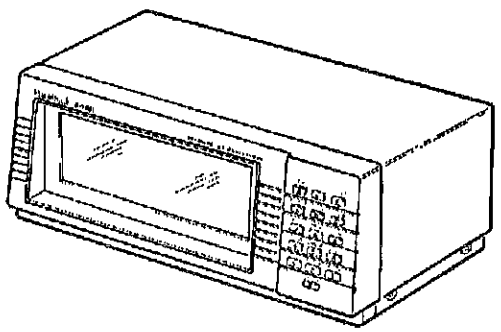
ADVANCED WEATHER COMPUTER

Model ID-5001B

OPERATION **595-4409**



HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

Your Heathkit Model ID-5001B Advanced Weather Computer is a microprocessor-based meteorological unit that measures and displays all of those weather variables that are so useful to boaters, pilots, farmers, amateur radio operators, meteorologists, climatologists, and general consumers.

You can set all of the display functions from the front panel keypad. A 6-digit clock displays the time in either a 12- or 24-hour format. Day and date are shown in a separate, 4-digit format. Automatic leap-year correction is provided, and auto daylight saving time adjustment is also selectable.

Two digits display the wind speed, while one of 16 indicators show the wind direction by compass point. The keypad allows you to select wind speed in miles-per-hour, knots, or kilometers-per-hour, which is then shown in the display. Instantaneous or average wind speed is keyboard selectable and displayed. The high or low wind speed that occurred since the memory was cleared can be recalled and is displayed with time and date of occurrence.

Indoor and outdoor temperatures are displayed continuously. You can select a temperature unit display in either Celsius or Fahrenheit and the readout will show the high and low temperatures with time and date. Wind chill temperature display is another keypad selection.

Barometric pressure is displayed in four digits. You can also have the display show the date and time of minimum or maximum pressure in either inches of mercury or millibars.

You can clear specific minimum or maximum values by pressing the CLEAR key while the high or low value to be cleared is displayed. You can clear both minimum and maximum indoor and outdoor values by depressing the appropriate key along with the CLEAR key.

Rate arrows, consisting of an arrow head to show increase or decrease, and three tails to indicate greater rates, are located to the right of the displayed values.

The word ALERT with one bar or ALERT-WARN with two bars is displayed if the rate exceeds a predetermined level.

ALERT-WARN and arrow segment rates are individually keyboard selectable.

You can adjust the display brightness at the highest and lowest expected level. The brightness will then automatically change for ambient light levels in between.

Battery backup is provided by a 9-volt battery that you can install either inside or outside the cabinet.

Indoor/outdoor humidity sensors, a rain gauge, and an RS-232C serial interface are also available as optional accessories. Humidity or rain legends are not displayed if the particular option is not installed.

Your Advanced Weather Computer will provide a vast amount of valuable weather information, and its handsome styling will be attractive in any decor.

NOTE: You will need to purchase the 8-wire cable to connect between the Weather Computer and the boom assembly. The following lengths of 8-wire cable are available from Heath Company:

50' Cable, Model IDA-1290-1
100' Cable, Model IDA-1290-2
150' Cable, Model IDA-1290-3

BATTERY INFORMATION

We recommend that you obtain a 9-volt rectangular battery to use as a backup for your Weather Computer's memory in case of power failure. A battery clip and connector have been provided with your kit for this purpose. This battery will provide the necessary backup power for approximately 18 hours.

Although you may use any battery that supplies from 6 to 9 volts at 30 milliamperes, we recommend a 9-volt alkaline battery. (Useful battery life ends when the battery voltage drops to 4.2 volts.) Representative manufacturers and their type numbers are listed below. We suggest that you purchase a battery before you complete your kit so you will have it for testing.

NEDA	#1604A
Duracell	#MN1604
Eveready	#522
Mallory	#MN1604
Ray-O-Vac	#A-1604

SPECIFICATIONS

DIGITAL CLOCK / 4-YEAR CALENDAR

Displays	6-digit, 12- or 24-hour format time readout; 6-digit date readout. AM-PM indicator in 12-hour format.
Time Accuracy	Determined by the accuracy of the AC line frequency. No accumulative error; .003% error with battery-backed clock during power failure.

WIND SPEED*

Displays	Two significant digits. Separate indicators show if the display is in miles-per-hour, knots, or kilometers-per-hour.
Gust Mode	Instantaneous peak wind speed; memory - date, time, and magnitude of minimum and maximum gusts.
Average Mode	One minute wind speed average; memory - date, time, and magnitude of minimum or maximum average wind speed.
Memory	Date, time, and magnitude of minimum or maximum gust or average wind speed. Changes in last hour or last 24 hours.
Accuracy	±5% or better.

*In conformance with the National Weather Service Federal Meteorological Handbook #9, Aviation Weather Observation, Chapter A8, Sections 3 & 3.5, Specifications for Supplementary Aviation Weather Reporting Stations.

WIND DIRECTION*

Display	32 points of resolution. One of 16 indicators arranged in a circular compass configuration. Identified by compass points and radial degrees.
Gust Mode	1 second averaging.
Average Mode	60 second averaging.
"Wind" Mode	60 second averaging of displays to nearest 10°.
Memory	Average direction when minimum or maximum gust or average wind speed occurred.

THERMOMETER

Displays	Indicates indoor and outdoor temperature 2-1/2-digit readout with "-" sign outdoor indicator, Fahrenheit-Celsius indicators, and rising/falling indicators. Rate of change per hour.
Temperature	-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 since cleared; change in the last 24 hours.

BAROMETER

Displays	4-digit readout. Separate indicators show if pressure is rising or falling and if display is in inches of mercury or millibars. Rate of change per hour.
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 since memory was cleared; change in the last 24 hours.

*In conformance with the National Weather Service Federal Meteorological Handbook #9, Aviation Weather Observation, Chapter A8, Sections 3 & 3.5, Specifications for Supplementary Aviation Weather Reporting Stations.

RAIN GAUGE

Displays	4 digit.
Units	Inches to 99.9, centimeters to 250, with automatic decimal point adjust.
Repeatability	±1 count in 10 for a 1-inch-per-hour rain fall.
Memory	Change in last hour or 24 hours.
Operating Temperature	Rain unit 0°C to 50°C (32°F to 122°F).
Dimensions	Rain unit 9.0" diameter x 9.6" high .
Weight	Rain unit 1.6 lbs. (.7 kg).

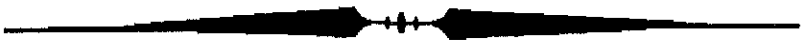
RELATIVE HUMIDITY

Displays	Indicates indoor and outdoor relative humidity 2-digit readout and rising and falling indicators. Rate of change per hour.
Measurement Range	10% - 90% relative humidity.
Accuracy @ 25°C (77°F)	±10 counts.
Response Time to 90% value at 25°C/77°F	From 10% to 43% relative humidity in less than 3 minutes. From 43% to 90% relative humidity in less than 5 minutes.
Memory	High and low since cleared, change in last 24 hours.
Operating Temperature Range	0°C to 50°C (32°F to 122°F).

GENERAL

Power Requirements	120/240 VAC, 50/60 Hz; approximately 19 watts. Provision for connection to an external 6- to 9-volt battery which can supply approximately 30 mA to retain memory contents and maintain clock and rain gauge operation during power interruptions. (This feature suspends all other functions during the interruption and draws current from the battery only during the interruption.)

Operating Temperature Range	15° C to 35°C (59° F to 95° F).
Dimensions (overall)	15-3/4" wide x 8-3/4" deep x 6" high. (40 x 22.2 x 15.2 cm).
Weight	9.8 lbs. (4.5 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.

INITIAL TESTS

NOTE: The following tests will require a high input impedance volt-ohmmeter. If you do not obtain the indicated results as described in the following steps, refer to the "In Case of Difficulty" section. Make sure you find the cause of the problem before you apply power; otherwise, damage could occur to the electronic circuitry. If a volt-ohmmeter is not available, skip the Resistance and Voltage Tests and proceed to "Operational Tests."

RESISTANCE TESTS

Refer to Pictorial 1-1 for the following steps.

( ) Set your ohmmeter range switch to the R X 10K or higher position.

( ) Connect the negative (-) ohmmeter lead to the round ground pin on the line cord plug. Leave the lead connected to this point until you are instructed to disconnect it.

( ) Connect the positive (+) ohmmeter lead first to one of the flat line cord plug prongs, and then to the other flat prong. The readings should be greater than 2 MΩ.

( ) Set your ohmmeter range switch to it lowest position. NOTE: If you are using a VTVM, set its range switch to the R x 100 position.

Touch the positive ohmmeter lead to the following power supply circuit board test points. At each location, you should obtain a reading greater than 100 Ω:

( ) TP1 at the anode of D315.

( ) TP2 at the cathode of D316.

( ) TP3 at the cathode of D319.

( ) TP4 at the cathode of D320.

( ) Disconnect the ohmmeter leads and set it aside.

This completes the "Resistance Tests."

VOLTAGE TESTS

Refer to Pictorial 1-2 for the following steps.

NOTE: During the voltage tests, if you do not obtain the indicated results, turn off the power immediately and refer to the "In Case Of Difficulty" section to help you locate the problem. Do not reapply power until you have corrected the difficulty.

( ) Connect the negative (-) voltmeter lead to the GND screw on the OUTDOOR HUMIDITY terminal strip.

( ) Preset the nine main circuit board controls fully counterclockwise.

( ) Temporarily disconnect the socket at S303 on the power supply circuit board.

( ) Set the voltmeter range switch to read +15 VDC.

( ) Connect the line cord plug to an appropriate AC outlet.

Touch the voltmeter's positive lead to the following pins at power supply circuit board plug S303:

( ) Pin 6 for a reading of +5.5 VDC.

( ) Pin 7 for a reading of +5 VDC.

( ) Pin 8 for a reading of -15 VDC. NOTE: Interchange the test leads if your voltmeter does not have the auto-polarity feature.

( ) Pin 9 for a reading of +15 VDC.

( ) Remove the line cord plug from the AC outlet.

( ) Disconnect the voltmeter leads and set it aside.

( ) Reconnect socket S303 to the power supply circuit board.

OPERATIONAL TESTS

NOTE: You may use the temperature sensor cables at their present lengths. However, if you want to shorten one cable, or both (because of where you are going to install your Weather Computer), do it now before you perform the "Calibration." Refer to the "Installation" section on Page 4-1, if necessary.

Refer to Pictorial 3-4 and temporarily connect the wires at the free end of the outdoor temperature sensor (longest cable) to the connector strip labeled OUTDOOR TEMPERATURE as follows:

( ) Silver wire to GND.

( ) White wire to WHT.

( ) Black wire to BLK.

Refer to Pictorial 3-4 and temporarily connect the wires at the free end of the indoor temperature sensor (shortest cable) to the connector strip labeled INDOOR TEMPERATURE as follows:

( ) Silver wire to GND.

( ) White wire to WHT.

( ) Black wire to BLK.

Refer to Pictorial 1-3 for the following steps.

( ) Connect the line cord plug to an appropriate AC outlet; you should observe the following conditions:

The green front panel LED will light.
The unit may "beep."
After approximately 10 seconds, the fluorescent lamp will light.

You should observe the following display indications:

A compass rose (wind direction) display
Wind Speed: 0
Random Inside and Outside Temperature (°F) readings
Barometer IN (inches): random reading
Hours
Minutes
Seconds
AM
Day
Month

Note that the Hours digits will flash when you first apply power, and will continue to flash for approximately one minute. After this period, the clock circuit will automatically begin to keep time, starting at **12:00.00 AM**. When any of the clock digits are flashing, it means that that function is in the "set" mode.

NOTES:

1. Whenever you are instructed to press two keyboard keys, be sure that both keys are depressed at the same time.

2. If the hours digits stop flashing before you are able to continue with the following steps, press the TIME SET and ENTER keys and then the TIME SET key again. The hours digits will then begin to flash once more.

( ) Press ENTER and the minutes will begin to flash.

( ) Press ENTER and the seconds will begin to flash.

( ) Press ENTER and AM will start to flash and the clock will begin to keep time.

( ) Press UNITS and the PM indicator will begin to flash.

( ) Press UNITS and AM will again appear and flash.

( ) Press 24 HR and the AM display will go out and the time will change to the 24-hour mode (military time).

( ) Press ENTER and the S (standard time) indicator will begin to flash.

( ) Press ENTER and the month will begin to flash.

( ) Press ENTER and the day will begin to flash.

( ) Press ENTER and the year (**87**)will begin to flash.

( ) Press ENTER to exit the "time set" sequence. At this moment, the month and day will be displayed. After a few seconds, the "arrow heads" (▲ for an increase, and ▼ for a decrease) will appear after the displayed temperature and barometer readings.

( ) Press PRESSURE (4) and HUMID (6) to make sure that all of the display segments are functioning properly as shown in Detail 1-3A. NOTE: This test will time out after 60 seconds.

