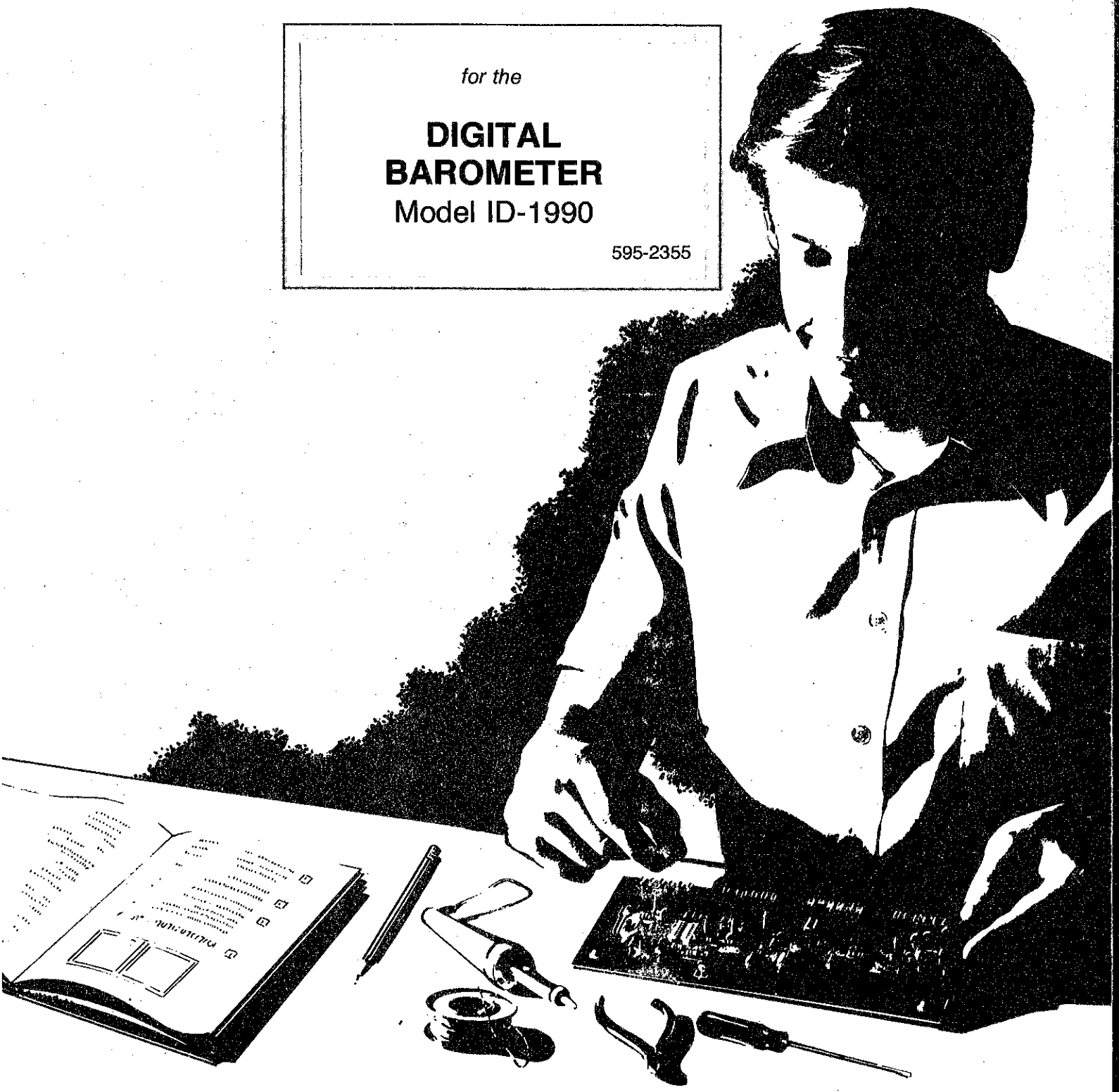
HEATHKIT® MANUAL

for the

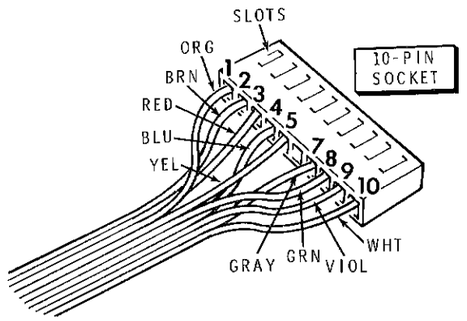
DIGITAL BAROMETER

Model ID-1990

595-2355



HEATH COMPANY • BENTON HARBOR, MICHIGAN



Detail 8-6A

Refer to Pictorial 8-6 (Illustration Booklet, Page 15) for the following steps.

( ) Place the chassis inside one of the oven cabinet halves as shown. Be sure the 9-wire cable is in the cutout in the end of the cabinet half.

( ) Place the remaining cabinet half on the assembly as shown. Temporarily secure the cabinet halves together with two sets of 4-40 × 1-3/8" hardware (at opposite corners). Be sure the slot in top cabinet half is on the end of the assembly that has the cable.

( ) Separate the wires at the free end of the 9-wire cable for 1-1/2" and prepare the ends.

( ) Trim the bare portions of the wires at the free end of the 9-wire cable to 1/8". Then install a spring connector on the end of each wire.

Refer to Detail 8-6A and push the spring connectors into a 10-pin socket as follows:

( ) Orange wire in hole 1.

( ) Brown wire in hole 2.

( ) Red wire to hole 3.

( ) Blue wire to hole 4.

( ) Yellow wire to hole 5.

NOTE: Skip hole 6.

( ) Gray wire to hole 7.

( ) Green wire to hole 8.

( ) Violet wire to hole 9.

( ) White wire to hole 10.

Refer to Pictorial 8-7 for the following steps.

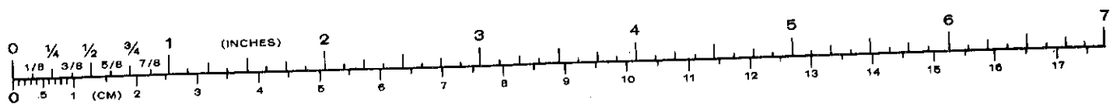
( ) Be sure the line cord of your Barometer is not plugged in.

