Heat Gun Manual - 2.1.4

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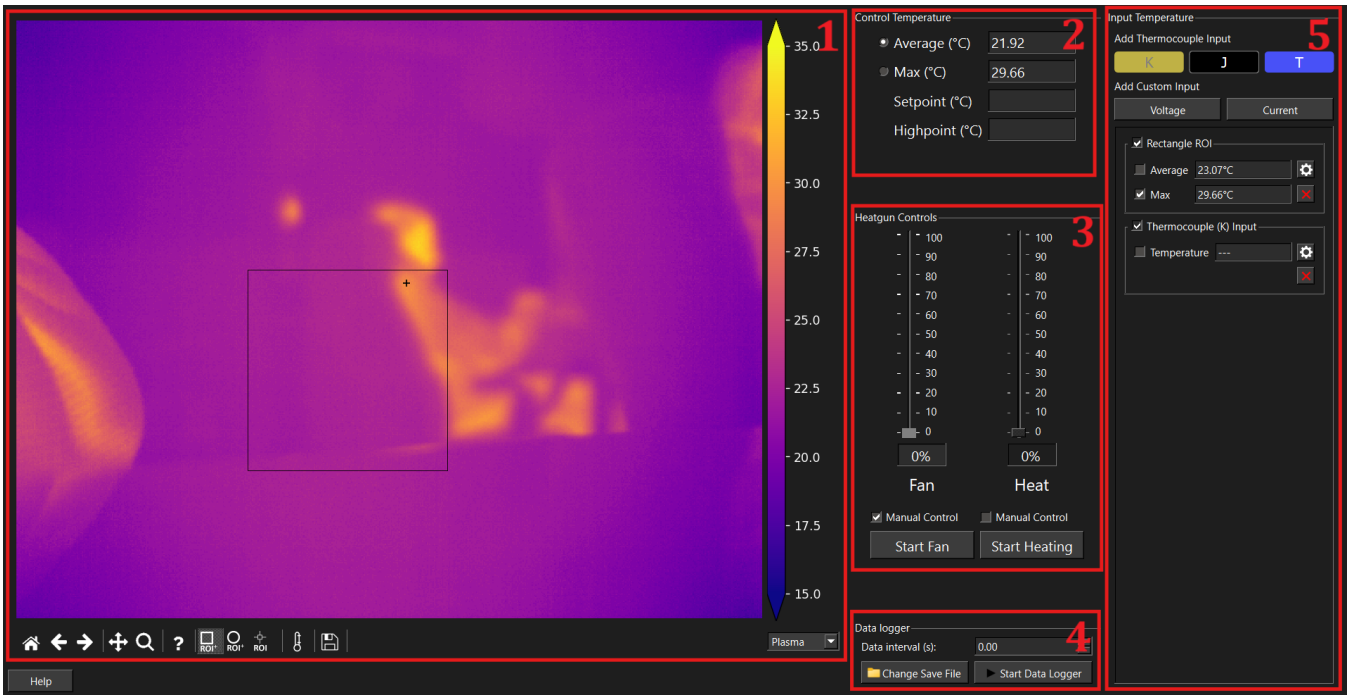
Setup

Above is an image of the Heat Gun Interface on the K500. It has all the necessary I/O for connecting to and controlling the Heat Gun.

1. Plug in the power cable for the heat gun into a wall outlet
2. Plug in the RJ45 cables for the Heat Gun into the Heat Gun Interface. On the K500, the box is mounted above the beamline, and below on the K150 beamline.
3. Point the Heat Gun at the part.
4. Turn on the Heat Gun by pressing and holding its rotary button for 2 seconds. The fan should spin to its minimum speed.
5. Press and hold down on the rotary button for 2 seconds and simultaneously rotate it clockwise 1 quarter turn. It should now read 'TempC'.
6. Rotate the rotary button 1 click counterclockwise. It should now read 'StorE'.
7. Press and release the rotary button. It should now read 'Off' and its fans will be running at its minimum speed. This means the Heat Gun is now ready.
8. At the Heat Gun Station, open the Heat Gun Controller Software.
9. The Heat Gun Station can be accessed either in the cave, or in the data room.

