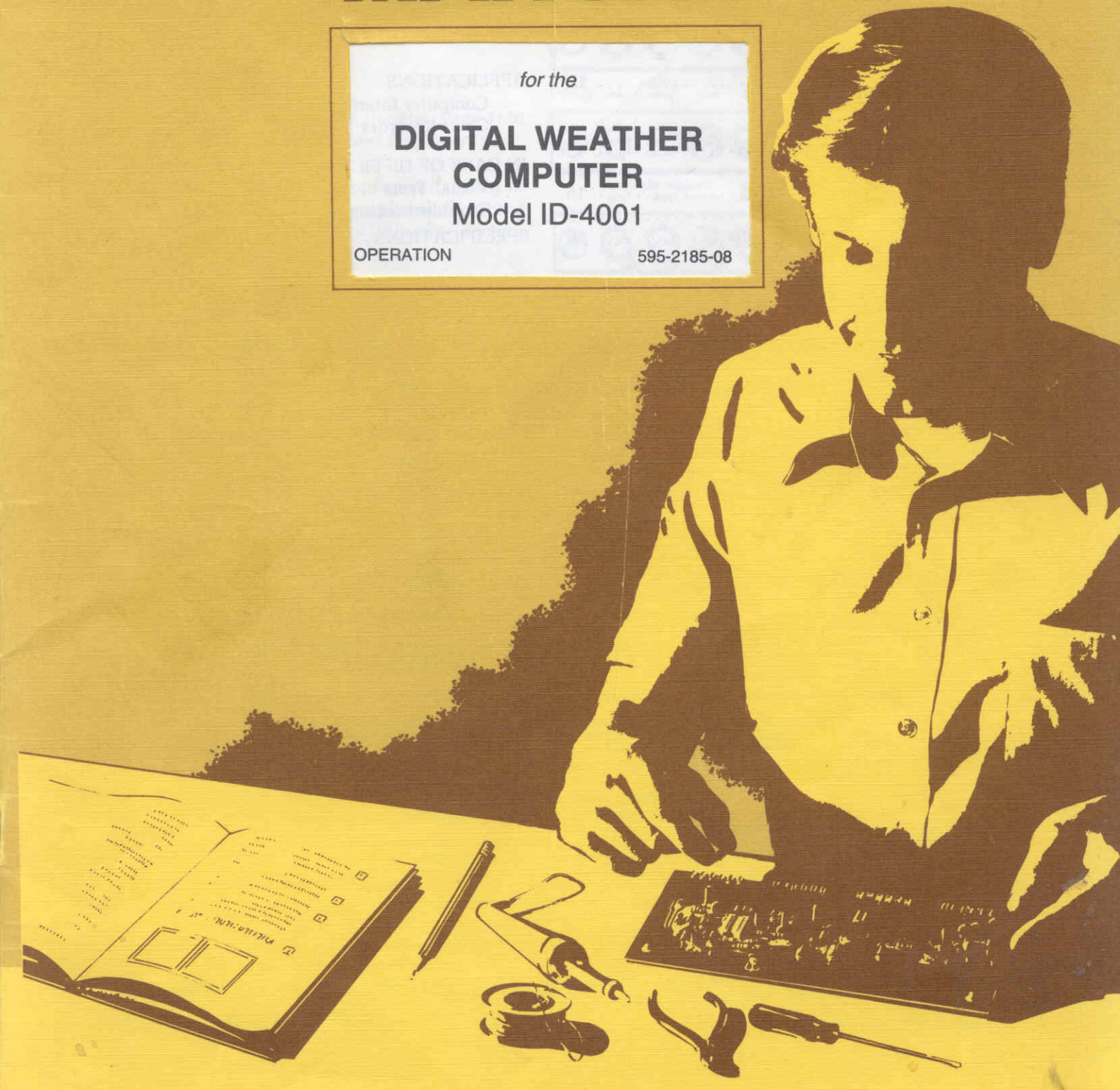
HEATHKIT® MANUAL

for the

DIGITAL WEATHER COMPUTER

Model ID-4001

OPERATION 595-2185-08



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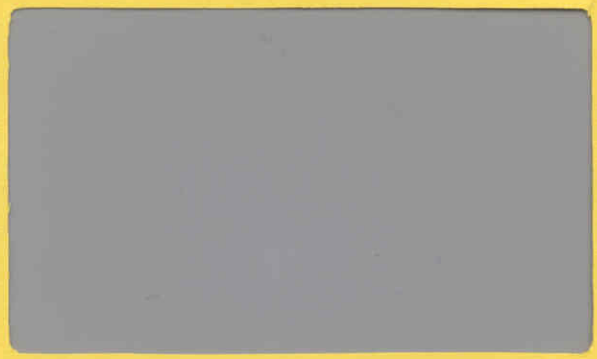

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Consumer Protection Plan for Heathkit Consumer Products

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If you are not satisfied with our service (warranty or otherwise) or our products, write directly to our Director of Customer Service, Heath Company, Benton Harbor MI 49022. He will make certain your problems receive immediate, personal attention.

Heathkit® Manual

for the

DIGITAL WEATHER COMPUTER

Model ID-4001

OPERATION 595-2185-08

HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INITIAL TESTS

Refer to Pictorial 1-1 (Illustration Booklet, Page 1) to identify the switches, controls, and displays.

NOTE: If you do not obtain the proper results in any of the following steps, immediately unplug the line cord and then proceed to the "In Case of Difficulty" section on Page 24.

( ) Place all nine rear panel switches to their up positions.

( ) Refer to inset drawing #1 and turn the four multi-turn controls on the CPU circuit board until the sliders are in the middle of the screws as shown.

( ) Turn controls R241 and R239 25 turns counterclockwise and then 10 turns clockwise.

( ) Place switch SW201 to its NORM position.

( ) Push the front panel WIND AVG switch to its OUT position.

( ) Plug the line cord into an AC outlet. Only the following indicators should light:

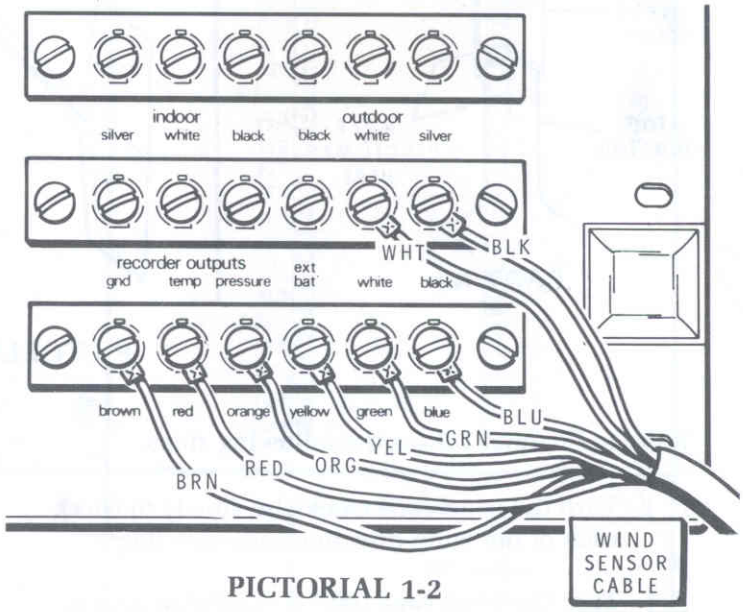
INCHES

FAHRENHEIT

Wind indicator SE

( ) If a voltmeter is available, refer to Detail 1-1A, (Page 1 in the Illustration Booklet) and check the voltages at plug P206 under Power Supply Voltages. The connections can be reached through the small slot on top of the socket. Touch the black voltmeter lead to GND and the red lead to the voltage points.

( ) Unplug the line cord.



PICTORIAL 1-2

WIND SENSORS

Refer to Pictorial 1-2 and attach the wires of the wind sensor cable to the connector strips on the bottom of your Weather Computer as follows:

( ) Blue wire to BLUE.

( ) Green wire to GREEN.

( ) Yellow wire to YELLOW.

( ) Orange wire to ORANGE.

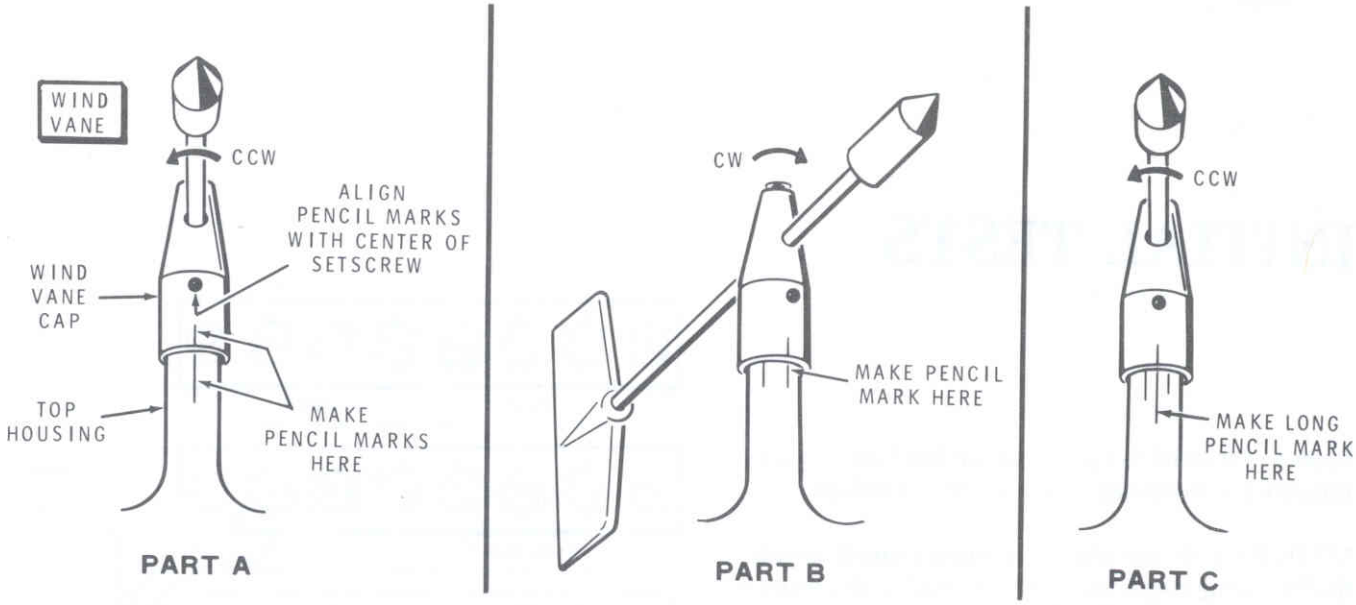
( ) Red wire to RED.

( ) Brown wire to BROWN.

( ) Black wire to BLACK.

( ) White wire to WHITE.

( ) Plug the line cord into an AC outlet. The wind direction indicator will now indicate some random position.