( ) Remove the six screws from the rear panel of your Barometer. Then remove the rear panel.

( ) Push the 10-pin socket coming from the oven assembly onto plug P303 on the analog circuit board. Be sure the slots in the socket face the top of your Barometer as shown.

( ) Reinstall the rear cover on the Barometer. Use six 6-32 × 1/4" black screws.

This completes the assembly of your Barometer. Proceed to "Calibration."



CALIBRATION

If at any time you do not obtain the proper results in the following steps, refer to the "In Case of Difficulty" section of this Manual and correct the problem.

( ) Make sure the oven assembly is connected to plug P303 on the analog circuit board.

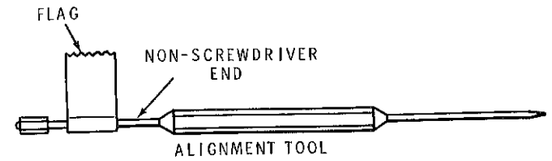
( ) Be sure the INCHES - Mb/kPa slide switch on the rear panel of your Barometer is at INCHES. NOTE: The settings of the other switches are not important at this time.

( ) Refer to Pictorial 9-1 and place a small tape "flag" on the non-screwdriver end of the alignment tool. This will aid you in counting the number of turns of the tool during calibration.

Refer to Pictorial 9-2 (Illustration Booklet, Page 17) for the following steps.

( ) Remove the top cabinet half from the oven assembly. Then use the alignment tool to preset the three controls in the assembly as follows:

GAIN ADJUST (R219)	25 turns counterclockwise; then 10 turns clockwise. (NOTE: This centers the control in its range).
COARSE ADJUST (R213)	25 turns counterclockwise; then 5 turns clockwise.
FINE ADJUST (R209)	25 turns counterclockwise; then 10 turns clockwise.



PICTORIAL 9-1

( ) Temporarily set the top cabinet half back onto the oven assembly. It is not necessary to secure it with hardware at this time.

( ) Plug the line cord of the Barometer into the proper AC outlet.

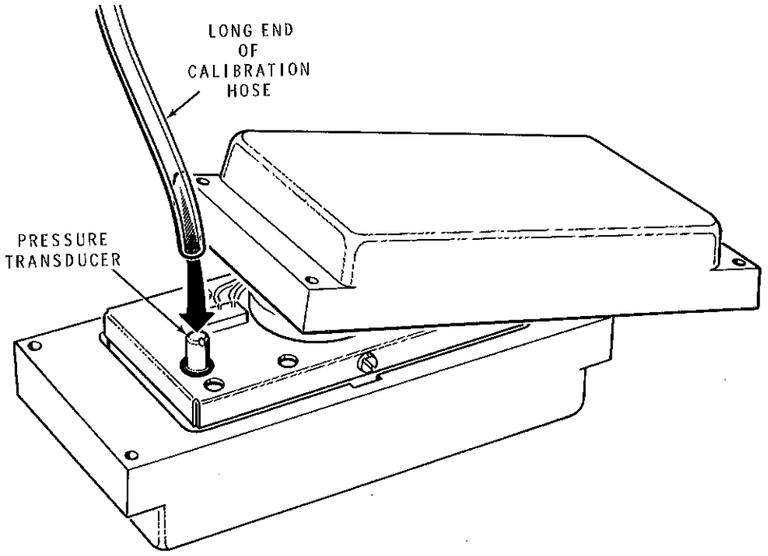
NOTE: The purpose of the calibration hose that you will use in the following steps, is to cause a change in pressure that is equivalent to a 2" drop in a mercury column.

( ) Fill the calibration hose with between 22 and 30 inches of water. Then clamp the hose in the top calibration clips as shown. Tap the sides of the hose to remove any air bubbles.

NOTE: Let the temperature inside the oven assembly stabilize for at least two hours before you continue.

( ) 1. Use the alignment tool to adjust the COARSE ADJUST control (R213) for an indication of approximately 30.00 on the display (not critical at this time). NOTE: Do not remove the cover from the oven assembly any longer than necessary.

( ) 2. Set the cover on the oven assembly so the pressure transducer is exposed (see Pictorial 9-2).



Detail 9-2A

IMPORTANT: It is very important that you do not get any water inside the pressure transducer. Make sure you position the oven assembly so it is higher than the water level in the hose.

( ) 3. Push the long end of the calibration hose onto the top of the pressure transducer (see Detail 9-2A).

( ) 4. Adjust the longer hose (right clip) so the water level in the hose is exactly even (see Pictorial 9-3 Part A, Illustration Booklet, Page 18).

( ) 5. After about 30 seconds, write down the indication on the display. NOTE: If this indication goes over 39.99, the hundreds digits will not indicate. Adjust the COARSE ADJUST counterclockwise until the display indicates approximately 30.00 (not critical).

( ) 6. Remove the hose from the left clip on the calibration fixture. Then clamp it in the bottom clip on the fixture.

( ) 7. Adjust the hose so the water levels are even with the top of their corresponding clips (see Pictorial 9-3 Part B, Illustration Booklet, Page 18).

( ) 8. After about 30 seconds, write down the new indication on the display.

( ) 9. Subtract the reading taken in step 8 from the reading taken in step 5.

( )10. If the result in step 9 is less than 2.00, turn the GAIN ADJUST control (R219) clockwise a small amount (depending on how much the difference is).

If the result in step 9 is greater than 2.00, turn the GAIN ADJUST control (R219) counterclockwise a small amount (depending on how much the difference is).

( )11. Return shorter hose to the top left clip of the calibration fixture. Then repeat step 4 through 10 until the result in step 9 is 2.00 (1.99 to 2.01 is okay).

( )12. Make sure the oven assembly is higher than the water level in the hose. Then remove the hose from the pressure transducer and set the top cabinet half back onto the oven assembly.