( ) Press the two previous keys once more and the display should look like the one shown in Detail 1-3B.

( ) Press the two keys once more and the display should look like the one shown in Detail 1-3C.

( ) Press the two keys once more and the display should go blank.

( ) Press ENTER and the display should return to the normal mode.

( ) Press the TIME SET and ENTER keys; release these keys and then press the TIME SET key again. The hours will begin to flash.

( ) Press 1 and 1 should be displayed and flash.

( ) Press 2 and 12 should be displayed and flash.

( ) Press 3 and 3 should be displayed and flash.

( ) Press 4 and 4 should be displayed and flash.

( ) Press 5 and 5 should be displayed and flash.

( ) Press 6 and 6 should be displayed and flash.

( ) Press 7 and 7 should be displayed and flash.

( ) Press 8 and 8 should be displayed and flash.

( ) Press 9 and 9 should be displayed and flash.

( ) Press 1 and 1 should be displayed and flash.

( ) Press 0 and 10 should be displayed and flash.

( ) Press ENTER several times until you exit the TIME SET mode. NOTE: You will know when you have exited the TIME SET mode when the time and date displays stop flashing.

( ) Press BAUD and 9600 should be displayed in the time display area.

( ) Press BAUD seven more times and the display should sequence as follows:

110
150
300
600
1200
2400
4800

( ) Press BAUD once more to return to a 9600 display.

( ) Press ENTER to return to the normal display.

NOTE: The following step is a viewing angle check. It will change the intensity of the lit and unlit segments of the display. There are five levels of change which are somewhat subtle.

( ) Press UNITS and INDOOR several times and watch for a change in intensity of the unlit segments of the display. You should also notice the lit segments change intensity if you view the display from an angle.

( ) Press ENTER and AL/WARN (alert/warning). This will turn the audio on for key clicks and turn the audio alarm on for alert and warning. Each key should produce a "click" whenever you press it.

( ) Press CLEAR and AL/WARN and the audio should be disabled.

( ) Place your finger tip over the photo resistor in the lower right-hand corner of the front panel opening. It will take about five seconds before the display's light intensity reaches its lowest level. After you remove your finger, the light intensity will again return to its normal level.

( ) Refer to Pictorial 3-4 and use a screwdriver blade to short the two terminal screws labeled "RAIN" together. The display should indicate "RAIN 0.01." Each time you short the terminals together, the numbers should increment by .01. NOTE: Contact bounce may cause the reading to read slightly higher.

( ) Press RAIN and CLEAR and the rain display should reset to 0.00.

NOTE: As soon as you short together the two terminal screws labeled "RAIN," the "RAIN" display will stay lit until all power, including any back-up battery, is removed to clear the Weather Computer's memory.

( ) Locate the 220 kΩ (red-red-yel) resistor that was left over after you completed the assembly of your Weather Computer.

( ) Refer to Pictorial 3-4 and connect one lead of the 220 kΩ resistor to BLK on the terminal strip labeled OUTDOOR HUMIDITY on the back of your Weather Computer.

( ) Touch the other resistor lead to the adjacent WHT screw. A random outdoor humidity reading should appear in the display.

( ) Remove the 220 kΩ resistor from the OUTDOOR HUMIDITY terminal strip.

( ) Connect one lead of the 220 kΩ resistor to BLK on the terminal strip labeled INDOOR HUMIDITY on the back of your Weather Computer. Then touch the other resistor lead to the adjacent WHT screw. A random indoor humidity reading should appear in the display.

( ) Disconnect the 220 kΩ resistor from the back of your Weather Computer.

NOTE: If you mounted the battery holder on the inside of the chassis, skip the next two steps; otherwise, complete the step.

( ) Refer to Detail 1-3D and plug the battery connector onto the terminals for the 9-volt battery (not supplied). Then install the battery in its rear panel holder.

( ) Note the current time in the display. Remove the plug from the AC outlet for a few seconds and then plug it back in. The clock should still be keeping accurate time.

Refer to Pictorial 3-4 and position the Weather Computer as shown. Then temporarily connect the wires at the end of the 8-wire cable to the connector strip labeled **WIND** on the back of your Weather Computer as follows:

( ) Remove the line cord plug from the AC outlet.

( ) Blue wire to BLU.

( ) Green wire to GRN.

( ) Yellow wire to YEL.

( ) Orange wire to ORG.

( ) Red wire to RED.

( ) Brown wire to BRN.

( ) Black wire to BLK.

( ) White wire to WHT.

( ) Plug the line cord plug into the AC outlet.

Refer to Pictorial 1-4 for the following steps.

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

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

( ) Slowly turn the wind vane counterclockwise until the NNW 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 NNE 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.

( ) Spin the wind cups with your hand. You should observe a wind speed indication in the display.

( ) Disconnect the battery connector from the 9-volt battery terminals.

( ) Disconnect the line cord plug from the AC outlet.

This completes the "Initial Tests." Proceed to "Calibration."

CALIBRATION

If you do not obtain the correct results in any of the following steps, refer to the "In Case of Difficulty" section on Page 6-1 of this Manual to correct the problem.

IMPORTANT: Both temperature sensor cables must be connected to the back of the Weather Computer before it will operate properly.

NOTES:

1. Disregard any arrows or Alert/Warning indicators that may appear in the display during the calibration.

2. Before you start to calibrate your Weather Computer, be sure it has been powered up until the pressure reading stabalizes and does not change for a 5 minute period or for about one hour (with the cover off).

BAROMETRIC PRESSURE

In the following steps, you will temperature compensate and calibrate the barometric pressure circuit of your 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.)

Pressure transducer A401, which is a very responsive and accurate device, is the heart of this pressure circuit. However, since it will reflect extremely minute variations in your environment, 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 Weather 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 the barometric pressure corrected at sea level.

- The difference in the barometric pressure gradients between where the reference barometer is and where your Weather Computer is.

- The stability of the environment that your Weather Computer is monitoring. The environment could easily be changed by such factors as window fans, a room's sound pressure level, an air conditioner, the opening and closing of doors and windows, placement of the Weather Computer after calibration (10' in height corresponds to +.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 period where the barometric pressure is fairly stable. Therefore, do not attempt to calibrate in a period during which the barometric pressure is changing rapidly, such as when a thunderstorm is approaching.

Refer to Pictorial 2-1 for the following steps.

NOTES:

1. If you are performing the barometer adjustments for the first time, complete the following steps. However, if you have previously performed the barometer adjustments, you may proceed to the step with the asterisk in the next column.

2. When you remove or install jumper sockets on the main circuit board, you may see a noticeable change in the display brightness. The display may darken completely.

( ) Remove any jumper sockets that may be installed on plugs P401, P402, P403, and P404, if this has not already been done.

( ) Install a jumper socket at plug P403, pins 1 and 2.

( ) Install a jumper socket at plug P404, pins 2 and 3.

( ) Turn control R413 (BAR INTERCEPT) 25 turns clockwise or until you hear a faint "click" from the control.

( ) Adjust control R414 (BAR SLOPE) 25 turns counterclockwise or until you hear a faint "click" from the control.

( ) Connect the line cord plug to an appropriate AC outlet, if this has not already been done. Then allow the Weather Computer to warm up until the pressure reading stabilizes and does not change for a 5 minute period, or for about one hour with the cover off.

( ) Adjust control R407 (A/D CURRENT ADJ) to obtain a barometer reading of 62.00 ±.20.

( ) Remove the jumper socket from plug P404, pins 2 and 3. Then install it on plug P404, pins 1 and 2.

( ) Adjust control R425 (BAR TRANSDUCER BIAS) to obtain a barometer reading of 62.00 ± .20.

( ) Remove the jumper socket from plug P403, pins 1 and 2; then install it on plug P403, pins 2 and 3.

( ) Remove the jumper socket from plug P404 and install it on plug P401, pins 1 and 2.

( ) If the barometer reading is .00, adjust control R424 (BAR BALANCE) clockwise to obtain a reading that is slightly higher than .00. Then adjust control R424 counterclockwise until the barometer readin just becomes .00.

( ) If the barometer reading is not .00, adjust control R424 (BAR BALANCE) counterclockwise until the barometer reading just becomes .00.

( ) Remove the jumper socket from plug P401 and install it on plug P401, pin 2 (with pin 1 open) for storage. Be careful not to bump R407.

( ) Remove the jumper socket from plug P403 and install it on plug P402, pins 1 and 2.

Refer to Pictorial 2-2 for the following steps.

NOTE: In the following numbered steps, be sure to complete only the step(s) that cause(s) the display reading to drop below 39.00. Do **not** cut any of the leads of resistor R405C.

( ) 1. If the display reading is greater than 39.00, refer to inset drawing #1 in Pictorial 2-2 and cut one end **only** of the bare lead that is connected across the 3-resistor parallel combination at R405.

( ) 2. If the display reading still is greater than 39.00, cut one lead **only** of resistor R405A. Cut the lead at its center location so you can resolder it together again, if necessary.

( ) 3. If the display reading is still greater than 39.00, cut one lead **only** of resistor R405B.

( ) Adjust control R414 for a display reading of 39.00.

( ) Adjust control R413 for a display reading of 30.00 (not critical).

( ) * Write down the exact reading of the barometer display.

( ) Temporarily refer to Pictorial 2-4 and install the cover on the Weather Computer. (NOTE: You may leave the screws out of the cover at this time, if you wish.) Leave the cover on for at least one hour to allow the Weather Computer's inside temperature to stabilize.

( ) Observe the new reading of the display and compare it to the reading that you previously wrote down. Write down the difference value between the two readings. Then remove the cover from the Weather Computer. NOTE: Ideally, this value should be as close as possible to 0.

( ) If the the reading increased by .10 or less, turn control R425 (BAR TRANSDUCER BIAS) **clockwise** to increase the displayed value by 1.00 inch for every .01 of difference between the two readings. For example, if the initial reading was 30.00 and the reading increased to 30.04, turn the control clockwise to increase the reading to approximately 34.04. If the difference value is greater than .10, turn control R425 clockwise to increase the displayed value by 10.00 inches.

If the reading decreased by .10 or less, turn control R425 (BAR TRANSDUCER BIAS) **counter-clockwise** to decrease the displayed value by 1.00 inch for every .01 of difference between the two readings. For example, if the initial reading was 30.00 and the reading dropped to 29.96, adjust control R425 counterclockwise for a reading of approximately 25.96. If the difference value is greater than .10, turn control R425 counter-clockwise to decrease the displayed value by 10.00 inches.

( ) Adjust control R414 for a display reading of 30.00 (not critical). If you cannot get down to 30, disconnect the next resistor. If you cannot obtain a high enough reading, reconnect the R405 combination resistor(s) or jumper lead that you disconnected earlier.

( ) If the difference value above was greater than .10, wait for 15 minutes. Then return to the step above that is marked with an * and repeat the above procedure.

If the difference value above was less than .10, it is not necessary to repeat the procedure. If you do, however, you can approach the ideal difference value.

NOTES:

1. In the following steps, it is very important that you do not get any water inside the pressure transducer. Therefore, be sure to place your Weather Computer higher than the top of the water level as shown in Pictorial 2-2.

2. The purpose of the calibration hose (medium clear tubing), which you will use in the following steps, is to cause a change in the pressure that is equivalent to a two-inch drop in a mercury column.

3. Filling the hose with hot water will remove any kinks in it and make it easier to work with.

( ) Remove the paper backing from the foam tape on the back of the barometer calibration fixture. Place the fixture in a convenient place and use the foam tape to fasten the fixture to a stationary object. Be sure to select a location where there is no risk of pulling off paint when you later remove the foam tape.

( ) Fill the calibration hose with 44 to 60 inches of water until you have a loop of water 22 to 30 inches high, as shown. Tap the sides of the hose to remove any air bubbles. Then clamp the hose in the top calibration clips, as shown. Pinch the clips together to hold the hose in place, if necessary.

NOTE: The pressure transducer that you received will either have one or two ports, where only one port is open in the two-port type. Complete the following step if you have the one-port transducer. Otherwise, skip this step.

( ) Refer to inset drawing #2 in Pictorial 2-2 and slide 1/2" of one end of the medium clear tubing over one end of the 5" length of small clear tubing. Then, using a pair of scissors, cut off the medium clear tubing even with the end of the small tubing as shown.

- If you received a one-port transducer, complete step 1 below. If you received a two-port transducer, complete step 2.

- When you install the 5" tubing in one of the following two steps, be sure to push it firmly onto the transducer port. Otherwise, air leaks will make it impossible for you to calibrate the Weather Computer. Also, water will run out of the calibration hose when you later reposition it on the fixture.

( ) 1. Refer to Detail 2-2A and slide the 1/2" end of the 5" length of small clear tubing onto the transducer port.

( ) 2. Refer to Detail 2-2B and slide either end of the 5" length of small clear tubing onto the indicated port P1 of the two-port transducer.