PICTORIAL 1-3

Refer to Pictorial 1-3 for the following steps.

( ) Turn the wind vane clockwise slowly to check each of the wind direction indicator lights.

( ) Turn the wind vane until N wind direction indicator lights.

( ) Slowly turn the wind vane counterclockwise until the NNE indicator just lights. Make a pencil mark on the wind vane cap and top housings as shown in Part A of the Pictorial.

( ) Slowly turn the wind vane clockwise until the NNW indicator just lights. This time, make a pencil mark on only the top housing, but directly beneath the pencil mark on the wind vane cap as shown in Part B of the Pictorial.

( ) Turn the wind vane counterclockwise and position the upper pencil mark midway between the two lower pencil marks. Make a longer pencil mark as shown in Part C of the Pictorial. You will use this long mark as a **north** indicator when you permanently install the sensors outside.

( ) Unplug the line cord.

IC INSTALLATION

Refer to Pictorial 1-4 for the following steps.

NOTE: The integrated circuits that you will install in the next three steps are rugged and reliable components. However, normal static electricity discharged from your body through an integrated circuit pin to an object can damage the integrated circuit. Read the entire instruction first. Then carefully perform each step without interruption.

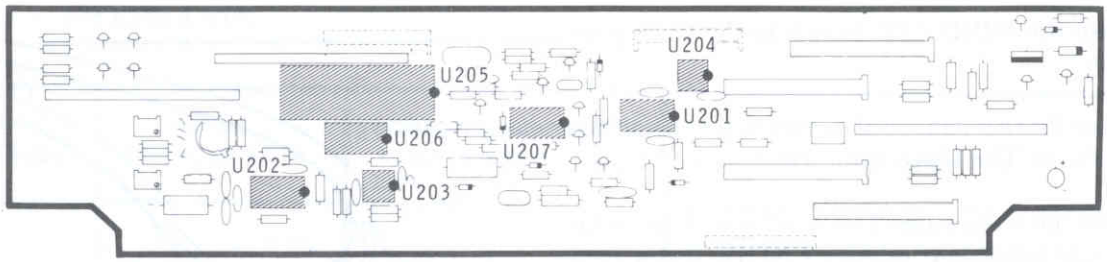
1. Remove the IC from the conductive foam.
2. Hold the IC in one hand and straighten any bent pins with the other hand.
3. Continue holding the IC, being careful not to touch it to anything while you touch the circuit board with your other hand.
4. Refer to Detail 1-4A and, as you install each IC in the following steps, position the pin 1 end of each IC (as shown in Part A of the Detail) toward the index mark on the circuit board (see Part B). Then insert the IC leads into the socket and push the IC down into place.
5. Install the IC in its socket.

( ) U205: MC3890 (#444-23).

( ) U206: MM2112-2 (#443-721).

( ) U207: CD4016 (#442-99).

MC14016B



PICTORIAL 1-4

( ) U201: LM324N (#442-602).

( ) U202: LM324N (#442-602).

( ) U203: MC1458 (#442-21).

( ) U204: MC1458 (#442-21).

COMPUTER TESTS

Again refer to Pictorial 1-1 for the following steps.

( ) Plug in the line cord. The following things should happen:

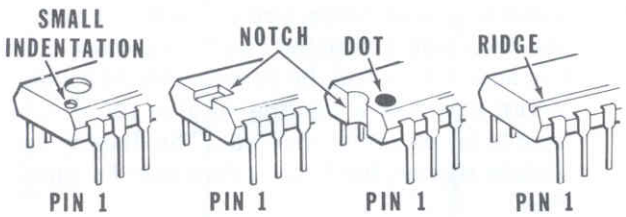
- The TIME/DATE display will indicate 12 00 00 and start keeping time. After eight seconds, 0 0 will be displayed for two seconds to represent the date and then the time will be displayed again. Also, the AM indicator should be lit. However, when the date is displayed, the AM indicator will be out.

- The INDOOR and OUTDOOR indicators will alternately turn on and off every two seconds. The TEMPERATURE indicated will be random numbers and the FAHRENHEIT indicator should be lit.

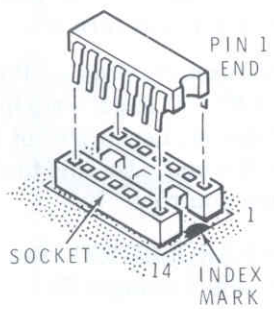
- As you spin the wind cups, the wind speed indicator will display a wind speed greater than zero and then return to zero as the cups stop turning. Also, a wind direction indicator and the MI/H indicator should be lit.

- The BAROMETRIC PRESSURE display should show a random number, the RISING indicator may or may not be lit, and the INCHES indicator should be lit.

( ) Push the WIND AVG switch to the IN position. As you spin the wind cups, the indicated wind speed will be an average and, therefore, will not change as quickly as before. Also, it will not indicate as high a wind speed as before (unless a high wind speed is held constant by using a fan, etc.).



PART A



PART B

Detail 1-4A

( ) Push the WIND AVG switch to the OUT position.

( ) Place the rear panel WIND switch to the KNOTS position. The KNOTS indicator should light.

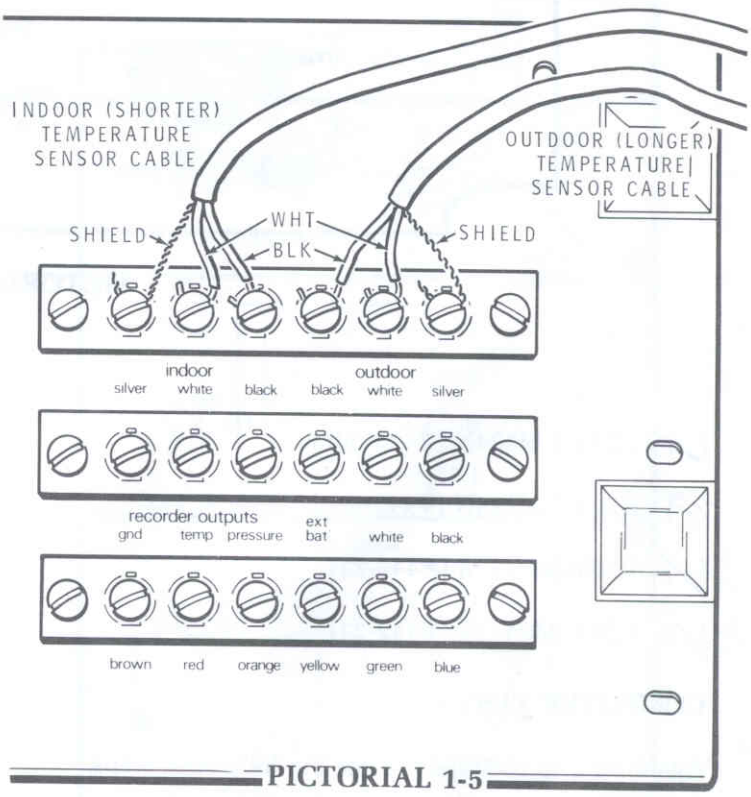
( ) Spin the wind cups. The wind speed indicator should indicate wind speed. NOTE: If you use a fan to spin the wind cups, the KNOTS position will produce a lower wind speed indication than the MI/H position if you alternate the WIND switch between the KNOTS and MI/H position.

( ) Place the rear panel WIND switch to the KM/H position. The KM/H indicator should light.

( ) Again spin the wind cups. The wind speed indicator will again indicate wind speed. NOTE: If you use a fan, the indication will be higher than when the switch is in the MI/H position.

( ) Unplug the line cord.

Refer to Pictorial 1-5 for the following steps.



PICTORIAL 1-5

Connect the wires of the outdoor temperature sensor cable (longer cable) to the OUTDOOR connector strip screws on the bottom of your Weather Computer as follows:

( ) Silver (shield) wire to SILVER.

( ) White wire to WHITE.

( ) Black wire to BLACK.

Connect the indoor temperature sensor cable (shorter cable) to the INDOOR connector strip screws as follows:

( ) Black wire to BLACK.

( ) White wire to WHITE.

( ) Silver (shield) wire to SILVER.

( ) Plug in the line cord. The indoor and outdoor temperature displays should both still indicate random numbers.

21.62

Pressure Display

NOTES:

1. In the following steps, you will adjust a control and then watch how the display changes. After you adjust a control, be sure to wait 24 seconds before you take a reading to give the display time to be properly updated. (The display may update sooner, but this update may be unreliable.)

2. If the display goes above 40, it will return to zero and increase from there. If this happens, the RISING indicator will turn off.

( ) Refer to the inset drawing on Pictorial 1-1 and install the 1/8" × 1" metal strip in the small end of the nut starter. Leave 1/8" of the blade protrude from the end. Use this tool for adjusting the next two controls.

( ) Record the BAROMETRIC PRESSURE indication. Then adjust control R241 (Pressure Fine Adjust) up approximately one full turn clockwise and wait 24 seconds. Now notice that the display has increased.

( ) In a similar manner, adjust control R239 (Pressure Coarse Adjust) up one turn clockwise. Again the display should increase.

NOTE: In the following steps, you will only need to wait 12 seconds for the display to update properly.

( ) Adjust control R205 (Outdoor Temp Intercept Adjust) upwards approximately two turns. The outdoor temperature display will increase.

( ) Adjust control R209 (Outdoor Temp Slope Adjust) upwards two turns. The outdoor temperature display will increase.

( ) Adjust control R224 (Indoor Temp Slope Adjust) upwards two turns. The indoor temperature display will increase.

( ) Adjust control R267 (Indoor Temp Intercept Adjust) upwards two turns. The indoor temperature display will increase.

REAR PANEL SWITCHES

Pressure

( ) Place the PRES switch in the MILLIBARS position. The MILLIBARS indicator will light and the decimal point indicator in the BAROMETRIC PRESSURE display will be off.

Temperature

( ) Place the TEMP °F/°C switch to the °C position. The CELSIUS indicator will light and the temperature shown will be in Celsius (a much lower number compared to the Fahrenheit indication).

( ) While the OUTDOOR indicator is lit, place the TEMP AUTO/HOLD switch in the HOLD position. The outdoor temperature should be displayed continuously.

Time/Date

( ) While the time is being displayed, place the TIME/DATE START/STOP switch in the STOP position. The seconds will stop counting. Then place this switch back in the START position.

( ) While the time is being displayed, place the TIME/DATE AUTO/HOLD switch in the HOLD position. Time will continuously be displayed.

( ) Temporarily press and hold the TIME/DATE HR/MO switch in the ADVANCE position. The hours of the TIME/DATE display will advance to 12. Then, as the hours change from 11 to 12, the PM indicator will light. The seconds will continue to run.

( ) Temporarily press and hold the TIME/DATE MIN/DAY switch. The units digit of the minutes display will advance (0 through 9) and repeat.

( ) Simultaneously press and hold the TIME/DATE HR/MO and MIN/DAY switches. The tens-of-minutes digit will advance (0 through 5) and repeat.