In the following steps you will calibrate the barometric pressure circuit of your Digital Barometer. You will do this by adjusting it to the same reading as a reference barometer at some local weather observing station (radio or TV station, Coast Guard station, airport, etc.).

At the heart of this pressure circuit is pressure transducer A201, a very responsive and accurate device. But since it will reflect extremely minute variations in the environment around you, several factors will affect the overall accuracy of your BAROMETRIC PRESSURE display, including:

- The accuracy of the reference barometer (mercury column, aneroid, etc.) from which your Barometer is calibrated.
- The accuracy with which the person takes the reading from the reference barometer, and how recently he took the reading.
- The accuracy of the observing station's conversion of atmospheric pressure to corrected sea level BAROMETRIC pressure.
- The difference in the weather pressure gradients between where the reference barometer is and where your Barometer is.
- The stability of the environment your Barometer is monitoring. The environment could easily be changed by such things as window fans, an air conditioner, the opening and closing of doors and windows, placement of the Barometer after calibration (10′ in height = +.01 in. Hg) and atmospheric pressure gradients within your environment.
- The accuracy of the calibration itself. The best time to do the calibration is during a stable and steady barometric pressure interval.

( )13. Call an airport, radio station, or TV station, etc. and ask for the barometric pressure. Usually, an airport flight service station (FSS) is best for this purpose.

NOTES:

1. In the following steps, after you adjust a control, wait at least 30 seconds for the Barometer to update the display.

2. Remove the cover from the oven assembly only long enough to make these adjustments.

( )14. Adjust control R213 (COARSE ADJUST) and set the display to the nearest 0.1 inch of mercury. Example: If the barometric pressure is 29.75, use this control to set the display to 29.7 and disregard the remaining .05 for now.

( )15. Adjust control R209 (FINE ADJUST) and set the display to the correct 1/100 inch of mercury. Example: If the barometric pressure is 29.75, use this control to set the display to indicate 29.75 exactly.

NOTES:

1. After completing the Calibration, and after the Barometer has been operating for one or two hours, repeat steps 14 and 15. After two weeks of operation, repeat only step 15.

2. For continued accuracy, we recommend you check the calibration of your Barometer at least every six months. You should only have to repeat step 15.

( ) Refer to Pictorial 9-4 (Illustration Booklet, Page 19) and secure the top cabinet half to the bottom cabinet half. Use 4-40 × 1-3/8″ hardware.

This completes the "Calibration." Proceed to the "Operation" section of this Manual.

OPERATION

Refer to Pictorial 10-1 (Illustration Booklet, Page 20) for the locations of the front panel displays and switches. Refer to Pictorial 10-2 (Illustration Booklet, Page 20) for the locations of the rear panel connections and switches.

NOTE: The numbers at the beginning of the following paragraphs correspond to the numbers on Pictorials 10-1 and 10-2.

DISPLAY

BAROMETER

1. BAROMETRIC PRESSURE display — Indicates the barometric pressure in inches of mercury, millibars (mb), or kiloPascals (kPa).

2. RISING/FALLING Indictors — Indicate if the barometric pressure is rising or falling. If the barometric pressure is steady, neither indicator will be lit.

3. INCHES/MILLIBARS/KILOPASCALS indicators — Indicate whether the barometric pressure is being displayed in inches of mercury, millibars, or kiloPascals. NOTE: KiloPascals is the metric measure of pressure. One bar (1000 mb) is equal to 100 kPa. Resistor R108 should be installed on the display circuit board to obtain the correct kPa indication on the display (see Pictorial 1-2 on Page 12).

TIME/DATE

4. HOURS/MONTH display — Indicates the hours (1-12 or 0-23) or the month (1-12).

5. MINUTES/DAY display — Indicates the minutes (0-59) or the day (1-31).

6. SECONDS display — Indicates the seconds (0-59).

7. AM/PM indicators — Indicate AM or PM while 12-hr time is displayed, but are turned off while the date or 24-hr time is displayed.

FRONT PANEL PUSHBUTTON SWITCHES

8. CLEAR — Clears the minimum or maximum pressure from memory. This switch and another switch (MINIMUM or MAXIMUM) must be pushed simultaneously. After you release these switches, any future pressure is entered into memory for later comparison. Also, the present date and time is put into memory.

9. MINIMUM — Causes the minimum pressure that was sensed after the last time this function was "cleared" to be displayed. Also, the time and date that this minimum pressure occurred will be displayed.

10. MAXIMUM — Causes the maximum pressure that was sensed after the last time this function was "cleared" to be displayed. Also, the time and date that this maximum pressure occurred will be displayed.

11. RATE — Causes the rate of pressure change within the last hour to be displayed. (The display will be the displayed barometric pressure for the first hour after you plug in the line cord.) There will be no Rate indication during the first hour of operation.

REAR PANEL SWITCHES

TIME/DATE

12. HR/MO ADVANCE — Advances the HOURS/MONTH display one hour, or one month, each half second.

13. MIN/DAY ADVANCE — Advances the MINUTES/DAY display one minute, or one day,each half second.

NOTE: When the two switches (HR/MO ADVANCE and MIN/DAY ADVANCE) are pushed together,they will advance the MINUTES/DAY display ten minutes each half second.

14. START/STOP — Starts and stops the clock. First, stop the clock. Then use the HR/MO ADVANCE, the MIN/DAY ADVANCE, and the AUTO/HOLD switches to set the date and time. As the time reaches the set time, start the clock.

15. AUTO/HOLD — In the AUTO position, the TIME/DATE display alternately displays the time and date. In the HOLD position, either the time or date is displayed continuously whichever one was being displayed when the switch was pushed to the HOLD position.

16. 12HR/24HR — Selects either the 12-hour or 24-hour format for displaying time.

PRESSURE

17. INCHES/Mb/kPa — Determines whether the barometric pressure will be displayed in inches of mercury, millibars, or kiloPascals. It also selects the INCHES or MILLIBARS (mb)/kiloPascals (kPa) indicator. NOTE: When this switch is in the mb/kPa position, the display will indicate millibars if resistor R108 is not installed on the display circuit board. If resistor R108 is installed, the display will indicate kiloPascals.

