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INTRODUCTION

The Heathkit Model ID-4001 Digital Weather Computer is a microprocessor-based meteorological unit which measures and displays several weather variables. It was designed by Heathkit in the mid 70's using a then "state of the art" MK3870 single chip microprocessor from Mostek. Unfortunately this part is no longer supported by Mostek, and the original program code has also been lost to history.

Microprocessors have come a long way since the mid 1970's. It is now possible to get a single chip microprocessor that is "field" programmable using modern "flash" memory. This memory can be written to, as well as re-written. Since semiconductor geometry's have become smaller and smaller, it is also possible to get a CPU with 8k of ROM space and 512 bytes of EEPROM for the same price as the old Mostek part that only contained 2k of ROM space and no non-volatile RAM. Because the new part contains 512 bytes of non-volatile RAM, it is no longer necessary to save data in the CMOS RAM chip. The extra program space has been utilized to add some additional features to the microprocessor that were not available in the original part. Although the original ID-4001 had a parallel type of interface for downloading data, this data was often corrupted because there was no way to stop it from changing while you were trying to read it. We have designed the new chip to save a snapshot of information, before being sent out a serial port so this kind of problem does not occur. In addition, a fading in and out of the clock and date, as well as the indoor and outdoor temperature has been added to make a more pleasing display.

We hope that you like the new features of the adapter board and are already planning new products to add to our product line in support of Heathkit products. We are always open to suggestions and welcome your comments.

CAUTION!

When the Heathkit ID-4001 unit is connected to power, there are potentially lethal voltages inside. Never work on any electrical unit when it is connected to power. Do not attempt to service any electrical item unless you are properly trained and qualified to do so. If you are not familiar with the Heathkit ID-4001 weather station, or are not comfortable working with electronic components, seek a qualified service technician to make the modifications for you. We are also available to perform the service involved in this modification by sending your Heathkit ID-4001 to us.

INSTALLATION

To install the ID-4001 CPU replacement board, it will be necessary to remove the existing static RAM chip, one diode, and the existing crystal. These components will not be needed as the RAM function has been moved into the new CPU chip's "flash" memory. "Flash" memory does not require a battery backup. A 4.0 MHz crystal on the new board has replaced the existing crystal so that the frequency of the serial interface will be correct. The diode D205 was originally designed into the circuit because the outputs of the Mostek MK3870 did not output a logic "1" close to 5 volts. The new Atmel part, being a CMOS processor, outputs a logic "1" at nearly 5 volts. These components should be carefully removed and set aside, should you wish to restore your Heathkit ID-4001 back to its original state. To remove the un-needed components and install the new CPU board, follow the directions below. Please read and understand the complete procedure before you begin. Check off each step as you complete it.

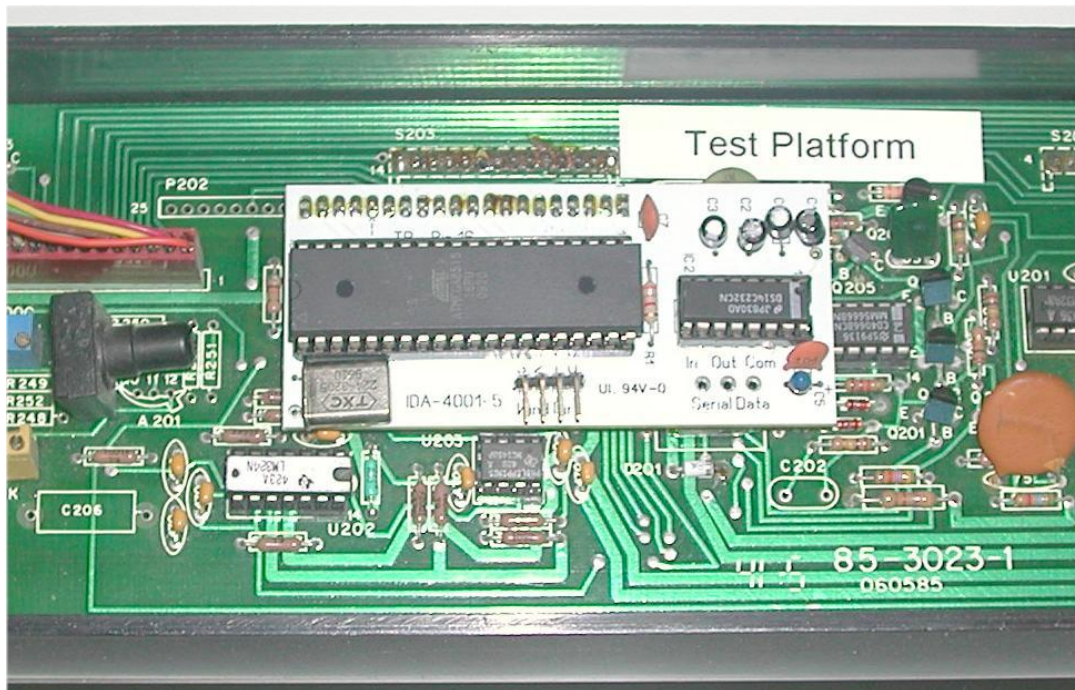
Before you begin, make certain that the ID-4001 is not plugged into any power, and that all wires have been removed from the external sensor connections on the bottom of the unit.