( ) Be sure the PM indicator is lit. (If it is not lit, push down the HR/MO switch until it is lit.)

( ) Place the TIME/DATE 12HR/24HR switch into the 24HR position. The TIME/DATE display should display the time in the 24-hour format (0 through 23), and the AM and PM indicators should both be off.

( ) Place the TIME/DATE AUTO/HOLD switch in the AUTO position. Then when the date is being displayed, place the switch back in the HOLD position. The date will be displayed continuously.

( ) Temporarily press down and hold the TIME/DATE HR/MO switch in the ADVANCE position. The month digit should advance (1 through 12) and start over repeatedly.

( ) Temporarily press down and hold the TIME/DATE MIN/DAY switch in the ADVANCE position. The day digits should advance through the number of days of the month being displayed, start over, and keep repeating.

( ) Return all the rear panel switches to their up positions.

FRONT PANEL PUSHBUTTONS

Temperature

1. ( ) When the OUTDOOR indicator is on, press in the TEMPERATURE MIN pushbutton. The TEMPERATURE display will continuously display an "outdoor" temperature as long as the pushbutton is held in. Also the TIME/DATE display will indicate time and date. (The time and date will alternately display but their numbers will not change.) As you release the pushbutton, the time display will be updated.

2. ( ) When the OUTDOOR indicator is on, again push in the TEMPERATURE MIN pushbutton. As you hold in this pushbutton, also push in the CLEAR pushbutton. Now, the outdoor minimum temperature will show −40, and the temperature, time, and date memories are cleared and updated.

( ) Repeat the previous two steps when the INDOOR indicator is on. The results should be the same except the temperatures will be "indoor" temperatures.

( ) When either the OUTDOOR or INDOOR indicator is lit, push in and hold the WIND CHILL pushbutton. The OUTDOOR indicator should turn on and again the outdoor temperature will be displayed. NOTE: If you spin the wind cups, after several seconds, the indicated temperature will decrease to show the "wind chill factor."

Pressure

( ) Simultaneously press in and hold the PRESSURE MIN and CLEAR pushbuttons. The BAROMETER PRESSURE display will go to 0.00. Then release the pushbuttons.

( ) After 12 seconds again press in and hold the PRESSURE MIN pushbuttons. Now a barometric pressure will be displayed and an unchanging time and date will be displayed.

( ) Simultaneously press in and hold the PRESSURE MAX and CLEAR pushbuttons. The BAROMETRIC PRESSURE MAX display will go to 0.00. Then release the pushbuttons.

( ) After 12 seconds, again press in and hold the PRESSURE MAX pushbutton. Again, barometric pressure will be displayed and an unchanging time and date will be displayed.

( ) Press in the RATE CHANGE/HR pushbutton. The display will read the barometric pressure for the first hour.

Wind

( ) Spin the wind cups and then let them stop turning.

( ) Push in and hold the WIND PEAK GUST pushbutton. A peak wind speed should be indicated.

( ) Simultaneously press in the WIND PEAK GUST and CLEAR pushbuttons for a moment. The SPEED indicator should change to zero.

CALIBRATION

In the following steps, if at any time you do not obtain the results called for, refer to the "In Case of Difficulty" section on Page 22 to correct the problem.

( ) If this has not already been done, refer to Pictorial 2-1 (Illustration Booklet, Page 2) and remove the display cover as shown.

( ) The temperature sensor cables may be used at their present lengths. However, if you want to shorten one cable, or both (because of where you are going to install the Computer), do it now before you do the "Calibration." Refer to the "Installation" section on Page 13 if necessary.

Refer to Pictorial 1-1 (Illustration Booklet, Page 1) for the following steps.

( ) Turn on your Weather Computer and allow it to warm up for 20 minutes. (While the Computer is warming up, perform the next three steps.)

1. ( ) Fill a glass-lined Thermos* bottle (or other brand vacuum bottle) half full of crushed ice.

WARNING: Do not allow the temperature sensors to come in contact with each other during the calibration procedure. This could result in a false temperature display later.

2. ( ) Place the outdoor temperature sensor into the vacuum bottle and finish filling the bottle with crushed ice.

3. ( ) Fill the bottle with cold water and allow it to set for five minutes.

*Registered Trademark, Thermos Co.

OUTDOOR TEMPERATURE

( ) While the OUTDOOR indicator is on, place the rear panel TEMP AUTO/HOLD switch in the HOLD position.

( ) Place the NORM/CAL switch SW201 on the CPU circuit board in the CAL position.

NOTES:

1. The accuracy of your Weather Computer will depend to a great extent on how carefully you perform the following steps. Be patient and take your time.

2. After you adjust a control in the following steps, be sure to wait at least 13 seconds before you take a reading. This will make sure that the display is properly updated.

3. When you turn the controls up, the display will increase. When you turn the controls down, the display will decrease.

( ) Adjust control R209 (Outdoor Temp Slope Adjust) for a display of 51 degrees Fahrenheit. NOTE: Neither the "+" sign nor the "−" should be on. If the "+" sign is on, the control is truned up to far. If the "−" is on, the control is turned down too far.

( ) In small steps, adjust the control up until the display just goes to 52; then stop.

( ) In very small steps, adjust the control back down until the display just goes to 51. The correct display is 51, but the control should be set as close to a 52 display as possible.

( ) Place the CPU circuit board NORM/CAL switch in the NORM position.

( ) Adjust control R205 (Outdoor Temp Intercept Adjust) to display +32 degrees Fahrenheit.

( ) In small steps, adjust the control up until the display just goes to +33; then stop.

( ) In very small steps, adjust the control back down until the display just goes to +32. The correct display is +32, but the control should be set as close to a +33 display as possible.

( ) Place the rear panel TEMP AUTO/HOLD switch in the AUTO position.

( ) Remove the outdoor temperature sensor from the bottle and set it aside.

INDOOR TEMPERATURE

( ) Place the indoor temperature sensor in the vacuum bottle using the same procedure that you used with the other sensor. Allow it to set for five minutes before you proceed.

( ) While the INDOOR indicator is on, place the TEMP AUTO/HOLD switch in the HOLD position.

( ) Place the NORM/CAL switch on the CPU circuit board in the CAL position.

( ) Adjust control R224 (Indoor Temp Slope Adjust) for a display of 51 degrees Fahrenheit. NOTE: Neither the "+" sign nor the "−" sign should be on. If the "+" sign is on, the control is turned up too far. If the "−" sign is on, the control is turned down too far.

( ) In small steps, adjust the control up until the display just goes to 52; then stop.

( ) In very small steps, adjust the control back down until the display just goes to 51. The correct display is 51, but the control should be set as close to a 52 display as possible.

( ) Place the CPU circuit board NORM/CAL switch in the NORM position.

( ) Adjust control R267 (Indoor Temp Intercept Adjust) to display +32 degrees Fahrenheit.

( ) In small steps, adjust the control up until the display just goes to +33; then stop.

( ) In very small steps, adjust the control back down until the display just goes to +32. The correct display is +32, but the control should be set as close to a +33 display as possible.

( ) Place the TEMP AUTO/HOLD switch in the AUTO position.

( ) Remove the sensor from the vacuum bottle.

This completes the indoor and outdoor temperature calibration.

BAROMETRIC PRESSURE

In the following steps you will calibrate the barometric pressure circuit of your Digital Weather Computer. 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.).

NOTE: Pressure transducer A201 is sensitive to direct light. You may want to cover it with tape or the back panel while you are adjusting the barometric pressure.

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 computer 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 computer is.

- The stability of the environment your computer is monitoring. The environment could easily be changed by such things as window fans, sound pressure level room modes, an air conditioner, the opening and closing of doors and windows, placement of the computer 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.

( ) 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.

NOTE: In the following steps, after you adjust a control, wait at least 24 seconds for the Computer to update the BAROMETRIC PRESSURE display.

( ) Adjust control R239 (Pressure Coarse Adjust) and set the BAROMETRIC PRESSURE display to the nearest 1/10 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.

( ) Adjust control R241 (Pressure 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 and set the display to indicate 29.75 exactly.

NOTE: After completing the Final Assembly, and after the Computer has been operating for 1 or 2 hours, repeat the preceding two steps. After several days of operation, repeat only the last step. You can reach these controls through the access holes in the display cover.

This completes the "Calibration" of your Digital Weather Computer. Proceed to "Final Assembly."

FINAL ASSEMBLY

Refer to Pictorial 2-1 (Illustration Booklet, Page 2) for the following steps.

Install the following labels on the chassis as shown. Remove the paper backing from the labels and press them in place.

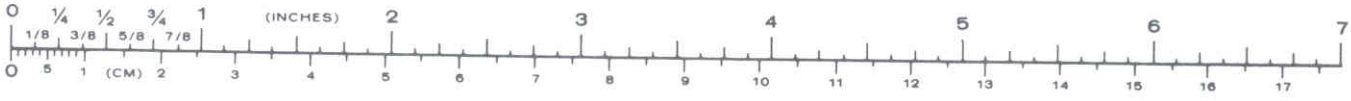
( ) Blue and white label.

( ) Caution label.

( ) Install the remaining six 6-32 × 1/4″ black screws that fasten the chassis and front panel together.

( ) Position the display cover as shown. Then cut a 1-1/2″ piece of U-gasket and install it in the cutout along the bottom edge of the cover.

( ) Mount the display cover on the display housing with four 6-32 × 3/8 black screws.



INSTALLATION

WARNING: Do not mount the temperature sensors against a metal surface. This could result in a false temperature display.

This section of the Manual gives you general information for mounting and connecting the temperature sensors and the wind sensor assembly. Your installation will vary to suit your particular requirements. You should have already cut the various cables to the proper length in the "Initial Tests" section of this Manual.

TEMPERATURE SENSORS

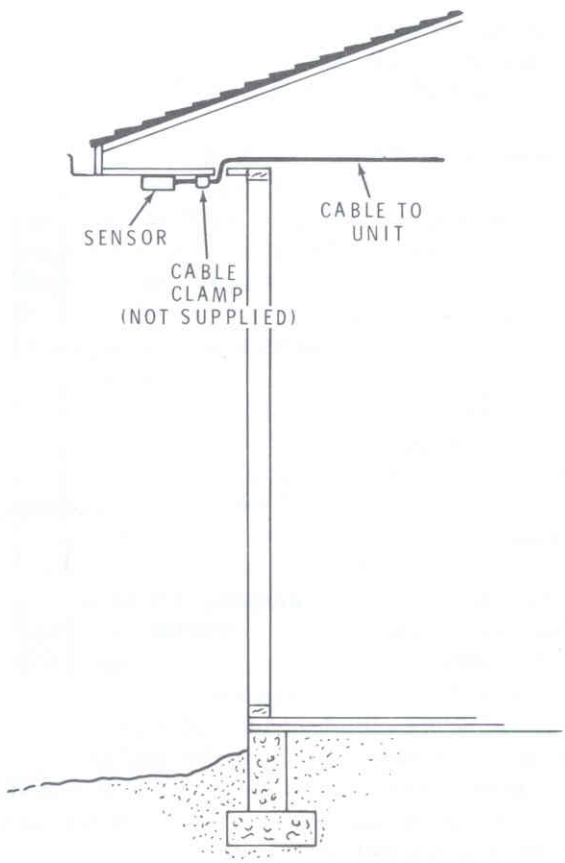
You may place these sensors wherever you want to monitor the temperature. Do not place the indoor sensor near any heat source, such as a heat register or TV set. This would produce false readings.