SETTING THE DATE AND TIME

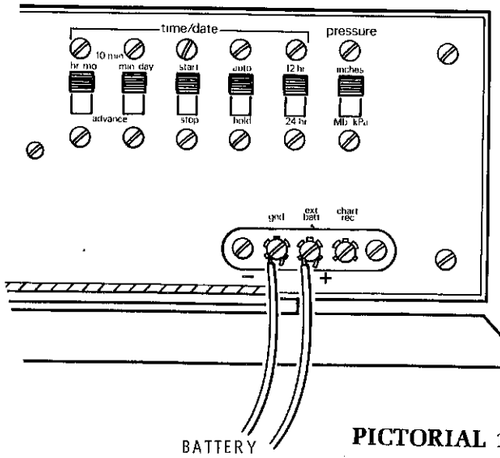
DATE

1. When the **date** is being displayed, slide the TIME/DATE AUTO/HOLD switch to the HOLD position.
2. Use the HR/MO and the MIN/DAY switches to set the date in the TIME/DATE display.
3. Slide the TIME/DATE AUTO/HOLD switch to the AUTO position.

TIME

1. When the **time** is being displayed, slide the TIME/DATE START/STOP switch to the STOP position.
2. Use the HR/MO and MIN/DAY switches to set the TIME/DATE display to the desired **time**. Also note the AM/PM indicators.
3. As real time reaches the time set in the display, slide the START/STOP switch to the START position.

REAR PANEL CONNECTIONS



PICTORIAL 10-3

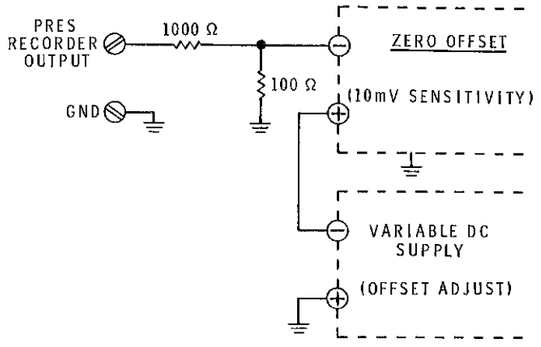
EXTERNAL BATTERY

An external battery will keep the memory intact during power interruptions. NOTE: The battery you use (not supplied) must be able to supply a voltage between 6.2 and 14 volts DC at 60 milliamperes during the extent of the power interruption.

Refer to Pictorial 10-3 and connect your battery as follows:

( ) 1. Connect the negative (–) terminal of the battery to GND (ground) terminal on the Barometer.

( ) 2. Connect the positive (+) terminal of the battery to the EXT BATT (external battery) terminal on the Barometer.



PICTORIAL 10-4

CHART RECORDER

Pictorial 10-4 shows you how to connect a chart recorder to your Barometer so you can graphically monitor the barometric pressure. The 1000 Ω and 100 Ω resistors (not supplied) set the slope (gain) of the pressure signal, while the DC supply provides an offset adjustment.

Use the following procedure to calibrate the chart recorder against the display on the Barometer:

1. Preset the chart recorder's Gain control to the center of its rotation.
2. Adjust the DC supply until the chart recorder indicates the desired mark on the graph paper. This mark becomes the value displayed on the Barometer. Each unit of resolution becomes .01 inches of mercury.

NOTE: The charted barometric pressure is used mostly as a trend and rate-of-change monitor, and is not intended for absolute accuracy.

IN CASE OF DIFFICULTY

WARNING: When the line cord is connected to an AC outlet, AC voltage is present on the rear panel (see Pictorial 11-1). Be careful you do not contact this voltage or an electrical shock can result.

Begin your search for any trouble that occurs after assembly by carefully following the steps listed below in the "Visual Tests." After you complete the "Visual Tests," refer to the "Troubleshooting Chart."

NOTE: Refer to the "Circuit Board X-Ray Views" for the physical location of parts on the circuit board.

VISUAL TESTS

1. Recheck the wiring. Trace each lead with a 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 that you have consistently overlooked.

2. About 90% of the kits that are returned to the Heath Company for repair do not function properly due to poor connections and soldering. Therefore, you can eliminate many troubles by reheating all connections to make sure they are soldered as described on Pages 10 and 11 of the Assembly Manual. Be sure there are no solder "bridges" between circuit board foils.

3. Check to be sure all transistors and diodes are in their proper locations. Make sure each lead is connected to the proper point. Make sure that each diode band is positioned above the band printed on the circuit board.

4. Check electrolytic capacitors to be sure their positive (+) mark or negative (−) mark is at the correct position.

5. Check to be sure that each IC is properly installed in its socket, and that the pins are not bent out or under the IC. Also be sure the IC's are installed in their correct positions.

6. Check the values of the parts. Be sure in each step that you wired the correct part into the circuit, as shown in the Pictorial. It would be easy, for example, to install a 22 kΩ (red-red-org) resistor where a 2200 Ω (red-red-red) resistor should have been installed.

7. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring.

8. Look between each circuit board and the chassis to be sure all leads were cut off short.

9. A review of the "Circuit Description" may also help you determine where the trouble is.

If you still have not located the trouble after the "Visual Tests" are completed, and a voltmeter is available, check voltage readings against those shown on the Schematic Diagram. Read the "Precautions for Bench Testing" before you make any measurements. NOTE: All voltage readings were taken with a high impedance voltmeter. Voltages may vary as much as ±20%.