Read the following numbered steps 2 through 9 to become familiar with the procedure before you continue.

Refer to Pictorial 2-3 for the following steps.

( ) 1. Adjust control R413 for a display reading of 30.00 (not critical at this time).

( ) 2. Adjust the longer hose (right clip) so the water level in the hose is exactly even (see Pictorial 2-3, Part A).

( ) 3. Push the long end of the calibration tubing into the 5" length of tubing that is already installed on the transducer.

( ) 4. Write down the reading of the display. NOTE: If the reading is less than 27.00 or greater than 33.00, adjust control R413 until the display reads approximately 30.00 (not critical).

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

( ) 6. Adjust the hose in both clips so the water levels are even with the top of their corresponding clips (see Pictorial 2-3, Part B).

( ) 7. Write down the new reading of the display.

( ) 8. Subtract the reading taken in step 7 from the reading taken in step 4.

NOTE: In the next step, each complete turn of control R414 will produce a change of .02 to .08 in the result in step 8. The variation per turn depends upon the value of R405A, B, and C, the greatest being with the resistors shorted.

( ) 9. If the result in step 8 is less than 2.00, turn control R414 clockwise (to increase the gain). This will cause the display reading to increase. NOTE: If you run out of adjustment range by turning control R414 fully clockwise, reconnect the last part (lead or resistor) that you disconnected from the lead/resistor parallel combination at R405.

If the result in step 8 is greater than 2.00, turn control R414 counterclockwise (to reduce the gain). This will cause the display reading to decrease. NOTE: If you run out of adjustment range by turning control R414 fully counter-clockwise, disconnect the component that is still connected to the top of the 3-resistor parallel combination at R405. If you still do not have enough range, disconnect the next component and so on until you do. NOTE: Do **not** disconnect R405C.

( ) 10. Return the shorter hose to the top left clip of the calibration fixture. Then repeat steps 2 through 9 until the result in step 7 is 2.00 (1.99 to 2.01 is okay).

( ) 11. Make sure the shorter end of the hose is clamped to the top left clip of the calibration fixture. Then remove the hose from the transducer.

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

( ) 13. Adjust control R413 for the correct pressure.

TEMPERATURE

NOTE: The thermometer supplied with your kit is only accurate at 120°F. Therefore, do not use it to measure ice water or air temperatures, as the readings will not be accurate.

Refer to Pictorial 2-1 for the following steps.

( ) Connect the Weather Computer's line cord plug to an appropriate AC outlet, if this has not already been done, and allow it to warm up for 60 minutes. NOTE: While it is warming up, perform the next three steps.

( ) 1. Fill an insulated container (glass-lined Thermos bottle or other brand vacuum bottle) half full of crushed ice.

( ) 2. Place both temperature sensors into the insulated container and finish filling the container with crushed ice.

( ) 3. Fill the container with cold water and allow it to set for five minutes, stirring the contents occasionally to insure a constant, uniform temperature.

NOTE: You will use the Fahrenheit scale when you perform the following temperature calibration. Therefore, complete the following step only if TEMPERATURE c appears in your display. Otherwise, skip this step.

( ) Press TEMP and UNITS and an "F" should appear after TEMPERATURE in the display.

NOTE: If you are performing the temperature calibration for the first time, complete the next two steps. Otherwise, skip them.

( ) 1. Record both temperature readings in the display.

( ) 2. Set controls R434 (TEMP OUTDOOR SLOPE) and R457 (TEMP INDOOR SLOPE) until the display indicates a reading that is 5°F higher than the one you obtained in step 1 above.

( ) In very small steps, adjust control R433 (TEMP OUTDOOR INTERCEPT) until the display just indicates 33° F; then stop.

( ) In very small steps, adjust control R433 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.

( ) In very small steps, adjust control R456 (TEMP INDOOR INTERCEPT) until the display just indicates 33° F; then stop.

( ) In very small steps, adjust control R456 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.

( ) Fill a second insulated container with hot water. NOTE: The thermometer that was supplied with your Weather Computer is calibrated to 120°F ±.5°F. Most hot water heaters provide water that is close to this temperature. If the water is not at least 120°, heat it on the stove.

WARNING: Do not leave the thermometer in water that is so hot that the liquid inside the thermometer touches the top of the tube.

( ) Place the thermometer and both temperature sensors into the hot water for at least five minutes. Stir the water. NOTE: If the thermometer indicates over 120°F, wait until the temperature is at or slightly below 120°F before you complete the following step.

( ) Adjust control R434 (TEMP OUTDOOR SLOPE) to produce a reading that is close to 120°F and agrees with the thermometer reading.

( ) Adjust control R457 (TEMP INDOOR SLOPE) to produce a reading that is close to 120°F and agrees with the thermometer reading.

( ) Repeat the adjustments for controls R433 and R456 (for the low temperature) and controls R434 and R457 (for the high temperature) until you can go back and forth between the cold water and hot water without error at either temperature end.

( ) Plug the battery connector onto the 9-volt battery terminals. NOTE: Do not leave the Weather Computer disconnected from the AC outlet with the 9-volt battery plugged in. Otherwise, the battery will discharge in less than 18 hours.

( ) Refer to Pictorial 2-4 and install the cover onto the Weather Computer with seven 6-32 x 1/4" screws. Be sure to position the lip of the cover inside the front panel before you slide the cover in place.

After the Unit has been on for at least 24 hours, remove the cover and let it set for an hour. Then return to the step marked with an * and repeat the steps for calibrating the barometer.

This completes the "Calibration" of your Advanced Weather Computer. Proceed to "Installation."

INSTALLATION

IMPORTANT: Do not mount the temperature sensors against a metal surface, as this would 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.

TEMPERATURE SENSORS

Ideally, the temperature sensors should be housed in white-colored louvered shelters (see Pictorial 3-1). If possible, install such shelters at least 100 feet from any concrete or other hard-surface area, and not closer to any object than four times the height of the object above the floor of the shelter. Install the shelter approximately four feet above the ground with the door opening facing north. Avoid rooftop installations, if possible. If you have to place the shelter on a roof, make sure that it is at least 30 feet from any exhaust fans, or large vertical reflecting surfaces.

You may place these sensors wherever you want to monitor the temperature; but do not place the indoor sensor near any heat source, such as a heat register or TV set. If you do, false readings will be displayed.

Mount the outdoor temperature sensor in a location that is shielded from direct or reflected sunlight, such as under an eave (see Pictorial 3-2). Also, select a location where ice and snow will not accumulate, as this would influence the reading.

WIND SENSOR ASSEMBLY

Ideally, the wind sensor assembly should be installed so that the distance to any obstruction is at least 10 times the height of the obstructions above the elevation of the ground on which the wind sensor assembly is located.

This assembly should be as far away as possible from objects that 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 3-3). The boom mounting clamp furnished will accept a tubular object up to 1-1/2" diameter. We do not recommend that 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 mounting masts, as outlined at the end of this section.

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

CABLE ROUTING

How you route the sensor cables is a matter for each individual installation. We recommend that you use plastic tape (not supplied) to secure the cables to a 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 that will remain pliable and will not harden.

CABLE CONNECTIONS

Refer to Pictorial 3-4 for the following steps.

( ) After you have properly routed the 8-wire cable from the wind sensor assembly, refer to the inset drawing in Pictorial 3-4 and install spade lugs on the end of this cable.

Position the Weather Computer as shown. Then connect the wires at the end of the 8-wire cable to the connector strip labeled **WIND** on the back of your Weather Computer as follows:

( ) Blue wire to BLU.

( ) Green wire to GRN.

( ) Yellow wire to YEL.

( ) Orange wire to ORG.

( ) Red wire to RED.

( ) Brown wire to BRN.

( ) Black wire to BLK.

( ) White wire to WHT.

( ) Cut two 1" lengths of black fiber sleeving. Then slide a 1" sleeving onto the silver wire at the free end of each of the two temperature sensor cables.

( ) Refer to the inset drawing in Pictorial 3-4 and install spade lugs on the end of the indoor and outdoor temperature sensor cables.

Connect the wires at the free end of the outdoor temperature sensor to the connector strip labeled **OUTDOOR TEMPERATURE** as follows:

( ) Silver wire with sleeving to GND.

( ) White wire to WHT.

( ) Black wire to BLK.

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

( ) Silver wire with sleeving to GND.

( ) White wire to WHT.

( ) Black wire to BLK.

LIGHTNING PROTECTION

A lightning strike can cause severe damage to your Weather Computer. The following paragraphs outline what you can do to protect your electronics equipment, as well as your family and home, from this danger.

It is impossible to absolutely eliminate the possibility of a lightning strike. But you can reduce the probability of a strike by intelligent operating procedures and proper grounding systems and techniques. Lightning is simply a passage of current from a negative to a positive potential. Reduce the places where potential differences exist and you will reduce the possible paths of a strike.

Actually, it is better and safer to mount the Weather Computer's sensors on a mast or tower rather than close to the rooftop of a house. A properly grounded mast (or tower) provides a "cone of protection" for a house, as shown in Pictorial 3-5. By presenting an existing path that will continuously bleed off static electricity, the probability of a potential difference is reduced considerably.

To protect your electronics equipment from a lightning-

induced static discharge, you must first bond all metal objects to an effective ground system. This system must provide a low-resistance, high-capacity reservoir for soaking up the static charges. Pay particular attention to your mast or tower since it will act as a giant lightning rod. Clean and lubricate all joints with a conductive grease; then tie the mast or tower to your ground system (a ground rod, for example) with heavy copper or aluminum wire (see Pictorial 3-6). Simply having the tower's base in the earth does not guarantee that it will shunt a lightning strike to ground.

Grounding

An effective ground system is a must for every home. The purpose of the ground system is twofold. First, it reduces the possibility of electrical shock if something in a piece of equipment should fail and the chassis or cabinet becomes "hot." If connected properly, three-wire electrical systems ground the chassis; however, the majority of electrical equipment still uses the ungrounded two-wire system. A ground system that prevents shock hazards is generally referred to as "DC ground." Second, it will serve as a path to bleed off static electricity.

For your electronic equipment, use your house's cold water pipe network as the primary ground source, assuming sweat-jointed copper tubing is used. This is far preferable to driving metal rods into the ground. Never use hot-water lines or iron pipe systems. Even with copper pipe, these makeshift grounds may be impossible to reach, unless you operate from the kitchen, bathroom, or laundry room.

If you do not have copper plumbing, use both a long (at least 8') heavily copper-plated 5/8" diameter steel rod and a #8 wire connection to the main power line ground lug at your electric service entrance box (see Pictorial 3-7). Keep in mind that you are trying 1) to dissipate existing static potential over as broad an area as possible and 2) to dissipate a heavy lightning strike if one should come.

The construction of a good earth ground, while not difficult, requires more than driving a metal rod into the lawn. The soil into which you drive the ground rod should present minimum resistance to the electric currents. When completely dry, most soils are non-conductors. Pure water is also a very poor conductor. The electrical conductivity of a soil is the result of electron transfer through electrolytes dissolved in the water that is present in that soil. This conductivity is greatly affected by moisture and salt concentration in the soil. There is a direct correlation between increased soil moisture and lowered resistance. Salts disassociate into ions when electron current passes through a medium; water provides the easy flow of these ions through the soil.

Chemical Treatment

CAUTION: Be extremely carefull when you apply chemicals that may pollute ground water, wells, or soil.

Chemical treatment of the soil around a ground rod will increase the effectiveness of your ground system. Rock salt, copper sulphate, or magnesium sulphate will inject large quantities of ions into the soil, resulting in an increase of the soil's conductivity. However, these salts will be gradually washed away by rain and groundwater. You should replace them every one to three years depending on climate and soil type.

Ground Rods

Copper pipe makes the best ground rod; however, it's expensive and too soft to be driven into the ground. The best practical rods are made of steel which is plated with copper to decrease resistance. Keep in mind that the length of a ground rod is more important than its diameter. Doubling its length will reduce resistance by 40%, while doubling the diameter will result only in a 10% reduction.

Spaced rods provide large reductions in the resistance of your earth ground system. Ground rods should be separated from each other by a distance equal to their length. This reduction of resistance is not proportional to the number of rods in the system. Three rods spaced 15 to 25 feet apart will provide an optimal ground system for all home installations.

A typical ground setup is shown in Pictorial 3-8. This is most effective since the chemical salts are distributed through a large volume of soil. Unfortunately, these salts are toxic to vegetation and can leave a ring of bare soil around each rod.

If you have a small lot for ground rods, you may use the

alternate installation method shown in Pictorial 3-9. While not quite as effective as the method shown in Pictorial 3-8, it allows much greater latitude in the placement of your ground rods.

