CircuitSolver®

A ThermOmegaTech® brand



Balancing Liquid Cooling in Data Centers with CircuitSolver®

What is Liquid Cooling?

Liquid cooling in data centers is an advanced cooling technology designed to manage and dissipate the heat generated by servers and other hardware more efficiently than traditional air-cooling methods. It is becoming increasingly popular in large-scale data centers due to its efficiency, energy savings, and ability to manage higher heat densities.

Liquid cooling systems are often quieter than traditional air-cooled systems since no noisy fans exist, and they enable data centers to house more densely packed servers.

Methods of Liquid Cooling:

- **Direct-to-chip or Cold-Plate Cooling:** Liquid-cooled cold plates are attached directly to the individual heat-producing components like CPUs and GPUs to absorb and transfer heat away.
- **Rack-Level Cooling:** Rack-level cooling solutions involve cooling entire server racks using liquid-cooled heat exchangers. This approach is less complex to implement than direct-to-chip cooling but still provides substantial benefits in terms of energy efficiency.
- **Rear-door Heat Exchangers:** The equipment's rear door is replaced with a liquid heat exchanger that operates in conjunction with air-cooling systems to service mixed rack densities.
- **Immersion Cooling:** Servers are submerged in a non-conductive coolant. Due to its unique challenges, this method is highly efficient but not as widely adopted.

Importance of Temperature Control

Thermal management of your data center goes beyond just ensuring things are cool. It means making sure things are at the right temperature. Balancing liquid-cooled data centers involves efficiently managing the cooling infrastructure to maintain the desired temperature and prevent hotspots while optimizing energy consumption.

Balancing valves can control cooling liquid temperatures by modulating flow as heat loads change to maximize performance levels and prevent equipment from overheating. Multiple variables impact the heat gain of the system, which is continually changing. An optimum balancing valve needs to be dynamic and alter flow with changing conditions.



CircuitSolver® Cold Water thermostatic balancing valves automatically regulate flow by modulating open and closed in response to the fluid temperature to keep it at the design temperature.

CircuitSolver® Balancing Methods

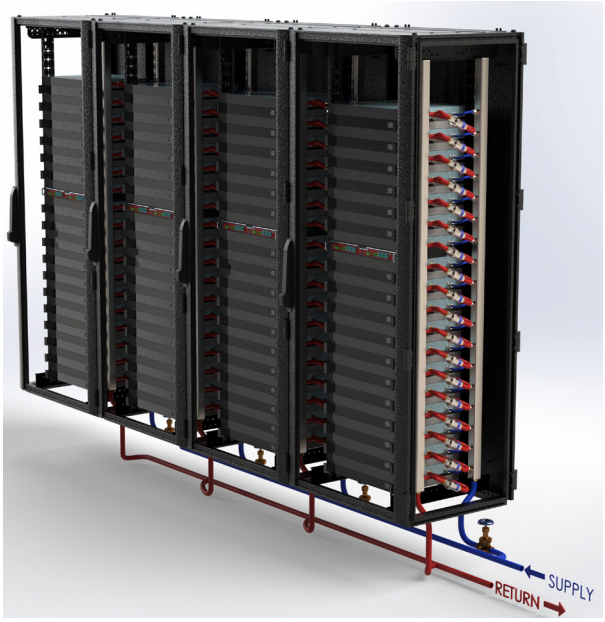
Unlike manual balancing valves, thermostatic balancing valves are dynamic. They continually react to changing conditions and adjust flow accordingly.

In **rack-level cooling** system designs, CircuitSolver® Cold Water balancing valves are **installed at the end of each rack** to control the temperature of the cooling fluid. As the temperature in a line increases, the valve proportionally modulates open, increasing the flow in that line to overcome heat gain.

As the fluid temperature approaches the desired control temperature, the valve proportionally closes, reducing the flow to efficiently maintain the temperature in the rack.



balancing rack-level cooling system



balancing direct-to- chip cooling system

In **direct-to-chip cooling** system designs, CircuitSolver® Cold Water balancing valves are **installed directly into each cold plate** to control the temperature of the cooling fluid as it leaves the cold plate. As the temperature increases, the valve proportionally modulates open, increasing the flow to overcome heat gain.

As the fluid temperature approaches the desired control temperature, the valve proportionally closes, reducing the flow to efficiently maintain the temperature.

Depending on the cooling fluid circulation design for **rear-door heat exchangers** and **immersion cooling** methods, CircuitSolver® can balance the fluid distribution to optimize flow based on temperature while simultaneously minimizing energy usage.

Summary

Balancing liquid cooling in data centers requires ongoing monitoring, adjustments, and maintenance to optimize cooling efficiency, minimize energy consumption, and ensure reliability. CircuitSolver® can help to mitigate these efforts by automatically providing a temperature solution to a temperature problem.

Benefits

- Dynamic and economical heat removal solution
- Precise temperature control
- Reduced system wear and improved efficiency
- Energy conservation

Design Features

- Reliable, long-lasting thermal actuator
- Never fully closes, small bypass of flow
- All stainless steel - corrosion-resistant construction
- Few moving parts

Because of continuous improvements, ThermOmegaTech®, Inc. reserves the right to change the design and specifications without notice