Mount the outdoor temperature sensor in a location which is shielded from direct or reflected sunlight, such as under an eave (see Pictorial 3-1). Also, you should select a location where ice and snow will not accumulate, as this condition would influence the reading.

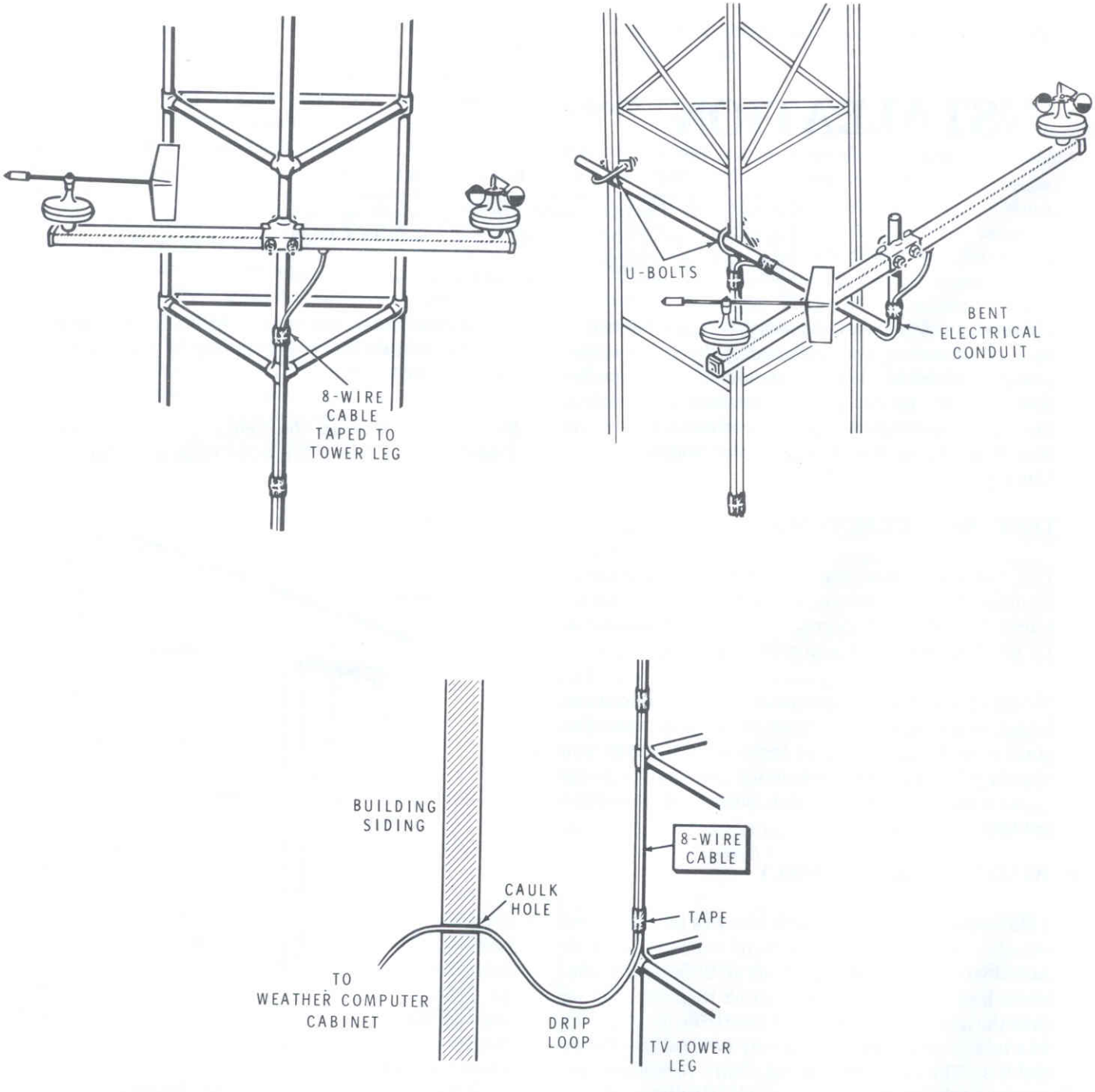
WIND SENSOR ASSEMBLY

This assembly should be as far away as possible from objects which will shield the wind sensors, cause air turbulence or vibration (such as an attic power ventilator), or divert the wind against them from other than the true wind direction. An existing facility such as a television tower or mast may be used (see Pictorial 3-2). The boom mounting clamp furnished will accept a tubular object up to 1-1/2" diameter. We do not recommend you mount the wind sensor assembly on a chimney mast because of corrosive fumes from the chimney. Several types of TV masts for roof mounting are available from TV installers. Some of these are suitable for mounting the assembly above the roof. Be sure to properly ground any of these any of these mounting masts. The boom should be no closer than two feet from the top of the mast it is mounted to.

Be sure you line up the pencil line (from "Initial Tests") on the side of the wind vane with due north.



PICTORIAL 3-1



PICTORIAL 3-2

CABLE ROUTING

How you route the sensor cables is a matter for each individual installation. We recommend you use plastic tape (not supplied) to secure the cables to a TV tower leg or mast. You can use staples or TV lead-in standoffs to secure the cables to wood.

You may be able to bring the cable into the building in the same manner as your TV lead-in. To keep out moisture, you should plug the entry hole with a good grade of caulking compound which will remain pliable and will not harden. Be sure to form a drip loop in the cables as shown in Pictorial 3-2.

CABLE CONNECTIONS

Refer to Pictorial 3-3 (Illustration Booklet, Page 3) for the following steps.

Refer to the inset drawing and install spade lugs on the end of the indoor and outdoor temperature cables.

Position the Computer as shown. Then connect the wires at the free end of the 8-wire cable to the connector strips on the bottom of your Weather Computer as follows:

( ) Blue wire to blue.

( ) Green wire to green.

( ) Yellow wire to yellow.

( ) Orange wire to orange.

( ) Red wire to red.

( ) Brown wire to brown.

( ) Black wire to black.

( ) White wire to white.

Connect the wires at the free end of the outdoor temperature sensor to the connector strip.

( ) Silver wire to silver.

( ) White wire to white.

( ) Black wire to black.

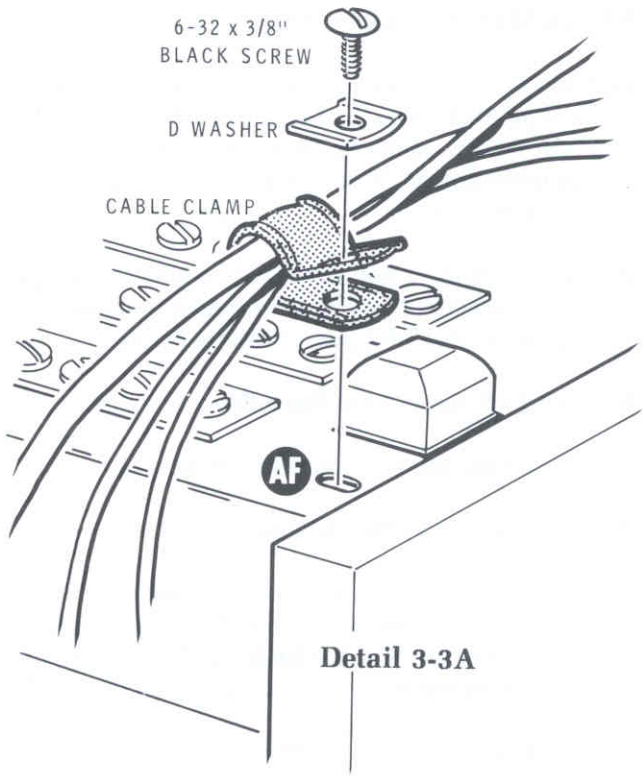
Connect the wires at the free end of the indoor temperature sensor to the connector strip as follows:

( ) White wire to white.

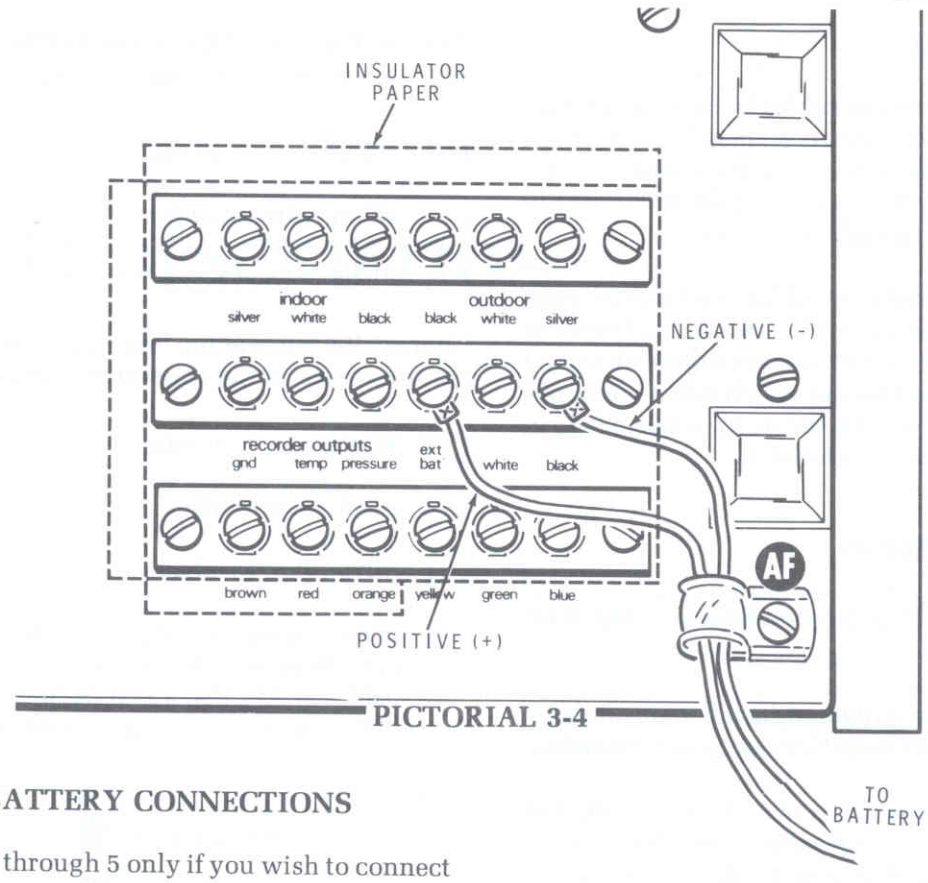
( ) Black wire to black.