Software

Overview



Above is an image of the Heat Gun Controller GUI. It is roughly split into 5 different sections:

1. **Camera View**: The camera view displays what the camera is currently capturing. Below it is a toolbar for interacting with the image. Some of the important tools are:
   (a) Region of Interest (ROI) Tools: 3 tools which can be used to select a region of the camera. The region and information about the temperature in it will then be added to the Input Temperature panel.
   (b) Absolute Temperature Scale: By default the color scale of the camera view will automatically adjust. This tool can be used to set the range of the scale manually.
   (c) Save Image: Saves the current frame of the camera as a float32 .tiff file.
2. **Control Temperature**: Displays the inputs and settings used for automatic control of the heat gun.
   (a) Average/Max: Displays the average/max temperature of all included input temperatures. If none are included they default to the entire camera frame. Either of these can be selected as the process variable used when automatically controlling the heat gun.
   (b) Setpoint: The user may input a desired temperature. The control loop will then compare this with the input temperature and control the heat gun until the temperature has reached the setpoint.
   (c) Highpoint: The user may input a temperature which, if reached, will turnoff the heating. This is intended to be used as a fail safe, in case the heating overshoots the setpoint too much.
3. **Heatgun Controls**: The heatgun has 2 controls, the fan speed and heating power.
   (a) Slider: The slider and its value can be manually set to control either variable.
   (b) Manual Control: The slider can only be interacted with which manual control is checked. While it is unchecked the value is automatically controlled by the software. By default, the Fan is set to manual.
   (c) Start/Stop/Reset: These buttons will start and stop the fan and heater. Stopping one will also stop its manual controls from functioning.
4. **Data Logger**: The data logger can be used to record the average temperature to a data file. The interval at which it records the data can be set in the input field (in seconds).
5. **Input Temperature**: Used to display and control the different Input Types.

Input Types

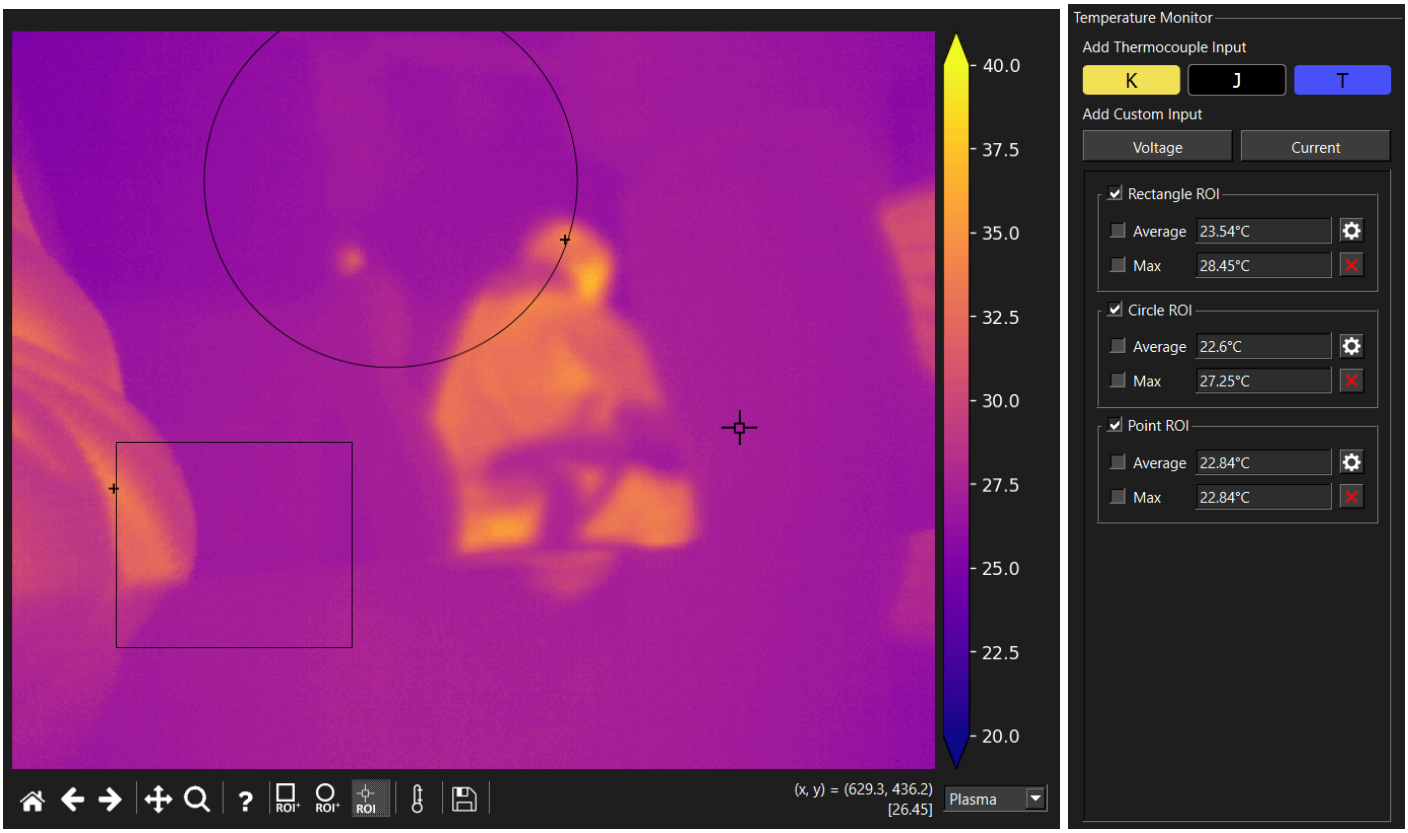
Each input can be controlled from the Input Temperature panel. Using the checkbox to the left of their name, they can be disabled. There are also buttons to open the settings for each input and remove them.