Radial Wires

If you live in an area that has been plagued with lightning strikes and resulting damage, you may consider using the ground system shown in Pictorial 3-10. Depending on the conductivity of your soil, use four 20 feet (or longer) lengths of solid, bare #8 copper wire. Each wire is connected to a common ground rod and buried at least 6" below the ground surface.

AC Power Surge Protection

In addition to grounding protection, it is a good idea to invest in surge suppressors (like the Heathkit Model GD-1495 Smart Outlet Box in kit form, the assembled Models RT-610 Surge Suppressor or RS-610 Extended Life Surge Suppressor) for your Weather Computer and other electronic equipment.

Since electrical storms frequently cause power outages, surge suppressors also protect the equipment when power returns. However, when power fails, turn off all equipment. Leave a low-wattage lamp on to signal return of power.

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

OPERATION

Your Weather Computer has two basic modes of operation:

- The "set-up" mode, which you use to set up its various operating parameters, such as the time, date, and display intensity; and
- The normal mode, where you are reading out and using information from its displays.

The Weather Computer will automatically proceed from one parameter to the next one when you are setting up the time and date information. As soon as you enter the current time in hours (by pressing the correct digit keys and ENTER), for example, it will be ready to accept the current time in minutes. And as soon as you enter either the 12-hour (AM or PM) or 24-hour format, it will be ready to accept the correct designation for "standard" or "daylight saving" time.

Each time you place the Weather Computer in the set-up mode, you will have a time period of exactly one minute in which to enter your new information. If you have not entered it by the end of this one-minute period (by pressing the necessary keys), the Weather Computer will automatically go back to its normal display mode.

In the set-up mode, two steps are necessary to enter information into your Weather Computer. First, you have to press the keys that will supply the information you need (digit keys, AM or PM, etc.). Your second step is to press the ENTER key. Nothing will be actually entered into the Computer until you press ENTER. If you make a mistake, press the necessary keys again and then press ENTER once more.

The term "default" refers to a decision that the Computer is programmed to make for you under certain conditions. For example, if you do not enter the time during the one-minute set-up period, the Computer will automatically reset the time to its "default" (preprogrammed starting) value of 12:00:00 AM.

Refer to Pictorial 4-1, which shows the LCD display and the keyboard keys, as you read the following information. NOTE: A "Quick Reference Guide," which provides a quick reminder on how to operate each key, is included in the back (Page A1) of this Manual.

SETTING THE TIME AND DATE

When you first apply power to the Weather Computer, it comes up in the time/date set-up mode. The time will be at 12:00:00 AM standard time, and the date (month-day of month-year) will be 1-1-87, with the hours digits flashing and the clock not running.

If the clock is already running, enter the time/date set-up mode by pressing and holding the TIME SET key while pressing ENTER; then release both keys and press only the TIME SET key once again.

To set the time/date display, use the following keys:

0 1 2 3 4 5 6 7 8 9 ENTER UNITS

You may modify any of the digits in that part of the display where the digits are flashing by first pressing keys 0 through 9 to enter the correct hours in the flashing hours display. After you enter the correct hours, press ENTER to actually load the hours into the clock. Then use the same procedure to enter the desired minutes and seconds. As soon as you enter the seconds, the clock will begin running.

After you enter the seconds, the AM indicator will flash; you can then set the time display for either AM, PM, or 24-hour format. (The 24-hour format modes do not display AM or PM.) Press the UNITS key to go between AM and PM; press the 24HR key to go between the 12-hour and 24-hour formats. After you set the desired mode, press ENTER to enter this mode into the Weather Computer.

As soon as you enter the AM-PM information, the Weather Computer will go into the standard or daylight saving time set-up mode. Initially, it should be in standard time as indicated by a flashing S. Press the UNITS key to go between standard and daylight saving time, where daylight saving time is indicated by a flashing D. After you set the desired mode, press ENTER to enter it into the Weather Computer's clock. NOTE: The D or S is never displayed, except when you are in the D-S set-up mode.

The date functions are called up next (this occurred when you pressed ENTER to set D or S). The order of setup is: month, day of month, and year. The year is not normally displayed; however, it is written over the day of month when you set the year. Enter this information, followed by ENTER, as you did when you used the digit keys to set the desired time. After you enter the year, the Weather Computer exits the clock set-up mode.

You can manually enter the time/day set-up mode anytime by first pressing the TIME SET and ENTER keys; then release these keys and press the TIME SET key again. If you just press the TIME SET and ENTER keys once, however, you enter a simple minute-update mode, where the seconds go to 00 when you press the ENTER key. If the displayed seconds are 30 or less when you press ENTER, the minutes remain unchanged. If the displayed seconds are greater than 30 when you press the ENTER key, "1" is added to the minutes. Then the clock will exit the set-up mode and start keeping time again.

RATE FUNCTIONS

When you press the RATE key, the rate value displayed for wind speed or rain reflects the change that has occurred since the value recorded exactly one hour earlier. The wind speed rate is based upon the average wind speed value. The rate values for barometric pressure, humidity, and temperature are based on the time between successive changes; however, the values are calculated and displayed based on the corresponding hourly rate. If you press the 24HR key, the rate value shown reflects the change that has occurred since the value recorded exactly 24 hours earlier for the various displays.

The rate displays will be held as long as you keep the key depressed, and will revert back to the normal display as soon as you release the RATE or 24 HR key. If the Weather Computer does not have enough data to base a rate upon, such as on initial powerup, two dashes (--) and two "arrow heads" (▲ for an increase, or ▼ for a decrease) will be displayed to indicate that no rate is yet available. The two dashes will be displayed for up to three hours after power is turned on. After this time, the current rate of change will appear in the display. However, rain will continue to display the current rain value for the rate, if it has been raining, and the optional Rain Gauge Accessory is installed.

Rain Rate

With the optional Rain Gauge Accessory, Model IDA-5001-2, an "instantaneous" rain rate is available in which the hourly rain rate is calculated based upon the time between the two previous pulses from the rain gauge. You can obtain this rate by pressing and holding the RAIN and RATE keys. If the time that has elapsed since the last two rain gauge pulses is greater than the time between the previous two pulses, the displayed rain rate value will gradually decrease in anticipation of the next pulse from the rain gauge, indicating a lower rain rate value.

Rate Arrows

NOTES:

1. After you enter the set-up mode, you have 60 seconds to make your desired changes before the Weather Computer automatically reverts to the normal mode. Therefore, be sure you are familiar with the information under the "Rate Arrows" heading before you actually enter the set-up mode.

2. If one or more of the rate arrows is not displayed, your Weather Computer has not yet registered a change that is large enough to light the arrow(s).

Rate arrows that appear after the temperature, barometer, and humidity show you how much each of these readings has changed in the last hour (the "hourly rate of change"). Each rate arrow has four "levels" and is made up of an arrow head and a "tail" consisting of one, two, or three bars. The default rates are shown below.

Humidity:	3%, 6%, 9%, 12%.
Barometer:	1, 3, 6, 8, (.01, .03, .06, .08 inches of mercury).
Outdoor Temp:	3°, 6°, 9°, 12° Fahrenheit.
Indoor Temp:	1°, 3°, 5°, 7° Fahrenheit.

NOTE: In the following steps, if you make an incorrect entry or "get lost" and the numbers start flashing in the display, simply wait for 60 seconds and the Weather Computer will return to the normal mode. Also, you may exit the mode you are in by pressing the number key(s) corresponding to the flashing number(s) followed by ENTER. Keep doing this until the display stops flashing. Then you can re-enter the mode.

If you wish to display the preprogrammed default values for the outdoor temperature, first press the TEMP and then the RATE key to enter the temperature rate arrow set-up mode. "3" and an arrow head will then appear in the display. Press the ENTER key; "6" and the arrow head with one bar will appear. Again press ENTER; "9" and the arrow head with two bars will be displayed. Again press ENTER; "12" and the arrow head with three bars will appear. Press ENTER one last time; you will exit the temperature rate arrow set-up mode and return to the normal display mode.

To display the preprogrammed default values for the indoor temperature, first press the TEMP and RATE keys to enter the temperature rate arrow set-up mode. "3" and an arrow will then appear in the outdooor temperature display. Press the INDOOR key; "1" and one arrow head will appear in the indoor temperature display. Then press ENTER to cycle through the various default values until the display reverts back to the normal display mode.

You can change these default values by entering the rate arrow set-up modes. Enter these modes by pressing and holding the TEMP, PRESSURE (or HUMID) key, as you press the RATE key. When you first enter one of these modes, only the arrow head is displayed, along with the rate value required to light just this portion of the rate arrow. You can then modify this value by entering the appropriate digits (05, for example), followed by ENTER to actually enter the value into the Weather Computer.

The next level of the arrow will then be displayed, along with the rate value required to light up this segment of the arrow display. You can then enter the digits to modify this value and so on until all four sections of the arrow are set up, and the display reverts back to the normal mode. Each entered rate value must be equal to or greater than the previously entered value; otherwise, the previous value will be displayed flashing to give an indication of the minimum rate value that you must enter to proceed.

If you attempt to change the default value that was initially assigned to the third section of the rate arrow's tail for the outdoor temperature from a 9 to a 5 (by entering 05), for example, a 6 will flash in the display after you press ENTER. This indicates that, for the **third** section of the rate arrow's tail, the Weather Computer will not accept a defalt value that is lower than the value (6) that was initially assigned to the **second** section. Thererore, you must select a value that is equal to or higher than the value initially assigned to that section; otherwise, your input will be ignored and, after 60 seconds, the rate arrow set-up mode will time out, and the Weather Computer will revert back to the normal mode.

You can enter the indoor rate arrow set-up modes by simply pressing the INDOOR key anytime the keyboard is in the corresponding outdoor rate arrow set-up mode for the particular display desired (Temperature or Humidity).

Alert/Warning Display

The Alert/Warning display is just an extension of the rate arrow concept. It provides you with first an alert and then a warning display (also alert and warning sounds, if you like) for rates of change that you feel are significant or critical for the temperature, pressure, and wind speed (but not the humidity). The Speed Alert/Warning display is based on wind gust speed and not on the average wind value. The display's Weather Alert or Warn indicators will stay turned on as long as the rate

change or wind speed meets the criteria to turn them on. The default values for these displays are shown below.

Indoor Temperature	99°	Alert
	99°	Alert/Warning
Outdoor Temperature	14°	Alert
	16°	Alert/Warning
Barometer	6*	Alert
	9*	Alert/Warning
Wind	40 mph	Alert
	40 mph	Alert/Warning

You can also change the default values for these displays by means that are similar to those for the rate arrows. You can enter the Alert/Warning mode by pressing and holding the AL/WARN key and either the TEMP, PRESSURE, or WIND key. Then enter the two-digit Alert value, followed by the two-digit value for Alert/Warning.

Press AL/WARN and ENTER to activate the audio circuitry. Ten short beeping sounds will occur whenever a measurement advances to an alert condition, and a steady tone will sound for about five seconds whenever a measurement advances to the warning condition. Press AL/WARN and CLEAR to disable the audio circuitry.

NOTE: If the sound circuitry is turned on, a clicking sound is activated whenever you press a key, or whenever the rain gauge trips when it is counting the amount of rain that it is collecting.

MIN/MAX FUNCTIONS

You can recall the minimum and maximum values for Temperature, Pressure, Humidity, and (wind) Speed by pressing one of these keys at the same time that you press either the HIGH or LOW key. The time and date that these maximum and minimum values occurred will also be shown.

As soon as you press one of these key combinations, you are in the MIN/MAX mode. You will remain in this mode as long as you hold the keys down, and for four seconds after you release them. The display will then return to normal.

When you are in this mode, you can easily recall other values simply by pressing the HIGH, LOW, TEMP, PRESSURE, HUMID, or WIND key. You can recall the indoor temperature or humidity simply by pressing the INDOOR key when in the temperature or humidity min/max mode. The min/max values for the wind speed will be for either "wind gust" or "wind average," depending on which one is being displayed when the min/max value for the speed was entered.

You may clear a specific minimum or maximum value for temperature, pressure, humidity, or speed to the current value simply by pressing CLEAR when in the min/max mode. You can clear both the minimum and maximum values at any time in the normal mode by pressing the appropriate key with CLEAR. Both outdoor and indoor min/max will be cleared for temperature and humidity. Exit the min/max mode immediately by pressing ENTER.

To clear the accumulated RAIN display in the normal mode, press and hold the RAIN and CLEAR keys.

You can clear <u>all</u> minimum and maximum values in the normal mode by pressing and holding the ENTER and CLEAR keys.

UNITS SETUP

You can step through the units for the (wind) Speed, Temperature, Pressure, and Rain displays by pressing any one of those keys with the UNITS key.

WIND SPEED

The display will indicate the wind speed in either the GUST or AVG (average) mode. To change from one mode to the other, press and hold the WIND key while you press the RATE key.

* .06 and .09 inches of mercury.

