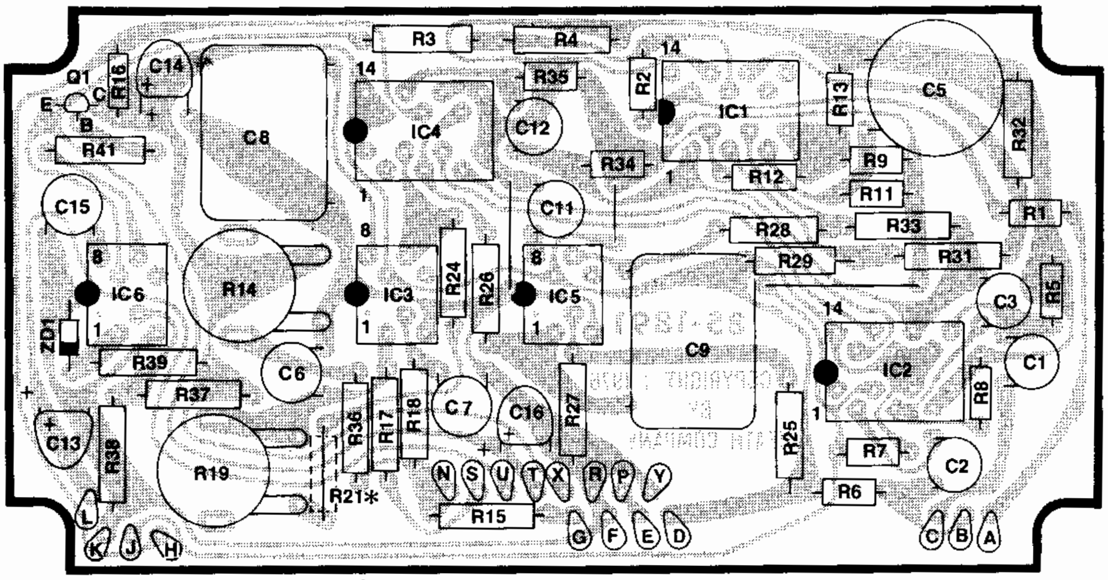
CIRCUIT BOARD X-RAY VIEWS

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View."

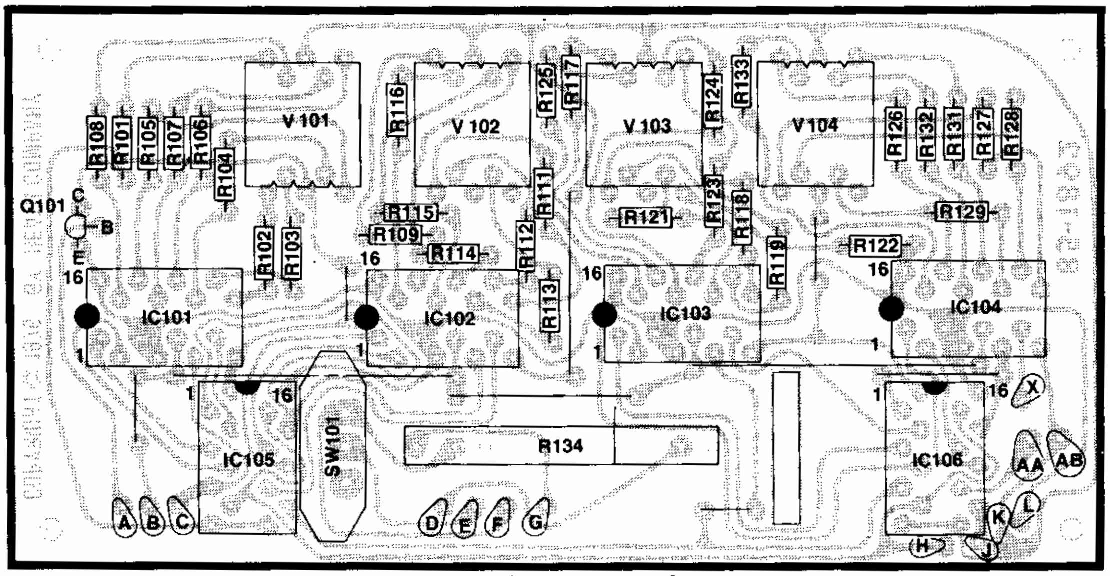
B. Locate this same number in the "Circuit Component Number" column of the "Parts List."