( ) Silver wire to silver.

( ) Dress the sensor cables as shown in the Pictorial. Then refer to Detail 3-3A and secure the cables at AF. Use a 6-32 × 3/8" black screw, a "D" washer, and a plastic cable clamp.



Detail 3-3A



PICTORIAL 3-4

EXTERNAL BATTERY CONNECTIONS

Perform steps 1 through 5 only if you wish to connect an external battery to the Computer. An external battery allows the memory to remain intact during a power interruption. If you do not have a battery, perform step 6 only.

NOTE: The battery you use must be able to supply a voltage between 6.2 and 14.8 volts at 60 milliamperes during the extent of a power interruption.

Refer to Pictorial 3-4 for the following steps.

1. ( ) Position the computer as shown.

2. ( ) Install spade lugs on both battery leads.

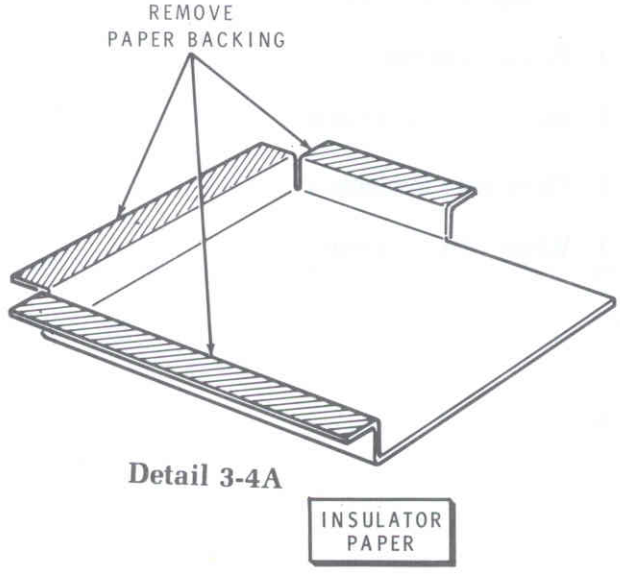
3. ( ) Connect the negative (−) battery lead to BLACK on the indicated terminal strip. Be sure the black wire from the 8-wire cable also remains connected to this terminal.

4. ( ) Connect the positive (+) battery lead to EXT. BATT.

5. ( ) Remove the screw fron the cable clamp at AF. Then position the battery leads with the other cables and reinstall the clamp.

6. ( ) Refer to Detail 3-4A and form the piece of insulator paper. Then remove the backing paper from the three indicated edges and press the insulator paper in place over the terminal strips as shown in Pictorial 3-4.

This completes the "Installation." Proceed to "Operation."



Detail 3-4A

OPERATION

Refer to Pictorial 4-1 (Illustration Booklet, Page 4) for the locations of the displays and switches. These switches and displays are described below. If necessary, again review the "Initial Tests" steps under "Rear Panel Switches" (Page 7) and "Front Panel Pushbuttons" (Page 8).

The numbers at the beginning of the following paragraphs correspond to the numbers on Pictorial 4-1.

DISPLAY

TEMPERATURE

1. FAHRENHEIT/CELSIUS indicators — Indicate whether the displayed temperature is in Fahrenheit or Celsius.

2. OUTDOOR/INDOOR indicators — Indicate OUTDOOR when the outdoor temperature is displayed and INDOOR when the indoor temperature is displayed.

3. TEMPERATURE display — Indicates the temperature.

TIME/DATE

4. 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.

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

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

7. SECONDS display — Indicates seconds (0-59).

WIND

8. WIND DIRECTION indicators — Indicate the direction that the wind is coming from.

9. SPEED display — Indicates the speed of the wind.

10. MI/H-KNOTS-KM/H indicators — Indicate the selected wind speed unit-of-measure.

BAROMETER

11. BAROMETRIC PRESSURE display — Indicates the barometric pressure.

12. RISING/FALLING indicators — Indicate if the barometric pressure is rising or falling.

13. INCHES/MILLIBARS indicators — Indicate whether the barometric pressure is being displayed in inches or millibars.

FRONT PANEL PUSHBUTTON SWITCHES

14. CLEAR — Clears the minimum (MIN) or maximum (MAX) temperature, pressure, or wind PEAK GUST from memory. This switch and another switch (MIN, MAX, PEAK GUST) must be pushed simultaneously. After this switch is released, any future temperature, pressure, or wind peak gust is entered into memory for later comparison. Also, the present time is put into memory.

TEMPERATURE

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

16. MAX — Causes the maximum temperature that was sensed after the last time this funtion was "cleared" to be displayed. Also, the time and date that this maximum temperature occurred will be displayed.

17. WIND CHILL — Causes the current wind chill temperature to be displayed.

PRESSURE

18. MIN — 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.

19. MAX — 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.

20. RATE CHANGE/HR — 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 CHANGE /HR indication during the first hour of operation.

WIND

21. PEAK GUST — Causes the peak gust of wind that was sensed after the last time this function was "cleared" to be displayed.

22. WIND AVG — Causes the SPEED display to indicate the average wind speed.

REAR PANEL SWITCHES

WIND

23. MI/H-KNOTS-KM/H — Selects the desired unit-of-measure for measuring wind speed.

PRES (Barometric Pressure)

24. INCHES/MILLIBARS — Determines whether the barometric pressure will be displayed in inches or millibars. It also selects the INCHES or MILLIBARS indicator.

TEMP (Temperature)

25. °F/°C — Selects either the FAHRENHEIT (°F) indicator or the CELSIUS (°C) indicator.

26. AUTO/HOLD — In the AUTO position, the TEMPERATURE display alternately displays the outdoor and indoor temperatures. Also, the corresponding OUTDOOR/INDOOR indicators light with the appropriate temperature display. In the HOLD position, either the outdoor or the indoor temperature, and the appropriate OUTDOOR/INDOOR indicator, is displayed continuously, whichever one was being displayed when the switch was placed in the HOLD position.

TIME/DATE

27. 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 time reaches the set time, start the clock.

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

29. 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 used together, they will advance the MINUTES/DAY display ten minutes each half second.

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

31. 12HR/24HR — Selects either the 12-hour or 24-hour format for displaying time.

SETTING THE DATE AND TIME

DATE

1. When the **date** is being displayed, place the TIME/DATE AUTO/HOLD switch in the HOLD position.

2. Use the HR/MO and MIN/DAY switches and set the date in the TIME/DATE display.

3. Place the TIME/DATE AUTO/HOLD switch in the AUTO position.

TIME

1. When the **time** is being displayed, place the TIME/DATE START/STOP switch in the STOP position.

2. Use the HR/MO and MIN/DAY switches and set the TIME/DATE display to the desired **time**.

3. As real time reaches the time set in the display, place the START/STOP switch in the START position.

APPLICATIONS

This section of the Manual shows you how to interface the Digital Weather Computer with another computer or a chart recorder.

COMPUTER INTERFACE

Your Weather Computer has a 25-pin parallel interface bus so you can connect it to any general-purpose digital computer. This allows you to access all of the available digital information which is derived by the Digital Weather Computer. Your own imagination and programming expertise are the only limitations to the use of this feature for computer assisted tabulation or weather research.

The following tables list the information which is present at the 25-pin bus and give the coding for the digit select and wind direction select. These tables, along with the "Circuit Description" and Schematic will help you develop your own computer interface.

PIN	FUNCTION	PIN	FUNCTION
1	Digit Select code D.	14	Wind direction select code B.
2	Digit select code C.	15	Wind direction select code C.
3	Digit select code B.	16	Wind direction select code D.
4	Digit select code A.	17	N.C. (no connection).
5	Segment d.p.	18	Front panel switch bus.
6	Segment a.	19	Rear panel switch bus.
7	Segment b.	20	Digit strobe.
8	Segment c.	21	N.C.
9	Segment d.	22	N.C.
10	Segment e.	23	N.C.
11	Segment f.	24	N.C.
12	Segment g.	25	GND.
13	Wind direction select code A.		

TABLE 5-1
THE COMPUTER BUS (P202)

DIGIT IDENTIFICATION	U101 D C B A	DISPLAY DIGIT
DS101	0 0 0 1	Temperature 10's digit.
DS102	0 0 1 0	Barometric pressure 10's digit.
DS103	0 0 1 1	Barometric pressure 1/10's digit.
DS104	0 1 0 0	Wind speed 10's digit.
DS105	0 1 0 1	Time 10's hours.
DS106	0 1 1 0	Time 10's minutes.
DS107	0 1 1 1	Time 10's seconds.
DS108	1 0 0 0	Temperature sign & overflow digit.
DS109	1 0 0 1	Temperature 1's digit.
DS110	1 0 1 0	Barometric pressure 1's digit.
DS111	1 0 1 1	Barometric pressure 1/100's digit.
DS112	1 1 0 0	Wind speed 1's digit.
DS113	1 1 0 1	Time 1's hours.
DS114	1 1 1 0	Time 1's minutes.
DS115	1 1 1 1	Time 1's seconds.

TABLE 5-2
DIGIT SELECT CODES

DIRECTION	Q134 Q137 Q136 Q135 D C B A
N	0 0 0 0
NNW	0 0 0 1
WNW	0 0 1 0
NW	0 0 1 1
SSW	0 1 0 0
SW	0 1 0 1
W	0 1 1 0
WSW	0 1 1 1
NNE	1 0 0 0
NE	1 0 0 1
E	1 0 1 0
ENE	1 0 1 1
S	1 1 0 0
SSE	1 1 0 1
ESE	1 1 1 0
SE	1 1 1 1

TABLE 5-3
WIND DIRECTION SELECT CODES

HEATH PART NO.	QTY.	DESCRIPTION
432-1075	1	25-pin plug
432-948	1	25-hole socket
432-866	25	Connectors
347-66	Specify (ft.)	25-wire flat cable.

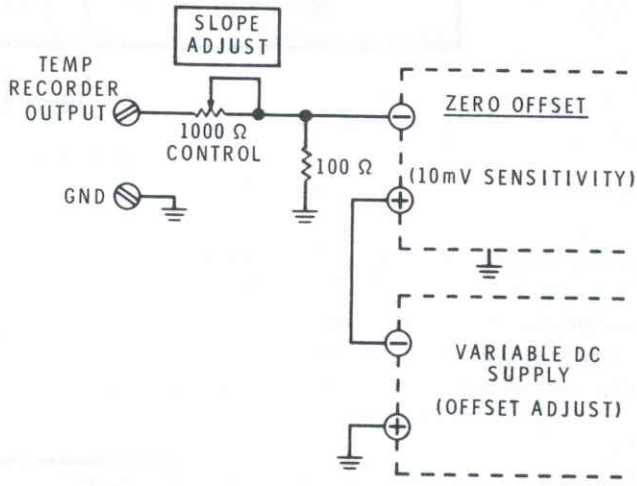
TABLE 5-4
HARDWARE REQUIRED
FOR COMPUTER INTERFACE

CHART RECORDER INTERFACE

Chart recorder outputs, for monitoring outdoor temperature and barometric pressure are readily available at the terminal strips on the bottom of the Digital Weather Computer. NOTE: These outputs may be referenced to the ground terminal.