WIND DIRECTION

In the normal display mode, one of 16 indicators shows the wind direction by compass point (S for south, for example). If you press the WIND key only, the wind speed display will indicate the average wind direction in degrees. Multiply the displayed number by 10 to obtain the actual reading. This corresponds to 18 (180 degrees) in the example given above. NOTE: The "SPEED" indicator will not be displayed if you press the WIND key only.

WINDCHILL

Press and hold the TEMP and WIND keys to obtain the windchill value in the outdoor temperature display. Either wind average or the current wind gust value will be used for the windchill calculation, depending upon which mode the WIND display is in (GUST or AVG).

FOG INDICATOR

The display's "FOG" indicator turns on when the relative humidity is 90% or higher, wind speed average is less than 5 mph, and the outdoor temperature is steady or falling.

DISPLAY INTENSITY SETUP

The backlit display intensity is controlled by the ambient light level, which is detected by the photo resistor in the lower right-hand corner of the front panel opening. You can set the desired intensity level at a particular high and low ambient light level; the display intensity will then vary as the ambient light level changes between these set points. To properly set these levels, the ambient light must be at the high or low level limits that you expect to have when you are setting the corresponding high or low backlit intensity.

Enter the intensity set-up mode by pressing the ENTER key while you press and hold the HIGH (or LOW) key, depending upon whether you desire the high or low intensity setup. When you set the low intensity level, by pressing the ENTER and LOW keys, the ambient light level must be somewhat less than when you set the high intensity level; otherwise, the Weather Computer will not enter the low intensity set-up mode. When you set the high intensity level, the ambient light level must be higher than when you set the low intensity level.

When you enter the intensity set-up mode, the seconds display will indicate the current backlit intensity level on a scale from 1 through 32. You may then use the HIGH or LOW keys to step the intensity up or down through this range until the desired level is reached. Press ENTER to set the intensity for the current ambient light level. NOTE: The LOW setting must be lower than the HIGH setting.

NOTE: Operating the fluorescent lamp inside your Weather Computer at less than full brightness greatly reduces its life. To obtain much longer life from the lamp, use the following procedure to set the brightness to its maximum level (32):

1. Hold your finger over the light sensor (located just below the lower right corner of the display) for approximately 30 seconds. Then keep your finger over the sensor for the next three steps.

2. While covering the light sensor, press and hold the ENTER key while you press the HIGH (2) key. Then release both keys.

3. Press and hold the HIGH (2) key until the seconds digits of the display indicate 32.

4. Press the ENTER key to return to normal operation.

DISPLAY VIEWING ANGLE

You can also adjust the vertical viewing angle of the display by pressing and holding the UNITS and INDOOR keys. You may select five different settings by simply pressing these keys repeatedly to step through the available angles. Refer to Detail 4-1A.

DISPLAY TEST

When you repeatedly press and hold the PRESSURE and HUMID keys, the display segments will turn on as follows: 1) all segments on; 2) one half of the segments on; 3) the other half of the segments on; 4) all segments off. If you press ENTER, the display will revert back to normal, or it will time out and default to a normal display after one minute.

ERRONEOUS DISPLAY READINGS

If the temperature sensors are disconnected from the back of the Weather Computer or if they are damaged (by lightning, for example), it can cause the input voltage to the analog switches on the main circuit board to exceed the supply voltages of the switches. This causes "crosstalk" which, in turn, causes false outputs that can affect the display brightness. This can also cause erroneous readings on two or more of the display indicators, such as the ones for temperature and barometer. The temperature probes are most likely to cause this situation; however, the humidity and pressure sensors can also cause the inputs of the analog switches to be overdriven.

IN CASE OF DIFFICULTY

Begin your search for any trouble that occurs after completing the 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" (Illustration Booklet, Pages 12 through 16) for the physical location of parts on the circuit boards.

VISUAL TESTS

1. Recheck the wiring. Trace each lead with a color 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 Page 1-3 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 each diode band is positioned above the band printed on the circuit board.

4. Check electrolytic capacitors to be sure their positive (+) 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 ICs are installed in their correct locations.

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 input 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.

If it ever becomes necessary to take (or ship) your kit to the Heath Company or to a Heath/Zenith Computers and Electronics Center for repair, be sure it is completely assembled — including all of the knobs and cabinet parts.

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 considerable damage.

If you make repairs to your Advanced 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 you put the unit back into operation.

TROUBLESHOOTING CHART

The following chart lists the "Condition" of a number of malfunctions and some "Possible Causes." If a particular part or area is mentioned (U301, D304, etc.) as a possible cause, check that part to see if it is correctly installed. Also check the parts connected to it for faulty connections. It is also possible, on rare occasions, for a part to be faulty and require replacement.

PROBLEM	POSSIBLE CAUSE
The "ResistanceTests" failed.	1. Line cord wiring. 2. Input filter wiring. 3. Power supply diode D315 through D321. 4. Input to regulator U302 through U305. 5. Power transformer.
The "Intial Tests" voltages are incorrect.	1. Short circuit on VCAA (+5), VCBB (+5.6), +15, or -15 volt supply line. 2. U301 through U305. 3. Q303 or Q307. 4. Wiring error.
Fluorescent lamp filament does not light.	1. Open light control line. 2. Q311, Q313, or D305. 3. Q309, Q312, or D306. 4. U301, Q307, Q303, Q305, or Q306. 5. Lamp. 6. D323, D324.
Fluorescent lamp filaments light but lamp does not turn on.	1. Q301 through Q306. 2. D302, D304, D325, D326. 3. T301 or T302. NOTE: Check ID dot position. 4. Display driver board.
A single keyboard key does not function.	1. Keyboard wiring for non-functioning key.
Several keyboard keys do not function.	1. Plug P407. 2. U406, U411, or U409.

Troubleshooting Chart (Cont'd.)

PROBLEM	POSSIBLE CAUSE
None of the keys function.	1. U417, U406, U411, or U409.
A segment does not light during "All 8's Test."	1. Open circuit between the segment and driver IC.
A segment lights during "All 8's Test," but not at all or intermittently during normal operation.	1. Short circuit between two drive lines. 2. LCD alignment in the mounting frame.
About 50% of the segments do not light on a line during "All 8's Test."	1. Short circuit on a line between a driver and the backplane. 2. LCD alignment in the mounting frame.
The fuse blows.	1. Short circuit on the +5, +15, or -15 volt supply line. 2. Fluorescent lamp is burnt out.
Cannot calibrate the pressure sensor, or it does not function properly.	1. A401 or its circuitry. 2. U402. 3. U405, U407, or U410. 4. VCO.
Cannot calibrate a temperature sensor, or it does not function properly.	1. Cable connections on the back of the main unit. 2. The sensor (A1 or A2) or its circuitry. 3. U404. 4. U405, U407, or U410. 5. VCO.
Time counts too fast or too slow.	1. 50/60 Hz wave-shaping circuitry. 2. Q405 or Q406. 3. U408C.
The Wind speed indicator does not function properly.	1. Outdoor sensor assembly or wiring. 2. U421 interface circuitry. 3. U421 or U419.
The Weather Computer does not keep proper time during a power failure.	1. D312. 2. Socket S301 or wiring. 3. Battery.
Shorting the terminal screws labeled "RAIN" does not produce the proper display reading.	1. Rear panel connections to the main board at plug P409-1. 2. R476 or R484. 3. D404 or D405. 4. C427. 5. U408 or U421.
Connecting a 220 kΩ resistor across the terminal screws labeled "HUMIDITY" does not produce the proper display reading.	1. Rear panel connection to the main board at plug P405 (pin 6 for outdoor; pin 7 for indoor). **Outdoor:** / **Indoor:** 2. R435 through R439, or R448. / 2. R441, R449, R451, R452, or R458. 3. C411. / 3. C413. 4. U404A or U407B. / 3. U404C or U407A.

CIRCUIT DESCRIPTION

Refer to the Interconnect Diagrams and the Schematic Diagrams (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 Schematics, circuit boards, and chassis:

0 - 99	Chassis
101-199	Display circuit board
201-299	Display driver circuit board
301-399	Power supply circuit board
401-599	Main circuit board
701-799	Humidity sensor circuit boards (optional).

The heart of the Advanced Weather Computer is U420, a Z80C microprocessor (CPU - central processing unit). This IC (integrated circuit) accepts input signals from the temperature, pressure, humidity, and wind transducers and processes these signals for use by the display and memory circuits. Proper conversion gating times are precisely derived from the 2.4576 MHz crystal clock oscillator (Y401), while a 50/60 Hz synchronous signal from the AC line allows the IC to keep proper 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 of the sensors (A701 for humidity, and A1 and A2 for temperature) provide a voltage that is proportional to the relative humidity in percent or temperature, respectively. When the slope and intercept controls on the humidity amplifiers are properly adjusted, the output voltage at U404A and U404C is proportional to the sensor output voltage. This voltage varies from 0 V to 1 V for a 0 % to 100 % relative humidity change, where DV/D% RH (the change in voltage per change in percent relative humidity) equals 10 mV/% RH.

For temperature, this voltage varies from 0 V to 1.98 V for a -40° F to +158° F temperature range, where DV/D°F (the change in voltage per change in degrees Fahrenheit) equals 10 mV/° F.

These voltages are applied sequentially to the frequency converter formed by U403A and U401 and provide a signal with a frequency that is proportional to the input voltage (Df/DV = 4000 Hz/V). The output of the A/D (analog-to-digital) converter is counted by CTC (counter/timer circuit) U412. The period over which this frequency is to be counted is selected by the microprocessor to be 1/40th second for all voltages, except the barometer voltage. The actual number of cycles counted is displayed for humidity (i.e. if the voltage is .5V, the resulting frequency at the A/D converter output equals 2000 Hz); the display is (2000 Hz) x 1/40 s = 50 counts or 50 % RH.

For temperature readings, the display for .5V would be (2000 Hz) x 1/40 s = 50 counts - 40 counts = 10 counts (required to make 0 Hz correspond to -40° F) or 10° F.

The barometric pressure is monitored by A101, which provides a voltage that is proportional to the pressure (DV/DP = 3.2744 mV/in. Hg*). This voltage is applied to a slope intercept correction instrumentation amplifier (made up of U402A, U402B, U402C, and U402D). The resulting voltage is proportional to the pressure (DV/DP = .05 V/in. Hg) and is referenced to a vacuum at 0 V. This voltage is applied sequentially to the voltage-to-frequency converter (U403A and U401) in the same manner as the other voltages.

The count period for the CTC is selected at .5 second when the barometer voltage is applied to the A/D converter and yields 50 % of the A/D converter frequency per volt. A 1.496 V output voltage from the barometer will produce 1.496 (4000/2) = 2992 cycles. This 4-digit number is displayed with a fixed decimal point between the second and third digits (i.e. 29.92).

Humidity, temperature, pressure, and ambient light level are all "read" by the CPU 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 CTC (U412). The CTC then determines the frequency of the pulses and transfers them on the data lines, in BCD (binary-coded decimal) form, to the CPU when requested. Wind direction is a 4-bit parallel "gray code," which is derived by the angular position of the wind vane. The CPU reads this code on data lines D0 through D3 via bus driver U421 and converts it to indicate one of 16 compass points.

Each time the Rain Gauge fills up and dumps its content, a logic 0 is applied on data line D5 from U408E and F through U421.

The CPU processes the temperature in degrees Fahrenheit (°F), barometric pressure in inches of mercury (in. Hg), and wind magnitude (speed) in miles per hour (mi/h). All other possible units of display (temperature in °C, pressure in millibars, and wind speed in knots or kilometers per hour) are converted by the microprocessor.

The CPU scans the keyboard by latching information on data lines D0 through D3 in U411, applying this information through U406 to the keyboard, and then "looking for" a return on the same lines via U409 if a key is pressed.

The CPU also sends information to the display drivers (U201, U202, and U203) via the eight data lines. Decoder U417 employs address lines A5, A6, and A7 to determine which IC the information is destined for. Along with the IORQ line, U417 also controls the enable lines to U409 and U411.

Decoder U419A employs lines A14 and MREQ to determine if the CPU wants to communicate with ROM (read only memory) U418 or RAM (random access memory) U416.

U419B decodes the information on lines A4 and IORQ to enable analog switch controller U410 and wind input buffer U421.

The CPU stores memory data into RAM U416 and also reads data from U416 and ROM U418 via the 8-bit directional data lines. This data, which is an 8-bit word, is located in memory with a 16-bit address that is also supplied by the microprocessor. A battery back-up circuit supplies power for all digital devices, except U406, in the event of a brownout or AC power interruption. This keeps the contents of the RAM intact and the clock running.

Power for the Weather Computer is provided by a +5 volt, a +15 volt, and a -15 volt supply, and a +5.5 volt battery-backed up supply.

NOTE: The following sections provide you with a more detailed description of each individual circuit.