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

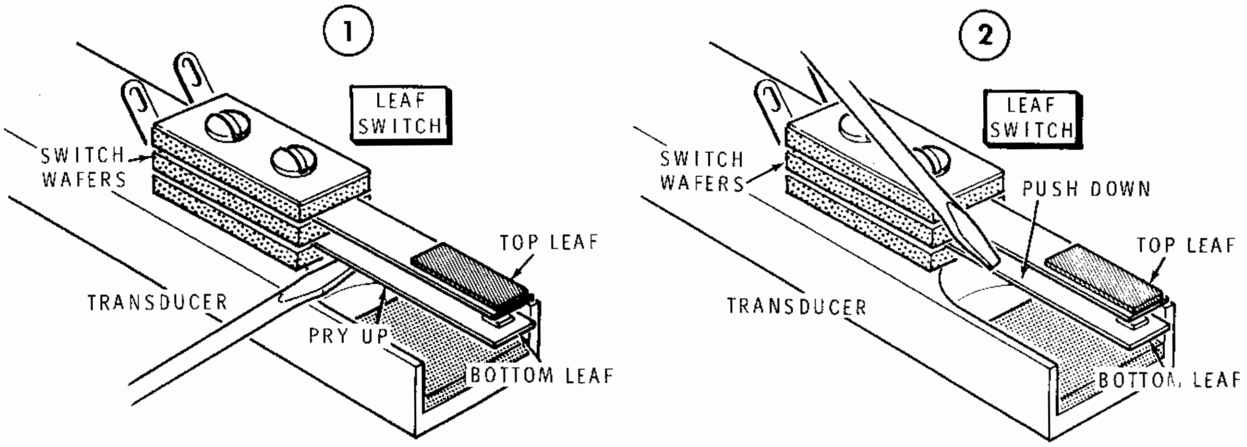


*OPTIONAL

A TO D CIRCUIT BOARD (VIEWED FROM COMPONENT SIDE)



DISPLAY CIRCUIT BOARD (VIEWED FROM COMPONENT SIDE)



Detail 3-12D

ADJUSTMENT OF TURN-ON SENSITIVITY

Use either one of the following two sections. "Increase Sensitivity" or "Decrease Sensitivity", to complete this adjustment. If you do not intend to adjust your scale, proceed to "Final Platform Mounting."

Increase Sensitivity

NOTE: In the following steps, you will increase (less weight required to turn the displays on) the turn-on sensitivity of your scale.

( ) Remove the platform top from the platform bottom. Then temporarily move the end of the left lever arm from the transducer to the cabinet bottom.

( ) Refer to Detail 3-12D, Part 1, and place a small screwdriver blade between the top of the transducer and the bottom leaf of the leaf switch, near the switch wafers. Bend the bottom leaf up slightly to bring the switch contacts closer together.

( ) Place the end of the left lever arm back in position on the end of the transducer and replace the platform top on the platform bottom. Check the turn-on sensitivity and repeat the procedure if necessary.

This completes the "Increase Sensitivity" procedure. Proceed to "Final Platform Mounting."

Decrease Sensitivity

NOTE: In the following steps, you will decrease (more weight required to turn the display on) the turn-on sensitivity of your scale.

( ) Remove the platform top from the platform bottom. Then temporarily move the end of the left lever arm from the transducer to the cabinet bottom.

( ) Refer to Detail 3-12D, Part 2, and place a small screwdriver blade between the top and bottom leaves of the leaf switch, near the switch wafers. Press down on the bottom leaf and widen the spacing between the contacts.

