

Heating Pad Controller

User Interface

2024-02-15 Rev 0.2

The Heating Pad Controller (HPC) is used to control the temperature of three separate heating pads. The temperature is obtained from a MAX31856 Thermocouple Amplifier using a K-Couple. The 12 VDC heating pads are pulsed by switching relays off/on using a PID Controller algorithm. The Microcontroller is an Arduino MEGA 2560. Note that all temperatures are in degrees Celsius.

The purpose of this document is to describe the operation of the Heating Pad Controller.



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Heating Pad Controller Operation

The HPC is powered by two connections. The Microcontroller is powered with a USB Connector (5VDC) and the Heating Pads are powered with a Power Supply (12VDC 6A) plugged into a 120 AC outlet.

The HPC is designed to recover after experiencing power failures. When the user selects START the HPC is in running mode. If power fails it will resume running when power is restored without requiring any user operation.

Rotary Encoder User Interface

The rotary encoder is a knob that can be rotated clockwise or counter-clockwise for the purposes of making a selection and for changing the setpoint values. The knob is also a push button which is used to make a selection.

Power Up Display

When the HPC is powered ON the following message is displayed on the LCD:



At this point pushing the knob button in will begin operation of the HPC using the current setpoints. Alternatively the rotary encoder can be rotated and the following message will be displayed. Continuing to rotate the knob will return to the START message.



Pushing the knob button when the SETTING message is displayed will allow you to change the setpoint values and to enable / disable any of the heating pads.



Changing Heat Pad Setpoints

Push the button to change any of the setpoints and you will see the following message.



Pushing the button again will enable you to change the setpoint for the #1 Heat Pad. You will see the current setpoint for #1 Heat Pad displayed.



You can rotate the knob clockwise to increase the setpoint temperature or counterclockwise to decrease the temperature. When you have the desired temperature push the button.



You will then be able to confirm your choice by pushing the button when the setpoint temperature and OK is displayed.



Alternatively you can rotate the knob and select to CANCEL the new setpoint value and restore the original setpoint.



After pushing the button to either OK or CANCEL the setpoint the display will return to a selection of the Heat Pad.



You can proceed to select a different Heat Pad by rotating the knob.

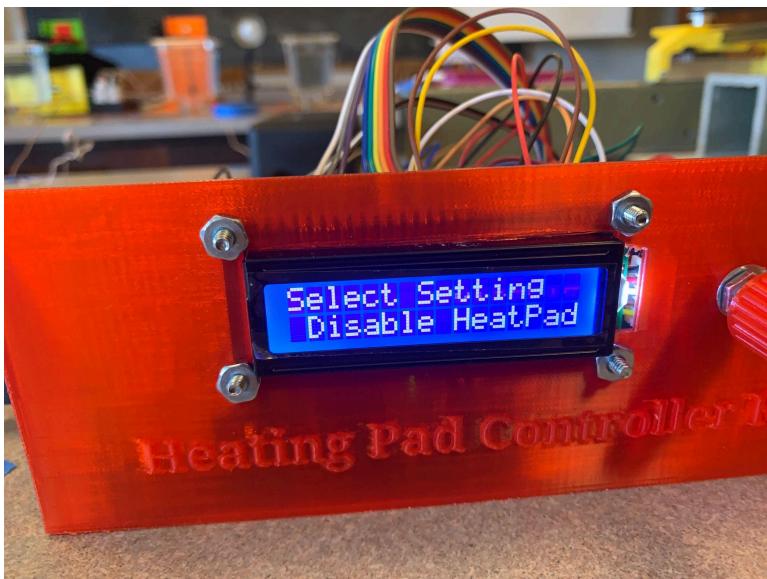


When you have completed changing setpoints select CANCEL to return to the SETTING screen.



Disable / Enable Heat Pads

Rotating the knob will allow you to Disable any Heat Pad.



Pushing the knob will display screens allowing you to select a Heat Pad to disable.



When you push the knob to select a Heat Pad you will see a message displaying the current state of the Heat Pad.



Continuing to rotate the knob will switch between the ON and OFF messages for the selected Heat Pad.



After your selection is made the screen will return to the Heat Pad selection for disabling a Heat Pad.