HUMIDITY SENSORS (optional)

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

*Hg is the symbol for mercury

A multivibrator circuit, consisting of ICs U701A and U701B, generates a signal with a stable, fixed frequency of approximately 10 kHz. This frequency is determined by an R/C network, which is made up of resistors R702 and R705 and capacitor C701. A second gated multivibrator (U701D and U701C) with resistors R701, R703, R704, and R710 and sensor A701 generates a signal that is controlled by the capacitance of the sensor and the gate signal to U701C-9 (pin 9). As the humidity increases at the sensor, its capacitance increases and the frequency attempts to decrease. However, the probe is held constant by the gate signal, which causes a variation in the duty cycle.
NOR gate U702 receives both multivibrator signals — the fixed-frequency signal at pins 2, 6, 9 and 13, and the variable-duty-cycle signal at pins 1, 5, 8, and 12. These signals are 180° out of phase and cancel when the duty cycles are equal. This results in an indication of 0 % relative humidity. As the relative humidity increases, the duty cycle of the signal on pins 1, 5, 8, and 12 varies. This causes a positive pulse to appear at the outputs of U702 (the outputs are in parallel with pins 3, 4, 10, and 11). Diode D701 rectifies this pulsed signal and applies a DC voltage through resistor R706 to capacitor C702 and through resistor R708 to plug P405, pin 7.

The combination of resistors R706, R708, R451, and R452, along with capacitors C702 and C413, provide a linear voltage at the input (pin 10) of operational amplifier U404C. Resistor R441, which is connected from U404C-10 to the -15 volt supply, insures that the voltage at the input of U404C will be 0 volt when the humidity sensors are not installed.

The sensor is replaced with a fixed capacitor, while intercept control R704 on the sensor board is adjusted to provide a minimum humidity reading. A second fixed capacitor, which will provide a 93% higher humidity measurement, is added and slope control R458 is adjusted to provide the proper slope. The calibration capacitors are then removed and, with the sensor reattached, the intercept control is adjusted to provide the correct humidity reading.

The output of U404C is connected to MOSFET bilateral switch U407A which, when the micro-processor selects the information from this port, couples the indoor humidity analog voltage to the input of voltage-to-frequency converter U403A and U401.

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 A2 is a 3-terminal device, since pins 1 and 2 are internally connected together in the sensor housing. This common junction is then connected via the 3-wire cable to chassis ground. Externally, pins 3 and 4 look like a 6.8-volt zener diode. In fact, however, the voltage between pins 3 and 4 varies linearly with the temperature.

A2 is connected via the cable to the outdoor temperature terminals on the back of the Weather Computer. Resistors R428 and R429 on the main circuit board supply the proper DC bias for this transducer via plug P405, pins 3 and 4. This resistor network and the internal 6.8-volt zener diode in the transducer, which is connected between the +15 and -15 volt DC supplies, establishes the required bias current. A voltage, which is proportional to the temperature, appears at both the top and bottom of the resistor network made up of R444, R445, and R433. Since the voltage change with respect to temperature is identical at the top and bottom of this resistor network, the network provides an offset (intercept) adjustment which is independent of the slope (amplifier gain).

The intercept is set with control R433, while the sensor is kept in an ice bath at 32°F. The slope or gain is set with control R434, while the sensor is kept in warm water of a known temperature. The thermometer that is supplied with your Weather Computer to determine the warm water temperature is calibrated and has a maximum error of ±.5°F at 120°F. The two adjustments are somewhat inter-active and should be repeated to get the best accuracy.

The output of U404D is connected to MOSFET bilateral switch U405C which, when the microprocessor selects the information from this port, couples the outdoor temperature analog voltage to the input of voltage-to-frequency converter U403A and U401.

PRESSURE SENSOR

Pressure transducer A401 is a piezoresistive bridge that is biased through the temperature-compensating network of resistor R426 and bias control R425. R425 is adjusted to provide a bias voltage that is equal to one half (1/2) of the voltage across zener diode D401. The positive voltage at A401-2 with respect to A401-4 is proportional to the atmospheric pressure, and is applied to pin 5 of inverting instrumentation amplifier U402B-C. To balance the amplifier, the two inputs are shorted together by installing a jumper socket on plug P401; R424 is then adjusted to set the output at pin 8 of U402C to 0 volt. NOTE: A small offset voltage, instead of the ideal 0 volt, will be present at the output of the transducer with zero pressure applied to it. The output voltage at zero pressure is about one fourth (1/4) of the output when the applied pressure is 30 inches of mercury.

Using the calibration hose, a vacuum corresponding to two inches of mercury is applied to transducer A401. Slope control R414 is then adjusted until the two-inch vacuum produces a two-inch change in the pressure displayed. The negative voltage at the output (pin 8) of U402C equals the transducer offset voltage plus the pressure-induced voltage times the gain of the amplifier. A positive voltage is supplied at the output (pin 1) of U402A. The two voltages are applied to the input (pin 13) of inverting/summing amplifier U402D. When the output of U402A is made equal to the applied offset voltage, by adjusting intercept control R413, the output of U402D is 1.5 volts at 30 inches of mercury, and varies .05 volt per inch. This voltage is supplied to the A/D converter via U405A-1.

WIND SENSORS

An infrared transmissive/interruptive sensor, which is formed by LED (light-emitting diode) D601 and light-sensing transistor Q601 (both inside the anemometer cup housing), determines the wind magnitude (speed) component. The optically-encoded disc, which is also inside the cup housing, provides 32 interruptions per revolution of the cups. These interruptions produce pulses that feed a two-transistor hysteresis switch (Q415 and Q410) via the green cable wire and plug P409-6. The hysteresis switch forces the logic level to be either high or low rather than somewhere in between. The output pulses from Q410 drive inverter U406F-13.

The output of U406F-12 drives the TRG3 input (pin 20) of counter timer U412, which counts the pulses from the wind speed sensor under control of the CPU and then transfers the count to the CPU, in BCD form, via the data bus when instructed by the CPU.

LEDs D602, D603, D604 and D605 and 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 the gray code. This 4-bit code is connected to the main circuit board via four wires (brown, red, orange, and yellow) of the 8-wire cable, through the back panel connector strip (labeled WIND), and plug P409, pins 10, 9, 8 and 7. Buffer transistors Q411, Q412, Q413, Q414 invert the code and apply it to the inputs of bus driver U421. The CPU then obtains the code on data line D0, 1, 2, and 3 by reading from the buffer.

VOLTAGE-TO-FREQUENCY CONVERTER

The voltage-to-frequency converter, which is formed by voltage-to-current converter U403A and timer U401, sequentially presents temperature, pressure, humidity, and ambient light information from the common bus that connect the outputs of the bilateral switches together. The analog voltage is applied to the non-inverting input of voltage-to-current converter U403A which, in turn, furnishes a constant current output that is proportional to the input voltage. The current charges capacitor C401 to the timer threshold voltage.

When the threshold is reached, C401 is discharged by the timer. A pulse is sent from U401-3; the charging of C401 then resumes to produce a series of pulses that are proportional to the input voltage at the output of U401. R401 and R402 form a voltage divider that reduces the output of the 15 volt supply to 5 volts. The pulses are applied through inverter U408D to the TRG0 input (pin 23) of counter/timer U412 to be counted under control of the CPU. Analog switch section U405D is always on and balances the inverting input with the non-inverting input. U407D is turned on between each of the other inputs, turning Q407 on to insure that C401 is at the same level before each updated voltage is supplied from the switches. A/D current control R407 provides a small adjustment range of the constant current output; R407

is adjusted by applying one half (1/2) of the voltage across zener diode D401 to the input (pin 3) of voltage-to-frequency converter U403A through barometer input switch U405A.

MICROPROCESSOR (CPU)

CPU U420, along with ROM U418 and RAM U416, form the heart of the Weather Computer. The ROM contains the preprogrammed instructions for the tasks that the CPU must perform. To access the instructions, the CPU sends an address on lines A0 through A13. HALT, MREQ, and A14 are applied to decoder U419A and, if HALT is high and MREQ and A14 are low, the ROM chip enable line (pin 20) will be low. When the RD line goes low, the ROM will place an 8-bit word from the ROM location on the data lines to be read by the CPU. A read from or write to RAM is essentially the same, except A14 is high to cause decoder U419A to enable the RAM. A read is performed if RD is low, or a write is performed if WR is low.

To determine which sensor signal is to be applied to the A/D converter, the CPU takes A4 and IORQ low. When decoder U419B sends an enable signal (low) to U410, the data on all of the output lines (except the selected line) from the CPU is low. When WR goes low and then high, the data is latched at the output of U410 in order to turn on one of the linear switches (U405 or U407A, B, or C).

The various data enters the microprocessor in units of degrees Fahrenheit (°F), miles-per-hour (mi/h), and inches of mercury (in. Hg). U420 converts this data into degrees Celsius (°C), knots or kilometers-per-hour (km/h), and millibars (MB). The same enable line is connected to U421. If RD goes low when this enable signal is low, the 4-bit wind direction code and the rain input are placed on the CPU data bus.

The keyboard has 16 keys electrically arranged as four columns and four rows with each key in a column connected to a different row. Data line D0 is connected through U411-3,-2, U406A-1,-2, and P407-8 to pin 8 of the keyboard. On the keyboard, pin 8 or D0 is connected to one side of SW516 (ENTER), SW513 (UNITS), SW514 (AL/WARN) and SW515 (INDOOR). The other side of each of these key switches is connected to keyboard pins 1, 2, 3, and 4 to P407-1, -2, -3, and -4. This side of the key switches is further connected to U409-2, -4, -6, and -10 through resistor pack RP401 and then through U409 to D0, D1, D2, and D3, respectively. With none of the keys closed, all inputs and outputs to U409 are high due to the pull-up resistors connected to them through RP402.

Resistor pack RP401, in series with the input lines to U409, provides protection against static discharges through the keyboard into these high impedance inputs.

To scan the keyboard, the CPU sends an address with A5 low and all other address lines high. With M1 high and IORQ and WR low, the address is decoded by U417. The output of U417 (pin 9) goes low causing the enable lines to the keyboard output latch and input driver to be low. The CPU places a 4-bit word on data lines D0 through D4 such that one line is high and the rest low. When WR goes high, the data is latched in the output of U411. The data is inverted by open-collector buffers U406A through D and applied to the keyboard columns via P407-8, -7, -6, and -5. The data line that was high and the column it is connected to will remain low until the CPU changes data and again writes to U411.

If a key connected to this row is pressed, an input line (pin 2, 4, 6 or 10) of U409 will go low until the key is released. The CPU again places A5 and IORQ low to enable both U411 and U409. This time, RD is low and the keyboard information at the input to U409 is passed to the CPU via data lines D0 through D3. The CPU knows which row is low and determines the pressed key by ascertaining the row returned low. If more than one row is returned low when a given column is low or a row is returned low by more than one column, multiple keys are closed.

Crystal oscillator Y401 generates a 2.4576 MHz square wave that is supplied to the clock input of CPU U420, CTC U412 and SIO (serial input/output) U414. The clock signal synchronizes these three devices to each other and provides for easier interchange of information.

The CPU communicates with the CTC by placing an address for one of the four counter/timers in the CTC using address line A0 and A1. Data is placed on the data line to indicate what is to be done. A2 is low to enable the CTC, and IORQ goes low to transfer the data. The CTC RD line is used as either read or write. If the CPU is writing to the CTC, RD is high and, if the CPU want information from the CTC, RD is placed low.

Once the CTC is told what it is to do, the CTC can carry out the instructions on its own and the CPU is free to do other tasks.

As with the CTC and counting or timing, the SIO is capable of handling all the serial input-output functions on its own. If either IC has completed a task or has information for the CPU, it lets the CPU know by setting the INT line low.

Communication between the CPU and SIO, U414 uses the same format except address line A3 is used to enable the SIO.

The CPU, CTC, and SIO use a daisy chain interrupt system. In this case, the higher priority is assigned to the CTC. The IEI (interrupt enable input) line, pin 13 of the CTC, is connected to VCCB and its IEO line pin 11 is connected to the IEI line, pin 6 of the SIO. A device in a daisy chain system can only generate an interrupt if its IEI is high and,when it does set INT low, it also sets its IEO low. In this circuit, the CTC has priority over the SIO. When the CPU is interrupted by a peripheral, the CPU responds by placing M1 and IORQ low. This "tells" the interrupter that the CPU is ready for it. The interrupter responds by placing eight bits of an address on the data lines. The CPU adds these eight bits to eight bits previously reserved to form a sixteen bit address which points to the location of the start of the program to handle the interrupt.

The CTC divides the clock signal, as instructed by the CPU, to furnish the correct clock frequency at the TO2 output (pin 9) of U412 to the transmit and receive clock inputs (pins 27 and 28) of U414 for the eight available baud rates.

Serial data is sent from U414-26 to the input (pin 12) of line driver U415; data is then passed from the output (pin 11) of U415 to P408-2 and P1-3.