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

PRECAUTIONS FOR BENCH TESTING

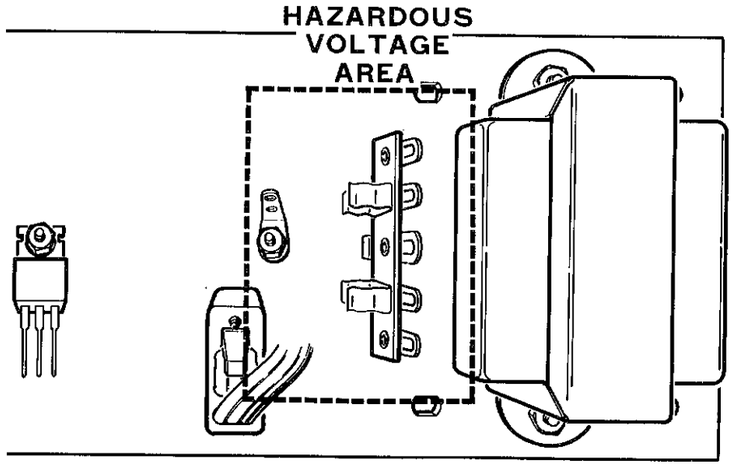
NOTE: Use a high input impedance voltmeter for voltage measurements.

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

2. Be sure you do not short circuit any terminals when you make voltage measurements. If the probe slips, for example, and shorts out a bias or voltage supply point, it is almost certain to damage one or more transistors, diodes, or IC's.

3. Do not remove any components while the kit is operating; this could cause considerable damage.

If you make repairs to your Barometer, make sure you eliminate the cause as well as the effect of the trouble. If, for example, you find a damaged resistor, be sure to find out what caused the resistor to become damaged. If the cause is not eliminated, the replacement resistor may also become damaged when the unit is put back into operation.



PICTORIAL 11-1

TROUBLESHOOTING CHART

The following chart lists conditions and possible causes of several specific malfunctions. If a particular part is mentioned (Q7 for example) as a possible cause, check that part to be sure it is installed and/or wired correctly. It is possible, on rare occasions, for a part to be faulty and require replacement. NOTE: Any time wiring is mentioned, this includes interconnections between the various circuit boards, if applicable. When a particular circuit is mentioned, refer to the "Circuit Description" for component details.

CONDITION	POSSIBLE CAUSE
No display (unit appears dead).	1. Transformer T1 wiring. 2. Fuse F1. 3. Integrated Circuit U1.
Only LED's and one decimal point lit.	1. Integrated circuit U102. 2. Crystal Y1.
Clock operates; barometer indicates 0.00.	1. Integrated circuits U201 or U202. 2. Pressure transducer A201. 3. Oven assembly unplugged.
Barometer is not stable (drifts).	1. Integrated circuit U202. 2. Pressure transducer A201.
Barometer drifts with temperature.	1. Integrated circuit U301 or associated components.
Oven assembly too hot or completely off.	1. Thermistor R233. 2. Integrated circuit U301 or associated components.
Cannot calibrate the Barometer.	1. Wrong calibration resistors installed during assembly. 2. Pressure transducer A201. 3. Parts interchanged on the oven circuit board
Switches do not operate properly.	1. Wiring. 2. Transistors Q114, Q115, Q116, or Q117.

SPECIFICATIONS

DIGITAL CLOCK/4-YEAR CALENDAR

Displays	6-digit, 12- or 24- hour format time readout; 4-digit date readout. AM-PM indicator in 12-hour format.
Time Accuracy	Determined by the accuracy of the AC line frequency. No accumulative error.
Controls (rear panel)	Clock start-stop. Hours/months advance. Minutes/day advance. 10 minutes advance. Time-date hold. 12- or 24- hour format.

BAROMETER

Displays	4-digit readout. Separate indicators show whether the pressure is rising or falling and whether the display is in inches of mercury or millibars/kiloPascals.
Pressure Range	28.00 to 32.00 in. Hg (inches of mercury). 98.1 to 1050 millibars. 9.81 to 105 kiloPascals.
Accuracy of Reading	29.00 to 31.00 in. Hg (inches of mercury). ±.03 in Hg (15°C to 35°C).
Memory	Date, time, and magnitude of maximum and minimum pressure.
Controls	
Front panel	Minimum pressure select and clear. Maximum pressure select and clear. Rate of change/hour select.
Rear panel	Millibars/kiloPascals or inches of mercury select.

GENERAL

Power Requirements	120/240 volts AC, 50/60 Hz; approximately 14 watts. Provision for connection of an external battery, which can supply 6.2 to 14 volts DC at 60 mA., to hold memory contents during power interruptions (this feature suspends all functions during the interruption and draws current from the battery only during the interruption).
Operating Temperature	15°C to 35°C (59°F to 95°F).
Dimensions (overall)	11-1/2″ wide × 5″ deep × 5-1/4″ high (29.2 × 12.7 × 13.3 cm).
Weight	4.8 lb. (2.2 kg).

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

GENERAL

Refer to the Block Diagram (Illustration Booklet, Page 21) and the Schematic Diagram (large fold-in) while you read the following general description. The component numbers are arranged in the following groups to help you locate specific parts on the Schematic, circuit boards, and the rear panel:

1-99	Parts on the rear panel.
101-199	Parts on the display circuit board.
201-299	Parts in the oven assembly.
301-399	Parts on the analog circuit board.
401-450	Parts on the switch circuit board.

The heart of the Digital Barometer is integrated circuit U102, a 3870 microprocessor (computer-on-a-chip). This IC accepts the input signal from the pressure transducer and processes this signal for use by the display and memory circuits. Proper conversion gating times are precisely derived from the microprocessor's 3.58 MHz crystal clock oscillator, while a 50/60 Hz synchronous signal from the AC line allows the IC to keep time.

When you first power up the Weather Computer, the microprocessor determines whether the AC line frequency is 50 or 60 Hz and properly scales this frequency for accurate timekeeping.

Pressure is monitored by A201, which provides a voltage that is proportional to the pressure ($\Delta V/\Delta P$ = 3.2744 mV/in. Hg). This voltage is applied to a slope correction amplifier (formed by U202A and U202B). The resulting voltage is proportional to the pressure ($\Delta V/\Delta P = -.1$ V/in. Hg) and is referenced to a vacuum at zero volts. This voltage is applied to the voltage-to-frequency converter, formed by U201A and U202C, and provides a frequency proportional to the input voltage ($\Delta f/\Delta V = -100$ Hz/V). The microprocessor displays barometric pressure as follows:

Display = 10[(−.1V/in. Hg)(−100 Hz/V)(P in. Hg)]

EXAMPLE: If P (in. Hg) = 29.92 (which is standard atmospheric pressure at sea level), then:

Display = 10 [(−.1V/in. Hg)(−100 Hz/V) (29.92)]

Display = 29.92

This 4-digit number is displayed with a fixed decimal point between the second and third digits (29.92).