Temperature

Pictorial 5-1 shows you how to connect a chart recorder to the Digital Weather Computer so you can graphically monitor the outdoor temperature. The 1000 Ω control and the 100 Ω resistor (not supplied) allow you to adjust the slope (gain) of the temperature signal. The variable DC supply provides you with an offset (correction) adjustment.



PICTORIAL 5-1

Use the following precedure to calibrate the chart recorder against the display on the Digital Weather Computer.

1. Preset the chart recorder's GAIN control to the center of its rotation.

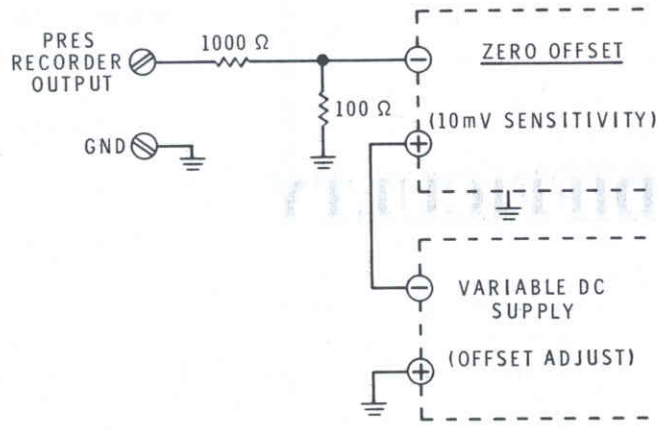
2. Adjust the DC supply until the chart recorder is near the center of the graph paper.

3. Place the outdoor temperature sensor in an ice bath and allow the display to stabilize. Then adjust the GAIN control on the chart recorder until the chart recorder indication agrees with the outdoor temperature display on the Digital Weather Computer.

4. Place the outdoor temperature sensor in a warm bath and allow the display to stabilize. Then adjust the SLOPE ADJUST control until the chart recorder indication agrees with the outdoor temperatures display on the Weather Computer.

5. Repeat steps 3 and 4 until the chart recorder indication agrees with the Weather Computer display with no further adjustment.

NOTE: The accuracy of the temperature as indicated on the chart recorder is affected by the accuracy of the Digital Weather Computer calibration and the chart recorder calibration. Normally, charted temperature is used mostly as a trend monitor and is not intended for absolute accuracy.



PICTORIAL 5-2

Barometric Pressure

Pictorial 5-2 shows you how to connect a chart recorder to the Weather Computer 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 Weather Computer:

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 Weather Computer. Each unit of resolution becomes .01 inches of mercury.

NOTE: As was the case with the temperature, 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

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 Charts.

NOTE: Refer to the "Circuit Board X-Ray Views" (Illustration Booklet, Pages 6 through 8) 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 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-orange) 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 or diodes.

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

If you make repairs to your Digital Weather Computer, 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.

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 also possible, on rare occasions, for a part to be faulty and require replacement. NOTE: Anytime 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
Initial tests fail before you install the IC's on the CPU circuit board or connect the 8-wire cable.	1. +5-volt power supply circuit U301.
Initial tests fail after you connect the 8-wire cable (no wind direction indicator lights).	1. U101. 2. +15-volt power supply circuitry. 3. Outdoor sensor assembly (diodes, transistors, encoding disc, wiring, etc.).
Display digits light incorrectly.	1. U205. 2. U206. 3. Display interface circuitry. 4. Power supply circuitry.
Fuse blows.	1. Short on +5-, +15-, or −15-volt supply. 2. U301, U303, U304, or U402. 3. Wiring error.
Cannot calibrate the pressure sensor, or it does not function properly.	1. A201 or its circuitry. 2. U207. 3. U205 or U206. 4. VCO. 5. R241 and R239 are too far clockwise. Turn them 25 turns counterclockwise and recalibrate the barometric pressure.
Cannot calibrate a temperature sensor, or it does not function properly.	1. Cable connections on the bottom of the main unit. 2. The sensor (A301 or A302) or its circuitry. 3. U207. 4. U205 or U206. 5. VCO. 6. R241 and R239 are too far clockwise. Turn them 25 turns counterclockwise and recalibrate the barometric pressure.
Time counts too fast or too slow.	1. Disconnect the external battery, if not already done, and power-up the computer again. 2. U205. 3. 50/60 Hz wave-shaping circuitry.
Wind speed indicator does not function properly.	1. Outdoor sensor assembly or wiring. 2. U205 interface circuitry. 3. U205.
Front switch functions fail.	1. Cable harness wiring. 2. Switching diodes. 3. U205 or front switch bus interface circuitry.
Back switch functions fail.	1. Cable harness wiring. 2. Switching diodes. 3. U205 or rear switch bus interface circuitry.

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 time format.

WIND VECTOR

Speed

Displays	2 significant digits. Separate indicators show whether display is in miles-per-hour, knots, or kilometers-per-hour.
Memory	Date, time, and magnitude of maximum gust.
Accuracy	±5% or better.
Controls	
Front Panel	Peak gust, wind average select and clear.
Rear Panel	Mi/h-knots-km/h select.

Direction

Display	One of sixteen indicators arranged in a circular compass configuration. Identified by compass points and radial degrees.
Accuracy	±11.25 degrees.

THERMOMETER

Displays	2-1/2-digit readout with "+" and "−" signs, indoor-outdoor indicators, and Fahrenheit-Celsius indicators. Display alternately indicates indoor and outdoor temperatures.
Format	Switch selected °C (Celsius) or °F (Fahrenheut) readout.
Temperature Range	−40°C to +70°C (Celsius). −40°F to +158°F (Fahrenheit).
Accuracy	±1° from −40°C to +70°C. ±2° from −40°F to +158°F.
Memory	Date, time, and magnitude of maximum and minimum temperatures.
Controls	
Front Panel	Wind chill select. Minimum temperature select and clear. Maximum temperature select and clear.
Rear Panel	Indoor-outdoor display hold. °C (Celsius) −°F (Fahrenheit) select.

BAROMETER

Displays	4-digit readout. Separate indicators show whether pressure is rising or falling and whether display is in inches of mercury or millibars.
Pressure Range	28.00 to 32.00 in. Hg (inches of mercury). 948 to 1083 millibars.
Accuracy of Reading	29.00 to 31.00 in. Hg (inches of mercury). ±.25% plus ±.033%/°C (±.075 in. Hg plus ±.01 in. Hg/°C).
Memory	Date, time, and magnitude of maximum and minimum pressure.
Controls	
Front Panel	Minimum pressure select and hold. Maximum pressure select and hold. Rate of change/hour select.
Rear Panel	Millibars or inches of mercury select.

GENERAL

Power Requirements	120/240 volts AC, 50/60 Hz; approximately 8 watts. Provision for connection of an external battery, which can supply 6.20 - 14.80 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	
Outdoor assemblies	−40°C to +70°C (−40°F to +158°F).
Unit	15°C to 35°C (59°F to 95°F).
Dimensions (overall)	16″ wide × 6″ deep × 7-1/4″ high. (40.6 × 15.2 × 18.4 cm).
Weight	9 lb. (4.08 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 5) and the Schematic fold-in while you read the following general description. The part numbers are arranged in the following groups to help you locate specific parts on the Schematic, circuit boards, and chassis:

101-199 Display circuit board

201-299 CPU circuit board

301-350 Front panel/Chassis

401-450 Back panel/power supply circuit board

501-550 Front panel circuit board

601-650 Sensor circuit boards

The heart of the Digital Weather Computer is integrated circuit U205, which is a 3870 microprocessor (computer-on-a-chip). This IC accepts input signals from the temperature, pressure, and wind transducers and processes these signals 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.

Each outdoor and indoor temperature sensor (A302 and A301 respectively) provides a voltage which is proportional to temperature. The equation, $\Delta V/\Delta T$ = 10 mV/°K (the change in voltage per change in temperature equals 10 millivolts per degree Kelvin) describes this proportion. These voltages are coupled through buffer amplifiers U201A and U201D to the slope and intercept correction amplifiers, U201B and U201C. The resulting voltage is proportional to the temperature in Fahrenheit and is referenced to −40°F at zero volts. The equation $\Delta V/\Delta T = -10$ mV/°F describes this proportion. These voltages are applied in sequential selected order to the voltage-to-frequency converter, formed by U202D and U203A, and provides a frequency proportional to the input voltage ($\Delta f/\Delta V = -100$ Hz/V).

Display = (−10mV/°F) ($T_{°F}$ + 40) (−100 Hz/V) −40

EXAMPLE: If T (°F) = 32° (ice water), then:

Display = (−10mV/°F) (32 + 40) (−100 Hz/V) −40

Display = 32

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 intercept correction instrumentation amplifier (formed by U202A, U202B, and U203B). The resulting voltage is proportional to the pressure ($\Delta V/\Delta P$ = −.1V/in. Hg) and is referenced to a vacuum at zero volts. This voltage is applied in sequential selected order to the voltage-to-frequency converter (U202D and U203A) in the same manner as the temperature voltages. 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 = 2992

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

Outdoor temperature, indoor temperature, and pressure are all "read" by the microprocessor, using programmed transfer.

The wind vector (speed and direction) uses an infrared optical technique. The wind speed sensor presents 32 pulses per revolution of the anemometer cups to the microprocessor using external interrupt transfer. Wind direction is a 4-bit parallel Gray code which is derived by the angular position of the wind vane. U102 and U103 decode this Gray code into 16 compass points.

U205 processes temperature in Fahrenheit, pressure in inches of mercury, and wind magnitude (speed) in miles per hour. All other possible units of display (temperature in Celsius, pressure in millibars, and wind speed in knots or kilometers per hour) use microprocessor conversion.

Microprocessor U205 generates a 4-bit code for use by the 4-to-16 line decoder, U101, which sequentially selects the correct one of 16 digits to be displayed. When this digit is selected, U205 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, U206, and also reads this data from U206 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 U206 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.

SENSORS

Temperature Sensors

The outdoor and indoor temperature sensor circuits operate in an identical manner. Therefore, only the outdoor sensor circuit will be described below.

Outdoor temperature transducer A302 is a 3-terminal device, since two pins (1 and 2) are internally connected together. This common connection is then connected via the 3-wire cable to chassis ground. Externally, pins 3 and 4 look like a 6.8-volt zener diode. Actually, however, the voltage between pins 3 and 4 varies linearly with temperature.