- () Remove the four screws holding the back cover in place. Set these aside as they will be used later.
- () Now remove the four 6-32 x 1/4" screws holding the board assembly in the display housing. Set these aside as they will be used later.
- () Unplug P201 and P206 from the PC board assembly.
- () Remove the circuit board assembly from the display housing.
- () Remove the two 6-32 x 1/4" screws holding the two PC boards together.
- () Carefully separate the two boards trying not to bend the pins of connectors P203, P204, and P205.
- () Carefully remove the IC at U206 (443-721) from its socket. This is a static sensitive part and although it will no longer be needed, you may wish to save it should you want to restore your ID-4001 back to its original state.
- () Carefully remove the IC at U205 (444-23) from its socket. Keep it with the part from the previous step.
- () Carefully unsolder the 3579.545 (404-238) crystal at X201 and remove it.
- () Carefully remove diode D205, and replace it with a short piece of wire.
- () Remove the protective foam from the pins of the ID-4001 adapter board.
- () Use the protective foam to store the original IC's should you want them later.

- () Carefully plug the 40 pins of the adapter board into the original IC socket for U205. Make certain that all 40 pins are inserted into their corresponding positions on the socket.

This is a Static Sensitive device. Be careful not to expose the part to any static electricity during this step.

If the adapter board is installed correctly, it will look like the following picture.



Make certain the all 40 pins from the adapter board are firmly inserted into the corresponding 40 pins of the original IC socket.

If you plan to use the serial interface on the new adapter board, there are three pads available for connection to a serial connector suitable for your computer. The pads are labeled “In”, “Out”, and “Com”. These are referenced from the controller on the board, so “In” refers to the RS-232 **Input to the controller** and should be connected to the RS-232 Output of the computer. “Com” is the common RS-232 signal connection. In addition, there are 4 pins available to capture the Wind Direction information from the ID-4001. This information was not originally directed to the Mostek CPU and therefore could not be picked up from the 40 pin socket. They are labeled “3”, “2”, “1”, and “0” above the label “Wind Dir”. These can be connected to P202 pins 16, 15, 14, and 13. Once the wind direction information is made available to the new adapter board, you will be able to read this information via the serial interface to your computer. These connections are not needed if you only plan to use the ID-4001’s existing display.

