ECAL Heater Controls Insulated Heater Test

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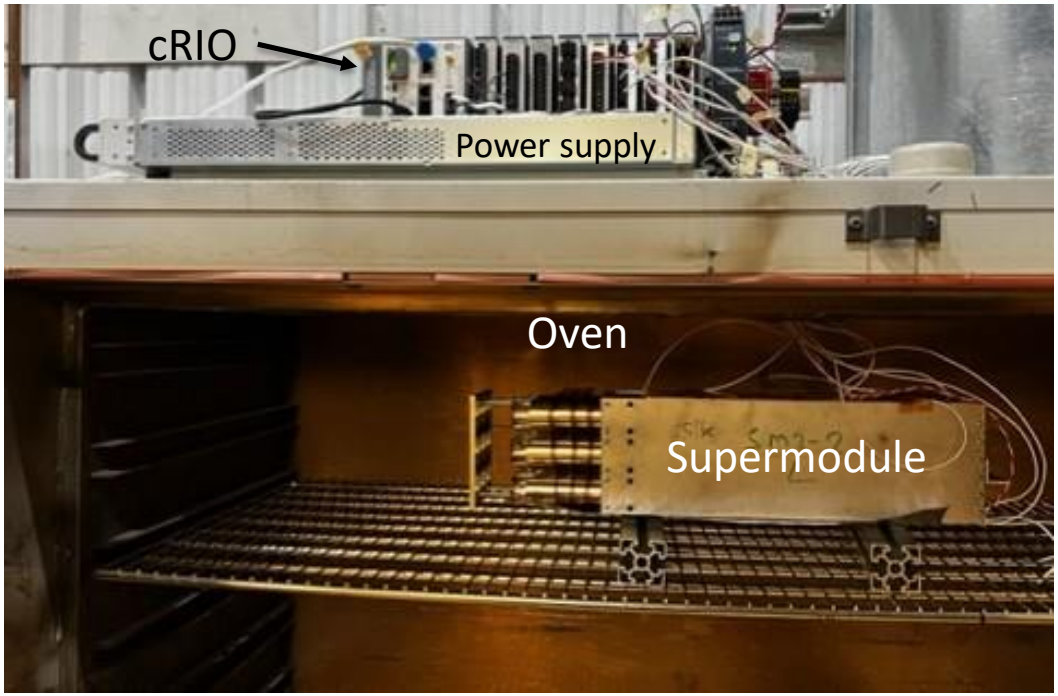
Objective

- Build insulated enclosure to replicate the internal heating space of the ECAL detector for a single supermodule
- Determine the required power to reach the target temperature on the supermodule front flange (250^{o}C)
- Monitor the temperatures along the length of the supermodule

Initial Heater Test at 76 W



During the initial test, the functionality of the instrumentation and controls system were verified. The heater, which is attached to the front flange, was set to produce 76 W and the temperature peaked at 150^{o}C. This was largely due to the internal volume of the oven enclosure (24 ft^{3}).