Microprocessor U102 generates a 4-bit code for use by the 4-to-16 line decoder, U101, which sequentially selects the correct one of 10 digits to be displayed. When this digit is selected, U101 provides an 8-bit segment code, which lights the proper segments in the display.

The microprocessor stores memory data into the random access memory IC, U103, and also reads this data from U102 via the 4-bit bi-directional data lines. This data, which is a 4-bit word, is located in the memory with an 8-bit address also supplied by the microprocessor. A battery backup circuit supplies power for U103 in the event of a brown-out or AC power interruption. This holds the contents of the RAM (read-write memory) intact.

All power for the Weather Computer is provided by a +5 volt, +15 volt, and −15 volt DC supply.

The switch functions are digit select signals which are selectively applied to the front and rear switch bus, and these functions are interpreted by the microprocessor.

NOTE: The following sections will give you a more detailed description of each individual circuit.

PRESSURE SENSOR

A piezo-resistive bridge forms pressure transducer A201. This transducer is biased by the 1.5mA constant current source formed by U201B, R207, and R208, which provides a voltage proportional to the atmospheric pressure that is referenced to zero within a vacuum. Optional components R201 through R206 compensate this bridge circuit to the required accuracy. The voltage is then applied to an amplifier formed by U202A and U202B and the associated components before it is applied to the voltage-to-frequency converter.

VOLTAGE — TO — FREQUENCY CONVERTER

The voltage-to-frequency converter is formed by integrator U202C and comparator U201A. The negative analog voltage from U202A is applied to R223 and integrates with time into a positive-going ramp across C208. When this ramp at the output of U202C reaches the comparator's threshold value, which is established by R227 and D202, the output from U201A quickly switches from −15 volts to +15 volts. This transition closes FET switch Q201 and reduces the voltage across C208 to zero. The output from U201A then returns to its quiescent state of −15 volts. C209 causes this transition to be quite fast.

U202C and U201A produce pulses which are applied through D301 to the input of the discrete monostable formed by Q303 and Q304. The output from Q304 is a constant pulse width which translates to +5 and 0 volts for compatibility with the microprocessor. These pulses enter the microprocessor (via pin 16), which uses programmed transfer to process the pulses for the display.

MICROPROCESSOR — RAM

Microprocessor U102 (a computer on a chip) forms the heart of this Barometer. This IC accepts the transducer sensor signal and interprets it into a display. It also stores data into RAM (Random Access Memory) U103, which you can retrieve any time you wish. This data is in the form of 4-bit words which sequentially enter the RAM via the 4-bit bidirectional data bus and ports I/O_1, I/O_2, I/O_3, and I/O_4. An 8-bit address bus (U103 pins 1 through 7 and 15) enables the microprocessor to read from or write the data into the RAM. The read-write command comes from U102.

Front panel switches enable you to retrieve information, maximum and minimum temperature, pressure, etc., for display. U102 interprets these commands along with commands from the switches at pins 18 and 19 so you can set the time and select the units of display. These switches are explained under "Switching."

The 3.58 MHz crystal connected to U102 pins 1 and 2 provides a clock for the operation of the microprocessor.

When you first power up the Barometer, the microprocessor determines if the AC line frequency is 50 or 60 Hz. Line frequency is then scaled properly for accurate timekeeping.

DIGITAL DISPLAY

Microprocessor U102 provides a 4-bit binary code to 4-to-16 line decoder U101. This code is used to select one of the 10 display digits (V101 thorugh V111) in a sequential, interlaced, multiplexed pattern.

The digit select signal for U101 is a logic 1 (+5 volts) and is applied to the base of the appropriate transistor at Q101 through Q111. The selected transistor sinks the current of the lighted digit. At the same time, the appropriate 8-segment code is applied to the segment bus drive circuitry formed by Q118 and Q119, Q121 and Q122, Q123 and Q124, Q125 and Q126, Q127 and Q128, Q129 and Q131, Q132 and Q133, and Q134 and Q135. The transistors that correspond to the segments to be lighted are switched high to provide a current source.

SWITCHING

U102, on the Display circuit board, monitors the two switch buses at pins 18 and 19 and determines which switches you have pushed in. Pin 18 monitors the front panel switches through switched buffers Q114 and Q115, while pin 19 monitors the rear panel switches through switched buffers Q117 and Q116.

POWER SUPPLY

Most of the power supply circuitry is located on the analog circuit board as is the battery back-up circuitry.

Transformer T1 steps down the 120-240-volt AC line voltage into two center-tapped secondary voltages. One of these windings provides power for the +5-volt circuits, while the others provide power for the +15-volt and −15-volt circuits.

Diodes D309 and D311, along with capacitor C311 supply 10.5 volts DC, which U1 regulates to +5 volts for use by the various circuits. This +5 volts is further filtered by C308 and C309 and supplies the display circuit board via the analog circuit board plug.

The +15 volt DC source for the analog circuitry is supplied by D312, D313, C314, U303, C313, and C312.

The −15 volts DC for the analog circuitry is supplied by D314, D315, C317, C316, C315, and U304.

Diode D303, along with the transistor switch circuitry formed by R327, R328, R329, C307, and Q314, provides a 50/60 Hz square wave for accurate timekeeping. The waveform is applied to microprocessor pin 17.

The battery back-up circuit, which keeps the contents of the RAM intact during a power interruption, is located on the analog circuit board. D305, D306, and C304 produce a full-wave rectified and filtered DC voltage which reverse biases D304 when AC current is present. This prevents current drain from the battery when it is not needed. Zener diode D308 and a transistor switch circuit, formed by R318, R319, R321, and Q307, monitor the AC line voltage and provide a "brown-out" threshold sensing circuit. If the sensing circuit detects a large enough brown-out or a complete loss of power, transistor switch Q307 shuts off and forward biases D304. The current through R321 turns transistor switch Q308 on, which quickly discharges C305. This turns on the transistor switch formed by D307 and Q309. When this happens, battery current is supplied to RAM U103. A series-pass regulator, formed by Q311, D320, and R325, holds the voltage to U103 to +5 volts. At the same time, the transistor switch formed by Q312 and R326 holds the microprocessor reset.

