

Testing a proposed power supply for the ECal heater controls

Marc McMullen
2023-05

This month I am working on converting the current ECal heater controls from a relay-based controls system to an analog source to power the heaters. The final system should use a 48V output supply with enough current to supply at least 100 W per supermodule.

The supply needs to be adjustable remotely to maintain a set temperature on the supermodule flange. The supermodule temperatures will differ, depending on the location in the detector assembly. Supermodules at the top will require less power than the ones on the bottom due to convection.

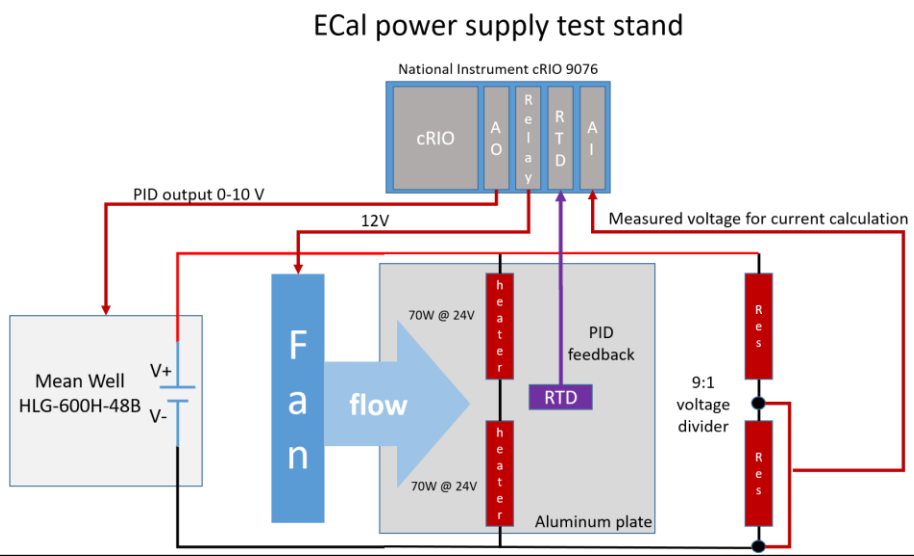
The Mean Well HLG-600H-48B is a 0 to 48V, 600W supply. The output current will track in proportion to a 0 to 10V signal. I will use an analog output module (AO) to adjust the supply.

The current software provides power to the heater by using a relay to switch AC power on or off depending on the readback from an RTD on the supermodule front flange. This method may affect sensitive detectors due to noise generated from the size of the current spikes when the relay closes.

To mitigate the issue, the new power supply out will be adjusted using proportional, integral, derivative (PID) control of the power supply control voltage (0 to 10V). Resulting in much smaller current spikes as the supply output continuously adjusts. PID controls monitor a feedback signal, in this case a temperature provided by the cRIO reading an RTD, and proportionally correct the error from the set point. The software will continuously calculate the right amount of power needed to compensate for error while minimizing the overshoot of the set point.

During testing, I used two heaters in series to make a single 140W heater load for the supply. The heaters are inserted in a 5" x 5" x 0.25 " aluminum block which has an Omega PT-100 RTD taped to the surface. The supply has more than enough power to produce well over 100°C on the plate. I used a PC fan to remove the heat, this way the supply and

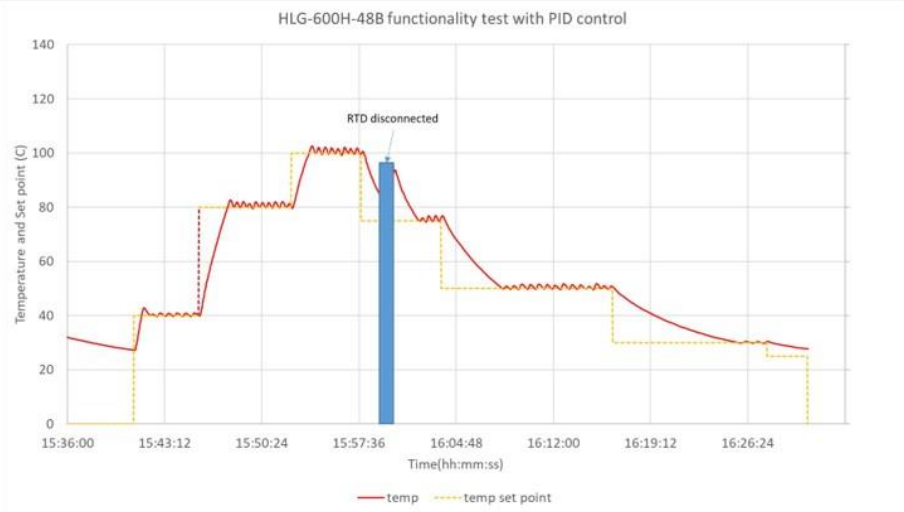
- Assembled a test stand to test a remote adjustable power supply
- Develop software to control and monitor the test stand
- Plot the results for review



Testing a proposed power supply for the ECal heater controls

PID would have to work to maintain the set temperature. For a basic test of the supply and software, I started the temperature set point at 40°C, then increased it in steps (80°C, and 100°C) before decreasing it in steps (75°C, 50°C, and 30°C). I recorded the data points so that I could plot the test for distribution and review.

In conclusion, I designed and assembled a test stand to test a new power supply that will provide power to heat multiple supermodules. I developed a PID-based code to control the output and maintain the temperature settings. Lastly, I successfully tested the supply at a range of temperature set points, and recorded and plotted the data. The power supply performed as expected.



Plot of the power supply set point range and measured temperature