A302 is connected via the cable to the outdoor temperature terminals on the bottom of the Weather Computer. Resistors R201 and R202 on the CPU circuit board supply the proper DC bias for this transducer via plug P206, pins 13 and 16. This resistor network and the internal 6.8-volt zener in the transducer, which is connected between the +15- and −15-volt DC supplies, establishes the required bias current. A voltage with respect to ground, proportional to the temperature, appears at both the top and bottom of the resistor network formed by R203, R204, R205, and R206. Since the voltage change with temperature is identical at the top and bottom of this resistor network, the network provides an offset adjustment which is independent of slope (amplifier gain).

Switch SW201A selects two different output points from the resistor network. In the CAL position, the output is a voltage proportional to temperature and is independent of any offset adjustment of control R205. If you submerge the temperature sensor in an ice bath and allow it to stabilize, the voltage from U201B can be calculated. If you use the microprocessor as a DVM (digital voltmeter), any error between the measured value and the calculated value is attributed to a slope (gain) error referenced back to absolute zero degrees Kelvin. Control R209 allows you to adjust the gain of the correction amplifier formed by U201A (a noninverting unity gain buffer) and U201B (an inverting gain amplifier) to correct the error. When control R209 is set so the display reads 51°F (a gain of about 1.8), the output from U201B is correct and becomes a voltage proportional to temperature. With switch SW201A set to the NORM position, the temperature voltage from U201B is an offset-adjustable voltage still proportional to temperature. To complete the outdoor temperature adjustment, control R205 is adjusted until the display reads the correct ice bath temperature of 32°F.

The output of U201B is connected to MOSFET bilateral switch U207C which, when the microprocessor selects the information from this port, couples the outdoor temperature analog voltage to the input of the voltage-to-frequency converter, formed by U202D and U203A. This converter processes the analog voltage to digital information so the microprocessor can display it.

Pressure Sensor

A piezo resistive bridge forms pressure transducer A201. This transducer is biased by the 1.5mA constant current source formed by U203B, R255, and R256 which provides a voltage proportional to the atmospheric pressure that is referenced to zero within a vacuum. Optional components R248, R249, R251, R252, and R254 compensate this bridge circuit to the required accuracy. The voltage is then applied to an inverting instrumentation amplifier formed by U202A, U202B, U202C, and the associated components. The offset voltage from this amplifier is within accepted limits so you can adjust the slope (gain) with controls R239 and R241 until the output from U202C becomes a voltage also proportional to pressure. When these controls are adjusted until the display indicates the proper pressure, you have corrected for component tolerances and the difference between the pressure at sea level and at your particular altitude.

The output of U202C is connected to MOSFET bilateral switch U207A which, when selected by the microprocessor and transistor switch Q203, passes this pressure voltage to the voltage-to-frequency converter. This converter functions the same as it did for the temperature display.

Wind Sensors

An infrared transmissive-interruptive sensor, formed by light-emitting diode D601 and light-sensing transistor Q601 (both inside the anemometer cup housing), determines the wind magnitude (speed or velocity) component. The optically-encoded disc, also inside the cup housing, provides 32 interruptions per revolution of the cups. These interruptions produce pulses which feed buffer transistor Q206 via the interconnecting cable and plug P206 pin 18. The output pulses from Q206 drive the external interrupt (pin 38) of the microprocessor. This causes interrupt transfer of the pulses which are porportional to the wind velocity. The microprocessor then displays the wind velocity.

Light-emitting diodes, D602, D603, D604, and D605 together with light sensing transistors Q602, Q603, Q604, and Q605 determine the angular (position) component of the wind vector. This circuit also uses an infrared sensing circuit, which is inside the wind vane assembly, and uses a system known as Gray code. This 4-bit code is connected to the display circuit board via the 8-wire cable, plug P206 pins 6, 7, 8, and 9 and plug P203 pins 1, 2, 3, and 4. Buffer transistors Q134, Q135, Q136, Q137, inverter transistor Q138, and 3-to-8 decoders U102 and U103 form the 4-bit Gray code for the 16 LED direction indicators. Only one of these indicators will light to show the direction from which the wind is originating.

VOLTAGE - TO - FREQUENCY CONVERTER

The voltage-to-frequency converter, which is formed by integrator U202D and comparator U203A, sequentially selects the temperature and pressure information from the common bus connecting the outputs of the bilateral switches together. The negative analog voltage is applied to R227 and integrates with time into a positive-going ramp across C211. When this ramp at the output of U202D reaches the comparator's threshold value, which is established by R231 and D201, the output from U203A quickly switches from −15 volts to +15 volts. This transition closes MOSFET bilateral switch U207D and reduces the voltage

across C211 to zero. The output from U203A then returns to it's quiescent state of −15 volts. C212 causes this transition to be quite fast.

U202D and U203A produce pulses which are applied through C200 to the input of the discrete monostable formed by Q204 and Q205. The output from Q205 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.

CHART RECORDING BUFFERS

The outdoor temperature signal voltage at the output of U201B passes through a non-inverting unity-gain buffer, U204B, to plug P206 pin 17. This provides a connection for an external chart recorder (with appropriate external slope and intercept scaling) which can display the outdoor temperature graphically.

Similarly, the barometric pressure signal at the output of U202C passes through another non-inverting unity-gain buffer, U204A, to plug P206 pin 19. This signal, with appropriate scaling, may be used to graphically display the pressure.

MICROPROCESSOR — RAM

Microprocessor U205 (a computer on a chip) forms the heart of the Weather Computer. This IC accepts all of the transducer sensor signals and interprets them into a display. It also stores data into RAM (Random Access Memory) U206, 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 (U206 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 U205 via pin 14.

The various data enters the microprocessor in units of Fahrenheit, miles-per-hour, and inches of mercury. U205 converts this data into Celsius, knots, or kilometers-per-hour, and millibars.

Front panel switches enable you to retrieve information, maximum and minimum temperature, pressure, etc., for display. U205 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 U205 pins 1 and 2 provides a clock for the operation of the microprocessor.

D401, R401, R402, Q401 and R403, on the back switch/power supply circuit board, supplies a 50 - 60 Hz square wave to U205 via plug P206 pin 14 for accurate timekeeping.

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

Wind speed is continuously present at the external interrupt input of U205 at pin 38 for transfer into the microprocessor.

Outdoor temperature, indoor temperature, and pressure sequentially enter U205 for program transfer via pin 16. Interpretation of these signals is controlled by the three select lines at pins 22, 23, and 24.

Parallel data of all the display information is present at the holes for plug P202 for interface to an external computer. Interface information is explained in more detail in the "Operation" section of this Manual.

DIGITAL DISPLAY

Microprocessor U205 provides a 4-bit binary code to 4-to-16 line decoder U101 via plug P205 pin 4, 5, 6, and 7. This code is used to select one of the 15 display digits (DS114 through DS101), in a sequential, interlaced, multiplexed pattern. The microprocessor also provides a strobe signal (pin 7) which identifies the start of the display interval of a given digit. This strobe signal is not used in the Weather Computer itself, but is present at P202 pin 20 for handshaking and interfacing with an external computer.

The digit select signal for U101 is a logic 1 (+5 volts) and is applied to the base of the appropriate transistor at Q115 through Q101. 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 Q132 and Q133, Q131 and Q129, Q128 and Q127, Q126 and Q125, Q124 and Q123, Q122 and Q121, Q119 and Q118, and Q117 and Q116. The transistors which correspond to the segments to be lighted are switched high to provide a current source.

SWITCHING

U205, on the CPU 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 Q212 and Q213, while pin 19 monitors the rear panel switches, through switched buffers Q214 and Q215. These selected requests are identified by the outputs of the multiplexed display digits DS105 through DS114 as described in the following tables.

FRONT PANEL SWITCH (Pin 18)	ISOLATION DIODE	MULTIPLEX DIGIT	FUNCTION
SW501	D501	DS106	Clear
SW502	D502	DS107	Min. Temp
SW503	D503	DS108	Max. Temp
SW504	D504	DS109	Wind Chill
SW505	D505	DS110	Min. Pres.
SW506	D506	DS111	Max. Pres.
SW507	D507	DS112	Rate Change/ Hour
SW508	D508	DS113	Peak Gust
SW509	D509	DS114	Wind Avg.
REAR PANEL SWITCH (Pin 19)			
SW401	D415	DS106	Mi/hour
SW401	D416	DS107	Km/hour
SW402	D417	DS108	Millibars
SW403	D418	DS109	°C
SW404	D419	DS110	Temp. Hold
SW405	D421	DS111	Time Hold
SW406	D422	DS112	Hr./Mo. Adv.
SW407	D423	DS113	Min/Day Adv.
SW406/SW407	D442/D423	DS112/DS113	Tens/Mins. Adv.
SW408	D424	DS114	Temp/Date Hold
SW409	D425	DS105	12/24 Hr. Select

In addition to the function listed in the table, switch SW401 also selects one of the three discrete LED indicators on the front panel (km/h, knots, and mi/h) by grounding the corresponding diode. SW402 applies +5 volts to the inches (LED113) or the millibars LED (D114) and SW403 grounds the °F LED (D105) or °C LED (D106).

POWER SUPPLY

Most of the power supply circuitry is located on the back switch/power supply circuit board. The battery back-up circuitry, however, is located on the CPU circuit board.

Transformer T301 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 D402 and D404, along with capacitor C301, supply 9.2 volts DC, which U301 regulates to +5 volts for use by the display circuit board. This +5 volts is further filtered by C402 and C403 and supplies the display circuit board via the CPU circuit board plugs. Diodes D403 and D405, together with capacitors C302, C404, and C405 and regulator U402, provide the regulated +5-volt supply for the CPU circuit board. These two +5-volt supplies are used to isolate the multiplex-generated switching currents and reduce the power dissipation of a single supply.

The +15-volt DC source for the analog circuitry on the CPU circuit board is supplied by D406, D408, C303, U303, C406, and C407. This voltage also supplies the infrared LED's D601 through D605 in the wind speed and direction sensors.

The −15 volts DC for the CPU circuit board is supplied by D407, D409, C304, C408, C409, and U304.

Diode D401, along with the transistor switch circuitry formed by R401, R402, R403, and Q401 provides a 50/60 Hz square wave for accurate time-keeping. The waveform is applied to microprocessor pin 17.

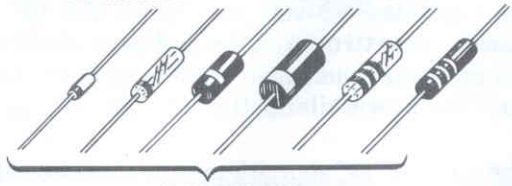
The battery back-up circuit, which keeps the content of the RAM intact during a power interruption, is located on the CPU circuit board. D411, D412, and C411 produce a full-wave rectified and filtered DC voltage which reverse biases D414 when AC current is present. This prevents current drain from the battery when it is not needed. Zener diode D413 and a transistor switch circuit, formed by R405, R406, R407, and Q403, monitors the AC line voltage and provides a "brown-out" threshold sensing circuit. If the sensing circuit detects a large enough brown-out or a complete loss of power, transistor switch Q403 shuts off and forward biases D414. The current through R407 turns transistor switch Q404 on, which quickly discharges C412. This turns on the transistor switch on the CPU circuit board formed by D208 and Q211. When this happens, battery current is supplied to RAM U206. A series pass regulator, formed by Q208, D206, and R264 holds the voltage to U206 to +5 volts. At the same time, the transistor switch formed by Q216 and R263 holds the microprocessor reset.