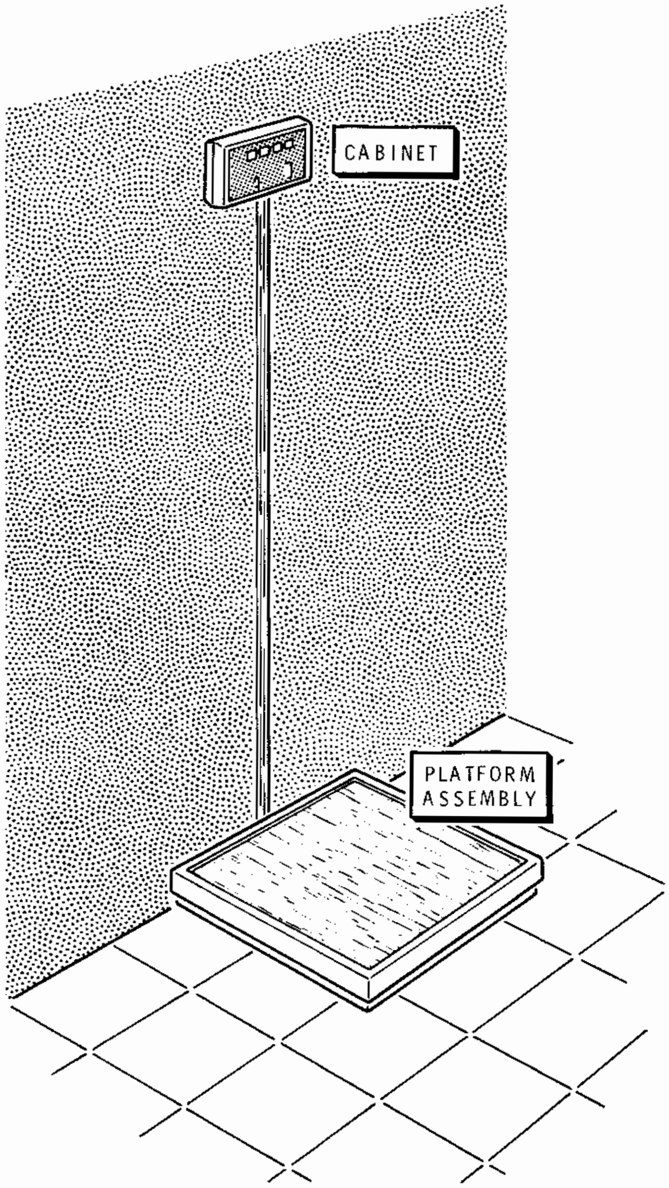
( ) Place the end of the left lever arm back in position on the end of the transducer and replace the platform top on the platform bottom. Check the turn-on sensitivity and repeat the procedure if necessary.

This completes the "Decrease Sensitivity" procedure. Proceed to "Final Platform Mounting."

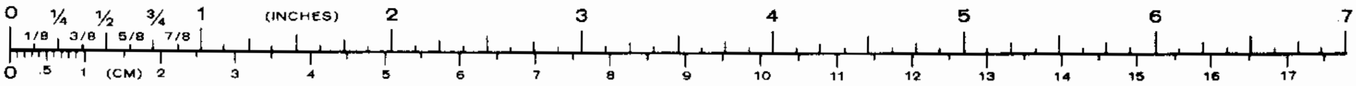
FINAL PLATFORM MOUNTING

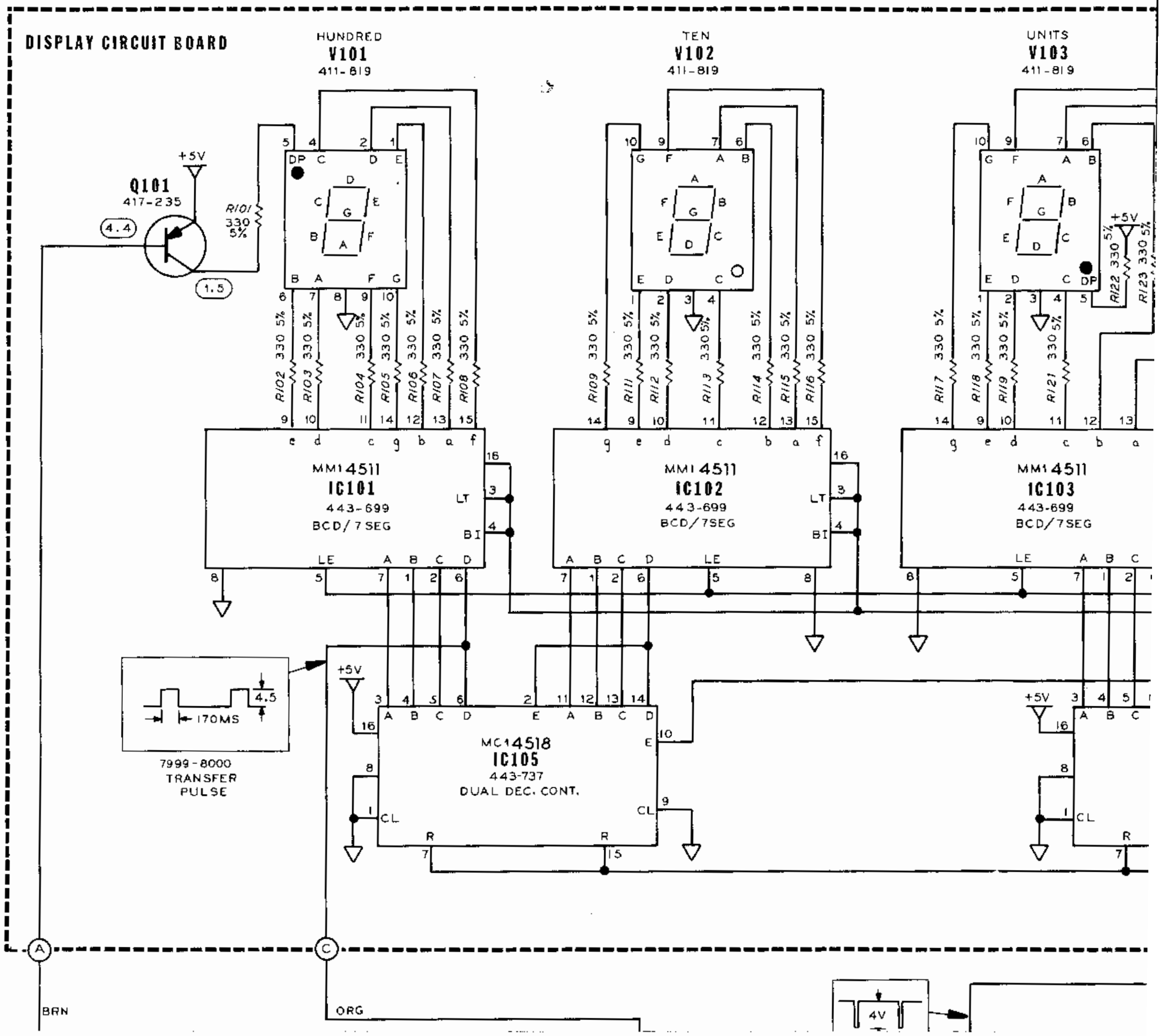
( ) Tilt the platform assembly only enough to turn the four clamps 90° as shown in the inset drawing of Pictorial 3-12.