The voltage at zener D320 also inhibits the RAM from performing read or write operations during the AC interruption.

When AC power is restored, the reverse of the above takes place. An RC circuit formed by C305 and R323 however, charges slowly to allow the AC line voltage to stabilize before it reactivates the RAM. The RAM now receives +5 volts from transistor switch Q313, which is turned on by the +15-volt supply. Q313 is reverse-biased during a power interruption.

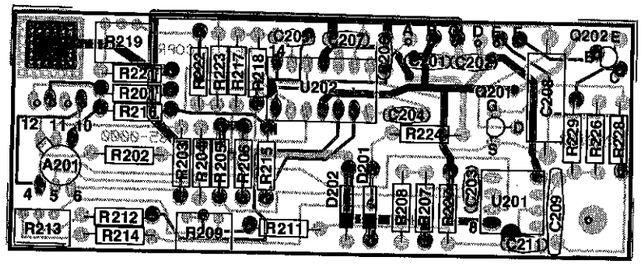
CIRCUIT BOARD X-RAY VIEWS

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

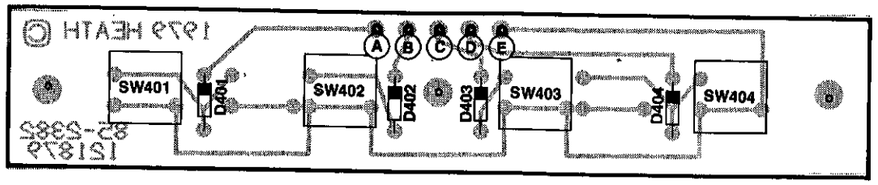
A. Find the circuit board number (R5, C3, etc.) on the X-Ray View.

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

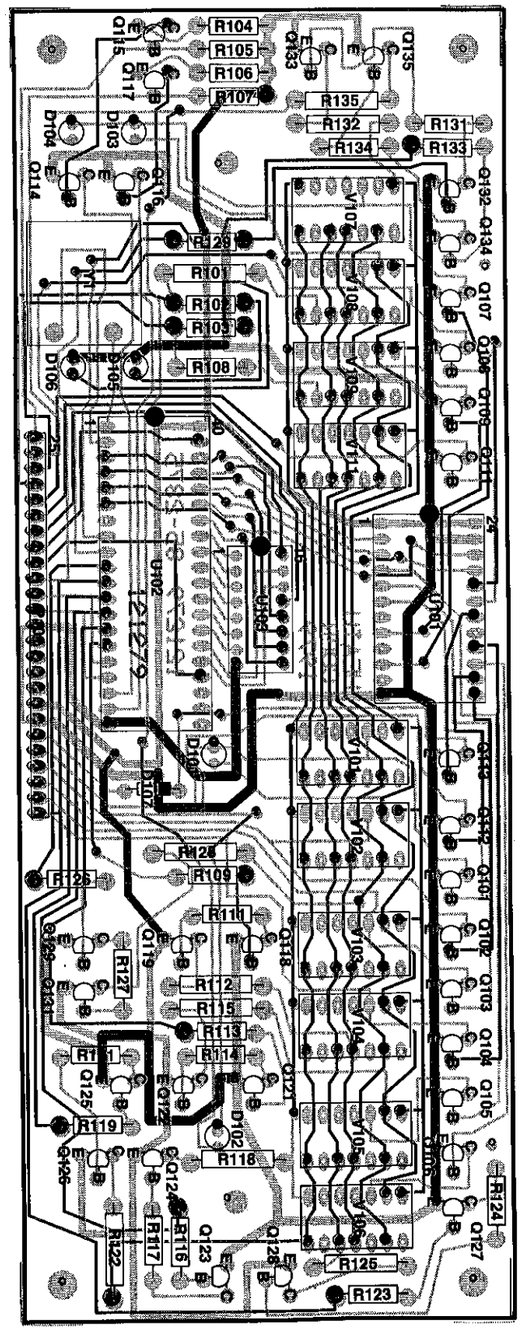
C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



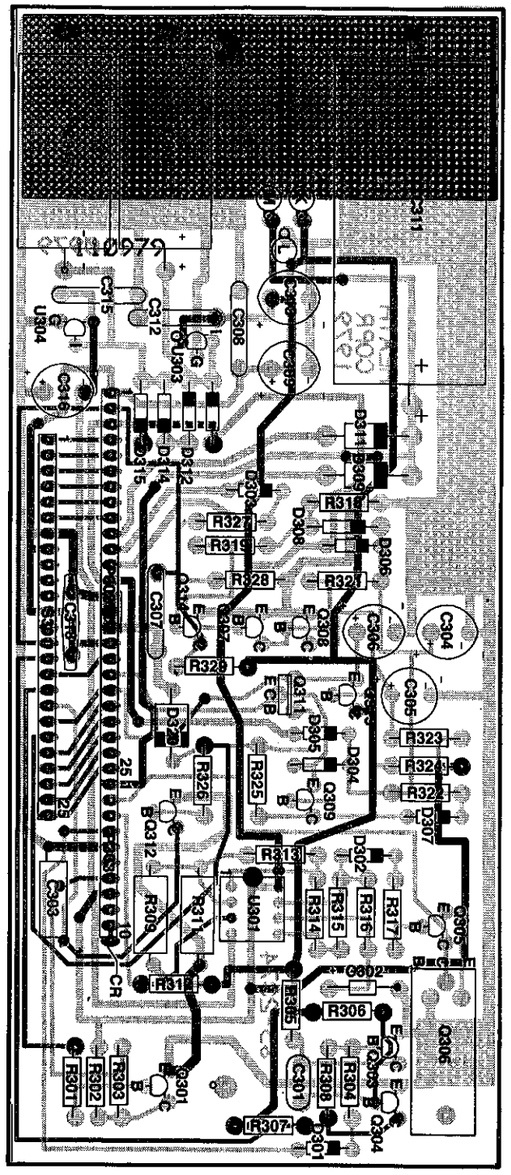
OVEN CIRCUIT BOARD
(Shown from the component side. The foil on the component side is shown in red.)