Serial data is received at P1-2 and P408-3 and then passed on via line receiver U413-13 and U413-11 to U414-29.

A clear-to-send signal is received at P1-4 and P408-4; this signal is then passed via U413-4 and U413-6 to U414-23.

A data-terminal-ready signal is sent via U414-25 to U413-5; this signal is then passed via U413-6 to P408-1 and P1-6.

The various coils and capacitors used between P408 and the input or output ICs, respectively, make up RFI filters.

The wire between P408-7 and P1-7 serves as signal ground, while P1-1 provides a separate chassis ground.

When the line cord plug is connected to the AC line, a sample of the line frequency is furnished via S303-10 to P406-10, and shaped into a square wave by Q405 and Q406; it is then applied through inverter U408C to input TRG 2 (pin 21) of the CTC, U412.

The instruction at the first interrupt is: "wait until the next interrupt to this address and see how long it takes." When the second interrupt occurs, the CPU determines from the time whether the line frequency is 50 or 60 Hz and sets up the real-time clock for accurate time keeping. An interrupt occurs at each half succeeding cycle. If the interrupts stop, the CPU will switch timekeeping to battery operation and uses its crystal oscillator for that purpose. The CPU also suspends any operations that are not battery backed.

SERIAL INTERFACE

The CTC divides the clock signal, as instructed by the CPU, to furnish the correct clock frequency at the TO2 output of U412 (pin 9) to the transmit and receive clock inputs (pins 27 and 28) of U414 for the eight available baud rates.

Serial data is sent from U414-26 to the input (pin 12) of line driver U415; data is then passed from the output (pin 11) of U415 to P408-2 and P1-3.

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The various coils and capacitors used between P408 and the input or output ICs, respectively, make up RFI filters.

The wire between P408-7 and P-7 serves as signal ground, while P1-1 provides a separate chassis ground.

DISPLAY

The display is a half duty, back lit, transparent liquid crystal display. With no segments lit, the panel is translucent blue. The segments would be clear when enabled, except for the white diffuser covering the back of the panel. 154 segment driver lines are used, each capable of driving two segments. The two backplane drive signals are applied to four connections, two on each end of the display. Display drivers U202 and U203 supply the segment drive while only U201 supplies the backplanes. Signals are always present on all drive lines. An off segment has the backplane and segment drive in-phase. On segments have out-of-phase signals.

U204, C207, R203, and R204 form a 125 kHz oscillator. The output of the oscillator is supplied to the clock input on all three display drivers. The drivers divide the clock frequency to produce segment and backplane signals that are continuously supplied to the display once the CPU informs the drivers as to which segments are to be on or off.

To communicate with the display drivers, the CPU uses address lines A5, A6, A7, and IORQ. The CPU first places A5 and A7 low and A6 high; then it places IORQ low. This causes U417-13 and the sync input line (pin 78) on all drivers to be low. This, in turn, ensures that the counting in all the drivers is synchronized.

The CPU then addresses the individual drivers through U417. It puts the address for the individual drivers on address lines A5, A6, and A7 with IORQ low. The address is decoded by U417 to enable the desired driver. The CPU first places RD low and reads the data bus. If the addressed driver is ready for update, it places D0 low. When the CPU see this, it repeats the above with data supplied on the eight data lines and WR low to write to the driver.

POWER SUPPLY

Power 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 other winding provides power for the +15 volt, -15 volt, and +17.5 volt circuits.

Diodes D319 and D321 and capacitor C316 supply 12 volts DC, which is regulated by U304 to provide a +5 volts DC source (VCCA). The output voltage is further filtered by C321 and C322 and power all circuits, which are not battery backed, requiring a +5 volt DC source.

The 12 volt DC source is also applied through diode D311 to regulator U303. U303's GND pin is connected to ground through diode D313, which establishes a 5.6 volt DC level for the output of the regulator. Capacitor C315 bypasses D313 to prevent variations in the output current from changing the voltage across it. This voltage is further filtered by C310 and C314. Referred to as VCCB, this voltage is supplied to all battery-backed circuits.

Diodes D315 and D317 and capacitor C318 supply -27 volt DC, which is regulated by U305 to provide -15 volts DC. This voltage is further filtered by C319 and C320, and supplied to the RS-232C output IC and analog circuits where required.

Diodes D316 and D318 and capacitors C317 and C323 supply +22 volts DC, which is regulated by U302 to provide +15 volts DC. This voltage is further filtered by C309 and C311 and supplied to the RS-232C output IC and the analog circuits. The +22 volts DC is also supplied to regulator U301, which controls the output of pass transistor Q307 via Q303. Resistor divider R304 and R309 returns a portion of the output voltage to pin 6 of the regulator to determine the output voltage which is approximately +17.5 volts DC. The voltage drop across R301A, B, and C is reflected at pin 1. If the current through R301 exceeds a predetermined value, the regulator circuit will quickly current limit the regulator. This protects the circuit until the fuse blows if the lamp does not light or has failed.

LIGHT CIRCUIT

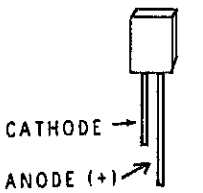
The CPU controls the display lighting by supplying on/off drive signals through U411-12 and the light control line (P406-5 and S303-5). When the unit is first turned on, the control line is low. Transistors Q301, Q312, and Q313 are off, while Q302, Q304, Q309, and Q311 are on. With Q302 and Q304 on, the bases of Q305 and Q306 are held low to keep them turned off. Because Q309 and Q311 are on, current passes through transformers T301 and T302, lamp filaments, D305 and D306, transistors Q309 and Q311, and resistors R314A and B and R315A and B. This preheats the lamps for approximately 10 seconds. When the light control goes high, the reverse occurs. T301, T302, Q305, Q306, C304, C305, C306, C307, D325, and D326 form an oscillator that drives the fluorescent lamp with a 25 kHz signal. To control the lamp brightness, the duty cycle of the oscillator drive versus filament on-time is altered at a 60 Hz rate.

SEMICONDUCTOR IDENTIFICATION

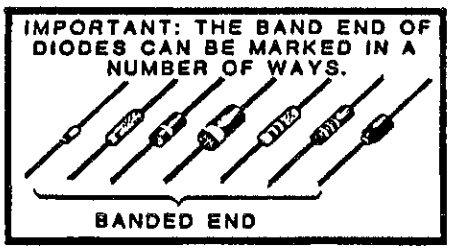
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
DIODES			
D101	412-657		A1
D301	NOT USED		
D302	57-65	1N4002	A2
D303	NOT USED		
D304	57-65	1N4002	A2
D305	57-27	1N5397	A2
D306	57-27	1N5397	A2
D307	56-56	1N4149	A2
D308	56-56	1N4149	A2
D309	56-56	1N4149	A2
D310	56-659	1N5998B (selected 8.2-volt zener)	A2
D311	56-56	1N4149	A2
D312	56-56	1N4149	A2
D313	56-56	1N4149	A2
D314	56-56	1N4149	A2
D315	57-65	1N4002	A2
D316	57-65	1N4002	A2
D317	57-65	1N4002	A2
D318	57-65	1N4002	A2
D319	57-65	1N4002	A2
D320	56-56	1N4149	A2
D321	57-65	1N4002	A2
D322	56-613	1N5231B	A2
D323	56-695	LM385Z-2.5	A3
D324	56-695	LM385Z-2.5	A3
D325	57-65	1N4002	A2
D326	57-65	1N4002	A2
D401	56-91	1N823A	A2
D402	57-65	1N4002	A2
D403	NOT USED		
D404	56-56	1N4149	A2
D405	56-56	1N4149	A2
D601	412-635	TIL-32	A4
D602	412-635	TIL-32	A4
D603	412-635	TIL-32	A4
D604	412-635	TIL-32	A4
D605	412-635	TIL-32	A4
DISPLAY			
LCD101	411-879*		B1

*Part available only from Heath Company.

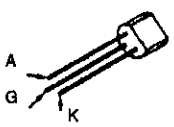
A1



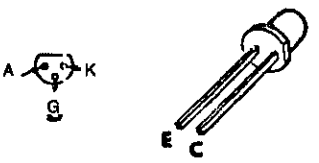
A2



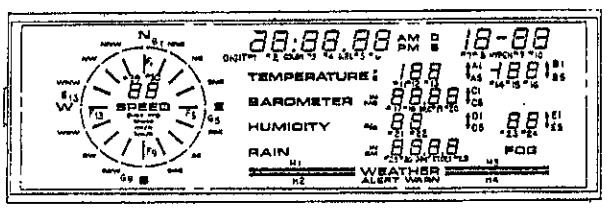
A3



A4



B1

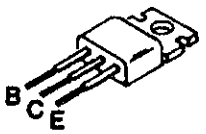


TRANSISTORS

COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
Q301	417-801	MPSA20	C1
Q302	417-864	MPSA05	C1
Q303	417-235	2N4121	C1
Q304	417-864	MPSA05	C1
Q305	117-17		C2
Q306	117-17		C2
Q307	417-856	MJE5979	C2
Q308	NOT USED		
Q309	417-195	MJE340	C3
Q310	NOT USED		
Q311	417-195	MJE340	C3
Q312	417-801	MPSA20	C1
Q313	417-801	MPSA20	C1
Q314	417-801	MPSA20	C1
Q315	417-801	MPSA20	C1
Q316	417-801	MPSA20	C1
Q317	417-235	2N4121	C1
Q318	417-801	MPSA20	C1
Q319	417-885	MPSA65	C1
Q401	417-235	2N4121	C1
Q402	417-801	MPSA20	C1
Q403	417-801	MPSA20	C1
Q404	417-885	MPSA65	C1
Q405	417-801	MPSA20	C1
Q406	417-801	MPSA20	C1
Q407	417-801	MPSA20	C1
Q408	417-801	MPSA20	C1
Q409	417-801	MPSA20	C1
Q410	417-801	MPSA20	C1
Q411	417-801	MPSA20	C1
Q412	417-801	MPSA20	C1
Q413	417-801	MPSA20	C1
Q414	417-801	MPSA20	C1
Q415	417-235	2N4121	C1
Q601	417-919	TIL-78	C4
Q602	417-919	TIL-78	C4
Q603	417-919	TIL-78	C4
Q604	417-919	TIL-78	C4
Q605	417-919	TIL-78	C4

C1

C2



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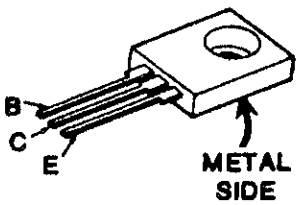
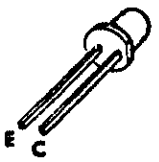


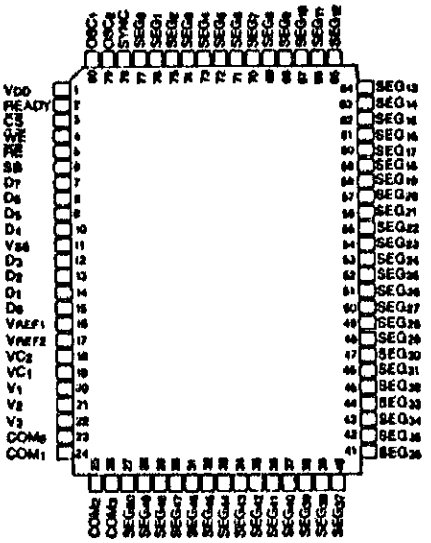
C4



INTEGRATED CIRCUITS (ICs)

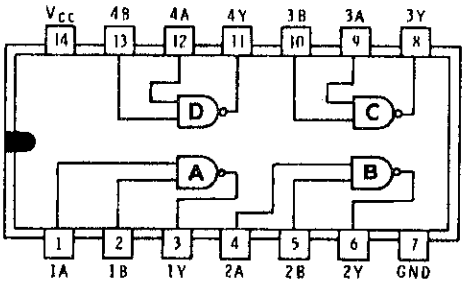
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
U201	643-95	HD61604	D1
U202	643-95	HD61604	D1
U203	643-95	HD61604	D1

D1

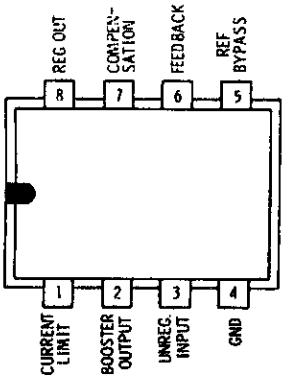


COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
INTEGRATED CIRCUITS (Cont'd.)			
U204	443-603	CD4011	D2
U301	442-24	LM376	D3
U302	442-63	UA7815	D4
U303	442-787	LP2950C	D5
U304	442-54	UA7805	D4
U305	442-613	MC7915	D6
U401	442-801	TLC555	D7
U402	442-602	LM324	D8
U403	442-707	LF353	D9