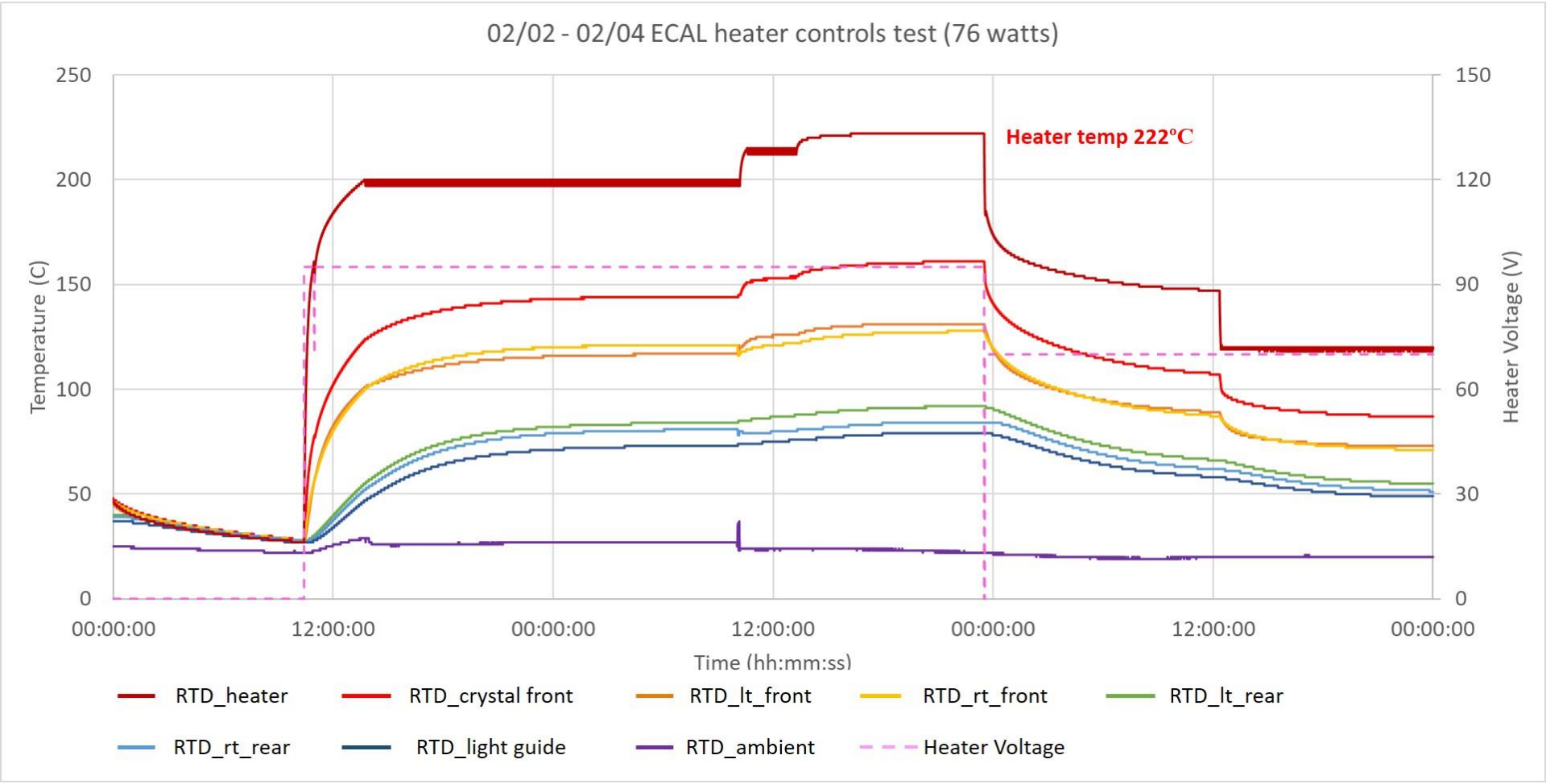
To increase the temperature, the volume of heated space needed to be reduced to realistic dimensions.

Insulated Enclosure

- 1”thick mineral wool insulation was used to contain the heat generated by the heater
  - 0.25” thick Teflon was used to support the insulation and provide a gap between the insulation and the supermodule
- The enclosure is closed on the front flange end with insulation
  - The distance between the front flange heater and the insulation is ~4”

