BOYD
TRUSTED INNOVATION

DESIGN CASE STUDY

BIO-RAD THERMAL CYCLER

PROJECT DETAILS

Customer: **Bio-Rad**

Application: **DNA Cycler/ Thermal Cycler**

Technology: **Fan / Heat Sink Combination**

Industry: **Medical & Diagnostic**

Location: --

BIO-RAD

THE DESIGN CHALLENGE

Thermal Cyclers (also known as DNA cyclers, thermocyclers, PCR machines, or DNA amplifiers) are used to amplify segments of DNA via the polymerase chain reaction and are essential for labs that rely on molecular biology. Their use is crucial for applications such as detection and diagnosis of infectious diseases and hereditary diseases, DNA cloning for sequencing, and DNA profiling.

Thermal Cyclers provide a thermally controlled environment for DNA samples that are necessary during temperature cycling. Because the process relies heavily on precise temperature control, it is vital that this equipment has proper thermal management.

Because they required the best possible thermal design for their newest Thermal Cycler design, Bio-Rad contacted Boyd.

To perform with peak accuracy, uniformity, and speed, the thermal optimization of the product needed to be designed with a heat sink configuration that maintained less than +/-0.5°C variation in temperatures from sample to sample.

Boyd also needed to determine the feasibility of removing edge heaters from the sample block by recommending an appropriate insulation scheme and thermal interface materials.

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> The design challenge for minimal temperature variation while in constant use and in a smaller form factor is the type of project that we really enjoy.

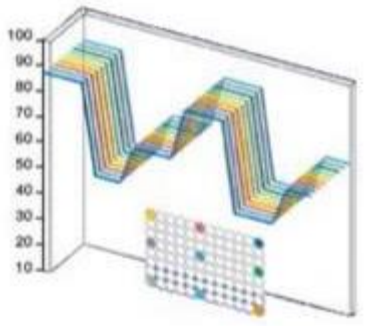
THE BOYD SOLUTION

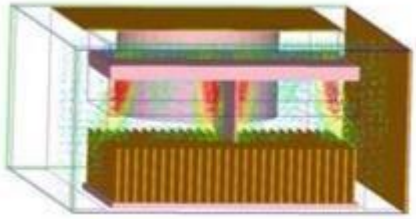
Boyd recommended utilizing a fan and heat sink combination to maintain the less than +/-0.5°C variation in temperatures required from sample to sample. Heat sinks and fans are widely used in electronics cooling. Their design and manufacture are well understood which offers high design flexibility at lower manufacturing cost and were the obvious choice to provide cooling.

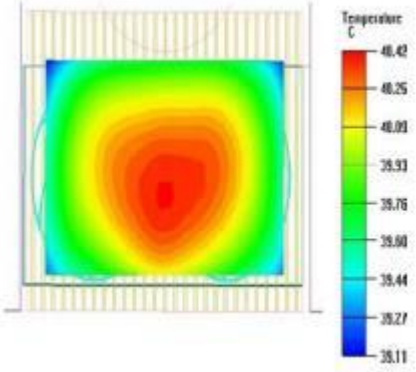
Boyd engineers evaluated several fan and heat sink combinations by creating airflow-thermal simulation models to choose a particular fan, number of fans, location of fans, heat sink geometry, etc. These simulations helped in the selection of an optimal combination of fan and heat sink. The team then created a prototype of the unit to capture all heat and airflow related details. The prototype was tested for temperature variation and the data was used to enhance the accuracy and reliability of simulation predictions.

To further optimize the overall product design, Boyd engineers evaluated the feasibility of removing heaters used to minimize the sample to sample temperature variation. It was shown using simulations that placing polyurethane foam at key locations can maintain the sample to sample temperature variation without the side heaters.

This Bio-Rad Thermal Cycler has now been in use for several years with excellent results. Over the years, the final products have maintained their accuracy and reliability and Bio-Rad is known for their robust, high-performing PCR amplification equipment.







DNA Cycler

February 2016