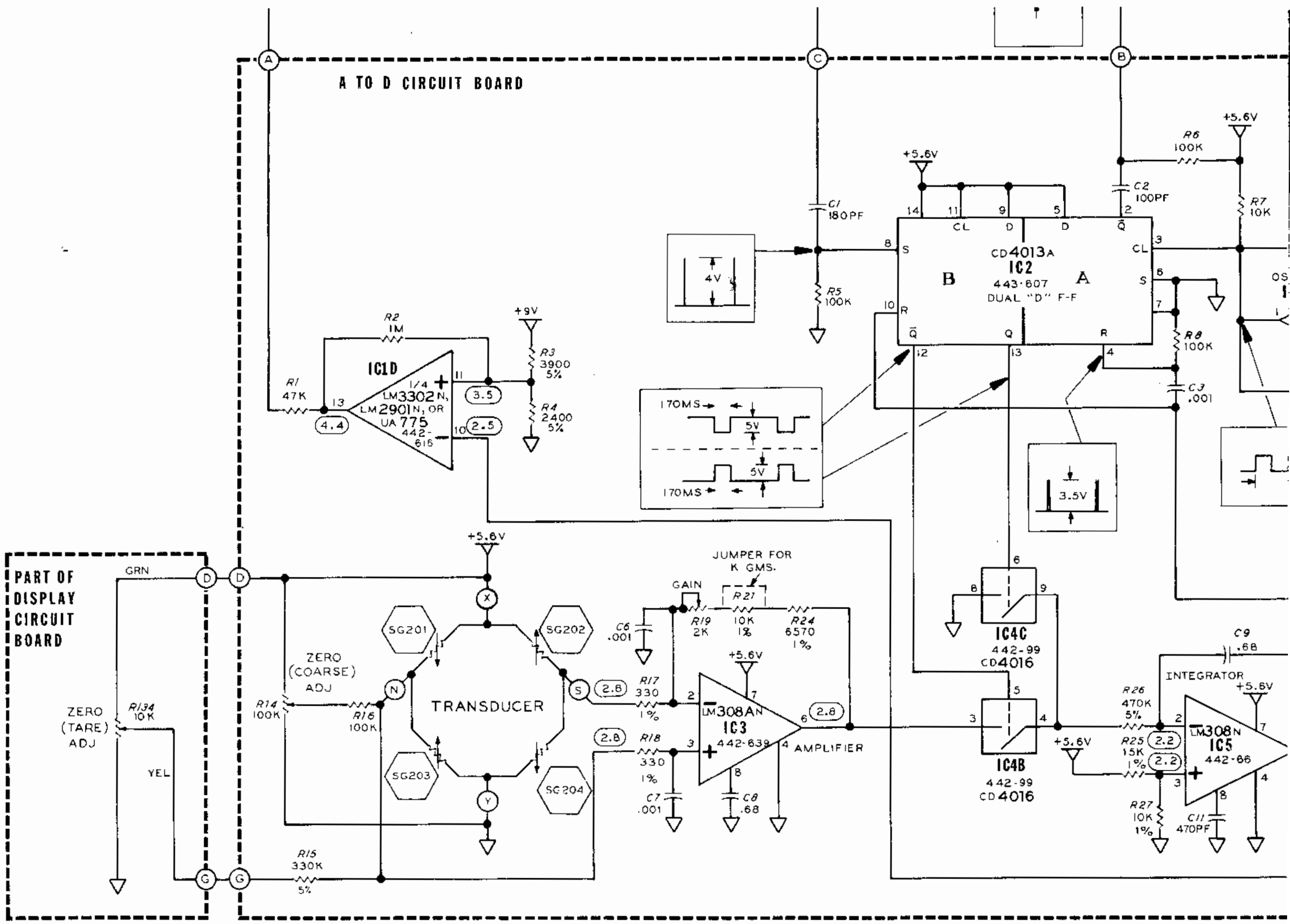
For floor mounting, this completes the "Final Assembly" of your Digital Scale; disregard the following five steps and proceed to "Operation." If you intend to mount the display cabinet on a wall, perform the following five steps.