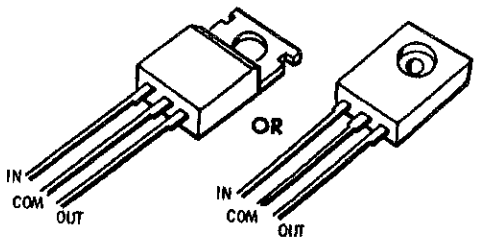
D2



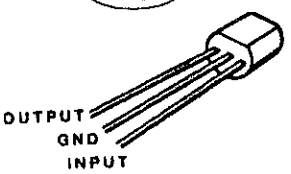
D3



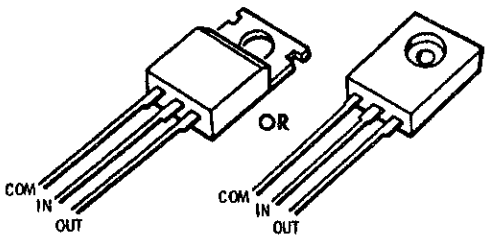
D4



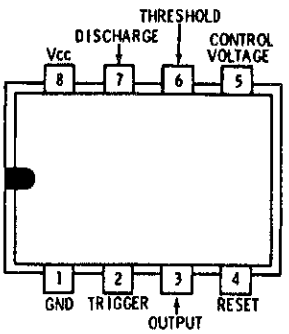
D5



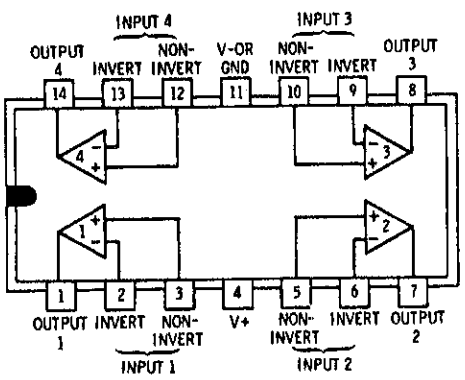
D6



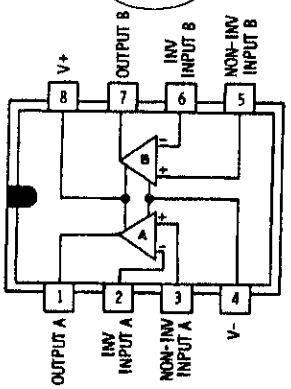
D7



D8



D9



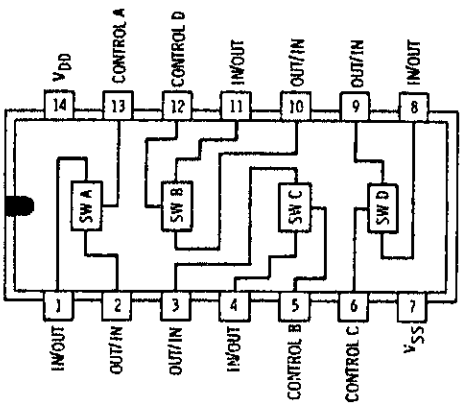
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER

INTEGRATED CIRCUITS (Cont'd.)

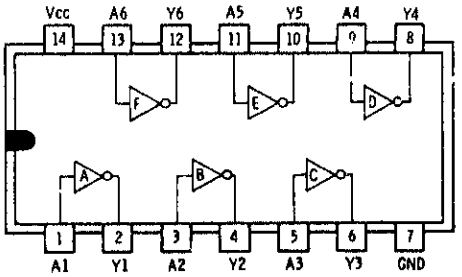
U404	442-602	LM324	D8
U405	442-744	CD4066	D10
U406	443-818	74LS05	D11
U407	442-744	CD4066	D10
U408	443-1308	74HC04	D11
U409	443-1391	74HC366	D12
U410	443-1362	74HC377	D13
U411	443-1362	74HC377	D13
U412	443-1393	84C30	D14
U413*	443-795	1489	D15
U414*	443-1394	84C42	D16

*RS-232 option.

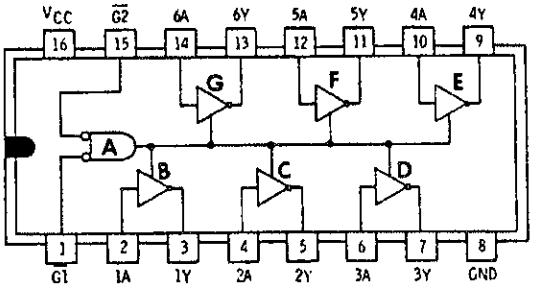
D10



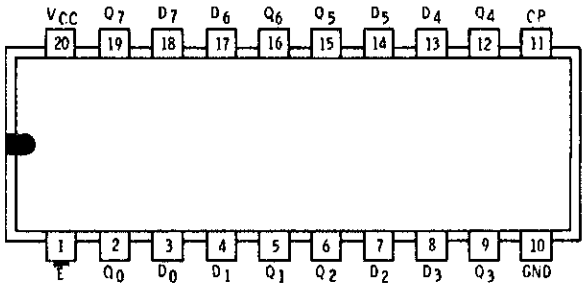
D11



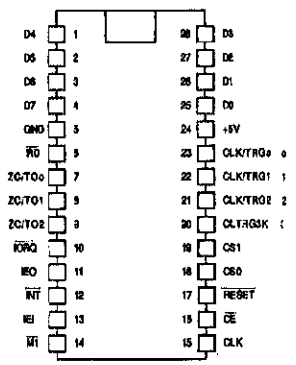
D12



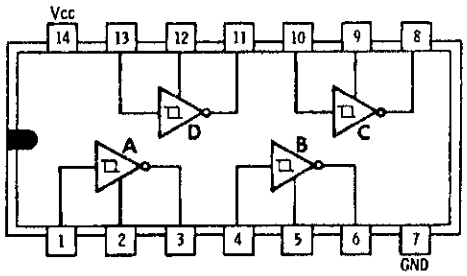
D13



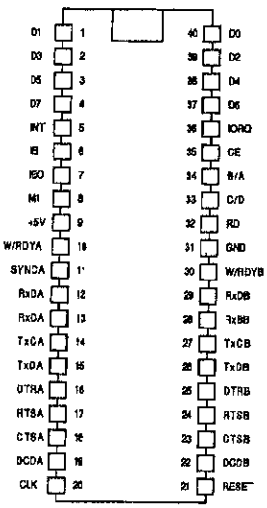
D14



D15



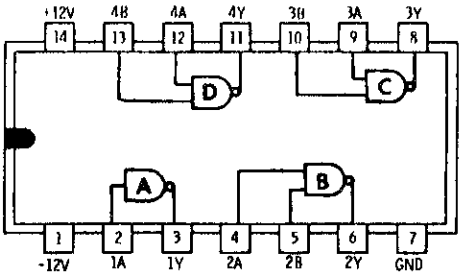
D16



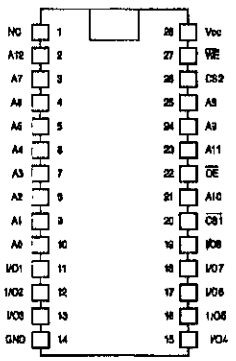
COMPONENT NUMBER	HEATH PART NUMBER	MAY BE REPLACED WITH	KEY NUMBER
INTEGRATED CIRCUITS (Cont'd.)			
U415*	443-794	1488	D17
U416	443-1422	6264	D18
U417	443-1311	74HC138	D19
U418	444-475**	27C256	D20
U419	443-1319	74HC139	D21
U420	443-1392	84C00	D22
U421	443-1390	74HC365	D23

*RS-232 option.
** Available only from Heath Company.

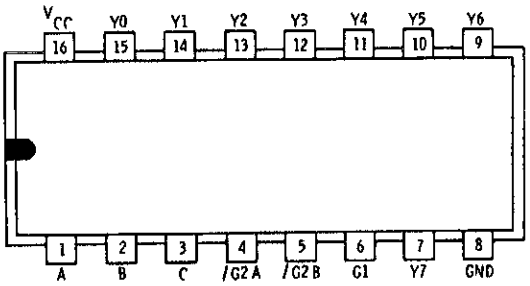
D17



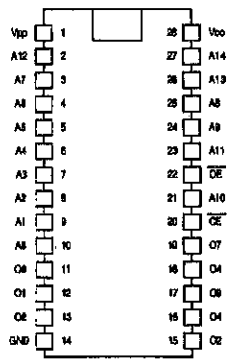
D18



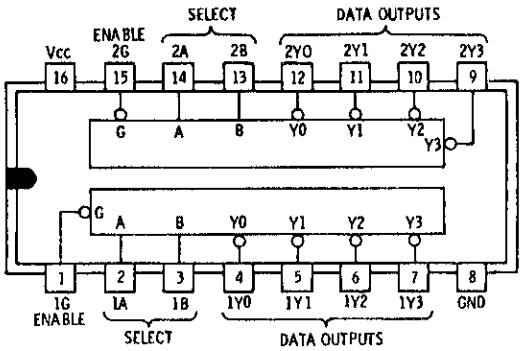
D19



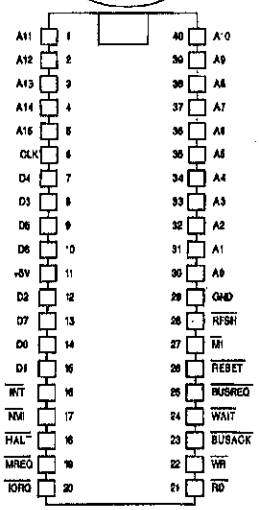
D20



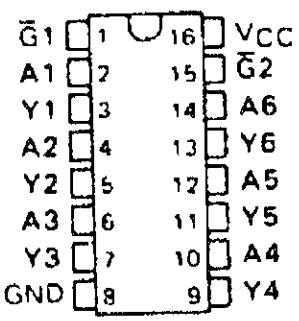
D21



D22



D23



QUICK REFERENCE GUIDE

TIME

Zero the Seconds -- Press TIME SET and ENTER keys; then press ENTER again. Rounds off seconds to nearest minute.

Set Entire Clock -- Press TIME SET and ENTER keys; then press TIME SET keys again. Enter hours, minutes, etc. with numeral and ENTER keys. Select AM or PM, and S (standard time) or D (daylight saving time), by pressing UNITS key while that display is flashing.

WIND

Wind -- Press WIND key. Multiply displayed number by 10 to obtain average wind direction in degrees.

Average or Gust

Select Average or Gust mode -- Press WIND and RATE keys. Read direction and speed from wind display.

Press WIND and HIGH keys to view time, date, speed, and direction of highest wind speed (average or gust).

Press WIND and LOW keys to view time, date, speed, and direction of lowest wind speed (average or gust).

Windchill (average or gust) -- Press TEMP and WIND keys.

RAIN

Rate -- Press RAIN and RATE keys.
Clear -- Press RAIN and CLEAR keys.

RATE

Hour Rate of Change -- Press RATE key.
24-Hour Rate of Change -- Press 24HR key.

FOG

Turns on when relative humidity is 90% or higher, wind speed average is less than 5 mph, and outdoor temperature is steady or falling.

AUDIO WARNING

Press ENTER and AL/WARN keys to turn on key click and audio alarm. Press CLEAR and AL/WARN keys to turn audio off.

ALERT WARNING

Press AL/WARN and either TEMP, PRESSURE, or WIND key. Enter 2-digit Alert value, followed by 2-digit Alert Warn value.

RATE VALUES

To Change Default Values: Press following keys and enter 2-digit number and ENTER. Press ENTER key to step through default selections and exit.

Outdoor Humidity: Press HUMID and RATE.
Indoor Humidity: Press HUMID and RATE, and INDOOR.
Barometer: Press PRESSURE and RATE.
Outdoor Temp: Press TEMP and RATE.
Indoor Temp: Press TEMP and RATE, and INDOOR.

UNIT SELECTION

While pressing SPEED, TEMPERATURE, PRESSURE, or RAIN key, press UNITS key to select knots, mi/hr, or km/hr; F or C; IN or MB; or IN or CM.

MIN/MAX FUNCTIONS

Press TEMPERATURE, PRESSURE, HUMIDITY, OR WIND and HIGH or LOW key to display maximum or minimum value. While in mode, can recall HIGH, LOW, TEMP, PRESSURE, HUMID, or WIND. Recall indoor temperature or humidity by pressing INDOOR key when in temperature or humidity min/max mode. Press CLEAR to remove value. Press ENTER to exit.

Press ENTER and CLEAR keys to clear all minimum and maximum values in normal mode.

BAUD

Press BAUD key to choose baud rate. Then press ENTER.

DISPLAY INTENSITY

Press ENTER and HIGH (or LOW) keys. Then press ENTER to set level.

DISPLAY ANGLE

Press UNITS and INDOOR keys. Press keys repeatedly to select setting.

DISPLAY TEST

Press PRESSURE and HUMID keys several times.