The checkboxes next to each temperature readout can be checked to include the temperature from that input in the Control Temperature panel. Values included in the Average Temperature will be averaged together. The Max Temperature will use only inputs that are included in it as well.

In case you are curious, the combined average and max temperatures can be found using the (rough) equations:

$$avgtemp = avg\left(\{avg(ROIpixels), thermocouple_{K,J,T}, custom_{V,C}\}\right)$$
$$maxtemp = max\left(\{ROIpixels, thermocouple_{K,J,T}, custom_{V,C}\}\right)$$

IR Camera



Make sure the camera is properly connected to the Heat Gun Interface using a RJ45 cable. Point the camera directly at your part and ensure it is in focus. The camera has a fixed focus, so if it is out of focus, you will need to move the camera.

When no other temperature inputs are selected, the software will default to measuring the entire camera frame. To restrict the measurement to a specific region, select one of the Region of Interest (ROI) Tools. The are 3 types: Rectangle, Circle, and Point. Click and drag to draw a region. The Rectangle and Circle regions will take an average of all pixels inside them. The max temperature measured in the region will be marked with a plus sign, '+', on the image. The Point region will only select a single pixel.

When averaging multiple ROIs, all pixels are weighted the same. This means that when 2 regions are overlapping, their shared pixels are not double counted.

Each region you draw will be added to the Input Temperature panel. From there, you can change the regions out and marker color.

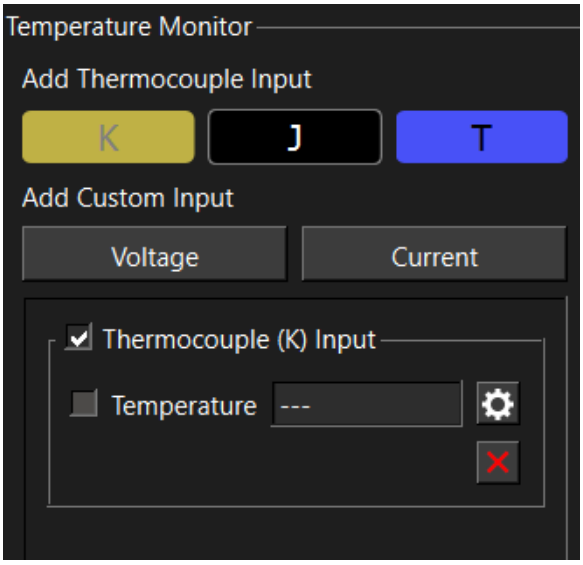
By default, the color bar will auto-scale to the range measured by the camera. This can be set to an absolute scale by clicking the Absolute Temperature Tool below the camera view. This will bring up a window to input a custom minimum and maximum temperature for the color bar to use.

The color scheme of the image can also be changed using the drop down box under the color bar.

The current frame of the camera can be saved using the Save Tool. The image is saved as a 640x512 float32 .tiff file where each pixel is in units of $°C$.

If the IR Camera is accidentally disconnected, the software should be able to reconnect to it when it is plugged back in. It may take around 20 seconds for it to reconnect.

Thermocouple

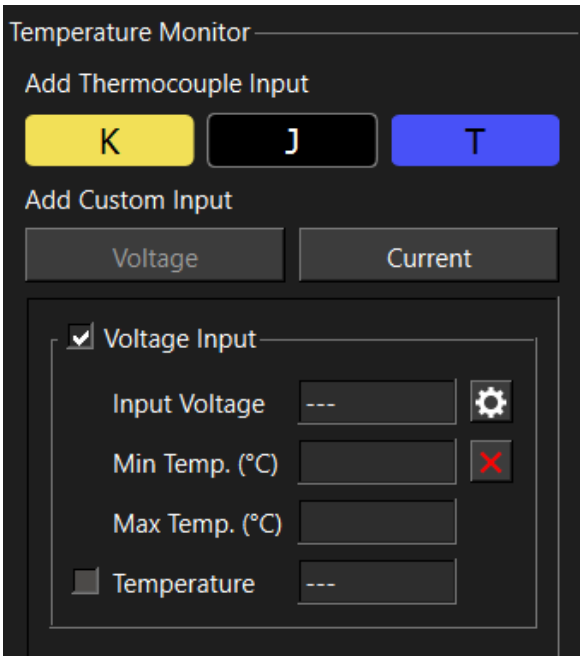


In thermocouple mode, you may select any of the thermocouples which are currently plugged into the Heat Gun Interface using their corresponding button. The thermocouple will then be added to the Input Temperature panel, where its temperature can be read.