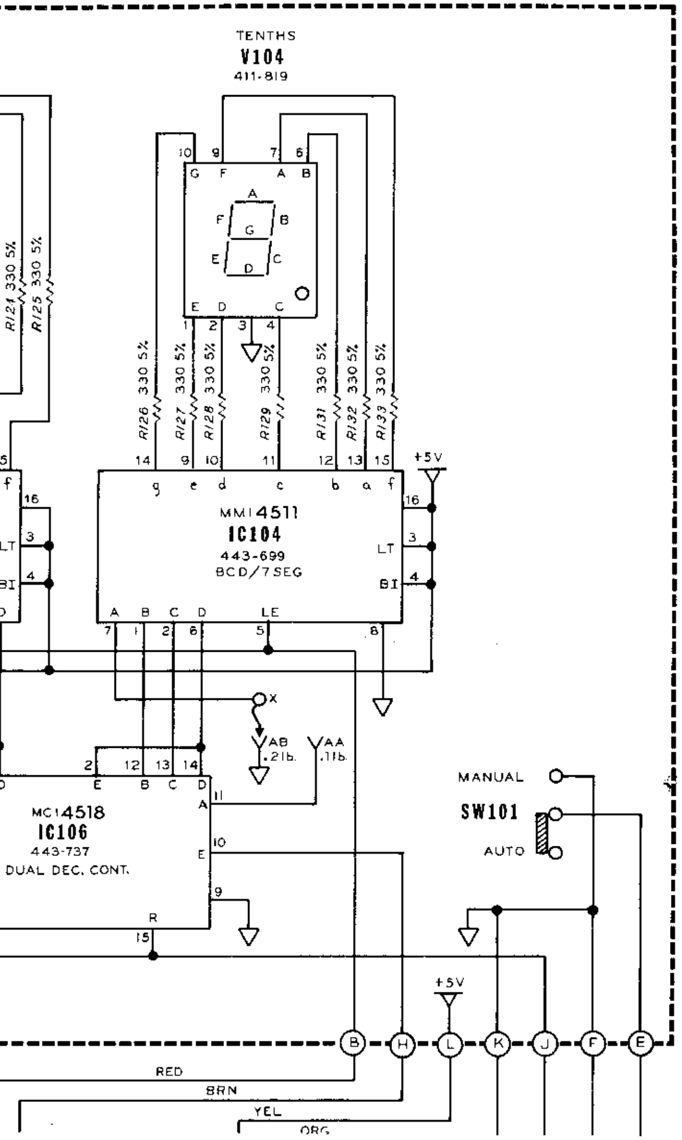


PICTORIAL 3-13




DISPLAY CIRCUIT BOARD
HUNDRED
V101
411-819
TEN
V102
411-819
UNITS
V103
411-819
Q101
417-235
+5V
R101
330
5%
MM14511
IC101
443-699
BCD/7SEG
MM14511
IC102
443-699
BCD/7SEG
MM14511
IC103
443-699
BCD/7SEG
MC14518
IC105
443-737
DUAL DEC. CONT.
170MS
4.5
7999-8000
TRANSFER
PULSE
BRN
ORG
4V