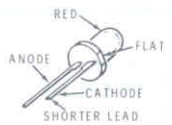
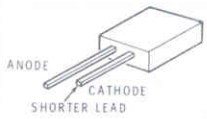
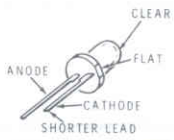
The voltage at zener D206 also inhibits the RAM from performing read or write operations during the AC interruption.

When AC power is restored, the reverse of the above takes place. An RC circuit formed by C412 and R409, 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 Q207 which is turned on by the +15-volt supply. Q207 is reverse-biased during a power interruption.

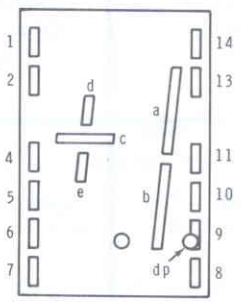
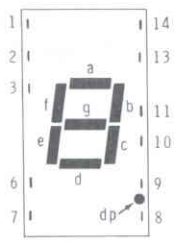
SEMICONDUCTOR IDENTIFICATION CHARTS

DIODES

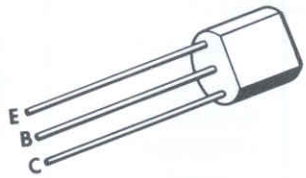
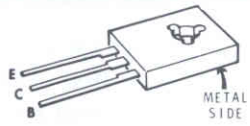
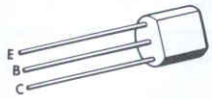
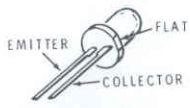
HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
56-56	1N4149	D202, D203, D207, D208, D401, D411, D412, D414, D415, D416, D417, D418, D419, D421, D422, D423, D424, D425, D501, D502, D503, D504, D505, D506, D507, D508, D509	IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.  BANDED END (CATHODE)
56-26	1N191	D205	
56-85	5V zener	D201	
56-616	5.6V zener	D206	
56-620	15V zener	D413	
57-42	3A1	D402, D404	
57-65	1N4002	D403, D405, D406, D407, D408, D409	

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
412-633	5082-4484	D101, D102, D103, D104, D105, D106, D107, D108, D109, D111, D112, D113 D114	
412-634	5082-4670	D115, D116, D117, D118, D119, D121, D122, D123, D124, D125, D126, D127, D128, D129, D131, D132	
412-635	TIL-32	D601, D602, D603, D604, D605	

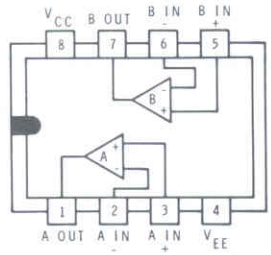
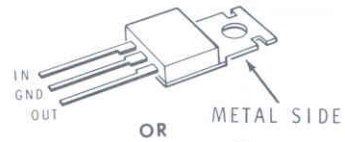
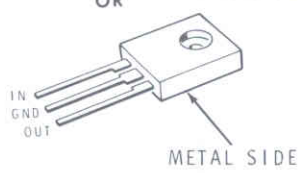
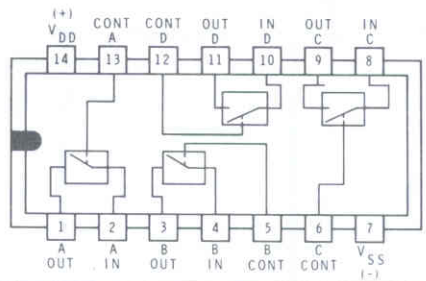
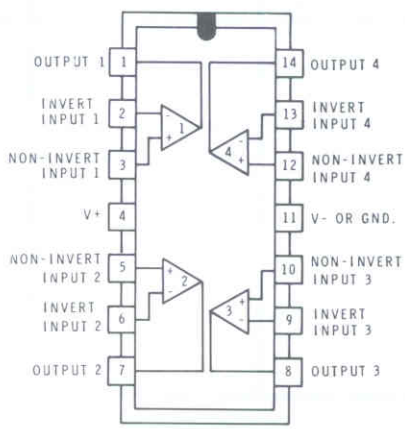
DISPLAYS

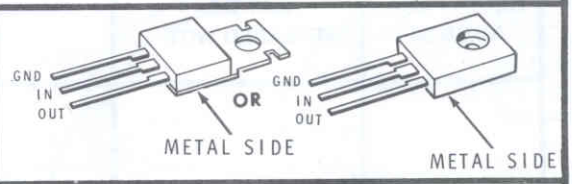
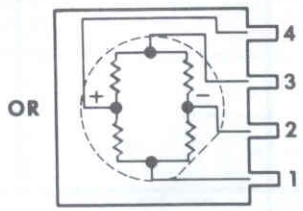
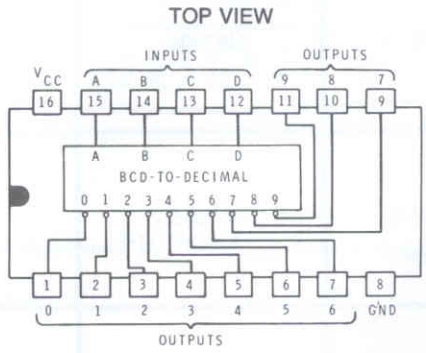
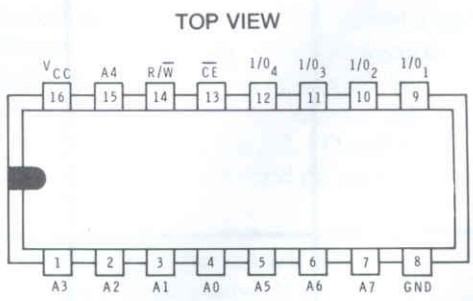
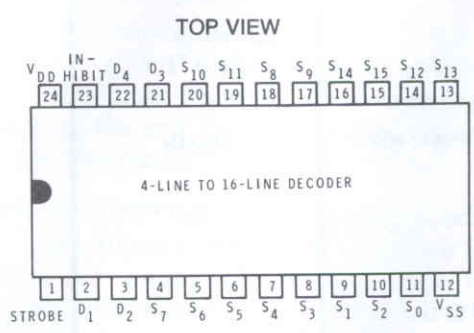
HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION (TOP VIEW)
411-859	5082-7756	DS108	 PIN CONNECTION 1. CATHODE d 2. ANODE d 3. NO PIN 4. CATHODE c 5. CATHODE e 6. ANODE e 7. ANODE c 8. ANODE dp 9. CATHODE dp 10. CATHODE b 11. CATHODE a 12. NO PIN 13. ANODE a 14. ANODE b
411-860	5082-7760	DS101, DS102, DS103, DS104, DS105, DS106, DS107, DS109, DS110, DS111, DS112, DS113, DS114, DS115	TOP VIEW  PIN CONNECTION 1. ANODE a 2. ANODE f 3. CATHODE 4. NO PIN 5. NO PIN 6. NO PIN 7. ANODE e 8. ANODE d 9. ANODE dp 10. ANODE c 11. ANODE g 12. NO PIN 13. ANODE b 14. CATHODE

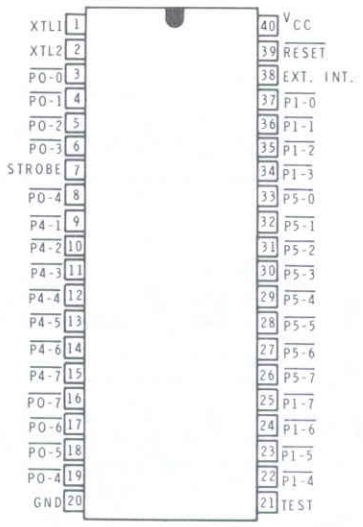
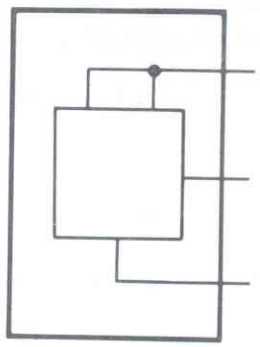
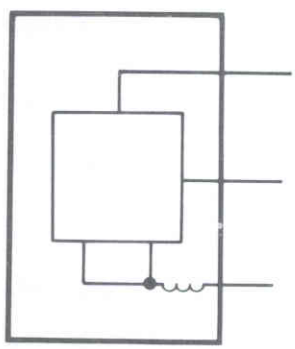
TRANSISTORS

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
417-235	2N4121	Q116, Q118, Q121, Q123, Q125, Q127, Q129, Q132, Q201, Q202, Q203, Q209, Q211, Q212, Q214	
417-801	MPSA20	Q117, Q119, Q122, Q124, Q126, Q128, Q131, Q133, Q134, Q135, Q136, Q137, Q138, Q204, Q205, Q206, Q207, Q213, Q215, Q216, Q401, Q403, Q404	
417-818	MJE181	Q208	
417-881	MPSA13	Q101, Q102, Q103, Q104, Q105, Q106, Q107, Q108, Q109, Q110, Q11, Q112, Q113, Q114, Q115	
417-919	TIL-78	Q601, Q602, Q603, Q604, Q605	

INTEGRATED CIRCUITS

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
442-21	MC1458	U203, U204	TOP VIEW 
442-54	UA7805	U301, U402	 OR 
442-63	UA7815	U303	
442-99	CD4016	U207	TOP VIEW 
442-602	LM324N	U201, U202	TOP VIEW 

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
442-613	MC7915CP	U304	
442-699	1873 or 136PC	A201	
443-87	MC74145N	U102, U103	
443-721	2112-2	U206	
443-871	MC14514	U101	

HEATH PART NUMBER	MAY BE REPLACED WITH	CIRCUIT COMPONENT NUMBER	IDENTIFICATION
444-23	MK3870	U205	TOP VIEW 
100-1728		A301	
100-1727		A302	

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

  Total enclosed $_____
- If you prefer COD shipment, check the COD box and mail this form. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date Purchased _____ Location Purchased _____

LIST **HEATH** PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE
TOTAL FOR PARTS			
HANDLING AND SHIPPING			
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

SEND TO: **HEATH COMPANY**
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only): 616 982-3571

THIS FORM IS FOR U.S. CUSTOMERS ONLY
OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUT ALONG DOTTED LINE

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

  Total enclosed $_____
- If you prefer COD shipment, check the COD box and mail this form. COD ☐

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CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

ZENITH

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.