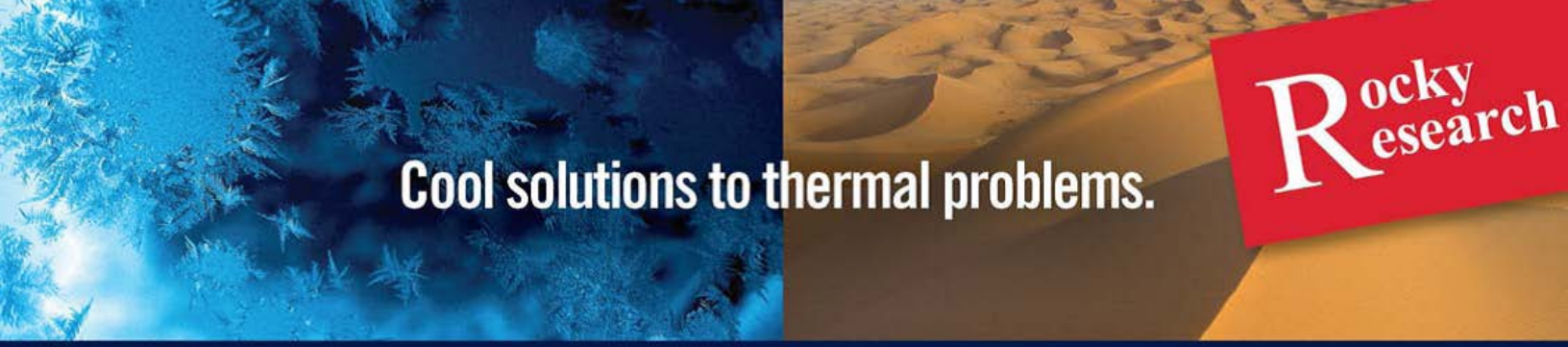

HVAC&R Solutions: Control Systems

Rocky Research combines an uncommon amount of expertise in thermal management with a focus on energy efficiency to develop dynamic solutions for the HVAC&R industry. From overall heating & cooling systems to flow control valves and operational controls management, our engineers, chemists, scientists and technicians have the experience and know-how to develop an HVAC&R solution for you.

Motor Controls

Rocky Research designs and manufactures motor control and power conversion systems for industrial and military applications. We are also the OEM of several SKUs for a major national brand's line of energy saving motor controllers. The motor controls encompass single phase and 3-phase power as well as NEMA-1 and NEMA-4X enclosures for standard and extended temperature environments. The motor controls are cETLus listed under UL-508 and CSA-22.2.

Rocky Research's Unique Capability in Controls Development

Rocky Research has a unique capability in controls development because its controls development engineers also have extensive experience in heat transfer and thermodynamics. This experience makes Rocky Research uniquely suited to the development of controls for thermal products (such as for the HVAC and process industries). It also allows us to take advantage of our heat transfer experience in the design of controls boards for high temperature environments of for high heat dissipation control boards. Rocky Research is capable of providing prototypes, limited production or full production volumes of control boards for a wide variety of applications.

The Controls Development Process

Rocky Research can present turn-key solutions for controls problems. We begin with analyses of control goals, process behavior and packaging constraints. This leads to the development of what sort of hardware class and associated programming will be used in the product. The hardware issues directly drive the thermal considerations. Proceeding with the development process, in the case of digital controls, a set of specifications (such as flow charts) is evolved to program code to govern final operation. It is developed according to the class and operation requirements. The results are then used in printed circuit board (PCB) design by our experienced staff, which produces efficiently organized layouts, in terms of using knowledge of circuit interactions and visual analysis.

We generally use PCB CAD design software for circuit board design which provides an

efficient user interface which in turn yields high throughput by the designer. Prototype assembly is set about by our experienced staff. This critical stage of the process can be a source of substantial and unnecessary cost if the need for tight quality control is not sufficiently recognized. In the case of digital controls, the program code and hardware assembly are combined by inserting a programmed microcontroller integrated circuit. The assembly is connected to the appliance or simulation as required and functionally tested. Final programming including customer changes are then carried out. Finally, the control is brought into union with the appliance or process to be controlled, and operational testing over the required range of conditions is carried out. For many applications, this testing can be performed in our well equipped test laboratories.

Hardware Applications

Rocky Research has experience controlling AC and DC components, including reactive loads. System reliability necessarily includes attention to detail in handling some loads like motors, which can do damage to under-equipped circuitry. Our strengths also include in-house developed power supplies for maintaining efficient operation of controlled-voltage or current devices. For the customer, savings can be generally be realized in the use of controllers built specifically for a given application rather than using a multi-application-oriented controller. Accordingly our experience level envelops bipolar transistors, MOSFETs, thyristors, magnetics, etc., and includes practices of isolation for safety and reliability.

Our repertoire of microcontrollers is extensive. The capabilities embodied in our processor experience are wide-spanning, including polyphase motor speed control, brushless DC motor speed control, analog process value measurement, and crystal-timed execution.

In the mechanical segment of design, such as of heat sinks and enclosures, a design goal of thermal effectiveness is maintained while striving for size and weight minimization. CAD is used for mechanical designs (generally metal or plastic), which lends itself to be integrally modeled by our experienced staff with finite element analysis (FEA) and computational fluid dynamics (CFD) modelling, if needed. This allows for the prediction of problem areas or opportunities to realize savings in heat sinks or for high ambient temperature operation.

Logic and Firmware

In the digital arena, we have produced functional reliable and PID control systems for various challenging processes, often for thermal processes or for high heat stress conditions. These algorithms can generally be tuned via effective user interfaces for an optimized final result. Inputs and measurements are carried out by analog to digital conversion. This is done in an efficient manner that produces both high response resolution and the capability to handle multiple, potentially interacting processes on single respective components of program code and hardware. The control results are provided to the load device by management code which converts scaled values to the appropriately modulated and meaningful output for the control element of the process. The operating systems in use by our microcontrollers are various and proprietary, providing optimized timing and memory usage specific to each application.

Analog Design

Our capabilities also include analog design. Our experience with analog systems is extensive and includes of analog-to-computer data acquisition systems. Digital controls indeed tend to offer high [thermal] efficiency, outward simplicity, and inward flexibility, but at times

they are not a suitable alternative. Analog controls can be cost effective for some applications. Our accomplishments include high-end-comparable audio circuitry which represents a demanding extreme of analog design. In certain cases, a simple analog system can operate on a smaller footprint than a similarly capable digital circuit. This can be desirable in response to concerns of portability or even reliability. Digital approaches generally still provide lower power consumption and this may also enhance portability, so the decision of whether to emphasize digital or analog is made after initial problem review and discussion.