If the checkbox to the left of Temperature is checked, the temperature will be included in calculation of the Average and Max Input Temperature.

Only one of each thermocouple type may be added at a time.

Custom Input



Custom input mode is useful if you would like to use your own instruments to measure temperature. A control signal can be input into either the Voltage Input or Current Input connection on the Heat Gun Interface. The Voltage Input range is 0-10V, and the Current Input range is 4-20mA.

The Input row shows the voltage or current measurements. In the Min Temp. row, input the temperature which you would like to correspond to the minimum value of input range (0V or 4mA). Do the same in the Max Temp. row for the temperature the corresponds to the max value of the input range (10V or 20mA)

The measured temperature will then be a linear interpolation between the minimum and maximum temperatures, based on the input value.

Only one of each custom input mode may be added at a time.

Controlling the Heatgun

Automatic Control

The heat gun can automatically hold a part at a specified temperature set point. It can ramp up and down to smoothly bring the part to the set point with minimal overshoot. To use automatic mode:

1. Enter your desired temperature in 'Setpoint'
2. Set the fan speed to your desired amount.
3. Ensure that the Heat 'Manual Control' checkbox is unchecked.
4. Click both Start Fan and Start Heating
5. The Heat Gun should now begin heating your part. If you would like to stop it, press both Stop Fan and Stop Heating.

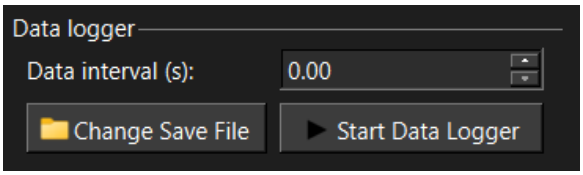
Note: To prevent the control loop from becoming unstable, its integration factor will be reset when the Setpoint is changed or when the Heating is stopped.

Manual Control

You can also manually control the heating power of the Heat Gun. For manual control, check the 'Manual Control' checkbox. The heating will still need to be Started and Stopped using the Start/Restart/Stop buttons.

Manual control can be useful when you need to cool down a part. This can be done by first, either turning off the heating or setting it to 0. Then, after waiting 20 seconds, set the fan to max speed. The fan will then start to rapidly cool both the Heat Gun and your part.

Data Logging



The data logger is able to record and save data at a set rate. The time between measurements (in seconds) can be set in the input field next to the Start/Stop button.

The file the data is saved to can be changed by clicking 'Change Save File'.

Before starting the Data Logger, be sure to enter a data interval. To start the data logger click 'Start Data Logger'. The data logger can be paused at any time by pressing 'Pause Data Logger'. If the data logger is resumed, it will continue to append to the previous data.

The data saved will be saved to a .txt file. The file will be as the table:

			Combined [$°C$]		Input Type [$°C$]		...
Time[s]	Setpoint [$°C$]	Highpoint [$°C$]	Avg. Temp.	Max Temp.	Avg. Temp.*	Max Temp.*	
⋮	⋮	⋮	⋮	⋮	⋮	⋮	

Each time a new Input Temperature is added or removed, a new table header will be appended to the data. I would recommend, making sure you have all your Input Temperatures needed set up before starting the data logger. This will ensure each run will be one continuous table.

*note: Only the region of interest input type will include both average and max temperature. Thermocouple and Custom inputs will only include one temperature.

Settings Files

A list of all current settings can be saved to a .json file. These include: setpoint, highpoint, temperature monitors, ROIs, data file, custom control loop parameters, etc. These settings can then be reloaded using the same file.

Shutdown

When you are done using the heat gun setup:

1. Exit the control software.
2. Disconnect the IR camera from the Heat Gun Interface
3. Turn off the Heat Gun by holding down the rotary button for 2 seconds. This will cause the fans to spin up to max speed to cool it down for 2 minutes. Once it finishes, the heat gun will shut down
4. Unplug the heat gun's power cord from the wall
5. Disconnect any cables to the Voltage or Current Input connections on the Heat Gun Interface.

To preserve the lifetime of the IR camera, always be sure it is unplugged when you are done using it.

Troubleshooting

The heat gun is not responding to the software

- Check the RJ45 cable connecting the heat gun to the Heat Gun Interface. It should be connected to the heat gun port
- In the software, be sure the Fan and Heating have been started. To start them click 'Start Fan' and 'Start Heating'
- Try powering down the heat gun and restart it. Then be sure to follow steps 4 - 7 of the Setup.