SWITCH CIRCUIT BOARD
(Shown from the component side.)



DISPLAY CIRCUIT BOARD
(Shown from the component side. The foil on the component side is shown in red.)



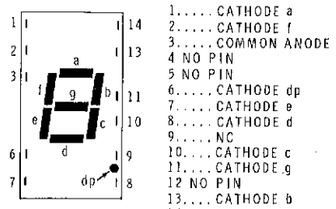
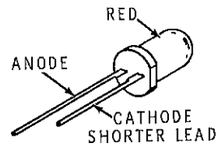
ANALOG CIRCUIT BOARD
(Shown from the component side. The foil on the component side is shown in red.)

SEMICONDUCTOR IDENTIFICATION CHARTS

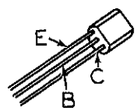
DIODES

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
D1, D2, D3, D4 D5, D7, D301, D302, D303, D304, D305, D306, D307, D401, D402, D403, D404	56-56	1N4149	
D201, D202	56-85	5-volt zener	
D320	56-616	5.6-volt zener	
D308	56-620	1N4744	
D309, D311	57-42	3A1	
D312, D313, D314, D315	57-65	1N4002	

INDUCTORS

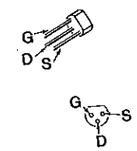
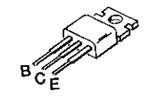
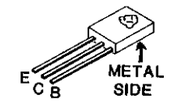
CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
V101, V102, V103, V104, V105, V106, V107, V108, V109, V111	411-835*	5082-7760	
D101, D102, D103, D104, D105, D106	412-633	5082-4484	

TRANSISTORS

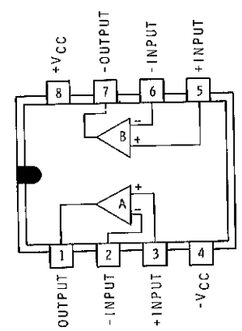
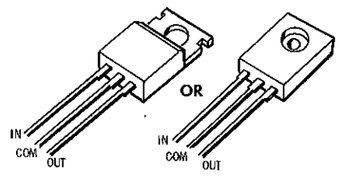
CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q115, Q117, Q119, Q122, Q124, Q126, Q128, Q131, Q133, Q135, Q202, Q309	417-235	2N4121	
Q112, Q113, Q114, Q116, Q118, Q121, Q123, Q125, Q127, Q129, Q132, Q134, Q301, Q303, Q304, Q305, Q307, Q308, Q312, Q313, Q314	417-801	MPSA20	
Q101, Q102, Q103, Q104, Q105, Q106, Q107, Q108, Q109, Q111	417-881	MPSA13	

* A brightness code letter (A, B, C, or D) is stamped on the side of each LED. This code letter should be identical for all of the LED displays. Include this code letter if you should have to order replacement LED's.

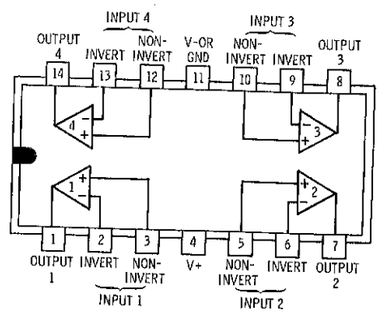
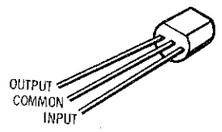
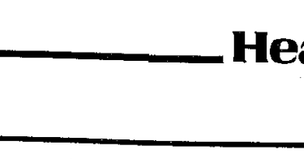
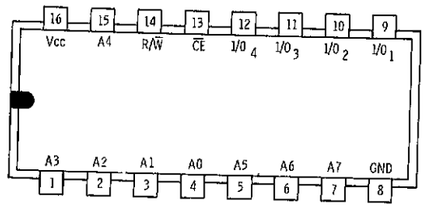
Transistors (cont'd.)

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
Q201	417-246	TIS74	
Q306	417-298	TIP41B	
Q311	417-818	MJE181	

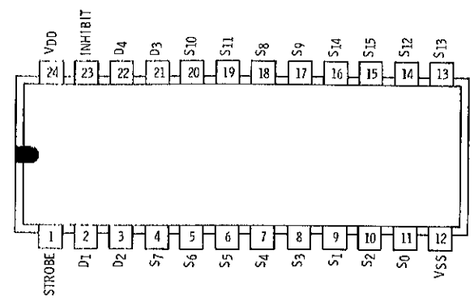
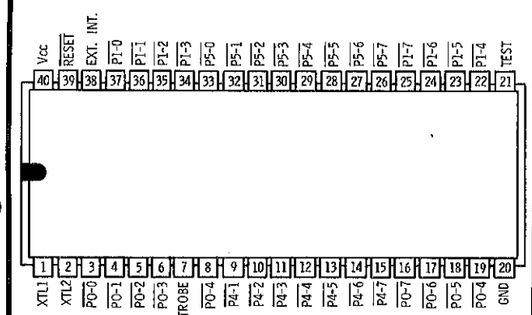
INTEGRATED CIRCUITS

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U201, U301	442-21	MC1458	
U1	442-54	UA7805	

Integrated Circuits (cont'd.)

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U202	442-602	LM324N	
U303	442-695	78L15	
U304	442-696	79L15	
A201	442-701	ORDER ONLY FROM HEATH COMPANY	
U103	443-721	MM2112-2	

Integrated Circuits (cont'd.)

CIRCUIT COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	IDENTIFICATION
U101	443-871	MC14514	
U102	444-23	MK3870 (AVAILABLE ONLY FROM HEATH COMPANY)	

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.