Serial and Wind Direction Connection Table

DB-9	DB-25	Adapter Board
5	7	Com
3	3	In
2	2	Out

P202	Wind Dir
13	0
14	1
15	2
16	3

Serial Interface Commands

- W Requests 16 weather parameters. Reply is 16 binary values: <WindDir, Seconds, Minutes, Hours + AMPM flag in MSB, Days, Months, Years, WindSpeed, InTemp, OutTemp, PressureLow, PressureHigh, FrontSwitchesLow, FrontSwitchesHigh, BackSwitchesLow, BackSwitchesHigh> (Convert InTemp or OutTemp to Fahrenheit by subtracting 40) (Calculate pressure via the expression: $Pressure = (2900 + PressureLow + 256 * PressureHigh) / 100$) (Convert WindSpeed to Miles/Hour by multiplying by 99/256)
- R Requests "dump" of RAM memory
- E Requests "dump" of EEPROM memory
- i requests last 31 days of weather min/max values, starting with the most recent day and extending back in time. Each day is represented by 15 bytes of data in the following order: (LowestTemp,LowestTempMin, LowestTempHour, HighestTemp, HighestTempMin, HighestTempHour, LowestPressure, LowestPressureMin, LowestPressureHour, HighestPressure, HighestPressureMin, HighestPressureHour, HighestWindSpeed, HighestWindMin, HighestWindHour) Data is encoded in the same way as the variables in the reply to the 'W' command.
- e,b 'e': requests 15 weather min/max values with time & date. (The 'b' command requests the remaining 10.) The reply to the 'e' command is 10 binary values: <Lowest Temp, LowestTempMin, LowestTempHour , + AMPM flag in msb, LowestTempDay, LowestTempMonth, HighestTemp, HighestTempMin, HighestTempHour , + AMPM flag in msb, HighestTempDay, HighestTempMonth, Lowest Pressure, LowestPressureMin, LowestPressureHour , + AMPM flag in msb, LowestPressureDay, LowestPressureMonth> (Convert HighestPres to pressure via expression: $Highest Pressure = (2900 + HighestPres)/100$), (Convert WindSpeed to Miles/Hour by multiplying by 99/256)
- T Requests the time Reply is 3 binary values: <Seconds, Minutes, Hours + AMPM flag in MSB)
- D Requests the date Reply is 3 binary values: <Days, Months, Years> where years is the binary equivalent of the low two digits of the current date.
- t Loads the time into the weather station Follow 't' command by 3 binary values for Seconds, Minutes, and Hours. If PM, set MSB of Hours.
- C Clears the min/max weather parameters
- d Loads the date into the weather station . Follow 'd' command by 3 binary values for Days, Months, and Years. (Years is the binary equivalent of the low two digits of the current date.)
- w Requests the wind speed . (Convert WindSpeed to Miles/Hour by multiplying by 99/256)
- v Requests the Software Version and Serial Number

- X Engages permanent "crystal" mode in which the crystal is used as the time base for the lock/calendar. Mode remains in Crystal mode even if power is lost. Terminate only by:
- 5 Engages 50 Hz mode and terminates Crystal mode. Mode still adapts on next power-up.
- 6 Engages 60 Hz mode and terminates Crystal mode. Mode still adapts on next power-up.

Serial interface is fixed at 19200 Baud, No Parity, 8 Bits, 1 Stop-Bit. All commands symbols are echoed before they are executed.

During serial transfers, the unit will continue to display normally. However, during some commands such as "set time" and "set date", the unit will suspend normal operation until all the parameters associated with these commands are received. If 3 seconds elapse before these parameters are all received, the unit will reset itself via a "watchdog" timer. All commands sent to the CPU are "printable" ASCII characters. Data being returned is 8-Bit binary data. Some values are sent in "paired" BCD format within an 8-Bit byte.

RE-ASSEMBLY

- () Re-check all above steps and look for any "cold" solder joints, or possible solder "bridges".
- () Carefully re-connect the two PC boards matching up the pins and sockets of P203, P204, and P205. Gently press the two boards together.
- () Using the two 6-32 x 1/4" screws secure the boards together.
- () Place the circuit board assembly into the display housing and align the mounting holes.
- () Using the four 6-32 x 1/4" screws, secure the PC board assembly into the display housing.
- () Attach P201 and P206.
- () Using the four 6-32 x 1/4" screws, install the back panel completing the assembly.

CALIBRATION

There should be no need to re-calibrate the ID-4001 when replacing the Mostek CPU. If the unit has not been operated for several months, you may wish to re-calibrate it anyway. Our new "Calibration" mode makes it easy to do.

Make certain that both temperature sensors are connected and turn the unit on. You should see the time and temperature displayed on the front panel.

Hold the "Clear" button down until the time display reads "CAL 1". You can now cycle between CAL0, CAL1, and CAL2 by pressing the "Clear" button repeatedly. You will notice that only the appropriate display is lit when the unit is in each of the calibrate modes. This can help to ensure you are adjusting the right control during calibration.

Place the unit in "CAL 0". Connect a frequency counter or oscilloscope to pin 16 of the old Mostek CPU socket, or pin 16 of the new Atmel part on our adapter board. Adjust the "Course" pressure adjustment for approximately 290 Hz. The barometer should display close to 30.00. You should now be able to bring the adjustment to the correct setting using the "fine" adjustment. If you need to use the "course" adjustment, don't turn it very far from the point where you measured 290 Hz.