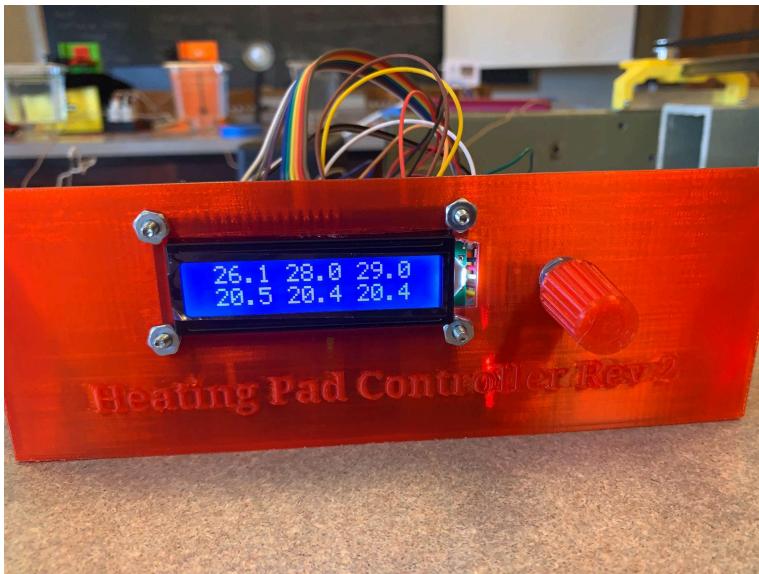


Starting the HPC Operation

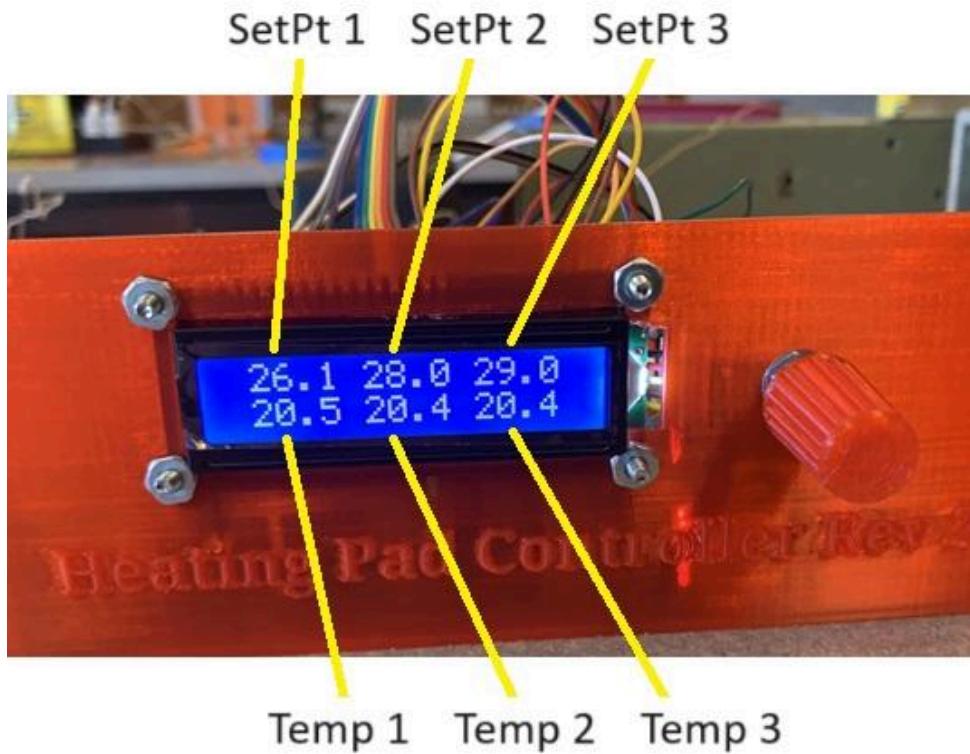
Rotate the knob to select a different Heat Pad or to the CANCEL message and push the button to return to the START message.



Pushing the button when the START screen is displayed will begin operation of the HPC using the setpoints for each of the three respective Heat Pads.



HPC running mode display



Cautionary Notes

The HPC supplies 12VDC to each of the Heating Pads at nearly 2 Amps for each Pad. If the 12VDC is supplied continuously the Heating Pads will reach a high enough temperature to melt Petri dishes. This is the voice of experience having melted several Petri dishes. The only time that the Heat Pads should be continuously ON is when the HPC PID Controller is ramping up to the setpoint value. Once the setpoint is reached the Heat Pad 12VDC should be pulsed by the HPC and you should hear audible clicking as the relays are turned ON/OFF.

WARNING the HPC will accept whatever setpoint value you choose. If you select a very high setpoint such as 50C it is likely that you too will melt a Petri dish!

If the HPC Microcontroller loses power the expected failsafe operation is that the relays are all turned OFF which will stop the 12VDC to the Heat Pads.

There is a considerable amount of exposed wiring in the HPC. Great care should be taken to ensure that no water is dripped onto the HPC!

The exposed wiring is also vulnerable to broken connections, particularly the wires attached to the Microcontroller. The HPC is robust once it is properly connected and operating but very fragile when it is moved around. This is typical of very low cost Microcontroller instruments.

When all else fails please email or text me:

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Note that text messages always get my attention and I'm not on email very often.
If you do send me an email, please text me to let me know to check my email ; -).

Component Diagram

Heating Pad Controller