A TO D CIRCUIT BOARD
PART OF DISPLAY CIRCUIT BOARD
GRN
YEL
ZERO (TARE) ADJ
R134 10K
ZERO (COARSE) ADJ
R14 100K
R16 100K
R15 330K 5%
TRANSDUCER
SG201
SG202
SG203
SG204
+5.6V
R1 47K
R2 1M
IC1D
1/4 LM3302N, LM2901N, OR UA 775 442-616
+9V
R3 3900 5%
R4 2400 5%
C1 180PF
R5 100K
4V
170MS
5V
3.5V
CD4013A
IC2
443-607
DUAL "D" F-F
C2 100PF
R6 100K
R7 10K
R8 100K
C3 .001
JUMPER FOR K GMS.
GAIN
R19 2K
R21 10K 1%
R24 6570 1%
C6 .001
R17 330 1%
R18 330 1%
C7 .001
LM308AN
IC3
442-639
C8 .68
AMPLIFIER
IC4C
442-99
CD4016
IC4B
442-99
CD4016
C9 .68
INTEGRATOR
R26 470K 5%
R25 15K 1%
R27 10K 1%
C11 470PF
LM308N
IC5
442-66

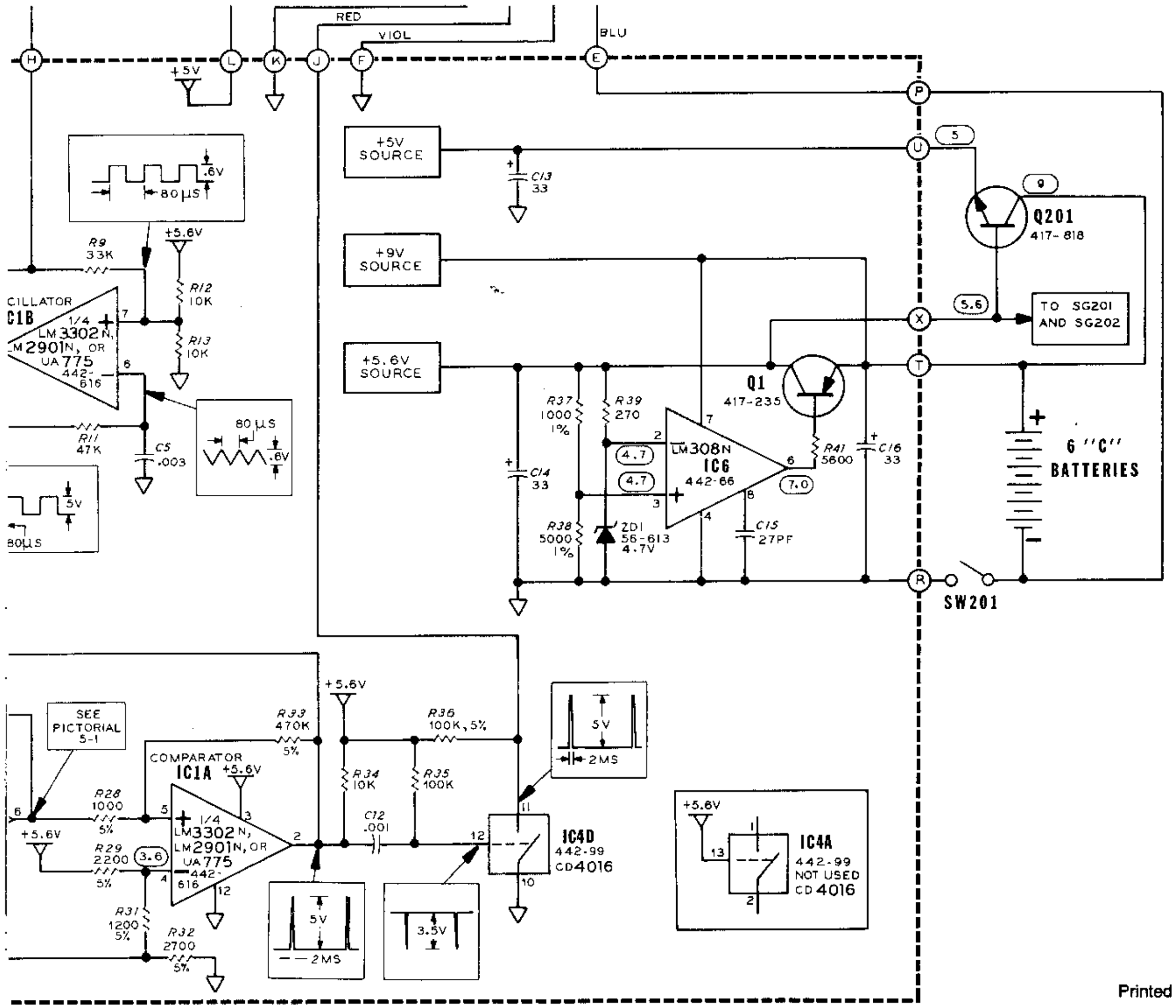


SCHEMATIC OF THE HEATHKIT® DIGITAL SCALE MODEL GD-1186

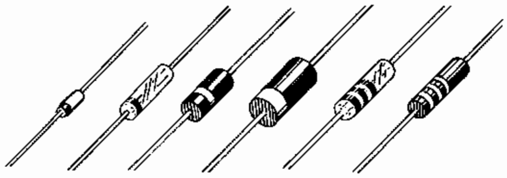
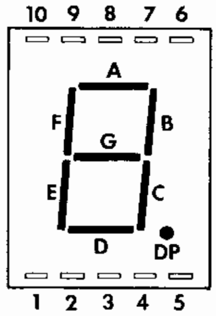
Part of 595-1948

NOTES:

1. ALL RESISTOR VALUES ARE IN OHMS (k=1000; M=1,000,000).
2. ALL CAPACITOR VALUES LESS THAN 1 ARE IN µF. CAPACITOR VALUES LARGER THAN 1 ARE IN pF.
3. REFER TO THE X-RAY VIEWS FOR THE PHYSICAL LOCATION OF PARTS.
4. ◯ THIS SYMBOL INDICATES A LETTERED CIRCUIT BOARD CONNECTION.
5. △ THIS SYMBOL INDICATES CIRCUIT BOARD GROUND.
6. ⬭ THIS SYMBOL INDICATES A DC VOLTAGE TAKEN WITH A HIGH IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO CIRCUIT BOARD GROUND. VOLTAGES MAY VARY ±20%. THE VOLTAGES WERE TAKEN WITH NO WEIGHT APPLIED TO THE SCALE.
