Rack-level Data Center Liquid Cooling System



Overview

Ingrasys offers a complete line of rack-level liquid cooling solutions based on where the heat is exhausted in the data center.

Key Takeaways

Rack-level liquid cooling is a data center cooling method that delivers liquid coolant directly to high-heat components within server racks, efficiently removing heat from CPUs, GPUs, and other dense IT equipment. Definition and OverviewRack-level liquid cooling refers to cooling solutions that bring liquid directly to the servers or components within a rack, rather than relying solely on air circulation to remove heat. This approach is increasingly used in modern data centers where rack power densities exceed 20–30 kW, making traditional air cooling insufficient.

By targeting the heat sources directly, liquid cooling reduces energy consumption, prevents hot spots, and allows higher-density deployments. Key TechnologiesDirect-to-Chip (Cold Plate) CoolingCoolant flows through cold plates mounted directly on CPUs, GPUs, or other high-heat components. The liquid absorbs heat efficiently, while fans may still provide airflow to remove residual heat.

Single-phase systems keep the coolant in liquid form, while two-phase systems allow the coolant to change state for enhanced heat transfer.

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Liquid-to-

Liquid and Liquid-to-Air SystemsLiquid-to-liquid: Coolant is circulated through the rack and then cooled by the building's water supply, ideal for high-performance or hyperscale data centers. Liquid-to-air: Heat is transferred from the liquid to air, often using rear-door heat exchangers, suitable for medium-density racks.

Immersion Cooling

Servers are submerged in dielectric fluids, allowing direct heat transfer from all components to the liquid. This method is less common at the rack level but is used in specialized high-density deployments.

Benefits

Higher Efficiency: Liquid has a higher thermal transfer capacity than air, reducing fan energy by up to 80%.

Supports High-

Density Racks: Enables racks with power densities from 5 kW up to 100 kW or more. Scalability and Flexibility: Modular liquid cooling systems can be added to existing racks or integrated into new data centers. Reduced Hot Spots: Direct cooling prevents localized overheating, improving reliability and performance.

Operational Reliability: Modern systems include leak detection, redundancy, and hot-swap capabilities to maintain uptime. ApplicationsRack-level liquid cooling is widely used in hyperscale data centers, high-performance computing (HPC), AI/ML workloads, and other processing-intensive environments where traditional air cooling cannot meet thermal demands. It allows data centers to increase compute density without expanding physical space and reduces overall energy costs associated with cooling.

In summary, rack-level liquid cooling is a targeted, efficient, and scalable solution for managing heat in modern high-density data centers, enabling higher performance and energy savings compared to conventional air-based cooling methods.

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NVIDIA GB200 NVL72

The liquid cooling infrastructure requirements are non-trivial: facility chilled water supply and return piping, rack-level manifolds with quick-disconnect fittings, leak detection systems, and

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4. In liquid-cooling technology, Horizon may help redefine industry standards. The entire data center architecture may eventually be restructured around liquid cooling. CDU placement,

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