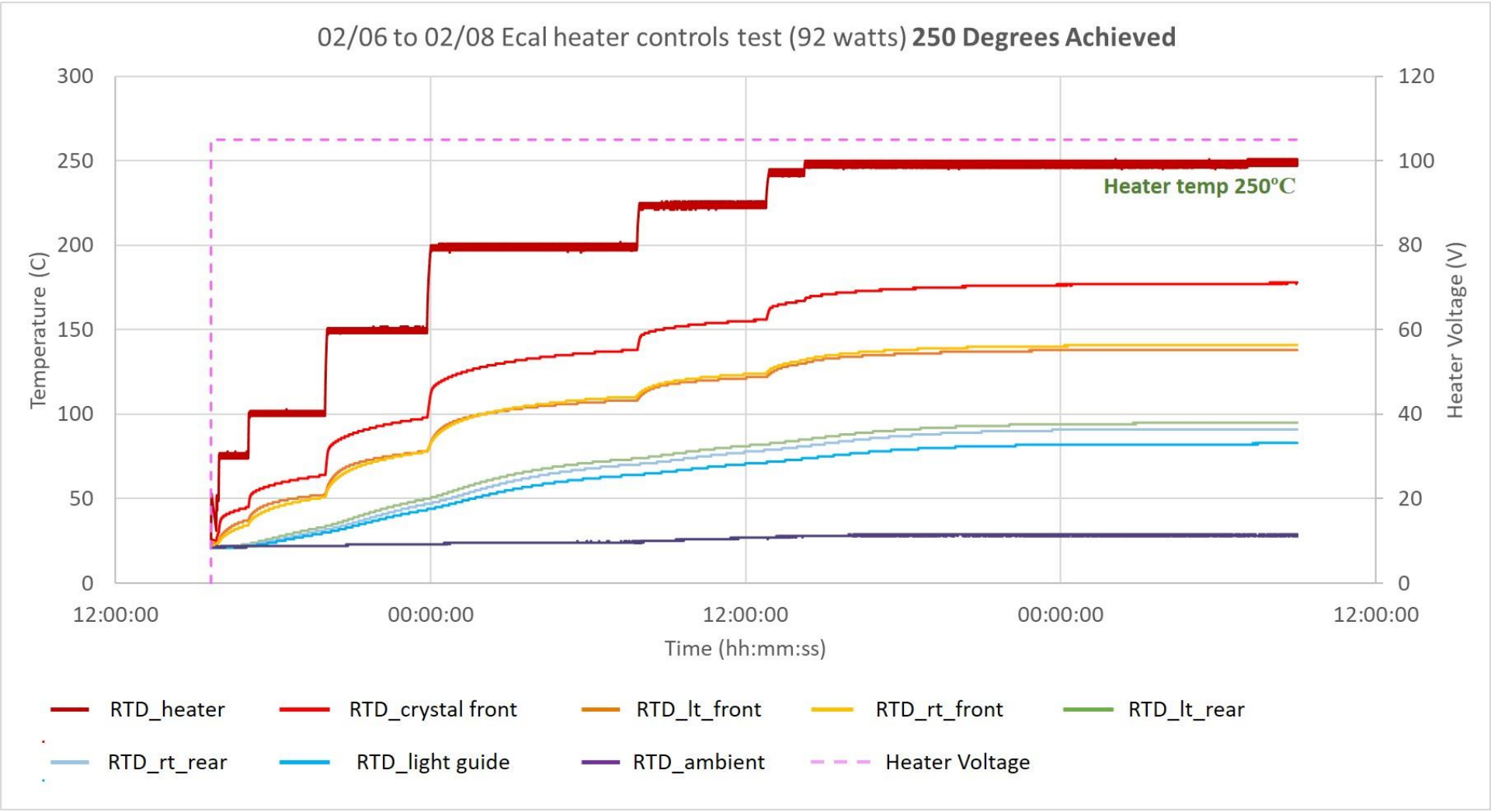
Note: Hall A uses 10” thick fiberglass insulation during the nine-supermodule test

Heater Test at 76 W



With the heated volume reduced to 0.6 ft^3, the heater temperature increased, but peaked at 222°C

Heater Test at 92 W



To reach the target temperature at the front flange, power was increased from 76 W to 92 W

Upcoming Project Activity

- ✓ Insulated heating test – completed 02/08/23
- System segmentation of 188 total supermodules
  - 47 channels needed; each channel powers four supermodules in parallel
    - **Power requirement calculation**
  - Full system temperature readback from 188 heater RTDs
    - **Readback channel multiplexing**
- Design changes to heater
  - Reduce 5” x 5” by ¼” in height and width
  - Increase hole size for easier alignment application
  - Customize resistance to accommodate system segmentation and power
- Develop two-channel controls system for the six supermodule test in March

Conclusion

- Insulation of the enclosure is critical to achieve the desired temperature profile throughout the full depth of the supermodule
  - ECAL group uses 10” fiberglass insulation in the six-module test stand
- The prototype heater achieved the target temperature of **250°C** at 92 W
  - 92 W is more than adequate to reach the target temperature at the front flange

The End