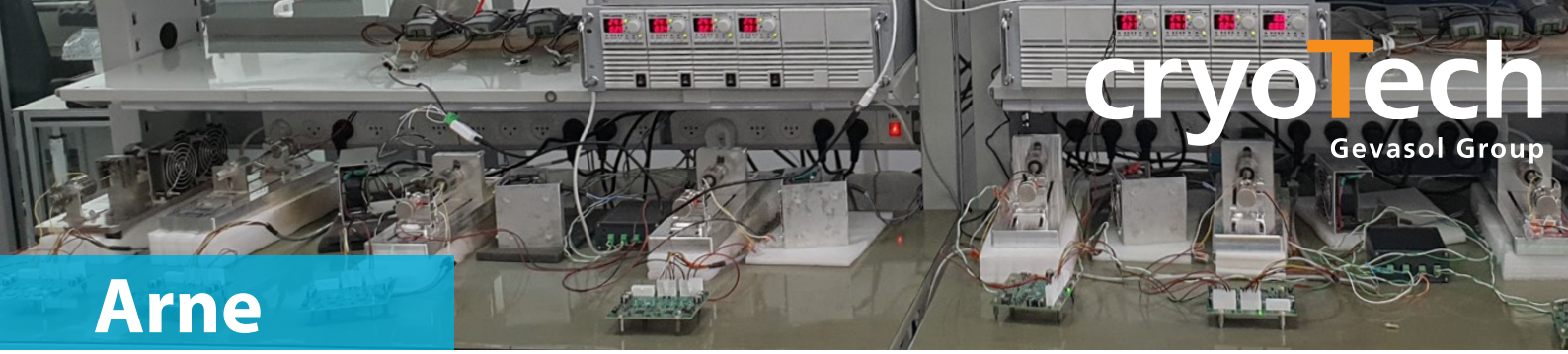

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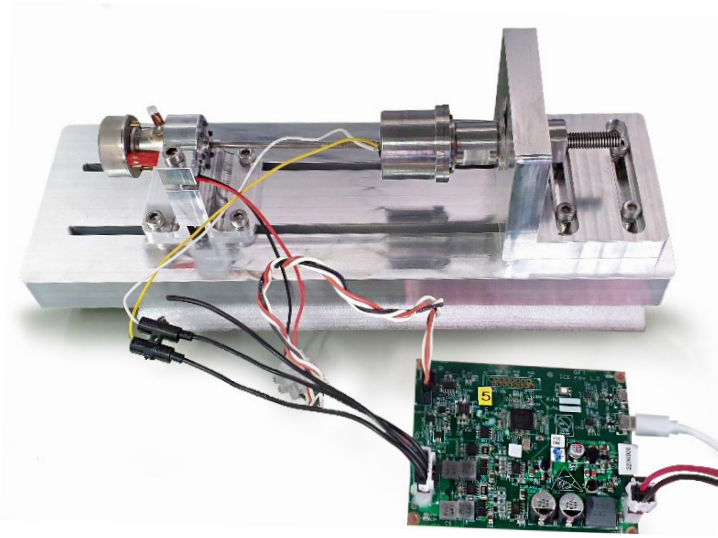
Controlling Linear Cryocoolers with Efficiency and Ease



A thermomechanical unit of a cryogenic cooler requires efficient supervision (i.e., a smart controller), but the available controllers leave a lot to be desired.

An electronic controller for such a unit is like the tail wagging the dog.
It should provide:

- Over-stroking protected fast cooldown (soft start)
- Accurate tuning and maintenance of the driving frequency
- Precise temperature control over over the range environmental condition
- Standby functionality
- Digital communication with the host users

Because it controls low cost, size, weight, and power cryocoolers, the controller should have a small footprint and a reasonable price tag.

For industrial and harsh environment applications, ruggedized controllers should withstand environmental extremes like temperatures, shock, vibration, humidity, fungus, etc.

And then there are more issues to tackle:
For the fast cooldown, the controller should provide short-term high-power output. This capability requires the use of power electronics—which appear to be oversized and inefficient when operating in a long-term low power temperature control mode.

In addition, during the temperature control mode, the weight of the idle losses (power consumed by the auxiliary circuitry) is comparable to useful power output. The result of this unfavorable combination is a low coefficient of the overall performance.

Further, the power stage of such a controller is not always matched in full—dynamically and electromechanically—to the resonant compressor of the thermomechanical unit.

This unit, in broad terms, is an "active consumer;" it features not only resistance and inductance but also a source of back electromotive force.

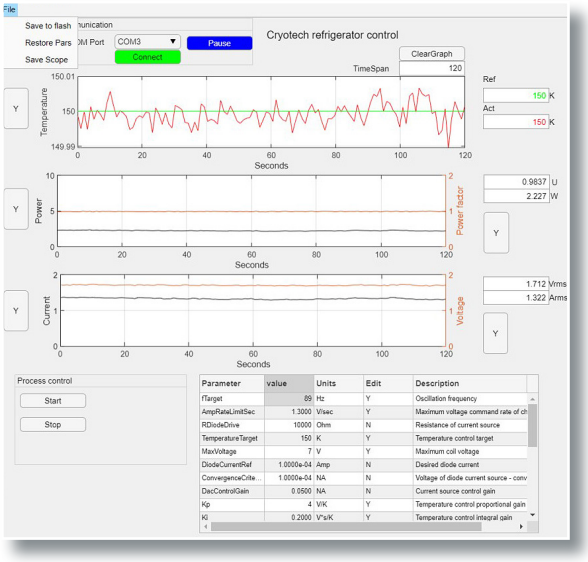
As of now, there are no good solutions to these issues. Responding to the need, CryoTech is developing a novel controller comprising low power auxiliary electronics and power electronics with a coefficient of performance over 95% over the entire range of output powers. The controller footprint should be smaller than 3x3cm.

As the first step in this direction—supervised by Dr. Yahali Theodor, the CTO of our sister company Gevasol Feedback Technologies — CryoTech has developed a demo board (shown in the picture below.) The board contains:

- Ultra low noise switching power stage, engineered of discrete components
- Low-power DSP, power supplies and conditioners
- 100uA DC power source for biasing a temperature diode
- on-board measurement circuitry (DC voltage and current, AC voltage and power)

The demo board is sparsely populated, facilitating access to the critical locations, handy alternations, and components replacements.

A MATLAB® driven GUI offering online alternations of the temperature setup, PID tuning, data acquisition, on-site real-time analysis, and throughput to disk (as shown in the picture below) supervises this demo board.



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