Server Rack System Immersion Liquid Cooling Configuration Solution

Article Overview

Immersion liquid cooling enables high-density, energy-efficient server rack operation by submerging servers in dielectric fluids for superior heat transfer compared to air cooling.

Overview

Immersion liquid cooling involves submerging servers or components in a thermally conductive, electrically non-conductive fluid, allowing heat to be removed directly from CPUs, GPUs, and memory modules. This method is increasingly adopted in AI, HPC, and high-density data centers where traditional air cooling is insufficient for modern thermal loads .

Key Benefits

o High Power Density: Systems can support up to 4 kW per 1RU or more, with some enclosures handling 140 kW per rack, enabling more compute power in the same footprint .
o Energy Efficiency: Immersion cooling reduces energy usage significantly, often enabling complete heat recovery and lowering PUE (Power Usage Effectiveness) compared to air-cooled systems .
o Reduced Noise and Maintenance: Fewer fans are required, lowering noise levels, and servers remain accessible for maintenance without messy tanks or complex disassembly .
o Scalability and Flexibility: Modular designs allow single or dual-level configurations, supporting standard 19" racks and various server architectures, including 21" and ORV3 .

Deployment Options
o Single-Phase Immersion: Servers are submerged in a dielectric fluid that absorbs heat and is circulated to a heat exchanger.
o Two-Phase Immersion: The fluid boils at a low temperature, and the vapor is condensed externally, providing highly efficient heat removal.
o Direct-to-Chip (DLC): Combines immersion with targeted cooling of high-heat components, enhancing thermal performance while minimizing fluid volume .

Integration Considerations

o Compatibility: Modern immersion enclosures support standard server form factors, allowing integration into existing racks without major infrastructure changes .
o Redundancy and Reliability: Systems often include 2N redundant pumps and heat exchangers to ensure uninterrupted operation .
o Coolant Selection: Engineered dielectric fluids like ThermaSafe R provide low viscosity, stable thermal

performance, and efficient convective heat transfer .
o Space Optimization: Immersion enclosures can achieve 2-3x more compute per rack compared to traditional air-cooled setups, maximizing data center footprint efficiency .

Leading Providers

o LiquidCool Solutions: Offers plug-and-play immersion-cooled servers with direct-to-chip technology, supporting high-density computing up to 4 kW per server .
o Supermicro: Provides rack-scale liquid cooling solutions for AI and HPC, including in-rack or in-row CDUs, supporting up to 80 kW per rack .
o DCX: Delivers modular immersion enclosures like the H1000, optimized for AI, HPC, and edge deployments, with cooling capacities up to 140 kW per rack .

Conclusion

Immersion liquid cooling is a highly effective solution for modern high-density server environments, offering superior thermal management, energy efficiency, and scalability. It is particularly suited for AI, HPC, and edge computing applications, enabling data centers to maximize compute density while maintaining reliability and operational flexibility .

Keep in mind, an immersion cooling server configuration is a huge departure from a traditional rack-mount server.

The Flex liquid-cooled system and rack solutions provide a versatile platform for hyperscalers and data center

Long proven for mainframe and gaming applications, liquid cooling is expanding to protect rack-mounted servers in data centers

Unlike immersion cooling systems, the server and the liquid never come into contact in direct-to-chip configurations.

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

The DCX Edge Server Immersion Enclosure is a compact, high-efficiency liquid cooling solution purpose

AHEAD has a dedicated AI and HPC rack integration facility for air- and liquid-cooled design, build, and deploy services. Individual

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This study narrows that gap through the computational analysis of the cooling systems for the server rack. Considering

Supermicro provides total liquid-cooling solutions including hardware and management software. Supermicro delivers fully tested and

Discover the advantages of liquid data center cooling for HPC. Featuring, Asetek, Motivair, OptiCool, CoolIt Systems, and

Immersion cooling (see Figure 2) is a liquid cooling method in which servers and other rack components are

What is it? Immersion cooling is a type of liquid cooling method where the servers are directly immersed inside a bath of non

Each cooling technology supports different rack thermal density and efficiencies, giving customers choices to match

Immersion cooling allows server and computing components to be submerged in dielectric liquid and

Supermicro is an end-to-end solution provider for rack scale liquid cooling solutions. Supermicro"s delivers a complete and fully

During the evolution of liquid cooling, we saw direct-to-chip liquid cooling solutions. Today, high-density, modular single

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