7. WAVEFORMS WERE TAKEN AT THE POINT INDICATED. THE AMPLITUDE IS SHOWN AS PEAK-TO-PEAK VOLTAGE. THE WAVEFORMS WERE TAKEN WITH NO WEIGHT APPLIED TO THE SCALE.
8. ⬡ SG201 AND SG204 ARE MOUNTED ON THE BOTTOM OF THE METAL BEAM. SG202 AND SG203 ARE MOUNTED ON TOP. THIS IS NOT A PART OF THE A TO D CIRCUIT BOARD.


RED
VIOL
BLU
+5V
+5V SOURCE
+9V SOURCE
+5.6V SOURCE
C13 33
C14 33
C15 27PF
C16 33
R37 1000 1%
R38 5000 1%
R39 270
R41 5600
ZD1 56-613 4.7V
LM308N IC6 442-66
Q1 417-235
Q201 417-818
TO SG201 AND SG202
6 "C" BATTERIES
SW201
80 µS
.6V
+5.6V
R9 33K
R12 10K
R13 10K
R11 47K
C5 .003
IC1B
1/4 LM3302N, LM2901N, OR UA775 442-616
5V
80µS
SEE PICTORIAL 5-1
COMPARATOR IC1A
R28 1000 5%
R29 2200 5%
R31 1200 5%
R32 2700 5%
R33 470K 5%
R34 10K
R35 100K
R36 100K, 5%
C12 .001
2MS
3.5V
IC4D 442-99 CD4016
IC4A 442-99 NOT USED CD4016

Semiconductor Identification Charts

<table>
<tr><th>COMPONENT</th><th>HEATH PART NUMBER</th><th>MAY BE REPLACED WITH</th><th>IDENTIFICATION</th></tr>
<tr><td>ZD1</td><td>56-613</td><td></td><td>IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.
</td></tr>
<tr><td>V101, V102, V103, V104</td><td>411-819</td><td>FND-500</td><td>PIN CONNECTIONS
(TOP VIEW)