Place the unit in either "CAL 1" or "CAL 2" mode. Submerge both of the temperature sensors in an ice/water bath and allow them to stabilize in temperature. With the Cal/Norm switch in the "Norm" position, adjust the intercept control to read 32° F on both the Indoor and Outdoor displays. Now place both of the temperature sensors in hot water with a thermometer at approximately 100° F. Adjust the temperature sensor slope controls to display the temperature indicated on the thermometer. Remember to change the "CAL" function to the appropriate Indoor/Outdoor by momentarily pressing the 'Clear' button for the setting (Indoor or Outdoor) that you are adjusting. You may have to go back and forth as these two adjustments will interfere with each other.

This should complete the calibration of the analog portion of the ID-4001. Hold down the "Clear" button again until the ID-4001 goes back into the normal operation mode.

The above calibration steps do not work when the ID-4001 is using the old Mostek CPU. Our "Calibration mode" will lock the ID-4001 into reading only one specific analog signal at a time.

OPERATION

Operation is very similar as described in the original Heathkit ID-4001 manual with the following exceptions:

Additional Features

- Display will fade in and out between date and time making it easier to read
- Data and time are stored in Non-Volatile EEPROM memory. If a power failure occurs, the unit powers up at the beginning of the hour and date that the time was lost.
- The Year is also maintained, but not displayed. The year is available over the serial interface.
- The Min and Max values of each day's measurements are recorded in EEPROM memory. This memory holds a month's worth of data in a circular queue. This data can be transferred over the serial interface.
- When the clear button is depressed, or at power up, a minute will elapse before new min/max values will be stored.
- Holding down the clear button for 10 seconds engages "Calibration Mode". In this mode, the two temperature values and pressure can be accessed individually by depressing the clear button briefly. While in this mode, CAL # is displayed in the time/date field. Depressing the clear button for 10 more seconds terminates the "Calibration Mode".
- Wind Chill is calculated by the precise floating-point definition of Wind Chill and not an approximation using a table lookup as in the original ID-4001 design.
- Added "Crystal" mode provides a 3rd option to the 50/60 Hz operation. This is useful for operation with a generator where the 50/60 Hz is not accurate.
- Added 5 minute "Wind Chill Mode". Hold the wind chill button down for 5 seconds, and the ID-4001 will display the wind chill temperature permanently for 5 minutes.
- During serial transfers and EEPROM memory write operations, selected indicator LED's will flash showing update of data.

Features not identical or changed

- Min/Max temperature is Outdoor only

Future Upgrade Policy

The current feature set of the adapter board for the ID-4001 will allow you to get your ID-4001 running again with many additional functions. We will periodically update the ROM to include new features as they are thought of or brought to our attention. If you would like to upgrade your processor in the future, there are two possible methods.

- 1) You may return your processor with a handling fee of \$15.00 to receive a new processor with the latest version of software; or
- 2) You may purchase an upgrade kit with the latest processor. The purchase price will be the same \$15.00 handling fee, however a "core" charge of an additional \$15.00 will be added. This additional \$15.00 will be refunded when you return the original processor. This allows you to continue using your current ID-4001 with minimal "down" time, until you receive your upgraded processor in the mail. When it arrives, you may return the old processor for a \$15.00 refund of the "core" charge.

All processors will be serialized and will not be replaced unless the original serial numbered part is returned, and the serial number matches the name and address of the purchaser.

Processor Software and Intellectual Property

The purchaser of this upgrade board is granted a "lifetime" license to use the software contained in the processor as a replacement CPU for the Heathkit ID-4001 Weather Station. We will also 'continue' support for this module if it has been resold along with the original ID-4001 weather station that it was installed in.

Any processor returned for upgrade may be denied if the serial number has been tampered with, or our records indicate the part may not be original.

Data Professionals or Transition Engineering, Inc. are not responsible for any direct or consequential damages or any damages of any kind arising out of the use of the chip. This includes any damages associated with "fitness for use" or any other damages that may not have been specified.

Data Professionals will at our option repair or replace any defective or damaged adapter board that does not meet the advertised feature set at the time of purchase for a period of 90 days.

You may contact Data Professionals at:

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