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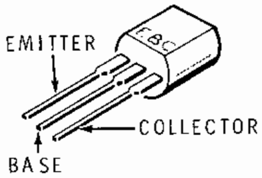
<tr><th>PIN</th><th>FND500</th></tr>
<tr><td>1</td><td>SEGMENT E</td></tr>
<tr><td>2</td><td>SEGMENT D</td></tr>
<tr><td>3</td><td>COMMON CATHODE</td></tr>
<tr><td>4</td><td>SEGMENT C</td></tr>
<tr><td>5</td><td>DP</td></tr>
<tr><td>6</td><td>SEGMENT B</td></tr>
<tr><td>7</td><td>SEGMENT A</td></tr>
<tr><td>8</td><td>COMMON CATHODE</td></tr>
<tr><td>9</td><td>SEGMENT F</td></tr>
<tr><td>10</td><td>SEGMENT G</td></tr>
</table></td></tr>
<tr><td>Q1, Q101</td><td>417-235</td><td>2N4121</td><td></td></tr>
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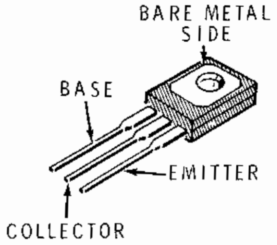
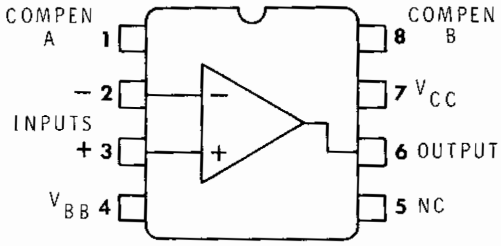
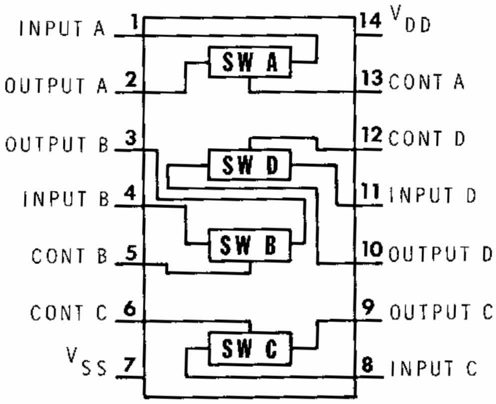
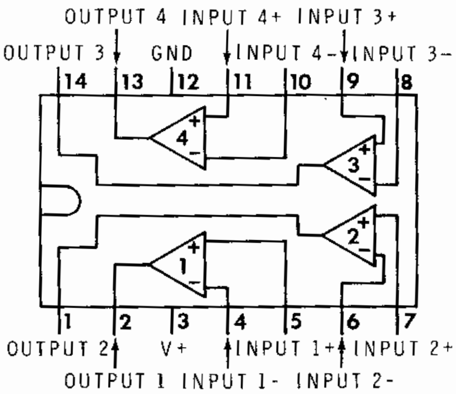
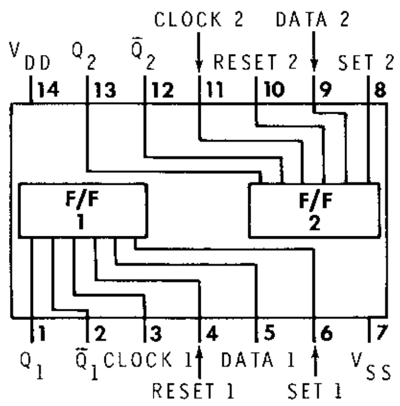
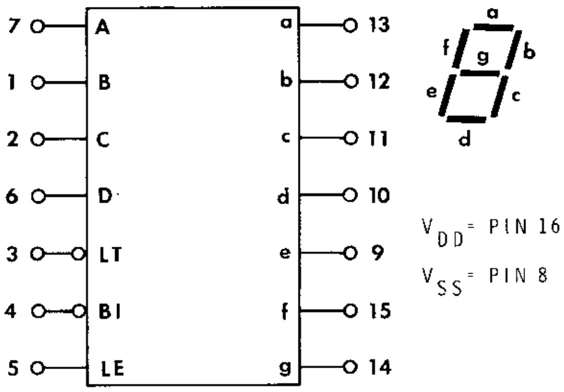
COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q201	417-818	MJE181	
IC5, IC6,	442-66	LM308N	TOP VIEW 
IC3	442-639	LM308AN	
IC4	442-99	CD4016	TOP VIEW 
IC1	442-616	LM3302N LM2901N, or UA775	TOP VIEW 

COMPONENT	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
IC2	443-607	CD4013AD	TOP VIEW 
IC101, IC102, IC103, IC104	443-699	MM14511	 DISPLAY 
IC105, IC106	443-737	MC14518